94th Congress
2d Session } JOINT COMMITTEE PRINT

SOVIET ECONOMY IN A NEW PERSPECTIVE

A COMPENDIUM OF PAPERS

SUBMITTED TO THE

JOINT ECONOMIC COMMITTEE
CONGRESS OF THE UNITED STATES

OCTOBER 14, 1976

Printed for the use of the Joint Economic Committee

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U.S. GOVERNMENT PRINTING OFFICE
73-720 WASHINGTON : 1976

For sale by the Superintendent of Documents, U.S. Government Printing Office
Washington, D.C. 20402 - Price $7.85

LETTERS OF TRANSMITTAL

OCTOBER 8, 1976.

To Members of the Joint Economic Committee:

Transmitted herewith for the use of the Members of the Joint Economic Committee and other Members of Congress and the interested public, is a study of the economy of the Soviet Union entitled "Soviet Economy in A New Perspective." This is a compilation of research papers prepared at our request, by scholars and experts.

It deals with the recent performance of the Soviet economy. It is the latest in a series of Soviet studies which the Joint Economic Committee has published, beginning in 1959. There is understandably a great deal of interest in the Soviet economy, its prospects and problems, and their implications for the United States and Western European countries. We believe that the volume will prove helpful to the Members of Congress in their policy deliberations related to our U.S.-Soviet relations, as well as to scholars and interested members of the public. We are indebted to the scholars who have given so generously of their time and their knowledge. They are listed in the Staff Director's memorandum to me and I would like to express the Committee's gratitude for their valued efforts.

Also I wish to express my appreciation to the Congressional Research Service for making available the services of Doctor John P. Hardt, senior specialist, who helped to plan the scope of the research, coordinated and edited the contributions, and wrote a Summary for the present study. Dr. Hardt was assisted by Ronda Bresnick, also of the Library staff.

It should be clearly understood that the views expressed in these papers are those of the individual contributors and do not necessarily represent the position of their respective government, or non-government institutions, the Joint Economic Committee, individual Members thereof, or the Committee staff.

HUBERT H. HUMPHREY,
Chairman, Joint Economic Committee.

OCTOBER 5, 1976.

Hon. HUBERT H. HUMPHREY,
Chairman, Joint Economic Committee, U.S. Congress,
Washington, D.C.

DEAR MR. CHAIRMAN: Transmitted herewith is a volume of materials on the economy of the Soviet Union entitled "Soviet Economy in A New Perspective." The study contains papers written by scholars and specialists who, as recognized authorities on the Soviet Union, were invited to contribute. The specialists have been drawn from the ranks of various universities here and abroad, private research institutes, several departments of the Federal Government and the Li-

brary of Congress. The papers they have submitted, in response to our request, cover the broad range of topics dealing with the recent performance of the Soviet economy. Included among these topics are economic policy, the defense burden, agriculture, politics, energy, industry, population, research, science, international trade, and foreign aid.

The Joint Economic Committee has undertaken a number of studies on the Soviet economy. Among the earlier studies were *Comparisons of the United States and Soviet Economies* (1959); *Dimensions of Soviet Economic Power* (1962); *New Directions in the Soviet Economy* (1966); and *Economic Performance and the Military Burden in the Soviet Union*. The latest of the Committee releases in the overall series was *Soviet Economic Prospects for the Seventies* (1973).

At a time when the relationships between the United States and the Soviet Union on arms control, and commercial, scientific, technological affairs all are entering a new stage, an assessment of Soviet economic policy appears especially timely. Indeed after several of the poorest economic performances in Soviet history in 1972 and 1975 special importance may be attached to a thoroughgoing professional assessment of current performance and future prospects.

The contributors to the study have been most considerate of our needs and generous in giving of their time and expertise to provide not only basic information but also an essential analytical perspective. The individual scholars who have participated in the preparation of the present study are:

Alan Abouchar
Hans Bergendorff
Joseph S. Berliner
Herbert Block
Morris Bornstein
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David W. Carey
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Paul K. Cook
Orah Cooper
M. Mark Earle Jr.
Warren W. Eason
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Richard B. Foster
Dimitri M. Gallik
Marshall I. Goldman
Alice C. Gorlin
Donald W. Green
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Theodore Shabad
Alan B. Smith
Maureen R. Smith
Per Strangert
Lawrence H. Theriot
Vladimir G. Treml
Albina F. Tretyakova

In addition, the Committee received the wholehearted cooperation from the following private organizations and Government agencies:

Brandeis University.
Bureau of East-West Trade, Department of Commerce.
Bureau of Intelligence and Research, Department of State.
Centre of Russian and East European Studies, University of Birmingham (Birmingham, United Kingdom).
Center for Russian and East European Studies, University of Michigan.
Economic Group, Chase Manhattan Bank.
Duke University.
Foreign Demographic Analysis Division, Bureau of Economic Analysis, Department of Commerce.
Georgia State University.
Russian Research Center, Harvard University.
Haverford College.
Hebrew University (Jerusalem).
Indiana University.
School of Advanced International Studies, Johns Hopkins University.
The New York Times.
Oakland University.
Office of Economic Research, Central Intelligence Agency.
Ohio State University.
Wharton School, University of Pennsylvania.
Soviet Program Area, Department of Agriculture.
Strategic Studies Center, Stanford Research Institute.
State University of New York at Binghamton.
Swedish Defense Research Institute (Stockholm, Sweden).
University of Toronto.
University of Virginia.
Wellesley College.

It should be clearly understood that the views expressed in these papers are those of the individual contributors and do not necessarily represent the position of their respective government, or non-government institutions, the Joint Economic Committee, individual members thereof, or the Committee staff.

The Library of Congress made available the services of John P. Hardt, senior specialist in the Congressional Research Service, who helped to plan the scope of the research, coordinated and edited the contributions, and wrote a Summary for the present study. Dr. Hardt was assisted by Ronda Bresnick, also of the Library staff.

JOHN R. STARK,
Executive Director,
Joint Economic Committee.

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SUMMARY

JOHN P. HARDT

Improving economic performance continues to be a major policy problem for the Soviet leadership. The Tenth Five-Year Plan for 1976–1980, unveiled at the Twenty-Fifth Congress of the Communist Party of the Soviet Union, highlighted both the prospects and problems in Soviet economic development. A long term trend in economic growth retardation is likely to continue and worsen. In the short term, crises such as the 1972 and 1975 agricultural shortfalls, the 1975 hard currency shortage in the balance of payments, will presumably continue to plague the Soviet economic planner. Pressing as the short term problems are, the long term opportunities and constraints may be even more difficult to deal with: commitments to Siberian development involving major regional energy and metal projects, a significant new railroad—the Baikal-Amur, and the outreach to plumb the resources of the seas. Further commitments from an already overstrained economy may be necessary now for obtaining results in fifteen or more years. Short or long run, all major claimants require more and better goods and services; the military to maintain and expand strategic and conventional forces; the planners for maintaining and modernizing the economy; and the consumers for incentives to raise the productivity of an overcommitted labor force. The resource slices needed are growing rapidly, while the economic pie from which they must come is expanding at a retarding rate.

Soviet Prime Minister Alexei Kosygin, in his major economic speech at the Party Congress, stressed not only quantitative and qualitative improvements in the economy but also the role of technological change in economic growth. Western technology inputs that add a degree of economic interrelatedness with the advanced industrial nations seemed to be emphasized as an important route for economic improvement.

At the same Congress, General Secretary Leonid Brezhnev spoke of the international and military prowess of the Soviet Union. Parity with the only other superpower—the United States—might promise an even stronger position in the world arena of future problems. Still economic power—the basis of long term political power—has not reached parity as indicated of the following selected indicators. (See Table 1.)

In the 36 chapters of this compendium some specialists from government, not-for-profit professional research, and academic institutions in the United States, Canada, Sweden, the United Kingdom, and Israel have assessed recent Soviet economic performance and its implications for the future. The chapters are arranged in three sections: Policy Assessment, Economic Performance, and Foreign Economic

Activities. Each of the authors provide analyses based on their own professional views. Many have provided their own summaries. The reader should reference the summaries and the full analyses before making judgments on the professional differences of views, or the validity of the conclusions. The following are some of the major questions raised by the papers with an indication of their responses and where in the compendium the appropriate analysis may be found.

TABLE 1.—UNITED STATES AND U.S.S.R.: SELECTED ECONOMIC INDICATORS*

	United States 1975 [1]	U.S.S.R. 1975	U.S.S.R. 1976 plan
GNP (billion 1975 U.S. dollars)	1,516.3	865.3	NA
Population, midyear (millions)	213.6	254.5	257.1
Per capita GNP (1975 U.S. dollars)	7,098.7	3,400	NA
Industrial production index (1970=100)	106.5	[1] 132.5	138.2
Net agricultural production index (1970=100)	112.9	96.8	NA
Bread grains [2] (million metric tons)	58.6	[1] 60.8	NA
Feed grains [3] (million metric tons)	163.9	[1] 58.4	NA
Potatoes (million metric tons)	14.3	88.5	NA
Meat (million metric tons)	21.5	15.2	NA
Total labor force [4] (millions)	94.8	136.1	138.4
Nonagricultural [4] (millions)	(81.4)	(101.5)	(104.4)
Agricultural (millions)	(4.4)	(34.6)	(34.0)
Total investment index [5] (1970=100)	NA	139.8	144.5
Per capita consumption index (1970=100)	NA	[1] 117.1	
Crude oil, including natural gas liquids (million barrels per day)	10.0	9.9	10.4
Natural gas (billion cubic feet)	20,100	10,215	11,053
Electric power (billion kilowatt-hours)	2,200	1,038	1,095
Coal (million metric ton)	584.8	701	715
Primary energy production (million metric tons of coal equivalent)	2,165	1,643	1,734
Crude steel (million metric tons)	105.9	141.0	147.0
Cement (million metric tons)	63.1	122.0	126.0
Copper, refined (million metric tons)	1.6	1.35	[6] 1.41
Iron ore (million metric tons)	82.6	233.0	NA
Phosphate rock (million metric tons)	44	[1] 25	NA
Automobiles (thousand units)	6,713.0	1,201.0	NA
Trucks and buses (thousand units)	2,272.2	763.0	NA
Electric generators (thousand kilowatts)	NA	17,100	NA
Machine tools, metal cutting (thousand units)	78.0	232.0	NA
Instruments and measuring equipment (million rubles, 1967 prices)	NA	[1] 4,300	NA
Computers and calculating machines (million rubles, 1967 prices)	NA	[1] 2,800	NA
Refrigerators (thousand units)	4,577	5,600	NA
Washing machines (thousand units)	4,228	3,300	NA
Radios (thousand units)	34,516	8,400	NA
Television sets (thousand units)	10,637	7,000	NA
Vacuum cleaners (thousand units)	7,637	NA	NA
Gold production (thousand troy ounces)	1,030	9,902	NA
Imports, f.o.b. (million U.S. dollars)	96,140	[1] 37,900	NA
Exports, f.o.b. (million U.S. dollars)	107,191	[1] 32,600	NA

[1] Preliminary.
[2] Wheat and rye.
[3] Corn for grain, oats, barley, and pulses.
[4] Including armed forces.
[5] New fixed investment.
[6] Calculated from 5-yr-plan data.

*Supplied to the Joint Economic Committee by the Office of Economic Research, Central Intelligence Agency, and released in "The Soviet Economy: Performance in 1975 and Prospects for 1976," June 1976.

1. *How did the Soviet leaders view the economic issue during their policy deliberations in the context of the Twenty-Fifth Party Congress and the Tenth Five-Year Plan (1976–1980)? Has the new economic strategy of modified economic interdependence been adhered to or changed? How are they coping with short term agriculture and balance of payment problems and long term difficulties emanating from slowing economic growth?*

"The most reasonable prognosis would seem to be that the Soviets will continue to pursue detente but with reduced expectations of the benefits obtainable. One benefit that is useful is access to West-

ern credits in order to help pay for imported technology and grains. And the need may well increase if the Soviet Union suffers another harvest shortfall—even if on a smaller scale than in 1975.

"In sum, problems persist and current Soviet policies seem unable to resolve them adequately. But they do not appear to be of an order of magnitude to generate actual crises. In fact, they closely resemble problems the Soviets have had to cope with over the years. And cope they have, however imperfectly.

"Western perceptions of the Soviet Union all too frequently focus entirely on military strengths, economic weaknesses, and on suppression of civil liberties. Soviet self-perceptions differ. Why should we change our ways, the leadership might ask, for they have been proven over time. For more than 30 years the Soviet Union has been at peace; it has attained recognition as the strategic equal of the foremost capitalist power, the United States; and while it may have certain economic weaknesses the economy has grown by leaps and bounds and today is the world's second largest. And, of course, this pride is buttressed by the belief that the balance sheet of world power is changing in their favor.

"In this context, the failure of the leadership to launch dramatic new initiatives at home or abroad should not be surprising. On the other hand, the extent to which the leadership's apparent decision to muddle through will suffice in today's environment is moot. But the leadership, despite their long tenure, is mortal. Whether their successors will speed up the present glacial evolution of Soviet society remains to be seen. Over the near term, however, more of the same seems to be the order of the day." (Cook, pp. 15–16.)

2. *Has the adoption of a price mechanism, so often heralded by western economists as necessary for Soviet economic efficiency, become a reality? Has price instability-inflation-become a problem in Soviet economic development? Have changes in price formulation served to decentralize decision making within or in place of the central planning process?*

"The remarkable stability of the official retail price indexes is explained partly by an extensive program of subsidies on food products, partly by statistical practices which ignore some kinds of price changes, and partly by pricing many commodities below market-clearing levels. There is considerable evidence of repressed inflation in the U.S.S.R., including widespread shortages, some formal and some informal rationing, black markets for certain goods, and rising prices for food products on the collective farm market.

"Within a traditional general policy of striving for "stability" (*stabilnost'*, *ustoichivost'*) of the level of prices, Soviet pricing authorities are increasingly interested in achieving "flexibility" (*gibkost'*) and "mobility" (*podvizhnost'*) in the relative price structure. More frequent adjustment of relative prices is seen as a logical counterpart of the greater emphasis since 1965 on sales and profitability as enterprise performance indicators, and on managerial incentives linked to these indicators. Prices are perceived increasingly not only as measuring "socially necessary labor costs" but also as influencing choices among outputs and inputs—subject to important constraints by plans and administrative allocations. Prices which fail to cover costs or which provide "below-normal" profits are viewed as im-

properly discouraging production and encouraging consumption of the goods involved. In turn, if prices are too high, they lead to excessive profitability which decreases pressure for cost reduction and retards the introduction of new technologically superior products.

"However, a more "active" price policy does not imply a diminution of central control over price determination. Rather, a "unified state price policy" (*edinaia gosudarstvenaia politika tsen*) is to continue, with the following features: (1) Central agencies like the SPC determine the general level of prices for major categories of output and branches of the economy. (2) These agencies also establish the actual prices of many basic types of producer and consumer goods. (3) Finally, they provide "methodological guidance" (*metodologicheskoe rukovodstvo*)—in the form of compulsory "recommendations, instructions, directive letters, elaborations, and interpretations"—to all other organizations and levels involved in price formation.

"Currently, this "unified" policy stresses adjustments in the relative prices of producer goods to press for cost reduction, promote new technologically superior products, and encourage quality improvements. In the case of consumer goods, attention is focused on altering relative prices of clothing, footwear, and consumer durables as the assortment changes, and on revising long-neglected services prices. . . .

"These efforts at greater price flexibility rest on continued central administrative determination of prices along established lines and reflect the rejection of two types of reform proposals.

"First, suggestions to give enterprises and associations authority to set prices, even within central guidelines, have met with little success. . . .

"Second, proposals of the "optimal planning" school, based in the Central Mathematical Economics Institute of the U.S.S.R. Academy of Sciences, for central calculation of plan targets and corresponding opportunity cost prices balancing supply and demand, also have had little effect on pricing practice. . . .

"Thus, though growing slowly, the role of the price mechanism in the Soviet economy remains subordinate to planning and administrative allocation." (Bornstein, pp. 60–62.)

3. *Has the changed policy of price determination in CEMA as between the Soviet Union and its economic partners represented a basic change in policy? Has the Soviet Union moved to maximize the benefits in exporting oil, gas and other commodities?*

". . . Since 1971, and particularly in 1974, prices in trade outside CEMA had moved in a manner that made continuation of existing intra-CEMA price relationships disadvantageous for the Soviet Union. The actual terms of trade of the U.S.S.R. vis-a-vis its CEMA partners had changed little during 1971–74. However, had changes in world prices in fact been applied to Soviet trade with other CEMA countries, the terms of trade would have moved substantially in the U.S.S.R.'s favor. Consequently, though violating the spirit if not the letter of CEMA pricing arrangements, the U.S.S.R. instigated a major overhaul of CEMA foreign trade prices a year ahead of schedule.

"The market disparity in early 1975 between actual CEMA price relationships and what those relationships would have been if CEMA prices had moved in conformity with world prices represented a significant reduction in the U.S.S.R.'s gains from trade with the rest of

CEMA. The amount of the loss equalled roughly one percent of Soviet GNP.

"The most striking example of the high cost to the Soviet Union of not adjusting CEMA price relationships to changes in world prices was provided by oil, a major Soviet export to Eastern Europe (with the exception of Romania). The price of oil on world markets at the beginning of 1975 was four times higher than it had been in the fall of 1973. Not surprisingly, therefore, oil prices were raised in 1975 more than prices of any other commodity in CEMA trade. The increase for crude oil, for example, was reportedly 130 percent. . . .

"The terms of trade advantage gained by the U.S.S.R. from the 1975 price changes seem moderate in light of world price changes in 1971–74. Moderation may have been partly dictated by the prematurity of the changes and partly by indications that world prices in 1975 would change to the U.S.S.R.'s disadvantage. The U.N. export price data suggest that the U.S.S.R.'s hypothetical terms of trade vis-a-vis the six countries of Eastern Europe did in fact deteriorate last year, by about 2 percent.

"Soviet restraint may also reflect opportunities for taking advantage of world price movements through means other than direct improvement in the U.S.S.R.'s terms of trade. For example, Western inflation has apparently helped the U.S.S.R. win Eastern European agreement to participate more heavily than ever before in investment projects on Soviet soil. The Eastern European contribution should speed completion of these projects while reducing the volume of resources the Soviets must commit to them. It should also strengthen the ties between the Soviet economy and the individual economies of Eastern European countries. At the same time, these projects benefit Eastern European countries by providing a relatively assured future supply of such commodities as natural gas, oil and other raw materials at prices that, at official exchange rates, are below world market levels.

"Perhaps the main reason why the U.S.S.R. has apparently adopted a moderate CEMA trade pricing policy is its recognition that the economies of Eastern European countries could be seriously damaged by sudden and substantial adverse movements in their terms of trade." (Kohn, pp. 68 and 77).

4. *While recognizing in the Helsinki agreement "the growing worldwide economic interdependence" has the Soviet economy moved significantly away from self sufficiency toward interdependence to make the process irreversible?*

". . . The Soviet Union is allowing itself to become more intertwined into the world economy. No one move by itself has been all that far reaching, but the totality of these processes in recent years and in years to come, may eventually bring about a qualitative change. As of now the U.S.S.R. may still be able to extract itself without too much trouble, but it is clear that if the present trend continues, the cost of severing ties with the West will mount rapidly. For example initially the U.S.S.R. did not buy as much feedgrain in 1975 as it should have. This necessitated the premature slaughter of at least 14 million pigs, about 20% of the herd. This show of independence proved to be too costly. Ultimately to prevent additional slaughter, the Soviet Union found it necessary to reenter the market in late April 1976 and supplement its initial large but obviously inadequate purchase. The same

type of phenomena is likely to occur if in the future the Soviet Union decides to cut itself off from an adequate flow of Western technology and interchange. . . ." (Goldman, p. 95.)

5. *How will demographic trends effect the labor force constraint on Soviet economic growth? Will future restrictions in the supply, characteristics, and quality of manpower significantly increase the economic burden inherent in retaining a very large Soviet military force? Are falling rates of fertility, especially among Great Russians and Baltic nationalities, likely to slow and reverse sufficiently to ameliorate the demographic pressures on future Soviet economic performance?*

"Given the demographic imperatives confronting the Soviet Union in the next few years major policy decisions will be required to cope with the resulting manpower problems. The growth rate of the population at the end of the century will drop to about one-third of the rate at the middle of the century. This will mean a much slower rate of growth in the labor force, as other sources of supply have been exhausted, and the new entrants in the working age population are the only numerically significant new supply. The continuing overall labor shortage is fully appreciated by the Soviet central authorities as is evident from the fact that they call for productivity gains as the key to achieving the economic growth expected during the current 5-year plan period. The problem of labor shortages appears even more acute when one looks beyond the aggregate figures at the regional differentials. In the absence of mass migration, past and current regional birth differentials will mean that most of the new labor supply will not be generated in the areas where most of Soviet industry is now located or where future expansion is planned. In addition, the military manpower shares that will come from the southern tier, or non-Slavic belt of the Soviet Union, may also have a major impact on the armed forces of the future. By the end of the century about one-third of the 18-year-old cohorts will be in this region." (Feshbach-Rapawy, p. 113.)

Soviet demographic trends, especially fertility patterns, are both difficult to explain and predict.

"Future fertility trends are notoriously difficult to predict, but the period of time of the recent increases in age-specific fertility is sufficiently long to suggest that the Soviet population may very well have entered upon a new stage of stable and even higher rates of reproduction. This reversal of trends may show up in the 1980 Soviet census, in the form of a higher proportion of the population in the youngest age-groups; and it should begin to have an influence on the rate of growth of the Soviet labor force by the early 1990's.

"Whether and to what degree the recent trends will continue and what their ultimate effect will be, of course, only time will tell. We must await the continued publication of annual data on fertility by age of mother and order of birth to see how this suggestive turn of events actually works out." (Eason, pp. 160–161.)

6. *In assessing Soviet technological development and its contribution to growth in important sectors such as energy output how can research and development behavior be assessed?*

"One of the classic problems for any R&D policymaker is the proper composition of his R&D portfolio. Three important aspects of this choice involve: (1) the balance between relatively predictable

short-run, versus more speculative, longer-run, efforts to improve the technology of some process; (2) the balance between in-house expenditures to solve a problem and acquiring technology from outside; and (3) the choice between competing paths to the solution of a given problem which are more or less comparable in the time horizon involved." (Campbell, p. 97.)

7. *How have economic and military aid which have played such important roles in Soviet foreign policy in the past changed in recent years? Have requirements for repayment of loans and a shift from aid to military sales in the Middle East shifted the focus from a dominantly political to an economic rationale?*

"Repayment obligations for Soviet aid equalled about 40 percent of the U.S.S.R.'s 1954–75 deliveries, 30 percent if only payments on principal are included. In the face of relatively stable deliveries and rapidly rising repayments of principal and interest, net aid to LDCs has narrowed significantly. Repayments of principal and interest in 1975 were twice the 1969 level or $300 million. Meanwhile, aid drawings rose less than 20 percent resulting in a net aid transfer to LDCs in 1975 of only about $100 million. This compares with $225 million in 1969. Major long-time aid recipients are already feeling the pinch. In 1975, India and Egypt paid more for servicing their aid debt to the U.S.S.R. than they received as aid. The negative aid flow to India has persisted since 1969. Iran and Iraq in 1975 also approached zero aid.

"Soviet aid has never competed on a global scale; it represents only about 1 percent of total official annual aid flows to the LDCs. The U.S.S.R. has contributed less than 0.05 percent of its GNP for aid, compared with an average of about 0.3 percent for Western industrial countries. The impact of Moscow's small program has been maximized, however, because of its focus on a few countries and its emphasis on showy industrial projects. In fact, because of this emphasis, Soviet aid has in some cases gained a competitive edge not warranted by its size.

"Moscow is looked to by some countries as an important source of aid. For example, until recently when OPEC aid was made available, Afghanistan's development program was tied largely to Soviet aid. In several instances when the U.S.S.R. jumped in with aid offers for major installations turned down by other donors, Moscow gained extra prestige. The Aswan Dam in Egypt is the classic example; others include the Bokaro steel mill in India and the Esfahan steel mill in Iran. Moscow scored in some countries by helping to develop public sector industrial complexes: In Egypt and India, it contributed importantly to publicly-owned heavy industrial plant capacity; Moscow was responsible for developing national oil industries in Syria and Iraq and for national gas industries in Iran and Afghanistan. Moscow's terms, which usually allow repayment in goods, also gave the program preferred status for some countries short of foreign exchange whose goods might not be saleable elsewhere. For some less developed countries the U.S.S.R. will continue as an important source of aid. Despite occasional setbacks, the small Soviet aid program continues to provide the U.S.S.R. some economic returns and in a few cases important political dividends." (Cooper, pp. 193–194.)

Various estimates on the size and the geographical distribution of the Soviet military aid program and the economic burden are being evaluated.

"Two main conclusions emerge from this section. First, the real amount of Soviet military aid (MA) to the region increased over the last twenty years at even higher rates than the rather high rates of growth in total Soviet MA to LDC's. Compared with a 3.6-fold increase of total aid from 284 (1955–66) to 1033 (in 1971–74) million (current) rubles, aid to the region increased from 158 to 891 million rubles over the respective periods—up by about 5.6 times. Second, the pattern of distribution of MA within the region seem to have shifted geographically in a centrifugal fashion—taking Egypt as the traditional center—eastwards, north and south, and westwards—and functionally towards soil countries. Still, despite this centrifugal movement, the real amount of MA to the confrontation countries (Main-3) as a group has increased over time. Total aid to Egypt, Syria and Iraq increased from a yearly average of 144 million rubles during 1955–66 to 708 million rubles during 1971–74, almost 5 fold (4 fold after a 20 percent discount). . . .

"The prospects seem to be good enough for the Soviet Union to try hard to pursue this economic interest, which I believe it has already been doing with considerable vigor during the last few years. I thus suppose that at least part of the explanation for the increased Soviet MA supplies to the region perhaps since the early 1970's but certainly since 1973, lies in their ability to reduce the total burden involved by selling more arms for hard-cash or hard cash goods and in their readiness to give up part of their political, ideological and military demands.

"There is no open source that sums up total Soviet hard currency income from arms sales to the region. From the number of fragmentary pieces of information available in the West it is clear that those concerned know the total so there is no point to try to estimate it here. It is now beyond doubt, however, that during 1973–75 such income may have reached a couple of billion dollars or even more. First, there is evidence that a considerable part of the arms supplied to Egypt and Syria since 1973 was paid for in hard cash by other Arab countries (Algeria, Libya, Saudi-Arabia, Kuwait and other countries). Secondly, it is quite clear that arms deals with oil countries, Iraq, Libya, and possibly Algeria and Iran are also payable in hard currency or in oil and gas—which are equivalent to it since they are reexported to the West. The increased proportion of arms sales also explains, I believe, the shift in recent years in the distribution of Soviet MA to the region—towards higher proportions of such "aid" going to oil countries—Libya, Iraq, Iran.

"In conclusion we must retreat a step and put things back in their right proportions. We still believe that political and strategic considerations play a major role in Soviet policy in the Middle East and that economic considerations are of secondary importance, and that especially when MA agreements are considered the political aspects are very crucial. But, when comparing the intensity of Soviet interests and resulting policy up to the early 1970's with what followed we have to conclude that the balance here shifted somewhat to give higher weight to economic considerations and lesser importance to political-strategic ones. It would be impossible of course to explain the shift of Soviet bilateral relations from Egypt to Libya, mainly on economic grounds. Clearly Egyptian interests and preferences play a big role

here. Let us not rule out, however, that at least the second half of that shift—the move to Libya—had something to do with economics." (Ofer, pp. 223 and 237–238.)

8. *Can change in the Soviet management of enterprises such as the development of production associations offer reform in economic administration, decentralize decisionmaking or otherwise affect the efficiency of the Soviet system?*

"A major theme throughout this paper has been the ability of the Soviet institutional structure itself to block attempts at simplication. The Soviet system is trying to defeat the reform, as it has successfully done before. In spite of these efforts reorganization plans have been formulated and to some extent implemented. But a lack of full commitment is reflected in some plans; merger patterns often do not make sense economically and little guidance in the form of operational principles is provided. This is also a consequence of the traditional lack of interest in administrative science. In such circumstances many mergers represent experiments; if the merged enterprises are unable to achieve true integration then they will be liquidated and other merger patterns will be tested.

"In spite of these problems, industrial reorganization has already had positive results. Performance of associations is somewhat better than overall industrial performance, although the gap is narrowing. Superior performance of associations is attributed to development of concentration and specialization, as well as centralization of managerial functions. These accomplishments depend on initiative being exercised within the associations, and here performance is very uneven. It is clear that many associations represent integration in a formal, not real, sense. Genuine integration requires time; several years of accumulated experience will give a fuller picture of association's accomplishments." (Gorlin, p. 187.)

9. *How accurate have Western intelligence estimates been in assessing Soviet economic growth in the aggregate, and by sector and the allocation of goods and services by end use? What kind of revisions need be made? What implications should be attached to the recomputations?*

"The GNP indexes presented here are the preliminary results of a major revision of the indexes which have been calculated and used by CIA for many years. These revisions are: (a) to incorporate 1970 base year weights, (b) to replace deflated value indexes with base year weighted quantity indexes where possible, and (c) to make the indexes comparable and consistent with the 1970 base year weights." (Greenslade, p. 282.)

In order to place Soviet economic statistics in perspective, Western analysts have often had to standardize and reconstruct aggregates from the available data.

". . . The purpose of this paper is to present Soviet input-output tables for 2 years, 1966 and 1972, in a comparable format and with the necessary brief methodological and explanatory notes.

"Soviet economic statistics have been improving steadily in terms of both reliability and coverage, and every year yet another formerly hidden part of the iceberg (as Western specialists have termed the Soviet statistical system) becomes visible. However, there still are numerous gaps, distortions, and ambiguities in the available data and

the input-output tables that are constructed in the U.S.S.R. are no exception. . . . The two tables presented in this study have been "reconstructed" by the authors, i.e., they have been prepared in the standard complete three-quadrant form, with the reconstruction being based on the published fragment of input-output data as well as other statistics. In this process, it was necessary to estimate some 20 percent of all the entries shown in the tables. . . .

"The Soviet Union was a latecomer in accepting and using a number of mathematical and econometric methods developed by Western economists, such as linear programming, game theory, and input-output analysis. Large-scale empirical work in the development and use of input-output techniques began in the U.S. in the late 1940's and was soon adopted and expanded by a number of Western countries. Until the late 1950's Soviet economists dismissed input-output analysis as a fruitless attempt to introduce some measure of order into market economies and denied any utility of the new technique for a planned economy such as the Soviet." (Treml et al., pp. 332–333.)

Problems in measurement invariably occur when comparing the economic strength between countries.

". . . The yardstick used is the gross national product (GNP); its many statistical problems are acknowledged and call for a warning that the figures presented on the following pages should be considered approximations and illustrations rather than precise measurements (today's consumers must be coddled).

"At this juncture there exists a special vexation: CIA has doubled its ruble estimate of Soviet national security expenditures for the past five years. While its previous assessments had definitely been on the low side, its new figures may stray too far in the other direction. Certainty about the real Soviet defense burden is unobtainable in the face of the U.S.S.R.'s secretiveness; future research will have to examine whether the revised military statistics make sense in the context of this national accounts or whether the latter require changes in their level, growth, and structure.

The much higher costs of weapons and space equipment point to a lesser productivity of the armaments industries. The cost difference is likely to reduce the investment series. This, in turn, poses the question of either slightly higher productivity in the civilian capital goods industries or a lower growth rate for the economy as a whole. Extrapolating the new defense estimates backward in time produces the, as yet unresolved, problem of whether the Soviet defense burden was also much higher in earlier postwar years or the growth of defense outlays steeper than thought or whether a mixture of these possibilities prevailed.

"Going even further back in history, the paper suggests that around 1860 Russia and the United States had a GNP of roughly the same size and, with 2.3 times as many Russians as Americans, a per capita GNP ratio of 40:100. By 1913 the ratio was 39:100 for the GNP totals. It dipped deeply during the war and revolution and recovered to 27:100 in 1928 when the Soviet Union regained its prewar GNP level, while the U.S. was on the height of a boom. There followed Stalin's industrialization drive and the American depression. In 1940, on the eve of the German invasion, the Soviet-U.S. ratio was 42:100: it would have been 38:100 if in that year the U.S. had fully utilized its resources.

"History now repeated itself. During the war the GNP ratio fell again sharply; it regained a proportion roughly that of 1928, namely 29:100, three years after victory. But several decades of violence had stunted the U.S.S.R's demographic growth, there were 162 Russians for 100 Americans in 1913, only 119 in 1948 (or now, for that matter). Consequently the GNP ratio per capita was 24:100 both in 1913 and in 1948. . . .

". . . Between 1958 and 1969 both superpowers expanded their GNPs at roughly the same rate and their ratio remained unchanged. But in 1970 another recession hit the U.S., whereas the U.S.S.R. had a very good crop, with the result that the ratio jumped from 44 to almost 50:100 in one year.

"The 1970s have brought troubles on both sides of the fence—inflation here—two severe crop failures there complicating economic conditions under a plan (for 1971–75) that deserved to be underfulfilled. Its implementation had been predicated upon greatly improved efficiency in utilizing capital goods and materials; actually factor productivity of the combined inputs of labor, capital, and land remained stagnant. In the current year 1976, with an American expansion underway and the U.S.S.R. under the weather both agriculturally and organizationally, the GNP ratio will not be much different from what it was in 1970. It is obvious that the Soviet economy continues to waste resources and resist innovation. Less obvious is the extent to which the investment volume has been curtailed in favor of military hardware procurement and a (demographically explicable) labor stringency has worsened by additions to the armed forces personnel." (Block, pp. 243–245.)

10. *Soviet leaders and economic planners had led us to believe that the Tenth Five-Year Plan (1976–1980) would be the first third of a Fifteen-Year Plan (1976–1990) and that both might be unveiled at the Twenty-Fifth Party Congress, but only the Tenth Five-Year Plan was discussed. Western economists specializing in the Soviet economic development process have developed models and made projections for the coming 15 years. What are some of the findings of these western mathematical economic studies of future Soviet performance?*

"Our major finding is that Soviet output expansion will continue to slow down. The gradual decline in achieved output growth rates since 1958 has been noted by many observers, both Soviet and Western; our tests show that it seems destined to continue into the future even under assumptions of extremely favorable surrounding conditions. The slacking off of labor-force increments, declining effectiveness of capital investment, and other forces underlying the tapering growth of the last 15 years, cast their influence forward into the baseline projection for the coming 15 years as well. Fairly strong assumptions about favorable domestic and external conditions do not generate enough upward responses to keep output growth rates at their present levels. The high rates of technological progress, sharp gains in agricultural efficiency, and drastic improvements in Soviet terms of trade that would be necessary to raise output growth rates back to the levels of 5 or 10 years ago are so extreme as to appear clearly implausible. One could, of course, describe the parameters for a far more flexible and sensitive economy that would respond very

actively to fortunate conditions, but nothing in Soviet experience suggests that the present Soviet economy itself could be made to conform to such a flexible model.

"The Soviet economy, especially outside agriculture, has been expanding in stable, unswerving fashion—though at gradually declining rates—for a quarter of a century. An accurate model of this economy will, therefore, have these same properties, and will thus display the relatively sluggish responses noted in the exercises we have gone through. These are not just the artificial simplications of a synthetic constuct. The bureaucratic immobility of the Soviet decision-making mechanism smothers a great deal of the volatility present in a normal market economy. Established procedures regularly grind out standard forms of output, while conventional methods enlarge capital stocks embodying orthodox technology. This stability has, of course, its advantages, but it also means that unfavorable conditions and unsatisfactory performance are hard to remedy. When new procedures are required in order to produce new forms of output involving altered capital stocks embodying unfamiliar technology, the Soviet system responds poorly. The rewards and penalties that motivate Soviet managers and workers serve admirably to replicate and enlarge the existing economy. These same rewards and penalties act negatively, however, with the effect of protecting the system against changes—even if the needed changes are improvements.

"While these limited computations can scarcely be considered conclusive, they suggest how hard it will be, in the absence of major institutional changes, for the Soviet economy to respond in any fundamental way to the benefits that can flow from large-scale participation in the world economy. Soviet exports and imports are only a small fraction of Soviet domestic economic activity. In spite of recent Soviet intentions, her domestic activities are still largely insulated from outside economic influences. Stubborn institutional barriers continue to hamper the incorporation of advanced foreign technology into Soviet industry and agriculture." (Hunter et al., pp. 211–212.)

Various econometric models have been constructed by Western analysts both to forecast the possible economic growth prospects in the Soviet Union and to evaluate official 5-year plans.

"Scenario analysis is a useful way of demonstrating the sensitivity of econometric forecasts to various shocks. These may be under the direct policy control of Soviet planners, as in the restriction of imports. Or, they may be outside planners' direct control as in the case of weather conditions or the business-cycle of the Western industrial economies. In three scenario experiments, we obtained interesting quantitative results which illustrate the behavioral properties of the Soviet economy. Thus, in a policy-type import restriction we observed a negative impact on industrial output, real household income and consumption and a positive effect on the gold reserve-import and debt-export ratios. Dual weather-impact scenarios demonstrated the importance of the weather factor for Soviet agriculture and, consequently, for the whole economy. In a third experiment, by a counterfactual imposition of normal world trading climate for the recession years 1974–75, we examined the negative impact of the Western recession on the Soviet economy." (Green-Levine et al., p. 319.)

Using the SRI-WEFA macroeconometric model of the Soviet economy, Dr. Hunter and his colleagues conclude:

"In particular processes where advanced foreign technology has been installed sucessfully, however, striking gains have resulted. In a recent application of the SRI-WEFA model to this question, Drs. Green and Levine have shown that imported high-technology equipment can raise capital productivity in Soviet industry several fold. After a two- or three-year period for fitting the new equipment into the production process, output gains can be quite substantial. . . .

"Comparing the impact of changes in foreign trade conditions with the impact of changes in defense outlays, there is evidence here of a significant contrast. The broad impact of defense changes is prompt and unambiguous, while the consequences of changes in external trade conditions are less certain. The econometric evidence accords with our understanding of the institutional structure. Many Soviet manufacturing plants produce civilian consumer goods along with their defense-related output; they can presumably switch proportions fairly easily. By contrast, as we have noted, use of the foreign trade sector to update Soviet technology and raise domestic productivity is a slow and problematic process. The two approaches need not, however, compete; for maximum growth benefits, Soviet authorities could direct their policies toward both reduced defense outlays and large-scale imports of high-technology equipment to be imbedded in a reformed, more flexible domestic economy." (Hunter et al., pp. 212–213.)

Analysis has also been extended to include estimates on the cost for the Soviets of increasing defense expenditures and specifically the effect such increases might have on the growth of GNP and consumption.

"If investments maintain their present share of GNP then only a 4% rate of growth of GNP would seem to be feasible over the 1975–1985 period unless drastic productivity improvements are achieved. The decline from the present 5+% growth rate is due to a slower growth of both capital stock and of the labor force. . . .

"Summarizing it appears that unless substantial improvements in productivity are achieved growth rates of defense spending would have to be held below the growth rate of GNP.

It is important to note that there are many elements of reality which are not captured by the model and that these may affect the conclusions.

"For example, it has been maintained that while the defense sector may claim no more than 10% of GNP it uses up a much higher share of very qualified resources such as R&D. It is very hard to quantify such relationships, but some sensitivity analyses have been made using reasonable assumptions to link civilian technical progress to the size of the defense sector. Introducing this linkage predictably made the growth rate of GNP much more sensitive to the size and growth of the defense sector although the maximum acceptable growth rate of defense spending were not much affected." (Bergendorff and Strangert, pp. 416 and 418.)

"In spite of these reservations we feel justified in drawing the conclusion that if consumption and GNP shall increase by 4 to 5 percent per annum (which cannot be considered as to ambitious goals for the Soviet leadership), the defense expenditure must then not increase

by more than some 2–3 percent a year. Strong economic pressure to keep down the rate of increase of defense expenditure must therefore be assumed. On the other hand a major reduction of Soviet defense expenditure can hardly be expected for economic reasons alone, since it implied consumption and/or production gains seen insignificant.

"These conclusions are likely to be modified, only if the increase of efficiency in the use of production factors should be significantly higher than before. However, this would require an unlikely and very advantageous combination of developments: efficiency promoting economic reforms, a higher rate of innovation, an extensive transfer and absorption of foreign technological know-how, and better results in the agricultural sector." (Calmfors and Rylander, p. 393.)

11. *How may a revised domestic investment policy in the Soviet economy spur economic growth?*

"During the Ninth Plan there was no shift of investment composition toward equipment and away from construction. While official data on the proportion of all capital investment on reconstruction, expansion, and technological reequipment of existing plant relative to total investment showed some modest rise, the level obtained in 1974 was not much ahead of the previous high attained in 1966. It remains to be seen if the replacement share increase contemplated in the Tenth Plan can be realized. This intention will be supported by the new depreciation guidelines adopted at the beginning of 1975.

"Exogenous factors make accomplishment more difficult, but at the same time, all the more imperative. Continued industrial expansion in Siberia requires large outlays for new productive plant and overhead facilities. The necessity to utilize less rich ore deposits requires construction of more extensive processing facilities. The higher proportion of industrial investment in raw materials, as distinguished from manufacturing sectors, involves a heavier construction component. Finally, the belated decision to invest in projects which would aleviate environmental disruption also implies proportionately higher construction outlays.

"If the technical structure of investment is beyond the control of planners, other key features relating to its composition are not. Particularly in the manufacturing sectors the bulk of future increases in production will depend upon replacement of existing assets. This imperative will require further measures to induce planners and managers to refrain from prolonging the lives of obsolescent assets through the traditional resort to large capital repairs and to make them more conscious of the significance of economic obsolescence in their investment choices. The new depreciation guidelines and the intentions announced in the Tenth Plan are steps in the right direction, but are too cautious in degree. Without their forthright implementation and more sweeping changes in direction from traditional investment practices, the high hopes of accomplishment from more rapid adoption of new tehnology will be frustrated. It will also be necessary to reduce existing prolonged construction and installation performance. Technology offers considerable promise for the Soviet economic future, but must be supplemented by significant changes in investment policies and practices." (Cohn, pp. 458–459.)

12. *Is self sufficiency of the Soviet economy in energy and other raw materials an attainable and economically desirable goal? To what*

extent is expensive and difficult Siberian development critical to retaining this position of economic independence?

"The U.S.S.R. is the only major industrial nation in the world that is self-sufficient in energy and likely to maintain this position for the foreseeable future. Furthermore, the U.S.S.R. has become a substantial net exporter of fossil fuels to Communist and non-Communist countries. Oil sales to the West are the Soviet Union's largest single source of hard currency earnings, totaling some $3.2 billion in 1975. Coal exports to the West—about 8 million metric tons in 1975—earned about $385 million in hard currency. The U.S.S.R. is in the early stages of becoming a sizable net exporter of natural gas, although at the present time it imports more gas from Iran and Afghanistan than it exports to Western Europe.

"Future growth in energy supply depends, however, on successful development of Siberian resources, as 80% of the reserves of primary energy lie east of the Urals. In the hostile environment of the northern part of West Siberia the U.S.S.R. is confronted with difficult petroleum exploration and development problems and has begun to purchase western equipment and technology to upgrade the petroleum industry's technical capability.

"Domestic production of energy, which accounts for 98% of the U.S.S.R.'s total energy supply, is scheduled to grow at an annual rate of 5.0% in 1976–80; slightly below the rate during 1971–75. Crude oil will continue to account for slightly more than two-fifths of total production. The share contributed by natural gas will rise to almost one-fourth by 1980, and coal's share will decline to just over one-fourth. Minor sources of energy, including hydroelectric and nuclear electric power, will account for the remaining few percent. Although a net exporter, imports—mainly of natural gas—accounted for 2% of total energy supply in 1975; imports will still be of minor importance in 1980.

"Exports of energy probably are expected to grow at about 4.7% per year in 1976–80, somewhat less than 7.3% rate of 1971–75. The bulk will continue to go to other Communist countries. Although exports of natural gas will rise sharply, exports of crude oil and petroleum products will still account for about two-thirds of total energy exports in 1980. Domestic consumption of energy apparently is projected at about 5.1% per year, a slight drop from the 5.2 rate of 1971–75. This rate of increase appears to be consistent with the planned overall growth of the Soviet economy in 1976–80.

"The U.S.S.R. probably will not be able to meet the ambitious targets set for oil and gas production in 1980 but it is likely that lags also will occur in other sectors of the economy thus preserving the overall balance between energy supply and requirements.

"The U.S.S.R. has not as yet released its long-range plan (1976–90) but forecasts made by Soviet energy experts in the early 1970's projected energy requirements through 1990 at a growth rate about equal to the rate now set for 1976–80. These forecasts point to a further slowdown in the growth of crude oil production, continued rapid increases in natural gas production, and a slight acceleration in the rate of growth in coal production. A very rapid buildup in nuclear energy production probably will be planned for the 1980's, but its share in total energy supply will still be small in 1990.

"The plan calls for Soviet crude oil production to reach 620–640 million tons in 1980. This output will require a 4.8%–5.4% average annual rate of increase compared with the 6.8% attained during 1971–75." (Jack, Lee, Lent, pp. 460–462.)

The 10th five year plan stresses the development of Siberia as it is rich in natural resources and key in developing Soviet energy potential.

"The U.S.S.R. is accelerating development of Siberian resources out of economic necessity. Continued growth of the Soviet and East European economies will depend to an increasing degree on Siberian resources.

"About 80% of the energy used in the Soviet Union is consumed in the European part of the country, but 80% of the reserves of primary energy lie east of the Urals.

"The U.S.S.R. supplies the bulk of the increasing quantities of energy required by the East European Communist countries, mainly from reserves in the western part of the country.

"Reserves of energy in the western U.S.S.R. are being depleted and are becoming more expensive to exploit.

"Growth in oil production from the extensive reserves of Western Siberia may slow down in five or six years, and additional reserves will have to be found farther east and offshore." (A. Smith, p. 480.)

The increasing importance of fossil fuel balances has led analysts to examine carefully the growth of fuel requirements, fuel productivity and fuel using sectors and their effect on the economies of the U.S. and U.S.S.R. overtime.

Key Findings:

"1. The fuel requirements of the U.S. and the U.S.S.R. differ substantially. These differences stem from differences in fuel productivity that affect each economy as a whole and from differences in the level of national output and its mix.

"2. The output mix of the U.S. economy stresses satisfaction of consumer wants while the Soviet Union strives for economic growth through heavy investment. This difference is reflected in the ultimate uses for fossil fuels. For example, 32 percent of U.S. fuel requirements in 1967 were used directly or indirectly to supply refined oil products to final demand. The corresponding figure for the U.S.S.R. was only 7 percent. The chief fuel-use for final demand in the Soviet Union in 1966 was construction, which consumed, either directly or indirectly, 18 percent of Soviet fuel. Construction in the U.S. accounted for only 9 percent of American fuel needs in 1967. To perform the same amount of construction, the U.S.S.R. requires between one-quarter and one-half more fuel input than the U.S.

"3. Between 1950 and 1972, the productivity of fuels in the U.S. increased at an average annual rate of 0.6 percent with high rates of growth in the early fifties and an absolute decline in the late sixties. In the Soviet Union over the same period, fuel productivity increased at an average annual rate of 1.3 percent.

"4. If past patterns of sectoral growth rates and increases in fuel productivity were to persist, Soviet aggregate fuel requirements would grow at an average annual rate of 5.2 percent between 1973 and 1990, with emphasis on oil and gas." (Kazmer, pp. 500–501.)

However, prospects for independence in bauxite supplies to meet expanding aluminum requirements are not so optimistic.

"Recent statements in the Soviet press suggest a general disenchantment with nonbauxitic domestic raw materials, both on technological and economic grounds. Having completed the two principal nonbauxitic projects—Achinsk nephelite and Kirovabad alunite—that had been designed in the late 1950's, the Soviet aluminum planners now appear to be turning increasing to imported raw materials as a source for future expansion of the industry.

"In addition to the planned bauxite-based expansion of the Kirovabad alumina plant, a new alumina plant is under construction on the Black Sea coast of the Ukraine. This plant, with an estimated capacity of 1 x 10^6 tons, is situated at Zhovtnevoye, a southern suburb of Nikolayey. It will process Guinean bauxite from the 2.5 x 10^6 tons mining operation at Debele (near Kindia) that was developed with Soviet credits, to be repaid in bauxite. Nikolayev alumina is to be hauled by railway over a distance of nearly 3,000 miles to the Sayanogorsk aluminum plant, with an estimated capacity of 500,000 tons. The Sayanogorsk plant is scheduled to go into operation in conjunction with the adjacent Sayan hydroelectric station, now scheduled for first power production in 1978.

"Soviet planners have also recommended the construction of a second seaboard alumina plant on the Pacific coast. This plant, which would be built in the 1980's, would have a capacity of 1.1 x 10^6 tons of alumina and would be located at a site yet to be determined in the Maritime Territory of the Soviet Far East. It would process imported bauxite, possibly from Australia, and ship its alumina to the aluminium plants of southern Siberia. The long-term Soviet intention is to re-export aluminum metal to countries in the Pacific basin. Such an operation would be greatly facilitated by the construction of the 2,000-mile Baykal-Amur Mainline railway, running parallel to, and to the north of, the present Trans-Siberian Railway, is designed mainly to open up new Siberian resource sites for export through Pacific ports. Much of the traffic on the BAM railway would thus be eastbound, making it particularly suitable to haul large volumes of alumina from the coast westward to the Siberian reduction plants. Over the long run, the growing hydroelectric complex of southern Siberia may well become one of the world's leading aluminum reduction centers of the world, importing raw material and re-exporting metal." (Shabad, pp. 672–673.)

13. *How are modern, technologically sophisticated industries being developed in the Soviet economy? How efficiently are the domestic bellwether industries, contributing to investment in Soviet construction faring?*

"The chemicalization program in the Soviet Union has succeeded in rapidly increasing the output of the chemical industry. This success can be attributed to the application of large amounts of new capital and labor to this sector. Chemicalization appears to be an application of the basic Soviet economic model to a particular industry. However one unique aspect of the program is a reliance on foreign capital and technology. Even though foreign capital has been actively imported for the economy in general on a large scale in recent years, the chemical industry's expansion has relied on foreign capital from its inception in 1958." (Rushing, p. 554.)

The Soviet cement industry has also grown rapidly.

"Soviet cement production will exert a major influence on future economic growth and economic welfare, as a major input into capital investment, affecting thereby the growth of all industries, and as a component of final consumption, chiefly housing, but also other components of urban settlement. In this study, I evaluate the efficiency of the cement industry in terms of certain critical and relatively unambiguous aspects of the industry's operation since World War II. In an earlier study of the prewar period I showed that the industry was ineffiicient in gross and unexpected ways, while performing very satisfactorily in one important respect—short-term transportation utilization. Accordingly, the primary objective of this study is to investigate the extent to which the prewar problems have been remedied in the postwar period." (Abouchar, pp. 558–559.)

14. *What are the prospects in the near and long term to Soviet Russia's chronic trouble spot—agriculture?*

"How well the U.S.S.R.'s economy performs during the course of the Tenth Five-Year Plan depends in large part on the pattern and severity of weather-induced fluctuations in crop production, particularly grain. If average weather prevails over the next five years, most of the agricultural goals are in reach. Should the Soviets suffer another harvest disaster, its effect would depend on timing.

"If weather conditions are beneficial during the 1976 growing season, the Soviets could harvest more grain than their minimum domestic requirements, estimated at roughly 175 million tons. Under these conditions, the U.S.S.R. could increase the weight of animals being marketed, begin the slow process of rebuilding livestock herds, and start to replenish carry-over grain stocks. If the harvest merely met minimum needs, expansion of herds would be postponed or depend on imported grain.

"Another grain shortfall—say 150 million tons—in 1976, would be a major calamity and would foredoom the goals of the five-year plan. A failure at this time would force further large reductions in livestock numbers and additional massive imports of grain from hard-currency areas, worsening the large trade deficit anticipated in 1976. In turn, this might force the U.S.S.R. to make substantial cutbacks in nonagricultural imports. The Soviet consumer would face another reduction in meat supplies, more than erasing the gains made under Brezhnev.

"On the other hand, good crops in 1976 and 1977 might well be enough to generate sufficient momentum to survive a shortfall late in the plan period." (Carey, pp. 594–595.)

15. *Is the Soviet tractor industry an example of a technologically advanced sector that might contribute to exports of manufactured goods competitive in the world market?*

"In the current Five-Year Plan period, the Soviets will try again to reach many of the same technical objectives that they failed to reach during 1971–75. If, as seems likely, most of the 1980 technical goals are met, the Soviets will have taken a major step toward upgrading their tractors to world standards. However, they probably will not achieve comparability with the U.S. The thrust in the U.S. tractor industry for improvements in tractor performance seems to be even more intense than in the U.S.S.R.

"One area that may prove difficult is raising average tractor horsepower to 93 horsepower as planned. To a large extent, that goal will depend upon successful full-scale production of new tractor models at Chelyabinsk and Pavlodar. Additional capacity is under construction at Chelyabinsk, but is moving slowly. Pavlodar plans to put into production the 300-horsepower K–701 wheeled tractor but has had experience producing only a single 90-horsepower track-laying model.

"In general, Soviet tractors in 1975 were better made and more powerful than those produced in 1970, although, on the average, not as well-made or as powerful as those produced in the United States; the average Soviet tractor still cannot be said to be the technological equivalent of the average U.S. counterpart. During the past five years, the technology gap with the United States has been narrowed sufficiently in Soviet export models to make them acceptable to at least some U.S. farmers, but acceptability in the U.S. market is not a sure indicator of technical equivalence as long as the Soviet price is substantially lower than the U.S. counterpart. Moreover, export models are manufactured with special care and cannot be said to be characteristic of Soviet production, generally.

"The Soviet drive to raise average tractor horsepower is well directed and should help to improve productivity in agriculture, and perhaps also to reduce agricultural manpower requirements. Even so, new, higher horsepower models are likely to be underutilized for many years because of shortages of complementary farm machinery. In addition, shortages of spare parts will continue to keep many tractors out of service for extended periods.

"A critical shortage of special-purpose heavy-duty industrial-type tractors, including pipelayers and tractors for construction work as bulldozers, is likely to persist throughout the remainder of the 1970s. This shortage, coupled with an anticipated growth in demand generated by projects such as the Baikal-Amur Railroad (BAM), make it likely that the U.S.S.R. will continue purchase of large tractors in the United States and other Western countries. The U.S.S.R. may also acquire U.S. production technology under a recently signed scientific and technical cooperation agreement with a large U.S. company." (Rubenking, p. 614.)

16. *Will the Soviet economy be able to provide more and better goods and services as effective incentives to the Soviet citizens as workers?*

"Over the past quarter century, the Soviet economic system and the policies of its leadership have produced an impressive rate of growth in total national product and in per capita consumption. The success

in raising levels of living quantitatively, however, has been accompanied by snail's pace progress in improving the population's lot in a qualitative sense. . . . As it enters the third quarter century, the Soviet economy faces the strong likelihood of much slower economic growth in the future and a slowing of growth in consumption, as well. Continued slowdown in the latter is implicit already in the goals established in the Tenth Five-Year Plan, which also reasserts the traditional priorities of significantly more rapid growth of producer goods than of consumer goods. . . .

"Should the leadership opt to seek a substantial increase in consumption and a major improvement in its qualitative aspects, it would find itself faced with dilemmas and conflicts of priorities and shackled by ideology. The fundamental conflict is between consumption and growth. A speedup in the rate of construction of housing, and infrastructure to service the automobiles provided, and more retail trade and service facilities would be a boon to consumers, but the substantial resources needed to overcome past neglect in these areas would divert labor and investment resources from growth-oriented ends. Industrial facilities for producing consumer goods are relatively technologically backward, and much capacity represents merely side-line production. Large gains, both quantitative and qualitative, could be had by building specialized plants, especially for consumer durables and the numerous items of ordinary household use. Such a program, however, would claim investment resources; imports of specialized modern plants from the West would take resources of hard currency that otherwise could be used to purchase modern plants to produce steel, for example. As an alternative, finished consumer goods could be imported on a larger scale and sold to consumers with the stiff price markups now in effect. While such a move would increase consumer satisfaction and absorb some of the rubles that otherwise might go into savings deposits, the requisite hard currency would have to be taken from competing uses. Except for the last, policies involving major reallocation of resources to consumption would not have quick payoffs, and any attempt to implement them quickly might create serious disruptions in the short-run, thus exacerbating the conflict between growth and consumption.

"Another source of conflict is inherent in the necessity to maintain work incentives, if economic progress is to continue. Along with steady increases in real consumption, the population has come to expect a steady, even if slow, rise in money incomes. In fact, despite much emphasis on "moral incentives" and socialist competition during the Tenth Five-Year Plan, the government is basically relying on material incentives to elicit work effort. Thus, money incomes are scheduled to grow, albeit slowly, during 1976–80, more or less in line with planned growth in goods and services. If past behavior prevails, the worrisome accumulation of liquid assets in the hands of the population will also continue. These accumulations have the potential for serious disruptive affects, should some crisis of confidence occur. The government's options for dealing with this situation are not very good. One easy method already being used to capture some of these rubles is to encourage the purchase of insurance. During 1971–75, net insurance premiums tripled and in 1975 amounted to 2 billion rubles.

Taxes could be raised and bond purchases made compulsory, but the government as of now has committed itself to reducing taxes and redeeming past bond issues. A change in this policy would carry great risks of alienating the populace, to the detriment of work incentives and perhaps also to social and political stability. For similar reasons, confiscation of savings accounts directly or via a currency revaluation would not be a likely remedy.

"An option that would both absorb large amounts of liquid asset holdings and increase quantitatively measured output would be to permit more private activity of various kinds. By easing restrictions on investment in cooperative and private housing, the government could induce the population to take over more of the cost of providing housing and to pay the full maintenance cost as well. Surely, both parties would be made economically better off thereby. Similarly, easing restrictions on private activity in providing services of all kinds would accomplish similar ends, and would also help to convert grey or black markets into legal ones. Restraints on private activities in agriculture could be eased, a policy that has invariably yielded quick response in output gains in the past. But official ideology militates against encouraging private activities. State-provided housing is viewed as the wave of the Socialist future, and private housing is viewed as a relic of the past. Private activities are considered an anachronism in a centrally planned economy where the means of production are supposed to be state property.

"Another measure that would benefit both consumers and the State would be to raise retail prices for selected goods and services, so as to clear individual markets and eliminate subsidies. With present prices, for example, there is excess demand for many foods and for housing, along with large State subsidies to maintain these prices. There, again, however, oft-repeated dogma stands in the way of raising prices. Low rents and stable retail prices are tauted as among the virtues of a centrally planned socialist economy. Indeed, the Soviet people have come to expect low and unchanging prices for a variety of basic goods and services. Aside from ideology, the leadership must take this expectation into account. Khrushchev's sudden hike in the prices of milk and meat in 1962 resulted in civil unrest.

"Painful though the choices may be in respect to policies designed to raise output of consumer goods and to better manage money incomes, they are probably much less so than those that attend any serious effort to provide major qualitative improvements in the consumer sector. . . .

"Each of the policy options discussed above is riddled with potential conflict within the political leadership, whether Brezhnev and company or their successors. None of the choices promises large gains in per capita consumption without an accompanying cost in investment and growth. An economic reform that ultimately might alleviate the qualitative problems could not be implemented without short-run costs and long-run problems of its own. Given these considerations, it is not surprising that Soviet leaders up to now have come down on the side of prudence. Treading along a familiar path may have its costs in continued frustration of the population's desires, but such a course carries minimal risk of social and political upheaval. No one can say what future leaders may opt to do. One can be fairly sure, however, that they will face the same difficult choices as does the present leadership. Mean-

while, painful decision can be postponed by a concerted effort to obtain the largest possible infusion of technological aid and consumer goods from the West on the best terms possible." (Schroeder-Severin, pp. 638–641.)

17. *Has the Soviet Union changed either temporarily or permanently its selective, limited commercial relations with the West, including the United States? What are the future prospects of trade? What are the specific prospects in feed grain?*

"The Soviet Union appears to have abandoned its past autarkic orientation in foreign trade in the late sixties. In the relatively short period of time since then it has not been possible to implement the new comprehensive system of foreign trade planning at all levels of the planning process. Yet it is currently possible at the level of central decision making to bring the new economic criteria to bear on major foreign trade decisions. This is a major achievement. Soviet foreign trade specialists do not seek to minimize the difficult tasks facing them currently, in particular the broadening of the system to lower levels of the planning hierarchy, the integration of foreign trade into national economic planning, the collection and processing of data, and the improvement of foreign trade incentives at the enterprise level. The nature of these tasks should stimulate further change away from the traditional autarkic model of decision making." (Brainard, p. 708.)

Soviet trade with the West has brought problems which some analysts believe may limit future trade prospects.

"The Soviet leadership, convinced that trade can play an important role in U.S.S.R. economic development as well as in foreign affairs, will probably try to maintain a rapid pace of foreign trade growth, particularly with the West. In addition to political imponderables, however, there are economic factors that somewhat cloud the outlook for continued rapid growth of Soviet trade with the West. Large hard currency trade deficits are limiting Soviet ability to buy for cash all but top priority foreign goods. Other uncertainties involve Soviet agricultural performance, Western demand for Soviet exports, the impact of Western inflation on the purchasing power of available Soviet foreign exchange, and the need to strike a balance among Soviet domestic requirements, CEMA needs and the supply of goods to export for hard currency.

"Because of these problems it seems unlikely that Soviet East-West trade in the years 1976–80 can equal the extraordinarily high growth rates achieved during 1973–75. These uncertainties about the East-West trade component may account in part for the surprisingly low overall foreign trade target set for the current Five-Year Plan—30 to 35%. Although nearly identical to the ninth Five-Year Plan goal, this range is less than half that of the actual growth for 1971–75.

"At the same time, there is every reason to expect further substantial growth. For example, during the past three years the U.S.S.R. has ordered machinery, equipment, large diameter pipe and construction materials and services from Western Europe and Japan adding to over $13 billion. Major Soviet new projects such as the Orenburg gas pipeline will continue to generate orders for Western equipment. Deliveries of raw and processed materials already contracted for under compensation agreements with Western firms will begin augmenting Soviet hard currency export flows. Over the years 1976–80 Soviet

deliveries under compensation agreements should earn $4–5 billion, which in large part will be used to pay for earlier deliveries of Western equipment.

"The U.S.S.R.'s major Western European trading partners, Japan and Canada have extended to the Soviet Union over $11 billion in government-backed credits since mid-1974 and half of these are not tied to specific projects. In addition, the Soviets directly and indirectly have obtained Eurocurrency loans and credits from commercial sources. For example, for the Orenburg Project alone the Soviets have obtained a total of almost $1 billion in Eurodollar loans through the CEMA." (Brougher, pp. 691–692.)

The prospects for grain trade between the U.S. and U.S.S.R. also are under question.

"A key question is how well the livestock goals match up with prospective feed production. Only a tentative conclusion can be drawn from the information available at this time. Attainment of the grain production target could make available on the average about 115 million tons of grain for feed annually and still permit a moderate rebuilding of stocks. Specific targets are not available for each of the other types of feed, nor are specific targets available for meat production by types of livestock or poultry. Based on assumptions about the distribution of meat by type and on projections of the level of availability of roughages and other feeds (largely linear extrapolation of past performance), however, a preliminary conclusion can be made: The livestock and feed production plans generally are consistent. If the Soviets hold to the livestock targets and if weather permits attainment of expected feed production, the U.S.S.R. may well approach self-sufficiency in feeds.

"Prospects for grain trade with the U.S.S.R. have been clouded by release of relatively low livestock production goals for 1976–80. Soviet grain imports seem likely to be affected most strongly by the following elements:

"1. Present and long-term commitments to import grain;

"2. Effects of year-to-year weather variability on grain output:

"3. Decisions concerning U.S.S.R. grain reserve stockpiling; and

"4. Pace of livestock herd rebuilding and the degree to which goals may be exceeded.

"The 5-year grain agreement with the U.S.S.R. for the 1976–80 marketing years seemingly puts the United States in a strong position to maintain grain exports of 6 to 8 million tons to that country. These exports may be boosted when poor weather affects Soviet crops. There is some suggestion in the announced plan to increase grain storage capacity and also in an objective cited in the 1976–80 plan—"creation of the necessary reserves of agricultural products"—that Soviet policy may elect to bolster grain reserves. Imports to cover some stock rebuilding are especially likely in 1976 unless another major shortfall is experienced in the U.S.S.R. grain harvest. Slow rebuilding of livestock herds would tend to restrain grain import needs. The Soviets apparently intend to rebuild hog inventories rapidly, however—to January 1, 1975 levels by January 1977. The U.S.S.R. may well resume moderate amounts of grain exports in the years ahead, thus offsetting a portion of the grain purchased from the world market.

"The emphasis in the plan on improving efficient use of resources, however, may augur well for development of a market in the U.S.S.R. for oilseeds or oilseed meals—at least until progress can be made toward the objective of increasing high-protein feed output. Owing to limited potential for increasing oilseed area, it does not appear that a major expansion in high protein feed production in the U.S.S.R. is possible during the next several years.

"If the livestock and feed production plans are consistent, still a major inconsistency may exist in the plan for 1976–80. Wages are scheduled to increase 16 to 18 percent, but the planned increase in per capita livestock production is only 2 to 6 percent on meat and 2 to 5 percent on milk. The previously-cited research study suggested that for each 10-percent increase in per capita incomes, demand for meat in the U.S.S.R. increases about 7 percent and for butter (still the principal component of dairy product consumption) increases about 6 percent. Results of this study suggest that the repressed demand for livestock products in the U.S.S.R. may increase substantially during the remainder of this decade.

"The Soviets may consider other alternatives besides livestock product supply increases to reduce this repressed demand. An increase in retail prices of livestock products is one possibility. The announced policy to maintain stable retail prices on major foods, however, indicates that this is not now intended. A more likely alternative is a substantial increase in imports of meat and other livestock products. Large meat imports are especially likely in 1976 as production slumps as a result of reduced herds. It is more difficult to foretell whether the U.S.S.R. will continue as a major meat importer in subsequent years.

"All in all, the draft 1976–80 plan seems relatively realistic in the agricultural sector in terms of matching planned outputs with resources. The plan, however, seems to call for considerable restraint on the part of the Soviet consumer and may result in an aggravation of repressed inflation. The sum effect on Soviet agricultural trade, assuming normal weather, is likely to be a less strong demand for grain imports, compared with the demand of the past few years, but perhaps a strengthened demand for livestock product imports. But then weather is rarely normal. Actual trade is likely to continue to be greatly affected by weather at least during the next several years. Both grain and meat imports seem likely to continue strong in 1976 as grain reserves and hog herds are rebuilt and meat production slumps." (Schoonover, pp. 818–819.)

18. *How well might the Soviet Union respond to the availability of most favored nation tariff treatment in expanding manufactured goods exports to the West?*

"If exports are to be expanded meaningfully, Soviet producers must be made directly accountable, and compensated accordingly, for the success or failure of their sales efforts in the West. To be effective this change would involve providing the producer with:

"Direct access to potential buyers, including participation in Soviet-owned companies in the West and a direct say in marketing efforts associated with the product;

"The ability to import Western technology and equipment needed to make his output more competitive;

"The authority to have component parts produced in the quantity and quality necessary to meet his export commitments; and

"Considerable freedom in production, allowing him to be responsible to changes in Western demands. . . .

"In addition to allowing producers direct access to buyers and holding them accountable for sales, other key indicators of a Soviet commitment to implement changes needed to significantly improve Moscow's exports of manufactured goods include:

"Affirmative action on recent high-level statements calling for the establishment of firms producing solely for Western export markets;

"Where required, some allowance for Western management and possibly equity participation;

"A greater availability of goods for export and a more flexible production schedule allowing for quicker delivery times; and

"A greater emphasis on spare parts production and the establishment of additional outlets in the West. . . .

"In the final analysis politics rather than economics may prove to be the major barrier to needed change. The Communist party maintains tight control over the Soviet economy and the political element plays a pervasive role at all levels of economic decisionmaking. This political element has proven very resistant to needed economic change in the past, particularly when such changes threatened to result in a diminution of its control. It is difficult to perceive of an economy responsive both to the needs of a capitalist market and the party. The creation of a special export sector, which like the military economic sector is distinct from the larger domestic economy, may prove to be the only feasible solution to this dilemma.

"Over the next several years continued implementation of recently initiated programs should allow the U.S.S.R. to continue to increase sales of manufactured products in the West. Sales will continue to be centered in those areas—automobiles, tractors, power equipment, machine tools—which have been the mainstay of past efforts. Until more meaningful changes are fully implemented, however, Soviet manufactured goods sales will remain a small percentage of total exports to the West; they should account for less than 10% of total exports for at least the balance of the decade." (Erickson, pp. 724–726.)

19. *With ever expanding import requirements from the West, how will the Soviet Union finance their Western trade and manage deficits when they occur?*

"Tight controls over hard currency outlays and a deferment of some orders for equipment will not significantly reduce the projected 1976 deficit. It may, however, allow Moscow to reduce substantially that portion of assets held in Western banks to cover day-to-day financial needs. There is little to suggest a sharper cutback on imports, and Moscow's ability to do so is constrained by contracts previously signed for equipment, steel products, and grains.

"The U.S.S.R. is again expected to obtain medium- and long-term credits to cover a major share of the estimated $4.5 billion to $5 billion in machinery and equipment which will be imported from the West this year. As in the past, a major portion of such credits will again be backed by Western governments. Approximately $1 billion in government-backed credits are expected to be advanced in support of Soviet large-diameter pipe imports. The U.S.S.R. also is expected to make

heavier use of promissory note financing in 1976, possibly to the detriment of concomitant attempts to obtain pure financial credits on the Eurocurrency market. Total medium- and long-term credits associated with equipment and pipe imports will thus probably reach $3.7 billion. Allowing for principal, and interest repayments on past medium- and long-term credit drawings, new drawings will net the U.S.S.R. roughly $1.4 billion which can be applied against the 1976 trade deficit.

"As in 1975, other invisibles and earnings from arms sales should net the U.S.S.R. $750 million, leaving roughly $2 billion to $4 billion to be covered by gold sales and additional financial credits from the West. Although the U.S.S.R. remains an excellent credit risk in the eyes of Western bankers, heavy Soviet borrowing in 1975 may have constrained Moscow's ability to borrow as heavily in the Eurocurrency market this year. At a minimum, it appears that the U.S.S.R. will have to pay higher interest rates and management fees for additional borrowing in 1976. The Soviets have traditionally resisted increases in interest rates and may instead opt for heavier gold sales. Press reports, for example, recently included an example whereby the U.S.S.R. used gold to cover a $7 million progress payment due a Swiss exporter." (Farrel and Erickson, pp. 735–736.)

20. *Will technology transfer to the Soviet economy via Western machinery exports have a significant long- or short-term effect in performance? What will be the conditions under which more or less favorable adaption of Western technology to Soviet conditions are likely?*

"We have seen that the import of Western technology by negotiable channels—principally, machinery and license purchases—remains small and has not increased dramatically relative to Soviet domestic investment. It is concentrated on relatively few industries and has had a major impact on the growth and product-mix of some of them.

"Its total impact on Soviet economic performance remains uncertain. Some macroeconomic calculations suggest that the total impact in recent years may have been substantial. Micro-economic evidence tends to raise doubts on this score. The degree of success in diffusing imported technology is likely to be very important in determining whether, in the Soviet case, the total impact of negotiable transfer on Soviet growth is or is not large. The evidence is that some successful diffusion occurs, but it is doubtful whether Soviet diffusion is generally very effective. It is arguable, further, that diffusion would tend to become less effective, on the whole, if the rate of direct technology import were to rise substantially.

"Whether Western governments should maintain or modify their policies on negotiable transfer is a contentious issue. It depends on a number of subsidiary issues, several of which are beyond the scope of this paper. What are the political *quid pro quos*', if any, for negotiable West-East transfer, and what are they worth? What are the benefits to Western economies in employment; incomes, the reverse flow of Soviet technology (which is not insignificant); the learning by doing that may come from tackling Soviet projects of a scale unheard of in the West, and the energy supplies with which the U.S.S.R. can repay some of its technology imports?

"Will greater East-West technology flows create an interdependence favourable to peace? Will they promote or, on the contrary, provide a substitute for Soviet economic reform? Will they tend to draw Soviet

policymakers into unplanned complementary resource commitments at the expense of military expenditure? Will they lock the Soviet Union into a pattern of technological dependence on the West?

"Amongst all these questions, the question of the economic consequences for the U.S.S.R. of greater international transfer from the West is the only one with which this paper is concerned. The underlying issue is whether technology transfer involves the West in selling cheaply a critical capability which we shall subsequently regret sharing with the Soviet Union.

"Wiles has argued that this is precisely the case. Vernon and Goldman have asked whether U.S. companies may not be selling technology too cheaply because of false expectations about the Soviet market and because of the bargaining power of Soviet f.t.o.'s.

"It seems inescapable that a buyer of a new technology dealing with competing suppliers stands to make saving much greater than the price he pays. In this sense the Soviet Union is likely to be the greater beneficiary of such deals obtaining a large "consumer surplus." But that is in the nature of technology sales. Two points should, however, be noted. First, Soviet f.t.o.'s are usually far from being the only potential buyers of a technology and hence are seldom able to exert monopoly bargaining power. Second, if there are competing suppliers of a technology it is probably not a very new technology; the very latest technologies are commonly monopolised by their originators for a while, so that a Soviet purchaser wanting the latest technology may often have in fact to pay a monopoly rent above the supply price.

"More generally, a centrally planned economy purchasing technology on the world market would seem to be in a position akin to that of a firm in a market economy adopting an 'imitative' rather than an 'offensive' or 'defensive innovation' strategy. In the Soviet case, at least, a technology lag seems almost to be built into the arrangement.

"The sharp imbalance in Soviet trade with the West in technology and sophisticated products, the lack of technological dynamism of the Soviet system and the inhibiting influence of balance of payments problems must be considered along with the small scale of West-East flows in relation to the Soviet economy and the doubts about Soviet diffusion. All this suggests that, though the Soviet economy probably benefits substantially from international technology transfer, the Soviet gains do not seem likely to transform the Soviet position. In civilian technology catching up, let alone overtaking, still seems a remote prospect." (Hanson, pp. 809–810.)

21. *What role do commercial agreements (CA) play in Soviet trade with Western governments and corporations such as those in the United States?*

"What are the motivations of those U.S. firms that have concluded CAs with the U.S.S.R.? The most frequent response is that the CA is seen as an entry vehicle into the large Soviet market, possibly enabling a firm to expand its sales in a broad range of product lines. CAs are also seen as possibly resulting in more end-user contacts and thereby providing a more effective means of assessing the Soviet market. There is, however, a lack of agreement among observers as to the value of CA as a market entry device. At a 1974 Commerce technology trade symposium, it was noted that "those (businessmen) who signed CAs are usually not those who sign contracts." Indeed, since

1972 little correlation is evident between the existence of CAs and the signing of commercial contracts by American companies. Another observer indicated that only travel has resulted from the CA signings, but that travel often leads to trade with the U.S.S.R. On the other hand, one U.S. executive felt that the SCST was the "appropriate vehicle for big deals."

"There are also some practical administrative advantages in CA's since the SCST can serve as official sponsor when a company applies for a business visa. It is illegal to conduct business in the U.S.S.R. on a tourist visa and a business applicant must have the sponsorship of some Soviet agency. Similar sponsorship is required for accreditation to open an office in the U.S.S.R.

"Broad Soviet motives for acquiring foreign technology were clearly defined by GOSPLAN in a 1970 assessment—foreign technology could be expected to advance the application of innovative techniques by two to five years, thereby satisfying product demands more quickly with the highest quality available domestically. This could be accomplished while economizing on domestic R&D expenditures and expanding hard currency earnings through exports of finished product. These objectives are certainly still applicable.

"The general assessment is that the Soviets are interested only in commercially usable, applied S&T and are little concerned with basic science research. Indeed, the Soviets have great praise for Japan's ability to utilize imports of technology to expand industrial capacity in the 1950s and appear to have committed themselves to emulating the Japanese experience. They have acted in accord with that commitment by concluding CAs with firms in technology areas with direct application to industrial production." (Theriot, pp. 750–751.)

22. *What are the main directions of Soviet policy toward development of industrial cooperation with Western trading countries?*

"Although the broad concept of industrial cooperation with the West has been endorsed by Soviet authorities, the preferred mode of such cooperation has been defined to meet Soviet requirements rather specifically as follows:

> Contracts involving large sums that extend over lengthy periods and which are signed with a firm or group of firms in the capitalist countries, usually on long-term credit, for machines, equipment, development or construction of a project (natural resource or industrial enterprises). Credits are reimbursed by the delivery of products turned out by the project.

"Industrial cooperation with enterprises in the West will have the following characteristics:

"The project is one with a major impact on the Soviet economy.

"The cost is normally substantial.

"The agreement covers a long (10–15 year) period.

"Equipment requirements for the project are normally purchased on long-term credit.

"Credits are reimbursed at least in part by the delivery of output from the project.

"Taking the Industrialized West as a whole, it is estimated that as much as 15% of 1975 contracts for export of machinery and equipment to the Soviet Union, or as much as $615 million in future exports, could be attributed to compensation arrangements.

"Because the U.S. participates in fewer compensation arrangements with the Soviet Union, the impact on overall trade flows is not immediately apparent. However, an analysis of contract data for 1975 indicates that as much as 17% of U.S. exports to the Soviet Union or some $100 million in sales, can be associated with compensation arrangements.

"For the future, the Soviets have indicated that any major and stable increment in U.S.-Soviet non-agricultural trade must be realized through compensation arrangements. The North Star and Yakutia natural gas projects, for example, would produce a sizeable increase in trade turnover. Citing the $1 billion 20-year Occidental agreement as an example, Deputy Minister Sushkov has estimated that perhaps 38% of U.S.-Soviet trade in the 1976–80 period would be governed by compensation arrangements. Even assuming that this estimate applies only to trade in machinery and equipment (and thus excludes substantial shipments of agricultural commodities) it would require markedly increased Soviet shipments toward the end of the period to realize this figure.

"Commodity composition—A second major directive of Soviet policy regarding future industrial cooperation with the West is a restructuring the commodity composition of such arrangements. . . ." (Smith, pp. 779–782.)

23. *Can Soviet leaders or planners by adopting a new growth strategy emphasizing foreign imputs provide for significant improvements in economic performance?*

". . . Foreign technology can certainly make a contribution both to the level of Soviet technology and to the rate of growth. All countries gain from trade based on comparative advantage. The Soviets as well as the other centrally planned economies have tended to "undertrade," in the sense that their volume of trade has been less than that of market economies at equivalent levels of economic development.

"They have sought to produce by their own effort a much larger range of products than have market economies, and as a consequence they have denied themselves some of the benefits of the international specialization of labor. Even if the technological level of Soviet production were on a par with that of the advanced capitalist countries, it would have paid them to improve more than it was their policy to do in the past. The growing volume of Soviet trade with those countries is therefore bound to provide the Soviets with benefits in the form of the gains from trade that they had formerly foregone. Imported technological equipment will also contribute to the general elevation of the quality of the Soviet capital stock and therefore to an increase in the rate of technological progress.

"It is nevertheless to be doubted that as an approach to the adoption of the new growth strategy, the import of foreign technology could prove to be satisfactory. If the domestic economy should remain no more capable than in the past of generating its own technological progress, it is hardly likely that the economy could generate in the future the rate of technological progress required by the new growth strategy. For one thing, the economy is so large that the overall impact of imported technology is likely to be marginal. The overwhelming proportion of the nation's annual increments in capital equipment will have to be of domestic manufacture. Hence unless the general level

of domestic technology improves, the contribution of techneological progress to overall growth is likely to remain small. Secondly, the technology of the advanced capitalist countries is adapted to the level of technological and managerial skills and knowledge of their own or of equivalent countries. Unless the broad level of technological and managerial skills and knowledge in the U.S.S.R. attains that level, the imported equipment is likely to operate at a lower level of productivity than is found in the host country, thus losing some of the gains from trade.

"But third, and most important, a country that relies on imports for a broad range of its advanced technology cannot expect to project itself by that means into the ranks of the leaders in the generation of new technology. Particularly in the fields of the most advanced and rapidly changing technology, the lead times are such that by the time a new enterprise outfitted with imported equipment is in full production, that equipment and its products have already begun to obsolesce. In short, the import of foreign technology cannot serve as a substitute for a technologically innovative economic system. Only to second approach, the augmentation of the domestic innovativeness of the economy, can provide a suitable basis for the new strategy of economic growth." (Berliner, pp. 435–436.)

Problems in Measuring and Assessing Soviet Economic Performance

The volume of economic data released from the Soviet Union has been increasing over the last several decades but problems in completeness, uniformity, and comparability continues.

Some of the problems include:

1. *Incomplete public reporting.* Although Soviet statisticians are gathering statistics for the entire economy it is still necessary for western analysts to estimate missing aggregates in their national input-output tables. Likewise, economic data related to military activity, new technological improvements, and a wide range of areas deemed to be sensitive for policy reasons are restricted in their release. Data reflecting poor performance such as a bad harvest is also withheld.

2. *Lack of uniformity.* No standard economic classifications are established as yet to ensure consistency in reporting from section to section or from year to year. Although instructions for reporting are often available it is not clear what each statistical series published includes.

3. *International comparability.* Even if statistics released were complete, comparison with performance in other nations would be difficult. It is for this and other, aforementioned qualitative means, that artificial national accounts are still constructed in the West using standard Western methodology and primary Soviet detailed data.

4. *Significance of available data.* As Soviet methodology is often not provided, the meaning of such data as prices is unclear and the appropriate use of this data in analysis is often difficult.

Scholarly exchanges between East and West have improved the mutual understanding of the utility of the data. More complete release of data based on the Helsinki agreement may provide a broader base for common professional analysis. Continued joint research between

western scholars and their Soviet counterparts may also lead to improvement in the statistical data base and its analytical utilization. This compendia indicates not only most of the western estimates of economic data but also a fair sampling of how western analysts assess the utility of this data when estimating current performance and future economic prospects in the Soviet Union.

Options and Prospects

Present and projected levels of Soviet economic performance suggest that those requirements set for goods and services during the Stalinist era could comfortably be met today. The military and heavy industry took priority during the Stalinist era and were considered constant while agriculture, light industry and consumption were residual claimants and considered variable. While priorities have now changed—the old constants have become variable and the residual claimants have become important—the old institutions of planning and management have shown considerable vitality and persistence. The Soviet leadership—also old—is probably comfortable with the past requirements set during an earlier era, but is also aware of the pressing new needs.

The long term pressures for change grow each year. Moreover the opportunities to raise the technological level of the massive Soviet economy to that of the western industrial economies are very attractive. At the same time, short term crises in agriculture and elsewhere bring home the urgency of improving the quality of consumer goods and incentives. Changes open to the leadership could make the Soviet economy a technological superpower, thus matching their geopolitical position and satisfying their domestic needs. But to rise to their potential level of performance, attention must be given to the following:

1. Military claims on material and human resources must be reduced and effective transfer of these resources to civilian production must be facilitated.
2. Technology transfer from the West must be linked to the transfer of resources from military programs to bring about a widespread modernization of their economy.
3. Planning institutions and management mechanisms must be geared on a priority basis to effectively shift and utilize resources.

Significant changes in the short run are not probable. Changes in economic develpment usually take place on the margin—that is in the allocation of incremental resources. Such may be the extent of likely change in the path of Soviet economic developments. Likely or not, significant change appears to become an increasingly more persuasive option. Compromises, half measures, and muddling through appear to become more expensive and to cause less productivity over time.

Part I. POLICY ASSESSMENT

THE POLITICAL SETTING

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The realities and prospects of the Soviet economy exist in the absolute and in the relative. There are innumerable things that can be measured, resurrected and projected—and a distressing number of which must be guessed at because of the Kremlin's obsessive concern with secrecy. The economy also is but one of several components of perhaps the most highly politicized society in the world. And, despite Khrushchev's short-lived attempt to reverse Lenin's dictum, politics remain superior to economics in the Soviet lexicon.[1]

The perceptions of the 26 men who direct not only the economy of the USSR but Soviet society in general are colored if not conditioned by a number of factors. In addition to their engineering training and life experience, which includes Stalinism at its worst and the cauldron of World War II, their outlook is profoundly affected by national security considerations. Their specific foreign concerns range from the state-of-play in strategic relations with the United States—subsumed under the rubric detente, to the other apex of the power triangle, China, on to Europe and the Third World. The more gutsy issues, of course, are domestic, such as the leadership's relations with the *narod* (people) and, more importantly, among themselves. The results of their assessment of the present and plans for the future are reviewed formally at quinquennial congresses of the Communist Party of the Soviet Union. The centerpiece at the Silver Jubilee Congress last February-March was Brezhnev's tour d'horizon on opening day.

I. U.S.-SOVIET DETENTE

If one is to judge solely by Brezhnev's accountability report to the 25th CPSU Congress and other Kremlin utterings, detente is alive and well only in the Soviet Union. The firmness of Moscow's commitment to make detente irreversible and to expand it from the political to military realm is trumpeted almost daily in Soviet media. But the

[1] See Michel Tatu, "Power in the Kremlin," p. 258.

almost exultant tone so characteristic of these pronunciamentos only four years ago has disappeared.

Kremlin propaganda is right in saying that the most vociferous public critics of detente as practiced since the June 1972 Moscow Summit are found in the West. The 1972 grain deal began the process of disillusionment for many Americans who were otherwise sympathetically inclined. Angola called into question Soviet bona fides for many others. And together with revelations about the continued build-up of Soviet military capabilities, the very term detente was deemed too vulnerable politically and it was officially dropped in favor of "peace through strength"—accompanied, however, by declarations of policy continuity.[2]

But if the bloom is off detente in the West, there is presumptive evidence that similar challenges have been raised in the Soviet Union. With the Jackson-Vanik and Stevenson amendments, in effect denying the Soviets MFN and severely limiting cheap government credits, the hoped-for cornucopia of US economic munificence was turned upside down and, relatively speaking, only a trickle reached Soviet shores. The absolute increase rather than the expected decrease in US defense outlays following withdrawal from Vietnam, coupled with the continued failure to reach agreement in SALT II, raised the specter of a renewed and wasteful arms race. And the rhetoric of the on-going US election campaign—typified by the charge that detente is a one-way street—has served to reinforce the suspicions of those elements of the Soviet body politic prone to paranoia.

The scene is not totally bleak, however. Thus far, judging by the latest polls, our election year hyperbole has not altered the basic endorsement of "detente" by US public opinion. The Soviets will have noted that the Congress is seriously considering postponing production of the B–1 bomber. The Senate has passed a resolution endorsing detente.[3] In Moscow the new "civilian" Minister of Defense, D. F. Ustinov, failed to voice the traditional call for strengthening the armed forces in his VE-Day Order of the Day.[4] According to press reports, the Soviets, temporarily in at least technical violation of the SALT I accords, seem to have set to with a vengeance to dismantle older missiles to stay within agreed-upon ceilings.[5] And Kremlin policy advisors have registered some concern at the extent to which th Soviet-supported Cuban adventure in Angola has alienated American public opinion, press and certain politicians.[6]

The current state of US-Soviet relations is perhaps best exemplified by the tortuous history of the Treaty of the Peaceful Uses of Nuclear Energy. After arduous negotiations extending over many months, an agreement was reached. After some scheduling difficulties, President Ford and CPSU General Secretary Brezhnev participated in ceremonies in Washington and Moscow on May 28, illustrating that both sides seriously desire to maintain the detente dialogue. And both governments have challenged critics of detente to pose viable alternatives.[7]

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[2] New York Times, Mar. 2, 1976.
[3] Senate Resolution 406, May 5, 1976.
[4] Pravda, May 9, 1976.
[5] New York Times, May 25, 1976.
[6] Georgiy Arbatov, Pravda, Apr. 2, 1976.
[7] The most recent Soviet challenge was contained in the USSR Government statement on the Federal Republic of Germany, Pravda, May 21, 1976. Explicitly the detente critics were in the West; implicitly, in the Soviet Union as well.

II. Other Aspects of Detente

If detente has been encountering heavy weather in the US-Soviet context, the sky has scarcely been true blue for the Soviets in other azimuths. Successes have been balanced by failures and seemingly intractable problems persist.

Moscow can, however, take considerable satisfaction in what it no doubt considers the US rout in Vietnam leading to the decline in US influence, not to say presence, in South East Asia and the seeming erosion in US prestige generally. But it is also clear that Moscow does not interpret each US loss as a Soviet gain. In South East Asia, for example. Hanoi appears to be less amenable to Soviet influence in peacetime than in wartime; Phnom Penh expelled the Soviets along with all other foreigners except the Chinese; only Laos seems to have welcomed an enlarged Soviet presence.

The overriding Soviet concern in Asia remains Peking. The virulence of their polemic waxes and wanes for inscrutable reasons. The release of the Soviet helicopter crew last December, accompanied by the "admission" that they were not spies, appears to have been an anomaly. Chinese attacks on the very concept of detente and "subversion" of Soviet-aligned Communist Parties continue to bedevil Moscow. Its obvious frustration with Peking suggests that in communist cant China has replaced the United States as "Enemy No. One." In any event, the resurgence of leadership struggles in China further beclouds prospects for Sino-Soviet detente over the near term. Meanwhile, the growing Chinese nuclear-missile capability is becoming a fact of life.

III. The European Outlook

Soviet perspectives in Europe are more favorable. Western Europe has been slow to recover from the economic dislocations initiated by the Arab oil embargo. Politically, NATO's southern flank has moved dramatically to the left, though just how far remains to be seen. And Moscow's long-sought-after Conference on Security and Cooperation in Europe (CSCE) was capped by the Helsinki Final Act initialled by, among others, President Ford and General Secretary Brezhnev.

On the other hand, though recovery has been uneven and weak spots remain, Western European economies appear to be reviving. The threat to NATO's cohesion occasioned by the dismemberment of the Portuguese Empire and the rise of the Portuguese Communist Party proved to be premature. To be sure, the prospect of the Italian Communist Party's participation in the government remains. Moscow does not appear to view attainment of the PCI's "historic compromise" as an unalloyed blessing, given the PCI's insistence on an autonomous course. Some observers have even speculated that the possibility exists that the PCI's entry into government, if it comes to pass, could be followed by further fractures in the international communist movement generated by Euro-communism, perhaps headquartered in Rome.[8] And Soviet insistence on maintaining good state-to-state rela-

[8] One long-time observer of Russia speculates that the wheel of history could complete a full revolution. Picking up Russian Orthodox claims that Moscow became the Third Rome after the fall of Constantinople (the Second Rome), and, of course, Rome, he notes the possibility that the Fourth Rome may be Rome itself.

tions with France not only has alienated the French Communist Party but also has sharpened its independence from Moscow, leading it to renounce the basic Marxist-Leninist tenet of the "dictatorship of the proletariat" and attacking Mother Russia itself for violations of the civil rights of its citizens. Finally Western stress on Basket III (Human Rights) of the Helsinki Final Act appears to have so soured Soviet expectations that Moscow has mounted a concerted counterattack against so-called Western violations of the spirit and letter of the Final Act.

Eastern Europe is relatively calm from the Soviet point of view. To be sure, Yugoslavia is as prickly and independent as ever and Romania pursues its rather autonomous foreign policies and continues a less than enthusiastic participant in the Warsaw Pact. The Pact itself, however, seems to be in relatively good shape as military alliances go these days. And the Council of Economic Mutual Cooperation continues to inch forward as a multilateral economic agency.

Propaganda claims to the contrary, however, the Eastern European "state" economies did not prove immune to the energy crises beginning in 1973, the impact of the 1975 Soviet harvest disaster, or the inflationary pressures plaguing the West. Government controls there did prove more effective than in the West, but Soviet price increases on fossil fuels and rumored delivery shortfalls caused by diversion of supplies to hard currency buyers adversely affected economic performance in Eastern Europe. The inability of Moscow to supply its traditional customers with food and feed grains last year added further strains. And the rise in prices for Western manufactured goods soon far outstripped those for traditional exports from the East.

The net effect was to materially lower growth rates and so narrow the "profitability" of their economies that politically dangerous increases in the prices of consumer goods, including food, have been decreed as one under consideration in several countries. Others have held the price line but are faced with shortages causing rising consumer dissatisfaction. With memories of the 1970 Polish riots which led to Gomulka's ousting, Moscow appears to have reluctantly taken steps to ease the price/cost squeeze. To be sure, Eastern Europe remains a net asset to the Soviets, but the trend must be worrisome to Moscow.

IV. The Third World

Developments in the vaguely defined Third World were less ambiguous. Since the publication of the previous volume in this series,[9] Soviet hopes for the transformation of the Allende government into a truly socialist regime in Chile as defined by Moscow went down the drain. For a while it seemed that the Kremlin would revert to the Stalinist conclusion that a "peaceful" as opposed to a violent transformation was theoretically impossible. But, after some months of soul-searching, the Kremlin apparently concluded that Chilean conditions were not advanced enough to warrant a "truly" socialist takeover. This did not inhibit, however, Portuguese CP leader Cunhal from pursuing a similar course. Nor did the Chilean disappointment prevent the Soviet-supported Angolan venture.

[9] For example, "JEC, Soviet Economic Prospects for the Seventies, US GPO, 1973.

The definitive account of Soviet involvement in Angola remains to be written. Two things, however, are clear. The Cubans would not have been able to introduce and sustain their "liberation" troops without massive Soviet support, and Moscow correctly estimated that the US would be unable to counter on the scene in time. But Moscow's decision to pursue tactical victory, on the other hand, appears to have underestimated the spin-off effect on US-Soviet detente, judging from what appears to be Soviet-inspired reports that Angola was first of all a Cuban adventure and that Castro and Company were being advised to cool it regarding the rest of Southern Africa.[10] Meanwhile, Soviet moves seem to have become a mite more circumspect. But the rhetoric accompanying the subsequent visit of Mozambique leader Machel indicates that Moscow is not foreclosing any options in the area.

The Middle East is another story. From a high point of only 4 years ago with 20,000 Soviet troops in Egypt, strong advisory contingents in Syria and Iraq, and seeming growing influence elsewhere, today the Soviet Union is clearly hanging on to residual clients in the area and is aware that these relationships, too, may prove transitory. Developments have been so much in the news lately there seems no reason to discuss them in detail. Suffice it to say that in connection with the ongoing Lebanese crisis, TASS "was authorized" to issue a statement in effect demanding that the protagonists pay heed to Soviet interests,[11] a galling position for a newly arrived super power to find itself in since virtually all the protagonists were at one time or another Soviet "clients" and were fighting with Soviet supplied arms.

Yet if the situation looks bleak from Moscow's point of view, it would certainly be premature to conclude that because of these setbacks the Soviet Union has no real alternative to withdrawal. Moscow's interests in the area long antedate Lenin and its investments there over the past 20 years are both diverse and immense. Added to this is Soviet cooption of Vincent Sheean's "long-view" of history.

This is evident when one looks at Soviet pursuit of its objectives in Latin America and the Asian sub-continent. Despite reverses in Chile, Cuba survives and, like the Soviet Union itself, has gained increasing respectability. The Soviets, once virtually without influence anywhere in Latin America, now have diplomatic relations with most countries, are a major supplier of arms to Peru, have significant trade with Brazil, and Mexico now has an affiliation with CEMA.

Ten years ago Soviet courtship of the Asian sub-continent had reached the point that the USSR was able to play the role of amicus curiae in the Taskhent Peace Talks between India and Pakistan. Since then it tilted strongly in favor of India during its 1971 war with Pakistan and has reaped some benefits, if only because of a decline in US influence. The hoopla connected with the recent visit of Indian Prime Minister Indira Gandhi indicates that the Soviets have reason to be somewhat satisfied with their present state of relations and hope for further gains in the area. That the course will not be smooth seems accepted, given rising nationalisms. But historical precedent strongly suggests Moscow will continue to press its interests everywhere possible on the Indian Ocean littoral.

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[10] Washington Post, March 29, 1976.
[11] Pravda, June 10, 1976.

V. The Silver Jubilee Congress

Party Congresses are major events in the Soviet Union. They are preceeded by months-long campaigns designed to whip up enthusiasm for the Party's goals, to instill a sense of responsibility among the population for implementation of directives, and to strengthen political and societal discipline.

A number of past Congresses have indeed been historical benchmarks; others have not.

The XVII Congress in 1934 was labelled the "Congress of Victors" but almost immediately led to the liquidation of millions in the Great Purge which included most of the "victors" as its victims.

The XVIII met in 1939 and attempted to repair some of the wounds of the previous five years, but they were soon torn asunder by the horrors of World War II which saw 20 million Soviets die.

The XIX convened only in 1952 to hear what turned out to be Stalin's soon-to-be forgotten valedictory.

The last session of the XX in 1956 heard Khrushchev deliver his so-called Secret Speech denouncing Stalinist repression and proclaiming that there were many roads to socialism, not just the violent one.

The XXI in 1959 saw the promulgation of the first and only 7-Year Plan which was expunged from the books following Khrushchev's ouster.

The XXII in 1961 was highlighted by Khrushchev's warning the Congress against those "comrades" who no longer listened to advice and, therefore, could return to the ways of Stalin; and the macabre removal of Stalin's remains from the Lenin Mausoleum on Red Square.

The XXIII in 1966 ratified the dismantling of Khrushchev's "harebrained schemes" and began the process of consolidation of what has become known as the Brezhnev era.

The XXIV in 1971 became known belatedly as the one that launched the Brezhnev Peace Program which culminated in "detente," first in Europe and then with the U.S.

At this reading, the XXV CPSU Congress, which met in the Kremlin from February 24 to March 5, 1976, could be characterized as one of decisions deferred. It was played as a businesslike look at the state of the nation and the Party. The stress was on continuity; there were no dramatic surprises in the 10th Five-Year Plan (1976–80) which it approved.

The thrust of Brezhnev's five-hour accountability report on the opening day of the Congress was to reaffirm the wisdom of policies laid out at the XXIV Congress and to pledge their continuation. However, his presentation was studded with caveats suggesting that support on all aspects was not universal. Basically, he:

Reaffirmed detente but defined it more narrowly;

Expressed general satisfaction with the state of US-Soviet relations while noting continuing problems;

Emphasized the need for further arms control measures but avoided forecasting quick solutions;

Gave a generally favorable assessment of Soviet relations with Western Europe, Latin America, and most of Asia and the Middle East; but

Harshly criticized the Chinese and those in the Communist movement who deviated to the right (implicitly the French and Italian parties) or to the left (the Maoists) of the Soviet line.

Brezhnev's recital of Soviet foreign policy triumphs over the past five years had its defensive overtones, and he evidently felt compelled to register a more than usually detailed explanation of the Soviet interpretation of "detente". Detente does not, he specified—with a domestic audience clearly in mind—"in the slightest way abolish, and cannot abolish or change the laws of the class struggle." Moreover, he said, it creates "more favorable conditions for peaceful socialist and communist construction" and does so without freezing the status quo and aiding capitalism, as "the leftists" claim. As proof, he cited the "great revolutionary changes" that have taken place in the world in recent years (e.g., dissolution of the Portuguese empire, Vietnam).

What detente does mean, Brezhnev told his audience, is "primarily" the avoidance of war, the use of force or threat of force in relations between states. He dismissed as "incomprehensible" Western failure to appreciate continued Soviet support for "other peoples' struggle for freedom and progress," since Communists never will, even under detente, become reconciled to capitalist exploitation anywhere.

Although Brezhnev gave pride of place in his address to foreign affairs, the bulk of his remarks and those of subsequent speakers dealt with domestic affairs. Here, too, the basic thrust was on continuity. To the extent that a change in direction was evident, it was in the direction of a limited reassertion of orthodoxy. A recrudescence of somewhat tougher policies seems to be on track; that is, greater pressure for political and social conformity at home.

Contrary to rumors that he would step down or be kicked upstairs because of ill health, Brezhnev emerged from the Congress with enhanced prestige. The other senior members of the leadership also held on. What changes were announced reflected already evident accomplishments or failures, and no serious steps were taken to prepare for a succession. There was, however, considerably greater emphasis on organs of collective leadership than in the past, perhaps with a succession in mind.

Substantively, the Congress was short on innovations domestically. The speeches of Brezhnev and of other Soviets, and the personnel changes in the Politburo and the Central Committee, reflected traditional goals and values.

Speakers on societal issues generally endorsed the status quo, albeit with a strongly conservative bias.

Kosygin did not promote systemic economic reform, despite widespread criticism of his constituency, especially the centralized planning apparatus.

The present system of management of the economy, including agriculture, appears firmly ensconced.

The only departure would appear to be the creation of new, specialized agencies under USSR and republic ministries for coordinating large-scale projects.

Brezhnev's praise of the KGB's prophylactic activities was balanced by admonitions against resorting to "administrative measures" for problem-solving. Similarly, his assertions regarding a revised codi-

fication of law and a new constitution some time in the indefinite future offered some hope for the evolution of Soviet society into one of laws, not men.

VI. Leadership Changes

All top leaders except Polyanskiy retained their membership in the Politburo and the Central Committee Secretariat. Two candidate members were promoted to full membership in the now 16-man Politburo, and three faces were added to the renewed but not rejuvenated leadership. The changes did, however, further tip the scales in favor of party apparatchiks as compared with government bureaucrats—from 8 to 7 in favor of the party to 10 to 6. They do not alter the average age of 63 years. Full Politburo members still average 66.

Polyanskiy was demoted again; this time, he lost his seat on the Politburo. He retained his membership on the CPSU Central Committee, but on March 16, was removed as the USSR Minister of Agriculture, and subsequently was named Ambassador to Japan. Failure of the 1975 grain crop and other agricultural problems ostensibly lay behind Polyanskiy's banishment.

Leningrad party boss G. V. Romanov, 53, was promoted from candidate to full member of the Politburo after only three years of Politburo membership, thereby restoring Leningrad to its traditional place in national policymaking circles. He is best known as an efficient manager who relies on structural changes to boost economic performance. He also appears to have a strong conservative bent with regard to society and culture, and is a proponent of ideological struggle as a concomitant of detente.

D. F. Ustinov, 67, was elevated to Politiburo full membership and brings to that body a lifelong specialist on armament production who has also been active in SALT matters. His promotion marks the first time in decades that a full-time defense industry man has joined the Politburo. With his inclusion, the Soviets have once again brought into that body representatives of all organizations concerned, among other things, with the negotiation and execution of foreign affairs.[12]

Election of Azerbaydzhan Party leader G. A. Aliyev, 52, to candidate membership fills the traditional Transcaucasus seat, long held by the former Georgian leader Mzhavanadze (dropped in 1972). Aliyev was a career KGB officer in Azerbaydzhan before becoming Party First Secretary seven years ago.

Pravda editor M. V. Zimyanin, 61, was named a CPSU Central Committee Secretary. He has left his Pravda post and, given his background, seems destined for the ideological and cultural portfolio formerly held by P. N. Demichev. A long-time Suslov associate whose roots are in Belorussia, Zimyanin is likely to exercise an ideologically conservative influence.

K. U. Chernenko, 64, was also named a CPSU Central Committee Secretary. He has worked as head of the General Department of the CPSU Secretariat, an office akin to the Executive Secretariat of a U.S. government department.

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[12] His naming as Minister of Defense following Marshal Grechko's fatal heart attack on Apr. 26, 1976, preserves this principle and did not require any enlargement of the decision-making circle reflected in the Politburo. In addition, his appointment reaffirmed the primacy of the civilian leadership over the military, an act somewhat softened by "combat veteran" Brezhnev, and later Ustinov himself, being elevated to the rank of Marshal of the Soviet Union.

VII. The Soviet System of Rule

How did the deliberations of the XXV CPSU Congress affect the Soviet system of rule? Not much.

The day-to-day activities of the 100 million non-labor force still are administered by a vast bureaucracy which makes ours pale by comparison numerically and especially in its often seemingly total disregard for the interests of its ostensible clients. Overseeing its operations are several-hundred thousand members of the Communist Party apparatus who set policy and strive to insure its execution.

The Political Bureau of the Central Committee of the Communist Party of the Soviet Union is the supreme policy-making body for economic as well as all other aspects of Soviet life. The majority of its 15 voting and 6 consultative members are engineers by training; the only trained economist is Foreign Minister Gromyko. The most junior member is 52; the ranking members are all 69 or older. By training and experience they are production oriented. During their rise to national prominence, the success criterion was quantity, not quality. During the years of tumultuous growth, especially after the desolation of World War II, these skills were in great demand. Now the emphasis has shifted to quality, not quantity. The leadership itself decreed the shift but seems unable or unwilling to face up to the hard realities of the technological revolution, such as allowing managers a truly free hand in decision-making based on cost-effectiveness, alternative choices, and a realistic pricing system.

As General Secretary of the Party, Leonid Ilyich Brezhnev, who will be 70 this December, usually chairs the weekly sessions of the Politburo where spokesmen for various groups thrash out policies large and small. (During his not infrequent absences in recent years, he has yielded the gavel to his senior associates, usually to his long-time associate Andrei P. Kirilenko, also 69. Brezhnev's absences may account for some of the drift or inconsistencies evident in Soviet policy.) But in any event, the Politburo lays down the guidelines of the annual and five-year plans which are then drafted by the government planning organization. The Politburo reviews these drafts and recommends their acceptance by the Party's Central Committee and Congress or "parliament" which, in turn, approves them. They are then formally ratified by the USSR Supreme Soviet or government legislative arm, thereby giving them force of law for every form of Sovet activity.[13]

In addition to Brezhnev, the Politburo membership includes the Party Secretaries for ideology, industry and agriculture, Chief of State Podgornyy, Head of Government Kosygin and his first deputy Mazurov, the ministers of foreign affairs, defense and state security (KGB), and ranking officials of other key establishments. Decisions are believed to be reached usually on the basis of a consensus, though no votes are ever published.

There is presumptive evidence, however, that serious differences do surface in Politburo deliberations, which have led *in extremis* to ousters from its ranks in recent years:

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[13] The only recent exception to this practice occurred when the USSR Supreme Soviet failed to ratify the draft directives of the 8th Five-Year Plan (1966–70) issued by the 23rd CPSU Congress—perhaps because of embarrassment for they were issued almost two years after the plan allegedly had gone into effect.

RSFSR Premier Voronov in 1973 for challenges to Brezhnev's agricultural policies;

Ukrainian First Secretary Shelest, also in 1973, for opposition to agreed consumer and investment policy, toleration of nationalism, and perhaps detente policy; and

Trade union boss Shelepin in 1975, most likely for ill-timed ambitions.

(Polyanskiy's dismissal and posting to Tokyo as Ambassador seems largely due to the need to find a scapegoat for the 1975 harvest debacle.)

Politburo decisions are usually promulgated in the name of the Central Committee to which the Politburo is formally subordinated. The reverse is really the case. Membership in the 426-man Central Committee is formally bestowed by Party Congresses whose members are selected on the basis of a series of indirect elections in which the rank-and-file participate only at the first stage. Actually, membership in the Central Committee appears to go with the full-time position an individual holds. Jobs of this importance are on the *nomenklatura* or patronage list administered by the Politburo through its secretariat staff. The leadership is thus a self-perpetuating oligarchy from which one departs by age, ill health, or death, or in political disgrace, and one joins through co-option.[14]

If the Politburo is the national command center, then the Party apparatus headed by the Secretariat is the nervous system. Also chaired by Brezhnev, its 11-man membership includes four other voting members of the Politburo, one consultative member, and five junior secretaries. It, too, meets weekly to check on the execution of decisions and to draft reports for the Politburo, using its internal staff of several thousand Party officials. The Secretariat is organized as a functional duplicate of Soviet society; there are departments responsible for monitoring industry, agriculture, propaganda, education, and the armed forces and police. It is the channel through which decisions are passed down through the Party system for execution and verification in every administrative-territorial division down to the basic Party organization formed in every institution, plant, or farm where there are at least three Party members. Each echelon in this system has its own smaller version of the Secretariat which controls and monitors activities within its own jurisdiction.

Though the Party formulates policy and oversees its execution, it directly administers little aside from propaganda agencies. The government furnishes the muscle which gets things done. It is organized on the European pattern with a Chief of State, 73-year-old Nikolay Podgornvy, and a Head of Government, 72-year-old Aleksei Kosygin. The former is largely a ceremonial office; the latter is a major one, for the encumbent chairs the 100-man USSR Council of Ministers which administers the entire economy. It determines the output of all major commodities, investment, military production, consumer goods,

[14] On two occasions in recent years, however, the Central Committee may have played a more important role when the leadership was divided. The evidence, on the other hand, is far from conclusive. In 1957 and 1964 the Central Committee was convened to resolve disputes within the Politburo. The first led to the ouster of the "anti-Party group" of Malenkov, Kaganovich, Molotov, etc.; the second, to the removal of Khrushchev. No official accounts of these sessions have ever been published and the voting allegedly was unanimous, including those being ousted with the notable exception of the Old Bolshevik Molotov. Unfortunately, the number of Central Committee members voting is not known; neither is the number which constitutes a quorum.

foreign trade, housing construction, sets prices and wages, etc. In effect it owns and operates the productive plant and trade organizations and also is the sole stockholder in all financial institutions.

The government functions at present in a highly centralized fashion, a reversal of Khrushchev's short-lived experiment with limited local control. There are ministries at the all-union, union republic, and republic levels. The all-union ministries are located in Moscow and directly supervise production facilities throughout the country; examples are the defense and aviation industries. Union-republic ministries have a central headquarters in Moscow and subordinate ministries in the republics; the central ministry directly controls major enterprises under its jurisdiction whereas the subordinate ministries administer the remainder. Typical union-republic ministries are agriculture and light industry. (Republic ministries usually handle industries of purely local significance.) The authorities are planning to transfer some functions from ministries to middle-echelon management but even if this is effectively carried out, the system of economic administration will remain highly centralized in comparison with any Western country.

In this vast, cumbersome bureaucracy, battles rage on a scale which puts to shame the infighting found in the relatively miniscule governments in capitalist countries. Unlike Stalin who drove the Soviet Union into the coal and steel phase of the industrial revolution, and Khrushchev who perceived the advantages of the petro-chemical phase but too frequently saw problems in isolation from one another, the current leadership appears well aware of the inter-relationships between the many problems besetting the Soviet economy. In addition to the time-honored State Planning Commission (Gosplan) which is supposed to be able to identify the needs of the economy and the sources necessary to meet those needs, and the State Committee for Material-Technical Supply (Gossnab) which theoretically is able to ensure the availability of all requisite materials but more often than not is barely able to keep abreast of demand, the leadership has reorganized and beefed-up the State Committee for Science and Technology. It is the agency charged with developing and encouraging the adoption of new approaches by production agencies. It is the agency behind much of the drive to computerize the Soviet economy, to develop new management techniques to raise labor productivity which in industry, according to inflated Soviet statistics, admittedly is only 55 per cent of that of the United States, and in agriculture, only 20–25 per cent.[15]

Meanwhile the leadership has continued the proclivity of its predecessors to tinker with the system of management. In 1965 they adopted a so-called economic reform which was mistakenly labelled in some Western publications as "creeping capitalism" because one of the success criteria was profits. Unfortunately, since the centrally set pricing system chronically lags far behind actual costs, managers began to produce what was profitable for their enterprise and slighted assortment which led to disproportions on a scale comparable to that which existed when weight or value were the prime determinants. As a result, ever more centralized controls have been reintroduced.

[15] Narodnoye khozyaystvo SSSR, v. 1974 g., p. 101.

The last panacea but one is self-financing "production associations" in place of numerous budget-funded enterprises in industry and construction (these "associations" amount in Western parlance to medium-sized vertical and horizontal trusts). Under a 1973 decree, the economic ministries were to have limited themselves to overall policy in planning, investment and technological improvement, while the "associations" were to control not only output in subordinate plants but also be responsible for research and development. The XXV Congress deliberations indicated some satisfaction with progress to date, even though economic performance per se fell notably below plan. On June 2, 1976, however, it was decreed that the "production association" form of management was to be more extensively introduced into agriculture.

The Congress decisions, on the other hand, also reveal that the current leadership does not contemplate any major reorganization of the present system of centralized management of the economy. Stress was placed instead on improvements in planning processes through certain better indicators and incentives for performance coupled with freeing the upper echelons of the economic bureaucracy from petty affairs.

The Congress also revealed the latest solution for major economic problems; i.e. the creation of something like the Manhattan Project model for undertakings involving long time periods and many agencies. Already operative are the RSFSR non-black soil drainage project and the construction of the Baykal-Amur Main Railroad project (BAM). Although Brezhnev and a number of other speakers at the Congress proposed this form of management structure at the optimal organizational mechanism, he and his colleagues explicitly opposed precipitate reorganizations of existing structures while calling upon the Council of Ministers, Gosplan and other central economic organs to take resolute steps to ease central restraints on economic management.

VIII. Future Prospects

Whither the Soviet Union? Storming down the (non-existent) super highways into the glorious future? Or stuck in the bottomless mud of the springtime steppe striving to climb aboard the passing technological bandwagon? The proceedings of the XXV CPSU Congress suggest that the future course of the leadership will be to muddle through much as they have done in the past.

One of the most striking features of the two-week-long Congress was the number of issues which should have been addressed, at least by Western standards, but evidently were not. Among them are the need to rejuvenate, not just renew, the composition of the Politburo, or at least to take precautionary steps to ensure an orderly transition of power when the current leaders depart the scene.

Domestically, while it is true that the economy continues to grow in gross terms, albeit ever more slowly and hardly at all when the harvest fails, no serious proposals were surfaced to restructure the cumbersome, overlapping and inefficient bureaucracy. Systemic reform per se seems beyond Soviet ken. Instead, the Congress was treated to the reiteration of standard palliatives to the effect that present policy is right, and all that is necessary is to implement it more effectively.

The thorny question of allocation of resources was addressed only indirectly. Brezhnev's rhetoric was suggestive of a wish to devote far more energy to the output of consumer goods and to ensure that heavy industry better service the needs of the civilian sector. But the 10th Five-Year Plan figures remain biased in favor of producers' as opposed to consumers' goods.

The burden of defense expenditures came up only in the international political context and was ignored in discussions of the economy, even though it is roughly twice as heavy in the Soviet Union as in the United States.[16] That the Kremlin has been and is willing to impose the burden for national security considerations is incontestable. But it is aware of the cost in terms of raising living standards and has shown signs of apprehension lest the arms race receive renewed impetus.

The Congress also displayed a certain immobilism in foreign affairs. Detente was endorsed but was defined essentially as avoidance of war supported by a web of other relationships which, while perhaps presently dormant, should and would grow in the future. In fact, Brezhnev's characterization closely approximated that of "competitive coexistence" as developed by William Taubman.[17]

The most reasonable prognosis would seem to be that the Soviets will continue to pursue detente but with reduced expectations of the benefits obtainable. One benefit that is useful is access to Western credits in order to help pay for imported technology and grains.[18] And the need may well increase if the Soviet Union suffers another harvest shortfall—even if on a smaller scale than in 1975.

Similar constancy was exhibited regarding Moscow's attempts to reassert its hegemony over that segment of the international communist "movement" which has not defected to Peking. At the Congress Brezhnev attempted to whip foreign communist parties into line, but to little avail as the Italian, French and Spanish Party leaders present, joined by the Yugoslavs, refused to be cowed. More recently, Moscow appears to have adopted somewhat more conciliatory tactics, but the convocation of the European Communist Party Conference largely seems to have served to widen the gap between the more independent parties and Moscow.

In sum, problems persist and current Soviet policies seem unable to resolve them adequately. But they do not appear to be of an order of magnitude to generate actual crises. In fact, they closely resemble problems the Soviets have had to cope with over the years. And cope they have, however imperfectly.

Western perceptions of the Soviet Union all too frequently focus entirely on military strengths, economic weaknesses, or suppression of civil liberties. Soviet self-perceptions differ. Why should we change our ways, the leadership might ask, for they have been proven over time. For more than 30 years the Soviet Union has been at peace: it has attained recognition as the strategic equal of the foremost

[16] CIA, "Estimated Soviet Defense Spending in Rubles, 1970–1975," SR76–10121U, May 1976.

[17] William Taubman, "Detente and the Debate About It: How To Understand Both," ms. 43 pp.

[18] For example, in 1975 Moscow ran up a hard currency trade deficit in excess of $6 billion, including $1.56 million with the U.S. Grain imports cost $2.4 billion worldwide of which $1.1 billion were in the United States.

capitalist power, the United States; and while it may have certain economic weaknesses the economy has grown by leaps and bounds and today is the world's second largest. And, of course, their pride is buttressed by the belief that the balance sheet of world power is changing in their favor.

In this context, the failure of the leadership to launch dramatic new initiatives at home or abroad should not be surprising. On the other hand, the extent to which the leadership's apparent decision to muddle through will suffice in today's environment is moot. But the leadership, despite its long tenure, is mortal. Whether its successors will speed up the present glacial evolution of Soviet society remains to be seen. Over the near term, however, more of the same seems to be the order of the day.

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Soviet Price Policy in the 1970s [1]

Although Soviet economists still, accurately, stress that the influence of prices (or "the law of value") continues to be subordinate to plans and administrative directives in guiding resource allocation in the USSR, the last decade has seen some serious efforts to make prices "a more active lever" in the regulation of economic activity.

An extensive network of agencies specifically responsible for pricing has been created, including the State Price Committee [2] (hereafter, SPC) attached to the USSR Council of Ministers; its affiliates at the union republic, oblast, and city (in Moscow and Leningrad) levels; price bureaus in ministries and departments (*vedomstva*); and even price sections in many enterprises and associations (*ob"edinenia*).

Intensive research is being conducted on many facets of pricing—by the SPC's own Scientific Research Institute of Price Formation (NII Tsen) and its regional affiliates; the State Planning Commission; the USSR Academy of Sciences' Scientific Council on Price Formation; various branch research institutes associated with ministries of agriculture, trade, services, etc.; and economists in universities and other educational institutions. A plethora of conferences on price problems has been held. The publication of books and articles on prices has mushroomed, with the topic now occupying a prominent place in the pages of leading economic periodicals, such as *Planovoe khoziaistvo* (Planned Economy), *Voprosy ekonomiki* (Problems of Economics), and *Ekonomicheskaia gazeta* (Economic Gazette), published respectively by the USSR State Planning Commission, the Institute of Economics of the USSR Academy of Sciences, and the Central Committee of the Communist Party. Moreover, in a striking departure from the traditional view of the USSR as the model for other "socialist" countries, this literature often includes a detailed examination of

[1] I wish to thank the Comparative Economics Program and the Center for Russian and East European Studies at The University of Michigan for financial support, Dennis A. O'Hearn for assistance in research, and the International Research and Exchanges Board for assistance in connection with a research trip to the Soviet Union. Source references in footnotes are to publications in the References section at the end of the paper.

[2] Although the Russian word *komitet* is often translated as "committee," this is somewhat misleading as it may convey a small group of representatives from various agencies. Because a *komitet* is, instead, typically a separate agency with many sections, a large staff, and specific operational responsibilities, "commission" or "board" would be a closer English equivalent.

SOVIET PRICE POLICY IN THE 1970s

MORRIS BORNSTEIN *

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pricing practices in Eastern Europe and, at least by implication and frequently more explicitly, their lessons for possible changes in the USSR.[3]

The result, according to Iu. V. Iakovets, Director of the SPC Research Institute, is the emergence of price formation as a "new branch of economic administration" and a new kind of economist, the "price economist" (*ekonomist-tsenovik*).[4]

These administrative and research organizations are studying a wide spectrum of pricing problems, including such diverse issues as the following:

1. Periodic adjustment of the level and structure of industrial wholesale prices to bring enterprise profits to levels considered commensurate with "businesslike operation," including striving for cost reduction, the elimination of losses and subsidies, adequate but not excessive allocations to enterprise incentive funds, and so forth.
2. Establishment and subsequent adjustment of the relative prices of new products so as to encourage technological progress and the improvement of quality—part of a broad effort to overcome traditional resistance to innovation and disregard of quality in sellers' market conditions.
3. Stimulation of greater agricultural output by adjusting relative prices of different products and in different regions, and by paying higher "premium" prices for above-plan deliveries by farms.
4. Attention to the pricing of long-neglected categories of consumption, such as consumer durables and personal services.
5. "Price discipline"—enforcing adherence to prices after they are established.

Within the space limitations for this paper, it is not possible to discuss all of these and other important problems, or to analyze any one of them exhaustively. Instead, the paper examines a number of selected issues of particular interest in regard to (a) the role of the price system in the management of the economy, such as its relationship to the system of national planning, and (b) problems of pricing which have proved particularly difficult to solve and over which active debate continues, such as pricing new technologically advanced products.

The study does not undertake to provide a comprehensive account of the organization and administration of the system of price formation, its historical development, or major theoretical controversies.[5] The paper also does not examine "foreign trade pricing" (i.e., the prices charged foreign customers for Soviet exports and the prices paid foreign suppliers for Soviet imports)—a subject covered elsewhere in this compendium.

The paper discusses in turn selected important developments and continuing problems involving industrial wholesale prices paid to producing enterprises (Part I), agricultural procurement prices paid to collective and state farms (Part II), and retail prices paid by households (Part III). These three types of prices are obviously related; for

[3] Some recent examples are Mitrofanova 73 on pricing of exports and imports; Azar 75 on services prices; Sorokin 76 on the calculation of production cost (*sebestoimost'*), to which a profit markup is added to obtain enterprise wholesale prices; and Borozdin 76 on the use of prices to stimulate technological progress.

[4] Iakovets 74, p. 8.

[5] Some of these aspects are discussed, for example, in Bornstein 62, Bornstein 64, and Bornstein 69.

example, the industrial wholesale price is one component of the retail price. And some important problems involve more than one type; for instance, budget subsidies keep retail prices on meat below agricultural procurement prices. But examining the three categories of prices separately is useful for two reasons. First, it corresponds to the way Soviet price economists themselves analyze the issues. They perceive industrial wholesale prices as one of various instruments of control over the state nonagricultural production sector; agricultural procurement prices as one of the means of regulating farm output; and retail prices as influencing the level, structure, and distribution of household consumption. Second, analyzing each type of price separately brings out sharply the conflicting objectives to be met and the trade-offs to be weighed in the operational decisions of fixing concrete specific prices.

Part IV concludes the study by summarizing some of the main findings and evaluating the extent to which the price system has acquired, or may acquire, a more active role in the guidance of the Soviet economy.

I. Industrial Wholesale Prices

Industrial wholesale prices are those at which goods are transferred within the state sector of the economy. The term covers prices of producer goods, including raw materials, semi-fabricates, and machinery, as well as manufactured consumer goods. It excludes prices at which procurement agencies obtain agricultural products from farms, but it includes the prices at which these agencies subsequently sell agricultural products to state enterprises for processing or to trade organizations for retail sale without further processing. It also excludes foreign trade prices charged foreign customers or paid to foreign suppliers, but it includes the prices at which foreign trade organizations buy from and sell to Soviet enterprises.

The Soviet industrial wholesale price system is composed of three types of prices. (1) The enterprise wholesale price (*optovaia tsena predpriatiia*) is the price at which a producing enterprise sells its output. (2) The industry (i.e., branch of industry) wholesale price (*optovaia tsena promyshlennosti*) is paid by the state-enterprise buyer and includes, in addition to the enterprise wholesale price: (a) the turnover tax, if any, on the product; (b) the markup of the branch sales organization; and (c) transportation charges if these are borne by the sales organization rather than the buyer. (3) Finally, a "settlement" or "accounting" price (*raschetnaia tsena*) is used in some branches, such as mining, where production costs diverge widely. Individual enterprises or groups of enterprises receive different settlement prices—rather than a single, uniform enterprise wholesale price—from the branch sales organization. The latter, however, sells to customers of the branch at a single industry wholesale price.

Enterprise wholesale prices are composed of the planned branch average cost of production (*sebestoimost'*) and a profit markup. The former has no exact equivalent in Western cost accounting. It includes direct and indirect labor, materials (including fuel and power), depreciation allowances, and various overhead expenses. The profit markup is supposed to provide a "normal" level of profit for the branch as a whole, although the profitability rate of the individual enterprise may be above or below "normal" depending upon the relationship of its

cost level to the branch average. Some profits are retained by the enterprise for bonus payments to its personnel and investment in productive and nonproductive (e.g., housing and recreational) facilities, and the remainder is paid to the state budget in various ways.

The industrial wholesale price reform of 1966–67 introduced major changes and set the basic pattern for the current level and structure of these prices.[6] The first section below explains and evaluates this reform. The next examines subsequent changes in industrial wholesale prices. The last discusses efforts to promote technological progress by adjusting the prices of new and of maturing products by various means.

A. 1966–67 REFORM

The main features of the 1966–67 [7] reform have been analyzed in detail elsewhere [8] and need only be summarized here.

1. The reform settled the intensive theoretical debate of the preceding decade concerning the basis for the profit markup to be added to production cost.[9] In the debate different schools had advocated relating profit (a) to labor cost only, (b) to total production cost, (c) to the value of assets (i.e., fixed and working capital), and (d) partly to labor cost and partly to assets—a combination of the first and third proposals. The reform accepted the principle of the third proposal—sometimes called "prices of production" following the use of this term by Marx in *Capital*, Vol. III—although it did not establish a single, uniform rate of profit in relation to assets for every branch of industry.

2. Other changes in wholesale price concepts included the following: (a) Bonuses of managerial, office, and technical personnel—formerly included in production cost—are now paid from profit. (b) Interest on short-term bank loans was changed from a cost item to a charge against profit. Interest on long-term bank loans—to be used for financing some enterprise investment under the economic reform—is also considered a charge against profit. (c) Some expenses for geological prospecting and forest maintenance were included, for the first time, at cost elements. (d) A capital charge was introduced, in the form of a tax on the average annual value of the enterprise's undepreciated fixed and working capital as shown on its balance sheet at original cost. (e) A differential rent payment, out of profit, was levied in some extractive industry enterprises.

3. Under the 1965 economic reform, profitability was made a major enterprise performance indicator (along with sales). In addition, en-

[6] In Soviet terminology, a "reform" (*reforma*) refers to a basic change in the way prices are constructed, involves many branches of the economy, and alters significantly the level and structure of prices. A "revision" (*peresmotr*) does not change the basic formula for price formation, usually covers a smaller group of branches, and modifies the level and structure of price less. Finally, "changes" (*izmenenie*) or "corrections" (*popravki*) refer to minor alterations in the prices of particular product groups. Thus, reforms of wholesale prices occurred only in 1936–40, 1949, and 1967. The 1949 reform was followed by revisions in 1950, 1952, and 1955. After the 1967 reform, the most significant revisions were in 1973 on machinery and light industry prices and in 1974 on freight rates. Minor corrections—for example of the prices of individual machines or grades of raw materials—are made more frequently as part of the "current regulation" (*tekushchee regulirovanie*) of prices. Maizenberg–76, pp. 91–96.

[7] New prices were introduced in some parts of light industry as of October 1, 1966; in other parts of light industry and in the food industry on January 1, 1967; and in heavy industry on July 1, 1967.

[8] See, for example, Schroeder 69 and Prybyla 71, pp. 279–96.

[9] Bornstein 64.

terprises were expected to use part of their profits to pay capital charges at a basic rate of 6 percent, and another part to form three "enterprise funds"—for bonuses, for "social-cultural measures" (such as housing, recreational, and child care facilities), and for small enterprise-initiated investments in production facilities. Therefore, the new prices were set high enough to provide most, if not all, enterprises in a branch enough profits for these purposes. It was estimated that an average branch profitability rate of about 15 percent in relation to assets would be sufficient for these purposes in most cases.

However, the same profitability rate was not planned for all branches, and there was considerable variation around the 15 percent average, for several reasons. (a) One constraint was the political decision that the industrial price reform should not lead to changes in the levels of agricultural procurement prices or retail prices. Therefore, a 15 percent profitability rate was rejected for agricultural machinery, on the one hand, and for the food industry, on the other. (b) Substitutes had to be priced according to their utility to the consumer—e.g., calorific content in the case of fuels—as well as in relation to production cost. For example, the price increase for coal had to take into account the price increase for oil, and planned profitability rates were set at only 8.0 percent for coal, compared with 14.6 percent for oil extraction and refining. (c) The ratio of profits to production cost was also considered. A 15 percent profitability rate in relation to assets would have yielded too little profit in relation to cost in the less capital-intensive branches and too high a profit in relation to cost in the highly capital-intensive branches. Thus, planned profitability rates in relation to assets were set at 26.8 percent in cotton textiles and only 10.0 percent in electric power.

4. Although profitability is now calculated in relation to assets (as well as production cost) by branch, this principle cannot be applied to individual products because it is considered impossible to determine the amount of assets involved in the production of each product. Hence, the prices of individual products are still formed by adding a profit markup to cost, though with the aim that the sum of profits so derived will yield the desired branch profitability rate in regard to capital. First, the target rate of profitability is applied to the branch's capital to get the target ruble amount of profits from the branch's planned sales. Second, this ruble amount of profits is divided by the estimated total cost of the output, to find a branch "normative" or standard rate of profit in relation to cost. Third, this standard rate is then applied to the (planned) cost of an individual product, to obtain a tentative price which would make that product of average profitability in comparison with the entire output of the branch. This tentative price may, however, subsequently be increased to secure above-average profitability to encourage production, say of new or scarce items, or reduced to provide below-average profitability to discourage production of obsolescent or unfashionable items.[10]

As part of the reform, profitability rates, in relation to cost, for individual products were reviewed, to reduce the wide variation (as much as 300 percent for some enterprises) which led to "violations of the

[10] Iakovets 74, pp. 159–63.

assortment plan"—i.e., departures from the product-mix assigned in the enterprise plan.

5. The use of price markups for quality differences was extended and used widely in fixing prices on ferrous metals, cement, machinery, and some other products.

The effect of the reform on official wholesale price indexes is shown in Table 1 for enterprise wholesale prices (excluding turnover tax) and Table 2 for industry wholesale prices (including turnover tax). For all industrial production, the former rose about 9 percent and the latter about 8 percent. The most striking increases were in heavy industry, particularly coal, ferrous metallurgy, petroleum, and electric power. There was little change in the light and food industries, and prices were reduced slightly in machine building and metal working and in the chemical industry. A comparison of the two tables shows that part of the increase in enterprise wholesale prices for some branches, notably electric power and petroleum, was offset by reductions in turnover taxes, which kept industry wholesale prices (Table 2) from rising as much as enterprise wholesale prices (Table 1).

TABLE 1.—INDEXES OF ENTERPRISE WHOLESALE PRICES (EXCLUDING TURNOVER TAX), END OF YEAR, 1966–74

[1965=100]

Commodity group	1966	1967	1968	1969	1970	1971	1972	1973	1974
All industrial production	101	110	110	110	110	108	108	107	107
Heavy industry	100	118	118	116	116	112	110	107	107
Electric power	98	133	133	133	133	133	133	133	133
Petroleum refining	100	142	142	141	141	138	138	138	138
Coal industry	100	180	180	180	180	180	180	180	180
Ferrous metallurgy	100	150	150	150	150	148	148	148	148
Chemical and petrochemical industry	96	96	96	96	96	98	96	96	95
Machine building and metal working	97	97	97	95	95	87	87	82	80
Timber and wood-processing industry	100	119	119	119	119	118	117	117	117
Cellulose and paper industry	100	124	124	123	123	121	120	120	120
Construction materials industry	100	119	119	119	119	119	119	119	119
Light and food industries	102	102	101	102	103	103	104	109	109
Light industry	103	103	103	104	106	106	106	114	114
Food industry	102	101	101	101	102	102	105	105	105

Sources: Calculated from index numbers with base 1949=100, in Nar. khoz. 69, p. 188; Nar. khoz. 70, p. 175; Nar. khoz. 73, p. 250; Nar. khoz. 74, p. 211.

TABLE 2.—INDEXES OF INDUSTRY WHOLESALE PRICES (INCLUDING TURNOVER TAX), END OF YEAR, 1966–74

[1965=100]

Commodity group	1966	1967	1968	1969	1970	1971	1972	1973	1974
All industrial production	98	106	106	106	106	105	105	105	105
Heavy industry	98	113	113	113	113	112	110	106	106
Electric power	98	114	114	114	114	114	114	114	114
Petroleum refining	100	107	107	113	137	137	134	133	133
Coal industry	100	180	180	180	180	180	180	180	180
Ferrous metallurgy	100	146	146	146	146	145	145	145	145
Chemical and petrochemical industry	93	93	93	93	93	92	92	90	90
Machine building and metal working	97	97	97	95	93	88	86	81	81
Timber and wood-processing industry	100	116	116	116	117	116	116	116	116
Cellulose and paper industry	100	123	123	121	121	120	120	120	120
Construction materials industry	100	119	119	119	119	119	119	117	117
Light and food industries	100	98	98	98	100	100	100	103	103
Light industry	100	100	100	101	101	101	101	105	105
Food industry	98	96	96	96	98	98	98	100	100

Sources: Calculated from index numbers with base 1949=100, in Nar. khoz. 69, p. 190; Nar. khoz. 70, p. 177; Nar. khoz. 73, p. 252; Nar. khoz. 74, p. 213.

On the positive side, the reform improved the relationship of price to cost by recognizing increases in labor and raw material costs since the last general price change in 1955. The reform also included in prices explicit, though arbitrary, capital charges and some rent charges. However, the resulting prices are still cost-plus non-scarcity prices which inadequately reflect and often ignore demand, and which frequently conflict with enterprise input and output plans, requiring plan directives and administrative rationing to override the "signals" provided by prices.

Because the new prices were calculated on the basis of costs in 1964–65, actual profitability rates proved to be higher than planned. For industry as a whole, profitability in relation to assets was 17.1 percent in 1967, rising to 21.5 percent in 1970, but falling thereafter to 17.7 percent in 1974 as a result of the net effect of cost and price changes.[11] Although the 1966–67 reform did make all branches, even coal, profitable on a branch-wide basis, and reduced the number of planned-loss enterprises, the profitability of enterprises in relation to both the value of assets and production costs continued to differ widely. According to results of a study of 23,000 industrial enterprises (almost half of the total) in 1969, shown in Table 3, about 12 percent were unprofitable and another 27 percent earned less than the "normal" rate of 15 percent on assets. On the other hand, 61 percent of the enterprises earned more than 15 percent on assets, and of these 30 percent had a profitability rate in excess of 40 percent.

TABLE 3.—PROFITABILITY OF INDUSTRIAL ENTERPRISES, 1969[1]

	Average profitability rate (percent)[2] on		Share (percent) of		
	Value of assets	Production cost	Total number of enterprises	Total value of assets	Total value of sales
All enterprises surveyed	20.0	18.1	100.0	100.0	100.0
Profitable enterprises, total	22.6	19.9	88.3	91.7	95.2
Of which those with profitability rate[2] (percent) on assets of:					
Above 40	68.6	23.1	29.8	11.8	32.8
30.1 to 40	34.7	23.4	9.9	8.0	11.1
20.1 to 30	23.9	20.2	13.5	16.5	17.8
15.1 to 20	17.4	19.1	8.1	11.9	9.5
10.1 to 15	12.3	20.9	9.2	19.8	10.7
5.1 to 10	8.0	12.5	9.4	15.1	8.3
0 to 5	2.8	4.2	8.4	8.6	4.7
Unprofitable enterprises, total	−8.8	−9.1	11.7	8.3	4.8
Of which those with loss rates (percent) on assets of:					
Below 5	−2.7	−2.8	4.0	3.5	2.0
5.1 to 10	−7.5	−8.0	2.8	1.9	1.2
Above 10	−17.0	−16.7	4.9	2.9	1.6

[1] Data from survey of 23,000 enterprises.
[2] Minus sign denotes rate of loss relative to assets or production cost.

Source: Iakovets 74, p. 164.

Similarly, the wide variation in the profitability (in relation to cost) of different items in a firm's product-mix remained very common—and enterprises accordingly continue to concentrate on the more profitable items in order to meet profitability targets and obtain the largest possible allocations to the enterprise incentive fund.

[11] Nar. khoz. 74, p. 741.

It is thus clear that the reform far from solved the problems of the level and structure of industrial wholesale prices and the use of the price system to make profitable every "normally operating" enterprise, to promote plan fulfillment, to encourage quality improvements, and to advance technological progress. Therefore, subsequent revisions of selected groups of prices were made in the following years, while the search for improved methods of price-setting continued.

B. PRICE CHANGES AFTER 1967

Beginning in 1969, after the 1966–67 reform had been "digested" somewhat and its results analyzed, a number of price revisions were undertaken successively in different branches of industry. These changes have been within the principles and framework of the 1966–67 reform, rather than a departure from it. As Tables 1 and 2 show, the most significant revisions have been in petroleum, machine building, light industry, and food industry prices.

For petroleum, enterprise wholesale prices (Table 1) were reduced slightly in 1969 and again in 1971, but industry wholesale prices (Table 2) were raised to make petroleum products more expensive for consumers.

For machine building and metal working, the official indexes show successive declines since 1969 in both enterprise wholesale prices and industry wholesale prices. In considering these figures, one should keep in mind that both Soviet and Western scholars have for a number of years criticized these indexes on various grounds, concluding that they have a serious downward bias. However, a discussion of the construction of these indexes is beyond the scope of this study.[12]

Soviet officials explain machinery price reductions as a response to cost reductions. First, they believe these cost savings should be passed along to buyers of machinery, in order to lower investment costs and encourage mechanization and automation. Second, they think that "excessive" profitability for machinery plants leads their managements to relax in the struggle for further cost reduction. Finally—in pursuit of the political goal of a "stable" price level—they consider it essential to cut prices on the output of machinery, chemicals, and other branches experiencing rapid technological progress, in order to offset inevitable cost increases in the extractive industries.

As Table 4 shows, by 1970 in machine building and metal working profitability rates in relation to both production costs and assets were well above the 1965 (i.e., pre-reform) levels for the branch as a whole and for most of its component subbranches. Therefore, as of January 1, 1973, prices were cut on a wide range of machinery and equipment. For all of the price lists affected, the average decrease was 12.3 percent, including average reductions of 13.9 percent on instruments, 11.4 percent on electrotechnical output, 9.6 percent on chemical machinery and on equipment for the light and food industries, and 8.9 percent on machine tools.[13] Since prices on many product groups (e.g., motor vehicles and tractors and agricultural machinery) were not decreased, and other prices may have been raised, the indexes in Tables 1 and 2

[12] See, for example, Bornstein 72, pp. 358–62; Becker 74; and Borozdin 74.
[13] Iakovets 74, p. 67.

show only a 6 percent reduction in enterprise wholesale prices and industry wholesale prices in 1973 compared with 1972. The 1973 revision also narrowed differences in the profitability of different products, and reduced profitability rates on older models while raising them on newer models, in order to encourage production of the latter.

TABLE 4.—MACHINE BUILDING AND METAL WORKING: INDEXES OF ENTERPRISE WHOLESALE PRICES, 1970, AND 1975 PLAN, AND PROFITABILITY RATES ON PRODUCTION COSTS AND ASSETS, 1965, 1970, AND 1972

Category	Index numbers for enterprise wholesale prices		Profitability rate (percent) on production cost			Profitability rate (percent) on value of assets		
	1970 (1965 =100)	1975 plan [1] (1970 =100)	1965	1970	1972	1965	1970	1972
Machine building and metal working, total	95	88	18.1	21.5	20.0	16.7	22.8	20.2
Heavy, energy, and transport machinery	105	90	17.5	20.4	20.9	14.1	18.9	18.4
Electrotechnical machinery	94	86	24.0	23.4	21.3	35.5	35.5	31.4
Chemical and petroleum machinery	101	91	22.3	20.4	19.8	19.2	19.2	19.0
Machine tools	104	89	18.6	25.4	26.9	13.5	20.8	22.3
Instruments	82	78	32.4	33.4	32.3	39.4	34.7	35.1
Motor vehicles and ball bearings	98	100	18.8	14.1	16.1	24.5	18.6	17.6
Tractors and agricultural machinery	107	109	15.4	11.9	11.7	20.2	14.3	17.2
Road construction and municipal services machinery	100	86	22.4	21.5	21.4	27.9	30.1	24.8
Machinery for light and food industries and trade	92	84	26.4	22.1	25.6	27.7	29.8	32.5

[1] Planned index numbers for corresponding ministries.

Source: Iakovets 74, p. 95.

In light industry, both enterprise and industry wholesale prices were raised in a delayed response to earlier increases in the prices paid to farms for agricultural raw materials such as cotton and wool (see Part II below). At first, the increase in light industry costs was covered by budget subsidies, but effective in 1973 light industry selling prices were raised in order to include the full cost of these raw materials in factory production costs and cover them from sales revenue. "Most" subsidies were eliminated, although they continue on some silk, linen, and fur products. Enterprise wholesale prices were raised by an average of more than 7 percent, but final retail prices were unaffected, because of reductions in turnover taxes at that stage. In addition, the light industry price revision widened the use of surcharges for quality differences, but narrowed profitability differences among products in an effort to promote fulfillment of "assortment" plans.[14]

Similarly in the food industry, enterprise wholesale prices on flour, tobacco, and sugar were raised in 1972, following increases in agricultural procurement prices. However, reductions in turnover taxes left the corresponding retail prices unchanged.[15]

C. PRICING FOR TECHNOLOGICAL PROGRESS

This is undoubtedly the problem which Soviet price specialists find both most pressing and most vexing. A thorough discussion of its many and complex facets is not feasible in this general survey article.

[14] Chemeritskii 74.
[15] Iakovets 74, pp. 69, 101.

Instead, it is possible only to provide a brief sketch of some of the main difficulties and some of the principal solutions tried, together with references to some of the now extensive literature in which a more detailed explanation is available.

The cardinal problem is how to set centrally prices which will promote the introduction of new and superior machines, materials and components. On the one hand, producers resist changes in their product-mix which they believe may disrupt production, raise costs, and reduce profits and bonuses. Instead, they prefer to produce the same "already mastered" products, at falling costs and rising profits. In turn, potential buyers of new machinery and materials also dislike innovation which requires difficult investment programs, new sources of supply, adaptation of production lines, and retraining of workers—threatening their sales, profits, and bonuses.

From an operational viewpoint, Soviet price specialists see two facets, or stages, to the problem. One refers to new products and concerns how to set prices on them high enough to induce producers to make them, but at the same time low enough to encourage prospective users to buy them. The second involves maturing and obsolescent products, whose prices should be reduced early enough and far enough to lead producers to replace them because they have become less profitable (despite cost reductions) than newer technologically more advanced products.

The New Products Fund and a complex Methodology for pricing new products are addressed to the first aspect. For the second, temporary prices, stepped prices, and the Price Adjustment Fund have been used. Each will be discussed briefly.

1. New Products Fund (NPF) [16]

The NPF was created in 1960 to develop an alternative to higher prices as a way of recapturing the cost of putting new machinery into production. The NPF is financed from charges against production cost, paid monthly by enterprises to their ministry at established rates. In turn, enterprises in the branch wishing to draw upon the fund apply to the ministry.

Four main criticisms have been levied against the NPF: [17]

First, it is too small, covering only about one-third of start-up costs associated with new production.

Second, the administration of the NPF by ministries is excessively centralized, and procedures for payments into and out of it are complex.

Third, in practice ministries usually prefer to include start-up expenditures in production cost, in order to increase planned cost and the price obtained by applying the (average or perhaps above-average) profit markup to cost.

Fourth, outlays financed from the NPF are not included in calculating the value of sales, and thus no profit can be earned on them, while outlays included in the cost of production are—with a profit markup—included in sales.

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[16] *Fond osvoenita novoi tekhniki*—literally "Fund for Mastering New Technology," but (following Berliner 75) more conveniently rendered as "New Products Fund."

[17] Becker 74, pp. 371–72; Iakovets 74, pp. 183–84; Koshuta 74, p. 54; Lapusta 75, pp. 71–74; and Malzenberg 76, pp. 123–24.

Several ministries—for electrical equipment and heavy, energy, and transport machinery—have established a Combined Science and Technology Fund (*Edinyi fond razvitiia nauki i tekhniki*) which includes funds which previously went into their NPFs and also allocations from the state budget for financing research and development (R & D). This scheme is supposed to have the advantage of coordinating the entire cycle from the preparation of technical designs up to the entry into serial production. But the amount of money in the new Combined Fund is not adequate to cover all start-up expenses as well as R & D costs. The new Combined Fund is thus not seen as a solution to the problems of the NPF.[18]

2. Methodology for pricing new producer goods

Analog pricing is a key approach of the Methodology for Determining Wholesale Prices on New Producer Goods approved by the SPC in 1969 and subsequently revised in 1974. Three categories of new products are distinguished according to the degree of dissimilarity from existing output. The first category includes "substitute products" which are intended to replace existing items. The second category contains "supplementary products" which fit into a given product group (such as generators or electric motors) but expand it by providing new technical characteristics. The last category involves "fundamentally (*printsipal'no*) new products" with no counterpart previously produced in the USSR.

(*a*) *Substitute products*

For this category, the 1969 Methodology sets forth a detailed procedure for establishing prices on new products between a lower limit—at which the producer would be indifferent between the new and the old product—and an upper limit—at which the prospective user would be indifferent between them. The price on the new product is to be set between these limits, sharing the "economic effect" of its introduction between producer and consumer so that both are interested in the substitution of the new for the old product. Briefly, the steps are as follows:

First, the lower limit of the price for the new product is calculated as the sum of the estimated production cost in the second year of serial output (to eliminate installation and break-in costs) plus the branch's standard profit markup above cost for such output.

Second, the upper limit of the price for the new product is found by identifying an analogous existing ("base") product and then adjusting its price to allow for the estimated differences between the new and the base products in (a) annual output, (b) service life, (c) production cost associated with the use of the machine, and (d) maintenance expenses. The first two items refer to quality or performance capabilities, the latter two to operating cost savings. Items (b) and (c) are discounted by a simple interest charge.

Third, the "economic effect" of substituting the new for the base product is calculated by subtracting the lower limit from the upper limit.

Fourth, the price on the new product is set as follows: If the upper limit exceeds the lower limit by less than 10 percent, the lower limit

[18] Maizenberg 76, pp. 124–25.

becomes the price for the new product. If the upper limit exceeds the lower limit by 10 percent or more, the price is to be set at an amount above the lower limit which gives the producer 30–50 percent of the "economic effect."

Among the many criticisms levied against this procedure are the following:[19]

(1) In selecting the "base" product, firms and ministries choose products whose price and profitability are relatively high—sometimes even items which they have in fact long since stopped producing.[20]

(2) Producers' estimates of the performance characteristics of new products are often exaggerated.

(3) The difference in performance and operating costs of a particular new machine, and thus its upper limit and economic effect, depend on the use to which an individual customer puts it, which varies widely for many new products.

(4) The mathematical form in which the upper limit is expressed provides a trade-off of longevity vs. productivity such that the producer can raise the upper limit (and thus the economic effect and the final price) more by increasing the life of a new machine than its productivity.

(5) The profit rate used in calculating the lower limit and the interest rate employed in figuring the upper limit are both arbitrary. Also, in the latter case, simple rather than compound interest is used, whereas the latter would be more appropriate.

(*b*) *Supplementary products*

In this case, the price of a new product is determined not by a direct comparison with a closely comparable "base" product it is to replace, but by "parametric" methods which attempt to price it properly in relation to the "group" in which it will fit and which it will supplement. Four different methods may be used:[21]

(1) The "individual indicators method" (*metod udel'nykh pokazatelei*) compares the new and analogous products in regard to a single basic performance indicator (such as the estimated mileage life of tires) whose relationship is supposed to determine the proper price for the new product in comparison with the prices of existing products.

(2) The "point method" (*ballovyi metod*) identifies a number of performance characteristics (e.g., for tractors: their motor capacity, weight, maximum speed, fuel consumption, tractive power); assigns a relative importance weight to each characteristic; awards points to the new and analogous products on each characteristic; and combines the weighted results in total scores intended to show the proper relative price of the new product.

(3) The "regression analysis method" (*metod regressionogo analiza*) analyzes a group of analogous items to determine the extent to which prices are statistically correlated with different features (e.g., of machines or instruments). The resulting correlation coefficients are then applied to the performance characteristics of the new product to find its price.

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[19] Lavelle 74 provides a detailed analysis, including an effort to overcome printer's errors and authors' mathematical errors in Soviet publications.

[20] Maizenberg 76, pp. 108–09.

[21] For a detailed explanation with critical comments, see Borozdin 75, ch. III.

(4) In the "aggregate method" (*agregatnyi metod*), the price of a new machine is obtained by adding together the costs (or prices) of its components and their assembly.

A number of problems are encountered in using these methods:[22]

First, it is often difficult—for example, in the case of particular types of machinery and equipment—to define properly the boundaries of the group of "analogous" products with which the new item is to be compared.

Second, the results of the comparisons depend on just which technical characteristics are chosen as relevant and how variation in them is judged to affect performance (e.g., the relationship between weight and service life of a machine).

Third, by basing the prices of new products on those of existing products, these methods reproduce in the new product's price the defects of the current price structure. For instance, because the main factor in prices of metal products has traditionally been weight, new price lists constructed by multiple correlation methods continued to relate prices chiefly to weight, after a policy of reducing weight had been adopted.

Fourth, it is claimed that parametric methods permit some decentralization of price-setting, in which producing enterprises themselves (subject to the complaints of customers) can calculate prices of new products in the light of prices of existing products and centrally established standard procedures. However, in practice, if there are many characteristics to be considered or their relationships are complex, the calculations prove too difficult to be done correctly by price economists at the enterprise level—and must be checked, or done in the first place, at higher levels.

(*c*) *Fundamentally new products*

The scope of this category is defined both according to the justification cited that the product is fundamentally new and according to eligible commodity groups.[23]

In the first respect, a product may be considered "fundamentally new" if (1) it is included in the state plan of scientific-research work or in plans for new technology of USSR ministries, as not having a domestic analog; (2) it is entirely or in part based on inventions protected by inventor's rights; or (3) it is produced under a foreign license agreement.

In the second respect, the product must be in one of the following commodity groups: (1) machines, equipment and instruments (except agricultural machinery); (2) synthetic rubber, inorganic and organic chemical products, resins and plastics, chemical fibers, varnishes and paints; (3) special oils and lubricants; (4) precision alloys and quality steels; (5) rolled nonferrous metals, rare metals, semiconductors, and electrode products; or (6) prefabricated reinforced concrete items.

Because no Soviet analogs are supposed to exist for products in this category, prices are not set—as in the Substitute Products and Supplementary Products categories—by comparison with existing items. Instead, a "temporary" wholesale price is set, equal to the

[22] Borozdin 75, ch. III; Iakovets 74, pp. 186–87; Maizenberg 76, pp. 126–28.
[23] Plotnikov 75, pp. 114–19.

planned cost of initial serial production plus the profit markup planned for the rest of the enterprise's output (but not less than 10 and not more than 20 percent). The temporary price should be used for not more than two years, after which a permanent price should be established, on the basis of planned cost in the second or third year of serial production (depending on the life span of the temporary price), plus the standard profit markup.

There are at least two kinds of risks in the use of the Fundamentally New Products category. First, the criteria for establishing that a product is "fundamentally new" are broad, and the range of commodities included is wide. Therefore, ministries may try to get into this category many products which are not "fundamentally new," in order to secure higher prices than would be possible if the items were instead classified as Substitute Products or Supplementary Products. Second, as explained below, the process of "temporary" pricing has been subject to many abuses.

The 1969 Methodology also established a procedure for "stepped prices" (*stupenchatye tseny*), discussed below.

Various additional documents on pricing new products were subsequently issued to supplement the 1969 Methodology, including instructions on pricing high quality production (1969), surcharges for greater service life and reliability (1970), calculation of stepped prices on machinery (1971), use of "parametric" methods (1972), and prices on test models (1972).[24]

Parts of these instructions were then incorporated in the 1974 revision of the 1969 Methodology, which made various minor changes in the 1969 version.[25]

Both the 1969 and the 1974 versions are "general" methodologies which are supposed to be implemented by more specialized documents applying their principles to specific branches and product groups. Following the issuance of the 1969 version, from 1970 to 1973 "about 60" of these specialized methodologies were prepared, of which only 45 were approved by the SPC.[26]

However, even where methodologies for particular product groups have been worked out and approved, they are often not used in actual

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[24] Plotnikov 75, p. 107.

[25] According to Balabanov 74, these included the following:

(a) Under the 1969 version, the higher profitability to the producer from the new compared to the base product was included in the regular wholesale price of the new product. Under the 1974 version, the difference in profitability is to be viewed as a special incentive surcharge on top of a basic wholesale price which provides only a standard rate of profit on the new product. (How this surcharge would be treated in price statistics is not explained.)

(b) In turn, discounts of at least 10 percent should be established on wholesale prices of obsolescent items.

(c) The base product should be the best of "already mastered" current output, not an item about to be withdrawn from production. However, in calculations of limits and economic effect, the price of the base item may be adjusted to its costs at the beginning of serial production plus the standard profit markup.

(d) In calculations of economic effect, start-up and break-in expenses covered by the NPF are now to be considered along with expenses included in the production cost of the product.

(e) Under the 1969 revision, the price of the new product was set at the lower limit if the upper limit did not exceed the lower limit by at least 10 percent. The 1974 version raised that figure to 16 percent.

(f) In the Fundamentally New Products category, temporary prices are to be established not later than one-and-a-half months before the first output is shipped, and the permanent price not later than two months before the end of the period set for the temporary price. The temporary price should expire at the end of a calendar year.

(g) The 1974 version recommends that social factors (e.g., safety, noise level, etc.) and environmental effects (e.g., air and water pollution) be considered in setting prices but gives no concrete suggestions on how to do so.

[26] Plotnikov 75, p. 106.

pricing decisions and the price set exceeds what the Methodology would permit.[27]

Thus, it seems clear, on the one hand, that the theoretical problems of pricing new products have not been solved by the Methodology and its various ancillary documents, and, on the other hand, that (perhaps partly as a result) actual pricing practice is often at variance with these official instructions. This is true also of efforts to adjust the prices of maturing and old products, as an examination of temporary prices and stepped prices shows.

3. Temporary prices [28]

A temporary price assigned at the beginning of production is supposed to be high enough to cover all start-up costs plus the prevailing standard profit rate for established products of the branch. After output expands, start-up costs have largely passed, and average cost approaches its long-run normal level, the temporary price is to be replaced by a new, lower, permanent price of the kind customarily set for the branch's output.

Although a temporary price is calculated by the same cost-plus-profit approach as a permanent price, there are some differences because of the special features of new products. (a) Because the temporary price is set before production of the item begins, it must be based on an estimate of future costs, rather than on actual cost experience. (b) In the case of a new product, produced by only one or two enterprises, the estimated cost must be "individual," rather than "branch average." (c) The estimated cost includes not only ordinary production costs but all start-up costs other than those financed by the NPF.

These cost estimates are prepared by the enterprise and submitted together with a proposed temporary price to the ministry. In about a year, when break-in costs are largely eliminated, the enterprise is supposed to prepare a new set of cost estimates and to propose a new lower price based on them. When officially approved, that becomes the product's "permanent" price.

Various problems have been encountered with temporary prices: (a) Some critics object that they are in principle too high because they attempt to cover relatively high costs at the beginning of serial production, including some start-up costs which should instead be met by other sources (the NPF or a budget subsidy) and thus excluded from price. (b) Because cost figures refer to estimates of future costs before production begins, enterprises are often able to pad them, with or without the consent of the ministry. (c) In order to gain larger profits while output is growing and costs are falling, enterprises and ministries try to delay the replacement of temporary prices by lower permanent prices. (d) Enterprises request temporary prices on ineligible products which do not differ sufficiently from established products to qualify as "fundamentally new."

It is claimed that, in recognition of these problems, the use of temporary prices has been curtailed since 1967, but the relevant statistics are not published. Enterprises (and ministries) continue to have

[27] Iakovets 74, pp. 182–83.
[28] This discussion is based on Berliner 75, pp. 526–32.

strong incentives to attempt to use the temporary price procedure to obtain, and retain, high prices. Therefore, it is doubtful that efforts to eliminate abuses have been completely successful.

4. Stepped prices [29]

Stepped prices attempt to overcome some of the deficiencies of temporary pricing, by establishing a schedule of automatic price cuts based on expected cost reductions. When a new product is introduced, it is assigned not a single (temporary or permanent) wholesale price, but instead a set of dated prices. Each price is to be in force for a stated period of time, at the end of which it is to be replaced by the next, lower price. The entire set of prices and their official periods of duration appear in the price catalog or supplements to it.

Generally, three stages in the "history" of the product—differing regarding cost and profit—are distinguished, although in a concrete case the number of steps in the price set may exceed three if more than one step is used for any stage.

Stage 1 is the "incentive stage," from the beginning of production to the end of break-in, that is, when rated output capacity is attained and costs approach their long-run stable level. Prices in this stage should be high enough to cover start-up costs and provide an above-standard profit.

Stage 2 is the "standard profit" stage, from the end of Stage 1 until the product becomes obsolete and production should be curtailed and eventually terminated. The Stage 2 price is lower than the Stage 1 price because costs are at their long-run stable level, and the profit markup is reduced from above-standard to standard.

Stage 3 is the "penalty stage" in which prices are further reduced to discourage production by allowing not more than half the standard profit markup.

In principle, stepped prices appear to have several advantages. First, by including a terminal low (or in extreme cases even negative) profit stage, they provide for the "euthanasia" of old products which firms might otherwise continue to produce because of their high or comfortable unit profits. Second, scheduled price reductions exert pressure on producers to cut costs. Third, the scheme handles the problem of adjusting profit differentials between older and newer products without requiring price changes not foreseen in annual plans. Instead, the planning and financial agencies have in advance the dated set of prices for the product.

However, the use of stepped prices involves its own set of problems. First, they require a forecast of the volume of output for the specific product for each year of its production, an estimate of its cost in each year, and an idea of what its price should be in relation to the prices of whatever its substitutes are in each period.[30] In practice, these future estimates are extremely difficult—discouraging to the use of stepped prices.[31] Second, knowledge that the price is to be cut on a certain date, as stated in the published price catalog, can lead the producer to speed up output in order to sell at the present higher price, while potential customers defer purchases waiting for the lower future price.

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[29] Berliner 75, pp. 539–40; Lapusta 75, pp. 52–57.
[30] Plotnikov 75, p. 140.
[31] Iakovets 74, pp. 187–88.

Thus, official hopes for the use of stepped prices are confined to branches, like machinery, where (a) obsolescence is rapid and (b) there is some reasonable basis for forecasting cost behavior. However, even in this sphere, their introduction has been limited.

Working out stepped prices is a new and difficult matter. Together with technical complexities, psychological difficulties, inherent in every new undertaking, are of great significance here. These partly explain their relatively timid introduction. In the wholesale prices on machinery output introduced in 1973, they do not occupy any significant place. In the price list for metal-cutting machine tools, they were established on 47 models. There are fewer of them in other price lists.[32]

5. Price adjustment fund (PAF) [33]

The PAF was established in 1966, in connection with the 1966–67 price reform, to meet complaints of planning and financial officials that price changes introduced after plans are approved complicate the monitoring of performance indicators, creation of enterprise incentive funds, flow of tax payments and budget grants, etc. The PAF helps to reduce these disturbances through offsetting payments from and to the budget. For example, if a permanent price is reduced, sales targets are not altered, but producers are reimbursed by a budget subsidy for the difference in actual sales revenue attributable to the price cut. On the other hand, purchasers pay to the PAF the difference between planned and actual production costs which is due to the cut in prices on purchased inputs. Both types of payments are intended to be strictly temporary, until the next plan is formulated in the new prices.

The PAF thus contributes to price flexibility on older products by permitting the introduction of new, lower prices at any time during the plan period. In fact, however, it has become common now in Soviet price formation to strive to make new prices effective at the beginning of a calendar year and to disseminate them far enough in advance that plans can be constructed and carried out in the new prices.

Despite energetic efforts along various lines, the complex problems of setting relative prices for sectors, branches, subbranches, product groups, and individual items are far from solved—as Soviet price specialists concede. The 1966–67 reform and subsequent revisions represent some progress toward more sensible price-cost relationships, but they still neglect the role of demand in price formation. The Methodology for pricing new producer goods has a number of serious shortcomings and pitfalls. And the use of such techniques as limit calculations, parametric methods, and stepped prices in practice appears to be limited.

II. Agricultural Procurement Prices

Agricultural procurement prices are those at which collective and state farms sell to state procurement agencies. Sometimes the term "purchase prices" (*zakupochnye tseny*) is applied to collective farm

[32] Plotnikov 75, p. 147.
[33] *Fond tekushchego regulirovaniia izmenenitia optovykh tsen*—literally "Fund for the Current Regulation of Changes of Wholesale Prices." The translation in this paper follows Berliner 75, p. 538, on which this section is largely based. See also Schroeder 69, p. 469.

sales, and the term "delivery prices" (*sdatochnye tseny*) to state farm sales.[34]

As part of the general neglect of agriculture during the Stalin era, agricultural procurement prices were set extremely low—imposing a heavy tax on collective farmers, on the one hand, and requiring very large budget subsidies to state farms, on the other. Beginning in 1953, a number of changes were made in agricultural procurement prices, including a large increase in their overall level, a revision in the relative price structure in favor of food products vs. industrial raw materials, and regional differentiation of prices.[35]

Table 5 provides data on the rapid increase in agricultural procurement prices for collective farms after 1952. Unfortunately, these figures are incomplete, both by commodity and by year. Although the USSR Central Statistical Administration makes detailed calculations of agricultural price statistics,[36] it does not publish them. Thus, the annual statistical yearbooks present official indexes of industrial wholesale prices and state retail prices, but no agricultural price indexes. However, although this information apparently is still considered somewhat sensitive, it is not regarded as secret, because some of the figures are disclosed from time to time in books and articles by Soviet price specialists.[37]

TABLE 5.—INDEXES OF AVERAGE PRICES ON COLLECTIVE FARM SALES TO THE STATE, BY PRODUCT, SELECTED YEARS, 1952–73

[1965 = 100]

Product	1952	1958	1962	1965	1966	1969	1972	1973
Grain	8	65	88	100	107	110	112	108
Potatoes	7	59	71	100	100	98	115	108
Vegetables	24	(1)	(1)	100	113	122	151	152
Sunflowers	9	69	61	100	105	85	88	100
Sugar beets	37	80	86	100	103	92	110	125
Cotton	69	73	74	100	95	103	117	118
Milk	17	72	78	100	100	101	126	132
Cattle[2]	4	53	69	100	104	118	141	141
Pigs[2]	5	58	69	100	102	109	113	114
Sheep and goats[2]	5	76	76	100	107	123	140	140
Wool	26	75	93	100	98	110	124	132
Eggs	28	91	94	100	100	107	118	112

[1] Not available.
[2] Live weight.

Source: Calculated from data on rubles per centner (or per 1,000 for eggs) in Emel'ianov 74, p. 101.

In considering the figures in Table 5 (and other tables in Part II), one should keep in mind that they refer to "average prices," which—without any change in official prices—may vary because of differences from year to year in the proportion of each product's sales accounted for by (1) different types (e.g., wheat, rye, oats, etc., within grain);

[34] This difference in terminology stems from the former practice of setting state farm prices below collective farm prices for the same commodities in the same regions. In connection with the decision to transfer state farms to "full *khozraschet*," state farm prices for many products were raised to the corresponding collective farm prices in the same region, increasing the state farms' revenues and profitability.

[35] Bornstein 66, pp. 77–82.

[36] Bornstein 69, pp. 366–70.

[37] The most comprehensive series of indexes, for prices on state procurements from collective farms and private plots, covering total sales and a 12-product breakdown from 1952 through 1966, appeared in a book by S. G. Stoliarov, Chief of the Department of Statistics of Prices and Price Formation of the USSR Central Statistical Administration. See Stoliarov 69, p. 121. Unfortunately, since his death no comparably detailed statistics for more recent years have been published. A detailed compilation of official prices (not indexes) effective in 1972 is available in Savitskii 74, pp. 449–62.

(2) different quality grades; (3) different regional price zones; and (4) "above-plan" sales at "premium" prices above base prices.

The major agricultural price changes in 1965 and 1970 are analyzed and evaluated in the first and second sections, respectively. The remaining sections discuss selected problems connected with the level and structure of agricultural procurement prices, including prices on industrial inputs into agriculture, the effect of procurement assignments on average realized prices and profitability, and regional differentiation of prices.

A. 1965 PRICE CHANGES

Under Brezhnev's multi-faceted new agricultural program of 1965, prices for various products were raised in two different ways—by increasing the base price and by establishing "premia" above the base price for above-plan sales.[38]

In the case of grain, base prices for wheat, rye, barley, oats, buckwheat, millet, and rice were increased. In addition, a 50-percent premium for above-plan sales was introduced for wheat and rye, and extended to buckwheat, corn, peas, millet, and barley in 1966.

Milk prices were raised about 20 percent, and the butterfat standard was lowered, thereby increasing the average price. Although the base price of cattle, pigs, sheep and goats was not altered, supposedly "temporary" surcharges (*nadbavki*) were added to the base price, ranging (depending upon the regional price zone) from 20 to 55 percent for cattle, 30 to 70 percent for pigs, and 10 to 70 percent for sheep and goats. The effective prices were thus increased substantially.

Finally, for deliveries above average sales during the preceding three years, a 50-percent premium was added to cotton prices and a 100-percent premium to sunflower seed prices.

As a result of these price increases—and the pattern of output changes—the average price of all collective farm sales rose 14 percent from 1964 to 1965. For state farms the corresponding figure was 20 percent.[39]

Table 5 shows, for various products, the difference between average prices of 1965 and those of 1958 and 1962, when the preceding general price increases were made. Calculations by another Soviet economist, presented in Table 6, provide more detailed information for different grain products.

TABLE 6.—INDEXES OF AVERAGE COLLECTIVE FARM PURCHASE PRICES, SELECTED PRODUCTS, 1965–70

[1964 = 100]

Product	1965	1966	1967	1968	1969	1970
Wheat	123	132	130	139	136	131
Rye	141	143	165	153	163	152
Corn	129	139	149	159	127	139
Millet	101	115	117	124	114	111
Rice	134	137	137	139	113	141
Sunflowers	123	127	122	118	107	112
Sugar beets	96	100	100	96	96	100

Source: Iakovets 74, p. 180.

[38] See Karcz 65 for a detailed examination of the 1965 agricultural program.
[39] Stoliarov 69, pp. 121–22.

The effect of the 1965 price increases on profitability (in relation to production cost) may be seen in Table 7, which contains data by product for collective farms. It shows how the 1965 price changes helped to raise the profitability of grain significantly, to reduce losses on milk, and to eliminate losses on cattle and pigs. Nevertheless, at the relative prices for grain and livestock products established in 1965, the former remained much more attractive, and farms thus continued to prefer to sell grain to the state rather than feed it to animals. Furthermore, costs in agriculture continued to rise, as a result of the introduction in 1966 of guaranteed pay for collective farmers at state farm wage rates, and increases in the latter; greater use of purchased inputs like fuels, fertilizers, pesticides, machinery, and construction materials; and increases in the wholesale prices of some of these industrial inputs as a result of the 1967 reform and subsequent revisions in industrial wholesale prices.

TABLE 7.—AVERAGE RATE OF PROFITABILITY OF U.S.S.R. COLLECTIVE FARMS, BY PRODUCT, SELECTED YEARS, 1958–71 [1]

[Percent]

Product	1958	1964	1965	1966	1970	1971
Grain	65	83	129	156	121	103
Potatoes	32	77	51	37	11	7
Sugar beets	92	61	33	25	16	9
Sunflowers	484	460	395	387	220	206
Cotton	102	39	42	32	40	34
Milk	−12	−25	−3	−6	6	5
Cattle	−43	−19	16	18	30	29
Pigs	−42	−20	17	23	30	24
Sheep and goats	19	16	26	23	26	22
Eggs	−12	− 2	−2	−0.1	14	19
Wool	30	33	28	16	28	22

[1] Profitability equals price minus cost divided by cost. Minus sign denotes rate of loss. Rounding of figures as presented in source.

Source: Suslov 73, p. 47.

Thus the average rate of profitability relative to cost for 1967–69 for all products was only 27 percent for collective farms and 16 percent for state farms. In contrast, most Soviet agricultural specialists believe that the average profitability rate for agriculture as a whole which is necessary to expand production at planned rates is 40–50 percent (with some variation by product and region, however).[40]

Also, the variation in profitability by product and product group remained striking. During 1967–69, for crops the average profitability rate was 57 percent for collective farms and 42 percent for state farms, compared with 7 percent and 6 percent, respectively, for livestock production.[41] Thus further and substantial price increases were judged essential to the expansion of livestock production.

B. 1970 PRICE CHANGES

In 1970, prices of various products were again raised by the same two methods as in 1965: increases in base prices and establishment of premia for above-plan sales.[42]

[40] Emel'ianov 74, p. 101. On the Soviet debate on this issue, see Bornstein 69, pp. 9–12.
[41] Emel'ianov 74, p. 101.
[42] Sokolov 75.

Basic purchase prices on grain were left unchanged, although it was expected that the expansion of production would increase the share of above-plan sales at premium prices in total sales, raising the effective average price.

In the livestock sector, milk and cream prices were increased 20 percent in 1970 (and subsequently another 8 percent in 1975).[43] The "temporary" supplements to meat prices established in 1965 were permanently incorporated in base prices, which were further increased somewhat. For example, the 1970 base price for the RSFSR was set at 40 percent above the 1965 base price, through the inclusion of the 35 percent surcharge and the addition of another 5 percent. Moreover, the 50-percent price premium was introduced for above-plan sales of cattle, milk, eggs, and wool.

Higher prices—differentiated by region, quality, and season of sale—were also fixed for potatoes, vegetables, and fruits.

For technical crops, the timing of price increases was different. Cotton prices had previously been raised an average of 15 percent in 1969. The increase for sugar beets did not occur until 1972, when the 50-percent premium for overfulfillment of the sales plan was also established.[44] Finally, a 10–13 percent increase in the base prices, and introduction of a 50-percent premium for above-plan sales, are scheduled for flax effective with the 1976 harvest.[45]

The substantial increases in the average prices of vegetables, sugar beets, cotton, milk, and cattle after 1969 may be seen in Table 5. As a result of these price changes, profitability of livestock output improved. On collective farms, losses on milk before the 1970 increase were replaced by an average profitability rate of 4 percent in 1970–72, according to data presented in Table 8. For the entire livestock sector, profitability rose from an average of 7 percent in 1967–69 to 16 percent in 1970–72. On state farms, the profitability of livestock increased from an average of 6 percent in 1967–69 to 15 percent in 1970–72, but milk output still was not profitable. The profitability of poultry also remained low on both collective and state farms.[46]

With stable procurement prices and rising costs, the farms' profitability worsened in 1973. The overall profitability of collective farms slipped to 27 percent, including 57 percent on crops and 10 percent on livestock products. For state farms, the respective figures were 23, 48, and 14 percent.[47] As Table 9 reveals, milk was barely profitable on collective farms and showed a loss of 6 percent on state farms. Poultry was sold at a loss on collective farms, and potatoes at a loss on both collective and state farms.

According to recent calculations of the Department of Prices and Production Costs of the All-Union Scientific Research Institute of Agricultural Economics, the profitability rates attainable at present agricultural procurement prices are not sufficient to permit every "normally operating" farm to cover costs and earn enough profits to pay bonuses and make scheduled investments. Profitability is con-

[43] Grushetskii 75, p. 45.
[44] Maizus 75.
[45] Grushetskii 75, p. 45.
[46] Emel'ianov 74, pp. 101–02.
[47] Grushetskii 75, pp. 43–44.

TABLE 8.—AVERAGE COST, AVERAGE PRICE, AND RATE OF PROFITABILITY FOR COLLECTIVE FARM AND STATE FARM SALES TO THE STATE, BY PRODUCT, ANNUAL AVERAGE 1970–72 [1]

Commodity group	Collective farms			State farms		
	Average cost (rubles per centner)	Average price (rubles per centner)	Rate of profitability (percent) [2]	Average cost (rubles per centner)	Average price (rubles per centner)	Rate of profitability (percent)
Crops, total	(3)	(3)	49	(3)	(3)	46
Grain	5	10.2	105	5	9.7	77
Potatoes	6.6	7.3	11	9	8.5	−5
Vegetables	9.9	11.5	15	9.8	11.1	13
Sugar beets	2.3	2.7	16	3.2	3	−6
Sunflowers	6	18.5	207	(4)	(4)	(4)
Cotton	41.1	55.6	35	37.8	51.4	36
Livestock, total	(3)	(3)	16	(3)	(3)	15
Milk	18.5	19.2	4	20.1	20	−0.4
Cattle [5]	124.3	156.1	26	132.8	139.6	5
Pigs [5]	128	157.1	23	122.4	154.7	26
Sheep and goats [5]	83	99.5	20	71.7	87.5	22
Poultry	168.5	181.4	8	179.3	191.5	7
Eggs [6]	72	84	16	66	102	56
Wool	420.4	499.6	19	353.2	435.3	23
Total production	(3)	(3)	29	(3)	(3)	24

[1] Different rounding of figures as presented in source.
[2] Rate of profitability equals price minus cost divided by cost. Minus sign denotes rate of loss.
[3] Not applicable.
[4] Not available.
[5] Weight gain.
[6] Data per 1,000 eggs.

Source: Emel'ianov 74, p. 102.

TABLE 9.—AVERAGE COST, AVERAGE PRICE, AND RATE OF PROFITABILITY FOR COLLECTIVE FARMS AND STATE FARMS, BY PRODUCT, 1973 [1]

Product	Collective farms			State farms		
	Average cost (rubles per ton)	Average price (rubles per ton)	Rate of profitability (percent) [2]	Average cost (rubles per ton)	Average price (rubles per ton)	Rate of profitability (percent)
Grain	47	97	107	53	94	77
Potatoes	70	69	−1	92	80	−13
Vegetables	95	111	17	93	106	14
Sugar beets	24	31	29	31	36	16
Sunflowers	58	199	243	62	202	225
Cotton	403	544	35	383	501	31
Milk	196	198	0.8	219	206	−6
Cattle	1,337	1,573	17	1,057	1,577	15
Pigs	1,347	1,558	15	1,256	1,567	25
Sheep	893	1,031	15	818	899	10
Poultry	1,842	1,826	−1	1,810	1,940	7
Eggs [3]	70	85	21	62	100	61
Wool	4,711	5,210	10	4,800	5,391	12

[1] Different rounding of figures as presented in source.
[2] Rate of profitability equals price minus cost divided by cost. Minus sign denotes rate of loss.
[3] Data probably per 1,000 eggs, although not so stated in source.

Source: Grushetskii, 75, p. 44.

sidered adequate or more than satisfactory on some products—for example, grain, sunflowers, cotton, pigs, and eggs—but too low on milk, cattle, sheep, potatoes, and vegetables.[48]

However, although conceding that profitability is not "optimal" at present prices, other Soviet agricultural specialists question whether further price increases are the best way to improve profitability. They point out that even at present prices many collective and state farms

[48] Grushetskii 75, p. 46.

cannot fruitfully use all of the funds they have available for the purchase of fertilizer, equipment, and construction materials, because supplies of these industrial inputs are inadequate.[49] These specialists also expect that rapid increases in farmers' money incomes comparable to those observed from 1965 to 1972—when average monthly wages rose from 51 to 81 rubles on collective farms and from 75 to 112 rubles on state farms—are not likely to occur in the 1970s. They believe that increases in rural living standards in the 1970s will have to come not chiefly from higher money incomes but instead from improvements in working and living conditions resulting from mechanization and infrastructure investments.[50]

C. PRICES OF INDUSTRIAL INPUTS

One important factor affecting the farms' costs and profitability at present agricultural procurement prices is the level of prices on industrial inputs.[51]

In an effort to hold down production costs in agriculture, in order to reduce the magnitude of agricultural procurement price increases, when higher prices on industrial inputs into agriculture were introduced as a result of the 1967 industrial wholesale price reform (discussed above), only part of the increase was passed along to the agricultural sector. Farms were charged the new prices for petroleum products, metal products, spare parts, lumber and construction materials. But in the case of mineral fertilizers, motor vehicles, tractors, combines, and earth-moving machinery, part of the price increases in 1967 and thereafter has been offset by budget subsidies which cover the difference between the higher price which the industrial producer receives and the lower price the farms pay.[52]

The average subsidy rate on the prices of the inputs involved was about 17 percent in 1974.[53] The total subsidy bill has been growing rapidly (from 1969 to 1973 it rose by 80 percent for agricultural machinery and by 117 percent for mineral fertilizers), because both (a) the ruble amount of the subsidy per machine or ton of fertilizer and (b) the total quantities of these goods delivered to agriculture are increasing.[54]

On the other hand, the Ministry of Agriculture has been criticized for failing to protect the interests of the agricultural sector in regard to the pricing of industrial inputs into agriculture.

One of the reasons for the existing imperfections in the system of purchase prices and application of increased release prices on industrial goods which do not provide the projected effectiveness in production, is that the USSR Ministry of Agriculture has not up to the present created a department for the analysis and planning of prices. The preparation of proposals for improving purchase prices is carried out irregularly (*epizodicheskii*), sometimes without a sound economic basis and without relating them to quality standards. Release prices

[49] ". . . it would be incorrect to [try to] remedy by endless increases in purchase prices the chronic excess of demand over supply existing for many agricultural products. Even if the collective farms have funds, but the additional tractors, motor vehicles, agricultural machinery, fertilizers, etc., are not produced in the needed quantity, it is impossible to expand the production of even very profitable products." Iakovets 74, p. 208.
[50] Emel'ianov 74, p. 102.
[51] Lukinov 76.
[52] Sokolov 75, p. 11.
[53] Semenov 74, p. 46.
[54] Semenov 75, p. 49.

on tractors, agricultural machinery, and other industrial goods for the countryside are dictated essentially by industry. To avoid this, there should be created a special department which could, in a properly qualified way, take part in the preparation of prices affecting the interests of the branch.[55]

D. SIGNIFICANCE OF PROCUREMENT PLANS

Soviet policy currently emphasizes the use of premia above base prices—rather than increases in the latter—as a way of stimulating output.[56] However, there are two problems associated with this approach: the sensitivity of average prices to the weather, and the incentive for farms to seek easy sales targets in order to increase the share of total sales which is made at premium prices. Both problems are serious because of the large difference between the premium price and the base price: 50 percent for grain, cattle, milk, and cotton; and 100 percent for sunflowers.

First, premium prices for above-plan deliveries cause the effective price to vary directly with the size of the crop. In years when the harvest is good, average realized prices are higher because more of the total output is available for above-quota sales. Conversely, when the harvest is bad, both quantities and average procurement prices are lower. (The size of the grain harvest in turn affects the ability of livestock producers to obtain the feed necessary to meet and surpass their sales targets.) Hence, in good weather years, profitability is higher because of larger quantities, higher average prices, and lower unit costs. In poor weather years, profitability is low because of smaller quantities, lower average prices, and higher unit costs—causing many farms to experience "acute financial difficulties."[57]

Second, because the "tautness" of the plan for sales at base prices affects the potential amount of above-plan sales at premium prices, farms strive to get easier sales targets from supervising agricultural agencies. Because of successful bargaining or the incompetence of local agricultural planning agencies, some farms receive easy plans which they overfulfill "without peak effort," getting unjustified revenue from premia for above-plan deliveries. Other farms are given "excessively taut assignments without sufficient regard to existing possibilities" of their labor force, machinery, soil, etc. In an effort to provide better guidelines for sales assignments which are "taut but really feasible," new "Methodological Recommendations for the Preparation of the Plan of State Purchases of Agricultural Products for 1976–1980" were recently worked out by the USSR Ministry of Agriculture and the All-Union Scientific Research Institute of Agricultural Economics.[58]

Another procurement problem is the widespread practice of giving farms sales targets for products which the farms can only produce at a loss and which they should not be producing at all.

In the case of grain, in 1970 sales assignments were given to 32,600 collective farms (98.5 percent of the total!), including 4,100 which sold at a loss (half of them with losses exceeding 30 percent). These 4,100 farms accounted for one-eighth of the total number with delivery

[55] Grushetskii 75, p. 49.
[56] Kosygin 76.
[57] Grushetskii 75, p. 48.
[58] Kosygin 76.

plans for grain, but provided less than 2 percent of total sales. Releasing from grain sales obligations such farms and others with profitability below 15 percent (on grain) would make little difference in the national grain balance. Indeed, because these farms buy for animal feed significantly greater amounts of grain forage and concentrated feed than the amount of grain they sell to the state, "the social benefit from savings on transport costs alone would be very significant," if their grain sales plans were eliminated.[59]

A similar situation prevails for other products. For example, in 1970–71, of more than 12,000 collective farms producing sugar beets, 4,000 (i.e., a third) did so at a loss but provided only 6 percent of total sales. In 1970–71, 28,000 collective farms, or 85 percent of the total, were producing potatoes for sale, but only 13,000 of them earned a profit on the commodity. The remaining 15,000 had losses (including 7,000 with losses exceeding 30 percent), while providing only 4 percent of total sales.[60]

E. REGIONAL DIFFERENTIATION OF PRICES

Because sales assignments for many agricultural products are given to such large numbers of (often inappropriate) farms, whose production costs vary widely because of differences in soil, topography, rainfall, temperature, and length of growing season, profitability differences would be enormous if a single national purchase price were set for each product at its marginal cost—with differential rents taken away by rental payments or income taxes—as some Soviet economists have proposed.[61] Instead, Soviet practice is to differentiate the prices of many commodities geographically, by price zone, in an effort to capture differential rents arising from more favorable natural conditions. These zonal prices are supposedly set with reference to the average costs of production in each zone, so as to provide lower prices but higher profitability in low-cost areas and higher prices but lower profitability in high-cost zones. However, the differentiation of zonal prices is also reported to take into account such additional elements as (1) the potential for future cost reductions, (2) the farms' need for retained earnings to finance investment planned for them by supervising agencies, (3) the tax burden to be placed on them, and (4) possible subsidies in the case of state farms.

Much attention has been devoted to revision of zonal price differences, with two main objectives. One is to increase the volume of procurements for a given average national price for the product, by redrawing zone boundaries and altering the degree of differentiation of prices for high-cost and low-cost zones. The second is to reduce large differences in the incomes of farms, and of farmers, in different regions, and within the same region, which are due to natural conditions, rather than differences in productive effort, managerial skill, or productive equipment.

The trend in price zoning in recent years has been to increase the number of price zones for each product and to widen zonal differences in prices, as Table 10 shows. For example, the 1965 price revi-

[59] Suslov 73, p. 48.
[60] Suslov 73, pp. 49–50.
[61] Bornstein 69, pp. 12–13; Malzenberg 76, p. 145.

TABLE 10.—ZONAL DIFFERENCES IN STATE AGRICULTURAL PURCHASE PRICES, BY PRODUCT, 1958–64, 1965–69, AND 1970–72

Product	1958–64			1965–69			1970–72		
	Number of price zones	Minimum and maximum prices (rubles per ton)	Excess of maximum over minimum price (percent)	Number of price zones	Minimum and maximum prices (rubles per ton)	Excess of maximum over minimum price (percent)	Number of price zones	Minimum and maximum prices (rubles per ton)	Excess of maximum over minimum price (percent)
Wheat	15	65–85	31	32	66–143	117	43	66–143	117
Rye	14	55–85	54	22	60–130	117	22	60–130	117
Oats	12	38–70	84	15	45–90	100	15	45–90	100
Barley	13	46–80	74	15	45–90	100	15	45–90	100
Sunflowers	8	160–225	40	8	160–225	40	8	165–220	40
Sugar beets	6	27–40	48	6	27–40	48	13	28–48	71
Cotton	19	300–750	150	11	332–750	126	11	270–770	185
Potatoes	1	60	(1)	1	60	(1)	7	63–130	106
Milk	12	120–165	38	25	130–220	77	113	170–620	265
Cattle [2]	19	765–1, 070	39	22	765–1, 070	40	67	1, 000–2, 800	180
Pigs [2]	12	870–1, 305	50	12	860–1, 365	52	35	1, 030–2, 400	133
Sheep [2]	19	460–720	56	27	460–970	111	36	637–1, 000	151
Poultry [2]	8	1, 345–1, 605	19	9	1, 345–1, 550	7	7	1, 540–2, 140	39

[1] Not applicable.
[2] Live weight.

Source: Sebestoimost' 74, p. 167.

sions increased the number of zones for wheat from 15 to 32 and the excess of the maximum over the minimum price from 31 to 117 percent. The corresponding changes for milk were from 12 to 25 zones and from 38 to 77 percent, and for sheep from 19 to 27 zones and from 56 to 111 percent.

In 1970, the number of wheat zones was increased from 32 to 43, but the range of price differences was not altered. For sugar beets, the number of zones rose from 6 to 13, and the excess of maximum over minimum price from 48 to 71 percent. For cotton, the number of zones was unchanged, but price differentiation increased from 126 to 185 percent. Zone prices for potatoes were first introduced in 1970, with 7 zones and a 106-percent difference in maximum over minimum prices. The most striking changes were in the livestock sector, where the number of milk zones was raised from 25 to 113, and the range of price differences from 77 to 265 percent. For cattle, 67 zones were established in place of 22, and the range of price differences widened from 40 to 180 percent. Changes of comparable magnitude occurred also for pigs and sheep.

Table 11 compares the 1965 and 1970 zonal price patterns and their effect on the profitability of selected products on RSFSR collective farms. Reading across line 2a of the table, one can see that relative regional differences in cost are much greater for crops (grain, potatoes, and vegetables) than for livestock products, reflecting the greater influence on the former of differences in soil and climatic conditions. The figures in line 2b show that the 1970 prices provided wider regional differentials than the 1965 prices for all products except pork. A comparison of lines 3a and 3b reveals that differences in profitability between the least and most profitable regions narrowed from 1965 to 1970 for all products except pork, although significant differences in profitability both by product and by region continued under the 1970 prices, which are currently in effect.

Although geographical price differentiation has thus increased in recent years, Soviet agricultural price specialists believe the present scheme still inadequately recognizes differences in natural conditions under which farms operate and thus causes unjustified differences in profitability by product and by farm. They point out that, in addition to variations in average cost from one zone to another, there are still greater differences in costs and thus profitability within zones, some of which cover large areas with big differences in soil, rainfall, and temperature. With zonal prices based on the average cost of such zones, those farms with above-average costs for the zone will have low revenues or even produce at a loss.[62]

Hence, many economists urge that the practice of differentiating prices within zones be extended. However, there is no agreed procedure for subdividing zones or grouping farms, or for determining the proper extent of price differentiation. In most cases, intrazonal price differences were introduced at the time of general price increases (e.g., in 1970), but without previous careful study of land characteristics, production conditions, etc.[63] In fixing intrazonal price differences, it is important not simply to set them so as to cover—and add a "normal"

[62] Grushetskii 75, p. 47.
[63] Sebestoimost' 74, pp. 181–83.

TABLE 11.—RSFSR COLLECTIVE FARMS: REPUBLIC AVERAGE AND REGIONAL DIFFERENCES[1] IN PRODUCTION COST, PRICE, AND RATE OF PROFITABILITY, SELECTED PRODUCTS, 1965 AND 1970

	Grain		Potatoes		Vegetables		Milk		Beef		Pork	
	1965	1970	1965	1970	1965	1970	1965	1970	1965	1970	1965	1970
1. RSFSR average:												
(a) Production cost (rubles per centner)	5.0	4.9	4.0	5.7	8.9	9.6	15.2	18.1	95.2	114.8	111.9	118.9
(b) Price[2] (rubles per centner)	12.1	10.2	7.2	6.7	9.8	12.0	14.7	17.9	109.0	139.8	128.8	152.9
(c) Rate of profitability[3] (percent)	142.0	108.2	80.0	17.5	10.1	25.0	−3.3	−1.1	14.5	21.8	15.1	28.6
2. Relative regional differences:												
(a) Production cost of highest cost region as percent of production cost of lowest-cost region	345.7	358.8	273.5	236.7	272.2	224.6	140.1	156.7	139.1	138.0	184.9	185.2
(b) Price[2] for highest-cost region as percent of price for lowest-cost region	137.4	160.0	135.6	179.4	112.0	201.2	117.0	153.2	134.7	138.0	185.8	175.0
3. Rate of profitability[3] (percent):												
(a) Least profitable region	21.5	18.0	6.5	−16.0	−23.8	6.7	−22.9	−5.5	1.6	8.5	8.2	13.9
(b) Most profitable region	205.7	164.7	114.7	32.4	85.1	63.4	21.8	19.2	44.5	39.0	21.3	44.1

[1] In these calculations, the RSFSR is divided into the following economic regions: Northwest, Central, Volga-Viatka, Central Chernozem, Povolzhe, North Caucasus, Ural, West Siberia, East Siberia, Far East.

[2] Average price obtained on sales to the state.

[3] Profitability = price − cost divided by cost. Minus sign denotes rate of loss.

Source: Khriplivyi 73, p. 114.

profit to—whatever the recent level of costs happens to be on a particular farm, without an analysis of the factors affecting current and future costs.[64]

In the absence of any standard procedure for handling intrazonal cost and price differences, various practical experiments are being undertaken. For example, in Lithuania differentiated purchase prices were introduced in 1970 by grouping farms according to an evaluation of land quality, fixed capital and inventories, and labor force—without regard to oblast and raion boundaries. In Georgia, the Republic authorities decided to redistribute income from valley farms with high-revenue crops (tea, wine grapes, fruits) to mountain farms raising low-profit sheep, goats, and pigs. Prices on the first group of crops are reduced by deductions into a centralized fund, from which surcharges are added to prices on sales by mountain farms.[65]

Such experiments are part of the continuing search for "technical" ways to adjust the agricultural price structure to affect output and income distribution without raising the general level of agricultural procurement prices—a difficult political decision.

III. Retail Prices

There are two principal types of retail prices at which goods are sold to households in the USSR: state retail prices and collective farm market (CFM) prices.

The state retail price (*gosudarstvennaia roznichnaia tsena*) is charged by state retail stores, consumer cooperative stores, and state and cooperative service establishments, such as restaurants, laundries, theaters, etc. The consumer cooperatives, which operate primarily in the rural areas, are closely supervised by the state, which determines their number, size, location, etc.; allocates goods to them; and establishes sales plans for them.

There are about 8,000 CFMs, approximately half of them in towns of various sizes and half in rural areas. Sellers include collective farms, peasants, and urban residents with garden plots. Prices are set by supply and demand in the individual market, and vary from market to market and from day to day in the same market. Of total state, cooperative, and urban CFM sales in 1974, the respective percentage shares of the three types were 69.0, 28.7, and 2.3. The CFMs' share was 3.8 percent of total food sales and 7.4 percent of total sales of the smaller range of food products sold in all three channels (e.g., excluding canned foods not available in the CFM).[66] However, in some cities the CFM accounts for 20 to 40 percent and more of total sales of various food products.

As a general principle, state retail prices are supposed to be fixed with the aim of clearing the market both in aggregate terms and for individual commodities. In the former respect, the objective is to set the general level of state retail prices so that total retail sales at that price level will absorb the money income which the population is expected to want to spend at state and cooperative retail outlets. For individual goods the standard goal is to fix the price of the item at a

[64] Malzenberg 76, p. 150.
[65] Malzenberg 76, pp. 147–48; Stolbov 72; Kharebava 74.
[66] Nar. khoz. 74, pp. 625–26.

level which equates planned supply and expected demand. However, retail prices are also set with other objectives which conflict with the aim of clearing the market. One such additional objective, stemming from administrative considerations, is to avoid changing prices very often. Another is to make the distribution of real income less unequal than the distribution of money income. For example, the government fixes lower prices for mass consumption goods (such as basic foodstuffs) which predominate in the family budgets of lower income groups, and higher prices for goods (e.g., some consumer durables and luxury foodstuffs) which are relatively more important in the expenditure patterns of higher income groups. In pursuit of this objective, prices of some food products are intentionally set below the equilibrium level, as persistent shortages attest. In this way, the informal rationing of queues and empty shelves helps to modify the distribution of real income from the initial distribution of money income. Finally, relative prices are also used to pursue other objectives of social policy. For instance, low prices are set on books for educational reasons, while high prices are intended to curb the consumption of vodka.

The principal components of the state retail price are (1) the enterprise wholesale price (or the agricultural procurement price plus the markup of the procurement agency); (2) the turnover tax or subsidy, if any; (3) the wholesale trade margin, and (4) the retail trade margin. In addition, there are transportation charges. The wholesale and retail margins are intended to cover expenses and provide a profit at the respective stages of the distribution process.

Turnover taxes (and subsidies) serve as a buffer which can separate the movement of retail prices paid by households from the movement of wholesale prices received by producing enterprises. Taxes and subsidies permit planners to alter producer prices without changing consumer prices correspondingly, and vice versa. Turnover taxes and subsidies separate not only the levels but also the structures of consumer and producer prices, because different rates of taxation (or subsidy) on different goods cause their relative consumer prices to vary from their relative producer prices. For most goods, the turnover tax is set as a specific ruble amount and there are separate wholesale and retail price lists, though for some items the tax is levied as a percentage of the enterprise wholesale price or the retail price.

A. PRICE CHANGES

A cornerstone of Soviet price policy is stability of the level of retail prices—as represented by the behavior of the official indexes of state retail prices, such as those presented in Table 12. These data indicate negligible changes in state retail prices since 1965—except for increases in prices for vegetables and potatoes in 1970 (following increases in agricultural procurement prices) and for higher-grade fish products in 1974, and reductions in prices on school supplies in 1971 and television sets in 1971–72. According to a Deputy Chairman of the SPC, apparently referring to 1971–75, prices were changed on only 1 percent of the volume of food sales and 8 percent of the volume of nonfood sales.[67]

[67] Kuznetsov 76, p. 22.

TABLE 12.—INDEXES OF STATE RETAIL PRICES, ANNUAL AVERAGES, 1970–74[1]

[1965=100]

Commodity group	1970	1971	1972	1973	1974
All products	99.7	99.6	99.4	99.4	99.3
Food products	100.3	100.6	100.6	100.8	101
Meat	100	100	100	100	100
Fish	97	97	97	97	100.8
Butter	99.9	99.9	99.9	99.9	99.9
Vegetable oil	99.8	99.8	99.8	99.8	99.8
Sugar	98	98	98	98	98
Confectionery products	97	97	97	97	97
Bread and bread products	99.6	99.6	99.6	99.6	99.6
Potatoes	105	104	102	103	103
Vegetables	118	117	120	123	121
Alcoholic products	101	103	103	103	103
Nonfood products	99	98	98	97	97
Cotton fabrics	97	97	97	97	97
Wool fabrics	97	97	97	97	97
Silk fabrics	96	96	96	96	96
Clothing	98	98	98	97	96
Knit goods	99	98	98	98	95
Leather, cloth, and combination footwear	99.6	99.6	99.6	99 6	99.6
Rubber footwear	99.2	99.2	99.2	99.2	99.2
Tobacco products	100	100	100	100	100
School notebooks, paper, and stationery products	92	85	84	84	82
Watches	100.5	100.5	100.5	100.5	100.5
Motorcycles	100	96	96	96	96
Television sets	96	88	75	74	74
Sewing machines	99	99	99	99	99
Cameras	98	98	98	98	98

[1] Different rounding of figures as presented in source.

Source: Nar. khoz. 74, p. 654.

The key to the stability of retail food prices is the regime's decision not to pass along in retail prices most of the increases in agricultural procurement prices in 1965 and 1970 (discussed in Part II above). Corresponding increases in retail prices would in turn have required raising wages (and pensions, stipends, and other transfer payments), with subsequent pressure on production costs throughout the economy.[68]

Instead, a broad program of budget subsidies kept retail food prices largely unchanged.[69] Estimates by product for 1969–75 (plan), made by Constance Krueger, are given in Table 13. They indicate that these subsidies have run about 15–16 billion rubles per year after the 1970 agricultural procurement price increases.[70] The subsidies are most important in holding down the prices of meat and dairy products. For example, the estimated 1974 (planned) subsidy for meat of 10.93 billion rubles in Table 13 was equal to 70 percent of the reported value of state and cooperative retail sales of meat products, 15.51 billion rubles. The estimated milk subsidy of 3.83 billion rubles was 62 percent of the value of state and cooperative retail sales of milk products, 6.09 billion rubles. For potatoes and vegetables, such comparisons of subsidies in

[68] Iakovets 74, p. 103.

[69] On the administrative arrangements for disbursing the subsidies, see Korovushkin 72 and Vesbland 75.

[70] These figures exclude the subsidies on some industrial inputs into agriculture (agricultural machinery, mineral fertilizers, and processed feeds), discussed above in Part II, which Krueger estimates at an additional 1.5–2 billion rubles.

relation to sales yield results of 14 and 11 percent, respectively.[71] The subsidy bill can only continue to increase if the present differences between agricultural procurement prices and retail prices are maintained while agricultural output rises and the volume of sales to which the subsidies are applied grows.

TABLE 13.—ESTIMATED SUBSIDIES ON GOVERNMENT PURCHASES OF AGRICULTURAL PRODUCTS, 1969–75 PLAN

[Billions of rubles]

Product	1969	1970	1971	1972	1973	1974 plan	1975 plan
Meat	5.30	8.74	9.83	10.42	10.19	10.93	11.86
Milk	1.38	3.12	3.22	3.31	3.62	3.83	4.08
Wool	(1)	.14	.15	.14	[2] 0	0	0
Eggs	0	.03	.04	.04	.05	.05	.06
Grain	.56	.71	.64	[2] 0	0	0	0
Potatoes	.08	.09	.09	.09	.12	.13	.14
Vegetables	.11	.13	.21	.21	.26	.29	.32
Sugar beets	.10	.11	.10	.60	.68	.70	.72
Sunflower and other oil seeds	.10	.11	.10	.09	.06	.06	.06
Hemp, flax, kenaf, hides					[2] 0	0	0
Cotton	.25	1.15	1.19	1.22	[2] 0	0	0
Total	7.88	14.33	15.57	16.12	14.98	15.99	17.24

[1] Negligible.
[2] Through reductions in turnover taxes on their manufactures, subsidies on several agricultural raw materials were discontinued: grain, beginning in 1972; wool, hemp, flax, hides, cotton, and several unidentified other agricultural raw materials, beginning in 1973.

Source: Krueger 74, where the derivation of these estimates is explained in detail.

Although the government aims to keep "stable" the retail price level for each major commodity group, it does wish to adjust relative prices within commodity groups in accordance with changes in the product-mix ("assortment"). This is especially important in the clothing industry, where fashion trends can exert considerable influence on demand. For example, the clothing industry was pleased when miniskirts and narrower men's trousers became fashionable, because they required less cloth per garment and so were more profitable to produce. But when fashion shifted back toward longer skirt lengths, clothing factories were reluctant to alter their output mix toward models involving more cloth.[72] Therefore, in 1974 the price lists on women's and men's outer clothing were revised extensively, to reflect more accurately differences in labor and materials costs—without changing the general level of retail prices on these product groups, however.[73]

Setting prices on new consumer goods within the constraint of no increase in the price level is a difficult task for Soviet pricing agencies. They wish to avoid price increases for individual items proportionally greater than increases in quality, while at the same time making the output of new items profitable enough to interest enterprises in producing them. If the price on a new item is simply fixed in line with the pattern of retail prices for the group, while production costs are higher than on existing items, the new product will in fact not be produced in significant quantity and the price so established will become a "dead price" (*mertvaia tsena*).[74]

[71] Retail sales data from Nar. khoz. 74, p. 632.
[72] Iakovets 74, pp. 71–72.
[73] Kuznetsov 74, p. 25.
[74] Iakovets 74, p. 195.

Some broad guidelines for handling these problems are provided in a "General Methodology (Temporary) for Determining Retail Prices on New Consumer Goods" issued late in 1973. Its approach is similar to that of the Methodology for pricing new producer goods discussed above in Part I. Parametric methods are recommended for "supplementary products," and temporary prices for "fundamentally new products." Temporary wholesale and retail prices may be applied to new fabrics, clothing, footwear, and furniture. The temporary wholesale prices are supposed to be high enough to cover all start-up costs of producers, because (unlike in the case of producer goods) there is no New Products Fund to pay part of the cost of introducing new consumer goods.[75] A device to provide adequate profitability for producers of new consumer durables is a temporary reduction in the turnover tax.[76]

However, as in the case of producer goods, in applying such procedures price-setting agencies must constantly combat producers' efforts to secure excessively high prices on "new" goods.

The special difficulty of carrying out the policy of stable retail prices is connected with establishing prices on new consumer goods and services furnished to the population. Here it is important not to permit hidden increases of prices. This is the main, central question. Large numbers of new goods are turned out. Therefore it is necessary to establish a huge (*ogromnoe*) quantity of new retail prices. It is enough to say that in 1972 alone the State Price Committee of the USSR Council of Ministers established more than 300,000 new prices on consumer goods.[77]

These problems explain some of the skepticism. on the part of Soviet as well as Western specialists, concerning the picture of retail price stability presented by official indexes like those in Table 12.

First, to the extent to which persistent shortages are common for various products (especially meat, some consumer durables, many household articles), the prices used to construct the official indexes are not market-clearing prices at which transactions freely occur at the buyer's option. Thus, with no change in money incomes, real purchasing power could increase if more goods became available at the same, or indeed even higher, prices.

Second, official descriptions of the construction of these indexes explain that they are calculated, for a sample which has not been disclosed. from prices obtained from official retail price lists. However, none of the following is considered a change in price which should affect the index: (1) new prices on goods not previously produced; (2) new prices for goods for which technical specifications have been changed; (3) temporary prices; (4) new prices on goods removed from production; and (5) reduction of prices on goods not in demand.[78]

Thus, while the official price indexes show no change, or even a decline, average prices actually paid may instead be rising. This would be acceptable to Soviet price specialists insofar as it occurred because new products were sold at higher prices exactly reflecting their superior quality compared to older items. But price-setters find it extremely difficult to enforce this standard, and prices commonly increase more than in proportion to quality improvement. Average prices also rise

[75] Iakovets 74, pp. 194–200.
[76] Iakovets 74, p. 171.
[77] Plotnikov 75, p. 197.
[78] Bornstein 72, pp. 371–72, provides more details on the construction of these indexes.

because cheaper varieties are dropped from the output mix, even though they are still in demand.[79]

B. REPRESSED INFLATION?

The existence of persistent widespread shortages for various consumer goods and services in the presence of "stable" administratively set retail prices has led many observers to conclude that "repressed" inflation prevails in the USSR. In "open" inflation, such as that experienced recently in the United States, Western Europe, and Japan, prices rise widely across the economy, though not all at the same time or the same rate—and these increases are reflected (often imperfectly) in official price indexes. In "repressed" inflation, the pressure of excess demand is present, but price control prevents this pressure from pushing up official prices spontaneously. (The pricing agencies may themselves raise official prices from time to time in an effort to reduce market disequilibria—though usually with a lag and not sufficiently to eliminate the excess demand fully.)

Repressed inflation might be general in scope, applying to many or most commodities, or limited to some categories or varieties of goods and services while others are readily available or even in surplus at prevailing officially fixed prices.

The kind of evidence usually cited for more general repressed inflationary pressure includes (1) a faster rate of growth of household money incomes than retail sales, leading to (2) the involuntary accumulation by households of liquid assets such as savings deposits and currency holdings. Soviet economists concede that the growth of money incomes has outstripped increases in the supply of goods and services in the last decade. As one source puts it: "The gap between money incomes of the population and market supplies grew." [80] Another source notes:

> One should not forget that the policy of stable retail prices must be carried out in complex conditions of excess demand over supply for many types of goods and paid services, rapid growth of deferred demand, enormous monetary accumulation by the population.[81]

Statistics on currency in circulation in the USSR have not been published for 40 years. However, data are regularly released on savings deposits. They show an average annual rate of increase from 1970 to 1974 of 14.0 percent for total deposits and 6.3 percent for the average size of deposits.[82] But some of this rise represents voluntary saving to buy certain durable goods like automobiles and furniture, and to accumulate down payments on cooperative housing. Recent calculations by Joyce Pickersgill indicate that the marginal propensity to save (defined for the USSR as the relationship of increases in real per capita savings deposits to increases in real per capita disposable income) over the period 1955–71 in the USSR was in the same range as the marginal propensity to save in many other countries with similar per capita income levels.[83]

These findings lend support to the view that repressed inflation in the USSR at present is of the more specific variety, affecting many

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[79] Kirichenko 73.
[80] Iakovets 74, pp. 208, 212–14.
[81] Plotnikov 75, p. 196.
[82] Nar. khoz. 74, p. 609.
[83] Pickersgill 74.

particular goods and services, while surpluses of others exist. The evidence for this type of repressed inflation may be found in (1) widespread shortages, (2) some formal administrative rationing (e.g., housing); (3) some distribution by queues; (4) sales personnel in state retail outlets demanding, and customers paying, prices above the official level; (5) the existence of a black market in which goods purchased at state retail prices are illegally resold at higher prices by "speculators";[84] and (6) rising prices in the collective farm market (CFM), onto which unsatisfied demand for food products spills over from state stores. No statistics are available on the first five of these, although they are amply documented by frequent press reports.

The Central Statistical Administration does not publish indexes of CFM prices or direct comparisons of CFM and state retail prices. However, a leading Soviet price specialist has reported that in 1972 CFM prices were about two-thirds above state retail prices for a group of goods sold in both trade channels.[85]

In evaluating such data one should keep in mind several points. First, the data pertain only to certain fresh food products sold on the CFM, like meat, milk and cheese, potatoes, vegetables and fruits. Second, part of the excess of CFM over state retail prices reflects superior quality and freshness in the CFM. Third, official methods of calculating the levels of state retail and CFM prices are very different. Fourth, there are many deficiencies in CFM price statistics.[86] Finally, these figures are national averages for the food products involved—and the difference (and change in the difference) between CFM and state retail prices varies both by product and by locality. Therefore, such comparisons can provide only a rough indication of excess demand pressures for a particular group of food products.

As explained above, some shortages (e.g., for housing and for various food products) occur because official prices are intentionally set below market-clearing levels for policy reasons. Other shortages (particularly of clothing and footwear products and some consumer durables) result because the relative producer price structure makes the output of some items less profitable than other varieties of the same product, some of which may even be in surplus.

Another reason for shortages is inaccurate estimates of consumer demand at particular retail prices. Although an account and evaluation of Soviet efforts at the study of consumer demand are outside the scope of this paper, some of the main problems may be mentioned briefly.

1. Official campaigns to intensify the study of consumer demand have led to a proliferation of organizations involved in this activity. They now include ministries of trade, light industry, food industry and those in heavy industry producing consumer durables; their respective research institutes, and these institutes' regional affiliates across the country; local government bodies; producing enterprises; and individual stores.[87] On the one hand, jurisdictions and responsibilities overlap. On the other, many of these organizations lack qualified personnel and sufficient data to conduct demand studies.

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[84] See Simes 75 for example.
[85] Iakovets 74, p. 72.
[86] Bornstein 72, pp. 382–83; Levin 74, p. 40.
[87] Solov'ev 75.

2. Even the stronger research institutes suffer from inadequate methodologies and a lack of experience in forecasting. Most of their research has been devoted to cross-section analysis of differences in consumption patterns of families in different income groups—on the assumption that as families in a lower-income group move up to a higher-income level their consumption patterns will change to resemble the current behavior of families now at that higher level. This extrapolation approach has been criticized for paying inadequate attention to changes in the availability of different goods (e.g., consumer durables) and changes in the share of collective farmer incomes received in money, rather than in kind, since the introduction of guaranteed pay in 1966—both of which lead to new spending patterns.[88]

3. Estimates of the elasticity of demand with respect to price are even less reliable, because the official policy of retail price stability provides few opportunities to study the response of sales to price changes. Most such changes in official retail prices have been reductions to discount surplus goods, but the cuts have usually been too small to accomplish their aim, as shown by experience with textiles, clothing, sports equipment, and other goods.[89]

4. Much of the effort in demand study has been devoted to the elaboration of "rational norms of consumption." These refer to what experts conclude it would be physiologically and socially desirable for people to consume—not what people are consuming, or what observed shortages and market surveys disclose people might wish to consume but cannot find.[90]

5. Many important types of statistics needed to forecast demand are deficient or nonexistent. (a) The samples for family budget studies are unrepresentative in several respects. (b) Retail sales statistics use a different commodity classification than family budget studies, precluding direct comparison of data from the two sources. The commodity breakdown in sales statistics is excessively aggregated—with one entry, for example, for sewn goods, a category which includes thousands of items. In contrast, demand must be estimated separately for overcoats, raincoats, suits, dresses, jackets, etc.—for men, women, and children. The retail sales statistics, furthermore, include sales to state institutions as well as households. (c) Existing statistics on the population's money income do not provide adequate data on the distribution by income group. (d) Rural family budget studies cover collective farmer families but exclude the other half of the rural population—state farm workers and the "rural intelligentsia"—whose expenditure patterns differ because, unlike collective farmers, they do not receive compensation in kind.[91]

These problems in the study of demand—along with other factors mentioned earlier—help to explain the concurrent existence of shortages for some goods and surpluses for others which characterizes the pattern of repressed inflation in the USSR.

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[88] On the methodology of demand study, see, for example, Cherniavskii 71, Krutikov 72, and Levin 73a.
[89] Levin 73b, p. 69.
[90] On rational norms, see Weitzman 74 and Maier 75.
[91] Levin 74.

C. CONSUMER DURABLES

The pricing of consumer durables has drawn increasing attention from Soviet economists in recent years. They believe that the income elasticity of demand for these goods is high and that it is potentially easier to satisfy this demand than the demand for food, clothing, and other products whose raw materials come from agriculture. Because shortages of consumer durables are so widespread, and market-clearing retail prices are precluded on political grounds, work on the pricing of these goods has concentrated on adjusting producer prices to stimulate output, as much as on the study of the retail prices themselves.

Work on the latter aspect has involved efforts to differentiate prices according to performance characteristics of goods, and to formulate criteria for price cuts on surplus goods, which are usually made too late and in too small an amount.[92] Retail prices were reduced in 1971 on some models of washing machines, television sets, motorcycles, and electric shavers, and again on television sets in 1972. But such price cuts are usually inadequate to offset the consumers' preference for superior new models. For example, even after large price cuts it is difficult to sell hand-wringer washing machines to households who prefer to pay the difference—and wait—for semiautomatic or automatic machines.[93]

Setting producer wholesale prices for consumer durables correctly is an especially difficult problem in the opinion of Soviet price specialists.[94] Unlike food and clothing products, consumer durables are not produced in a separate branch under the control of a single ministry, but are instead made by enterprises under various jurisdictions, ranging from heavy industry ministries (e.g., in the case of automobiles, washing machines, and refrigerators) to local industry bodies (for instance, in the case of pots and pans, dishes and hand tools).

Heavy industry enterprises do not find the production of consumer durables attractive. It is a sideline activity in which requirements for appearance, fashionability, and quality are more demanding, and changes in product features more frequent, than in their "basic" heavy industry output. Because the range of their consumer durables output is small—usually only one or two models—heavy industry enterprises do not have the same opportunity as light industry firms to alter the product mix from less to more profitable items. Hence, their consumer durables production must be more profitable than their "basic" output to induce them to expand production to achieve potential economies of scale and cost reductions, which can in turn lead to lower wholesale and retail prices.

In recognition of past cost reductions, on January 1, 1973, enterprise wholesale prices on many consumer durables were revised with the following average percentage reductions: radios, 30; television sets, 20; washing machines, 20; refrigerators, 16.5; sewing machines, 12; and cameras, 8.[95] In addition, relative prices within product groups were revised to reflect more closely differences in performance, reliability, and service life.[96]

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[92] Salimzhanov 74, ch. IV.
[93] Iakovets 74, p. 215.
[94] Salimzhanov 74, pp. 18–26.
[95] Iakovets 74, p. 216.
[96] Salimzhanov 74, pp. 70–81.

These changes in absolute and relative wholesale prices on consumer durables, without corresponding modifications in retail prices, were possible because of changes during 1967–73 in the method of collecting turnover taxes on most consumer durables, including radios, television sets, sewing machines, refrigerators, washing machines, vacuum cleaners, dishes, and various other products. Formerly, the tax was levied as a uniform percentage of the retail price for an entire product group, and producer prices were derived as residuals, with the same relative price structure as retail prices. To increase the ability to adjust wholesale and retail prices separately, the turnover tax is now set as a particular ruble amount for each product.[97] Since many items are produced by only one or two enterprises, this approach also permits adjusting the turnover tax to secure a profitability rate for "sideline" consumer goods output which makes it more attractive to heavy industry enterprises.

D. "EVERYDAY" SERVICES

The expansion of educational and health services is often cited as one of the impressive achievements of Soviet economic growth. In contrast, there has been a striking lag in the development of "communal" services (*kommunal'nye uslugi*)—such as housing and urban transport—and "everyday" services (*bytovye uslugi*)—such as laundries, dry cleaning, and repair of shoes, clothing, and consumer durables.[98] However, in the last decade the supply of many personal services has increased rapidly, as the data for "everyday" services in Table 14 show. As a result, more attention has been paid to various problems in the prices of these services, including their level, structure, and geographical differentiation.

TABLE 14.—INDEXES OF REAL VOLUME OF SALES OF "EVERYDAY" SERVICES, 1970–74

[1965=100]

	1970	1971	1972	1973	1974
Everyday services, total	213	237	261	289	317
Shoe repair and custom shoemaking	195	206	216	232	246
Clothing repair and custom tailoring[1]	176	181	193	205	216
Repair of radios, television sets, household appliances, motor vehicles; repair and custom manufacture of metal articles	258	312	358	418	484
Repair and manufacture of furniture	347	451	550	645	738
Drycleaning and dyeing	224	257	279	306	338
Repair and custom manufacture of knitted articles[1]	424	484	545	621	723
Laundries	210	238	259	287	314
Baths and showers	109	111	108	110	110
Hairdressers and barbers	155	164	174	184	194
Rental agencies	257	299	376	459	541
Photography	179	198	217	239	271
Construction and repair of apartments	780	959	1,109	1,287	1,419

[1] Excluding materials.

Source: Calculated from data on sales in constant prices in Nar. khoz. 74, p. 671.

1. The low rates of profitability in relation to cost on most personal services in 1963–69 are shown in Table 15. For many services, profit-

[97] Miroshchenko 74, pp. 98–99.

[98] Ofer 73 is a standard source. Some more recent data are in Gorbunov 74. The development of services in the USSR, Poland, and Hungary is compared in Zlomanov 76.

ability dropped sharply in 1965, when wage increases boosted labor costs (the main element in total cost), without an offsetting increase in retail prices. In some cases, growth of labor productivity and reduction in unit cost in subsequent years could not restore profitability to the 1964 level. Thus in 1970, according to the calculations presented in Table 16, 62 percent of the value of sales of services was at profitability rates below 10 percent. As Table 17 shows, the entire category of "everyday" services is (along with urban transportation, hotels, movies, and food service) in the "low" profitability group, below most "communal" and transportation services. Only housing (rent), water transportation, and health resorts—often operated at a loss—are less profitable than "everyday" services.

TABLE 15.—AVERAGE RATES OF PROFITABILITY, BY TYPE OF SERVICE, ON "EVERYDAY" SERVICES SOLD TO HOUSEHOLDS BY ENTERPRISES OF UNION-REPUBLIC MINISTRIES OF "EVERYDAY" SERVICES,[1] 1963–69

	Rate of profitability in relation to cost (percent)[2]						
	1963	1964	1965	1966	1967	1968	1969
Total, all types of services	5.1	6.9	4.7	5.2	6.1	5.5	6.6
Shoe repair	.9	3.2	2.7	4.1	5.6	4.8	5.3
Custom shoemaking	8.5	8.9	10.1	11.4	15.6	18.5	21.1
Repair of sewn, fur and leather articles, hats, and textile haberdashery	−3.5	−2.8	−1.3	.8	.6	.9	2.0
Custom manufacture of sewn, fur and leather articles, hats, and textile haberdashery	−4.3	−2.8	−2.1	−1.7	−.8	−.9	.2
Repair of household appliances; repair and manufacture of metal articles	23.5	23.0	19.5	17.9	15.3	12.9	14.3
Dry cleaning and dyeing	10.8	10.6	10.1	12.0	12.4	5.6	7.0
Laundries	28.6	6.1	10.9	9.0	7.9	7.2	10.2
Photography and film processing	41.6	40.3	37.1	36.4	37.3	35.2	36.1
Baths and showers	10.3	.4	−6.2	−12.0	−11.4	−20.3	−20.8
Hairdressers and barbers	18.4	17.9	10.3	8.7	9.6	8.2	8.4
Rental agencies	4.8	5.4	6.9	8.7	13.0	12.7	18.1

[1] These enterprises provide about 80 percent of the total volume of these services. The data exclude industrial production in these enterprises as well as services sold to organizations, rather than to households.
[2] Minus sign denotes rate of loss.

Source: Kosiachenko 71, pp. 86–87.

TABLE 16.—"EVERYDAY" SERVICES: SHARE OF DIFFERENT PROFITABILITY GROUPS IN TOTAL SALES AND PROFITS, 1970

Profitability group	Percent of total sales	Percent of total profits
Concessionary [1]	0.2	−0.7
Low [2]	62.3	27.0
Average [3]	24.1	39.1
High [4]	13.4	34.6
Total	100.0	100.0

[1] Zero profitability or loss.
[2] Minus sign denotes losses.
[3] Profitability in relation to cost above zero but below 10 percent.
[4] Profitability in relation to cost from 10 to 20 percent.
[5] Profitability in relation to cost above 20 percent.

Source: Azar 74, p. 53.

TABLE 17.—COMPARATIVE PROFITABILITY OF DIFFERENT TYPES OF SERVICES

Type of service	Rate of profitability in relation to cost			
	High [1]	Average [2]	Low [3]	Concessionary [4]
Housing:				
Rent				×
Heat		×		
Water	×			
Sewerage	×			
Electricity		×		
Hot water		×		
Other		×		
Transportation [5] and communications:				
Rail transportation	×			
Motor transportation	×			
Air transportation	×			
Sea transportation				×
Streetcar, trolley bus, subway transportation			×	
Communications	×			
Leisure:				
Health resorts				×
Hotels			×	
Movies			×	
Radio and television	×			
Everyday services			×	
Trade and food service establishments:				
Trade	×			
Food service establishments			×	

[1] Above 20 percent.
[2] From 10 to 20 percent.
[3] Above zero but below 10 percent.
[4] Zero profitability or loss.
[5] Passenger transportation only.

Source: Azar 74, pp. 52–53.

Because turnover taxes are not levied on these personal services, there is no opportunity to use turnover tax reductions to raise producer prices without changing consumer prices.[99] And proposals to eliminate losses and boost profitability by raising retail prices—even with offsetting reductions in other prices and increases in money wages—have been rejected.[100] Thus, as the supply of services expands and costs rise in response to wage increases, while the level of services prices is maintained, losses and budget subsidies to cover them will grow.[101]

2. The structure of services prices has been criticized on the ground that relative profitability is not correctly related to the "social importance" of the service. For example, as Table 18 shows, a "luxury" service like custom tailoring is often in the "concessionary" category—provided at no profit or at a loss—along with "basic necessities" like shoe repair, dry cleaning, and public baths.[102]

3. Regional differences in prices and profitability of personal services are very large. One reason is differences from one area to another in labor and materials costs and the level of mechanization. A more important reason [103] is that personal services prices are established locally—by autonomous republic, oblast, and krai authorities; by city authorities in Moscow, Leningrad and Kiev; and by union republic bodies only if the republic is not divided into oblasts. Thus the

[99] Fridliand 75, p. 56.
[100] Iakovets 74, pp. 108–09.
[101] Kosiachenko 74, p. 158.
[102] Azar 74, p. 51.
[103] Fridliand 75, pp. 61–63.

TABLE 18.—DISTRIBUTION OF ADMINISTRATIVE UNITS[1] OF THE RSFSR BY PROFITABILITY GROUP FOR SELECTED TYPES OF "EVERYDAY" SERVICES, 1970

Profitability group	Shoe repair	Custom tailoring of sewn articles	Custom tailoring and crocheting of knitted articles	Drycleaning and dyeing	Photography and film processing	Hairdressers and barbers
Concessionary[2]	25	30	9	46	2	19
Low[3]	35	36	5	18	5	21
Average[4]	10	5	12	6	12	31
High[5]	3	2	54	4	54	2
Total number of administrative units	73	73	73	[6] 74	73	73

[1] Administrative units include oblasts, krais, etc.
[2] Zero profitability or loss.
[3] Profitability in relation to cost above zero but below 10 percent.
[4] Profitability in relation to cost from 10 to 20 percent.
[5] Profitability in relation to cost above 20 percent.
[6] Figures for this column total to 74 in source.

Source: Azar 74, p. 54.

RSFSR has 73 administrative units setting prices on "everyday" services; the Ukraine, 27; Kazakhstan, 17; etc. Altogether, there are more than 150 governmental units faced with the task of setting administratively a very large number of prices on "everyday" services—estimated at over 10,000 in Leningrad, for instance.[104]

Methods of calculating costs, notions of appropriate profitability rates, and even the format of price lists (classification, degree of disaggregation, extent to which the service is described) differ considerably from one region to another. As a result, prices and profitability vary widely. For example, in 1971, for photography establishments the profitability rate ranged from 9.8 percent in Estonia to 50.6 percent in Moldavia, while for shoe repair shops the spread was from losses of 2 percent in Lithuania to profitability of 17.1 percent in the Turkmen Republic. The variation by oblasts was even larger.[105] (Relevant data for the RSFSR are in Table 18.) Big differences in prices and profitability for the same service sometimes occur even within a single raion, depending upon the administrative agency to which a service establishment is subordinate.[106]

The first attempt to bring order into this chaotic situation was undertaken by the Ukrainian State Planning Commission in 1961. A uniform methodology was adopted, the number of entries in the price lists was consolidated from 800,000 to 26,000, and 95.6 percent of all prices were made uniform across the republic (the remainder varying by oblast)—resulting in a 2.4 percent reduction in the overall level of services prices.[107]

In 1967 the SPC and its republic affiliates, together with ministries of everyday services, started work on uniform formats for price lists, with identical classifications and technical descriptions, beginning with shoe and clothing repairs and dry cleaning.[108]

In 1971, the SPC issued a set of Methodological Instructions to guide the revision of services prices, specifying that changes be made

[104] Fridliand 75, pp. 56–57.
[105] Iakovets 74, pp. 107–08.
[106] Kosiachenko 70, p. 150.
[107] Kolesnikov 69.
[108] Rokk 68, pp. 177–78.

within the constraint that there should ordinarily be no increase in the level of prices for each type of service prevailing in each oblast. In special cases where prices for a particular category of services are raised to eliminate losses, prices on other services should be reduced, to leave the overall level of prices on "everyday" services in the area unchanged.[109]

However, progress in applying this methodology has been slow, because of continuing controversy over three issues. First, in view of the "social significance" of certain "basic necessity" services, to what extent should price cover or exceed cost—or should budget subsidies or low profits continue in the new price lists? Second, since production costs and demand factors do differ from one place to another, how far should rate revision go in the direction of a "single, uniform" schedule? Third, what is the elasticity of demand for price changes on services? As a leading specialist notes: ". . . up to now questions of changes of demand depending on the level of rates are not studied anywhere, but they require attention." [110]

Thus, work on services prices is one of the difficult tasks facing the SPC in the Tenth Five-Year Plan period.[111]

IV. Conclusion

Recent trends in the major categories of Soviet prices may now be summarized briefly, with reference to the selected indexes presented in Table 19.

TABLE 19.—SELECTED INDEXES OF SOVIET PRICES, 1970–74

[1965=100]

Index	1970	1971	1972	1973	1974
Enterprise wholesale prices (excluding turnover tax):					
All industrial production	110	108	108	107	107
Heavy industry	116	112	110	107	107
Coal	180	180	180	180	180
Machine building and metal working	95	87	87	82	80
Light and food industries	103	103	104	109	109
Light industry	106	106	106	114	114
Food industry	102	102	105	105	105
Agricultural procurement prices paid to collective farms:					
All products	(1)	(1)	(1)	(1)	(1)
All crops	(1)	(1)	(1)	(1)	(1)
Grain	(1)	(1)	112	108	(1)
Cotton	(1)	(1)	117	118	(1)
All livestock products	(1)	(1)	(1)	(1)	(1)
Milk	(1)	(1)	126	132	(1)
Cattle	(1)	(1)	141	141	(1)
State retail prices:[2]					
All products	99.7	99.6	99.4	99.4	99.3
Food products	100.3	100.6	100.6	100.8	101
Nonfood products	99	98	98	97	97

[1] Not available.
[2] Different rounding of figures as presented in original source.

Sources: Tables 1, 5, and 12.

Official indexes of industrial wholesale prices show stability for fuels and raw materials, reductions in some heavy industry branches such as machine building and metal working, and increases in the

[109] Planirovanie 74, p. 194.
[110] Kosiachenko 74, p. 156.
[111] Glushkov 76.

light and food industries—as a result of revisions of selected groups of prices, particularly in 1973.

Soviet price specialists point out that it will be difficult in the future to maintain the present level of industrial wholesale prices because various factors are pushing up costs of fuels and raw materials. In response both to growing domestic needs and to hard-currency export opportunities, these industries are extracting their output at greater depths in the European part of the USSR and developing new deposits in Siberia which require heavy infrastructure investments and greater costs for transportation of supplies to them and of output from them to industrial users. Higher wages and improvements in living conditions are recognized as necessary to attract and retain workers in the eastern and northern regions. Also, the recent revaluation of fixed assets and introduction of new amortization norms have raised depreciation charges. Finally, geological prospecting and some environmental protection expenses are now supposed to be included in cost and recovered in price.[112]

New prices for coal, natural gas, petroleum, timber products, and electricity are to be issued later in 1976 and to become effective on January 1, 1977.[113] It may be possible in some cases, such as oil, to raise enterprise wholesale prices for producers without increasing industry wholesale prices to users, by reducing turnover taxes separating the two types of prices. However, this possibility does not exist for many fuels and raw materials. Therefore, stability of the industrial wholesale price level depends crucially on the extent of cost, and price, reductions which can be achieved in those branches of industry, such as machine building, benefiting from economies of scale and rapid technological progress.

In the case of agricultural procurement prices, the last major changes occurred in 1970. However, the average procurement prices shown in Table 19 vary from year to year because of differences each year in the proportion of a product's sales accounted for by (1) different types (e.g., wheat vs. corn), (2) different quality grades, (3) above-plan sales at premium prices, and (4) different regional price zones. Although the 1970 price changes improved somewhat the profitability of livestock production, it is still inadequate, contributing—along with other factors, such as the lack of animal feed after bad grain harvests—to current meat shortages.

The remarkable stability of the official retail price indexes is explained partly by an extensive program of subsidies on food products, partly by statistical practices which ignore some kinds of price changes, and partly by pricing many commodities below market-clearing levels. There is considerable evidence of repressed inflation in the USSR, including widespread shortages, some formal and some informal rationing, black markets for certain goods, and rising prices for food products on the collective farm market.

Within a traditional general policy of striving for "stability" (*stabilnost'*, *ustoichivost'*) of the level of prices, Soviet pricing authorities are increasingly interested in achieving "flexibility" (*gibkost'*) and "mobility" (*podvizhnost'*) in the relative price struc-

[112] Iakovets 74, pp. 89–91.
[113] Kholodkov 75.

ture.[114] More frequent adjustment of relative prices is seen as a logical counterpart of the greater emphasis since 1965 on sales and profitability as enterprise performance indicators, and on managerial incentives linked to these indicators. Prices are perceived increasingly not only as measuring "socially necessary labor costs" but also as influencing choices among outputs and inputs—subject to important constraints by plans and administrative allocations. Prices which fail to cover costs or which provide "below-normal" profits are viewed as improperly discouraging production and encouraging consumption of the goods involved. In turn, if prices are too high, they lead to excessive profitability which decreases pressure for cost reduction and retards the introduction of new technologically superior products.

However, a more "active" price policy does not imply a diminution of central control over price determination. Rather, a "unified state price policy" (*edinaia gosudarstvennaia politika tsen*) is to continue, with the following features: (1) Central agencies like the SPC determine the general level of prices for major categories of output and branches of the economy. (2) These agencies also establish the actual prices of many basic types of producer and consumer goods. (3) Finally, they provide "methodological guidance" (*metodologicheskoe rukovodstvo*)—in the form of compulsory "recomendations, instructions, directive letters, elaborations, and interpretations"—to all other organizations and levels involved in price formation.[115]

Currently, this "unified" policy stresses adjustments in the relative prices of producer goods to press for cost reduction, promote new technologically superior products, and encourage quality improvements.[116] In the case of consumer goods, attention is focused on altering relative prices of clothing, footwear, and consumer durables as the assortment changes, and on revising long-neglected services prices. As explained above in Parts I and III, a wide variety of methods is used to fix new prices—including calculations of upper and lower "limits," stepped prices, and "parametric" techniques—and each has its difficulties.

Soviet price specialists agree that prices should be reviewed, and altered as appropriate, more frequently than in the past. For both producer goods [117] and consumer goods,[118] they believe this should be done at least every five years, and for some product groups more often. However, frequent revision is opposed by some organizations. First, ministries, especially in machine building, object that frequent price revisions to "trim" (*podrezat'*) profitability on older products reduce the interest of enterprises in expanding output and cutting costs on these products, since they will not reap the benefits, in greater profits, for a long enough time.[119] Second (as noted above in Part I), planning and financial agencies dislike changes in prices during plan periods. They complain that it is more difficult to monitor enterprise performance regarding plan targets for costs, sales revenue, profits, and tax payments; and that special payments to and from the budget are needed to offset price changes.

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[114] Plotnikov 75, pp. 189–90.
[115] Plotnikov 75, p. 188.
[116] Mansurova 76.
[117] Orlov 75, p. 49.
[118] Shkliarnik 74, p. 101.
[119] Pekarevich 74 and Zhigalin 75, p. 25.

To deal with the last problem, starting in 1973 all new prices are supposed to become effective on January 1 but should be announced by the preceding April 1, so that annual and five-year plans can be constructed in the prices effective at the beginning of the plan period.[120] However, in practice new plans and new prices are often worked out at the same time by different agencies, making it difficult to mesh changes in the two mechanisms of guiding the economy.[121]

These efforts at greater price flexibility rest on continued central administrative determination of prices along established lines and reflect the rejection of two types of reform proposals.

First, suggestions to give enterprises and associations authority to set prices, even within central guidelines, have met with little success. It is feared that such administrative decentralization of pricing cannot be effectively controlled: "In practice this would lead to the spontaneous establishment of prices, with negative consequences for the economy of the country (spontaneous redistribution of the national income, increase of prices, etc.)." [122]

Second, proposals of the "optimal planning" school, based in the Central Mathematical Economics Institute of the USSR Academy of Sciences, for central calculation of plan targets and corresponding opportunity cost prices balancing supply and demand, also have had little effect on pricing practice.[123]

Unacceptable also are suggestions that the planning of wholesale and retail prices should widely take into account the relationship of demand and supply on production, its scarcity for the current and perspective balancing of the national economy. These suggestions are based on an exaggeration of the role of the law of value in a socialist economy.[124]

Thus, though growing slowly, the role of the price mechanism in the Soviet economy remains subordinate to planning and administrative allocation.

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[120] Plotnikov 75, pp. 178–79.
[121] Kotov 72.
[122] Plotnikov 75, p. 191.
[123] A concise recent survey of "optimal planning" proposals is in Swann 75, while Petrakov 71 explains in more detail the implications for pricing.
[124] Plotnikov 75, p. 191.

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DEVELOPMENTS IN SOVIET-EASTERN EUROPEAN TERMS OF TRADE, 1971–75*

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I. INTRODUCTION

In early 1975, The Council of Mutual Economic Assistance (CEMA) announced that prices of a broad array of goods in intra-CEMA trade would be raised.[1]

The increases came as a surprise. Revisions in CEMA prices had not been scheduled to take place until 1976, after the expiration of the five-year plan periods for CEMA countries that began in 1971. During 1971–75 prices in intra-CEMA trade were supposed to be based on averages of so-called world prices in the 1965–69 period.[2] The increases, furthermore, were not only premature but substantial and extensive as well. Most important, they altered Soviet terms of trade

*I would like to express my appreciation to Nicholas R. Lang for his very valuable assistance in the preparation of this article. His contribution to the data gathering process was most helpful. In addition, I have benefited from analytical work he has done on economic developments in Eastern Europe in recent years. I am also most grateful to John R. Patton, whose efficient preparation of statistical data for the computer was of great assistance. I would also like to thank Irene B. Jaffe, Angelo R. Mascaro, David N. Miller, and James A. Treichel for taking time to read the article in draft and for the very useful suggestions they made. Finally, I would like to thank Priscilla Baker for so rapidly and efficiently typing the manuscript.

[1] CEMA is composed of Bulgaria, Cuba, Czechoslovakia, The German Democratic Republic (GDR), Hungary, Mongolia, Poland, Romania, and the Soviet Union. CEMA was created in 1949. Its basic objective is to promote economic cooperation and integration among the member countries.

[2] As will be discussed below, foreign trade prices in CEMA appear to have been far from rigidly fixed in 1971–74; but price changes evidently had little effect on terms of trade within CEMA.

vis-a-vis CEMA's six Eastern European members much to the USSR's advantage.

Changing the terms of trade in this direction was indeed the prime reason for the price rises. Since 1971, and particularly in 1974, prices in trade outside CEMA had moved in a manner that made continuation of existing intra-CEMA price relationships disadvantageous for the Soviet Union. The actual terms of trade of the USSR vis-a-vis its CEMA partners had changed little during 1971–74. However, had changes in world prices in fact been applied to Soviet trade with other CEMA countries, the terms of trade would have moved substantially in the USSR's favor. Consequently, though violating the spirit if not the letter of CEMA pricing arrangements, the USSR instigated a major overhaul of CEMA foreign trade prices a year ahead of schedule.

The marked disparity in early 1975 between actual CEMA price relationships and what those relationships would have been if CEMA prices had moved in conformity with world prices represented a significant reduction in the USSR's gains from trade with the rest of CEMA. The amount of the loss equalled roughly one per cent of Soviet GNP.

The most striking example of the high cost to the Soviet Union of not adjusting CEMA price relationships to changes in world prices was provided by oil, a major Soviet export to Eastern Europe (with the exception of Romania). The price of oil on world markets at the beginning of 1975 was four times higher than it had been in the fall of 1973. Not surprisingly, therefore, oil prices were raised in 1975 more than prices of any other commodity in CEMA trade. The increase for crude oil, for example, was reportedly 130 percent.[3]

Prices of many other goods, including Soviet imports as well as exports, were raised. But largely because of the steep rise in the price of oil—sales of which accounted for 12 percent of Soviet exports to the six Eastern European CEMA members in 1974—the terms of trade in 1975 moved to the advantage of the USSR by about 10 percent.

It is possible that the price boosts of early 1975 were intended not only to increase Soviet gains in trade with Eastern Europe but also to discourage Eastern European demand and thus increase the volume of Soviet goods available for sale to the West. However, these price increases could be expected to have only limited effect in freeing Soviet goods for such sales. Eastern European demand for the raw materials that account for a large proportion of Soviet exports to the West is probably quite inelastic over a broad range of prices. The 1975 price increases, moreover, failed to raise CEMA foreign trade prices for several major Soviet exports to world price levels, thus giving Eastern Europe no incentive to turn to alternative suppliers. The CEMA price of crude oil, for example, was raised (as measured by the official dollar-ruble exchange rate)[4] from about $3 to about $7 a barrel, leaving it about $4 below the world price.[5] Finally, Eastern Europe's need to

[3] Recently released Soviet foreign trade statistics indicate that the actual increase from 1974 to 1975 in the unit value of all petroleum products sold to Eastern Europe by the USSR was 87 percent. From 1971 to 1974, there had been a 17 percent increase in this unit value.

[4] The rate averaged $1.41 per ruble in the first quarter of 1975. It is currently $1.32.

[5] And despite the price rise, the volume of Eastern European purchases of Soviet crude oil and petroleum products rose by 8 percent in 1975.

limit its hard currency expenditures might make the USSR the preferred supplier of many commodities even if CEMA prices reached or exceeded world prices.

Nevertheless, the desire to damp Eastern European demand, if only marginally, cannot be ruled out as a contributor to Soviet motivation for instituting the 1975 price increases. In recent years the Soviet Union has placed great importance on rapid expansion of imports from the West of advanced technology and of goods embodying that technology. The Soviets apparently view such imports as valuable stimulants of economic growth and instruments for modernizing the Soviet economy. To earn the hard currency needed to finance rapid growth in imports from the West, the USSR must increase its exports to the West at a fast pace. Thus the opportunity cost to the Soviets of selling goods in Eastern Europe that could be sold for hard currency at much higher prices in Western markets is very high.

Oil again exemplifies the point. In the early 1970's, the USSR's hard currency exports and imports both expanded very rapidly. Oil became the USSR's major hard currency export, earning $1.4 billion in 1973 and $2.6 billion in 1974, equal, respectively, to a quarter and a third of total hard currency export receipts in these two years. Clearly, diverting some of its oil exports from Eastern Europe—the recipient of about half of such exports in volume terms—to Western buyers would be to the USSR's economic advantage.

However, the Soviet Union cannot single-mindedly pursue its economic advantage to the detriment of its political interests in Eastern Europe. This is probably the main explanation why the Soviets did not raise prices to world levels in 1975. Indeed, the estimated 10 per cent improvement (cited above) that the 1975 CEMA price increases apparently produced in the USSR's terms of trade vis-a-vis Eastern Europe was only about a third of what it would have been had CEMA price movements in 1971–74 paralleled world price movements.

The Soviets may have refrained from a full restoration of terms of trade relationships as they had been at the beginning of the five-year plan periods in 1971 partly because there were other, more indirect ways of closing the gap between actual and potential terms of trade movements. For example, Moscow has prevailed upon Eastern countries to make substantial contributions to joint CEMA investment projects on Soviet soil, such as the Orenburg natural gas pipeline from the southern Urals to the Czechoslovak border. Awareness, too, that the terms of trade, as measured by world price movements, could reverse direction—as in fact they did in 1975—may also have moderated Soviet actions. But the chief restraining influence was probably Soviet concern that too zealously moving the terms of trade in its favor would damage the economies of Eastern Europe with potentially destabilizing political effects there. By the beginning of 1975, inflation and recession in the West were affecting Eastern European trade with the non-Communist industrialized world, to the detriment of economic growth targets in Eastern Europe. The CEMA price rises at the beginning of 1975 intensified the squeeze on the Eastern European members of CEMA, most of which depend heavily on Soviet exports, par-

ticularly of oil and raw materials. But, evidently, the Soviets were taking care to keep the pressure within tolerable bounds.[6]

The divergence between terms of trade movements in 1971–74 as measured by CEMA prices, on the one hand, and world prices, on the other, demonstrated the impracticality of maintaining stable price relationships in intra-CEMA trade for prolonged periods. In a world economic environment where inflation has become increasingly severe and where prices of key commodities are very volatile, the opportunity cost of CEMA price rigidity to CEMA members that would benefit from changes in world prices can be exceedingly high.

Apparently in recognition of the hazards of price rigidity in intra-CEMA trade in an inflationary world, CEMA indicated in early 1975—simultaneously with its disclosure of the price increases—that a more flexible system of applying world prices would be introduced in 1976. Under the new arrangement, prices in CEMA trade, instead of supposedly being fixed for five-year periods coincident with five-year plans, are to be adjusted every year. Prices in any given year are based on an average of world prices in the preceding five years.

The likelihood that this formula will be literally applied may not be great. One can easily imagine circumstances under which it could lead to marked and unsustainable discrepancies between world and CEMA prices. Nevertheless, the introduction of the new formula at least establishes the principle of greater but still limited flexibility in pricing in intra-CEMA trade.[7]

The remainder of this paper will elaborate on points brought out above. The next section will discuss the theory behind the use of world prices in intra-CEMA trade and the ways in which world prices are actually applied. The following section will present calculations I have made to quantify actual movement in the USSR's terms of trade vis-a-vis its six Eastern European CEMA trading partners and what these movements might have been had world prices been applied. The final section examines why the USSR was apparently content in 1975 to effect a relatively moderate improvement in its terms of trade vis-a-vis the rest of CEMA.

II. Use of World Prices in Intra-CEMA Trade[8]

Export prices in world markets provide the basis for the prices of goods traded by CEMA countries among themselves. These so-called world prices do not dictate CEMA trade prices, since CEMA as

[6] For an illuminating discussion of the USSR's problem in striking a balance between furthering its economic interests and meeting Eastern European needs, see Paul Marer, "Has Eastern Europe Become a Liability for the Soviet Union—The Economic Aspects," paper prepared for Conference on the International Politics of Eastern Europe, Columbia University, March 27, 28, 1975.

[7] The formula does appear to have been rigorously applied, however, with respect to Soviet oil exports to CEMA countries in 1976. The evidence is as follows: (1) The Soviet oil export price introduced in 1975 was reportedly based on a 3-year average of world oil prices in 1972–74. (2) The price of Soviet crude oil exports to CEMA countries in 1976 was apparently raised by 8 percent. (See Eastwest Markets, February 9, 1976, p. 8–9.) (3) The average price of Saudi Arabian crude oil—a good indicator of world prices—in 1971–75 was 8 percent higher than the average in 1972–74. If the 5-year average formula continues to be applied and if world oil prices remain at their 1975 levels, then the price of Soviet crude oil exports within CEMA will rise by 30 percent in 1977; 22 percent in 1978; 16 percent in 1979; and stay the same in 1980. At a steady annual rate of increase in the world price of 10 percent, the rises in the Soviet price would be 34, 28, 23 and 8 percent in 1977, 1978, 1979, and 1980, respectively.

[8] This subject has been treated in many published sources. An excellent recent discussion can be found in Edward A. Hewett, *Foreign Trade Prices in the Council for Mutual Economic Assistance*, London: Cambridge University Press, 1974.

an organization has no price setting power. Instead, world prices are used as guides and bargaining tools by CEMA countries in negotiating trade prices with each other. Trade within CEMA is conducted largely on the basis of bilateral arrangements that result from bargaining between pairs of CEMA members over what is to be traded, in what quantities, and at what prices. CEMA has long maintained that intra-CEMA trade is moving toward greatly expanded multilateralism. For instance, fostering of multilateralism was the prime reason for the creation of the International Bank for Economic Cooperation (IBEC) in 1964. The clearing mechanism provided by this CEMA institution was intended to facilitate multilateral trade arrangements within CEMA. In fact, however, a least 95 percent of intra-CEMA trade continues to be conducted bilaterally, with each country as a rule trying to keep its trade with each of its CEMA trading partners in approximate balance. The persistence of bilateralism reflects the tight central control CEMA countries generally strive to maintain over planning and administration of foreign trade. Such control is threatened by the uncertainties associated with multilateralism.[9]

Why, in trading with each other, do CEMA countries resort to world prices? Why not, instead, simply sell to each other at domestic prices using existing exchange rates? There are two fundamental reasons why this is not done. First, in these non-market economies, domestic prices generally fail to reflect the interplay of production costs and demand factors that determine prices where market forces are given free play. That is, these domestic prices are—in terms of how prices, at least in theory, are established in market economies—disequilibrium prices. The disequilibrium character of domestic prices is probably more pronounced in the Soviet Union, which accounts for about 55 percent of intra-CEMA trade turnover, than in most CEMA countries.

Second, exchange rates are not established in a way that would produce equilibrium ratios—in the market economy sense of equilibrium—for the currencies of CEMA countries vis-a-vis each other. CEMA country currencies are inconvertible, with respect to each other as well as non-CEMA country currencies. Thus exchange rates are not in any way determined by the supply of, and demand for, different currencies for trade and other external transactions.

This is to be expected, of course, given that trade and other international transactions of CEMA countries are not determined by the actions of a multitude of independent economic entities, as is basically the case in most non-Communist industrialized countries. Instead, such transactions, for the most part, are centrally planned and regulated in such a way that makes the official exchange rates of CEMA countries largely irrelevant. As a result, such rates are inappropriate for use in setting foreign trade prices.

Because of the prevalence of disequilibrium domestic prices combined with disequilibrium exchange rates, resort to other yardsticks for determining intra-CEMA trade prices is understandable. Furthermore, a reasonable case can be made for using prices prevailing on

[9] See Franklyn D. Holzman, *Foreign Trade Under Central Planning*, Cambridge, Mass.: Harvard University Press, 1974. Note page 149 in particular.

world markets as a guide for such prices. If (a) the world were reasonably free of trade barriers and (b) CEMA countries freely participated in world trade—and given that CEMA countries, as trading nations, are too small to exert much market power as either buyers or sellers on the world scene—the USSR and the countries of Eastern Europe presumably would trade with each other at world prices.

However, application of world prices by no means insures that intra-CEMA trade is conducted with maximum efficiency or anything near it. First, even if trading at world prices makes a certain amount of sense, the inadequacies of domestic prices and exchange rates in CEMA countries make rational decisions about what goods to trade very difficult. Second, even if this critical deficiency is ignored, determining what the world price for a commodity is can be a formidable, often insoluble task. Market imperfections of various sorts can cause prices even of homogeneous products to vary from market to market, even allowing for differing transportation costs. In the case of sharply differentiated products—e.g., machinery—where quality differences may be marked even if comparable goods can be cited as guides for price setting, the problem of selecting a suitable world price is greatly intensified. Thus, as stated at the beginning of this section, world prices serve as indicators and bargaining instruments, not as clear-cut, unchallenged determinants of price.

The fact that the same goods may bear different prices as between different CEMA trading partners illustrates this point. Perhaps one of the most important functions of world prices in price determination in intra-CEMA trade is to protect a weaker CEMA member from being forced to accept excessively disadvantageous terms of trade where a stronger CEMA member chooses to press a superior bargaining position to the maximum extent possible.

It should be stressed that once a world price has been agreed upon—through picking a suitable market and then documenting what the appropriate price in that market was—several adjustments are supposed to be made. Supposedly, the world price is corrected to eliminate the effects of seasonal and cyclical factors. It is also purged of so-called speculative and monopolistic influences. How these alleged distortions are defined, identified and measured is by no means clear. The base price is also adjusted, through application of rather complicated formulas, to include transportation costs. The world price is also subject to alteration to take account of quality differences between the good whose price is serving as a guide and the good actually being traded by the CEMA trading partners.[10] Routine adjustments reportedly can produce a difference between the base world price and the actual CEMA price of as much as 20 percent.[11]

The prices at which intra-CEMA trade takes place are denominated in so-called transferable rubles. The transferable ruble is not a real currency, but a unit of account. The price ratios at which goods

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[10] The Soviets have reportedly complained in the past that quality differences are insufficiently taken into account in the pricing of machinery, with the result that machinery traded in CEMA is overpriced. Since the Soviets import far more machinery than they export, such alleged overpricing would work to the USSR's disadvantage. The ratio of Soviet exports to Soviet imports of machinery, equipment, and means of transportation in intra-CEMA trade was 0.48 in 1970, rose to 0.59 in 1974, and fell back to 0.50 in 1975.

[11] Hewett, Op. Cit., p. 34.

are exchanged are in general determined by the adjusted world prices described above. These world prices can then be expressed in transferable rubles by applying the official transferable ruble exchange rate to the currency in which the world price was denominated.[12]

III. Measurements of Movements in the USSR's Actual and Hypothetical Terms of Trade

This section explains and summarizes calculations that quantify the divergence cited in the introduction between actual and potential movements since 1971 in the USSR's terms of trade with the six Eastern European members of CEMA. By potential movements are meant changes in the terms of trade that might have taken place had changes in world prices been consistently applied in Soviet trade with these six countries. 1971 was chosen as the base year since it was the initial year of the five-year plan period in which prices in intra-CEMA trade were to be based on an average of world prices in 1965–69.

The main findings were that:

The USSR's actual terms of trade with the six countries remained essentially the same from 1971 to 1974.

The USSR's terms of trade, had world prices been applied, would have improved on the order of 30 percent in this period.

The potential improvement can be largely ascribed to the rise in world oil prices in late 1973 and in 1974.

The price changes instituted in early 1975 appear to have changed the terms of trade in favor of the USSR by about 10 percent.

A. Actual Terms of Trade, 1971–74

One measure of changes in Soviet terms of trade vis-a-vis CEMA as a whole can be easily computed from official Soviet data on the value and volume of trade. Since the USSR's trade with the six Eastern European countries accounts for about 90 percent of its total CEMA trade turnover, the results presumably give a close approximation of the USSR's terms of trade movements vis-a-vis these countries.

Changes in total value of the USSR's exports to, and imports from, other CEMA countries can be computed from official Soviet trade statistics. The USSR also publishes an index of the physical volume of its trade with the rest of CEMA. By dividing value indices for exports and imports by corresponding volume indices, price indices can be derived for both exports and imports. Dividing the export price indices by the appropriate import price indices yields the net barter terms of trade.

The results of these computations are summarized in table 1.

[12] Reports indicate that some intra-CEMA trade—presumably a very small portion of it—is conducted on the basis of actual hard currency payments. For example, the Soviets are reportedly paying hard currency for much of their meat imports from Hungary (probably to help offset hard currency losses Hungary has suffered because of EC restrictions on its purchases of meat from Hungary). However, it is not certain that this hard currency trade will result in net hard currency earnings for Hungary, which may be making offsetting hard currency purchases from the USSR. To the extent that the hard currency trade within CEMA is in balance between individual trade partners, it is not substantively different from the trade denominated in transferable rubles. In effect, it is simply a question of using one unit of account instead of another in what amounts in essence to a barter system of trade.

TABLE 1.—USSR TERMS OF TRADE VIS-A-VIS CEMA, 1971–74

[1971 = 100]

	1972	1973	1974	1975
Soviet exports to CEMA:				
Value	113	124	148	202
Volume	110	109	131	145
Derived export price index	103	114	113	139
Soviet imports from CEMA:				
Value	121	130	143	188
Volume	115	117	128	150
Derived import price index	105	111	112	125
Terms of trade	98	103	101	111

Source: Soviet Foreign Trade Statistical Handbooks (Vneshnyaya Torgovlya SSSR).

The above table indicates that prices in Soviet trade with the rest of CEMA did change from year to year in the 1971–74 interval. But at the end of the three-year span, the terms of trade, as measured above, were essentially the same as at the beginning of the period. (The results for 1975 are discussed below.)

Alternative calculations of the Soviet terms of trade vis-a-vis the six Eastern European countries using unit values as proxies for Soviet foreign trade prices were also made. Terms of trade measured by the unit value method were computed for 1974 vis-a-vis 1971 only.

Price indices using unit values as price surrogates were calculated for Soviet exports to, and imports from, each of the six Eastern European countries. Terms of trade indices were then derived for each of the six countries from these price-surrogate indices. By weighting the individual export and import price indices by the value of Soviet exports to and imports from these countries, export and import price indices for Soviet trade with the six countries as a group were computed. From these indices, terms of trade indices for Soviet trade with the six countries were calculated. There are two versions of each index, one using 1971, the other 1974, trade value weights.

The method by which the indices based on unit values were calculated is explained in detail in the appendix, as are the drawbacks associated with them. It is necessary to stress at this point only that these indices can give only a rough idea of terms of trade changes. They were compiled mainly to see how closely an alternative measure of the terms of trade matched the results in Table 1. As Table 2 shows, both sets of indices yield similar results for 1974 vis-a-vis 1971. Table 2 also indicates that, though the overall terms of trade changed little, (a) the

TABLE 2.—SOVIET-EASTERN EUROPE TERMS OF TRADE, 1974 VIS-A-VIS 1971 [1]

[1971 = 100]

	Soviet export prices		Soviet import prices		Terms of trade index	
	1971 wts.	1974 wts.	1971 wts.	1974 wts.	1971 wts.	1974 wts.
Bulgaria	108	111	105	105	103	106
Czechoslovakia	106	107	107	110	99	97
German Democratic Republic	108	110	110	109	98	101
Hungary	109	113	113	114	96	99
Poland	106	104	114	111	93	94
Romania	108	112	107	108	101	104
6 countries combined	107	109	109	110	98	99

[1] For explanation of derivation of Table 2, see appendix.

Source: Soviet Foreign Trade Statistical Handbooks.

terms of trade changes differed, in some instances quite sharply, from country to country and (b) prices of goods in Soviet-Eastern European trade changed perceptibly from 1971 to 1974.

B. Hypothetical Terms of Trade, 1971–74

To determine how the USSR's terms of trade might have behaved if Soviet foreign trade prices had moved in conformity with world prices, hypothetical Soviet export and import price indices were constructed by weighting UN export price indices for several commodity groups by the value of Soviet trade with Eastern Europe for the corresponding commodities. The export indices were then divided by the appropriate import indices to yield the net barter terms of trade.

Five separate UN indices were used: a unit value index for manufactures, covering SITC commodity groups 5 through 8 and four primary commodity export price indices based on price quotations. The four categories were food, agricultural non-food, metal ores, and fuels. How these indices were used to derive a hypothetical measure of Soviet terms of trade is shown in Table 3.

TABLE 3.—HYPOTHETICAL MEASURES OF SOVIET TERMS OF TRADE IN 1974 VIS-A-VIS EASTERN EUROPE

[1971=100]

	U.N. price indices	Soviet value weights (Share of total)		UN index multiplied by:	
		1971	1974	1971 weights	1974 weights
Exports:					
Manufactures	154.3	0.553	0.589	85.3	90.9
Food	206.9	.089	.052	18.4	10.8
Agricultural nonfood	209.5	.109	.095	22.8	19.9
Fuels	457.6	.173	.198	79.2	90.6
Metal ores	166.4	.076	.067	12.6	11.1
Export price index				[1] 218.3	[1] 223.3
Imports:					
Manufactures	154.3	0.840	0.848	129.6	130.8
Food	206.9	.104	.098	21.5	20.3
Agricultural nonfood	209.5	.015	.012	3.1	2.5
Fuels	457.6	.027	.024	12.4	11.0
Metal ores	166.4	.015	.019	2.5	3.2
Import price index				[1] 169.1	[1] 167.8

Terms of trade: 1971 weights, 100(218.3/169.1)=129.1; 1974 weights, 100(223.3/167.8)=133.1.

[1] Sum of column.

Sources: Soviet Foreign Trade Statistical Handbooks and UN Monthly Bulletin of Statistics, March 1976, p. xx-xxi.

An alternative calculation was made in which the fuels index was replaced by an oil price index (1974=528) and a coal price index (1974=125). The oil price index was calculated from 1971 and 1974 prices for Saudi Arabian crude oil. The coal price index was an average of French and German coal price changes as reported by the OECD. The oil price index was weighted by the value of trade in oil and natural gas; the coal price index—by the value of trade in coal and other fuels other than oil and natural gas. The results of these alternative calculations show the terms of trade moving even more to the advantage of the USSR. The terms of trade index with 1971 weights is 132.7 and with 1974 weights 138.2. The alternative using a separate oil

price index seemed appropriate in view of the disparity between the increases in oil and other fuel prices in 1974. However, a suitable coal price index was not readily available, and it is not clear how accurately the two indices from which an average was computed reflect the general movement of coal prices.

Even the results derived from a single fuel index indicate that the Soviets in 1974 were forgoing large gains from trade by not more closely tailoring their CEMA trade prices to world price movements. Total Soviet trade turnover with the six Eastern European countries in 1974 was 17.3 billion rubles. Assuming that the actual terms of trade in 1974 had changed little from 1971 but, in terms of world prices, should have improved by roughly 30 percent, the lost gains from trade would equal over 5 billion rubles. This is a sizable amount—on the order of 1 percent of Soviet GNP.

This estimate is not meant to imply that the gap between actual and potential terms of trade changes can be calculated with any precision. First, the UN indices are at best only indicative of trends in prices in world trade. Second, the export and import price indices in Table 3 are calculated from highly aggregated data. For example, the manufactures index had to be weighted by the sum of the value of Soviet trade with Eastern Europe in machinery, equipment, means of transportation, manufactured consumer goods, and metals (Soviet trade classification Groups 6 through 8 plus the metals entries in Group 2). More disaggregated world price indices presumably would have produced a clearer picture of movements in the USSR's hypothetical terms of trade. Nevertheless, even the highly aggregated and admittedly imperfect hypothetical indices derived above probably do provide reasonable orders of magnitude.

Analysis of the UN data on world price changes points to two further conclusions about changes in the USSR's potential terms of trade with Eastern Europe. First, virtually all of the improvement would have taken place in 1974. From 1971 to 1973, the terms of trade would have changed in favor of the USSR by only about 6 percent. Second, the hypothetical 1974 improvement was overwhelmingly attributable to the huge jump in the price of oil. Indeed, removal of the fuels component from the computations produces a result indicating a slight deterioration in the USSR's potential terms of trade from 1973 to 1974.

C. Terms of Trade Changes in 1975

The broad gap that opened up in 1974 between actual and hypothetical movements in the USSR's terms of trade was no doubt the major impetus behind the price increases in intra-CEMA trade in early 1975. Prices covering a broad range of both Soviet intra-CEMA exports and imports were raised, but, led by the 130 percent oil price hike, the terms of trade were clearly pushed in favor of the USSR.

The improvement, however, fell far short of the hypothetical movements in 1971–1974. Calculating the changes in USSR–CEMA terms of trade by the method used in Table 1 indicates that the gain was about 10 percent, resulting from apparent rises in export and import prices of 23 and 12 percent, respectively. (See the last column of Table 1.)

Detailed Soviet trade statistics for 1975 were published too late to permit calculation for inclusion in this article of terms of trade indices

for the USSR vis-a-vis individual Eastern European countries through the unit value method discussed above. However, rough calculations of terms of trade changes based on admittedly sparse information on the 1975 price changes suggest that, with respect to individual countries, the changes were: Czechoslovakia—20 percent; GDR—12 percent; Hungary—11 percent; Poland—8 percent; Bulgaria—7 percent; and Romania—2 percent.[13] These changes, when weighted by the total trade turnover of each country with the USSR in 1974 and 1975, yield a change in the USSR's overall terms of trade vis-a-vis the six countries of about 11 percent, virtually the same as the 10 percent change computed from the aggregate volume and value indices.

IV. The Moderate Nature of the 1975 Price Increases

The terms of trade advantage gained by the USSR from the 1975 price changes seem moderate in light of world price changes in 1971–74. Moderation may have been partly dictated by the prematurity of the changes and partly by indications that world prices in 1975 would change to the USSR's disadvantage. The UN export price data suggest that the USSR's hypothetical terms of trade vis-a-vis the six countries of Eastern Europe did in fact deteriorate last year, by about 2 percent.

Soviet restraint may also reflect opportunities for taking advantage of world price movements through means other than direct improvement in the USSR's terms of trade. For example, Western inflation has apparently helped the USSR win Eastern European agreement to participate more heavily than ever before in investment projects on Soviet soil. The Eastern European contribution should speed completion of these projects while reducing the volume of resources the Soviets must commit to them. It should also strengthen the ties between the Soviet economy and the individual economies of Eastern European countries. At the same time, these projects benefit the Eastern European countries by providing a relatively assured future supply of such commodities as natural gas, oil and other raw materials at prices that, at official exchange rates, are below world market levels.

Perhaps the main reason why the USSR has apparently adopted a moderate CEMA trade pricing policy is its recognition that the economies of Eastern European countries could be seriously damaged by sudden and substantial adverse movements in their terms of trade.

In contrast to the still substantially self-sufficient USSR, most Eastern European countries depend heavily on foreign trade. In recent years, many of these countries have rapidly expanded their trade with the West as a key element of their efforts to promote growth and technological progress. But the recent Western inflation and recession led to serious hard currency trade deficits and a consequent sharp rise in hard currency indebtedness. As a result, many of these countries now feel constrained to curtail much needed imports from the West.

[13] These results were computed from reports last year of price changes in Soviet-Hungarian trade. Soviet exports prices were said to have risen by 52 percent on average for raw materials including oil; and by 3.3 percent on average for machinery and equipment. Hungarian export prices reportedly were boosted by 15 percent for machinery and equipment; 28 percent for agricultural commodities; and 19 percent for products of light industry. The computation for Poland assumed a doubling in the price of Polish coal exports.

Western economic difficulties most severely affected Eastern Europe during 1975 but were already having adverse consequences before then.

Despite the growing importance of trade with the West, the USSR remains the dominant trading partner for most of the six Eastern European countries. The Soviet Union accounts for at least a quarter of total trade turnover for all of these countries except Romania. It plays a particularly important role in meeting CEMA energy needs, Soviet exports, for example, providing practically all of the oil consumed by Eastern Europe, again with the exception of Romania.

A massive deterioration in its terms of trade with the USSR could thus pose a serious threat to Eastern Europe's economic growth, which is already being impeded by adverse developments in trade with the West. Economic reverses could of course have destabilizing political effects. This possibility would explain why the USSR would be reluctant to press terms of trade changes as far in its favor as world price movements might suggest they should go.

Appendix

Explanation of Derivation of Terms of Trade Indices Using Unit Values

Unit values are computed by dividing the total value of exports (or imports) in a given group of goods in a given period by the number of units measured in physical quantity terms that were exported (or imported). Clearly, then, unit values may be misleading indicators of price. Unit values for a single homogeneous commodity may equal or closely approximate price. But unit values for groups composed of heterogeneous goods may give an inaccurate picture of price changes, since changes in unit values may reflect not merely changes in price but changes in the composition of the group.

Use of unit values as price surrogates can be justified in this paper nevertheless, since there is no reason to suspect that the inevitable inaccuracies in measuring price movements for individual groups will be biased in one direction. Unit values were used in an effort to measure overall price movements in the USSR's trade with other CEMA countries; measuring changes in individual product groups was not of prime interest. Consequently, since it was assumed that the inaccuracies in measuring price movements via unit value changes more or less cancelled each other out, likely distortion in individual groups was not considered a valid reason for rejecting use of unit values.

The method I used to calculate terms of trade movements is essentially the same one devised by Edward A. Hewett to measure such movements in intra-CEMA trade for earlier years.[1] I have in effect updated his findings for the USSR. It should be emphasized, however, that I have omitted several refinements he employed, notably a systematic method for eliminating unit values that so substantially change between periods as to threaten serious distoration of his results. In a few instances, I, too, eliminated, through inspection, unit values that exhibited enormous changes—i.e., two or three-fold or greater increases. However, such unit values were removed only if it was obvious that their weight in a given trade classification group was so large that the huge change would significantly influence the change computed for the overall price index for that particular classification group and where that classification group itself had a substantial weight in the overall export or import price index.[2]

[1] Edward A. Hewett, *Foreign Trade Prices in the Council for Mutual Economic Assistance*, London : Cambridge University Press, 1974.

[2] In one case, an addition was made. The USSR imports a substantial amount of metals and ores from Czechoslovakia. However, only the value of these imports is given, preventing calculation of a unit value index. It appeared, however, that the import price index would be less distorted by assigning an arbitrary unit value index to these imports than to omit them entirely. Therefore, it was assumed that Soviet imports of metals and ores from Czechoslovakia had increased from 1971 to 1974 by the same percentage as Soviet exports to Czechoslovakia of all goods in Soviet Foreign Trade Classification Group 2, which includes metals and ores.

The overall terms of trade index was computed as follows:

1. Using the annual Soviet Foreign Trade Statistical Handbooks for 1971 and 1974, unit values were computed for each separately listed exported (imported) item for which both value and physical volume figures were given for each year. This was done for Soviet trade with each of the six Eastern European countries.

2. Unit value indices for each of these items were then computed by dividing the 1974 unit value by the 1971 unit value.

3. Unit value indices were then computed for each of the separate trade classification groups in the Soviet trade nomenclature for exports and imports for each of the six countries.[8] The individual classification group indices were compiled by weighting the unit value index for each item by the value of exports (imports) of that item. Two indices were compiled for each export (import) classification group, one using 1971, the other 1974, value weights.

4. The individual trade classification group unit value indices were then combined to form a total export (import) price index by weighting each classification group index by the total value of trade for that group. Again two indices were compiled for both exports and imports for each country, one using 1971, the other 1974, value weights. The weights used in constructing the overall export and import price indices were larger than the weights used in compiling the unit value indices for individual trade classification groups, since both value and volume statistics were given for only some of the items in any trade classification group. For many items, only value figures were given.

5. Two net barter terms of trade indices were then computed for each country by dividing the 1971 (1974) weighted export price index by the 1971 (1974) weighted import price index.

6. 1971 and 1974 weighted export (import) price indices were then computed for total Soviet trade with the six countries by weighting each of the individual country indices by the total value of exports (imports) used in computing each of these indices.

7. Finally, overall terms of trade indices were computed for Soviet trade with the six countries by dividing the total 1971 (1974) weighted export price index by the 1971 (1974) weighted import price index.

The formula for all of these export and import unit value and price indices followed the general pattern of

$$I_{p71\,(or\,74)} = 100\left[\frac{\sum\left(\frac{p_{i74}}{p_{i71}}\right)v_{i71\,(or\,74)}}{\sum v_{i71\,(or\,74)}}\right]$$

where:

$I_{p71\,(or\,74)}$ = the export or import price or unit value index being computed with 1971 or 1974 value weights

$\frac{p_{i74}}{p_{i71}}$ = the ratio of price or unit value in 1974 to the price or unit value in 1971 for an individual item or trade classification group.

$v_{i71\,(or\,74)}$ = the value or exports of imports of the item or of the trade classification group in 1971 or 1974.

The net barter terms of trade indices are computed by dividing I_p for exports by I_p for imports.

Two final points about the limitations of the indices in Table 2. First, the unit value indices which form the basis of these terms of trade indices are drawn from items that account for only a relatively small share of total trade, as is shown in Table A1.

[8] Soviet trade is broken down into ten broad categories: machinery, equipment, and means of transportation; fuels, mineral, raw materials, and metals; chemicals, fertilizers, and rubber; construction materials and parts; non-food raw materials and commodities refined from such raw materials; livestock; raw materials used to produce food; food commodities; industrial consumer goods; and miscellaneous.

TABLE A-1.—VALUE OF ITEMS USED IN COMPUTING UNIT VALUE INDICES AS A SHARE OF TOTAL TRADE

[Percent of total exports or imports]

	Exports		Imports	
	1971	1974	1971	1974
Bulgaria	59.7	48.9	63.9	50.0
Czechoslovakia	72.2	67.0	37.0	30.7
German Democratic Republic	65.7	60.9	34.9	31.8
Hungary	69.4	69.9	26.6	26.0
Poland	68.1	57.6	39.4	30.7
Romania	63.6	50.4	38.2	42.9

Source: Soviet Foreign Trade Statistical Handbooks.

Second, the weighting of the individual trade classification groups to compute overall export and import price indices for each country does not include total Soviet trade. Trade listed by classification group never adds up to total exports and imports. The unexplained residual of Soviet trade with these six countries averages 12 or 13 percent.

AUTARCHY OR INTEGRATION—THE U.S.S.R. AND THE WORLD ECONOMY

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TABLE

1. Soviet imports from the United States and Germany for selected years in million rubles

A presumed byproduct of increased trade with the Soviet Union is that such trade will involve the Soviet Union in a web of international interrelationships and interdependencies from which it will prove too costly to withdraw. Supposedly, as the Soviet Union increases its contacts and contracts with the OECD countries, it will find itself being drawn even deeper into an irrevocable need for imports and technicians as well as outlets for exports and hard-currency earnings. It will no longer be possible, or at least it will be increasingly expensive, for the Soviet Union to retreat into autarchy. This growing trade relationship will foster not only a growing normalization of international relations, but possibly increased liberalization of domestic, political and economic life. Such a goal is not the only, or even the most important, reason for fostering American-Soviet trade. Yet if increased and prolonged trade is accompanied by growing interdependence, it might lead to more harmonious international relations.

Analysis of whether or not the Soviet Union is becoming more interdependent is difficult to make. There are too many unknowns, both political and economic. But it may be useful to examine previous Soviet experience with Western trade in the 1930's and to see how, if at all, that differs from the present situation. This involves an analysis of what, if any, freedom of choice Soviet officials continue to have to be autarchic and what, if any, forces are drawing the Soviet Union into an irreversible relationship.

*The author wishes to express his thanks to John Hardt for his help and suggestions with this essay.

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I. A Return to Autarchy Is Possible

In considering whether the Soviet Union can revert to autarchy, it is necessary to review a little Russian history. As Alexander Gerschenkron pointed out, the Russian quest for Western technology, equipment, and specialists is not unique to the Soviet government.[1] From at least the time of Peter the Great, Russian regimes have periodically turned to the West to upgrade their industrial system. Each time, however, the pre-revolutionary regimes ultimately lost their interest in the West and reverted to their former insular ways.

The pattern of seeking Western help was repeated after the Revolution. Stalin, like so many of his predecessors, concluded that the only way to upgrade Soviet industry was to import entire factories. Such purchases began in earnest in the late 1920's with the inauguration of the First Five-Year Plan and hit a peak in 1930 and 1931. For example, as indicated in Table I, American exports to the U.S.S.R. in 1930 totaled about $230 million. The United States was the world's largest exporter to the Soviet Union that year.[2] Not only was this an important market for American exporters in a depression year (Soviet purchases constituted two thirds of all American exports of agricultural equipment and power-driven metal working equipment), but this level of exports from the United States was not matched (except for Lend-Lease sales) until 1972.

Soviet imports of German technology during the First Five-Year plan were also very important. (See Table I.) German exports in 1931 and 1932 significantly exceeded the 1930 level of the United States. In addition, during this period over 2,000 German engineers and technicians went to the Soviet Union to help install and operate German exports.[3]

In a controversial analysis, Anthony Sutton argues that almost all Soviet technology can be traced to either American or West European sources.[4] Companies such as Ford (the Gorky and Moscow Automobile and Truck plants), International Harvester (the Stalingrad Tractor plant), General Electric (Khemz Turbine factory at Kharkov), and DuPont (the Kalinin and Shostka Nitric Acid plants) were among some of the more notable suppliers and builders.[5]

And as in the German case, a large number of American engineers were sent to the Soviet Union to help install and operate the newly purchased technology. Similarly over 100 Soviet technicians visited and, in some cases, studied in American factories in the period of January 1, 1929 to June 15, 1930.[6] The Ford Motor Company alone trained 81 specialists.

Given such substantial dependence, it was reasonable to assume that the relationship once started would be ongoing. Presumably the

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[1] "Economic Backwardness in Historical Perspective" (Cambridge: The Harvard University Press, 1962), pp. 133–135.
John P. Hardt and George D. Holliday, "Technology Transfer and Change in the Soviet Economic System," mimeographed December 1975, p. 60.
[2] Marshall I. Goldman, "Detente and Dollars: Doing Business With the Soviet Union" (New York City: Basic Books, 1975), p. 15.
[3] Ibid., p. 18.
[4] Anthony Sutton, "Western Technology and Soviet Economic Development, 1917–1930" (Stanford: Hoover Institution Press, 1971), pp. 100, 185, 246–248, 343.
[5] Anthony Sutton, "Western Technology and Soviet Economic Development, 1930–1945" (Stanford: Hoover Institution Press, 1971), pp. 100, 185, 246–248, 343.
[6] Ibid., p. 277.

TABLE I.—SOVIET IMPORTS FROM THE UNITED STATES AND GERMANY FOR SELECTED YEARS IN MILLION RUBLES

[1969 rubles][1]

	United States	Germany		United States	Germany
1918	11	----	1933	13	116
1920	1	5	1934	14	23
1921	32	43	1935	23	17
1921/22	35	66	1936	37	55
1922/23	4	48	1937	42	34
1923/24	40	36	1938	69	11
1924/25	158	81	1939	52	10
1925/26	96	138	1940	76	72
1926/27	114	127	1946	213	----
1927/28	147	195	1947	99	----
1929	139	153	1948	47	----
1930	207	197	1949	23	----
1931	180	322	1950	7	----
1932	25	257			

[1] 1 ruble equals $1.11.

Source: Ministerstvo Vneshnei Torgovli SSSR, (hereafter MVT SSSR) "Vneshniaia Torgovlia" SSSR, 1918–66, Moscow Mezhdurnarodnye Otnosheniia, 1967, pp. 8–13, 64–68. (Hereafter statistical handbooks of the MVT SSSR will be referred to as "VT SSSR" and the appropriate year or years.)

Soviet Union should have had a continuing need for Western machinery to equip new facilities and to supply spare parts for existing factories and for Western technicians to train Soviet workers and to operate the new and relatively sophisticated equipment. Instead as Table 1 shows, Soviet imports of American equipment fell sharply from 180 million rubles in 1931 to 25 million rubles the following year. German imports fell shortly thereafter. Purchases of 257 million rubles of German goods in 1932 were cut back to 23 million rubles in 1934. The use of foreign technicians was similarly curtailed.[7]

The main reason for such a contraction was that the Soviet Union unexpectedly found that it could not pay for all its purchases. The Soviets discovered that they, like everyone else, were trapped by the Great Depression. Initially they thought they could keep importing but in a short time they found they could not export enough to pay for their purchases. But the virtual suspension of their imports reflected more than a valuta (foreign exchange) shortage. A rash of "wrecker" and "sabotage" trials involving foreign engineers strongly suggested that xenophobia was also a major consideration in the decision to cut off Western imports in technology.

A similar expansion of trade and subsequent cutback occurred in the mid-1940's. Initially the Soviet Union received large quantities of civilian as well as military goods under the wartime Lend-Lease program. Such deliveries continued after the war, but then dropped off sharply in 1947. Imports of American goods fell from about $230 million in 1946 to about $110 million in 1947 to about $10 million in 1950, a testimony to the intensity of the Cold War. As in the 1930's, American technicians were sent back to the United States and Soviet technicians were returned to the USSR.

On the surface at least, the Soviet economy did not seem to suffer significantly from the cessation of American-Soviet trade. As in the 1930's, Soviet technicians somehow managed to repair or improvise the necessary replacement parts in order to operate the equipment on

[7] Goldman, op. cit., p. 19.

their own. Undoubtedly, productivity was not as high as it might have been with open and continuing American assistance, but the Soviet Union still managed to achieve notable growth rates in the years that followed.[8]

Nor has the Soviet government in the past allowed itself to become too dependent on the United States for grain imports. Like the Czarist governments before it, it exported grain even though there were domestic shortages at home. Thus while the Soviet Union found it necessary to accept 583,000 tons of famine relief grain in 1921–22 (including 251,000 tons from the United States), even before the grain shipments stopped, Lenin had resumed the exportation of grain.[9] While the United States relief program under Herbert Hoover continued until 1924, the Soviet government exported 732,000 tons in 1922–23.[10] The pattern continued under Stalin. In 1930 in the middle of the great drive to collectivize agriculture when millions of lives were lost due to starvation, the Soviet Union exported 4.8 million tons of grain and increased that to 5.2 million tons in 1931.[11]

Again after World War II, from 1946–1948, UNRRA supplied the Soviet Union with emergency grain supplies. But according to Krrushchev, "In 1947 in several oblasts of our country, for instance in Kursk Oblast, people were dying of starvation. Yet bread grain was being [exported]." [12] Thus in 1947 while the Soviet Union imported 255,000 tons of grain, it exported 800,000 tons. In 1948 imports were 587,000 and exports were 3.2 million tons.[13] Khrushchev claims to have broken the pattern in 1963–64 when grain imports did exceed grain exports.[14] There were reports of bread riots at the time, but no human starvation. Even then, however, the pig herd fell precipitously from 70 million head on January 1, 1964 to 41 million head the following year.[15]

If Russian history tells us anything, it is that the Russians have been able to tighten their belts and make do without foreign help, both in industry and in agriculture. The belt may pinch, and even cut off circulation for a time, but thus far the country has survived.

But it is not only history that suggests a remarkable ability and even preference (even if touched with masochism) for standing alone. There are contemporary arguments for such a stance. In some respects these arguments parallel the Slavophile debates with the westernizers in the 19th century. One experiences déjà vu when reading Solzhenitsyn's call for a "Russian first policy" of "let's save our raw material patrimony for future Russian generations" and Sakharov's rebuttal stressing the need to import western technology. This was vividly expressed by Solzhenitsyn in a letter dated September 5, 1973 where he urged Soviet leaders to turn their backs on the outside world and concentrate on internal Soviet development. He called for an end to

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[8] The Soviets did not seem to suffer the same production disruption that the Chinese did when the Russians withdrew about 1400 of their technicians from China in 1960. Marshall I. Goldman, "Soviet Foreign Aid." New York: Praeger Publishers, 1967. p. 48.

[9] Peter G. Filene, "Americans and the Soviet Experiment, 1917–1933" Cambridge: Harvard University Press, 1967, p. 82.

[10] Ministerstvo Vneshnei Torgovli SSSR, "Vneshniaia Torgovlia SSSR za 1918–1940 gg" Moscow: Vnestorgizdat, 1960, p. 1066.

[11] Ibid., p. 144.

[12] Pravda, December 10, 1963, p. 1.

[13] Ministerstvo Vneshnei Torgovli SSSR, "Vneshniaia Torgovlia SSSR za 1918–1966 gg" Moscow: Vnestorgizdat, 1960, pp. 88, 110.

[14] Ibid., pp. 91, 113.

[15] Goldman, Detente and Dollars, p. 30.

the stress on rapid industrialization and urged a halt to further sales to the West of Russia's natural resources such as Siberian natural gas, oil and timber. In response Sakharov argued that such a policy would be isolationist. He asserted that, "Our country cannot exist in economic and scientific isolation without world trade, including trade in the country's natural resources or divorce itself from the world's scientific technical progress—a condition that holds not only danger but at the same time the only real chance of saving mankind." [16]

Granted that Solzhenitsyn and Sakharov can hardly be mistaken for official spokesmen of the Soviet government, they nonetheless reflect some of the prevailing moods of the population at large. Occasionally even Soviet officials espouse similar views publicly. For example when he realized that there might be shortages in the U.S.S.R., the Soviet minister of the petroleum industry, V. D. Shashin drew back from earlier indications that the Soviet Union would be happy to supply the Japanese with petroleum exports of 40 million tons a year by 1980.[17] He later reassured the Japanese that the Soviet Union would supply at least 25 million tons, but there was no mistaking that the switch to a smaller commitment reflected the desire to preserve valuable national resources.[18]

The debate does not only express the need to husband Soviet raw materials for the future. Periodically there are recurring strains of the theme of "socialism in one country", that also brings with it the call for Russian self reliance. For instance Pravda on December 18, 1975, printed an article by Professor K. Suvorov, which seemed to be seeking a policy which would "insure Soviet economic independence from the world capitalist economy." [19]

Interestingly in the original Pravda article, Suvorov went so far as to invoke Stalin as the one who set out the idea of economic independence. This was thoughtfully omitted in the otherwise fairly complete reporting of the article in the London Soviet Embassy report, Soviet News, January 13, 1976, p. 50.

There are indeed signs that the U.S.S.R. has at least tried to maintain its economic independence even where it is most vulnerable—in food. Whereas in the early 1970's the Soviet Union appeared to be willing to allow itself to become dependent on the United States for feedgrains to supply its livestock, it apparently changed its mind in 1975. At least it looked that way initially. Thus the Soviet Union imported about 27 million tons of grain in 1972 (a little over 19 million tons from the United States) with a harvest of 168 million tons; in 1975 it purchased about the same as three years earlier even though its harvest was only 140 million tons. Moreover, the 1975 harvest was a serious shortfall from an expected yield of 215 million tons. Evidence that this left the Soviet Union with less grain than it intended or would like is indicated by the contraction of its livestock herds. In 1972 the Soviets bought quantities of grain sufficient to maintain their livestock herds. As a result the pig herd fell only from 71 million head on January 1, 1972 to 67 million head the following year. But reminiscent of what happened in 1963–1964 when they also did not buy

[16] The New York Times, April 15, 1974, p. 1. The New York Review of Books, January 13, 1974, pp. 3–4.
[17] Washington Post, May 28, 1974, p. 1. The New York Times, May 28, 1974, p. 59. Soviet News, July 15, 1975, p. 242.
[18] The New York Times, June 6, 1974, p. 1.
[19] Pravda, December 18, 1975, p. 2.

enough grain, the pig herd in 1975 fell from 72 million head to 58 million. Until April 1976, it looked like the Soviet Union would again be faced with a depleted livestock herd. Thus, despite its promises of more meat in the diet, the Soviet Union seems prepared to impose at least limited hardships on its population when it wants or is forced to.

It may be that Soviet authorities felt they had no choice and that they were forced to hold down their grain purchases because of a serious shortage of foreign currency due to the sudden deterioration in their balance of trade.[20] Undoubtedly this was a factor as was the imposition of an export embargo on American grain sales to the Soviet Union in August 1975. Nonetheless one reason for the virtual cessation of foreign trade with the capitalistic world in the early 1930's was also a shortage of valuta and the inconvertibility of the Soviet ruble. Nor is there much reason to feel that the valuta situation is likely to change much in the next few years.

The Soviets are also unlikely to open themselves up to any true co-production arrangements: certainly none that involve interdependence on foreign manufacturers for basic components. Factories within the Soviet Union seek to be as self-sufficient for their components as possible. Subcontracting with other Soviet suppliers and pure assembly work is avoided wherever possible. Under the Soviet planning system failure to receive components on time means that the plan fulfillment is jeopardized as is the payment of bonuses. Moreover transportation delays and supply breakdowns are endemic in the Soviet system. Given this pervasive distrust of subcontracting inside the Soviet Union, it is unlikely that the Soviet enterprise manager will alter his conditioned response. Agreeing to component deliveries from outside the country will jeopardize his plan fulfillment even more.

Finally it must be remembered that all industry is state-owned in the Soviet Union. The state also maintains a foreign trade monopoly. Thus if the government ever decides to sever all trade and interchange with foreign companies, such a decision is relatively easy to implement. There may be some resistance and deception, but compliance will be much faster and complete than would be the case in a pluralistic society. Sixty years of Soviet history demonstrates the Soviet government's ability to reverse its course almost overnight. Presumably it would take a fundamental and radical change before such revisions to isolationism would become difficult or unlikely.

II. Soviet Integration Into the Western World

Having argued that the Soviet Union has not yet become irrevocably interlinked to the capitalistic economic world, let us now look at evidence that suggests basic changes in the Soviet's relationship with the capitalist world are indeed taking place. What, if anything, is different about the 1970's? Predictions about new social and political changes in the U.S.S.R., like all futurology are highly speculative, yet there are some intriguing developments which do suggest that a fundamental change may be taking place.

More than anything else, the question of whether or not the Soviet Union will be able to cut itself off completely from the rest of the world

[20] Marshall I. Goldman, "The Soviet Economy Is Not Immune," Foreign Policy No. 21, Winter 1975–76, p. 76.

depends on whether or not the Soviet system can produce another Stalin. It takes an unusual person who is willing to impose such suffering on his people. Certainly Russian history suggests that Stalin was not all that unique, but for the time being at least, the circumstances that produced Stalin-like figures are less likely to recur today. First, Russia historically has thrust forward such draconic leaders only in a time of trouble when Russia felt itself hopelessly backward in relation to its neighbors and competitors. Second, the governing process in the Soviet Union since Stalin's death seems to reward, as Robert Kaiser has put it, "the steady and sure." When someone like Khrushchev comes along who displays independence and arbitrariness, the committee system feels itself threatened and casts out the troublemaker because of his "harebrained" ideas. As long as the Russians are able to feel that they have not fallen far behind the West, it seems unlikely that they will tolerate the type of extreme measures and "extraordinary personality" expressed by Stalin and his historical antecedents.

What economic developments might prevent the Soviet Union from cutting itself off from the rest of the world again? The usual approach is to analyse whether or not the Soviet Union has come to depend on others for imports and infusions of foreign technology. Although it is often neglected, the need of the Soviet Union to export may be an equally important factor in increasing the cost of the Soviet Union of any return to autarchy. Usually Soviet exports are viewed solely as a means to finance Soviet imports. However once developed, the exportation of some Soviet goods takes on a momentum of its own which if cut off, could be very disruptive. We shall begin with a consideration of the Soviet Union's growing need for imports and its changing role with CMEA (Council of Mutual Economic Assistance). We shall also seek to determine the circumstances under which exports increase the Soviet stake in continuing its participation in foreign trade. Finally we shall consider whether or not the Soviet Union can again cut itself off from modern technological developments as it did in the 1930's.

A. Imports

Because of its size and natural wealth, it is usually assumed that the Soviet Union is well endowed or at least self sufficient in raw materials. And where it has not been self sufficient, the Soviet Union has always appeared to be able to tighten its belt and do without or at least with less. Certainly that seemed to be the case in the 1930's and was at least partially true in the 1960's. Even though Khrushchev did decide to buy some grain, he did not buy as much as he should have. If he had, there would not have been the forced slaughter of the pig herd we mentioned earlier.

By stressing the need to increase meat consumption, however, Soviet authorities have marked a major turning point. Because of its geographical limitations, the Soviet Union can not grow the quantities of corn needed to feed a large livestock herd. While they do produce large quantities of wheat, they do not grow enough to feed both a large populace and a large livestock herd. Moreover wheat is not as efficient a food for livestock as corn. The decision to build up a livestock herd committed the Soviet Union therefore to the continuing purchase of feedgrains from the United States, the only country that could provide

the large quantities needed by the Soviet Union. That assumption was shaken when as we saw the Soviets in 1975 bought much less than logic suggested they should have. The initial conclusion was that the Soviet Union had decided to hold back as before from full dependence on foreign markets albeit at the cost of the promised improvement in meat supply.

Of course it could be argued that even the somewhat reduced purchase of 25 million tons (13 million of which was from the United States) was a major purchase. After all this involved an expenditure of approximately $3 billion in hard currency (about 30% of all Soviet hard currency imports in 1975). But it was still bothersome. While the Soviet Union in 1972–73 with a harvest of 168 million tons has imported 27 million tons of grain, in 1975–76 with a considerably smaller harvest of 140 million tons, they were only planning to import 25 million tons.

The advocates of economic interdependence should have been pleased therefore when the Soviet Union suddenly reentered the grain markets in late April 1976. In quick order they bought 2.7 million tons of corn from the 1975 harvest. This pushed their world 1975–76 crop year purchases over those of 1972–73. They also ordered 1.7 million tons of corn and 550,000 tons of wheat from us and 2 million tons from Canada and one ton from Australia from the new 1976–77 crop. The prospect of the continued slaughter of the Soviet livestock herd probably had a sobering effect on Soviet policy makers and caused them to buy additional quantities of grain—primarily corn for their livestock. Despite the expense and shortage of hard currency, the Soviet leaders apparently concluded they could not risk the consequences of continuing shortfalls and disappointments in meat production and therefore they did go back into the market—a sign they have indeed become more dependent on the world economy.

While grain is the most critical example of Soviet interdependence, Theodore Shabad of the New York Times has discovered another. In a forthcoming article in Resources Policy, he demonstrates that as of 1975, about 40 percent of Soviet aluminum output is based on imported raw materials.[21] According to Soviet statistics cited by Shabad in 1974, over 500,000 tons of bauxite were imported from both Greece and Yugoslavia. Over 200,000 tons were imported from both Turkey and Guinea. The Soviet Union also imported 323,000 tons of alumina from Hungary, 143,000 tons from Jamaica and 127,000 from Turkey which it then refined further.[22] Shabad points out that the Soviet Union had indigenous sources of bauxite or substitutes available but for reasons of cost and efficiency found it cheaper to import a major portion of the necessary raw materials from foreign sources. Imports of bauxite doubled to 3.5 million tons in 1975, making the imported share even more important. The U.S.S.R. also imports almost all of its natural rubber, which given the increased output of vehicles, is now a critical commodity. Such dependency marks a sharp divergence from traditional Soviet policy and along with feedgrains indicates an unprecedented willingness to rely on foreign trade.

[21] Theodore Shabad, "Raw Material Problems of the Soviet Aluminum Industry," p. 1; see also The New York Times, May 9, 1976, Financial Section, p. 5.
[22] MVT SSSR, VT SSSR 1974.

B. CMEA

Even those who argue that the Soviet Union may still revert to autarchy nevertheless acknowledge that such autarchy will not affect the U.S.S.R.'s continuing relationship with the Council of Mutual Economic Assistance countries or at least the East European faction of CMEA. Indeed the Soviet post-World War II return to autarchy coincided with its cultivation of a very intense relationship with Eastern Europe. While there is much that is irrational about the CMEA trading bloc, it nonetheless does represent a relatively high degree of interdependence for the Soviet Union. The Soviets consciously forced the East Europeans to organize their economics around Soviet raw materials. For example, Polish and Czech steel mills were located and designed to process Soviet iron ore and almost all of Eastern Europe came to depend on Soviet oil and natural gas. To accommodate these needs, the Soviet Union built up extra capacity and supply facilities. In turn, the Soviet Union agreed to consume much of the industrial output of its East European allies. Generally this has resulted in a higher dependence by the East Europeans on the Soviet Union than vice versa. Nevertheless, it has involved the Soviet Union in some highly intricate relationships that were new and novel.

It is intriguing therefore that the Soviet Union now seems to be seeking to restrict its ties with Eastern Europe in favor of more extensive trade with the capitalist world. Much of this change stems from the Soviet realization that it had to turn to the capitalist world to obtain the new post-World War II technology it needed to keep up industrially. East European industrial products were no substitute. In order to pay for these Western imports, the Soviet Union soon realized it would also have to export to the West. The only items that seemed salable were raw materials. Soviet authorities quickly discovered that it would not be enough to export only the surplus available after the satisfaction of Soviet domestic needs and the sale to traditional importers in Eastern Europe and the developing countries. Even as far back as the mid-1960's, Soviet economists began to warn the East Europeans that they should start looking elsewhere for raw material supplies. Implicit in this warning was the realization that the Soviet Union intended to divert these products instead to the hard-currency countries.[23] These urgings assumed an especially insistent note as the Soviet Union found itself riding the crest of the raw materials boom which was set off by the Yom Kippur oil embargo. Attracted by the sudden jump in prices, the Soviet Union actively sought to maximize its profits and participate in the market system, just as any red-blooded profit maximizer in a capitalist country would. In some instances they raised their asking price of oil from about $2.30 a barrel to at least $10.00 a barrel, and in some cases to as much as $18.00 a barrel.[24]

[23] Volkov, "Struktura vzaimnoi", pp. 10, 12; G. Prokhorov, "Mirovaia sistema sotsializma i osvobodivshiesia strany", *Voprosy Ekonomiki*, November 1965, pp. 84, 85; O. Bogomolov, "Khozialstvennye reformy i ekonomicheskoe sotrudnichestvo sotsialisticheskikh stran", *Voprosy Ekonomiki*, February 1966, pp. 85, 86; M. Sladkovskii, "XXII s'ezd KPSS i problemy ekonomicheskogo sotrudnichestva sotsialisticheskikh stran", *Voprosy Ekonomiki*, April 1966, p. 96.

[24] Marshall I. Goldman, "The Oil Crisis: In Perspective—the Soviet Union" *Daedalus*, Fall 1975, p. 129.

The East Europeans got the message. Whereas some countries such as Czechoslovakia were at one time wholly dependent on the Soviet Union for their crude oil and much of their refined oil, by 1970 even Czechoslovakia had begun to import from other sources, mainly in the Middle East. The Soviet Union still supplied the bulk of the East European needs, but whereas East Germany depended on the Soviet Union for 94 percent of its refined petroleum prior to 1972, by 1973 it received only 81 percent. Over the same period the Czechs moved from 100 percent dependence on the Soviet Union for crude oil to 92 percent.[25]

C. Exports

Of course the Soviet Union can always induce the East Europeans to expand their purchases of Soviet petroleum and other products again. Moreover, if it is just a question of selling raw materials, the Soviet Union can probably redirect its product away from the capitalist world without any great loss. Indeed in evaluating the Soviet export policy for signs of whether or not the Soviet Union is becoming linked more intricately into the world market system, the main criteria should be not only the absolute volume of exports but the size of investment made by the Soviet Union in order to honor these export commitments. In particular are the Soviets continuing to put new resources into these projects and are these investments the kind which cannot be converted to alternate domestic purposes?

There are several signs that the Soviet Union is basing some of its export policies on the premise that this will be a long-run not a short-run policy. One is the way the Soviet Union behaved during the oil embargo itself. As we saw, while Soviet political officials sought to prolong the Arab embargo, Soviet economic operators acted like any businessman with oil to sell would have. The Soviet Union showed no hesitation in selling to the United States and the Netherlands despite the fact that both countries were the main object of the oil embargo. In this instance at least, the profit potential outweighed the political reward from honoring the embargo.

Nor was the Soviet action during the oil embargo unique. There are other signs of a fundamental change in attitude and practice, particularly in the way the Soviet Union is moving to sell its raw materials. For example together with some European investors, the Soviet Union has formed a large oil trading company called Nafta. Nafta in turn has built a large oil storage terminal in Antwerp, Belgium with a capacity of about one million tons. This terminal ships petroleum to buyers all over Western Europe and the United States and in turn has set up its own network of wholly owned and financed filling stations. There is also a Nafta in the United Kingdom which is seeking to expand its service station network. There was even talk for a time of building a refinery in Belgium and in the United States. It is unfortunate that the refining projects have now lapsed since they would have increased the Soviet stake in continued East-West trade. Consequently for the time being the Soviet investment in overseas petroleum operations is still too minor to cause the Soviet Union to worry about its vested interests. Yet the Soviet involvement in foreign busi-

[25] Ibid., pp. 136–7.

ness operations is growing. Now that all the countries of Western Europe and even the United States seem hospitable to the importation of Soviet raw materials, the Soviet Union appears to be moving to take advantage of the hard-currency opportunities that were frequently closed to them as recently as 1971.

Besides Soviet involvement in international oil operations, there are many other overseas investments that also suggest a growing Soviet participation in world commerce. For example, the Soviet Union has established an extensive network of overseas banks. Led by the Moscow Narodny Bank in London, with assets exceeding $2 billion, the Soviet Union also owns banks in Paris, Teheran, Frankfurt, Beirut, Singapore, Kabul, Zurich, Vienna, and Luxembourg. In addition, the Soviet Union has opened up foreign affiliates in such diverse fields as the sale and assembly of automobiles, the sale of tractors, machine tools, watches, timber, chemicals, computers, laboratory equipment, and insurance.[26]

Some of these operations date back to before World War II, and in the case of London Moscow Narodny Bank, to before the revolution. Obviously the existence of Soviet multi-national corporations before 1950 did not prevent the Soviet Union from relapsing into autarchy when Stalin wanted to. Nonetheless, the number of such ventures has multiplied since the 1960's and continues to grow yearly. Moreover, some of them are becoming increasingly involved in highly sophisticated transactions and investments that suggest a gradual interweaving of economies.

An example of a more recent, sophisticated investment is the expansion of the Soviet tanker and general merchant marine fleet. These ships can be used for little else than foreign trade. Moreover, the rapidly increasing size of the fleet indicates it would be hard to utilize these ships at full capacity if shipping were limited only to communist or soft-currency countries. The Soviet Union has now become a shipper to be reckoned with, not only in the Baltic and Mediterranean, but in the Pacific. Furthermore, it has invested in an elaborate container operation that, in part, is focused largely on either exports or transit freight for foreign shippers. It is true that the Soviet Union can use the container carriers domestically if need be within the Soviet Union itself to move freight. But already in 1974–75 a specially designed port at Nakhoda, built with Japanese assistance was handling 70,000 containers a year, both incoming and outgoing.[27] Having realized the hard-currency potential in such an operation, the Soviet Union is now engaged in opening a second container facility at Port Vostochny on Wrangel Bay that will handle an additional 60,000–70,000 containers a year. Most of these containers are now going to Tokyo, but the Soviet Union is also seeking to establish regular service to Manila and Hong Kong.[28]

In the same way, the Soviet decision to build the Baikal-Amur Railroad (BAM) reflects the new Soviet "export imperative" as John Hardt has put it. Granted that this route which parallels the Trans-Siberian Railway has strategic significance since it is much further from the Chinese border, the outside observer is still struck by the

[26] Goldman, Detente and Dollars, pp. 298–300.
[27] Vodny Transport, Nov. 22, 1975, pp. 2–3.
[28] Ibid.

fact that the territory and raw materials that it is opening up in East Siberia are much closer to the export markets of Japan and the Pacific than those of Moscow and central Russia.

Some of the pipeline construction and electrical grid projects extending outside the borders of the Soviet Union involve the same type of outward orientation. This applies particularly to the billions of dollars the Soviet Union has invested and is prepared to invest in pipelines and processing facilities to supply natural gas to Western Europe, Japan, and the United States. By 1980, the Soviet Union will probably be the world's largest exporter of natural gas. Most of the financing so far for the export pipelines has come from companies and governments in Western and Eastern Europe. However, $25 million each has also been lent to the Soviet Union by banks in Japan and the United States for development of the Yakutia gas field. There is the prospect of $100's of million more to come.

As with petroleum, the Soviet Union could probably adjust if it decided to disconnect the gas pipelines, particularly since a good part of the collateral (the pipelines themselves) lie within Soviet borders. There is probably not much the lenders could do to force Soviet repayment if such pressure was ever necessary. But cutting off the flow of gas would be disadvantageous and wasteful for the Soviet Union. Some of the natural gas fields are so remote from Soviet population centers, particularly those being developed in isolated regions like Yakutia, that these gas fields and pipelines only make sense if developed for an export market like Japan, Western Europe or the United States. For the same reason, if the Soviet Union should commit itself to the building of a liquefied gas plant at the end of those pipelines, the plants even if financed in large part by the United States and Japan, would still tie the Soviet Union into an on-going relationship and force upon them a vested interested in continuing their exports. Located where they are, the $500 billion LNG conversion plants would not be much good for anything else, especially if the Japanese and the United States retained ownership and control of the $125 million pressurized and refrigerated tankers which are needed to transport the LNG.

The Soviet Union not only has pipelines going out, but pipelines coming in. The Afghans for example have been supplying about 3 billion cubic meters of natural gas a year and the Iranians about 10 billion cubic meters. By 1980 the Iranian total will more than double. This increase is part of a complex deal whereby the Soviet Union will use the Iranian natural gas inside the U.S.S.R. and send a like amount of its own natural gas (less a transit fee of about 20%) to Western Europe. Obviously a suspension of Soviet gas exports might well precipitate the suspension of Soviet gas imports. In such a case because the pipeline network so far is not completely interconnected, the Soviet Union would find itself with gas surpluses in some parts of the country and gas deficits in others. The decision both to export and import natural gas is a bit more complicated than the petroleum pipeline arrangements. Such intricate dealings increase the pressure on the Soviet Union to maintain a continuing involvement in a world economy.

One of Armand Hammer's agreements is designed with the same purpose in mind. To maintain Soviet interest in the success and re-

payment of his project, Armand Hammer has designed his contract so that not only the American side but the Soviet side as well will receive the product. Thus the Soviet Union is to supply Occidental Petroleum with 1.5 million tons of ammonia and 1 million tons of urea and 1 million tons of potash a year, while Occidental in turn will supply the Soviet Union with 1 million tons of superphosphoric acid. Each side thus can exercise leverage on the other in an arrangement that commits both sides for at least twenty years.

All too often however, it seems that the Soviet side negotiates deals whereby it is no longer dependent on the Western contractor once he turns the key. As in the case of the Germans, French and Italians who have financed the natural gas pipelines to the west, it is the Western partner who puts up the cash and equipment in advance and who then must wait for his repayment in kind. If anything such arrangements tend to increase the reward for default. Of course such a default would hinder the prospects for financing in the future.

In some instances however, even though it appears that the Soviet Union has most of the bargaining advantage, the U.S.S.R. may still be faced with enormous pressure to keep up its good relations with the capitalist world. For example if there should be a default, this would hinder the prospects for financing in the future. Moreover, many of these factories inside the Soviet Union are being built with excess capacity intended for export. The danger however, at least in the short run, is that the Soviet market is usually so starved for goods, that it can absorb most products a factory might be forced to divert. Nevertheless over the years the Soviet Union has begun to develop an excess capacity in some goods which thus far it has indeed exported. Among the products it exported in 1974 were 940,000 cameras, 15.7 million watches 790,000 bicycles, 370,000 T.V.s, and 1.3 million radios.

D. Technology

There is also reason to believe that given the different nature of the new technology the Soviet Union is currently purchasing, the Soviet Union will find it more difficult than it has in the past to isolate itself. Unlike the technology of the 1930's, and the 1940's, the technology of the 1970's is far more complicated and faster moving. While the Soviet Union managed to do without an on-going flow of foreign spare parts in the past, the technology then was simpler. Today much of it, particularly in electronics, computers, and chemicals, is more complicated and harder to duplicate without the proper infrastructure. Moreover, if the Soviet Union ever hopes to become competitive, it will not be enough to duplicate the existing facilities. The Soviet Union will have to maintain a current flow of new parts and new technology as well as of spare parts.

The need to update technology and processes is never ending. At the minimum this requires a continued flow of personnel, parts and methods. Unless technological progress in the West ceases, the Soviet Union will have to involve itself in some sort of perennial exposure and renewal. Isolation and stagnation would stop the process. If the Soviet Union is to keep abreast, it must continually upgrade existing procedures and factories with new purchases and send Soviet specialists overseas and invite foreign specialists to the Soviet Union. Another

possibility is that the Soviet Union may eventually decide to do as some of their East European colleagues have done. Some East European nations have joined with capitalist corporations to form on-going joint production relationships. While the Soviet authorities are unlikely to go so far as to agree to share equity with the foreign companies as the Eastern Europeans have done, the Soviets have been considering other arrangements that would permit a continuing updating of technological developments in the West in exchange for some royalty sharing other incentive arrangement. While it is uncertain when or if such agreements will be signed, the Soviets are taking such proposals seriously enough to authorize the deputy minister of foreign trade, V. N. Sushkov, to mention them in the February issues of Vneshniaia Torgovlia.[29] He specifically cited negotiation for the manufacture of automobile parts and clothing. It would seem from the automobile parts negotiation at least that the factory if constructed, would have an export capacity built into it that could not be absorbed by the relatively small domestic market, at least in the short run. This tendency is further reflected in Premier Kosygin's speech to the Twenty Fifth Party Congress. Kosygin suggested that the USSR would develop special export-oriented industries.[30]

Given the need for such an on-going involvement in a growing number of areas, it will prove to be increasingly difficult to terminate interchanges of technologies and technicians once started. Of course, such an assertion must be made cautiously given the fact that such a break would probaby have looked equally improbable in the 1930's. But there does seem something different quantitatively in what is happening now. For instance American and Western exporters have begun to obtain access to the final Soviet user, not only at the industrial ministry level, but in an increasing number of instances, at the enterprise itself. Not all Soviet enterprises are quite so fortunate, but what is remarkable is that so many compared to previous practice do manage to break through the barrier of the Ministry of Foreign Trade. Moreover there seems to be a much greater interchange of technical personnel than before. This refers not only to the number but to the degree of those involved. It would be rash to argue that the large numbers have brought about a qualitative change as well, but that remains a possibility. In any case the numbers are impressive.

In contrast to the few dozen foreign specialists who were sent by the Ford Motor Company to work at the Gorky Automobile plant in the 1930's, "about 2,500 Western personnel" was sent to help construct the Zhiguli plant at Tolyatti.[30] In a more recent instance, as many as 500 Soviet engineers passed through the Pullman-Swindell offices in Pittsburgh in the process of completing the design work for the Kama River truck plant. There are now 50 Americans working at and living in the Kama River site. Other companies have been involved in similar exchanges. American offices have been opened in Moscow and Soviet offices such as the Kama River purchasing office have been opened up in New York and Pittsburgh. Although no contract has been signed yet, one American company has been approached by Soviet officials to build and help operate a massive paper complex that would involve

[29] Foreign Trade, February, pp. 10–11.
[30] Sotsialisticheskaia Industriia, March 2, 1976, p. 3.

the stationing in the U.S.S.R. of a technical group consisting of 100 American specialists plus their families. The contract is tentatively to be set for a five-year period of time. Such projects do not involve equity but expertise. In the same way Soviet officials have come to reconcile themselves with the need for on-going servicing and adapting of such highly technical products as computers. Allowing for such long-term contact is indicative of the new recognition by Soviet officials that turnkey projects involve more than just one turn of the key.

III. Conclusion

What the combined effect of all these various factors will be remains to be seen. The Soviet Union is allowing itself to become more intertwined into the world economy. No one move by itself has been all that far reaching, but the totality of these processes in recent years and in years to come, may eventually bring about a qualitative change. As of now the U.S.S.R. may still be able to extract itself without too much trouble, but it is clear that if the present trend continues, the cost of severing ties with the West will mount rapidly. For example initially the U.S.S.R. did not buy as much feedgrain in 1975 as it should have. This necessitated the premature slaughter of at least 14 million pigs, about 20 percent of the herd. This show of independence proved to be too early. Ultimately to prevent additional slaughter, the Soviet Union found it necessary to reenter the market in late April 1976 and supplement its initial large but obviously inadequate purchase. The same type of phenomena is likely to occur if in the future the Soviet Union decides to cut itself off from an adequate flow of Western technology and interchange. The Soviet Union will need this interchange to continue to use its new sophisticated technology such as computers, copiers and chemical and electronic equipment. This is the inevitable result when the Soviet Union involves itself in economic activities which necessitate continual interchange with foreign countries.

Based on the record to date, there is strong evidence to indicate that the Soviet Union may already find itself interdependent. Thus they have maintained their commitment to trade actively despite what may have been some of the most trying and embarrassing aspects of interdependency. Certainly if they had wanted to, in the last few months Soviet leaders could have found adequate excuse for returning to autarchy. The passage of the Jackson-Vanik and Stevenson Amendments probably did anger some Soviet leaders into calling for a cessation of trade. Indeed imports from the United States did fall slightly shortly after the passage of this restrictive legislation. Nonetheless Soviet foreign trade continued at a high level throughout the rest of the world and subsequently by late 1975 even imports from the United States rose and reached a new record. They not only exceeded the levels in 1973, but were second only to the purchases made in Germany.

Similarly the valuta crisis of 1975 and the embargo imposed on American shipments of grain to the Soviet Union might have led the Soviet Union to withdraw from world markets as it did in the 1930's. But the Soviet Union endured.

If they can endure adversity as well as they have, then it seems reasonable to assume that if something resembling a détente-like

atmosphere prevails in the future, Soviet leaders are likely to expose themselves to more and more of these dependency-like situations. That assumes, of course, that the non-Communist economies of the world will continue to prosper both in terms of standard of living and technical achievement. As long as the Soviet Union perceives that a gap exists, it will probably continue to turn to the West for the products and technology needed to pull the Soviet Union abreast. The longer this process continues, the harder and more costly it will be for the Soviet Union to return to autarchy.

ISSUES IN SOVIET R&D: THE ENERGY CASE

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I. INTRODUCTION

One of the classic problems for any R&D policymaker is the proper composition of his R&D portfolio. Three important aspects of this choice involve: (1) The balance between relatively predictable short-run, versus more speculative, longer-run, efforts to improve the technology of some process; (2) the balance between in-house expenditures to solve a problem and acquiring technology from outside; and (3) the choice between competing paths to the solution of a given problem which are more or less comparable in the time horizon involved. These are aspects of R&D behavior in the USSR which have not been examined extensively, and I want to use this article for investigating them in the concrete case of R&D management in the Soviet energy field. The first task is to explain the nature of the choices more fully in the remainder of this section. Section II will describe in these terms some concrete R&D policy choices which the U.S.S.R. faces in the present energy situation. Section III will attempt some interpretations of how these policy choices are made in the energy sector, both on the basis of the lines being followed currently and on the basis of some earlier examples.

1. In seeking technological progress, there is usually a choice between what might be described as incremental improvements along a well established technical line, and more fundamental breakthroughs involving new concepts and principles. The former approach is usually susceptible to tolerably accurate projections of cost, timetable and degree of improvement in performance. This approach may suffer, however, from declining rates of improvement and may face some upper limit on the performance levels achievable. Thus the gains from raising the steam conditions at which turbogenerator units operate are fairly predictable, the conditions making them possible are understood, but the gains from additional reheats and higher temperatures and pressures, get smaller as this direction of improvement is pursued.[1]

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[1] FPC National Power Survey: *Energy Conservation, The Report and Recommendations of the Technical Advisory Committee on Conservation of Energy,* December 1974, Washington, D.C.

The second approach usually involves a shift to new principles, as from use of a steam turbine prime mover alone to thermodynamic cycles which combine magneto hydro dynamic generators or gas turbines with steam turbines. Any given line of technological improvement might be thought of as following a slow adaptation that enables it to take advantage of and fully occupy some technical-economic niche. "Niche" is here to be understood in such terms as relative input scarcities or scale of application. Changes in this environment niche may make it necessary to go over to some quite different technology.

The distinction made here parallels somewhat that between basic and applied research, though even the long range approaches are likely to be based on some already discovered property or principle. Thus an approach to large scale power transmission utilizing super-conductivity is based on a well-demonstrated physical phenomenon, but the employment of this principle will have to involve a wide search for knowledge how the phenomenon varies with kind of conductor and temperature.

Exploiting a familiar tactic to improve technology is often justified by its predictability, but whoever is managing the overall program should also be buying insurance against changes in the environment and knowledge to improve the predictability of alternative approaches. The two may also differ regarding the possibility of a trade-off between time and resources. For the more speculative approach a way may have to be felt out slowly along a branching network, and it may be impossible to shorten the process just by throwing resources at it. But in pursuing established principles, it is often possible to accelerate progress by trading resources for time.

To properly understand the problem posed by the alternative strategies, it must be recognized that there is likely to be a spectrum rather than a dichotomy, and that the real problem is not just to achieve an optimal balance at a given time, but a need for dynamic management. It is necessary to decide when a long range speculative approach has either shown enough promise to justify moving on to the next stage or sufficiently discouraging results that it should be terminated. Similar decisions are required to carry it on through experimental pilot plant stages and finally to its introduction into the economy.

2. In relation to national R&D policy, the inside-outside choice means domestic development versus borrowing from abroad. For the USSR this choice is importantly colored by the fact that it is generally behind other countries technologically on a broad front. Whenever Soviet R&D managers are considering the type of improvement based on incremental change, the technological stage to which they aspire is likely to be available through borrowing. If the USSR needs improved compressors for gas pipeline operation, it could get them from abroad instead of developing or improving the domestic product. It is much less likely to be possible to do this for the other type of change, and countries not too far outdistanced by the front runners may have almost as favorable prospects as the advanced countries for making a breakthrough in pursuing novel approaches.

Borrowing shortens the waiting period and diminishes uncertainty beyond even resort to domestic exploitation of a proved tactic. It does not eliminate delay and uncertainty entirely because there is a prob-

lem of absorbtion, and it may be necessary to maintain indigenous R&D effort in the relevant technology to be able to adapt and diffuse the borrowed technology. There are costs in acquiring technology by transfer from outside and the issue is how much saving can be realized in domestic development efforts. How transferable such saved resources are will usually be important in this choice, and R&D resources that have failed in matching technological innovations made outside may not be easy to utilize effectively. In particular they may not be suitable for work at the farther horizon.

3. A third problem is that of allocating resources between competing alternatives. Even when one is thinking in terms of a given time horizon and the utilization of a given principle (say power from fusion by the end of the century) there are likely to be competing concepts that can be followed. As Academician Artsimovich is reported to have said about fusion research, "It is still unknown on what branch this golden apple will grow." (*Vestnik ANSSSR*, 1975 :2, p. 30.) Within the portfolio, therefore, the effort at any degree of speculativeness requires a decision as to whether there should be competing programs and institutes, and how resources should be allocated between them.

These problems are inherent in all R&D policy planning, but they appear to be especially prominent in the energy sector. The next section of the paper describes in these terms some of the R&D issues which Soviet planners find themselves facing as they analyze the current energy situation, i.e., some of the "tasks and issues" in energy R&D.

II. R&D Choices in Soviet Energy

The energy problem in the Soviet context differs somewhat from the way it is seen in the United States, but expressed in the most general terms it is the same, i.e., to take action to increase (or conserve) energy supply at as low a cost as possible. Some important choices at the strategic level are what level of foreign trade in energy products should supplement domestic production or consumption; the choice between increasing primary energy output versus increasing the effectiveness with which energy resources are used; and for any given level of primary energy output, what balance to strike among competing sources such as coal, natural gas, oil, nuclear and hydroelectric power. The choice among these alternatives is complicated by uncertainties about cost, growing out of uncertain rates of technological change that will occur as a consequence of R&D programs already in operation or newly undertaken to improve technologies or develop new ones. These changes will take place not only in the technology of discovery and production, but also in transport and utilization. To be concrete, the increment in Soviet energy output in the Tenth Five Year Plan will come mostly from Siberia—to the extent of almost 90 percent.[2] Utilization of this output in the European part of the USSR will require novel or significantly improved transport technologies, such as the cooling of gas for transport and development of long distance high voltage power transmission. The use of Kansk-Achinsk coal will involve changes in utilization technology, since without the development

[2] This section is based mostly on data in the "Guidelines" as reported in *Ekonomicheskaia Gazeta*, 1975 : 51, with additional detail on the minor sources from the early 1976 issues of the branch journals.

of processes for converting this low-quality lignite to a product with higher heating value it is not transportable, and even its use in mine-mouth power plants has not yet been mastered.

Much of the growth in Siberian energy output could be achieved on the basis of current technology, but the magnitude of the output increases, and the impact of the novel elements is such that this would take far too long and involve unacceptably high costs. It would be possible to mine Siberian coal in mines much like those now in use, but the planned increment of almost 100 million tons is so large that the new mines ought to be exploited with much better equipment than that now used. The size of gas flows is such that a decision simply to replicate current pipelines would mean very large construction outlays including very large inputs of steel for pipe. Hence there is a strong motivation to introduce new technologies that will raise throughput of a given size line. The transmission of the amount of power intended to be produced at coal based plants in Siberia to the European USSR at the upper voltage limit now mastered on long distance transmission lines (750 KV) will be far too costly, so it is necessary to move to a higher voltage level. To use that coal only at mine mouth so that its energy output would be available in Europe only in the form of electric power is too confining, so there is a strong inclination to develop processing technologies to make the coal shippable as a solid or liquid fuel as well. The Tenth Five Year Plan guidelines envisage a significant shift to hydroelectric plants and to nuclear power in the construction of new capacity. (Each are to account for about 20 per cent of new capacity in the quinquennium.) The hydroelectric alternative does not involve significant technical breakthroughs, but the shift to nuclear plants does involve a considerable R&D effort. The Russians have developed several types of nuclear powerplants, but there is a big technological problem to be overcome if nuclear power is to take on the important role assigned for the 1976–1980 period. Much of the capacity installed so far has been essentially tailor-made and the calculations justifying a rapid shift to nuclear power involve big economies from large scale production of equipment for nuclear stations. As the Minister of the industry producing the equipment says, "serious qualitative changes will occur in atomic machinebuilding with the transition to series production of larger unified power equipment for nuclear blocks of 1–1.5 GW capacities." (V.V. Krotov, in *Ekonomicheskaia Gazeta*, 1976 :15, p. 5.) In other cases as well Soviet planners are quite candid about the fact the the guidelines for fuel and energy presuppose successful solutions to significant R&D problems.

For the conservation alternative, some of the choices are among alternative ways to improve fuel efficiency in thermal power generation. Some possibilities are MHD generators, gas-steam turbine cycles, and the design of more economical equipment for heat and power combines. Some of these lines of energy conservation are less dependent on technological leaps than on responsiveness to altered price and incentive signals.

The kind of R&D tasks that need to be done at a somewhat lower, less strategic, level can be illustrated with a sample of technological issues taken from each of the energy branches. There is no point in trying to make an exhaustive inventory, but it will be helpful to

describe enough examples to provide a concrete idea of what the managers of energy R&D are up against.

In oil and gas exploration and development the major technological needs are improved drilling, improved recovery, offshore exploration and production technology. These illustrate the theme of competing technologies—if it were possible to drill deeper, develop offshore production, get more recovery it would be possible to avoid the kinds of improvements that will otherwise have to be made in finding, transporting and producing Siberian oil and gas. Exploitation of offshore potential is a case where foreign borrowing is an obvious maneuver to bypass the poor performance domestic R&D efforts have achieved, but there are many other such cases all across the spectrum of oil exploration and development technology.

Gas transport and storage is viewed by Soviet officials as in need of a complete technical re-equipment. Here too, there are many possibilities for skirting the weaknesses of the domestic innovation process by importing foreign technology, and indeed gas transport is one of the areas where the decision has often been to do so, by importing pipe, compressors, and gas processing equipment. But gas transport is probably most interesting as an example of the balance between pursuing traditional routes to technical progress versus thinking farther ahead. Gas is simply very uneconomic to transport in comparison with liquid fuels, and involves very large capital investments. So far, larger throughput capacities have been achieved by increasing pipe diameter, compressor station horsepower, and pressures, and by building additional lines on a given route. These tactics all exhibit falling returns to further extensions, and there is now much interest in sending gas in liquified form.[3] The throughput capacities of such pipelines would be so large as to make them suitable only for very large flows, but exploitation of Siberian gas will generate such flows and such a technology offers the possibility of big savings. But from an energy point of view liquification is very wasteful, and to be economical it needs to be designed as part of an energy *system*, rather than merely as a transport technology. Some way needs to be found to use the heat rejected at the compression end, and to use the cold at the regeneration end. Such pipelines also require new kinds of steel, cooling equipment, and much else. So there would seem to be a problem of balancing effort toward developing such a technology against effort intended to extract the last possible gains within the present technological framework. These could include internal coating for pipes, new grades of pipe that can both save steel and permit higher working pressures, cooling the gas slightly, and more reliable turbocompressors to permit capital savings.

In coal mining, the routes toward saving current inputs (especially labor) and in minimizing the investment requirements needed to meet output expansion targets are basically to increase stripmined output beyond its share of 31.7 per cent in 1975, and a thoroughgoing technical re-equipment of both strip and underground mining. These are to some extent alternative possibilities, implying different allocations of effort in research and development. The Soviet planners have a

[3] This argument is eloquently developed in a pair of articles in the 1975:5 issue of *Ekonomika i organizatsiia promyshlennogo proizvodstva*—V. A. Smirnov, "Gazovaia promyshlennost," and O. M. Ivantsov, "Ekonomika szhizhennogo prirodnogo gaza."

strong preference for the expansion of open pit mining in Siberia as the answer because it is the bold new step into the unknown, that does not involve the problems of dealing with existing organizations and personnel, and adapting technical change to a great variety of situations. But expansion of strip mines involves some significant gambles in achieving technological breakthroughs. The USSR has never fully realized the great economies of scale possible with the use of larger equipment in strip mines. Soviet excavators and trucks are relatively small, for example, the largest Soviet truck used in open pit mining was for a long time 27 tons compared to truck capacities of up to 150 tons in the US. A few 40 ton trucks were introduced in the last years of the Ninth Five Year Plan (*Ugol'*, 1976:2, p. 38). The average shovel size for excavators in the Kuzbass in 1972 was only $3m^3$ (*Ugol'*, 1972:8, p. 27), compared to $5\text{-}6m^3$ in the US, and the largest Soviet excavator has a 35 cubic meter bucket (*Ugol'*, 1976:2, p. 35), compared to a US model with a 170 cubic meter bucket (*Bituminous Coal Facts.*, 1972, p. 14). If the large new open pit mines are to improve on the extremely low labor productivity now characteristic of Soviet coal mining, much larger equipment will have to be developed.

For electric power, the strategic goals are to reduce construction costs per KW, improve utilization of capacity, reduce the heat rate. These depend on improved equipment and on fuller integration of stations into systems, which in turn depends on automatic control and on high voltage transmission. More will be said about the first three in the next section, but it is apposite here to note that the transmission task is a striking example of the need to balance short and long run approaches. These are discouraging penalties in pursuing the present strategy of raising voltage to reduce line losses. As voltages rise, the problem of insulation increases, and the capital investments become very large. The towers must be higher and the conductors farther apart, to maintain air insulation between conductors and between the conductors and the ground. At the same time the size of the corridor must be increased. These relationships lead to a maximum economical capacity for a line, and to handle really massive transfers from Siberia to Europe, such a line will have to be replicated several times over. The design capacity for the proposed 1500 KV DC line from Siberia is 6 gigawatts, i.e., the same as the capacity of the large mine-mouth station to burn Kansk-Achinsk coal. (*Energetik*, 1971:3, p. 8.) The eventual capacity for the Siberian coal-based generating complex is to be about 70 gigawatts. Academician V.I. Popkov, one of the most noted Soviet scientists in this field, asserts that following the present line can only lead to a dead end. The alternative is a move to some very high capacity alternative such as gas-insulated conductors, waveguides, or superconductive, cryogenic lines. (*Vestnik ANSSSR*, 1967:5) But that technology is still at the purely conceptual and experimental stage. The issue is again how to spread research resources between expansion along the traditional path and the search for a breakthrough on the novel path.

These are only a small sample of the technological tasks that will have to be performed to carry out plans for the fuel and energy sector in the coming years. The purpose in describing them has been mainly to illustrate some principle points concretely, i.e., that the level of

technology in the Soviet energy sector is sufficiently backward that Soviet planners can think of technological transfer as one alternative; that they must think beyond the time perspective of the current FYP base for more radical breakthroughs; and that they have competing alternatives among which they must allocate their effort for solving some of the technological requirements. The next section undertakes to explain how these choices are made, and in the process will add to this list of specific technological tasks and issues.

III. Decisionmaking Approaches

What can be said about how the three basic choices described in Section I are handled in the Soviet context? At one level it is simple to state how these choices should be made—given information on alternatives and a choice criterion, the matter is easily settled. The dominant feature of economic choices about R&D, however, is that information is not given, that uncertainty is inherent in the situation. The simple answer to this dilemma is to mask uncertainties with forecasts, and optimize on the basis of those forecast,[4] while allocating some resources to reduce the range of uncertainty. This process must be repeated over and over as experience and new knowledge changes the forecasts. At this level of generality, Soviet discussions of energy policy and the associated energy R&D policy seem eminently sensible. The planners are fully appreciative of the problem of uncertainty, the need for revisions of forecasts, the importance of creating a backlog of information that can improve decisions as time passes. Academician Styrikovich puts it well in his discussion of optimizing energy decisions:

> While choosing the most probable variant of the energy balance it is necessary to make provision for small expenditures to support the possibility of a timely transition to a less likely variant if time shows that development goes in that direction. . . . Long term calculations, even though imprecise, are nevertheless exceptionally important, since only they make it possible to plan scientific research aimed at far-distant goals, which require a long period of time for their conduct. . . . It is natural that work on optimizing the development of the fuel and energy sector should have a continuous character, correcting calculations as the prospects for the development of technology and new scientific discoveries become clearer.[5]

The problem is how to operationalize these commonsense ideas. Also, our experience with Soviet descriptions of how planning works suggests that there is always a more complex and less coherent reality behind any superficial general description. So we will proceed to two levels, both giving some idea of the planning approaches and machinery for these decisions and looking at some actual cases that suggest the kind of problems encountered in making them work.

A. Modeling and Forecasting

The basic approach in Soviet efforts to chart energy policy is modeling. In particular, energy is the sector where linear programming

[4] No attempt will be made here to go into the substantive issues of this process—i.e., what kind of variables are forecast, whether they are forecast as point values or distributions, what an optimum means when variables are forecast as distributions, etc. Suffice it to say that the Soviet literature includes discussion of such issues.

[5] In ANSSR, *Oktiabr' i nauchnyi progress*, Vol. 1, M, 1967, pp. 348–351.

models have been applied in the USSR on the largest scale and with the greatest impact on planning.[6] The basic approach is to forecast cost or technology co-efficients and demand, then to choose sources, transport modes, allocations by fuel among users and regions to minimize cost. The models may be run with variant assumptions about costs and technology, to suggest the areas of technical progress most important for reducing the total input bill. An exercise conducted by the Academy of Sciences, the State Committee on Science and Technology, and a number of ministries and departments, for example, distinguished between optimal, cautious and intermediate assumptions about technical progress, showing the consequences of each for capital requirements.[7]

Modeling may also be used to set technological goals. The people responsible for testing alternative technologies for meeting peak needs in power generation (pumped storage, gas-turbine plants, more system inter-connections to make surplus capacity available) set a criterion that no proposed solution should raise cost more than would addition of capacity in standard thermal stations. They then calculate a shadow price for the permissible capital investment cost per KW, and examine under what conditions various proposed new technologies could meet this condition.[8]

It is also possible to make forecasts in which technological change is treated as more or less exogneous, and there is a very large Soviet literature of this kind.

An especially instructive statement of the relationship of forecasts and models to energy policy is found in an issue of *Energetika i transport* (see 1974:3) almost wholly devoted to surveying overall fuel policy and the many technological trends that will have an impact on it. Examples of surveys on more specialized aspects of technology are forecasts of changes in thermal power engineering, and boiler technology in *Teploenergetika*, 1975:5 and 1975:9.

This forecasting and modeling work is performed and reviewed in a great variety of Academy and branch NII's and Gipros (project making organizations), the State Committee on Science and Technology, the Scientific Councils controlled by the Academy and other organizations,[9] and the Scientific-technical Councils of the ministries. Some forecasts appear to constitute rather perspectives by knowledgeable individuals, but most of the work involves rather elaborate institutional efforts which may include extensive surveys of foreign experience, large scale data collection, laboratory or computer studies for more technical issues. Some may involve fairly extensive technical-economic analyses of alternative solutions on the basis of alternative assumptions about prices, technical parameters, and forecasts of input-output ratios. A typical example is a forecast of the economic areas

[6] Soviet experience with energy modeling is described in detail in A. A. Makarov and L. A. Melent'ev, *Metody issledovanitia i optimizatsii energeticheskogo khoziaistva*, M, 1973, pp. 269–273. The authors list 139 references to significant studies of this type, covering all the important energy branches.

[7] *Vestnik ANSSSR*, 1974: 2; *Neftianik*, 1975: 1, pp. 4–7; or *Energetika i transport*, 1974: 3.

[8] See for example *Teplotekhnika*, 1971: 3, p. 4, or E. R. Sivakov, (ed); *Tekhniko-ekonomicheskia voprosy elektromashinostroenita i energetiki*, M, 1972, pp. 40–45.

[9] These scientific councils have responsibility for reviewing scientific progress in various areas, pointing out the possible implications for new technology, and recommending research programs to follow them up. There is, for example, a scientific council in "scientific foundations for the utilization of super conductivity in power engineering" which developed such a plan in 1972.

of application for electric motors with superconductive excitation, based on data for a design in the stage of laboratory study at VNII Energomashinostroeniia.[10]

One finds abundant reflection in the Soviet literature of this institutional and methodological machinery at work—the forecasts and proposals themselves, description of studies, summaries of discussions at the scientific councils, and the recommendation they adopt. What does not come through at all clearly is much sense of the quality of this forecasting and evaluation work, or of the decision process. We can only make conjectures and deductions about these matters. One general weakness is likely to be the failure to set up and evaluate enough variants or subject projects and forecasts to serious and objective evaluations. One discussion of modeling says that compared to the energy modeling in capitalist countries, Soviet researchers have inadequate computer capacity to exploit its potential. (Makarov and Melent'ev, *op.cit.*; p. 61.) And there are enough indications of mistaken technology forecasts to suggest that serious commitments are made on the basis of insufficiently tested ideas.

It is interesting, for example, to compare what was in the minds of the technical experts in power engineering at the beginning of the Seven Year Plan with what later happened. One question was what size and steam conditions should be employed for the next step upward from the then standard 160 MW units. A number of suggestions and alternatives were considered, but the basic idea was to go for a 300 MW unit using steam at 240 atmospheres and 580° Centigrade. These conditions were chosen explicitly on the basis of a forecast that it would be possible to build such equipment using perlitic steels (*Elektricheskie stantsii*, 1958:2, pp. 2–6). The forecast about the properties of the steel was seriously in error, and in the design phase the steam temperature was lowered to 565°, then in operation to 545° because the inadequacy of the steel led to excessive repair.[11]

Errors in forecasting are inevitable in any system, but there are strong hints in many of these cases of overoptimistic forecasts of the technical level achievable given the quality of supporting inputs and fabrication skills. Many of the early 300 MW units performed very badly, with low reliability and high fuel costs, and it has been suggested that the decision to go with this model was taken on the basis of too little knowledge and experience.[12]

The crucial questions remain obscure—how funding levels for long range research are set; the mechanisms by which forecasts get turned into decisions about technological directions and development commitments; the process of reality testing by which a decision is made to give up an idea; how a perspective is corrected in the light of growing knowledge; how the judgment is made that the time has come to choose a direction and move ahead. Perhaps the best way to get some perspective on these questions is to proceed to look at some cases.

[10] E. R. Sivakov, *Perspektivy razvitiia i effektivnost' elektroenergeticheskikh mashin i sistem*, M. 1973, pp. 78–81.

[11] Leonkov, A. M., *et al. Spravochnoe posobie tenloenergetika elektricheskikh stantsii*, Minsk, 1974 and "U.S. Delegation Visits Russian Facilities," *Electrical World*, Sept. 15, 1974, p. 70.

[12] CIA, Directorate of Intelligence, *Comparison of Powerplant Technology and Costs in the USSR and the United States*, Nov. 1965, p. 6.

B. The Long and the Short View

A simple deduction from the short time horizon characteristic of Soviet planning might be that one could expect a neglect of speculative work on potential long range solutions. But such a working hypothesis would be quickly rejected. Indeed due attention to forward looking research may be the strong point of the system. The energy technology sector exhibits many examples, such as work on exotic approaches to long distance power transmission; early work on underground coal gasification; pilot plant experimentation with lignite processing to produce high quality fuel as early as 1957; early and continuous support of a breeder reactor in the nuclear program; the extensive work on MHD, construction of an experimental tidal power station; and work with peaceful nuclear explosions in energy applications.

These programs are often pursued for a very long time in the face of adversity. The turbodrill program suffered setback after setback from the time it began in the 30's until it became an effective contributor to drilling technology in the fifties. There was a similar persistence in the effort to develop underground coal gasification. Asked at a public lecture what the prospects for coal gasification were, the deputy minister of the coal industry replied:

> We have worked on this for decades—institutes, groups of specialists and engineers. We have experimental gasification sections in the Moscow and Kuznetsk basins. Unfortunately, during all these years we have not gotten any positive results. The gasification process turns out to be uncontrollable, and the heat value of the gas obtained is low.[13]

Not every far-out possibility gets supported, of course. There are complaints that the great potential of solar energy is underestimated, and that the geothermal program has gotten lost in a bureaucratic limbo. There is a scientific council for geothermal research in the USSR Academy of Sciences, and there has long been support for geothermal research, but it is of little interest to the gas industry that was supposed to be its patron, or to the user ministries. As one exasperated advocate says, "There is today no clear line defining a program for geothermal resources." [14]

It is true that officials at the highest levels appear unimpressed with exotic sources in general, disparaging their ability to make any contribution to the problem of "big energy." (G. V. Aleksenko in *Elektrichestvo*, 1970:4) What seems to influence the high level decision makers in these cases, however, is not so much how long such approaches are likely to take, as how much of a contribution they will make even if successful.

My guess is that there is little careful effort to balance the two kinds of effort against each other field by field. Rather long and short term approaches are treated as two different spheres of activity, one of which is to create a *nauchno-tekhnicheskii zadel*, *i.e.*, an inventory of new ideas and experimental results that can serve as a basis for the solution of future problems, and the other to develop technology to solve current production tasks. Provision is made for each, and each is allowed to proceed more or less on its own. Work on longer range

[13] L. Grafov in *Energetika budushchego*, M, 1974, p. 46.
[14] *Ekonomicheskaia Gazeta*, 1973 : 48. See also a recent plea for more attention to renewable sources in *Kommunist*, 1976 : 2, pp. 62–65.

alternatives is assured by "decoupling" a part of the R&D establishment and budget from the control of decision-makers concerned with solutions that can be used currently. This is the obverse of the frequently noted independence and unresponsiveness of the R&D establishment to the needs of industry. This is often seen as a defect of the R&D enterprise in the U.S.S.R., but it has the important advantage of defending the R&D establishment from the myopic bias of production officials.

The greatest weakness is probably in the movement from speculative exploratory research to more applied stages. There may be a kind of indecisiveness at this stage. Once an institute gets started on some project, or an experimental effort is initiated, it is likely to coast along, neither being dropped because of discouraging results or moving on to a next stage if there are encouraging results. Three examples illustrating this conjecture include the experimental geothermal power plant at Pauzhetsk, the project for power-technological processing of lignite, and the program for using diamond bits with the turbodrill. The power plant at Pauzhetsk is said to have operated successfully since 1966, but this success has never been followed up. The lignite processing program stagnated between the time it reached the pilot plant stage in 1957 (*Elektricheskii stantsii*, 1958:2), and the present, when hindsight suggests that a larger scale plant should have been built to accumulate experience in preparation for the current urgent need to move to very large installations. The long experimental program with diamond bits for use with the turbodrill gave very promising results,[15] but has never spawned a real commercial followthrough.

MHD is an interesting case in this respect, since it represents a more or less continuous movement from early research on a novel idea to an ambitious program of development. But it may not be a very typical case; the ability to shift to applied development with the big investment which this decision involves is probably best explained by the fact that MHD began as the brainchild of V. A. Kirillin who later became the director of the State Committee on Science and Technology and was thus in a position to see that the project was not neglected. Furthermore, the decision a few years ago to construct an experimental plant may have been premature in terms of the readiness of the supporting technology, and the basic understanding of the relevant phenomena. The principal difference between the US and the Soviet MHD programs is that we have not yet moved to the kind of expensive experimental installation the Russians chose but have focused on generating test data for alternative concepts.[16] The Russians have been able to make up for some of the obstacles to their program (especially the equipment to develop strong magnetic fields) through co-operation with the US. And the final word is not yet in on the success of the Soviet approach. It is interesting that in the guidelines for the Tenth Five Year Plan and in current discussions of prospective technology improvements in electric power generation, the planners omit any mention of prospects for the early introduction of MHD.

It seems likely that the dynamic management of the development process is distorted by a strong proclivity for going from forecasts to general strategies that then control allocations and directions for a

[15] N. N. Pobedonōsteva, *et al., Ekonomicheskaia effektivnost' almaznykh dolot*, M. 1972.
[16] Rudins, G., *U.S. and Soviet MHD Technology: A Comparative Overview*. Rand Corporation, R-1404-ARPA, January, 1974.

long time, combined with great inertia that makes it difficult to re-evaluate these strategies. This is what one would expect in a large and highly centralized organization. There are numerous examples, one of which will be described here—i.e., policy on heat and power combines.

In heat and power combines (*teploelektrotsentrali* or *tetsy*) heat rejected in power generation is captured and supplied to factories and urban apartment complexes for industrial processing and space heating. But this strategy was not adapted to fit the actual conditions. Errors were apparently made in several respects.[17] A doctrine grew up that condensing type turbines with intermediate withdrawal of steam were preferable to the back pressure type since they could add to power output even when there was no heat load, but in the conditions of many stations the overexpenditure of fuel during operation as condensing stations more than offsets the fuel saving during the time when there is a heat load. Also the line of heat and power equipment was never redesigned to fit the new situation when standard condensing stations achieved low heat rates via improved steam conditions. And calculations underlying the economic justification of the combines were always falsified by actual heat loads lower than those projected in the calculations.

This kind of inertia also causes problems farther downstream in the development process, as the policymakers seem to stick to some chosen solution and scale in the face of an inability of the economy to carry it out. The handling of the peak load problem in electric power generation is an example. The task is to design equipment that operates a relatively small fraction of the time. So it must be capable of being started and shut down quickly. Also for this reason the designers can accept high fuel expenditures to economize on capital. The Soviet Union had to face the peaking problem rather later than other countries, since such features of the Soviet market as multishift operation, long work weeks and the heavy dominance of industry over household and commercial demand gave them a relatively flat load curve. At the same time the large share and wide distribution of hydroelectric capacity permitted its use for peaking purposes, and made it possible to optimize thermal units for base-load operation. In doing so the designers created units incapable of stable operation at low loadings. But these conditions have changed and though there was early and widespread awareness of the need to develop both peaking equipment to operate for a few hours a day and semi-peaking equipment to operate 10–12 hours a day, progress was slow. Work was started early on pumped storage and gas turbine units—but these efforts appear to have faltered at the intermediate, pilot project stage needed to turn them into working parts of the technological inventory. The gas turbine units were not optimized for their role—and the semi-peaking problem was not even addressed.[18]

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[17] A. M. Leventae' and L. A. Melent'ev, *Tekhniko-ekonomicheskie osnovy razvitiia teplofikatsii v energosistemakh*, M–L. 1961.

[18] The history of delays in the experimental program can be reconstructed from a series of decrees in *Reshenüia Partii i Pravitel'stva po khoziaistvennym voprosam, 1917–72*, volumes 1–8, and from the electric power industry journals. M. A. Styrikovich in *Energetika i transport*, 1973 :2, p. 7, is the source for the point about optimal design. The adverse consequences of the delay in the effort to develop semi peaking equipment are evident in pronouncements by power industry spokesmen in the current journals.

C. Competing Alternatives

How is a choice made between competing alternatives for a given mission within a given time horizon? The general impression most observers have of the Soviet system is that there is great reluctance to pursue more than one alternative at the development stage. This impression is generally confirmed in what I have found so far in the energy sector. There is extensive consideration of competing alternatives at the concept stage, and at the stage where competing concepts are worked up into preliminary (eskiznye) project designs for technical-economic comparison. But beyond that point there is great reluctance to pursue more than one alternative.

In a few cases there does seem to have been conscious competition. At the point when it was decided to go beyond the 300 MW turbogenerator unit, the Leningrad Metal Plant produced two different 800 MW turbine units and at the same time the Khar'kov Turbine Plant produced a 500 MW unit to be fueled with Kansk-Achinsk coal (from the Nazarov mine). All three seem to have been conceived of as competing alternatives. In the end it was decided that as between the two 800 MW units the single shaft version was the most suitable for development. The 500 MW unit was apparently a complete failure, but a decision was made at some point to make a second try, and a second 500 MW unit was created and installed in the Troitsk power station in 1974. This second version is designed to burn Ekibastuz coal rather than Kansk-Achinsk lignite, however, so I suspect that in addition to the problems with the generator and turbine on the original 500 MW unit, (acknowledged in *Energetik*, 1975, pp. 5–6), there was a problem with the boiler unit as well. That is, it could not handle the low quality lignite from the Nazarovo mine.

The nuclear power program embodies in obvious form the problem of pursuit of competitive technologies both within a given time horizon and over different time horizons. A fast neutron program was conducted more or less in parallel with the thermal neutron programs, and two rather different paths were simultaneously pursued in the latter—the VVR, (a water-moderated, vessel-type reactor) and the channel-type, graphite-moderated reactor. There seems never to have been a significant high temperature gas reactor program, however. The history of the two slow-neutron reactors provides tantalizing hints of the competitive process at work. The first Soviet experimental power reactor was a graphite-moderated reactor, and out of the original program there developed several second stage efforts to improve this type of reactor. There must have been some doubts about it, or some decision adverse to it, however, and the first significant commercialization was based on the VVR. At the time the Seven Year Plan was being worked out, one source reported that the Leningrad nuclear plant would be of the same type as the Novovoronezh plant—i.e. the VVR.[19] When actually built, however, the Leningrad plant was the first to use the commercial version of the channel type reactor, the RBMK–1000.

[19] Zolotarev, T. L., and E. O. Shteingauz, *Energetika i elektrifikatsiia SSSR v semiletke*, M–L, 1960, p. 158.

When the US nuclear power delegation visited the USSR in 1970, their Soviet hosts were in general very forthcoming on most matters but apparently provided no indication that there was an active program to develop the RBMK–1000. When another group visited in 1971, they were therefore much surprised to find work well advanced on the Leningrad station, employing this new type.[20] The development of the RBMK–1000 must have gone back some time, of course, and a Soviet book published in 1969 speaks of a 1000 MW graphite-moderated, channel type reactor as very promising.[21] I have not yet found enough information to offer an interpretation of how the competition between these two programs worked, but even these superficial glimpses suggest that at some point the commitment to the graphite-moderated reactor wavered seriously. The subsequent explanations of the rationale for this design in Soviet sources [22] (safety, and its ability to produce significant amounts of the plutonium needed for any significant expansion of breeder reactors) provide tantalizing links to other of our concerns, i.e., the problem of co-ordination over time, and the changes in the outside variables to which the technological planners are trying to adapt their choices.

Another example is provided by competing versions for processing Kansk-Achinsk coal into a transportable fuel. Apparently the two institutes ENIN and IGI have developed alternative methods for processing this coal, there has been some kind of competitive evaluation, and the ENIN method has been recommended for scaled up development at the Kansk-Achinsk fields.

The procedure was for Teploenergoproekt (one of the major electric power gipros) to make a recommendation to the scientific-technical council of Minenergo, on the basis of which Minenergo decided to move to the pilot plant stage. (*Energetik*, 1974 :8, p. 37.)

But these and similar examples are probably outweighed by others in which commitment to large scale development and deployment of only one among competing alternatives seems to be the rule. We may cite the example of the turbodrill, in which a whole hearted commitment to this technology meant a simultaneous neglect of traditional rotary drilling technology.[23] The process of deciding on a boiler design for the burning of untreated Kansk-Achinsk coal can be seen at work in several reports in *Teploenergetika* in 1974 and 1975. The boiler people produced *eskiznye proekty* in several variants, which they presented to the Scientific-technical Council of Minenergo. The council made some decisions as between the alternative concepts, but asked the R&D organization to re-examine some aspects of the alternatives and report further. (*Teploenergetika*, 1957 :7, p. 92.) It is clear that Minenergo has no intention of authorizing more than one experimental version of the boiler.

It is common, of course, to resort to competing technologies when there is trouble with one already chosen. There has been a long standing commitment to gas-turbine powered compressors for gas pipelines, but as a consequence of the failure of this solution to work effectively,

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[20] *Soviet Power Reactors, 1970*, August, 1970 ; *Science*, September 10, p. 1003.
[21] Batov, V. V., and Iu. I Koriakin, *Ekonomika iadernoi energetiki*, M. 1969, p. 16.
[22] See, for example, the article by an official of Glavatomenergo in *Energetik*, 1974 : 6, pp. 3–4.
[23] Robert Campbell, *The Economics of Soviet Oil and Gas*, Johns Hopkins Press, 1968, pp. 103–108.

the planners have on numerous occasions backtracked to resort to alternatives—substitution of electric motors, use of piston compressors, aviation type turbines, and import of foreign equipment (a point to which we will return below). But this is more in the nature of a response to an emergency, rather than a conscious effort to pursue alternatives simultaneously, and to differentiate them for specific needs.

D. Borrowing Versus Domestic Development

Finally, let us consider specifically how a decision is made to borrow rather than depend on local efforts to handle some technological problem. First, the notion that it may be cheaper to borrow technology than to develop it domestically is still somewhat novel for Soviet policy makers. They have surely often thought that it would be convenient to solve some problem with foreign equipment, but the notion of a conscious policy choice to be made routinely and systematically is probably still not very common. The general Soviet approach to technological progress is to have a full range of institutes supposedly competent to develop the technology in every field or branch. This is well illustrated in the energy field, where there is an extremely large and comprehensive set of specialized NII's, KB's, PTI's and project-making institutes covering every aspect of energy. The size and scale of the network of institutes serving the coal industry for example is quite extraordinary in comparison with that which exists in the United States. There would seem to be no aspect of coal technology overlooked, from safety to coal processing.

In any given case the decision to go abroad for technology must deal with the question of why the task of developing the technology should not be assigned to the corresponding local organization. Whenever such a decision is contemplated there must arise a dispute in which the Soviet R&D organization argues that if only it were given more resources and a little time, it could handle the problem easily enough. A statement in a recent article in the Gosplan journal puts it explicitly:

> There are more than a few examples where ministries and departments try for years to solve through their own efforts problems that have long ago been solved in other countries. In a number of cases the leaders and specialists of certain scientific organizations consider the decision to buy licenses as testimony regarding their own scientific and technical inadequacy. But only a precise and competent opinion as to how each item and process compares with the world standard and to its prospects for further improvement should be the important consideration in the decision to accelerate our own research and development or to turn to the acquisition of a foreign license.[24]

That last sentence is probably a good clue. Decisions to borrow only grow out of situations where some urgent task requires to be done, but it can be demonstrated that the local level of accomplishment is so far behind the world level that the domestic organizations are hopelessly outclassed. An illustrative case is offshore drilling rigs.[25] The domestic capability was apparently judged to be so inadequate that it was decided to import a foreign prototype. But then the interesting thing to be explained is why in this case only a single rig was imported and the local organization (Gipromorneft) was then given the task of copying it.

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[24] *Planovoe khoziaistvo*, 1975 : 11, p. 8.

[25] Helpful sources for reconstructing this case are articles in *Azerbaidzhanskoe neftianoe Khoziaistvo*, 1974 : 6 and 1975 : 9.

Another clue to the decisionmaking process comes from a discussion concerning a method for figuring the effectiveness of payback deals. Two economists from VNIISt (The All-Union Scientific Research Institute for the Construction of Pipelines) have explained their methodology for calculating the effectiveness of a compensation agreement for the development and export of gas at a meeting of the Scientific Council on Effectiveness of Capital Investment and New Technology.[26] Basically the authors' approach is to net out all the foreign exchange elements in the project[27] and just measure effectiveness in terms of the cost in domestic resources against the output available to the domestic economy. They do add that one of the important variables that needs to be taken into account is what the project will do for the domestic level of technology (p. 151), but they shy away from explaining how those effects might be assessed. The striking thing about this approach is that it sets up the question in such a way that the choice between foreign and domestic technological effort is simply bypassed. The import of technology is a foregone conclusion. There is an issue of how to optimize the project[28], which suggests a question of how much of the technology for the project is to be supplied by each side, but the authors say very little about that, and apparently assume that all important elements determining the technical level will be supplied by the foreign partner (p. 159).

The experience of technology imports in the energy sector in general suggests that the decision to borrow is very heavily influenced by the consideration of foreign exchange availability. The oil and gas industry has been one of the most significant users of borrowed technology, and part of the rationale must surely be the combination of an urgent pressure to expand output with a realization that this expansion of output itself generates the foreign exchange. The coal industry also offers a similar lesson. The policy there has long been to be self-sufficient in technology, despite the demonstrated incompetence of the domestic agencies for generating new coal mining technology. But there has been a recent turn in policy, with decisions to import such items as power shovels, and large vehicles for open pit mining, precisely to assist in the expansion of exports.

IV. Conclusion

As a kind of reconnaissance survey of the problem of some issues in R and D management, this article has not been able to answer definitively any of the questions it started with. But it surely reveals that the experience of the Soviet energy sector is rich in the kind of choices under consideration, and has suggested some possible distinctive features of the system. For many of the cases described here, as well as some others in the energy sector, the next step is further research to reconstruct a more fully documented history of the related R&D programs and decisions, on which to base a more certain judgment as to how the institutional and incentive structure has affected either favorably or adversely the choices discussed here.

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[26] AN SSR, *Metody i praktika opredelenia effektivnosti kapital'nykh vlozhenii i novoi tekhniki, vypusk* 25, pp. 142–180.

[27] They do have the problem of including as a benefit the foreign exchange earnings beyond those required to pay off the foreign credit obtained for the project.

[28] This involves the usual procedure of *variantnaia prorabotka* of the project, using different assumptions about exogenous variables and different values for the choice variables.

SOVIET POPULATION AND MANPOWER TRENDS AND POLICIES

MURRAY FESHBACH AND STEPHEN RAPAWY

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I. INTRODUCTION

Given the demographic imperatives confronting the Soviet Union in the next few years major policy decisions will be required to cope with the resulting manpower problems. The growth rate of the population at the end of the century will drop to about one-third of the rate at the middle of the century. This will mean a much slower rate in the labor force, as other sources of supply have been exhausted, and the new entrants in the working age population are the only numerically significant new supply. The continuing overall labor shortage is fully appreciated by the Soviet central authorities as is evident from the fact that they call for productivity gains as the key to achieving the economic growth expected during the current 5-year plan period. The problem of labor shortages appears even more acute when one looks beyond the aggregate figures at the regional differentials. In the absence of mass migration, past and current regional birth differentials will mean that most of the new labor supply will not be generated in the areas where most of Soviet industry is now located or where future expansion is planned. In addition, the military manpower shares that will come from the southern tier, or non-Slavic belt of the Soviet Union, may also have a major impact on the armed forces of the future. By the end of the century about one-third of the 18-year-old cohorts will be in this region.

This paper incorporates analyses of both population and manpower in the Soviet Union. Because of limited space and time, however, only basic population and manpower trends can be covered here. A preliminary examination is made of military manpower, not to derive new

estimates or to confirm previous estimates, but to try to determine the impact on the economy of the precipitous drop in the size of increments to the able-bodied ages in the 1980's. Because of the indicated regional birth differentials, regional and ethnic factors will become more important in the potential supply of new recruits. An alternative working hypothesis related to various noncombat troops is propounded here to reconcile the varying estimates of the size of the armed forces. A model projection of the potential supply of 18-year-old males indicates that unless changes are made in the term of military service, the length of the workweek, or some other aspect of manpower allocation, demographic, educational, and military factors oblige the Soviet Government and the Party to reduce the size of the armed forces.

For the present paper, the publication of the results of the 1970 U.S.S.R. census of population and the new annual population statistics volume are invaluable. Projections of population prepared by the Foreign Demographic Analysis Division are given to the year 2000 to show the sweep of demographic changes during the remainder of the century. The labor force projections have been prepared for the period up to 1990, whereas annual employment estimates are for the current period, extended somewhat on the basis of the plan for the current 5 years. This paper also presents for the first time a series of man-hour estimates by branch of the economy and by branch of industry, which cover the period 1950–74. These data are indispensable for more precise measures of productivity and of human capital.

II. Population

A. Population Growth

The assessment of the basic dynamics and structure of the population of the U.S.S.R. given in the previous Joint Economic Committee volume remains essentially unchanged.[1] There had been a decline in fertility leading to a marked decrease in population growth; presumably the rate is generally stable. The age and sex distributions of the population are still returning to normal as the effects of the terrible losses during the Second World War recede. However, as a consequence of the slowdown in the overall growth rate, there is at the same time a serious increase in the proportion of the population in the pension ages. Nationality patterns of birth differentials are maintained. Although there was a drop in the actual level of crude birth rates in the Central Asian region, the differentials remain high. As a result, there will be both a drop in the aggregate supply of new labor and a geographic shift of labor resources to the south.

After continued and sustained growth during the 1950's, the rate of growth of the total population of the U.S.S.R. began a deceleration in the middle 1960's (table 1). Because of the drop in the annual average rate of increase from 1.7 percent in 1951–55 to only one-third that rate in 1996–2000, the absolute size of the annual increments will also drop to about half of its peak during the 1950's. Although not following the Soviet pattern precisely for the entire period 1950–2000, the U.S. population's rate of increase drops similarly from 1.7 percent per

[1] See Frederick A. Leedy, "Demographic Trends in the U.S.S.R.," in Congress of the United States, Joint Economic Committee, *Soviet Economic Prospects for the Seventies*, 93rd Congress, 1st Session, Washington, D.C., 1973, pp. 428–484.

year during 1951–55 to 0.6 percent during 1996–2000. Between 1950 and 2000, the total populations increase almost at the same rate—the U.S.S.R. by 73.4 percent and the U.S. by 72.4 percent.[2]

TABLE 1.—ESTIMATES AND PROJECTIONS OF U.S.S.R. POPULATION AND AVERAGE ANNUAL PERCENT CHANGES: 1950 TO 2000

[Absolute numbers in thousands as of July 1]

Year	Total population	Absolute change	Average annual percentage changes
1950	180,075	(1)	(1)
1955	196,159	16,084	1.7
1960	214,329	18,170	1.8
1965	230,936	16,607	1.5
1970	242,757	11,821	1.0
1975	254,462	11,705	.9
1980	267,057	12,595	1.0
1985	280,383	13,326	1.0
1990	292,324	11,941	.8
1995	302,746	10,422	.7
2000	312,215	9,469	.6

[1] Not applicable.

Source and methodology: Estimates and projections of the Foreign Demographic Analysis Division, prepared in March 1976, which were based on the age-sex distributions from the 1959 and 1970 censuses and official figures for total population, births, and deaths for the years 1950–74. The projections for the years 1975–2000 were based on the assumptions that fertility will decline by 7 percent between 1975 and the year 2000, that mortality will decline by an amount equivalent to an increase in life expectancy at birth of approximately 2.5 years, and that net migration will be insignificant. Three different projections are used throughout the paper. The first, prepared in March of 1974 for the U.S.S.R. as a whole is usually juxtaposed with the regional projections prepared in June of the same year. In March of 1976, new estimates and projections were prepared for the U.S.S.R. as a whole. It is anticipated that new regional projections will be developed later this year. The March 1976 projection gives a population total for 1990 that is smaller by 2,500,000, or less than 1 percent, than the previously projected total. By the year 2000, the new total is 5,500,000, or 1.8 percent, less than the figure previously projected.

The aging of the Soviet population reflects the changes in vital rates and the demographic catastrophes which have occurred since the First World War. Thus, as can be seen from table 2, there will be a virtual doubling of the share of the older population (i.e., in ages above the able-bodied, as defined in the U.S.S.R.), from 10.4 to 19.2 percent. However, there are major differences in the proportion of older persons by region. In Central Asia and Kazakhstan, the share of persons in the pension ages will decrease from 10.3 percent in 1970 to 9.4 percent in 2000.[3] In the remainder of the country, therefore, the proportion of the population in these "overaged" categories will more than double.

TABLE 2.—PERCENT DISTRIBUTION OF THE POPULATION BY AGE GROUP IN THE U.S.S.R.: 1950 TO 2000

[Based on the population as of July 1. Figures may not add to 100 percent due to rounding]

Age group	1950	1960	1970	1980	1990	2000
0 to 15 years	32.2	31.8	30.7	26.1	27.0	25.2
16 to 59/54 years	57.4	55.7	54.2	58.3	55.4	55.5
60/55 years and over	10.4	12.4	15.1	15.5	17.6	19.2

Source and methodology: Same as in table 1.

[2] Cf. Table 1 and U.S. Bureau of the Census, "Population Estimates and Projections. Projections of the Population of the United States: 1975 to 2050." *Current Population Reports*, Series P–25, No. 601, Washington, D.C., October 1975, p. 3. Series II projections were used.

[3] Godfrey Baldwin, *Projections of the Population of the U.S.S.R. and Eight Subdivisions, by Age and Sex: 1973 to 2000*, U.S. Department of Commerce, Bureau of Economic Analysis, Series P–91, No. 24, Washington, D.C., June 1975, pp. 20, 23, and 36. Series B was used.

The long-term trends in the aging of the population are readily discernible in the age-pyramids for 1897, 1926, 1959, 1970, and 2000 given in figures 1a to 1e. The pyramids also show the effects of the First World War, the Civil War and the famine of the early 1920's, the pre-war collectivization, the purges of the late 1930's, and the Second World War. The aging of the population begins to be noticeable in the 1959 pyramid and the drop in the birth rate in the pyramids for 1970 and 2000.

Regional aspects of the Soviet population, as will be seen throughout this study, are to play an even more significant role in all aspects of population and manpower trends and policies. Changes in regional distribution over time are due in large part to continuation of birth differentials, and in part to net migration within the country. If massive movement out of Central Asia were to be mandated or otherwise achieved, many of the problems described herein would be moderated appreciably. But we doubt that major shifts will take place in the pattern of births and settlement by nationality before the end of the century without strong administrative measures. Extreme measures are not anticipated but obviously cannot be dismissed as impossible.

Natural increase for the country as a whole is expected to drop to 5.8 per 1,000 population in the year 2000, about one-third the level of 1950 (table 3). This is a result of the decline in the national crude birth rate from 26.7 to 16.0, a decrease of about 40 percent, over the same period. Due to the aging of the population, the crude death rate began to increase by 1970, and by 1990 it will exceed the level at the beginning of the period. There has recently been an unexpected but significant rise in infant mortality, which has increased from 22.9 to 27.9 per 1,000 live births in the years 1971–74.[4] Not all of this increase can be explained as due to improved reporting in the Central Asian republics. In Lithuania the rate increased by 20 percent between 1971 and 1973 and in Latvia by 10 percent between 1973 and 1974.[5] Why this is occurring and how long it will continue is not known. According to Soviet official statistics for 1971–72, there is a difference of 10 years betwen the life expectancies of males and females at birth (64 years for males and 74 for females). According to statistics given in the United Nations Demographic Yearbook for 1974, with the single exception of Gabon, there is no other country in the world in which life expectancy of males is as much as 10 years less than females. This gap will persist throughout the remainder of the century. It is no longer possible to explain such an extreme differential as a consequence of the aftereffects of World War II. An extraordinary jump in the crude death rate occurred in 1975. According to the published data, the rate increased by 0.6 per thousand in 1975 to 9.3 deaths per 1,000 population.[6] More research on aggregate and regional differ-

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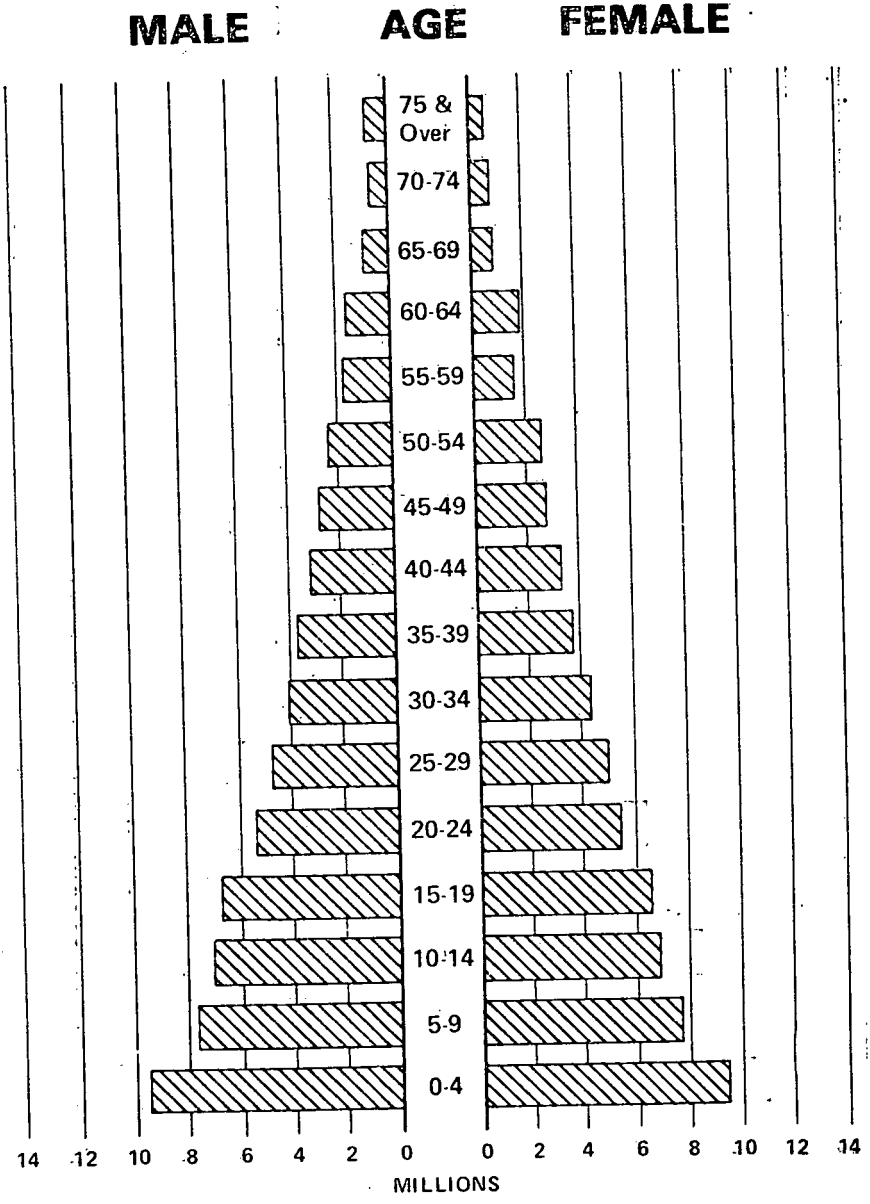
[4] TsSU SSSR. *Narodnoye khozyaystvo SSSR v 1974 godu; statisticheskiy yezhegodnik*, Moscow, Statistika. 1975. p. 44.

[5] TsSU Latviyskoy SSR, *Narodnoye khozyaystvo Latviskoy SSR v 1974 godu; statisticheskiy yeshegodnik*, Riga. Liesma. 1975. p. 10. and TsSU Litovskoy SSR, *Ekonomika i kul'tura Litovskoy SSR v 1973 goda; statisticheskiy yezhegodnik*, Vil'nyus. Mintis, 1974. p. 21.

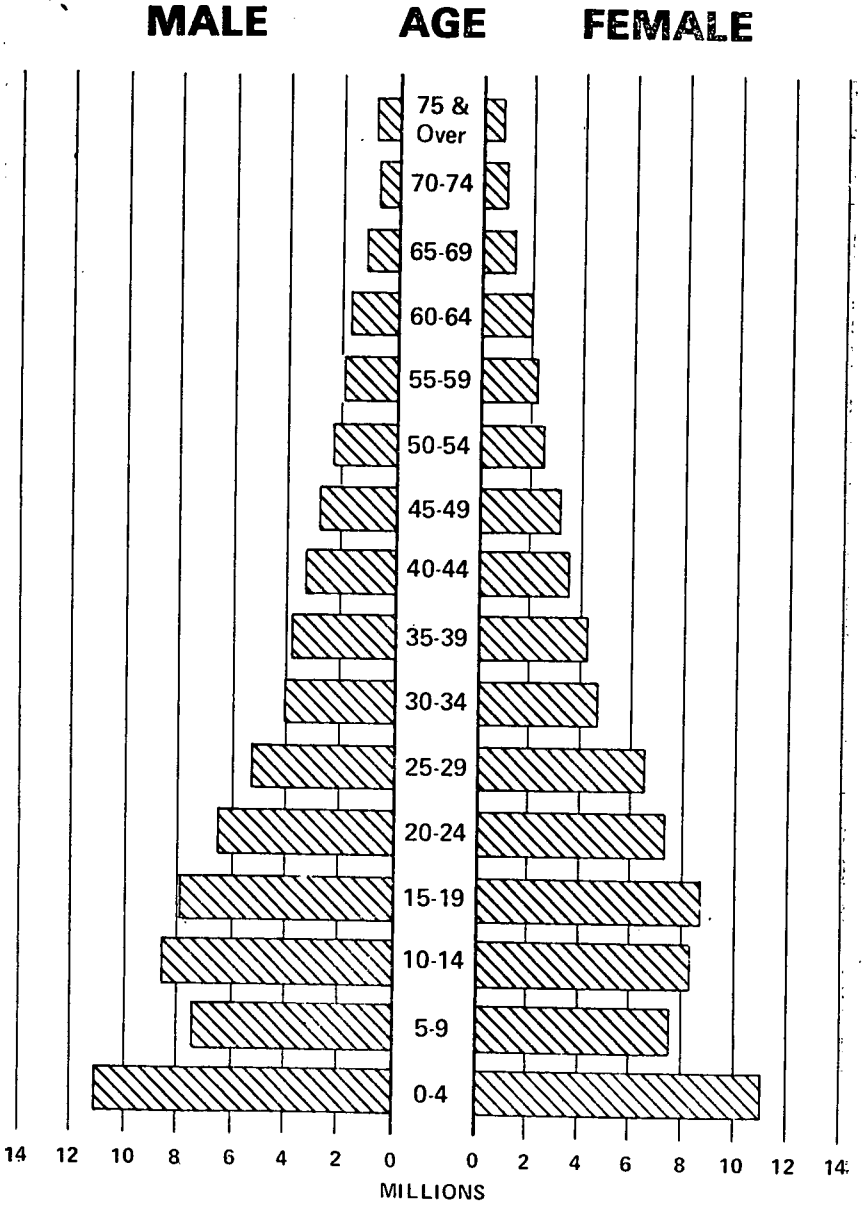
[6] TsSU SSSR. *SSSR v tsifrakh v 1975 g.; kratkiy statisticheskiy sbornik*, Moscow, Statistika, 1976, pp. 64–65.

Figure 1a. AGE — SEX PYRAMID 1897



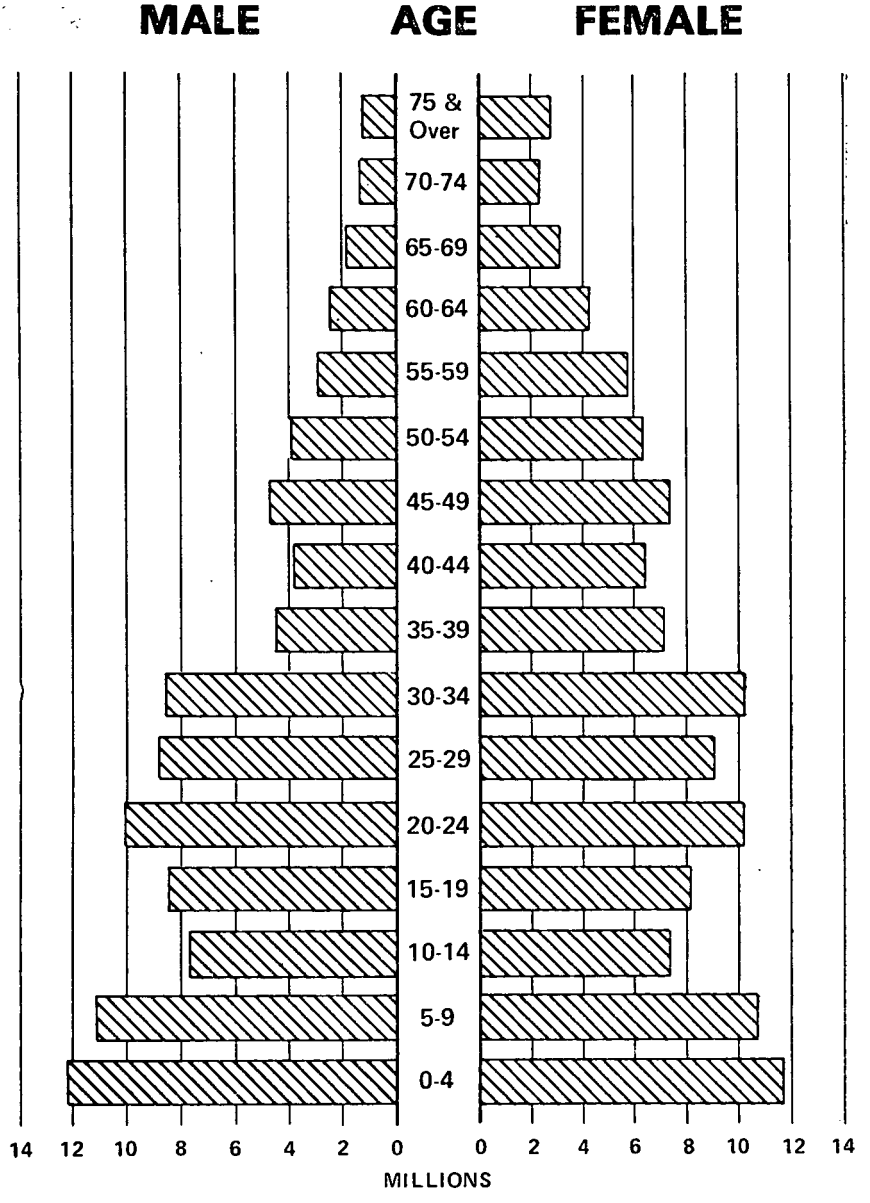
Source: Corresponding census volumes

Figure 1b. AGE — SEX PYRAMID 1926



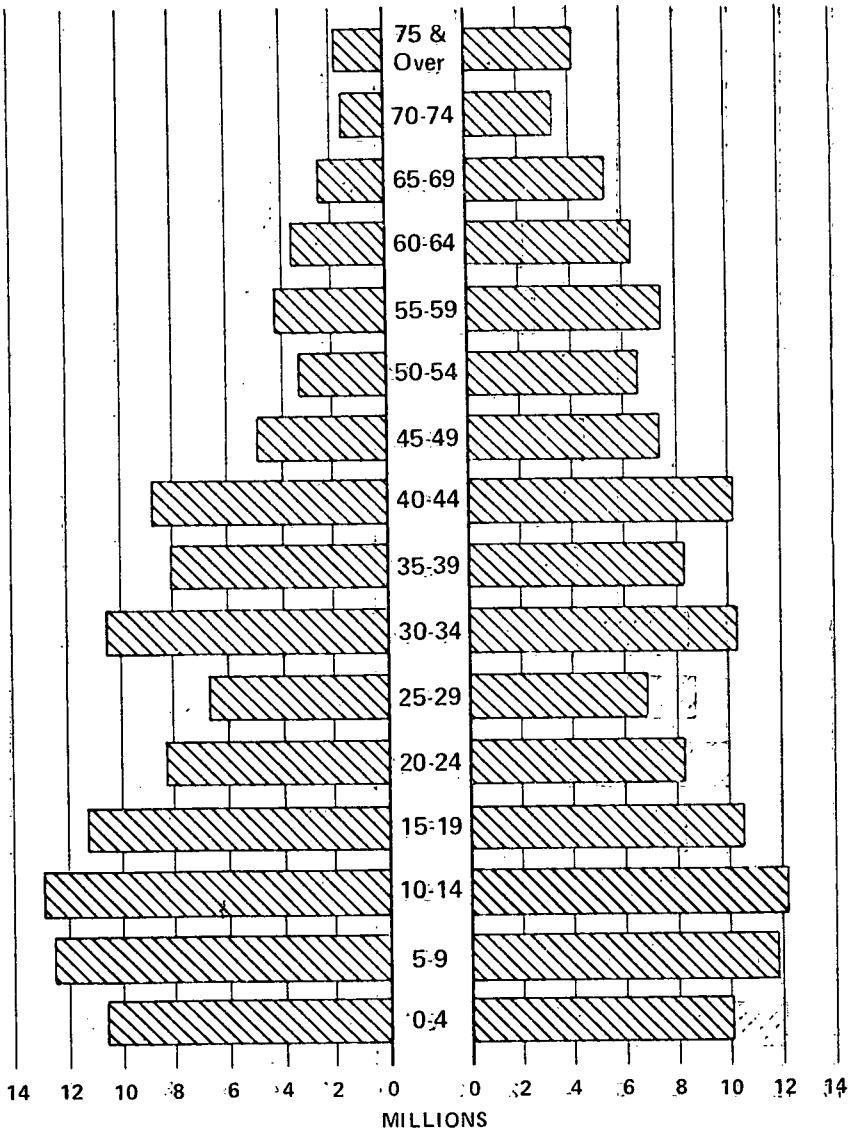
Source: Corresponding census volumes

Figure 1c. AGE — SEX PYRAMID 1959



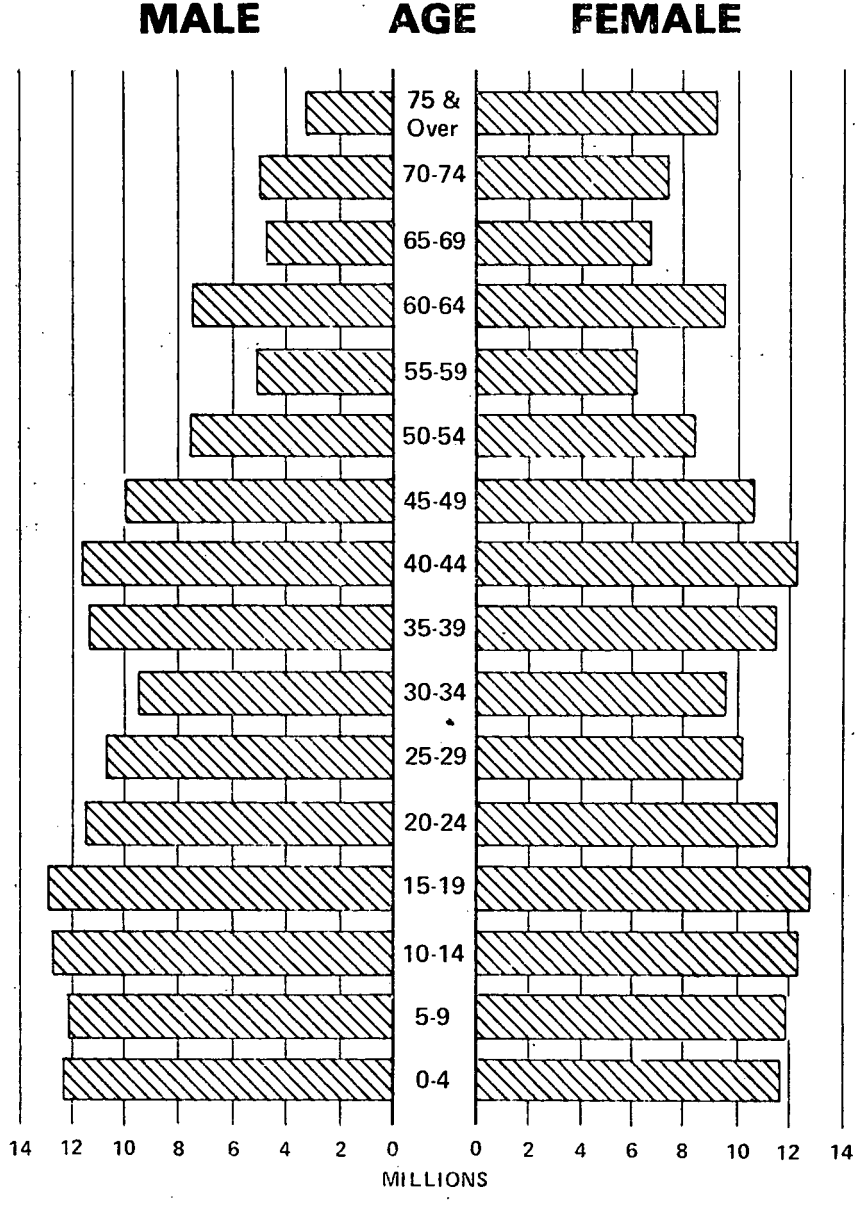
Source: Corresponding census volumes

Figure 1d. AGE — SEX PYRAMID 1970



Source: Corresponding census volumes

Figure 1e. AGE — SEX PYRAMID 2000



Source: Unpublished estimates and projections of the Foreign Demographic Analysis Division. Medium projection.

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ences in death rates by cause and by sex is necessary before a satisfactory explanation can be offered.[7]

TABLE 3.—VITAL RATES FOR THE U.S.S.R.: 1950 TO 2000

[Per 1,000 population]

	Births	Deaths	Natural increase
Year:			
1950	26.7	9.7	17.0
1960	24.9	7.1	17.8
1970	17.4	8.2	9.2
1980	19.2	9.3	9.9
1990	17.3	9.8	7.5
2000	16.0	10.2	5.8

Source: TsSU SSSR, Naseleniye SSSR (chislennost', sostav i dvizheniye naseleniya) 1973; statisticheskiy sbornik, Moscow, Statistika, 1975, p. 69 for 1950–70, and estimates and projections of the Foreign Demographic Analysis Division, prepared in March 1976, for the remaining years.

It is only in the past several years that concerted national policies have been adopted to encourage births. In July of 1974, it was announced that in addition to the "mother-heroine" designation, women who have given birth to and raised ten or more children would be eligible for a "Glory of Motherhood" order and a "Motherhood Medal." [8] More substantial incentives were provided by a directive "On the Introduction of Aid to Children in Low-Income Families," [9] which was to go into effect on November 1, 1974. Although the aid is a nominal 12 rubles per child per month until the age of 18, it amounts to a substantial percentage for families whose income is less than 50 rubles per capita per month. Although not explicitly described as a measure to encourage larger families, this law could well have that effect. A proposed regulation would provide for partial payment of a woman's salary during a period of 1 year's maternity leave to care for her child.[10]

The current and projected vital rates for the U.S.S.R. and for the republics indicate that an increasing share of the net population growth in the future will occur in Central Asia, Kazakhstan, and the Transcaucasian republics (table 4). The natural increase for these regions, despite some reduction in crude birth dates, will remain at about two-and-one-half times the national rate for Kazakhstan and the Transcaucasus and five times for the four Central Asian republics. (The disparity would obviously be much greater if one were to compare these ratios with those for the remaining seven republics alone.)

The female fertility rates for the prime child-bearing ages (15 to 49 years of age) by republic provide further evidence of regional fertility differentials (table 5). Although the differences seem to be generally

[7] TsSU SSSR, *Narodnoye khodyaystvo SSSR v 1974 godu; statisticheskiy yezhegodnik,* Moscow, Statistika, 1975, p. 610, and United Nations Statistical Office, *Demographic Yearbook 1974, Twenty-Sixth Issue,* New York, United Nations, 1975, pp. 1004–1035.

[8] *TASS,* in English, July 8, 1974, in FBIS, *Daily Report,* July 23, 1974, p. R2.

[9] *Vedomosti Verkhovnogo Soveta SSSR,* No. 40, October 2, 1974, article 663, p. 795.

[10] *Trud,* March 2, 1976, p. 2. Writing 3 years earlier, Perevedentsev noted that Hungary already has a program of 3-year paid leave which, at the official exchange rate, provides 44 rubles per month. *Nash Sovremennik,* No. 7, July 1973, pp. 128–148, translated in *Translations on U.S.S.R. Political and Sociological Affairs,* No. 428, JPRS 59922, August 29 ,1973, p. 49.

TABLE 4.—VITAL STATISTICS FOR THE U.S.S.R. BY REPUBLIC: 1950 TO 2000

[Per 1,000 population]

Republic	1950			1960			1970		
	Births	Deaths	Natural increase	Births	Deaths	Natural increase	Births	Deaths	Natural increase
U.S.S.R	26.7	9.7	17.0	24.9	7.1	17.8	17.4	8.2	9.2
Baltic Republics	20.3	12.6	7.7	19.3	9.1	10.2	16.2	10.1	6.1
Estonia	18.4	14.4	4.0	16.6	10.5	6.1	15.8	11.1	4.7
Latvia	17.0	12.4	4.6	16.7	10.0	6.7	14.5	11.2	3.3
Lithuania	23.6	12.0	11.6	22.5	7.8	14.7	17.6	8.9	8.7
R.S.F.S.R	26.9	10.1	16.8	23.2	7.4	15.8	14.6	8.7	5.9
Belorussia	25.5	8.0	17.5	24.4	6.6	17.8	16.2	7.6	8.6
Ukraine	22.8	8.5	14.3	20.5	6.9	13.6	15.2	8.9	6.3
Moldavia	38.9	11.2	27.7	29.3	6.4	22.9	19.4	7.4	12.0
Transcaucasian Republics	27.9	8.5	19.4	34.6	6.6	28.0	23.9	6.6	17.4
Georgia	23.5	7.6	15.9	24.7	6.5	18.2	19.2	7.3	11.9
Armenia	32.1	8.5	23.6	40.1	6.8	33.3	22.1	5.1	17.0
Azerbaydzhan	31.2	9.6	21.6	42.6	6.7	35.9	29.2	6.7	22.5
Kazakhstan	37.6	11.7	25.9	37.2	6.6	30.6	23.4	6.0	17.4
Central Asia	31.7	8.8	23.0	38.6	6.0	32.6	33.3	6.0	27.3
Uzbekistan	30.8	8.7	22.1	39.8	6.0	33.8	33.6	5.5	28.1
Turkmenia	38.2	10.2	28.0	42.4	6.5	35.9	35.2	6.6	28.6
Kirgiziya	32.4	8.5	23.9	36.9	6.1	30.8	30.5	7.4	23.1
Tadzhikistan	30.4	8.2	22.2	33.5	5.1	28.4	34.8	6.4	28.4

Republic	1980			1990			2000		
	Births	Deaths	Natural increase	Births	Deaths	Natural increase	Births	Deaths	Natural increase
U.S.S.R	19.2	9.3	9.9	17.3	9.8	7.5	16.0	10.2	5.8
Baltic Republics	15.7	11.0	4.7	14.5	11.2	3.4	13.5	11.8	1.7
Estonia	NA	NA	NA	NA	NA	NA	NA	NA	NA
Latvia	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lithuania	NA	NA	NA	NA	NA	NA	NA	NA	NA
R.S.F.S.R	16.7	10.2	6.5	13.7	11.3	2.4	12.4	12.3	.1
Belorussia	18.2	8.7	9.5	16.1	9.2	6.9	14.0	10.1	4.0
Ukraine	16.0	10.3	5.6	13.8	11.2	2.6	12.8	12.0	.8
Moldavia	22.1	8.3	13.9	19.2	8.7	10.5	17.5	9.2	8.3
Transcaucasian Republics	25.0	6.9	18.1	24.3	6.8	17.6	21.1	6.8	14.2
Georgia	NA	NA	NA	NA	NA	NA	NA	NA	NA
Armenia	NA	NA	NA	NA	NA	NA	NA	NA	NA
Azerbaydzhan	NA	NA	NA	NA	NA	NA	NA	NA	NA
Kazakhstan	26.0	6.7	19.3	24.4	6.8	17.6	21.7	7.0	14.7
Central Asia	36.5	6.2	30.3	36.8	5.5	31.3	34.0	5.0	29.1
Uzbekistan	NA	NA	NA	NA	NA	NA	NA	NA	NA
Turkmenia	NA	NA	NA	NA	NA	NA	NA	NA	NA
Kirgiziya	NA	NA	NA	NA	NA	NA	NA	NA	NA
Tadzhikistan	NA	NA	NA	NA	NA	NA	NA	NA	NA

NA—Not available.

Source: 1950–70: Data for individual republics were obtained from TsSU SSSR, "Naseleniye SSSR (chislennost', sostav i dvizheniye naseleniya) 1973; statisticheskiy sbornik," Moscow, Statistika, 1975, pp. 69–83. Figures for regions were derived from statistics reported in ibid., pp. 10–11 and 69–83, and population data reported by republic in TsSU SSSR, "Narodnoye khozyaystvo SSSR v 1970 godu; statisticheskiy yezhegodnik," Moscow, Statistika, 1971, p. 9; "Vestnik statistiki," No. 2, 1971, pp. 85–86; and "Vestnik statistiki," No. 4, 1964, pp. 86–89. Population data are reported as of Jan. 1, and midyear population was used in the calculations to make them consistent with reported data for republics. This required averaging data for 2 adjacent years in order to obtain a midyear figure.
1980–2000: Foreign Demographic Analysis Division's estimates and projections: U.S.S.R., March 1976; others June 1974

diminishing, the four core Central Asian republics in 1973–74 still have no less than twice as many births per 1,000 women as the U.S.S.R. average, and in Kazakhstan, although the Kazakhs are a minority in their own republic, the female fertility rate is 41 percent higher. One of the leading commentators on the Soviet demographic scene, V. Perevedentsev, estimated that each 1,000 women in Latvia will bear

1,986 children on the average over their lifespan, but in Tadzhikistan, the number of children will be 6,071.[11]

TABLE 5.—FEMALE FERTILITY RATES IN THE U.S.S.R., BY REPUBLIC: 1958 TO 1974

[Rates are number of births per 1,000 females 15 to 49 years of age]

Republic	1958–59	1965–66	1969–70	1972–73	1973–74
U.S.S.R.	88.7	70.8	65.7	66.4	66.8
Baltic republics:					
Estonia	59.9	55.3	59.3	58.5	57.9
Latvia	59.2	51.9	53.5	53.8	53.4
Lithuania	82.8	68.6	67.2	63.1	60.9
R.S.F.S.R.	82.9	59.0	53.4	54.9	55.3
Belorussia	91.0	67.1	61.3	59.7	58.9
Ukraine	70.7	57.1	55.2	56.2	55.7
Moldavia	111.7	79.2	71.6	75.6	75.1
Transcaucasian republics:					
Georgia	85.0	78.2	73.3	69.0	69.4
Armenia	159.2	122.4	92.9	87.3	84.7
Azerbaydzhan	163.3	165.8	134.6	111.4	108.0
Kazakhstan	143.0	107.9	95.1	93.6	94.1
Central Asia:					
Uzbekistan	158.8	165.3	158.5	156.0	156.8
Turkmenia	161.6	176.6	165.6	159.3	158.6
Kirgizia	140.1	137.2	134.7	132.9	131.6
Tadzhikistan	123.5	166.2	166.4	168.0	170.6

Source: 1958–73: TsSU SSSR, "Naseleniye SSSR (chislennost', sostav i dvizheniye naseleniya) 1973; statisticheskiy sbornik," Moscow, Statistika, 1975, pp. 137–138. 1973–74: "Vestnik statistiki," No. 12, 1975, p. 80.

These regional differentials will have a ripple effect now and throughout the remainder of the century, particularly for supply of new labor force and especially for potential military manpower supply and quality.

B. Migration

If massive migration out of the Central Asian republics were to take place, then at least so far as numbers are concerned, many of the impending difficulties in the available supply of labor would be mitigated. However, as indicated in our previous study prepared for the Joint Economic Committee report of June 1973 (p. 493), the fact that 96 percent of the population of the five Central Asian nationalities lived in Central Asia in 1959 and 97 percent in 1970 is evidence that there is little migration of the indigenous population out of the region. At the time of the 1970 census, 5.7 percent of the population of the country as a whole had resided less than 2 years at the place where they were enumerated, but for the nationalities comprising the four core Central Asian republics the rates ranged from 1.4 to 2.5 percent.[12] There is increasing evidence that most internal migration in the U.S.S.R. is within rather than between republics. According to I.S. Maslova of the Institute of Economics of the Academy of Sciences, USSR,

> Analysis of statistics on the mechanical movement of the population among urban settlements of the USSR for 1960 and 1971 allows us to conclude that there is a significant reduction in inter-republic and inter-oblast migration and an increase in intra-oblast migration.[13]

[11] V. Perevedentsev, "O kazhdom iz nas i obo vsekh vmeste," *Literaturnaya gazeta*, August 13, 1975, p. 12.

[12] TsSU SSSR, *Itogi Vsesoyuznoy perepisi naseleniya 1970 goda: migratsiya naseleniya, chislo i sostav semey v SSSR, soyuznykh i avtonomnykh respublikakh, krayakh i oblastyakh*, Vol. VII, Moscow, Statistika, 1974, p. 184.

[13] I. S. Maslova, "Problemy ispol'zovaniya trudovykh resursov SSSR v usloviyakh intensifikatsii ekonomicheskogo rosta," *Seriya ekonomicheskaya*, No. 3, May–June 1974, p. 62.

As evidence she adduces the fact that intraoblast migration in the R.S.F.S.R. accounted for only one-half the growth of the urban population in 1960, whereas in 1971 the proportion was 84 percent. The renowned ethnographer, Yu. V. Arutyunyan, has surveyed popular perceptions of the relative attractiveness of city life and village life and found virtually identical attitudes in the various republics. For example, in Uzbekistan, 20 percent thought city life to be more attractive (*privlekatel'na*). However, stated preferences may be very different from concrete plans and actions under specific circumstances in a specific period of time. In Kaliningrad Oblast 16 percent of the rural population intended to move to the city, of which 11 percent expected to do so within the next 2 years. In Uzbekistan, only 5.5 percent planned similar moves, of which only 2.9 percent hoped to carry out their intentions in the near future.[14] In Turkmenia, rural to urban movement accounted for 68.6 percent of the urban growth in 1960, 52.7 in 1965, and 27.0 percent in 1970.[15]

The Soviet Union recently published for the first time data by republic on arrivals and departures of residents of urban places. The figures are absolutes and cover the years 1950–73. These movements involve between 7 and 8 percent of the total population of the U.S.S.R. every year during the entire period.[16] However, the failure to include data on rural to rural migration precludes measurement of total movement and the available data do not permit us to distinguish movement within a republic from movement between republics. Nonetheless, these data and other information [17] lead us to conclude that about half of the recorded movement in and out of urban places is intrarepublic and that the proportion may be higher for the Central Asian republics and Kazakhstan. For the five republics, moreover, the net outmigration to urban places in other republics ranges from 0.7 percent of the population in Uzbekistan to 1.6 percent Kazakhstan.[18] Since some of this movement is to other republics within the region, movement out of the region is minuscule.

At a meeting of the Academy of Sciences' Scientific Council on Socio-Economic Problems of the Population in the first part of 1975, the issue of the nonmigration of the rural population of the Central Asian economic region was raised. One speaker cited the language barrier as the specific reason for the "weak" migration pattern. The same source asserts that, according to the 1970 census, the proportion

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[14] Yu. V. Arutyunyan, "Razvitive obshchestvennykh otnosheniv i izmenemye psikhologii sel'skogo naseleniya," in M. V. Gramov and M. A. Morozov (Eds.), *Kommunisticheskoye vospitaniye truzhenikov sela i voprosy povysheniya kul'tury sel'skogo byta; po materialam Vsesoyuznoy nauchno-praktichcskoky konferentsii v Tashkente (may 1975 g), Moscow,* Politizdat, 1975, pp. 145–146.

[15] M. P. Medvedeva, "Sotsial'no-ekonomicheskiye i demograficheskiye protsessy urbanizatsii v Turkmenskoy SSR." in T. V. Ryabushkin et al. (Eds.), *Metodologicheskiye problemy izucheniya narodonaseleniya v sotsialisticheskom obshchestve; Materialy Vsesoyuznoy konferentsii g. Kiev, 6–8 dekabrya 1973 g.,* Kiev, n.p., 1973, p. 231.

[16] TsSU SSSR, *Naseleniye SSSR (chislennost', sostav i dvizheniye naseleniya), 1973, statisticheskiy sbornik,* Moscow, Statistika, 1975, p. 178. The information in this source has been used almost exclusively in this paper to discuss issues related to Central Asia. This is not intended to gainsay the importance to the Soviet national economy of officially induced or forced migration to resource rich areas of Siberia and the Far East. Net outmigration from the east continues despite all efforts by the Soviet Government and Party. Among others, see Murray Feshbach and Stephen Rapawy, "Labor Constraints in the Five-Year Plan," in Congress of the United States, Joint Economic Committee, *Soviet Economic Prospects for the Seventies,* 93rd Congress, 1st Session, Washington, D.C., 1973, pp. 538–541, especially p. 539.

[17] *Vestnik statistiki,* No. 2, February 1973, pp. 91–92.

[18] TsSU, *Naseleniye,* 1975, pp. 9 and 188–189.

[19] See R. Galetskaya, "Demograficheskaya politika: yeye napravleniya," *Voprosy ekonomiki,* No. 8, August 1975, p. 152.

of persons of non-Russian nationalities that do not have command of the Russian language has grown.[19] It is not possible to prove this assertion statistically because data on second languages from the 1959 census are not completely comparable with those from the 1970 census, but the proportion of each nationality who responded that their nationality language is their native tongue increased between 1959 and 1970, with the minor exception of the Kazakhs, whose rate decreased only from 98.4 to 98.0 percent. The rates for all other nationalities in Central Asia increased and are within the range of 98 to 99 percent. In 1970, slightly over 40 percent of the Kazakhs speak Russian, but the other nationalities report a level of only about 15 to 20 percent.[20] While there may be a higher percentage of Russian speakers among the younger generation, it cannot be very large because the overall percentage who speak Russian is small. It is no wonder that the central government repeatedly calls for intensive study of Russian in nationality schools (see also below).

The lack of substantial progress in moving the Central Asian nationality population out of rural areas to increase the potential urban industrial labor force and the supply of military manpower is indicated by the data in table 6. In columns 1 and 2 we can see the extent of urbanization between 1959 and 1970 in each republic. Even the Virgin Lands republic of Kazakhstan is about 50 percent urban according to the 1970 census. However, between 1959 and 1970 very little change has taken place in the proportion rural among the Kazakh population throughout the country. Among the Kazakhs residing within the republic (columns 3 and 4), the proportion rural is half again as high (columns 5 and 6) as the Kazakhstan as a whole. Further, if we look at the proportion rural among the nationality in the titular republic alone (columns 5 and 6), we see no major changes among any of the Central Asian nationalities including Kazakhs.

In the summer of 1974 a directive was issued by the Council of Ministers USSR to the effect that a new passport system would be implemented in 1976. Up to that time persons in the rural interior of the country were not issued an internal passport. At first glance it appears as though the new system was meant to assure freedom of movement to all citizens.[21] However, for rural residents at least during the transition period from January 1, 1976 until December 31, 1981, special certificates and documents were to be issued to people who wish to travel depending on the length of time they are to be away from their normal residence. If the process of issuing passports extends over a 6-year period some of these passports will not be issued until the latter part of the period. Given the 1975 debacle in agriculture, the delay in issuing of new passports may be a device to restrain some of the outmigration of rural residents. On the actual document, it is clearly stated that once nationality is entered it is no longer possible to change it under any circumstances.[22] No information is available as to the frequency with which nationality designations on passports were changed under the old regulations, but it was probably an infrequent occurrence.

The U.S.S.R. has always had a policy of encouraging migration to certain specified areas. In May 1973, a decree of the Council of Min-

[20] TsSU SSSR, *Itogi Vsesoyuznoy perepisi naseleniya 1970 goda; natsional'nyy sostav naseleniya SSSR, soyuznykh i avtonomnykh respublik, krayev, oblastey i natsional'nykh okrugov*, Vol. IV, Moscow, Statistika, 1973, p. 9.

[21] See "Polozheniye o pasportnoy sisteme v SSSR." *Byulleten' Ministerstva vysshego i srednego spetsial'nogo obrazovaniya SSSR*, No. 12, December 1974, pp. 12–16.

TABLE 6.—RURAL POPULATION AS A PERCENT OF TOTAL POPULATION AND TOTAL NATIONALITY, BY REPUBLIC AND BY NATIONALITY: 1959 AND 1970

Republic	Total republic population		Nationality population		Nationality within titular republic		Nationality
	1959	1970	1959	1970	1959	1970	
	(1)	(2)	(3)	(4)	(5)	(6)	
U.S.S.R.	52.1	43.7	52.1	43.7	(1)	(1)	
Baltic republics	51.7	42.6	58.7	49.9	59.7	50.8	Baltic nationalities:
Estonia	43.5	35.0	52.9	44.9	53.1	45.3	Estonians.
Latvia	43.9	37.5	52.5	47.3	53.3	48.3	Latvians.
Lithuania	61.4	49.8	64.9	53.3	66.4	54.1	Lithuanians.
R.S.F.S.R.	47.6	37.7	42.3	32.0	45.1	34.4	Russians.
Belorussia	69.2	56.6	67.6	56.3	74.5	62.9	Belorussians.
Ukraine	54.3	45.5	60.8	51.5	63.4	54.2	Ukrainians.
Moldavia	77.7	68.3	87.1	79.6	90.4	82.8	Moldavians.
Transcaucasian republics	54.1	48.9	57.6	51.1	60.5	53.0	Transcaucasians:
Georgia	57.6	52.2	63.9	56.0	65.1	57.2	Georgians.
Armenia	50.0	40.5	43.4	35.2	47.8	37.3	Armenians.
Azerbaydzhan	52.2	49.9	65.2	60.3	63.7	58.7	Azerbaydzhani.
Kazakhstan	56.2	49.7	75.9	73.3	75.7	73.7	Kazakhs.
Central Asia	65.1	61.9	79.1	75.3	80.2	76.5	Central Asians:
Uzbekistan	66.4	63.4	78.2	75.1	79.8	77.0	Uzbeks.
Turkmenia	53.8	52.1	74.6	69.0	73.7	68.3	Turkmen.
Kirgiziya	66.3	62.6	89.2	85.4	89.0	85.5	Kirgiz.
Tadzhikistan	67.4	62.9	79.4	74.0	80.4	74.5	Tadzhiks.

[1] Not applicable.

SOURCE

Cols. 1 and 2: TsSU SSSR, "Narodnoye khozyaystvo SSSR v 1974 godu; statisticheskiy yeghegodnik," Moscow, Statistika, 1975, pp. 9–11.
Col. 3: TsSU SSSR, "Itogi Vsesoyuznoy perepisi naseleniya 1959 goda SSSR (svodnyy tom)," Moscow, Statistika, 1962, pp. 184 and 196.
Col. 4: TsSU SSSR, "Itogi Vsesoyuznoy perepisi naseleniya 1970 goda; national'nyy sostav naseleniya SSSR, soyuznykh i avtonomnykh respublik, krayev, oblastey i natsional'nykh okrugov, vol. IV, Moscow, Statistika, 1973, pp. 20 and 35.
Col. 5: Table 53 in the corresponding census volume for each republic of the 1959 census.
Col. 6: TsSU SSSR, "Itogi," vol. IV, 1973, pp. 43, 55, 152, 164, 192, 195, 202, 208, 223, 229, 253, 256, 263, 267, 273, 275, 276, 278, 280, 282, 284, 288, 295, 297, 303, 305, 306, 309, 317, and 319.

isters U.S.S.R. entitled "On New Benefits Granted to Citizens Resettling in the Country's Collective and State Farms," was enacted. This decree offered the highest fringe benefits and monetary awards, as well as special vacation periods and opportunities to purchase automobiles and motorcycles for those who moved to the area along the border with the People's Republic of China.[23]

III. Manpower

As indicated in our paper published by the Joint Economic Committee in June 1973, the labor shortage is serious and will become even more so in the future as the supply drops precipitously. Labor shortages will be exacerbated by competing demands among the civilian and military sectors for skilled young people.

A. Labor Supply Problems

According to our projections prepared in June 1974 for the U.S.S.R. and for eight subdivisions of the country [24] a significant upturn in the annual increments to the population of able-bodied ages has been taking place since 1970 and will continue throughout the present

[22] *Ibid.*, p. 12.
[23] *Sobraniye postanovleniy Pravitel'stva SSSR*, No. 13, 1973, pp. 266–280.
[24] Baldwin, *Projections*, P–91, No. 24, 1975, 36 pp.

decade. It is expected that persons in these ages will constitute over 92 percent of the new additions to the labor force during the 1971–75 plan period.[25] With all other major sources exhausted, the dependence on the able-bodied age group is total. In the 1980's there will be a downturn in the size of the annual increments to the able-bodied ages to just over one-fifth of the numbers in the first half of the current decade and the increments in the latter half will be only slightly larger (table 7). In the 1990's the increments will increase again, but the increase in the latter half of the decade will still be less than three-quarters of the total for 1971–75.

The projections indicate that the increase in the able-bodied ages in Central Asia and Kazakhstan will actually exceed that for the U.S.S.R. as a whole during the 1980's. The Transcaucasus also will supply a positive increment to the net growth over the entire period. A net decrease will occur in the R.S.F.S.R. and the Ukraine beginning in 1980 and in the Baltic Region after 1990. Although there will be a reduction in the share of the Central Asian region and Kazakhstan during the 1990's, and that of the Transcaucasus will decline from 1985 onward, the contribution of these areas to the national increase in the able-bodied population will continue to be much higher throughout the latter part of the century than it was during the 1970's. These prospects pose serious problems relating to mobility, ability to speak Russian, urbanization, and industrialization. Before long it is likely that the Soviet Union will be obliged to undertake a crisis management approach involving various legislative and administrative expedients to cope with the labor, investment, political, and military implications of these changes.

There are various indications that the Soviets hope more pensioners can be induced to return to work, even if only part-time. A decree was issued in September 1973 reiterating the need to mobilize pensioners to work in enterprises designated for this purpose or to work at home.[26] There is no available evidence as of this date as to whether or not this directive has been successful. As of January 1, 1974, only 12,500 of approximately 4 million working pensioners were working part-time. Many nonworking pensioners expressed a preference to work part time.[27]

Despite the fact that the Soviet Union desperately needs to improve agriculture and to increase sharply the productivity of farmers through additional inputs of labor as well as capital, as of January 1, 1968, they have lowered the pension age for collective farmers to that for workers and employees in the state sector. As of April 1, 1975, they have lowered the pension age for female farm machine operators even more in an effort to make work more attractive to them.[28] Thus, the authorities appear to have a fundamental ambivalence in their treatment of collective farm workers.

The first indications of a policy to import foreign labor to help solve shortages in bottleneck areas and to bring in scarce specialties

[25] Feshbach and Rapawy, "Labor," 1973, p. 506.

[26] "O merakh po dal'neyshemu uluchsheniyu ispol'zovaniya truda pensionerov po starosti i invalidov v narodnom khozyaystve i svyazannykh s etim dopolnitel'nykh l'gotakh," in K. U. Chernenko and H. S. Smirtyukov (compilers), *Resheniya partii i pravitel'stva po khozyaystvennym voprosam. Tom 9, fevral' 1972 g.—sentyabr' 1973 g.*, Moscow, *Politizdat*, 1974, pp. 646–651.

[27] A. Maykov, "Trudovyye resursy v devyatoy pyatiletke," *Sotsialisticheskiy trud*, No. 4, April 1973, p. 122.

[28] "O snizhenii vozrasta dlya naznacheniya pensii po starosti zhenshchinam-mekhanizatoram," *Vedomosti Verkhovnogo Soveta SSSR*, No. 11, March 12, 1975, article 182, p. 161, and *Vedomosti Verkhovnogo Soveta SSSR*, No. 36, September 27, 1967, article 520, p. 563.

TABLE 7.—ESTIMATED INCREMENTS TO THE POPULATION IN THE ABLE-BODIED AGES IN THE U.S.S.R., CENTRAL ASIA AND KAZAKHSTAN, AND THE TRANSCAUCASUS, BY PLAN PERIOD: 1959 TO 2000

[Based on data as of Jan. 1, in thousands]

Plan period	U.S.S.R.		Central Asia and Kazakhstan		Transcaucasus	
	Total increase	Average annual increase	Total increase	As a percent of national increase	Total increase	As a percent of national increase
1959–65	5,173	739	NA	X	NA	X
1966–70	7,808	1,562	NA	X	NA	X
1971–75	12,726	2,545	3,551	27.9	1,231	9.7
1976–80	10,408	2,082	3,495	33.6	1,148	11.0
1981–85	2,687	537	2,823	105.1	701	26.1
1986–90	2,830	566	2,938	103.8	531	18.8
1991–95	4,020	804	3,565	88.7	628	15.6
1996–2000	9,012	1,802	4,999	55.5	1,082	12.0

NA—Not available.
X—Not applicable.

Source and methodology: Estimates of the Foreign Demographic Analysis Division, March 1974. The projections for the years 1973–2000 were based on the assumptions that fertility will remain constant at the estimated 1972 level, that mortality will decline by an amount equivalent to an increase in life expectancy at birth of approximately 2.5 years, and that net migration will be insignificant.

were discernible in 1973.[29] Since then this program has been expanded to cover a wide variety of activities and forms. Among the most interesting of the projects involving foreign labor is the building of the Orenburg pipeline, designated portions of which are to be built by the East European countries using their own labor and capital. It is expected that at the peak of the effort some 20,000 foreign workers will be engaged in building the pipeline and associated production and support facilities.[30] Approximately equal sections of 550 km. each will be built by workers from Bulgaria, Czechoslovakia, East Germany, Hungary, and Poland (Romania will send money but not men). Work is to be completed by the third quarter of 1978 according to the original plan. Several other important construction projects carried out within the U.S.S.R. also involve the joint efforts of several countries. The Ust'-Ilimsk pulp and paper complex is being built in the Irkutsk region of Eastern Siberia with Bulgarian, East German, Polish, and Romanian assistance. Two thousand foreign workers are scheduled to be part of the 26,000 building the complex.[31] The Kieyembaysk Asbestos mining and enriching complex in the Orenburg Oblast of the R.S.F.S.R. also involves workers from the six East European countries.[32]

Another means of obtaining labor from foreign countries is in barter exchanges of materials or products for labor. Bulgarian workers were employed at 23 different sites in 1973, and by now may number some 30,000 throughout the country.[33] As indicated in our 1973 study, 7,000

[29] Feshbach and Rapawy, "Labor," 1973, p. 503.
[30] See for example, A. Vesel'yev, "Gasoprovod Orenburg-Zapadnaya granits: Sovmestnymi usiliyami stran-chlenov SEV," *Ekonomicheskaya gazeta,* No. 39, September 1975, p. 24.
[31] *Rabochaya gazeta,* April 8, 1975, p. 1.
[32] V. Zolotyev, "Novaya forma sotrudnichestva stran SEV—v deystvii." *Vneshnyaya torgovlya,* No. 9, September 1974, p. 33. A very interesting matrix for the origin and destination of foreign workers among six East European countries (Bulgaria, Czechoslovakia, East Germany, Hungary, Poland, and Yugoslavia) and the U.S.S.R. is derived in Friedrich Levcick, *Migration und Ausländerbeschäftigung in den RGW-Ländern und ihre Probleme,* Nr. 32, Wiener Institut für Internationale Wirtschaftsvergleiche, Vienna, December 1975, p. 14. He estimates that about 166,000–176,000 workers are involved in these "transactions."
[33] Ye. L. Manevich, "Ispol'zovaniye trudovykh resursov v usloviyakh nauchno-tekhnicheskoy revolyutsii; simpozium v Moskve," *Vestnik Akademii nauk SSSR,* No. 3, March 1973, p. 88.

North Koreans were engaged in cutting timber in the Khabarovsk Kray, and there are reports that their numbers are increasing.[34] Labor to supplement domestic resources also comes from Western countries. Finland has contracted with the Soviet Union to build a hotel and a hydroelectric dam and to cut timber. Late in 1973 it was reported that 3,000 Finns would participate in the building of an iron ore mine and concentrating plant.[35] A Soviet-Finnish Treaty signed in 1971 contained references to ten joint construction projects (including some of Finnish territory).[36] Italian workers participated in the building of the Togliatti plant, the French are to provide labor to build hotels in Moscow, and, if any of the gas and oil deals being negotiated in "above-plan" agreements between the U.S.S.R. and American and Japanese firms are consummated, foreign labor will undoubtedly be required in other than supervisory roles.

The emigration of Jews, ethnic Germans, Armenians, and others has reduced the available labor supply to the extent that these individuals were economically active. Taken together, the 125,000 Jews who emigrated in the post-war period, the 5–6,000 ethnic Germans who left each year, the annual exodus of a small number of Armenians, and the "other nationalities [who] left at the rate of 3,800 annually," are only a small fraction out of a labor force of 126,000,000, and therefore do not add significantly to the severity of the labor shortage.[37]

In all, then, the demographic picture bodes ill for the future labor supply until the end of the century. Not only will the increase in the total numbers be constricting, but the picture afforded by examination of the regional components underscores the necessity for improvements in productivity and efficiency if past or current economic growth paths are to be followed in the future.

B. The Labor Force

From the discussion of the basic tasks for the current 5-year plan period in the introductory section of the "Basic Directions for the Development of the National Economy of the U.S.S.R. in 1976–1980" [38] it is clear that the Party and Government are seriously concerned about their labor force problems. The leadership is considering a wide range of possible solutions—mechanization of auxiliary and subsidiary work, reduction of the share of manual labor, restricting employment growth in existing enterprises, more rational utilization of labor, especially those employed in the nonproductive sphere, improving the norming of labor, reducing labor turnover, raising labor discipline, more efficient use of worktime, elimination of idleness and all other irrational uses of labor inputs, improvement of training and skills of cadres, and providing more amenities in the Siberian and Far Eastern regions of the country.[39]

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[34] *Ekonomicheskaya gazeta*, No. 12, March 1974, p. 20, and Feshbach and Rapawy, "Labor," 1973, p. 503.

[35] Theodore Shabad, "Finland to Help Develop Big Iron-Ore Deposit in Soviet," *New York Times*, December 19, 1973, pp. 65–66.

[36] See *Sotsialisticheskaya industriya*, April 6, 1974, p. 3, for interview with the Finnish Minister of Foreign Affairs.

[37] Very interesting emigration data are provided in a letter written by Boris Ponomarev, the head of the Foreign Affairs Department of the Central Committee, to West European Communist Parties. The letter, which "has fallen into Western diplomatic hands" is summarized in an article by Murray Seeger, "Kremlin Defensive in Letter to Reds in West," *Los Angeles Times*, March 11, 1976, p. 1.

[38] *Pravda*, December 14, 1975, pp. 1–6.

[39] *Ibid.*, p. 2.

Again because of limits in space and time, the present article deals primarily with the size of the labor force, its rate of growth, its overall structure, the annual average employment, and its distribution by branch, and provides estimates of man-hours of work. Man-hour data afford a more precise measure of labor inputs than do other kinds of labor force data and are much more useful for temporal and spatial comparisons of labor productivity. Only brief mention can be made here of various new developments in the manpower area, including the issuance of new-style labor booklets and the expansion of activities of the State Committees on Labor Resources Utilization. Some indication of the proportion of engineering graduates from part-time (evening and correspondence) schools is also available. Most of the estimates and projections of labor force, annual average employment, and man-hours given below are from a forthcoming report by Stephen Rapawy,[40] the detailed notes and methodology for which will not be repeated here.

The total Soviet labor force is estimated at 125,612,000 persons in 1970 (table 8). This figure represents 51.7 percent of the total population of the U.S.S.R. and 95.4 percent of the population in the able-bodied ages. If persons of able-bodied and pension ages in private agriculture are excluded, the latter proportion is reduced to 89.9 percent. The labor force participation rates are at a very high level at this time and there are no significant untapped labor resources that can be drawn on for future needs. (See appendix tables.) The growth of the labor force is estimated to be slightly larger between 1970 and 1990 than it was between 1950 and 1970 (30.9 million as compared to 28.0 million), but because of the larger base the rate of growth by 1986–90 is only about one-third the level of 1950–58 (table 9). The labor force estimates given here are based on the population projections described earlier, rates of economic activity by age and sex, and assumptions about trends in the agricultural sector. Given the problems in Soviet agriculture, the assumption that labor may be drawn from the farms without commensurate productivity gains may perhaps be too "optimistic."

According to the estimates given here the share of the labor force in agriculture drops from 54.0 percent in 1950 to 30.7 percent in 1970 and to 17.6 percent in 1990. The agricultural labor force figure for 1970 is different from the Soviet 1970 census figure. According to the published census report there were only 1,823,499 persons "engaged in the private subsidiary agricultural economy."[41] This figure is patently incomplete. If one were to compare the annual average figure of 4.9 million persons working solely in this activity in 1969 reported in the statistical yearbook for that year[42] with the corresponding 1970 census figure, it is obvious that the latter is far less inclusive. The explanation appears to be relatively simple. In October 1964, between the 1959 and 1970 censuses, a law was passed authorizing payment of state pensions to collective farmers effective January 1, 1965.[43] By the end of 1965,

[40] Stephen Rapawy, *Estimates and Projections of the Labor Force and Civilian Employment in the U.S.S.R.: 1950 to 1990*, U.S. Department of Commerce, Bureau of Economic Analysis, 1976 (forthcoming).

[41] TsSU SSSR. *Itogi Vsesoyuznoy perepisi naseleniya 1970 goda: raspredeleniye naseleniya SSSR, soyuznykh i avtonomykh respublik, krayev i oblastey po obshchestvennym gruppam, istochnikam sredstv sushchestvovaniya i otraslyam narodnogo khozyaystva*, Vol. V. Moscow. Statistika. 1973. p. 162.

[42] TsSU SSSR. *Narodnoye khozyaystvo SSSR v 1969 godu; statisticheskiy yezhegodnik*, Moscow. Statistika, 1970, p. 420.

[43] K. U. Chernenko et al. (Eds.). *Spravochnik partiynogo rabotnika, vypusk shestoy*, Moscow, Politizdat, 1966, pp. 268–281.

7.0 million persons on collective farms were receiving old-age pensions.[44] There is no doubt that a very large proportion of these people continued to work on their private plots and orchards.

TABLE 8.—ESTIMATES AND PROJECTIONS OF THE LABOR FORCE IN THE U.S.S.R.: 1950 TO 1990

[In thousands, as of July 1]

Year	Total	Males	Females	Armed forces	Civilian labor force					
					Total	Nonagricultural sectors	Agricultural sectors			
							Total	State	Collective farm	Private
1950	97,641	(NA)	(NA)	4,600	93,041	42,796	50,245	4,261	36,070	9,914
1955	104,937	(NA)	(NA)	5,800	99,137	49,753	49,384	6,865	32,411	10,108
1959	109,264	52,722	56,542	3,900	105,364	57,780	47,584	6,359	31,723	9,502
1960	110,132	53,215	56,917	3,973	106,159	60,723	45,436	7,764	28,853	8,819
1965	116,494	56,420	60,074	3,380	113,114	73,077	40,037	10,001	21,343	8,693
1970	125,612	61,283	64,329	3,535	122,077	84,577	37,500	10,594	19,669	7,237
1971	127,672	62,515	65,157	3,675	123,997	87,028	36,969	10,700	19,248	7,021
1972	129,722	63,736	65,986	3,675	126,047	89,609	36,438	10,807	18,826	6,805
1973	131,610	64,876	66,734	3,725	127,885	91,977	35,908	10,913	18,406	6,589
1974	133,600	66,065	67,535	3,835	129,765	94,388	35,377	11,019	17,985	6,373
1975	135,767	67,350	68,417	4,005	131,762	96,916	34,846	11,125	17,563	6,158
1976	137,987	68,670	69,317	4,005	133,982	99,666	34,316	11,232	17,142	5,942
1977	140,140	69,956	70,184	4,005	136,135	102,350	33,785	11,338	16,721	5,726
1978	142,214	71,241	70,973	4,005	138,209	104,955	33,254	11,444	16,300	5,510
1979	144,201	72,473	71,728	4,005	140,196	107,473	32,723	11,550	15,879	5,294
1980	146,068	73,648	72,420	4,005	142,063	109,870	32,193	11,657	15,458	5,078
1981	147,753	74,726	73,027	4,005	143,748	112,086	31,662	11,763	15,037	4,862
1982	149,215	75,681	73,534	4,005	145,210	114,079	31,131	11,869	14,616	4,646
1983	150,521	76,534	73,987	4,005	146,516	115,916	30,600	11,975	14,195	4,430
1984	151,672	77,294	74,378	4,005	147,667	117,597	30,070	12,082	13,774	4,214
1985	152,647	77,960	74,687	4,005	148,642	119,103	29,539	12,188	13,352	3,999
1986	153,466	78,526	74,940	4,005	149,461	120,453	29,008	12,294	12,931	3,783
1987	154,207	79,036	75,171	4,005	150,202	121,725	28,477	12,400	12,510	3,567
1988	154,950	79,505	75,445	4,005	150,945	122,998	27,947	12,507	12,089	3,351
1989	155,734	79,997	75,737	4,005	151,729	124,313	27,416	12,613	11,668	3,135
1990	156,555	80,503	76,052	4,005	152,550	125,665	26,885	12,719	11,247	2,919

NA—Not available.

Source: Stephen Rapawy, "Estimates and Projections of the Labor Force and Civilian Employment in the U.S.S.R.: 1950 to 1990," U.S. Department of Commerce, Bureau of Economic Analysis, 1976 (forthcoming). Variant I.

The armed forces figures given in table 8 will be discussed below.

Annual average employment of workers and employees in the State sector was scheduled to increase by 11.1 million during the 5-year plan period just completed.[45] From information in the plan fulfillment report for 1975, it is possible to estimate that state sector employment reached 102.2 million persons, an increase of 12.0 million during the period, which was 8 percent higher than what was projected in the plan.[46] The absolute level in 1975 is 13.3 percent higher than in 1970. However, the rate of increase is somewhat less than that for the previous 5 years, and the aggregate growth is only about half that in each of the three previous 5-year periods.[47] Information available about the Tenth Five-Year Plan, 1976–80, does not permit an estimate of the expected increase in the number of workers and employees. However, based on the midpoints of the production/productivity relationships

[44] TsSU SSSR, *Narodnoye khozyaystvo SSSR v 1974 godu; statisticheskiy yezhegodnik,* Moscow, Statistika, 1975, p. 614.

[45] See Gosplan SSSR, *Gosudarstvennyy pyatiletniy plan razvitiya narodnogo khozyaystva SSSR na 1971–1975 gody,* Moscow, Politizdat, 1972, p. 89.

[46] Based on index of growth in *Izvestiya,* February 1, 1976, p. 1, and TsSU SSSR, *Narodnoye khozyaystvo SSSR v 1974 godu; statisticheskiy yezhegodnik,* Moscow, Statistika, 1975, p. 550.

[47] Based on table 10 and Feshbach and Rapawy, "Labor," 1973, pp. 520–521.

TABLE 9.—GROWTH RATES OF SELECTED POPULATION AND MANPOWER MEASURES

[In percent per year]

Indicator	1950–58	1959–65	1966–70	1971–75	1976–80	1981–85	1986–90
Population:							
Population of able-bodied ages	1.8	0.5	1.2	1.9	1.5	0.4	0.3
Population of pension-age	3.6	3.2	3.3	1.3	1.2	2.3	2.1
Population 18 years of age	2.0	−3.6	5.8	2.3	.4	−4.0	.7
Population 19 years of age	1.7	−7.0	9.0	2.4	1.4	−4.4	−.1
Labor force:							
Total	1.4	1.0	1.5	1.6	1.5	.9	.5
Civilian	1.5	1.0	1.5	1.5	1.5	.9	.5
Nonagricultural	3.3	4.0	3.0	2.8	2.5	1.6	1.1
Agricultural	−.1	−3.1	−1.3	−1.5	−1.6	−1.7	−1.9
Annual average employment:							
Total civilian	1.9	2.0	1.9	[1] 1.7	(NA)	(NA)	(NA)
Nonagricultural	3.7	4.5	3.5	2.5	(NA)	(NA)	(NA)
Industry	4.0	3.9	2.9	1.5	.7	(NA)	(NA)
Services	3.0	5.5	4.3	3.3	(NA)	(NA)	(NA)
Other	4.8	4.3	3.4	3.0	(NA)	(NA)	(NA)
Agricultural	.1	−1.3	−1.1	[1] −.4	(NA)	(NA)	(NA)
Man-hours:							
Total civilian	1.7	.9	2.0	[1] 1.9	(NA)	(NA)	(NA)
Nonagricultural	2.9	2.8	3.6	[1] 1.9	(NA)	(NA)	(NA)
Industry	3.2	2.2	3.1	[1] 1.4	(NA)	(NA)	(NA)
Other	3.1	3.3	4.1	[1] 3.3	(NA)	(NA)	(NA)
Agricultural	.4	−1.7	−1.1	[1].3	(NA)	(NA)	(NA)

[1] 1971–74.
NA—Not available.

Note: Rates for each period were calculated on the basis of data for the terminal year of the preceding period.
Source: Population: Unpublished estimates and projections of the Foreign Demographic Analysis Division made in June 1972 and March 1976. Labor force: Table 8. Annual average employment: 1950–75, Table 10. 1976–80: "Izvestiya," Mar. 7, 1976, p. 3. Man-hours: Table 13.

given in the "Basic Directions" of the plan, it can be estimated that the rate of industrial employment growth in 1976–80 will slow to half the rate of 1.5 percent during 1971–75.[48] The 1.5 percent rate of growth was less than half the rate of the previous period, which in turn was markedly lower than the rates of the preceding 15 years.[49] if a rate of growth of national income similar to that in the past is to be achieved, labor productivity must rise sharply, hence it is no surprise that the plan calls for "special attention to be concentrated on accelerating the growth of labor productivity." [50]

The proportion of agricultural employment in the state, collective farm, and private sectors has been steadily declining, though it remains very high compared with the proportion employed in agriculture in the United States. According to our estimates, agricultural employment in the U.S.S.R. has dropped from 53 percent of total annual average (civilian) employment in 1950 to 32 percent in 1970 and to under 30 percent in 1974. The absolute level, however, has remained at over 35 million persons, more than 5 times the Soviet official estimate of American agricultural employment and over 7 times the unadjusted American figures.[51] Services in the Soviet Union have grown from only 16 percent of total employment in 1950 to 25 percent in 1970 and close to 30 percent in 1974. As the figures in table 9 show, employment in services has grown more than twice as fast as overall

[48] Based on *Izvestiya*, March 7, 1976, p. 3.
[49] See Feshbach and Rapawy, "Labor," 1973, p. 510.
[50] *Izvestiya*, March 7, 1976, p. 2.
[51] See TsSU's discussion in *Narodnoye khozyaystvo SSSR v 1794 godu; statisticheskiy yezhegodnik*, Moscow, Statistika, 1975, pp. 832–833.

employment since 1959. The growth of employment in all service branches in the aggregate is given in table 10 and in individual service branches in table 11 along with that for other state sector branches of the economy. Presumably this pattern will continue in the future as the Soviet leadership responds to pent-up demand for more and better services.

The importance of the growing machine-building and metalworking branch is evident from the figures in table 12. This branch accounted for 28 percent of industrial employment in 1950, 32 percent in 1960, 38 percent in 1970, and 40 percent in 1974. In the latter year it employed 3 times as many workers as in 1950. Other fast-growing industries are the electric power and the chemical and petrochemical industries, employment in each of which has grown over 2.6 times in the past 24 years (1950 to 1974). For certain industries such as nonferrous metallurgy, no data have ever been published. For other industries the data for particular years are missing from Soviet statistical yearbooks. These annual average employment figures had to be estimated in order to develop our estimates of man-hours.

1. MAN-HOURS OF WORK

Estimated man-hours of work are given here for the first time. Except for industry in the very recent period, no such estimates have ever been published in the Soviet Union. These estimates are based on very scattered data and take account of changing definitions of branches as well as shifts from authorized (or scheduled) worktime to actual worktime. The figures in table 13 and in appendix tables III and IV are a first approximation and may be refined in the future with better information and improved methodology. Some very interesting patterns of change and growth appear in the current estimates. The impact of the reduction in the workweek carried out in 1956–60 is noticeable in these figures, especially during the period 1959–61. The index number of total man-hours worked in the national economy calculated with 1968 as a base year rises from 76.4 in 1950 to 87.7 in 1958, drops to a low of 86.0 in 1961, then resumes its climb to 111.6 in 1974 (Table 13). In industry, however, although there was a slowdown in the rate of increase in man-hours worked during 1956–61, there was no actual decrease in the absolute amount as there was in the man-hours for the economy as a whole, because employment growth more than compensated.[52]

In the national economy, employment grew faster than man-hours by about 11 percent over the 23-year period (tables 10 and 13). In the nonagricultural sectors alone, employment grew by 1.4 times and man-hours by 0.97 times. In agriculture, the reduction in employment and in man-hours was just about equal, down 14 and 12 precent, respectively.

[52] See the doctoral dissertation by Philip Grossman, *Hours and Output: The Reduction in the Soviet Workweek, 1956–60*, Washington, D.C., The American University, 1970, for a detailed discussion of the program to reduce worktime.

TABLE 10.—ANNUAL AVERAGE EMPLOYMENT IN THE NATIONAL ECONOMY, U.S.S.R: 1950 TO 1975

[In thousands]

Line No.	Item	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962
1	Total	80,646	80,421	80,746	82,337	86,194	87,642	90,383	91,496	93,702	94,047	95,398	97,968	99,727
2	Nonagricultural sectors	37,611	39,309	40,727	41,840	43,546	44,568	46,219	48,082	50,197	52,480	55,404	58,514	60,616
3	Industry	15,317	16,230	16,873	17,617	18,499	18,984	19,702	20,357	20,997	21,670	22,620	23,817	24,677
4	Other nonagricultural sectors	21,666	22,505	23,334	23,757	24,635	25,226	26,213	27,475	29,003	30,629	32,619	34,548	35,806
5	Services [1]	13,091	13,483	13,871	14,030	14,415	14,800	15,278	15,906	16,553	17,310	18,447	19,811	20,840
6	Other [2]	8,575	9,022	9,463	9,727	10,220	10,426	10,935	11,569	12,450	13,319	14,172	14,737	14,966
7	Independent artisans	628	574	520	466	412	358	304	250	197	181	165	149	133
8	Agricultural sectors	43,035	41,112	40,019	40,497	42,648	43,074	44,164	43,414	43,505	41,567	39,994	39,454	39,111
9	State	3,437	3,565	3,693	4,026	5,966	6,041	5,954	6,628	6,005	5,568	6,793	7,496	7,817
10	Collective farm	27,600	26,933	26,267	25,600	25,200	24,800	25,700	24,300	24,900	24,500	22,300	20,700	20,000
11	Private	11,998	10,614	10,059	10,871	11,482	12,233	12,510	12,486	12,600	11,499	10,901	11,258	11,294
12	Socialized sector	68,020	69,233	70,167	71,000	74,300	75,051	77,569	78,760	80,905	82,367	84,332	86,561	88,300
13	Workers and employees	40,420	42,300	43,900	45,400	49,100	50,251	51,869	54,460	56,005	57,867	62,032	65,861	68,300
14	Collective farm	27,600	26,933	26,267	25,600	25,200	24,800	25,700	24,300	24,900	24,500	22,300	20,700	20,000
15	Private sector	12,626	11,188	10,579	11,337	11,894	12,591	12,814	12,736	12,797	11,680	11,066	11,407	11,427
16	Independent artisans	628	574	520	466	412	358	304	250	197	181	165	149	133
17	Private agriculture	11,998	10,614	10,059	10,871	11,482	12,233	12,510	12,486	12,600	11,499	10,901	11,258	11,294

Line No.	Item	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
1	Total	100,905	103,465	107,929	110,669	112,636	114,853	116,600	118,565	120,574	122,443	124,553	126,649	NA
2	Nonagricultural sectors	62,689	65,191	68,296	70,884	73,491	76,238	78,861	81,012	83,306	85,601	87,587	89,684	91,831
3	Industry	25,442	26,317	27,447	28,514	29,448	30,428	31,159	31,593	32,030	32,461	32,875	33,433	34,030
4	Other nonagricultural sectors	37,130	38,773	40,764	42,301	43,990	45,773	47,680	49,413	51,270	53,134	54,706	56,245	57,795
5	Services [1]	21,757	22,829	24,027	25,052	26,183	27,483	28,649	29,615	30,670	31,763	32,870	33,849	34,855
6	Other [2]	15,373	15,944	16,737	17,249	17,807	18,290	19,031	19,798	20,600	21,371	21,836	22,396	22,940
7	Independent artisans	117	101	85	69	53	37	22	6	6	6	6	6	6
8	Agricultural sectors	38,216	38,274	39,633	39,785	39,145	38,615	37,739	37,553	37,268	36,842	36,966	36,965	NA
9	State	7,954	8,168	8,704	8,894	8,836	8,899	9,083	9,180	9,499	9,647	9,885	10,102	10,330
10	Collective farm	19,400	19,200	18,900	18,600	18,400	18,100	17,500	17,000	16,500	16,200	16,100	15,900	NA
11	Private	10,862	10,906	12,029	12,291	11,909	11,616	11,156	11,373	11,269	10,995	10,981	10,963	NA
12	Socialized sector	89,926	92,458	95,815	98,309	100,674	103,200	105,422	107,186	109,299	111,442	113,566	115,680	NA
13	Workers and employees	70,526	73,258	76,915	79,709	82,274	85,100	87,922	90,186	92,799	95,242	97,466	99,780	102,155
14	Collective farm	19,400	19,200	18,900	18,600	18,400	18,100	17,500	17,000	16,500	16,200	16,100	15,900	NA
15	Private sector	10,979	11,007	12,114	12,360	11,962	11,653	11,178	11,379	11,275	11,001	10,987	10,969	NA
16	Independent artisans	117	101	85	69	53	37	22	6	6	6	6	6	6
17	Private agriculture	10,862	10,906	12,029	12,291	11,909	11,616	11,156	11,373	11,269	10,995	10,981	10,963	NA

[1] Includes trade, public dining, material-technical supply and sales, and procurement; housing-communal economy and personal services; education and culture; art; science and scientific services; credit and insurance organizations; and government administration.

[2] Includes construction; forestry; transport; communications; and other.

NA—Not available.

Source: Stephen Rapawy, "Estimates and Projections of the Labor Force and Civilian Employment in the U.S.S.R.: 1950 to 1990," U.S. Department of Commerce, Bureau of Economic Analysis, 1976 (forthcoming); and TsSU SSSR, "SSSR v tsifrakh v 1975 g.; kratkiy statisticheskiy sbornik," Moscow, Statistika, 1976, pp. 174–177.

TABLE 11.—ANNUAL AVERAGE EMPLOYMENT IN THE STATE SECTOR, BY BRANCH OF THE ECONOMY, U.S.S.R.: 1950–75

[In thousands; figures in parentheses were interpolated linearly]

Year	Total	Agriculture	Nonagricultural branches														
			Total	Industry	Construction	Forestry	Transport	Communications	Trade, public dining material-technical supply and sales, and procurement	Housing communal economy and personal services	Health services	Education and culture	Art	Science and scientific services	Credit and insurance organizations	Government administration	Other
1950	40,420	3,437	36,983	15,317	3,278	444	4,117	542	3,360	1,371	2,051	3,315	185	714	264	1,831	194
1951	[1] 42,300	(3,565)	38,735	16,230	3,414	(453)	(4,370)	(554)	(3,444)	(1,428)	(2,139)	(3,434)	(194)	(772)	(263)	(1,809)	231
1952	[1] 43,900	3,693	40,207	16,873	3,578	462	4,623	565	3,528	1,485	2,226	3,553	(202)	829	262	1,786	235
1953	[1] 45,400	4,026	41,374	17,617	3,685	416	4,694	582	3,496	1,519	2,308	3,647	(211)	860	263	1,726	250
1954	[1] 49,100	5,966	43,134	18,499	4,064	(402)	(4,925)	(596)	(3,626)	(1,551)	(2,468)	(3,817)	(219)	(926)	(264)	(1,544)	233
1955	50,251	6,041	44,210	18,984	4,119	389	5,056	611	3,756	1,583	2,627	3,988	288	992	265	1,361	251
1956	51,869	5,954	45,915	19,702	4,523	390	5,232	624	3,826	1,666	2,736	4,103	(245)	1,094	266	1,342	166
1957	54,460	6,628	47,832	20,357	5,014	377	5,368	641	4,017	1,721	2,892	4,250	(263)	1,208	261	1,294	169
1958	56,005	6,005	50,000	20,997	5,495	367	5,681	664	4,190	1,754	3,059	4,378	(280)	1,338	260	1,294	243
1959	57,867	5,568	52,299	21,670	5,921	352	5,984	691	4,389	1,815	3,245	4,556	(298)	1,474	260	1,273	371
1960	62,032	6,793	55,239	22,620	6,319	359	6,279	738	4,675	1,920	3,461	4,803	315	1,763	265	1,245	477
1961	65,861	7,496	58,365	23,817	6,541	378	6,518	790	5,010	2,030	3,677	5,165	346	2,011	277	1,295	510
1962	68,300	7,817	60,483	24,677	6,523	389	6,677	832	5,253	2,096	3,818	5,521	340	2,213	283	1,316	545
1963	70,526	7,954	62,572	25,442	6,684	399	6,841	877	5,487	2,182	3,933	5,835	353	2,370	289	1,308	572
1964	73,258	8,168	65,090	26,317	6,883	404	7,054	928	5,752	2,282	4,082	6,204	362	2,497	296	1,354	675
1965	76,915	8,704	68,211	27,447	7,301	402	7,252	1,007	6,009	2,386	4,277	6,600	370	2,625	300	1,460	775
1966	79,709	8,894	70,815	28,514	7,549	409	7,364	1,073	6,261	2,489	4,427	6,895	380	2,741	313	1,546	854
1967	82,274	8,836	73,438	29,448	7,880	412	7,467	1,123	6,575	2,674	4,545	7,172	387	2,850	329	1,651	925
1968	85,100	8,899	76,201	30,428	8,149	421	7,606	1,187	6,964	2,800	4,747	7,507	393	2,990	346	1,736	927
1969	87,922	9,083	78,839	31,159	8,572	426	7,803	1,269	7,287	2,930	4,927	7,777	403	3,128	363	1,834	961
1970	90,186	9,180	81,006	31,593	9,052	433	7,985	1,330	7,537	3,052	5,080	8,025	412	3,238	388	1,883	998
1971	92,799	9,499	83,300	32,030	9,549	432	8,203	1,394	7,816	3,213	5,239	8,262	420	3,374	411	1,935	1,022
1972	95,242	9,647	85,595	32,461	9,986	443	8,446	1,435	8,100	3,376	5,386	8,482	428	3,544	439	2,008	1,061
1973	97,466	9,885	87,581	32,875	10,091	444	8,705	1,465	8,392	3,527	5,522	8,708	434	3,735	465	2,087	1,131
1974	99,780	10,102	89,678	33,433	10,339	449	8,922	1,499	8,640	3,664	5,655	8,924	441	3,864	493	2,168	1,187
1975	102,155	10,330	91,825	34,030	10,550	450	9,150	1,540	8,890	3,815	5,790	9,145	445	4,010	520	2,240	1,250

[1] Data were reported as rounded to tenths of millions.

Source: Stephen Rapawy, "Estimates and Projections of the Labor Force and Civilian Employment in the U.S.S.R.: 1950 to 1990," U.S. Department of Commerce, Bureau of Economic Analysis, 1976 (forthcoming).

TABLE 12.—ANNUAL AVERAGE EMPLOYMENT OF INDUSTRIAL-PRODUCTION PERSONNEL, BY BRANCH OF INDUSTRY, U.S.S.R.: 1950 TO 1974

[In thousands]

Year	Total, industry	Total, selected branches [1]	Electric power	Coal	Oil and gas				Chemical and petrochemical		Ferrous metallurgy	Nonferrous metallurgy	Machine-building and metalworking	Construction materials	Timber, woodworking, and pulp and paper		Light industry	Food industry	Residual
					Total	Oil extraction	Oil refining	Gas	Total	Chemical [3]					Total	Pulp and paper			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)
1950	15,317	14,508	184	859	121	68	44	9	469	371	743	582	4,307	699	2,208	140	2,653	1,683	809
1951	16,230	15,159	197	875	129	70	50	9	494	395	780	619	4,535	757	2,268	144	2,780	1,725	1,071
1952	16,873	15,807	211	891	139	76	54	9	521	418	817	624	4,775	819	2,329	148	2,913	1,768	1,066
1953	17,617	16,491	226	926	149	81	59	9	549	443	850	619	5,028	887	2,392	152	3,053	1,812	1,126
1954	18,499	17,201	242	986	151	77	66	8	579	467	871	604	5,294	960	2,457	156	3,200	1,857	1,298
1955	18,984	17,928	260	1,047	164	82	73	9	610	490	891	577	5,565	1,039	2,524	161	3,348	1,903	1,056
1956	19,702	18,664	283	1,129	173	83	80	10	643	503	916	577	5,860	1,129	2,557	163	3,445	1,952	1,038
1957	20,357	19,414	308	1,194	181	83	85	13	678	517	941	576	6,171	1,227	2,590	165	3,545	2,003	943
1958	20,997	20,199	335	1,256	192	86	88	18	715	530	966	576	6,498	1,334	2,624	167	3,648	2,055	798
1959	21,670	20,955	364	1,245	191	85	88	18	754	567	996	593	6,842	1,450	2,658	169	3,754	2,108	715
1960	22,620	21,742	397	1,196	196	85	93	18	792	603	1,047	611	7,206	1,575	2,698	173	3,860	2,164	878
1961	23,817	22,602	422	1,171	200	87	95	18	868	658	1,090	629	7,682	1,602	2,722	180	3,957	2,259	1,215
1962	24,677	23,456	449	1,162	204	88	97	19	951	730	1,122	648	8,189	1,629	2,746	187	4,030	2,326	1,221
1963	25,442	24,272	477	1,158	205	(2)	(2)	20	1,042	825	1,161	668	8,729	1,657	2,771	195	4,034	2,370	1,170
1964	26,317	25,361	507	1,166	221	92	106	23	1,142	900	1,200	687	9,305	1,685	2,796	203	4,171	2,481	956
1965	27,447	26,505	540	1,200	229	94	110	25	1,251	972	1,236	709	9,905	1,716	2,819	212	4,308	2,592	942
1966	28,514	27,524	581	1,202	242	99	116	27	1,346	1,033	1,267	734	10,400	1,774	2,827	235	4,471	2,680	990
1967	29,448	28,466	602	1,204	252	102	122	28	1,424	1,093	1,298	742	10,846	1,831	2,830	245	4,651	2,786	982
1968	30,428	29,363	625	1,194	254	101	125	28	1,468	1,127	1,333	755	11,282	1,901	2,858	252	4,800	2,893	1,065
1969	31,159	29,998	635	1,168	256	101	127	28	1,523	1,169	1,348	757	11,698	1,955	2,833	255	4,914	2,911	1,161
1970	31,593	30,469	633	1,120	263	102	132	29	1,568	1,203	1,359	745	12,017	1,996	2,848	259	5,019	2,901	1,124
1971	32,030	30,876	645	1,090	263	101	133	29	1,598	1,226	1,352	752	12,369	2,039	2,829	260	5,036	2,903	1,154
1972	32,461	31,279	655	1,056	265	101	136	28	1,626	1,248	1,354	760	12,718	2,070	2,821	262	5,034	2,920	1,182
1973	32,875	31,673	659	1,025	268	99	141	28	1,667	1,279	1,356	768	13,049	2,093	2,807	264	5,045	2,936	1,202
1974	33,433	32,187	671	1,002	268	96	144	28	1,706	1,309	1,366	776	13,424	2,115	2,799	267	5,074	2,986	1,246

[1] Sums of columns 3–5, 9, 11–15, and 17–18.
[2] Rubber and asbestos industries are excluded.
[3] Combined employment for oil extraction and oil refining were reported at 185,000.

Note: Many of the figures shown here were estimated. Details of the methodology are given in the source.

Source: Stephen Rapawy, "Estimates and Projections of the Labor Force and Civilian Employment in the U.S.S.R.: 1950 to 1990," U.S. Department of Commerce, Bureau of Economic Analysis, 1976 (forthcoming).

TABLE 13.—ESTIMATED MAN-HOURS OF EMPLOYMENT IN THE NATIONAL ECONOMY, BY SECTOR, U.S.S.R.: 1950–74

[Absolute figures are in millions of man-hours]

Year	Total	Index, 1968=100	Nonagricultural sector				Agricultural sector			
			Total	Industry	Other nonagricultural sectors	Independent artisans	Total	State	Collective farm	Private
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1950	155,781	76.4	78,764	33,054	44,355	1,355	77,017	7,696	45,808	23,513
1951	155,626	76.3	82,143	34,927	45,981	1,235	73,483	7,984	44,695	20,804
1952	156,476	76.7	84,903	36,209	47,578	1,116	71,573	8,272	43,589	19,712
1953	159,894	78.4	87,094	37,736	48,360	998	72,800	9,016	42,476	21,308
1954	168,156	82.4	90,480	39,569	50,030	881	77,676	13,360	41,811	22,505
1955	171,052	83.9	92,403	40,531	51,108	764	78,649	13,528	41,146	23,975
1956	174,294	85.4	93,814	41,020	52,161	633	80,480	13,336	42,623	24,521
1957	175,313	85.9	95,659	41,386	53,765	508	79,654	14,848	40,334	24,472
1958	178,815	87.7	99,343	42,393	56,552	398	79,472	13,448	41,328	24,696
1959	177,017	86.8	101,118	42,560	58,203	355	75,899	12,696	40,663	22,540
1960	176,533	86.5	102,975	42,752	59,911	312	73,558	15,192	37,002	21,364
1961	175,515	86.0	104,360	43,061	61,030	269	71,155	14,735	34,356	22,064
1962	178,259	87.4	107,622	44,616	62,766	240	70,637	15,428	33,075	22,134
1963	179,661	88.1	111,026	45,897	64,918	211	68,635	15,631	31,717	21,287
1964	184,765	90.6	115,948	47,713	68,052	183	68,817	15,988	31,451	21,378
1965	191,038	93.7	120,555	49,377	71,025	153	70,483	16,961	29,946	23,576
1966	196,352	96.3	125,694	51,553	74,016	125	70,658	17,185	29,379	24,094
1967	200,031	98.1	130,654	53,389	77,169	96	69,377	17,143	28,889	23,345
1968	203,974	100.0	135,794	55,288	80,439	67	68,180	16,968	28,441	22,771
1969	207,017	101.5	140,748	56,741	83,967	40	66,269	17,164	27,237	21,868
1970	211,108	103.5	144,279	57,405	86,863	11	66,829	17,584	26,957	22,288
1971	216,088	105.9	149,154	58,554	90,589	11	66,934	18,270	26,579	22,085
1972	219,693	107.7	153,011	59,217	93,783	11	66,682	18,557	26,572	21,553
1973	222,718	109.2	155,567	59,557	95,999	11	67,151	19,096	26,530	21,525
1974	227,609	111.6	159,463	60,671	98,781	11	67,606	19,516	26,600	21,490

Source: Stephen Rapawy, "Estimates and Projections of the Labor Force and Civilian Employment in the U.S.S.R. 1950 to 1990," U.S. Department of Commerce, Bureau of Economic Analysis, 1976 (forthcoming).

2. LABOR PRODUCTIVITY

Labor productivity, which is a function of incentive to work as well as of numbers of workers and man-hours, capital equipment, and organization of work, is to receive special attention in the current 5-year plan, as noted earlier. Inasmuch as the labor supply is limited as never before, it is not surprising that the Soviet authorities must henceforth depend increasingly on the growth of productivity to achieve their output goals.

As table 14 shows, the current 5-year plan calls for a growth of labor productivity in the basic branches of the economy—industry, construction, railroad transport, and agriculture—that is lower than that in the previous 5-year plan [53] and also below the actual average annual increase achieved during the period 1951–75 for some branches (1951–74 for agriculture). There has been a great variation in labor productivity growth year by year, even excluding agriculture which is particularly volatile for a variety of reasons. The fact that the Soviet Union expects a lower rate of growth in productivity during the current 5-year plan period in spite of the greater dependence on productivity to achieve growth in output [54] indicates that the anticipated growth of manpower must be less than in earlier periods. In

[53] See Feshbach and Rapawy, "Labor," 1973, p. 546.

[54] About 90 percent of industry, no less than 95 percent in railroad transport, and all of construction and agriculture. *Izvestiya*, March 7, 1976, p. 2.

industry, the only branch for which planned employment growth can be calculated, the rate of growth is 50 percent below that of the previous period, as estimated above. Except for the gas industry, the branch of industry productivity plans also call for a lower productivity increase than that recorded during the previous plan period.[55] Where planned output is specified, and the output in the current plan is the same as or less than that in the previous plan, no increase in employment is implied when the output rates are combined with the planned changes in productivity.

TABLE 14.—ANNUAL GROWTH OF LABOR PRODUCTIVITY, BY BRANCH OF THE ECONOMY, 1951–80

[In percent]

Year	Industry	Construction	Railroad transport	Agriculture
1951	10.1	9.9	9.1	1.0
1952	6.8	6.1	3.4	11.9
1953	7.3	4.3	6.0	3.5
1954	7.5	9.6	3.9	5.1
1955	9.5	11.3	12.2	12.2
1956	7.0	8.6	9.8	10.1
1957	6.6	9.5	11.0	5.3
1958	6.2	9.3	6.8	15.0
1959	7.4	9.8	9.4	3.3
1960	5.4	8.1	4.2	6.8
1961	4.4	3.1	5.3	5.4
1962	5.5	6.5	6.1	3.3
1963	4.8	4.0	5.7	−6.8
1964	3.7	6.7	5.2	18.0
1965	4.8	5.7	4.9	−1.6
1966	5.2	5.0	3.7	11.7
1967	6.7	6.5	8.1	3.7
1968	5.2	4.2	5.5	6.5
1969	4.8	−1.5	3.2	−1.0
1970	7.0	6.4	4.2	12.3
1971	6.3	5.0	4.5	3.6
1972	5.2	5.4	3.8	−4.2
1973	6.1	4.4	6.1	17.6
1974	6.3	5.5	4.0	−1.9
1975	5.9	5.5	3.6	−7.0
1976–80 (plan)	5.7	5.5	3.5	[1] 5.1

[1] Includes state and collective arms only.

Source and methodology: Industry, construction, and railroad transport: 1951–74: TsSU SSSR, Narodnoye khozyaystvo SSSR v 1974 godu; statisticheskiy yezhegodnik, Moscow, Statistika, 1975, p. 85.
1975: Izvestiya, Feb. 1, 1976, p. 1.
1976–80: The official plan figures for 1976–80 are: Industry—30 to 34 percent; construction, 29 to 32 percent; and railroad transport, 18 to 20 percent (Izvestiya, Mar. 7, 1976, pp. 3 and 6). The midpoints of these figures were used in calculating annual growth rates.
Agriculture: 1951–70: Derived from data in TsSU SSSR, Sel'skoye khozyaystvo SSSR; statisticheskiy sbornik, Moscow, Statistika, 1971, p. 423.
1971–74: Derived from data in TsSU SSSR, Narodnoye khozyaystvo SSSR v 1974 godu, 1975, p. 86.
1975: TsSU SSSR, SSSR v tsifrakh v 1975 g., kratkiy statisticheskiy sbornik, Moscow, Statistika, 1976, p. 24.
1976–80: The official plan figure for the 5-year plan is 27 to 30 percent (Izvestiya, Mar. 7, 1976, p. 5). The method used in estimating annual growth rates was the same as for the other branches.

Various tasks designed to raise productivity are set forth in the new plan, such as improvement in mechanization of labor, reduction of auxiliary labor, reduction of manual labor, and improvement of norming. In the past such efforts have not achieved major success. Progress toward improvement of productivity is not likely to be substantial if the share of auxiliary workers, whose labor productivity

[55] Cf. *Izvestiya*, March 7, 1976, pp. 3–5, and *Ekonomicheskaya gazeta*, No. 8, February 1971, pp. 5–7.

is significantly lower than that of basic workers, grows rather than declines. Kostin, writing in *Kommunist*, indicates that the share of auxiliary workers had grown from 46 percent in 1965 to 49 percent "at the present time," presumably 1972.[56] Auxiliary workers comprise an estimated 50–54 percent of employment in the machine-building industry in the U.S.S.R., as compared with only about 30 percent in the U.S.[57] One of the main reasons why the high proportion of auxiliary workers places a major constraint on the growth of labor productivity in the U.S.S.R. is that they perform mostly manual rather than mechanized work. Kostin indicates that the share of mechanized labor among auxiliary workers was 2.3 times lower than for basic workers. Very little progress appears to have been made in reducing the share of auxiliary workers since 1959, when they were about 55 percent of all industrial workers. In 1962, the proportion was 53 percent, in 1965, 52 percent,[58] in 1969, still "more than half," and in 1972, 48.6 percent.[59]

In March 1975, N. Rogovskiy, head of the Labor Department and member of the State Planning Committee (Gosplan U.S.S.R.), made reference to the need for gradual elimination of heavy manual labor. Even more surprisingly, he indicated that at that time there was "no overall program for the mechanization of manual work." [60] Perhaps as a result of the clear call in the new plan for improvement in this area a program will be initiated.

Assuming similar levels of technology, scale, flow of other inputs, etc., specialization of production within plants devoted to producing a single product line is undoubtedly accompanied by higher levels of labor productivity. For example, a Soviet source indicates that Soviet specialized plants producing iron castings have a productivity 5 to 10 times higher and those producing steel castings 15–20 times higher than do the nonspecialized plants producing the same products.[61] The same source states that 27 percent of U.S. workers are employed in specialized plants, and they account for 21 percent of the total output; in the Soviet Union, only 1.7 percent of the workers in industry are in specialized plants, and they produce 1.5 percent of all machine-building output.[62] Only 18 percent of all parts-building enterprises are engaged in the specialized production of parts for the Soviet machine-building industry.[63] Plants of individual ministries may have

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[56] It is assumed that Kostin's current data were from the survey taken the year before the date of his article. L. Kostin. "Proizvoditel'nost' truda i nauchno-tekhnicheskiy progress." *Kommunist*, No. 17, November 1973, p. 46.

[57] S. M. Yampol'skiy (Ed.), *Khozraschetnyye faktory uskoreniya tekhnicheskogo progressa v promyshlennosti*, Kiev, Naukova Dumka, 1973, p. 94.

[58] Feshbach and Rapawy, "Labor," 1973, p. 547.

[59] V. Kostakov, "Zanyatost' naseleniya v usloviyakh intensifikatsii proizvodstva," *Voprosy ekonomiki*, No. 4, April 1974, p. 37; and S. A. Kheynman, "Mashinostroyeniye: Perspektivy i rezervy," *EKO*, No. 6, November–December 1974, p. 41. These figures for mechanized labor may be high. Using Kheynman's definition of manual labor, which includes those workers who work on machinery by hand, would subtract another 8 percentage points in 1965 and 7 in 1972 from the figures for mechanized labor given here.

[60] N. Rogovskiy, "Nekotoryye problemy narodonaseleniya i trudovykh resursov," *Planovoye khozyaystvo*, No. 3, March 1975, p. 10.

[61] A. A. Denisov et al. (Eds.), *Rabochaya sila v sisteme sotsialisticheskikh proizvodstvennykh otnosheniy*, Yaroslavl', n.p., 1973, p. 125.

[62] *Ibid.*

[63] I. Filatov and O. Shilov, "Spetsializatsiya: rezul'taty i perspektivy," *Promyshlennost' Belorussii*, No. 12, December 1974, p. 25.

product-lines that are almost entirely within the same branch of industry. For example, in 1970, 93.0 percent of the output of enterprises of the Ministry of Precision Instrument Building were commodities defined as within that branch of industry, but these enterprises produce only 64.8 percent of all of the output in the country that is classified as precision instrument building commodities.[64] In all branches of industry there is room for further specialization to increase labor productivity. But since most Soviet enterprises operate as feudal manors because of the vagaries of the supply system, conversion to specialized plants is not likely to proceed very rapidly.

The Soviet Union seems to be making some progress toward a better educated and therefore more productive industrial labor force. As of March 1, 1952, 72.1 percent of all industrial wageworkers (*rabochiye*) had 4 years of schooling or less. By June 1, 1973, the proportion with such a low level of education had been reduced to 29.1 percent. Of workers under 30 years of age, only 6 percent had so little schooling.[65] Still, in 1973, 70.3 percent of all workers in industry and 49.5 percent of those under 30 years of age had not completed secondary school.[66]

Equally important in terms of its contribution to productivity is the training of engineers in part-time as compared to full-time faculties, or divisions. The Soviet Union has a vast program of evening and correspondence faculties for degree earning in all fields, but unfortunately, while we know the aggregate proportion of admissions, enrollment, and graduations, almost no data have been published by field of study or specialty group. Recently, however, national data on engineer and technician graduates for the 1950's were published in a obscure source. In 1950, when graduates of part-time divisions were only 17.5 percent of graduates in all fields, the share of part-time engineering graduates was correspondingly small, but in 1958, when the share of all graduates had increased to 29.4 percent, the share of part-time graduates among all engineering graduates increased markedly (table 15).[67] In 1968, the peak year, almost half of all graduates, 48.6 percent, earned their degree from evening and correspondence divisions of higher educational institutions.[68] It may be assumed that a large proportion of engineers in the U.S.S.R. at the present time have obtained their degrees in this fashion. It is likely that the quality of part-time training is not equal to that of full-time study, hence the high proportion of engineers who qualified in this manner probably imposes some constraint on the growth of productivity.

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[64] Increased in both cases from 86.0 to 57.0 percent, respectively, in 1965. M. Gazaliyev, "Osnovnyye napravleniya razvitiya spetsializatsii v mashinostroyenii," *Voprosy ekonomiki*, No. 5, May 1974, p. 50.

[65] *Vestnik statistiki*, No. 7, July 1974, p. 93.

[66] *Ibid.* Incomplete secondary education is defined as 7 or 8 years of schooling, depending on date of school leaving. It would add over 40 percentage points in both cases in 1973.

[67] For the United States, part-time enrollment amounted to 8 percent of all undergraduate engineering enrollment in the surveys of fall 1968, 1971, and 1974. Engineering Manpower Commission of the Engineers Joint Council, *Engineering and Technology Enrollments: Fall 1974*, New York, April 1975, p. 12. Enrollment in part-time engineering technology curricula grew from 14 percent in 1968 to 24 percent in 1971. *Ibid.*, p. 112. In the United States part-time engineering enrollment is mainly in work-study programs rather than studies undertaken in addition to a full-time job.

[68] TsSU SSSR, *Narodnoye khozyaystvo SSSR v 1969 godu; statisticheskiy yezhegodnik*, Moscow, Statistika, 1970, p. 684, and TsSU SSSR, *Vysshoye obrazovaniye v SSSR, statisticheskiy sbornik*, Moscow, Gosstatizdat, 1961, p. 94.

TABLE 15.—GRADUATES OF PART-TIME ENGINEERING FACILITIES OF HIGHER EDUCATIONAL INSTITUTIONS, 1950 AND 1958

[In thousands, except percent]

Engineering specialty group	1950			1958		
	Total	Part time	Percent of part time	Total	Part time	Percent of part time
	(1)	(2)	(3)	(4)	(5)	(6)
Geology and exploration of useful mineral deposits	1,700	26	1.5	5,100	132	2.6
Development of useful mineral deposits	1,400	33	2.4	6,600	261	4.0
Energetics	2,400	118	4.9	6,800	1,077	15.8
Metallurgy	1,400	118	8.4	3,800	562	14.8
Machine-building and precision instrument building	9,100	845	9.3	23,600	5,492	23.3
Electrical machine-building and electrical precision instrument building	1,400	30	2.1	5,000	527	10.5
Radiotechnology and communications	1,400	100	7.1	5,400	943	17.5
Chemical technology	2,600	73	2.8	5,600	438	7.8
Timber engineering and wood technology, pulp and paper	700	10	1.4	3,400	268	7.9
Technology of food products	2,300	58	2.5	2,600	156	6.0
Technology of consumers' goods	1,200	93	7.8	3,000	549	18.3
Construction	4,900	313	6.4	13,100	1,454	11.1
Transport	3,100	97	3.1	5,700	906	15.9

Note: This list does not include all Soviet engineering specialties.

Source: Col. 1: TsSU SSSR, Narodnoye khozyaystvo v 1960 godu, statisticheskiy yezhegodnik, Moscow, Gosstatizdat, 1961 p. 776.

Cols. 2 and 5: A. I. Lutchenko, Sozdaniye inzhenerno-tekhnicheskikh kadrov v gody postroyeniya sotsializma v SSSR 1926–1958 gg., Minsk, Vysheyshaya shkola, 1973, p. 217, citing a previously unknown handbook entitled Vyssheye i srednyeye spetsial'noye zaochnoye i vecherneye obrazovaniya v SSSR, Moscow, n.p., 1960.

Col. 3: Col. 2 divided by col. 1.

Col. 4: TsSU SSSR, Narodnoye khozyaystvo SSSR v 1962 godu; statisticheskiy yezhegodnik, Moscow, Gosstatizdat, 1963, p. 570.

Col. 6: Col. 5 divided by col. 4.

3. UTILIZATION OF LABOR RESOURCES

Regardless of the division in which the engineers or technicians were trained, many work in jobs not related to their field of specialization. This may well lead to a reduction in their potential productivity. The misallocation of graduates, and their movement into jobs outside their field was discussed in our previous paper.[69] Perhaps the most extreme example available is the case of the Chief Administration for Construction Materials of Leningrad, which includes among its "engineers and technicians" 49 agronomists, veterinarians, and zootechnicians, 91 teachers of literature, mathematics, history, and geography, 10 specialists in public dining, bakery and other trade specialties, and 13 pharmacists and paramedics.[70] According to recent indications, agricultural specialists, who had been particularly prone to change their branch of employment, are to be controlled more closely in the future. Priority will be given to enrolling rural youth in agricultural studies, conditions for those assigned to work on farms are to be improved by the republic ministries of agriculture, and managers of individual farms are to be held strictly accountable for hiring only those with proper documents and not releasing young specialists without authority from their superiors. The Ministry of Agriculture U.S.S.R. and the

[69] See Feshbach and Rapawy, "Labor," 1973, pp. 527–533.

[70] Academician S. Batyshev, Academy of Pedagogical Sciences, "Po 'teti-maminoy rekomendatsii.'" *Komsomol'kaya Pravda*, July 23, 1975, p. 2. The author's primary concern was the wrong choice of a profession and the savings to the State if these could be prevented.

Central Statistical Administration U.S.S.R., are enjoined to study the distribution and utilization of specialists and to determine what other measures may be necessary to reduce labor turnover among this group.[71]

The effect of labor turnover on labor productivity both before and after the changing of jobs is an area of constant concern to Soviet planners. Recent data indicate a small reduction in the turnover rate in the last few years. Between 1965 and 1970, the percentage of workers in industries who quit voluntarily or were fired for infractions of labor discipline hovered between 21 and 22 each year. In 1972 it was down to 19.8 percent and in 1974 it dropped four-tenths of a percent to 19.4.[72] Efforts to reduce labor turnover have taken a number of directions. New types of labor booklets designed to "strengthen labor discipline" among workers and employees were introduced on January 1, 1975.[73] The introductory paragraph of the 1975 directive on labor booklets for collective farmers indicates that they were intended to serve a similar purpose.[74] The State Committees on Labor Resources Utilization, which provide information on job opportunities and direct individuals to jobs throughout the country, have been increasing their activities, but not as rapidly as when they were first formed in 1967.[75] By this means the interval between jobs has been reduced and therefore labor productivity enhanced. Of the 128,000 persons who applied for help in the urban offices of the R.S.F.S.R. committee in 1969, 95,000 were referred to jobs, and 47,500 were actually placed. By 1972, the number of job applicants had grown nine-fold to 1,126,000, referrals to 961,000 and placements to 655,000. The figures for the next 2 years were at about the same level.[76] Apparently only 20 to 30 percent of all persons hired in enterprises and organizations of all branches use the offices of the Committees. In 1973, 86.4 percent of all new workers and employees taken on by industrial enterprises were hired "from the gate." [77] A new planning procedure was instituted in 1972 which required that labor productivity plans specify goals on a yearly basis and not just for the entire 5-year plan period. In conjunction with assigned levels of output, productivity plans place an indirect limit on employment in any given enterprise.[78] The explicit purpose of this regulation was to counteract the propensity of enterprises to lower their labor productivity growth targets. Whether all of these measures will be sufficient to overcome the recent retardation in growth of labor productivity and to

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[71] "Zabotyas' o molodykh spetsialistakh." *Pravda*, January 8, 1976, p. 2.

[72] See L. M. Danilov, "Problemy snizheniya tekuchesti kadrov i sozdaniya ustoychivykh trudovykh kollektivov," in A. A. Dimitriyev (Ed.), *Sotsialisticheskaya distsiplina truda: Opyt, problemy; Po materialam nauchno-prakticheskoy konferentsii "Osnovnyye napravleniya povysheniya ideologicheskoy raboty partiynykh komitetov po vospitaniyu sotsialisticheskoy distsipliny truda,"* Moscow, Profizdat, 1975, p. 154; Feshbach and Rapawy, "Labor," 1973, p. 539; and N. Rogovskiy, "Ratsional'no ispol'zovat' trudovyye resursy," *Planovoye khozyaystvo*, No. 11, November 1973, p. 20.

[73] The older versions are to be retained by those holding them at the present time and will not be replaced. "O trudovykh knizhkakh rabochikh i sluzhashchikh." Directive of the Council of Ministers USSR and the All-Union Council of Trade Unions, dated September 6, 1973, in Chernenko and Smirtyukov, *Resheniya*, 1974, pp. 638–645.

[74] *Sobraniye postanovleniy Pravitel'stva SSSR*, No. 11, 1975, article 63, pp. 209–216. This regulation is to take effect on January 1, 1977.

[75] Murray Feshbach, "Manpower Management," *Problems of Communism*, Vol. XXIII, No. 6, November–December 1974, pp. 30–33, and Feshbach and Rapawy, "Labor," 1973, pp. 541–544.

[76] A. Kotylar et al., "Problemy sovershenstvovaniya trudoustroystva naseleniya," *Sotsialisticheskiy trud*, No. 3, March 1975, p. 111.

[77] See Danilov, "Problemy," 1975, p. 159; and Kotlyar, "Problemy," 1975, p. 111.

[78] A. Dadashev, "O povyshenii effektivnosti ispol'zovaniya trudovykh resursov," *Voprosy ekonomiki*, No. 4, April 1974, p. 120.

compensate for the marked drop in new labor supply in the future is an open question.

C. Military Manpower

Perhaps the most vital question that concerns us here is the size of the armed forces in the Soviet Union. In table 8, a constant figure of 4,005,000, the estimate for 1975 obtained from the International Institute for Strategic Studies of London, England, is used for the years 1976–90. Since the late 1950's, the Institute's estimates of armed forces for all countries of the world have been considered to be the most authoritative available.

An effort is made here to place the size of the Soviet Armed Forces in some perspective, not to derive a new figure per se. The implication of varying numbers and their connection with the impending labor shortages in the 1980's also will be discussed briefly.

A lively debate has recently broken out as to the "actual" size of the Soviet Armed Force. Alternative figures range from a total of 4,000,000 given by Mr. William Colby, former Director of the Central Intelligence Agency, in June 1975 to one of "6,000,000 or more" cited as a possible number by Mr. William Lee, a student of Soviet military affairs.[79] Within this range fall the figure of 4.5 to 5 million given by Lt. Gen. Daniel Graham, former Director of the Defense Intelligence Agency,[80] and a figure of 4.8 million put forward in a study for the Senate Armed Services Committee.[81] The figure of 6,000,000 seems the least likely of the various estimates regardless of the definition of "armed forces" used. While there is no doubt that the Soviet Armed Forces have grown since the low of 3,325,000 in 1961 because of efforts to meet perceived threats from China, the replacement of Czech forces by Soviet forces in Warsaw Pact formations, and the growth of the Navy. However, 6,000,000 would seem to be inconsistent with any reasonable assumptions about the balance of numbers between officers, warrant officers, and extended service enlisted men who comprise the career service personnel and the numbers of males inducted each year. Given an average of about 2 years service at the present time for all draftees,[82] and assuming that 25 percent of the armed forces are cadres, then, in order to achieve a total of 6,000,000, conscription would have to absorb an impossibly high proportion of the annual cohorts of potential draftees.

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[79] William T. Lee, "Military Economics in the USSR," *Air Force Magazine*, March 1976, p. 50. Lee notes that "One of the paradoxes of our perception of USSR, Superpower, is that while we know a great deal about the number and characteristics of Soviet weaponry, we don't know how many people the USSR has in uniform. Estimates range from a low of 3,000,000 to as high as 6,000,000 or more. A likely minimum is around 4,500,000—with as many as 6,000,000 being possible. One authority on the problem recently put the *combat* service at 4,800,000 men."

[80] Congress of the United States, Joint Economic Committee, *Allocation of Resources in the Soviet Union and China—1975*, 94th Congress, 1st Session, Washington, D.C., 1975, pp. 73 and 121.

[81] John M. Collins and John S. Chwat, *The United States/Soviet Military Balance: A Frame of Reference for Congress*. Study prepared by Congressional Research Service for the Senate Armed Services Committee, Congress of the United States, 94th Congress, 2nd Session, Washington, D.C., January 1976, p. 16.

[82] The 1967 draft law changed the draft age to 18 years old from 19 and reduced the length of service to 2 or 3 years, the 3-year term for the smaller services, such as the Navy. However, since graduates of higher educational institutions are only required to serve 1 year on active duty, it is assumed that the average is 2 years for all draftees. See Herbert Goldhamer, *The Soviet Soldier; Soviet Military Management at the Troop Level*, New York, Crane, Russak & Co., 1975, pp. 4–7; John Erickson, "Soviet Military Manpower Policies," *Armed Forces and Society*, Vol. 1, No. 1, November 1974, pp. 32–38; and D. I. Ol'khov, "Novyy zakon o vseobshchey voinskoy obyazannosti," *Sovetskoye gosudarstvo i pravo*, No. 5, May 1968, pp. 138–143.

The Institute's figures for armed forces plus paramilitary troops are used here for several reasons. First, they are internally consistent. Second, and more significant, it is our hypothesis that the construction, medical and railroad troops, at least, and perhaps also those few troops assigned to work on military state farms, are already included in the "civilian" employment figures, and hence should not be added to the armed forces figures used here in order to avoid double-counting. Reasons for making this inference are given below.

The armed forces figure for 1975 and subsequent years given in table 8 is 20 percent lower than some of those offered by other analysts cited above. This 1975 figure appears to be in line with the 1959 Soviet census figure of 3,623,000 for the armed forces. It is our present conclusion that there is ample evidence to indicate that our earlier interpretation of the 1959 figure as the total armed forces was incorrect. First, the figure of 3,623,000 [83] is suspicious in that, although it is supposed to be the sum of the armed forces figures for the 15 republics, which are given to the last digit, it ends in three zeros, a highly improbable circumstance. The term used in the census volume to define the coverage of the figure is "*nakhodyashchikhsya v ryadakh Sovetskoy Armii*" (which translates literally as "located in the ranks of the Soviet Army"). However, the same figure is identified in many other sources as "*Vooruzhenyye sily*" (armed forces). The use of the latter term should have been a warning sign that the coverage of the figure needed more careful examination. Instead of including all categories of military-related personnel, the term may refer only to combat-type troops (including their command and staff personnel) and excludes non-weapons-bearing troops.

Another suspicious circumstance is the fact that only 632 females were reported to be in the armed forces according to the census results. If we look at "civilian" health services according to the noncensal current statistics, we find that females comprised 85 percent of the workers and employees in this sector at the time of the census.[84] During World War II, two-thirds of all Soviet military medical personnel were females.[85] Hence it seems unlikely that the sex composition of the military medical services at present would differ so radically from that in the civilian sector and in the military during World War II. A military service of 3.6 million would require perhaps 50 to 100 thousand medical troops. Even if the figure of 632 represents only uniformed women doctors, it would seem to be too low. Is it possible that apart from the 632 women, the military medical service is comprised solely of civilian workers and employees (*volnonayemnyye*—voluntarily hired personnel)? The suspicion that medical personnel serving the armed forces are included under the civilian health services sector is strengthened by Abraham Becker's conclusion in 1964 that the "sharp increase in the unidentified 'health'

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[83] TsSU SSSR. *Itogi Vsesoyuznoy perepisi naseleniya 1959 goda, SSSR (svodnyy tom)*. Moscow. Statistika. 1962. p. 104.

[84] TsSU SSSR. *Narodnoye khozyaystvo SSSR v 1958 godu; statisticheskiy yezhegodnik*. Moscow. Gossfatizdat. 1959. p. 664.

[85] James T. Reitz, "Soviet Defense-Associated Activities Outside the Ministry of Defense." In Congress of the United States, Joint Economic Committee. *Economic Performance and the Military Burden in the Soviet Union*, 91st Congress, 2d Session, Washington, D.C., 1970. p. 155.

residual in the Union budget reflects a transfer of military medical outlays from 'defense' to 'health'." [86]

There are somewhat more definite indications that certain "military" personnel may be included in "civilian" employment statistics. In the reference book edited by A. G. Gornyy and published in the Officer's Library Series, it is explicitly stated that the service of military construction troops is "structured on a somewhat different basis" than that of the regular troops.[87] Although they are in uniform, they must have a different official status, otherwise why is it necessary to stipulate that they are authorized to obtain "the same benefits established for ordinary (*ryadovogo*) troops who are on active duty (*na deystvitel'nuyu sluzhbu*)," and that the payment for their work is "made on the basis of existing labor legislation," i.e., on the same basis as for ordinary construction workers.[88] General of the Army A. Komarovskiy, the Deputy Minister of Defense of the U.S.S.R. for Construction and Billeting of Troops, seems to acknowledge the similarity between military and civilian construction workers in his statement that "military construction workers are an integral part of the multimillion army of Soviet construction workers," which may be an indication that they are counted in the civilian construction sector. Assuming that the Bulgarians have very closely copied the Soviet system, it is perhaps significant that all young persons have the option of serving full time either in the Bulgarian Armed Forces or in the Construction Troops.[89]

Among other troops possibly included in the civilian employment figures are the railroad troops and those assigned to military state farms. According to Kruzhin, there were 55,000 persons assigned to the railroad troops contingent when they were first organized in 1932.[90] The number serving in this capacity at present is not published, but it is known that they continue to work on the Baykal-Amur Mainline Railroad presently under construction and undoubtedly do guard duty as well as construction work. Military state farms, which employ troops and civilians, have in "recent years" yielded a profit in the "millions of rubles" according to the head of the Food Supply Administration of the Ministry of Defense.[91] If it were known to what extent uniformed troops perform activities of the *voyentorg* (military retail trade supply) system, then their numbers could also logically be included in the civilian employment rolls, since it can be shown that the value of trade turnover in this system is included in the civilian total in the standard Soviet statistical yearbooks.[92]

In sum, there is a broad range of military support (non-weapons bearing) activities in the U.S.S.R. which could easily employ about 800,000 persons, roughly the difference between the International In-

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[86] Abraham Becker, *Soviet Military Outlays Since 1955*, Santa Monica, Calif., The RAND Corp., 1964, p. 24.

[87] A. G. Gornyy (Ed.), *Osnovy Sovetskogo voyennogo zakonodatel'stva*, Moscow, Voyenizdat, 1966, p. 112.

[88] *Ibid.*, p. 113.

[89] *Rabotnichesko delo*, July 23, 1970.

[90] Peter Kruzhin, "Soviet Military Personnel Used for Civilian Work," *Radio Liberty Dispatch*, RL-276-75, July 4, 1975, pp. 1-2.

[91] F. Saushin, "Rationally Utilize Each Hectare of Land," *Tyl i snabzheniye Sovetskikh vooruzheniykh sil*, No. 4, April 1973, p. 53. See also Herbert Goldhamer, *The Soviet Soldier*, New York, Crane Russak & Co., 1975, p. 325, regarding use of troops on farms.

[92] The total value of activities of different parts of the trade system, including *voyentorg*, is given as 49.30 billions of rubles in 1960 in A. I. Abaturov, *Izderzhki obrashcheniya v roznichnoy torgovli*, Second edition, Moscow, Gostorgizdat, 1962, p. 50. The same figure is given in TsSU SSSR, *Narodnoye khozyaystvo SSSR v 1961 godu: statisticheskiy yezhegodnik*, Moscow, Gosstatizdat, 1962, p. 634, without indication whether *voyentorg* is included.

stitute for Strategic Studies' figure and the recent estimates referred to above.[93] They may not be included in the lower figure given by the Institute. If one adds up the force component figures given in the annual *The Military Balance* for the strategic rocket forces, the air defense forces, the army, the navy, the air force, and the paramilitary security and border troops, these add exactly to the totals shown by the Institute for the armed forces plus the paramilitary troops, which leaves no room for the support troops.[94]

When we turn to the question of how the Soviet military forces compete with the civilian economy for the available manpower, the discussion becomes much more tenuous. If we assume a baseline figure of 4.5 million persons under arms for the future, a number of questions arise as to the possibility of maintaining a force of this magnitude and in addition the construction, farm, railroad and other support troops without placing severe pressure on the manpower resources available for the civilian economy. What about the quality of those to be drafted? What about their proficiency in Russian, the lingua franca of this multinational country's armed forces? What about the size of the career cadres (officer and enlisted), and the draft rates necessary to maintain the military forces at a given size? The changing size of the cohorts of 18-year-olds (see the population pyramids on pp. 117–121), the changing regional distribution, and the different levels of educational attainment, all complicate the military manpower questions.

No figures on numbers of cadres or draftees are available from Soviet sources. Nonetheless we can postulate ranges within which the proportion of career cadres and draft rates probably fall. Erickson estimates that the officer corps is about 20 percent.[95] If 3 to 5 percent of the armed forces in any given year are reenlisted NCO's and soldiers, then about 25 percent of all military personnel are retained from year to year.[96] This would mean that conscripts would account for 75 percent, or 3,375,000 draftees assuming a total force of 4.5 million. With an average of 2 years service, the call-up rate would be 1,687,500 men per year. If there were 4.8 million in service, of whom as few as 20 percent were cadres, it would be necessary to draft 1,920,000 recruits per year. This latter figure would amount to 85 percent of the cohort of 18-year-olds in 1970, 75 percent in 1980, 90 percent in 1990, and 75 percent in 2000. In 1987, the year with the smallest cohort of 18-year-olds, 2,012,000 males, a draft of 1,687,500 would entail a call-up of 84 percent. Even at first glance this seems an improbably high rate. Writing in *Air Force Magazine*, Col. William F. Scott (USAF retired) indicates that less than 30 percent are exempt.[97] Although more precise figures are not

[93] Some estimates of specialized troops are given in the article by Congressman Les Aspin, "Numbers Games Magnify 'Red Horde'." *The Washington Star*, April 4, 1976, pp. C1 and C4; and John W. Finney, "U.S. Statistics on Soviet Question Extent of Threat," *The New York Times*, April 24, 1976, p. 3.

[94] The very first edition of *The Military Balance* in 1959 made reference to the inclusion of labor battalions along with an estimate of 350,000 for internal security troops (Institute for Strategic Studies, *The Soviet Union and the NATO Powers, The Military Balance*, London, The Institute for Strategic Studies, November 1969, p. 2). In the next year's volume, reference was made in the foreword to changes since the prior edition. The only mention in the 1960 edition of a force of 350,000 is to "armed police of one kind or another" (Institute for Strategic Studies, *The Communist Bloc and the Free World; The Military Balance 1960*, London, The Institute for Strategic Studies, 1960, p. 2). No subsequent volume has ever made reference to "labour battalions" or any similar type of troops.

[95] John Erickson, *Soviet Military Power*, London, Royal United Services Institute for Defense Studies, 1971, p. 14, cited in H. Goldhamer, *The Soviet Soldier*, 1975, p. 4.

[96] In an unpublished manuscript entitled "Soviet Military Compensation and Conscription: An Economic and Statistical Analysis," University of Wisconsin, 1973, p. 10, from *Army Information Digest*, September 1959, p. 54, Earl Brubaker estimates that only 14 percent of military personnel are officers.

[97] Wm. F. Scott, *Air Force Magazine*, April 1974, p. 28.

available, it is possible that all the various exemptions and deferments may add up to no less than 20 percent of the cohort at the present time. There are medical exemptions, which may be more or less easily granted at different times, but probably never fall below 5 percent, and family exemptions for sole supporters of invalid parents, and fathers of two or more children, which must add at least several more percentage points. Other exemptions are reportedly granted to those who have jobs in sensitive industries. Graduates of *voyenfak's* (military faculties) of universities get deferments and apparently some get exemptions. Legally in the reserves as an *ofitser zapasa*, these ROTC-equivalent graduates may be called up if needed to fill deficit military specialties. Others receive deferments when attending vocational-technical and specialized secondary schools. Indirect evidence indicates that specialized secondary schools also have an ROTC program, therefore some of their graduates would not be drafted. The significance of educational deferments may grow as higher education expands. It is understood that persons who served in prison for more than 3 years are also exempt. Perhaps some deferments may be obtained by bribery by individuals wishing to avoid the draft until they pass age 27, the upper age of conscription. In sum, exemptions and deferments constitute a sizeable diminution of the available pool of potential draftees. However, some persons who receive deferments become available again upon completion of school, upon the death of an invalid parent, upon the correction of a medical disability, and so forth, adding to the manpower pool.

The regional distribution of population also affects the number and quality of recruits and their suitability for service in units requiring technical skills. In 1975, it is estimated that 16.8 percent of the cohorts came from the five Central Asian republics (including Kazakhstan), or 22.9 percent if the Transcaucasus is included. By the end of the century, the shares are projected to be 27.4 and 34.6 percent, respectively. According to the 1970 census, some 24 percent of the national population do not speak Russian fluently.[98] How fluent the remaining 76 percent are may be open to question, since fluency for census purposes is not determined by testing, but by taking the respondent's word for it. Hence, the 76 percent claiming fluency may be taken as a maximum figure.

Increasing the level of competence in Russian among the population does not seem to be easy. At the time of the XXII Party Congress in 1961, it was stated that the "Russian language has become in reality the overall language of international communication and cooperation of all peoples of the U.S.S.R." [99] However, several years ago the Party Central Committee of Kirgizia admonished the local Ministry of Education to improve the teaching of Russian.[100] Michael Parks says that he was informed in 1973 that graduation from school was made "virtually conditional on becoming fluent in Russian." Nevertheless, 3 years later, at the Republic Party Congress held in Frunze on January 17, 1976, prior to the national Party Congress, it was necessary to remind the delegates of the importance of this issue, implying that success was limited. Similarly, the Lithuanian, Georgian, and Armenian congresses made direct references to the need to upgrade training in the Russian

[98] TsSU SSSR, *Itogi*, Vol. IV, 1973, p. 20.
[99] *XXII S"yezd Kommunisticheskoy partii Sovetskogo Soyuza: 17–31 oktyabrya 1961 goda; stenograficheskiy otchet;* III, Moscow, Gospolitizdat, 1962, p. 314.
[100] *Sovetskaya Kirgiziya*, April 28, 1973, pp. 1–2, cited in H. Goldhamer, *The Soviet Soldier*, 1975, p. 196, fn. 123.

language for "inter-national" (*internatsional'nyy*) communication and to its political and practical significance.[101] Knowledge of Russian plays a part also in the assignment of draftees to various services. Central Asians are frequently assigned to construction troop units because they do not speak Russian well enough to be assigned to any of the elite troops, such as the strategic rocket forces.[102] Even in the midst of the Second World War, when the military manpower situation was desperate, the three slavic nationalities comprised almost 90 percent of the personnel of 100 rifle divisions.[103] In the future, the language problem may be expected to become more serious as the share of the non-Slavic cohorts grows.

To understand the manpower problems facing the Soviet Union, even a crude hyopthetical model of the manpower pool and the effects of the various demands upon it may be helpful. Assuming a military force of 4.5 million and accepting the estimates and projections of population prepared by the Foreign Demographic Analysis Division, the future supply of 18-year-olds can be calculated. Withdrawals for educational purposes, natural losses, permanent exemptions due to medical, family, and hardship reasons, and other subtractions can also be estimated. Table 16 indicates approximate allocations to the various categories. The allocation for education ranges from 20 percent in the year with peak cohort size, 1978, to 26.5 percent in the year in which the cohort is at its nadir, 1987. Deaths are few at this age level but must also be accounted for. Emigration is an even smaller factor, and can be ignored here, but it might under some circumstances become significant in the future. Exemptions for noneducational purposes are estimated here to amount to 10 percent of the cohort in any given year. Expired deferments, which are in the order of 8–11 percent of the cohorts during the period, are shown in column 9. In making estimates for this category it must be remembered that ROTC-type studies in both higher and specialized secondary education offer an avenue of escape from conscription unless the student has obtained a specialty which is required by the military.[104] Table 16 indicates that until 1983, when the figure for males available for the economy turns negative, it will be possible to meet the needs of the military if the draft quota is no different than is assumed here. After that year, however, there must be some alteration in the system if a force as large as 4.5 million persons is to be maintained.

This might include changing the length of service obligation from 2 to 3 years, as was the rule before the 1967 draft law, drafting or enlisting more women, eliminating or reducing the numbers of construction and other kinds of support troops under direct control of the military, and so forth. However, releasing construction, medical and other support troops from military service constitutes no real addition to the

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[101] See the four-part series of translations by Joint Publications Reading Service, *Republic Communist Party Congress Materials*, JPRS 66908–1 to 4, 5 March 1976, pp. I–53, I–198; II–333, II–395; and IV–862.

[102] See H. Goldhamer, *The Soviet Soldier*, 1975, p. 28.

[103] Among the personnel of the 100 rifle divisions, Russians made up 51.18 percent, Ukrainians 33.93 percent, and Belorussians 2.04 percent, on July 1, 1944 (M. P. Kim [Ed.], *Bratskoye sotrudnichestvo sovetskikh respublik v khozyaystvennom i kul'turnom stroitel'stve*, Moscow, Mysl', 1971, p. 87). In January 1976, two Soviet sources made reference to the "special significance" of and "special attention" required for training of military officers of Azerbaydzhan and Turkmen nationalities. Both articles apparently criticized the lack of concern about this problem in the past. See Radio Liberty, *Referativnyy byuletten'*, No. 2, February 15, 1976, p. 11, citing *Bakinskiy rabochiy*, January 29, 1976 and *Turkmenskaya iskra*, January 24, 1976.

[104] N. Voronov, "Komandnyye, politekhnicheskiye i inzhenerno-tekhnicheskiye kadry armii i flota," *Kommunist vooruzhennykh sil*, No. 13, July 1974, p. 73.

TABLE 16.—HYPOTHETICAL MODEL OF THE POTENTIAL SUPPLY OF 18-YEAR-OLD MALES FOR THE MILITARY AND FOR THE ECONOMY: 1975 TO 1990

[In thousands]

Year	Males, 18 years of age as of July 1	Minus, educational deferment, full-time studies in—			Minus, male deaths	Minus, males with exemptions and deferments for non-educational reasons	Net number of males 18 years of age available for the draft and for the economy	Net number of males as percent of male cohort	Plus, males whose exemptions and deferments have expired	Total available for draft	Minus, conscriptees	Conscriptees as percent of—		Net number of 18 year olds available for economy
		Higher education	Specialized secondary education	Vocational-technical education								Cohort	Net number available	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
1975	2,493	234	167	98	3	249	1,742	69.9	206	1,948	1,688	67.7	86.7	260
1976	2,558	235	167	104	4	256	1,792	70.1	216	2,008	1,688	66.0	84.1	320
1977	2,605	235	167	109	3	260	1,831	70.3	220	2,051	1,688	64.8	82.3	363
1978	2,646	236	167	114	3	265	1,861	70.3	225	2,086	1,688	63.8	80.9	398
1979	2,637	237	167	119	4	264	1,846	70.0	234	2,080	1,688	64.0	81.2	392
1980	2,542	237	167	124	3	254	1,757	69.1	236	1,993	1,688	66.4	84.7	305
1981	2,432	238	167	124	3	243	1,657	68.1	239	1,896	1,688	69.4	89.0	208
1982	2,308	239	167	124	2	231	1,545	66.9	240	1,785	1,688	73.1	94.6	97
1983	2,173	239	167	124	3	217	1,423	65.5	235	1,658	1,688	77.7	101.8	−30
1984	2,106	239	167	124	3	211	1,362	64.7	230	1,592	1,688	80.2	106.0	−96
1985	2,062	240	168	124	2	206	1,322	64.1	223	1,545	1,688	81.9	109.3	−143
1986	2,020	240	168	124	2	202	1,284	63.6	211	1,495	1,688	83.6	112.9	−193
1987	2,012	241	168	124	3	201	1,275	63.4	214	1,489	1,688	83.9	113.4	−199
1988	2,034	242	168	124	2	203	1,295	63.7	212	1,507	1,688	83.0	112.0	−181
1989	2,097	242	168	124	3	210	1,350	64.4	210	1,560	1,688	80.5	108.2	−128
1990	2,142	243	168	124	3	214	1,390	64.9	210	1,600	1,688	78.8	105.5	−88

SOURCE AND METHODOLOGY

Col. 1: Unpublished estimates and projections of the Foreign Demographic Analysis Division prepared in March 1974.

Col. 2: Based on the following information and relationships: There were 565,600 admissions (of both sexes) at the beginning of the 1974/75 school year (TsSU SSSR, "Narodnoye khozyaystvo SSSR v 1974 godu, statisticheskiy yezhegodnik," Moscow, Statistika, 1975, p. 693). Females comprise 50 percent of all students enrolled in all divisions (TsSU SSSR," Zhenshchiny v SSSR; statisticheskiy sbornik," Moscow, Statistika, 1975, p. 69), and therefore, there were 282,800 males admitted. The arithmetic mean of growth in admissions over the 4 school years 1970/71—1974/75 was 16,000 per year (both sexes). Assuming the same growth also up to the 1975/76 school year, the growing share of full-time schooling (up to 25,000 per year in 1990 in the annual increment) a straight-line interpolation for males alone of 0.8 thousand per year was added and then rounded to the nearest thousand. The total number of graduates from all divisions of general secondary schools in 1967 and 1970 were 2,355,000 and 2,591,000, respectively (TsSU SSSR, "Narodnoye obrazovaniye, nauka i kul'tura v SSSR, statisticheskiy sbornik," Moscow, Statistika, 1971, p. 102). According to Zhil'tsov (Ye. Zhil'tsov, "Rol' srednikh uchebnykh zavedeniy v povyshenii obshcheobrazovatel'nogo i professional'nogo urovnya naseleniya" in D. I. Valentey et al. [Eds.], "Obrazovatel'naya i sotsial' no-professional'naya struktura naseleniye SSSR, " " seriya narodonaseleniye," Moscow, Statistika, 1975, p. 21), 14.7 and 15.2 percent of the 1967 and 1970, respectively, of general secondary school graduates went directly to full-time studies in higher educational institutions. For 1967, the resulting number of students (393,800) represents 78.7 percent of all admissions to the day division and for 1970, 79.2 percent. Thus, 79 percent was used to apply to admissions of males to full-time day studies in higher educational institutions.

Col. 3 and 4: Similar procedures and sources as in col. 2.

Col. 5: Unpublished estimates and projections of the Foreign Demographic Analysis Division.

Col. 6: Estimated as 10 percent of the cohort in the given year.

Col. 7: Col. 1 minus the sum of cols. 2–6.

Col. 8: Col. 7 divided by col. 1.

Col. 9: Includes 45 percent of male entries to vuzy 4 years earlier. This is based on 50 percent for higher education school graduates who have to serve only 1 year rather than 2 for all others on the average, minus 5 percent to allow for ROTC graduates who are not drafted subsequently. In addition, 5 percentage points are added to the 45 percent to allow for death of invalid parents as well as other reasons changing deferment status. Arbitrarily taken as 5 percent of cohort 3 years earlier.

Col. 10: Col. 7 plus col. 9.

Col. 11: See text, at 75 percent of 4,500,000 military with 2 years average service, 1,687,500 per year rounded to 1,688,000.

Col. 12: Col. 11 divided by col. 1.

Col. 13: Col. 11 divided by col. 10.

Col. 14: Col. 10 minus col. 11.

labor force as long as they continue with their present work; only a reduction in combat-type troops would increase the pool available for the civilian labor force. For the present we will continue to use the 4.5 million figure and assume that all other institutions and policies remain the same. Column 9 shows the proportion of the cohort actually available for the draft and for the economy. It is only until 1983 that there will be a sufficient number to cover draft requirements of 1,688,000 persons per year. This model shows that the manpower constraints on the Soviet economy and military are even more stringent than the previous discussion would imply.

The numbers of 18-year-old males available for the civilian labor force will vary widely in the next 15 years according to the model, ranging from 399,000 in 1978 to −204,000 in 1987. During these years, according to our estimates, based upon population projections and labor force participation rates, the annual labor force increments will drop to one-third of the level during the current 5-year plan period. (According to estimates derived from table 8, the average of the annual increments in the period 1976–80 is 2,060,000 persons per year, whereas in the Twelfth Five-Year Plan period of 1986–90, it will be only 787,000 on the average.) The need for more labor is beyond doubt unless labor productivity rises to three times the present level. During the last two decades the long-term growth in labor productivity for the four basic sectors has averaged about 6 percent per year (see table 14). If the current average labor force is considered to be the demand level, with perhaps some minor adjustments for changes in productivity and output, then it can be estimated that there will be a labor shortage of about 800,000 persons per year during the next 5-year period and about 1.300,000 per year during the period which follows, assuming that output will grow at 7 percent per year and productivity at 6 percent, so that the labor force would have to grow by about 1 percent per year. These estimates include not just 18-year-olds but all ages of both sexes. Thus, in sum, the results of this examination would indicate that the Soviet Party and Government are faced with an increasingly acute competition for manpower between the civilian economy and the military.

More research is needed on the structure, organization, and activities of support troops before a conclusive evaluation can be made of their economic significance and definite answers can be given as to whether all support troops are included in the "civilian" employment figures, whether the structure of the military forces requires support at such a high level, and where the support troops appear in the budget. Also, consideration should be given to the possibility of a major change in the role of women in the military. Moreover, since there are regional differentials in educational attainment, or school continuation, a study of school enrollment by republic is necessary to ascertain whether the nondeferred supply of manpower for the military is in the less well educated regions of the country, and how the quality of this supply will match the needs of a modern, technologically advanced military force. The trends in population and manpower discussed in this paper have crucial significance for Soviet economic and military policy in the future. All of the choices open to the Soviet authorities have their costs. A reduction in the size of the combat forces would seem to imply some reduction in military capabilities. A continued increase in higher educational attainment would diminish the numbers available for

military service at age 18 and reduce the term of service of those entering the military upon completion of their education. It is hard to see how the present control structure with its Great Russian dominance can continue while the new manpower increments come increasingly from the non-Slavic republics. Whether and how the Government and Party will address and resolve these issues remains to be seen.

Appendix Tables

TABLE I.—ESTIMATES AND PROJECTIONS OF THE POPULATION IN THE U.S.S.R.: 1950 TO 1990

[In thousands, as of July 1]

Year	All ages	Able-bodied ages [1]	Year	All ages	Able-bodied ages [1]
1950	180,075	103,345	1976	256,885	147,200
1951	183,191	104,848	1977	259,352	149,881
1952	186,378	106,708	1978	261,869	152,229
1953	189,491	109,184	1979	264,438	154,193
1954	192,710	112,033	1980	267,057	155,773
1955	196,159	114,658	1981	269,716	156,932
1956	199,658	116,873	1982	272,400	157,726
1957	203,170	118,639	1983	275,089	158,292
1958	206,806	119,574	1984	277,758	158,770
1959	210,529	119,606	1985	280,383	159,191
1960	214,329	119,459	1986	282,941	159,523
1961	218,145	119,622	1987	285,417	159,935
1962	221,730	120,233	1988	287,803	160,558
1963	225,063	121,245	1989	290,100	161,239
1964	228,149	122,586	1990	292,324	161,902
1965	230,936	124,142	1991	294,492	162,506
1966	233,533	125,681	1992	296,613	163,023
1967	235,994	127,183	1993	298,694	163,613
1968	238,317	128,632	1994	300,738	164,410
1969	240,552	129,957	1995	302,746	165,388
1970	242,757	131,685	1996	304,717	166,485
1971	245,083	134,015	1997	306,650	167,821
1972	247,459	136,491	1998	308,543	169,523
1973	249,747	139,021	1999	310,397	171,443
1974	252,065	141,663	2000	312,215	173,378
1975	254,462	144,406			

[1] Officially defined as males 16 to 59 years and females 16 to 54 years, inclusive.

Source: Unpublished estimates and projections of the Foreign Demographic Analysis Division prepared in June 1972 for the years 1950–69 and in March 1976 for the remaining years.

TABLE II.—ESTIMATES AND PROJECTIONS OF LABOR FORCE PARTICIPATION RATES IN THE U.S.S.R., BY SEX AND AGE: 1959–90

[In percent]

Sex and age	1959	Variant I		
		1970	1980	1990
Male:				
16 to 19 years	69.4	53.3	48.4	43.9
20 to 29 years	91.0	89.7	89.5	89.5
30 to 39 years	95.0	97.6	97.6	97.6
40 to 49 years	93.0	95.9	95.9	95.9
50 to 54 years	90.1	90.0	90.0	90.0
55 to 59 years	83.5	79.9	79.9	79.9
60 years and over	52.5	49.0	50.0	51.0
Female:				
16 to 19 years	71.0	47.8	40.8	35.0
20 to 29 years	80.4	86.3	86.1	86.1
30 to 39 years	77.7	92.7	92.7	92.7
40 to 49 years	75.4	90.6	90.6	90.6
50 to 54 years	67.7	77.3	77.3	77.3
55 to 59 years	48.5	44.4	45.4	46.4
60 years and over	33.8	25.0	26.0	27.0

Source: Stephen Rapawy, "Estimates and Projections of the Labor Force and Civilian Employment in the U.S.S.R.: 1950 to 1990," U.S. Department of Commerce, Bureau of Economic Analysis, 1976 (forthcoming).

TABLE III.—ESTIMATED MAN-HOUR EMPLOYMENT IN SELECTED NONAGRICULTURAL BRANCHES OF THE ECONOMY, U.S.S.R.: 1950 TO 1974

[In millions of man-hours]

Year	Total	Construction	Forestry	Transport	Communications	Trade, public dining, material-technical supply and sales, and procurement	Housing-communal economy and personal services	Health services	Education and culture	Art	Science and scientific services	Credit and insurance organizations	Government administration	Other
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
1950	44,355	6,756	960	8,946	1,170	7,301	2,964	3,885	5,466	400	1,538	571	3,979	419
1951	45,981	7,043	977	9,470	1,192	7,463	3,079	4,045	5,651	418	1,658	567	3,920	498
1952	47,578	7,389	993	9,990	1,212	7,624	3,193	4,205	5,834	434	1,776	563	3,860	505
1953	48,360	7,617	893	10,341	1,247	7,541	3,260	4,359	5,986	453	1,839	564	3,723	537
1954	50,030	8,408	861	10,608	1,275	7,810	3,324	4,653	6,254	469	1,977	566	3,326	499
1955	51,108	8,530	832	10,870	1,304	8,075	3,386	4,950	6,529	488	2,114	567	2,926	537
1956	52,161	9,390	814	10,972	1,299	8,023	3,475	5,090	6,599	511	2,273	555	2,814	346
1957	53,765	10,429	768	10,988	1,303	8,223	3,506	5,314	6,722	536	2,451	532	2,649	344
1958	56,552	11,452	742	11,549	1,341	8,518	3,548	5,603	6,888	566	2,696	526	2,631	492
1959	58,203	11,937	693	11,836	1,357	8,681	3,572	5,859	7,033	586	2,889	512	2,518	730
1960	59,911	12,309	680	11,949	1,395	8,897	3,636	6,132	7,217	597	3,325	502	2,369	903
1961	61,030	12,297	685	11,869	1,428	9,123	3,678	6,379	7,532	627	3,628	502	2,358	924
1962	62,766	11,852	705	12,159	1,504	9,566	3,798	6,622	8,055	616	3,992	513	2,396	988
1963	64,918	12,118	721	12,430	1,582	9,970	3,945	6,813	8,501	638	4,266	523	2,377	1,034
1964	68,052	12,541	734	12,881	1,682	10,503	4,146	7,088	9,066	658	4,517	538	2,472	1,226
1965	71,025	13,200	725	13,141	1,812	10,888	4,302	7,400	9,594	667	4,712	541	2,646	1,397
1966	74,616	13,717	741	13,410	1,940	11,401	4,510	7,677	10,057	689	4,945	567	2,815	1,547
1967	77,169	14,357	749	13,635	2,036	12,006	4,859	7,894	10,480	703	5,156	598	3,015	1,681
1968	80,439	14,880	767	13,919	2,157	12,744	5,099	8,255	10,986	716	5,421	630	3,177	1,688
1969	83,967	15,687	777	14,311	2,311	13,364	5,347	8,574	11,397	735	5,684	662	3,364	1,754
1970	86,863	16,529	788	14,613	2,417	13,793	5,558	8,829	11,746	750	5,870	707	3,446	1,817
1971	90,589	17,542	791	15,102	2,548	14,389	5,886	9,134	12,142	769	6,099	753	3,562	1,872
1972	93,783	18,304	810	15,515	2,617	14,880	6,171	9,379	12,444	782	6,450	802	3,689	1,940
1973	95,999	18,376	806	15,887	2,655	15,315	6,405	9,588	12,719	788	6,753	844	3,809	2,054
1974	98,781	18,858	817	16,309	2,721	15,794	6,665	9,826	12,972	802	6,998	897	3,963	2,159

Source: Stephen Rapawy, "Estimates and Projections of the Labor Force and Civilian Employment in the U.S.S.R.: 1950 to 1990," U.S. Department of Commerce, Bureau of Economic Analysis, 1976 (forthcoming).

TABLE IV.—ESTIMATES OF MAN-HOUR EMPLOYMENT IN SELECTED BRANCHES OF INDUSTRY, U.S.S.R.: 1950 TO 1974

[In millions of man-hours]

Year	Total, industry	Total selected branches	Electric power	Coal	Oil and gas				Chemical and petrochemical		Ferrous metallurgy	Nonferrous metallurgy	Machine-building and metalworking	Construction materials	Timber, woodworking, and pulp and paper		Light industry	Food industry	Other industry
					Total	Oil extraction	Oil refining	Gas	Total	Chemical					Total	Pulp and paper			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)
1950	33,054	31,244	398	1,846	261	147	95	19	983	777	1,606	1,225	9,295	1,533	4,765	302	5,715	3,617	1,810
1951	34,927	32,563	425	1,884	278	151	108	19	1,032	826	1,682	1,299	9,759	1,655	4,881	310	5,971	3,697	2,364
1952	36,209	33,867	454	1,919	298	163	116	19	1,086	871	1,757	1,305	10,247	1,785	4,998	318	6,240	3,778	2,342
1953	37,736	35,269	485	1,990	320	174	127	19	1,142	921	1,824	1,292	10,770	1,930	5,124	326	6,527	3,865	2,467
1954	39,569	36,733	519	2,109	323	165	141	17	1,203	970	1,867	1,259	11,324	2,086	5,256	334	6,832	3,955	2,836
1955	40,531	38,209	556	2,226	350	175	156	19	1,265	1,016	1,906	1,201	11,881	2,254	5,389	344	7,135	4,046	2,322
1956	41,020	38,890	591	2,346	361	173	167	21	1,301	1,018	1,913	1,172	12,212	2,388	5,329	340	7,193	4,084	2,130
1957	41,386	39,376	632	2,277	372	170	175	27	1,358	1,036	1,909	1,137	12,459	2,535	5,418	345	7,101	4,178	2,010
1958	42,393	40,857	627	2,315	399	179	183	37	1,295	960	1,786	1,036	13,301	2,736	5,434	346	7,617	4,311	1,536
1959	42,560	41,241	665	2,146	375	167	173	35	1,336	1,005	1,818	1,053	13,397	2,893	5,430	345	7,756	4,372	1,319
1960	42,752	41,084	755	2,052	371	161	176	34	1,425	1,085	1,932	1,097	13,331	3,024	5,293	339	7,508	4,296	1,668
1961	43,061	40,931	771	1,923	364	158	173	33	1,542	1,169	1,976	1,110	13,989	2,943	4,970	329	7,218	4,125	2,130
1962	44,616	42,482	820	1,908	371	160	176	35	1,690	1,297	2,034	1,143	14,912	2,992	5,014	341	7,351	4,247	2,134
1963	45,897	43,868	869	1,897	372	(1)	(1)	36	1,847	1,463	2,100	1,176	15,861	3,037	5,049	355	7,342	4,318	2,029
1964	47,713	46,068	928	1,919	403	168	193	42	2,035	1,604	2,182	1,215	16,991	3,104	5,119	372	7,629	4,543	1,645
1965	49,377	47,777	981	1,960	414	170	199	45	2,212	1,718	2,230	1,244	17,948	3,137	5,122	385	7,819	4,710	1,600
1966	51,553	49,892	1,061	2,009	440	180	211	49	2,397	1,840	2,296	1,294	18,938	3,259	5,162	429	8,142	4,894	1,661
1967	53,389	51,647	1,102	2,017	459	186	222	51	2,525	1,938	2,365	1,316	19,664	3,373	5,207	451	8,493	5,126	1,742
1968	55,288	53,398	1,144	2,005	463	184	228	51	2,622	2,013	2,422	1,335	20,601	3,509	5,219	460	8,784	5,294	1,890
1969	56,741	54,680	1,165	1,966	468	185	232	51	2,726	2,093	2,455	1,341	21,407	3,617	5,184	467	9,012	5,339	2,061
1970	57,405	55,474	1,187	1,898	480	186	241	53	2,771	2,126	2,457	1,310	21,891	3,689	5,211	479	9,096	5,484	1,931
1971	58,554	56,554	1,214	1,875	483	186	244	53	2,834	2,174	2,457	1,330	22,641	3,785	5,203	484	9,184	5,548	2,000
1972	59,217	56,932	1,217	1,796	485	185	249	51	2,863	2,193	2,451	1,338	23,168	3,817	5,142	486	9,084	5,571	2,285
1973	59,557	57,326	1,220	1,746	488	180	257	51	2,921	2,241	2,442	1,346	23,626	3,829	5,092	486	9,055	5,561	2,231
1974	60,671	58,461	1,244	1,727	489	175	263	51	3,000	2,301	2,469	1,364	24,397	3,893	5,082	492	9,138	5,658	2,210

[1] Estimated at 336,000,000 man-hours for oil extraction and oil refining combined.

Source: Stephen Rapawy, "Estimates and Projections of the Labor Force and Civilian Employment in the U.S.S.R., 1950 to 1990," U.S. Department of Commerce, Bureau of Economic Analysis, 1976 (forthcoming).

DEMOGRAPHIC PROBLEMS: FERTILITY[1]

WARREN W. EASON

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In broad outline, the nature of Soviet demographic problems, especially concerning fertility, is well-known to students of Soviet affairs. On the one hand, fertility has been declining for some time in the European parts of the country, as well as in most of Siberia and the Far East, reaching levels associated with "negative" population growth. On the other hand, fertility remains very high in Soviet Central Asia and most of the Caucasus.

These trends are seen as "problems" by Soviet demographers largely because of their long-run implications for economic growth and the manpower aspects of growth. For example, the rate of increase of the labor force is already slowing down as the direct result of the declining fertility rates of recent decades; and the problem of allocation and distribution of labor among regions is becoming increasingly complicated by differential labor force growth rates resulting from the widely differing fertility rates.

It is not surprising, therefore, that demography has become a relatively well-developed science in the Soviet Union, and that two questions claim most of its attention. The first is how to explain the patterns of fertility decline and regional differentials that have manifested themselves over the years, and the second is how to develop population policies that can be expected to modify these patterns—in the direction of raising fertility rates in the major regions of the country where the population is not reproducing itself, and of lowering rates in the regions of rapid population growth.

[1] Most of the research on which this paper is based was developed with the support of the National Institute of Child Health and Human Development. Contract number NIH-70-2191.

Murray Feshbach's paper in the present volume and other papers in previous volumes in this series[2] have dealt with the manpower questions, have reproduced major portions of primary data from Soviet sources, and have exmined a number of demographic issues. The present paper will not attempt such a comprehensive review of the data and the issues.

Instead the present paper will attempt to ascertain whether the pattern of declining fertility, which has affected major sections of the country and more than three-quarters of the population, may indeed have run its course; that is, whether a "bottoming-out" has finally been reached; and whether in fact a significant reversal of these long-term downward trends is not already underway.

The possibility of coming to grips with this important question on the basis of concrete information lies in the exploitation of a major category of primary data on Soviet fertility that has heretofore been utilized only partially and superficially.

I. Methodology

The major category of primary data on Soviet female fertility referred to above is the sizeable mass of statistics on births by age of mother and order of births that have been published from time to time in a number of sources, mostly Vestnik statistiki, beginning in the 1960's.

The compilation from these data that is most useful for analytical purpose is the age-specific fertility rate, defined, following Soviet methodology, as a two-year moving average of the number of children born to women in a given age-group, expressed per thousand women in the corresponding population on January 1 of the second of the two years. Age-groups used in Soviet sources for this purpose are: 15–19, 20–24, 25–29, 30–34, 35–39, 40–44 and 45–49. The general fertility rate, in turn, is defined as the two-year moving average of total births expressed per thousand women age 15–49. (Some examples of the general fertility rate are given Murray Feshbach, table 5, p. 124, this volume.)

Age-specific fertility rates and the general fertility rate, for the U.S.S.R. as a whole, have been published for two prewar years (1926/27 and 1938/39), for one year in the mid-1950's (1954/55) and annually thereafter from 1957/58 through 1973/74. These rates are reproduced in Table 1. Because they are much less influenced by the age and sex structure of the population, these age-specific rates comprise a more accurate set of indicators of female fertility than the crude birth rate (total births per thousand total population). For comparison, a two-year moving average of the crude birth rate, 1960/61 through 1973/74, is reproduced in table 1.

The absolute number of births by age of mother is also reported annually for 1960 through 1974 in Soviet sources, cross-tabulated by order of births (first, second, etc., through tenth and over). In and of

[2] Murray Feshbach and Stephen Rapawy "Soviet Population and Manpower Trends and Policies, p. 113 of this volume; Frederick A. Leedy, "Demographic Trends in the USSR." *Soviet Economic Prospects for the Seventies:* A compendium of papers submitted to the Joint Economic Committee, 1973, pp. 428–484; Murray Feshbach and Stephen Rapawy, "Labor Constraints in the Five-Year Plan," also in *Soviet Economic Prospects for the Seventies,* pp. 485–563; *New Directions in the Soviet Economy,* Part III Passim, Joint Economic Committee. GPO Print 1966.

themselves, these absolute data are not very useful. However, combined with (a) the female population (as of January 1) by age-groups, when available, or with (b) the female population by age-groups that can be calculated from the age-specific fertility rates referred to above and the absolute total number of births (all orders together) by age of mother—it is possible to derive the age-specific fertility rates and the general fertility rate for each order of births, expressed as a two-year moving average. Primary data are sufficient to enable these rates to be derived for every two-year period from 1960/61 through 1973/74, except for 1964/65 and 1965/66. These derived rates are also reproduced in Table 1.

The fact that the reported rates are to the nearest tenth, and the absolute data to the nearest 100, renders the derived rates by order of birth accurate and mutually consistent with the total rates to within a margin of error of only one or two tenths. (Rates by order of birth consequently sum to the corresponding rates for total births to within this same margin of error.)

II. Conclusions

The age-specific female fertility rates for the U.S.S.R. as a whole which are reproduced in Table 1 can provide a basis for answering the question posed above. The question is whether the decline in fertility has ended and a reversal begun.

In using data for the U.S.S.R. as a whole to answer this question, of course, we are including the influence of those regions where fertility has remained very high; but since the latter comprise a relatively small proportion of the total population, the overall rates will reflect primarily what is going on in the areas that have experienced lowered fertility in the past.

We begin with a brief review of long-term trends since the early Soviet years, and then examine the data for more recent years in some detail.

1. Overall historical trends.—According to the age-specific and general fertility rates for total births in table 1, female fertility in the Soviet Union has been in the process of a general decline since the beginning of the period of rapid industrialization. The data indicate that this downward movement has passed through four stages (in terms of the years reported) and that a fifth stage of overall stability with definite signs of increasing fertility among the female population of the prime reproductive ages is now well underway. These stages may be characterized as follows:

a. 1926/27 to 1938/39, a period of moderate decline of some 12 percent, more or less proportionately in each and every age-group;

b. 1938/39 to 1954/55, a period of sharp decline to almost one-half the 1926/27 rate overall, with an even greater decline among the youngest (15–19) and oldest (45–49);

c. 1954/55 to 1960/61, a period of relative stability, showing a slight rise in the overall rate, with declining rates among the older age-groups (25 and over) "balanced" by increasing rates among the younger (15–24);

TABLE 1

2-YEAR MOVING AVERAGE OF THE CRUDE BIRTH RATE, 1960-61 to 1973-74; AND AGE-SPECIFIC FERTILITY RATES AND THE GENERAL FERTILITY RATE BY ORDER OF BIRTHS, AS REPORTED AND AS DERIVED FROM REPORTED DATA ON THE NUMBER OF BIRTHS BY AGE OF MOTHER AND THE FEMALE POPULATION BY AGE-GROUPS: U.S.S.R., 1926-27, 1938-39, 1954-55, AND 1957-58, TO 1973-74[1]

[Number of births per thousand females in the corresponding age-group]

Age of mother	1926–27	1938–39	1954–55	1957–58	1958–59	1959–60	1960–61	1961–62	1962–63	1963–64	1964–65	1965–66	1966–67	1967–68	1968–69	1969–70	1970–71	1971–72	1972–73	1973–74
2-YR. MOVING AVERAGE OF THE CRUDE BIRTH RATE							24.2	23.1	21.8	20.4	19.0	18.3	17.8	17.3	17.1	17.2	17.6	17.8	17.7	17.8
TOTAL BIRTHS:																				
15 to 19	38.2	32.8	15.6	23.9	29.2	34.4	35.2	29.6	24.1	22.7	23.7	25.5	26.9	27.7	28.9	30.4	32.0	32.4	32.4	33.3
20 to 24	259.4	214.4	146.9	160.1	162.2	165.3	164.8	162.8	162.1	162.6	157.6	159.6	158.6	158.0	157.0	163.9	170.2	173.9	172.3	173.4
25 to 29	269.0	230.6	172.9	166.7	164.8	161.3	160.7	155.8	151.4	145.6	138.9	136.0	132.7	129.7	128.8	128.7	132.1	137.1	135.9	134.8
30 to 34	224.5	183.5	127.6	116.4	110.1	114.2	110.1	105.2	101.3	97.6	95.5	97.0	97.0	94.7	92.0	88.1	87.1	84.3	81.8	79.3
35 to 39	171.6	131.7	74.4	66.8	66.6	63.7	60.7	56.4	54.2	52.0	50.9	50.6	49.2	47.9	47.4	48.5	49.6	49.4	48.0	45.5
40 to 44	90.8	68.1	35.4	24.7	24.1	24.2	23.5	22.7	22.3	21.4	20.3	19.1	17.7	16.9	16.2	15.3	14.9	14.6	14.3	14.4
45 to 49	23.0	19.0	7.1	5.7	5.0	4.5	4.8	3.8	3.7	3.9	4.2	4.4	4.0	3.8	3.4	2.9	2.4	2.0	1.9	1.7
15 to 49	159.1	139.5	86.2	86.9	88.7	91.5	90.6	87.2	83.2	78.4	73.5	70.8	68.5	66.3	65.3	65.7	66.9	67.2	66.4	66.8
1ST BIRTHS:																				
15 to 19							32.0	27.1	22.2	21.0			25.1	23.8	26.9	28.3	29.7	30.2	30.2	31.1
20 to 24							107.8	105.6	103.8	102.0			105.9	109.1	109.6	115.0	118.6	119.5	116.0	114.8
25 to 29							46.8	47.1	46.9	45.9			40.1	37.3	34.9	33.6	35.2	39.0	40.1	39.3
30 to 34							15.2	14.2	13.2	12.7			12.9	13.0	12.4	11.7	11.1	10.0	9.4	8.9
35 to 39							5.6	5.2	5.0	4.9			4.4	4.2	4.1	4.1	4.1	3.9	4.0	3.8
40 to 44							1.3	1.3	1.4	1.4			1.3	1.2	1.2	1.1	1.1	1.0	.9	.9
45 to 49							.2	.2	.1	.2			.2	.2	.2	.2	.1	.1	.1	.1
15 to 49							34.5	33.0	30.5	28.0			24.3	24.0	25.0	26.7	28.4	29.2	29.3	29.8
2ND BIRTHS:																				
15 to 19							3.0	2.3	1.8	1.6			1.7	1.7	1.9	2.0	2.1	2.0	2.0	2.1
20 to 24							43.8	43.5	43.7	44.6			38.2	37.0	36.3	37.3	39.1	41.5	43.4	45.1
25 to 29							59.0	56.6	55.3	53.3			50.6	50.2	51.1	52.5	54.0	56.4	56.9	57.5

30 to 34	31.1	29.8	28.5	27.2		28.7	28.8	29.9	30.1	30.2	29.8	28.5	26.5
35 to 39	10.3	9.8	9.5	9.3		8.6	8.1	7.9	8.4	9.0	9.6	9.8	9.5
40 to 44	1.9	1.9	1.9	2.0		1.7	1.7	1.6	1.5	1.4	1.3	1.3	1.2
45 to 49	.3	.2	.2	.2		.2	.2	.2	.2	.1	.1	.1	.1
15 to 49	24.7	23.9	23.0	21.8		18.7	17.6	17.6	17.6	17.7	18.1	18.2	18.6
3RD BIRTHS:													
15 to 19	.2	.2	.2	.1		.2	.1	.2	.2	.1	.1	.1	.1
20 to 24	10.5	10.8	11.5	12.2		9.9	8.8	8.3	8.7	9.2	9.4	9.6	10.2
25 to 29	31.4	29.4	27.4	25.3		21.3	20.4	20.2	20.0	20.1	19.9	19.0	18.7
30 to 34	24.5	22.9	21.6	20.2		18.3	17.2	16.4	15.6	15.4	15.0	14.5	14.2
35 to 39	10.9	10.0	9.5	9.1		7.9	7.3	7.0	7.2	7.4	7.6	7.5	7.2
40 to 44	2.4	2.3	2.3	2.3		1.8	1.7	1.5	1.4	1.3	1.3	1.2	1.1
45 to 49	.4	.3	.3	.3		.3	.2	.2	.2	.1	.1	.1	.1
15 to 49	12.9	12.4	11.9	11.2		9.0	8.0	7.6	7.3	7.6	6.9	6.7	6.7
4TH BIRTHS:													
15 to 19	0	0	0	0		0	0	0	0	0	0	0	0
20 to 24	2.1	2.2	2.5	3.0		2.9	2.4	2.1	2.2	2.5	2.5	2.5	2.6
25 to 29	15.0	14.5	13.9	13.2		12.2	12.1	12.1	11.7	11.6	11.4	10.9	10.6
30 to 34	17.0	16.0	15.4	14.5		13.0	12.0	10.9	9.7	9.2	8.6	8.2	8.0
35 to 39	9.6	8.7	8.0	7.4		6.3	5.9	5.7	5.5	5.4	5.3	5.0	4.6
40 to 44	3.0	2.8	2.6	2.4		1.8	1.7	1.5	1.4	1.3	1.3	1.2	1.1
45 to 49	.6	.5	.5	.5		.4	.3	.3	.2	.2	.1	.1	.1
15 to 49	7.5	7.1	6.9	6.6		5.7	5.1	4.7	4.2	3.9	3.7	3.5	3.4
5TH AND HIGHER ORDER BIRTHS:													
15 to 19	0	0	0	0		0	0	0	0	0	0	0	0
20 to 24	.7	.6	.6	.8		.9	.8	.8	.8	.8	.8	.8	.8
25 to 29	8.4	8.3	7.9	7.9		8.9	9.7	10.6	11.0	11.3	10.4	9.1	8.8
30 to 34	22.2	22.2	22.7	23.0		24.3	23.7	22.6	21.2	21.4	21.1	21.2	21.7
35 to 39	24.3	22.8	22.1	21.3		22.0	22.4	22.8	23.4	23.8	23.1	21.8	20.5
40 to 44	14.9	14.4	14.1	13.3		11.0	10.7	10.3	9.8	9.8	9.7	9.6	9.9
45 to 49	4.7	3.8	3.8	4.0		3.9	3.7	3.2	2.8	2.3	2.0	1.8	1.6
15 to 49	10.9	10.9	10.9	10.8		10.9	10.6	10.4	10.0	9.7	9.3	8.7	8.4

[1] Detailed information on sources may be found on p. 161.

d. 1960/61 to 1968/69, a period of renewed decline, by more than 25 percent overall, with each age-group (except 15–19) participating to one degree or another. This decline in age-specific birth rates contributes to the decline in crude birth rates (see Table 1), over and above the "war babies" effect.

e. 1968/69 to 1973/74, a period of stability in the general fertility rate, combining increases in the rates of ages 15–29 with decreases in the rates of ages 30–49. Stability in the general fertility rate over these years parallels the stability in the crude birth rate, also shown in Table 1; however, both of these aggregate measures conceal fundamental changes in age-specific fertility which are strongly suggestive of the possibility that a reversal of long-term downward trends in fertility has been underway for some time now.

2. Reversal of the decline in female fertility.—Evidence that a new pattern of increased fertility is underway in the Soviet Union is found in the age-specific rates for the prime reproductive ages (20–29), as well as for the "lead-in" age-group, 15–19; and it is most apparent in terms of the rates for these age-groups by order of birth. For reference, all age-specific rates in Table 1 that display increases after certain points in the 1960's are set forth in italics, and the respective percentage increases, from the lowest level of rate of 1973/74, are summarized in Table 2.

Several observations may be made about these recent developments.

a. The most dramatic percentagewise increase in fertility is shown in first births for females age 15–19, namely, 48.1 percent from 1963/64 to 1973/74. The extent to which this reflects changing patterns of age of marriage as distinct from decisions to have the first child is difficult to say without further study. In any event, the change in the number of births which this implies is relatively small.

b. Of greater consequence is the increased incidence of first, second and third births among women of prime reproductive ages. Increases range from 12.5 percent (first births, ages 20–24) to 24.2 percent (second births, ages 20–24). But perhaps the most important aspect of these increases is that of timing. Note that the increased incidence of first births among women age 20–24 began in 1963/64, while the increased incidence of second births among women age 25–29 began four or five years later in 1967/68. Many of the same women in one and the same five-year age-cohort would be involved here. The recent trends for this group are consistent with the hypothesis that an increasing proportion of these women are having one child rather than none, and two children rather than one.

In sum, Soviet fertility seems clearly to have been increasing for the past ten years or so among females age 15–29, thus reversing a downward trend that has existed over virtually the entire Soviet period. Despite increased fertility among younger females, however, fertility is still declining among females in the older age-groups. The result is that total female fertility, as measured by the crude birth rate and general fertility rate (Table 1), shows only a slight increase since about 1968–69.

Future fertility trends are notoriously difficult to predict, but the period of time of the recent increases in age-specificity fertility is sufficiently long to suggest that the Soviet population may very well have entered upon a new stage of stable and even higher rates of reproduction. This reversal of trends may show up in the 1980 Soviet census, in the form of a higher proportion of the population in the youngest age-

groups; and it should begin to have an influence on the rate of growth of the Soviet labor force by the early 1990's.

Whether and to what degree the recent trends will continue and what their ultimate effect will be, of course, only time will tell. We must await the continued publication of annual data on fertility by age of mother and order of birth to see how this suggestive turn of events actually works out.

TABLE 2.—PERCENTAGE INCREASES IN AGE-SPECIFIC FERTILITY RATES: TOTAL BIRTHS AND BY ORDER OF BIRTH, U.S.S.R., 1973/74 COMPARED TO LOWEST RATE IN LATE 1960's

Age of mother	Percent by which 1973/74 rate is higher than recent lowest rate	
	Date of recent lowest rate	Percent
TOTAL BIRTHS:		
15 to 19	1963/64	46.7
20 to 24	1968/69	10.4
25 to 29	1969/70	4.7
1ST BIRTHS:		
15 to 19	1963/64	48.1
20 to 24	1963/64	12.5
25 to 29	1969/70	17.0
15 to 49	1967/68	24.2
2D BIRTHS:		
20 to 24	1968/69	24.2
25 to 29	1967/68	14.5
15 to 49	1967/68	5.7
3D BIRTHS:		
20 to 24	1968/69	22.9

Source: Calculated from data in table 1.

The rising series in Table 1 are sufficiently long-lived to suggest more than random fluctuations. Fertility trends, however, are notoriously difficult to predict, so we can only await the publication of further data on fertility by age of mother and order of birth, starting with data for 1975, to see how this suggestive turn of events actually works out.

SOURCES TO TABLE 1, PAGES 158 AND 159

Two-year moving average of the crude birth rate, 1960/61 to 1973/74. Calculated from annual crude birth rates reported in TsSU SSSR, *Naselenie SSSR (chislennost', sostav i dvizhenie naselenia) 1973:statisticheskii sbornik (moscow, 1975), p. 69,* and in *Vestnik statistiki, 1975, No. 12, p. 79.*

Total births. 1926/27, B.Ts. Urlanis. *Rozhdaemost' i prodolzhitel'nost' zhizni v SSSR* (Moscow, 1963), p. 42; 1938/39, 1957/58, 1958/59 and 1960/61–1962/63, TsSU SSSR, *Narodnoe khoziaistvo SSR v 1963 g.: statisticheskii ezhegodnik* (Moscow, 1964), p. 31; 1954/55, G. A. Slesarev, *Metodologiia sotsialisticheskogo issledovaniia problem narodonaseleniia* (Moscow, 1965), p. 104; 1959/60, B. Ts. Urlanis, *Problemy dinamiki naselenia SSSR* (Moscow, 1974), p. 85; 1963/64, *Narodnoe khoziaistvo SSSR v 1964,* p. 36; 1964/65, *Narodnoe khoziaistvo SSSR v 1965,* p. 44; 1965/66, *Naselenie SSSR (1975),* p. 136; 1966/67, *Narodnoe khoziaistvo SSSR v 1967,* p. 38; 1967/68 and 1969/70, *Vestnik statistiki,* 1971, No. 12, p. 75; 1968/69, Urlanis, *Problemy dinamiki . . .,* pp. 85 and 90; 1970/71 and 1971/72, *Vestnik statistiki,* 1973, No. 12, p. 75; 1972/73, *Vestnik statistiki,* 1974, No. 12, pp. 87–88, and 1973/74. *Vestnik statistiki,* 1975, No. 12, p. 80.

First, second, third, fourth and fifth and higher order of births. The age-specific fertility rates in these sections of the table are calculated in several steps. (1) The absolute number of births by order of birth and age of mother is reported for 1962 through 1964 and 1966 through 1974 in the following issues of *Vestnik statistiki:* 1966, No. 2, pp. 94–95; 1966, No. 12, pp. 81–82; 1967, No. 11, pp. 89–90; 1969, No. 2, p. 82; 1970, No. 6, p. 90; 1971, No. 12, p. 74; 1973, No. 12, p. 74; 1974, No. 12, p. 87; and 1975, No. 12, p. 79. For 1960 and 1961, the corresponding absolute numbers are derived from percentage distributions of number of births by order of birth and age of mother reported in TsSU *Narodnoe khoziaistvo SSSR v 1961 g.: statisticheskii ezhegodnik* (Moscow, 1962), p. 30, and the total number of births by age of mother. (2) The average number of births for successive two-year intervals (e.g., 1960/61), by order of birth and age of mother, is derived by arithmetic from the data in (1), above. (3) The female population by the age-groups of Table 1 is derived by dividing the total number of births by age of mother reported in the same sources as (1), above, by the age-specific fertility rates for total births (reproduced in Table 1). (3) Age-specific fertility rates by order of birth are then derived by dividing the data in (2) by (3), above.

INDUSTRIAL REORGANIZATION: THE ASSOCIATIONS

ALICE C. GORLIN*

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I. INTRODUCTION

In 1961 a little noticed event occurred in the city of Lvov in the Western Ukraine. Five shoe plants were merged to form a firm since known as Progress. This organizational innovation occurred because of local initiative by the managers of the plants and some Communist Party officials. Official support at higher levels was soon forthcoming and the Soviet merger movement was launched. Today, there are over 1,500 of these merged entities; they are now most often called

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production associations (proizvodstvennye ob"edineniia) but the term firm (firma) is also used. (See Table 1 for the most recent industry breakdown.)

Once official support for mergers became translated into procedures for effecting them, local initiative was much less important; the ministries were put in charge. Nevertheless, the merger movement was for years haphazard; many ministries did little or nothing in this area, and firms were frequently liquidated. By early 1973 it was unclear where the merger movement was going. But in March of that year the movement gained new momentum with an announcement by the top leadership of their intention to eliminate all small-scale industry through mergers. Associations would replace enterprises as the basic industrial units.

TABLE 1.—*Number of associations, Jan. 1, 1974*

Total (including the following All-Union and Union republic ministers)	1425
Chemical industry	19
Heavy, electrical and transport machine building	7
Electrotechnical industry	34
Chemical and petroleum machine building	18
Instrument making, means of automation and management systems	15
Automobile industry	7
Agricultural machinery	14
Machinery for light and food industries and appliances	15
Forestry and wood working	101
Construction materials	112
Light industry	320
Food industry	250
Meat and dairy products industry	28
Total	1,425

Source: Tsentralnoe statisticheskoe upravlenie, *Narodnoe khoziaistvo SSSR v 1973 godu* (Moscow: Statistika, 1974), p. 203.

At this point some explanation of terminology is in order. In the Soviet context, enterprise is a legal term and refers to the lowest level of the ministerial hierarchy which administers Soviet industry. Enterprise and plant are usually synonymous. The enterprise is the unit to which plans have traditionally been delegated and with which higher levels in the hierarchy have communicated. After industrial reorganization most units at the bottom of the hierarchy will be multiplant associations. Higher administrative organs will communicate with these associations rather than with individual plants.

The ministry is the highest level in the industrial hierarchy. Each industrial ministry is in charge of the administration of a branch of industry, for example the Ministry of Light Industry. All-union or U.S.S.R. ministries are located in Moscow; their subordinates are answerable directly to them. Union-republican ministries have offices both in Moscow and in the republics in which production takes place. Each enterprise has dual subordination, to a ministry in Moscow, as well as the capital of the republic in which it is located. A republican ministry is in charge of a branch of industry within a republic and has no direct superior in Moscow.

The glavk (plural: glavki) is the administrative unit between the ministry and the enterprise. It may be functional (for example, a glavk

in charge of the finances of a group of enterprises), territorial (in charge of the enterprises in a certain region), or industrial (in charge of a certain specialized sub-branch of the industry).

A common hierarchy in Soviet industry is ministry-glavk-enterprise. But often there are additional levels. Union-republican industries have two ministerial levels. In addition, trusts exist in some industries; they are administrative organs between enterprises and glavki. The trust is a horizontal combination of enterprises which do not have contractural relationships with each other. The trust handles sales, supply and relationships with higher administrative organs (ministries, glavki, Gosplan).

The reformers' intention in 1973 was completion of all mergers by the end of 1975. However, recently it was announced that ministries' reorganization plans will be part of the Tenth Five-Year Plan (for the first time). The present intention is to complete industrial reorganization by 1980. This paper is an analysis of a number of industry reorganization plans and their prospects for improving Soviet industrial management.

The Soviet leadership expects associations to improve industrial efficiency through development of concentration and specialization. Associations have made some progress in these areas.[1] A further expectation is that mergers will facilitate rationalization of the administrative structure so as to reduce bureaucratic waste. There is a general consensus among Soviet writers on the subject that the administrative structure is too complex and that there are an excessive number of levels and bodies in some industrial hierarchies. A third expectation is that reorganization will be accompanied by decentralization of the day-to-day operation of the economy. Associations are expected to take over routine administration, freeing ministries to work on long-range planning and technical progress.

The typical production association contains four enterprises. If all 50,000 industrial plants were to be merged, there would be some 12,500 associations.[2] Thus the number of units at the lowest levels of the various hierarchies would be dramatically reduced. Also, the typical unit would be considerably larger. At present 72 percent of the associations employ more than 1,000 and 15 percent employ more than 5,000.[3]

Once the industrial reorganization is completed, all industries will be organized in two-, three-, or four-stage hierarchies, as shown in chart 1. At present, five-, and six-stage hierarchies are not uncommon. The two-stage hierarchy, being the simplest, is supposed to be adopted whenever possible. Here a number of large producing units are directly subordinate to a ministry (all-union or republican). The three-stage hierarchy is expected to be most common, at

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[1] Alice C. Gorlin, "Soviet Firms and the Rationalization of the Shoe Industry of the USSR" (unpublished Ph. D. dissertation, University of Michigan, 1972); Alice C. Gorlin, "The Soviet Economic Associations," Soviet Studies, vol. XXVI, no. 1 (January 1974), pp. 3–27.

[2] This assumes that four enterprises per association will continue to be typical. However, a Gosplan official predicts that the typical association of the future will contain seven units. See A. V. Bachurin, "Novaia struktura. Opyt i problemy razrabotki general'nykh skhem upravlenila i sozdaniia ob"edinenii," Ekonomicheskaia gazeta, 1974, no. 35, p. 5.

[3] Iu Subotskii, "O razvitii ob" edinenii v promyshlennosti," Voprosy ekonomiki, 1974, no. 6, pp. 30, 32.

Chart 1

Possible Industrial Hierarchies

Two-Stage	Three-Stage	Four-Stage
ministry	ministry	union-republic ministry of the USSR
		union-republic ministry of the republic
	all-union or republican (industrial) association[a]	republican (industrial) association[a]
producing unit (production association,[b] combine[c] or enterprise)	producing unit (production association, combine or enterprise)[d]	producing unit (production association, combine or enterprise)

Source: "O nekotorykh meropriiatiiakh po dal'neishemu sovershenstvovaniiu upravleniia promyshlennost'iu," Ekonomicheskaia gazeta, 1973, no. 14, p. 3.

Notes:

[a]The "industrial association" is a larger entity than the production association. The industrial association is either all-union, in which case it has jurisdiction over all the enterprises of a particular sub-branch, or republican, in which case it has jurisdiction over all the enterprises of a particular sub-branch within a republic.

[b]The "production association" is identical to the associations that have been described so far.

[c]A combine is a vertically integrated multiplant enterprise. What distinguishes it from the association is that the enterprises are located adjacent to each other.

[d]Two variants of the three-stage scheme are:

(i) union-republic ministry of USSR--union-republic ministry of republic--producing unit;

(ii) republican ministry--ministry of automous republic--producing unit

least in the short run. In this scheme the ministry may be all-union, union-republican or republican. The four-stage scheme will only be adopted in union-republican industries. Although the chart indicates that single-plant enterprises may be at the base of the hierarchies, only very large plants would qualify. Smaller plants would be merged into associations.

The distinguishing feature of the three-, and four-stage hierarchies is the industrial association. So far, its role, importance, and

relation to the production association are unclear. According to one Soviet source industrial associations will be the basic management sub-units in industry, while other sources stress the two-stage hierarchy and the production association.[4] Industrial associations are considerably larger than production associations and often include non-producing organizations such as research and development (R. & D.) institutes, design organizations, and technical institutes. These large associations are supposed to be in charge of the development of the industrial complex represented by their subordinates. Many of their functions—study of demand, introduction of technical progress—are identical to functions performed by glavki. (Most glavki are to be abolished as part of reorganization.) The feature distinguishing the industrial association from the glavki is khozraschet status; the association's expenses are covered by deductions from members' profits rather than by the budget. Also industrial associations presumably have more powers and (through the various funds at their disposal) control more resources than glavki.[5] Soviet economists argue vigorously that industrial associations are not renamed glavki, that they are formed according to different principles. However, what these principles are is as yet unclear except for vague statements that an industrial association represents an industrial complex of related enterprises. The industrial associations are expected to be most prevalent in the light and food industries. There are at least 200 such associations now operating.[6]

Two variations on the association receiving increasing attention are the R. & D. associations and the agri-industrial associations. The R. & D. association merges research institutes, design organizations, and the factories which will eventually produce the new products. By the middle of 1974 there were 132 of them.[7] The major objective is to reduce the time lag between invention and mass production of a new product. This is an area in which Soviet performance has never been very good, because of physical separation of R. & D. and production activities and the short-run orientation of Soviet managers. The literature cites examples of R. & D. associations in which the time lag from invention to production has been dramatically reduced, sometimes by half.[8] However, it is too soon to pronounce these associations a success. Internal incentives are not properly geared to research since the most important bonuses are paid for fulfilling the current output plan.[9] Also, such associations represent formal merger only, since the R. & D. organizations and factories continue to oper-

[4] B. I. Gostev, "Sovershenstvovanie upravlenila ekonomikoi," Ekonomicheskaia gazeta, 1973, no. 15, p. 3. Some economists think industrial associations are a temporary phenomenon and that they will eventually be converted to several production associations. See V. Seliunin, "General'nye skhemy otraslei," Sotsialisticheskaia industriia, May 28, 1975, p. 2; summarized in ABSEES (Soviet and East European Abstracts Series), vol. VI, no. 4 (October, 1975), p. 22.

[5] Iu. M. Kozlov, "Ob"edinenila v promyshlennosti," Vestnik Moskovskogo universiteta, Pravo, 1973, no. 5, p. 21.

[6] R. D. Vinokur, "Proizvodstvennye ob"edinenila i nauchno-technicheskii progress," Finansy i nauchno-technicheskii Progress (Moscow: Finansy, 1973), p. 20.

[7] Julian Cooper, "Research, Development and Innovation in the Soviet Union," Economic Development in the Soviet Union and Eastern Europe, vol. 1, ed. Zbigniew Fallenbuchl (New York: Praeger Publishers, 1975), p. 171.

[8] Vinokur, op. cit., p. 19.

[9] M. Morozov, "We Have Responsibilities: What About Our Rights," CDSP (Current Digest of the Soviet Press), vol. XXV, no. 44 (November 28, 1973), p. 15; translated from Pravda, November 4, 1973, p. 2.

ate under their previous jurisdictions, with separate wage funds, bank accounts and bonus arrangements.

Agro-industrial associations are mergers between farms and food processors. A typical example is a merger of fruit and vegetable farms with canneries. Such associations may also include the retailing stage. The chief objective is to speed up the delivery of foods to processors so as to improve quality and reduce waste. These associations are expected to be especially important in the production of perishable products.[10]

Trade associations, or combinations of trade organizations, have also come into existence recently. The major objective is apparently to consolidate all the trade organizations dealing in a particular product so as to exert countervailing power against producers who try to sell shoddy goods.[11]

II. Sources of Concern Over Industrial Administration

In general the study of administrative organization has been neglected in the Soviet Union. The quantitative aspects of production have been stressed instead. Until recently there was no conception of management or administration as a science. The administrative structures which evolved were often dictated by political rather than efficiency considerations.

> Administration organization has been a political question decided at the highest Party levels; not a technical question to be decided by scholars and practitioners.[12]

Low levels of concentration and specialization, multi-stage hierarchies, parallel jurisdiction, and evasion of responsibility by bureaucrats—all these are attributed to the neglect of administrative science.[13]

A. Irrationality of Present Administrative Structure

The Soviet administrative structure has three major deficiencies. First, the hierarchies contain too many administrative bodies. Second, too many people are employed in administrative-managerial positions. Third, many enterprises are in the wrong hierarchies.

As the Soviet economy has developed and become increasingly complex, the number of administrative bodies has grown as well. The ministerial system for industry was set up in 1932 with three ministries; by April of 1973 there were 39 industrial ministries.[14] Not only has the number of ministries increased, the hierarchical structures under them have become increasingly complex. In 22 industrial ministries studied

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[10] For a more detailed discussion see N. Smetanin, "Agro-Industrial Integration in the USSR," Problems of Economics, vol. XVII, no. 8 (December 1974), pp. 46–64; translated from Voprosy ekonomiki, 1974, no. 3.

[11] For a more detailed discussion see V. Bumistrov, "What do Associations do for Trade," CDSP, vol. XXV, no. 45 (December 5, 1973), pp. 15–16; translated from Pravda, November 9, 1973, p. 2.

[12] John H. Wilhelm, "The Soviet Attempt at Regional Economic Planning: The Sovnarkhoz 1957–1965" (unpublished Ph.D. dissertation, University of Michigan, 1974).

[13] N. M. Oznobin, "Organizatsionnaia struktura promyshlennogo proizvodstva kak faktor sovershenstvovaniia upravleniia," Ekonomika i organizatsiia promyshlennogo proizvodstva, 1973, no. 1, p. 90.

[14] Paul R. Gregory and Robert C. Stuart, Soviet Economic Structure and Performance (New York: Harper and Row, 1974), p. 119.

by two Soviet economists there were 125 different hierarchies in charge of industrial production, some of which had five and six levels. The authors of the study emphasize that the number of administrative personnel grows with the number of steps in the hierarchy.[15]

As the number of administrative bodies grows, duplication of efforts, an obvious source of inefficiency, is more frequent. Another problem is introduction of technical improvements into production. Scientific-technical problems often cannot be solved within the jurisdiction of a single administrative body but require cooperation among a number of bodies. The more bodies that are involved, the more difficult is such cooperation.[16] It is suggested that ministries and departments should be consolidated, in order to facilitate coordination of their activities.[17] However, consolidation and simplification of the individual hierarchies are probably conflicting goals.

There is currently a lively controversy about whether Soviet administrative-managerial personnel are excessive and the extent of the problem, if it exists. It is not the intention here to delve deeply into this problem, but rather to emphasize that the Soviet leadership evidently feels that growth of administrative personnel is a genuine problem. Some data certainly bear this out. Gertrude Schroeder has estimated that since the Brezhnev era began employment in the state bureaucracy has risen by 50 percent.[18] Even according to Soviet statistics, which tend to underestimate the numbers employed in administration, administrative personnel have been growing considerably faster than industrial production personnel. In 1973 administrative personnel officially defined grew almost 4 percent while industrial production personnel grew 1.3 percent.[19] In the late 1960's in a number of industries the increase in administrative expenditures exceeded the growth rates of production and employment. In eight industries studied by two Soviet economists, administrative expenses in 1968 as a percentage of the 1966 level ranged from 120.6 percent to 142 percent (not counting management at the enterprise level).[20] As a result administrative costs rose much faster than production costs.

An alleged cause of administrative excesses is the large number of small and medium-sized enterprises. In manufacturing alone the number of small enterprises (employment from 100 to 500) grew from 14,278 to 18,079 from 1964 to 1968.[21] With many enterprises, planning and administration are more expensive. In this connection it is interesting to note that in the eight-industry study mentioned above, the average increase in administrative expenses in the industries in which the number of independent enterprises was reduced was 26.8 percent,

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[15] I. Kuznetsov and A. Tikhomirova, "Voprosy effektivnosti organizatsii upravlenila ostrasl'iu promyshlennosti." Voprosy ekonomiki, 1970, no. 11, p. 76.

[16] More generally it is argued that modern industrial problems tend to involve a number of branches of industry. Therefore managerial organs should not be too narrowly specialized, for then they will be unable to solve complex, interbranch problems. A. Bachurin, "Kompleksnyi podkhod k upravleniiu," Trud, February 17, 1973, p. 2.

[17] M. I. Piskotin, "The Functions of the Socialist State and the Administrative Apparatus," CDSP, vol. XXV, no. 48 (December 26, 1973), pp. 6–7, 18; translated from Sovetskoe gosudarstvo i pravi, 1973, no. 10, pp. 3–11.

[18] Gertrude E. Schroeder, "Post-Khrushchev Reforms and Public Financial Goals," unpublished paper, p. 10.

[19] *Narodnoe khoziaistvo v 1973 godu*, pp. 574–575.

[20] Kuznetsov and Tikhomirova, op. cit., p. 76.

[21] A. Pavlova, "Ob ekonomicheskikh uslovilakh sozdanila proizvodstvennykh ob "edinenii," Planovoe khozlaistvo,, 1973, no. 4, p. 123.

while the average increase for industries in which the number of enterprises grew was 33.2 percent.

The 1965 reform contributed to administrative excesses at the enterprise level. Under the reform enterprises were supposed to devote some of their time to new activities such as demand studies and R. & D. Thus managerial expenses rose (especially in small enterprises).[22] A strong argument for associations is that various functions can be centralized within them and therefore performed more efficiently.

With many administrative bodies, there are questions about the proper subordination of enterprises. Enterprises producing identical or similar products, and enterprises having contractual relations with each other, are often subordinate to different glavki and even different ministries. For example, there are four glavki in charge of instruments, four in charge of agricultural machinery and six in charge of automobiles. In Lithuania, 13 factories of the machine tool and instrument industry are subordinate to six glavki.[23] Other examples could be multiplied. The problem exists even when output is simple and homogeneous; a group of 20 factories which mine and process salt are subordinate to five ministries.[24]

Although improper subordination is a consequence of administrative excesses, it is also a cause of them. Establishment of contractual links among plants which are subordinate to different ministries or glavki is more expensive than establishment of links among plants with a common superior.

B. Autarky and its Consequences

Several features of the Soviet economy, in particular the overcommitment of resources in the plans, compel administrative organs to aim for maximum self-sufficiency in order to ensure that the plans of their subordinate enterprises are fulfilled. Cooperation with administrative units of other industries is undertaken only if it aids plan fulfillment. Such behavior hinders the development of specialization in plants having different superiors. Such plants often duplicate each other's activities and their superiors do not cooperate with each other to develop specialization. And of course there is a tendency for individual plants to integrate vertically and to hoard scarce items, in order to ensure input supplies.

Autarky is most evident in production of machinery. Lifting-transport equipment is produced by 320 enterprises subordinate to 35 ministries and departments; about 250 of these factories produce it for their own use. Thus much machinery output is produced in small, inefficient shops. The ministries which are nominally in charge of certain products may in fact produce a very small proportion of them; the ministry in charge of lifting-transport equipment produces only 14 percent of it.[25]

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[22] Iu. V. Subotskii, Novyi etap razvitiia ob "edinenii v promyshlennosti (Moscow: Znanie, 1973), p. 28.

[23] Iu. V. Subotskii, "Ekonomicheskie problemy organizatsii upravlenila v otrasli promyshlennosti," Organizatsiia raboty ministerstv v usloviiakh ekonomicheskoi reformy (Moscow: Nauka, 1972), pp. 43–44.

[24] A Seleznev, "Khoziaistvennyi raschet i deiatel'nost' organov upravlenila promyshlennykh ob"edinenii," Ekonomicheskie nauki, 1974, no. 10, p. 51.

[25] Iu. Subotskii, "Ob"edinenila v sisteme ekonomiki razvitogo sitsializma," Kommunist, 1973, no. 13, p. 61.

Reorganization through mergers cannot eliminate autarky, since it is a consequence of taut planning. However, mergers do ease the pressure on individual plants to integrate vertically. Associations can centralize parts and other auxiliary production on a larger, more efficient scale.[26]

III. General Principles of Industrial Reorganization

Soviet economists and planners believe that administrative costs are strongly influenced by the number and complexity of links among enterprises. According to a Gosplan official the number of economic links increases at a minimum as the square of the number giving the growth in the volume of output. Thus if output doubles the number of links increases by four times.[27] In the absence of a market such links must be established and regulated administrativelv; mergers reduce the number of links by reducing the number of independent enterprises and by internalizing some links within associations. It is also believed that multi-level hierarchies are more costly than simple hierarchies. Thus two general principles of reorganization are: (1) reduction in the number of levels in the industrial hierarchies, and (2) reduction in the number of units at the bottom of the hierarchies.

Soviet economists stress that reorganization must be an optimizing process. Prior administrative (geographical or ministerial) boundaries should not be an obstacle to rational combinations of enterprises. Associations of enterprises subordinate to different ministries should be permitted and encouraged.

A general operational principle of reorganization is that plants which are "alike" in one or more ways should be merged. Alikeness may be defined in various ways: production processes employed, equipment used, other inputs used, outputs produced, or vertical ties.[28] The criteria chosen depend on the unique characteristics of the industry in question. For example, if in a particular industry development of product specialization has great potential for increasing efficiency, then plants producing the same products would be merged. If vertical specialization is the major route to increased efficiency then plants having vertical links with each other would be merged.

Once the enterprises of a branch are merged into associations, a hierarchy must be constructed to manage them. According to Soviet analyses the number of levels needed depends on: (1) number of independent units to be administered (enterprises or associations); (2) the territorial dispersion of these units; and, (3) the number of products produced by the industry. The Soviet literature does not contain a systematic analysis of the way these factors influence the hierarchy. However, such an analysis would probably contain the following arguments. In general, the more enterprises there are in an industry, the more levels are needed in the hierarchy. Given two industries in which identical closeness of supervision is desirable, the one with more enterprises will in general need more administrative units. Because

[26] See Gorlin, "Soviet Firms . . .," for a detailed description of how this was done in the Soviet shoe industry.

[27] N. Drogichinskii, "O dal'neishem sovershenstvovanii upravleniia promyshlennost'iu." Ekonomicheskie nauki, 1973, no. 7, p. 40.

[28] D. A. Allakhverdian and E. N. Slastenko, Metodologicheskie osnovy formirovaniia ob''edinenii v promyshlennosti (Moscow: Ekonomika, 1974), p. 36; Subotskii, Novyi etap . . ., pp. 21, 22.

of span of control considerations (the fact that an administrative unit can only manage so many subordinates), more administrative units generally means more administrative levels as well.

The larger and more territorially dispersed the enterprises of an industry are, the steeper the hierarchy must be, other things being equal. Supervision of a number of large enterprises is more time-consuming than supervision of an equal number of small enterprises. Also, supervision of a group of dispersed enterprises means that more expenditure must be devoted to travel and communications. The number of products produced by the industry affects the steepness of the hierarchy in a positive way. The more products, the more complex the supervision and the more levels are needed.[29]

A number of other factors are probably relevant as well. One is the nature and complexity of the technology. If the technology is complex, involving many different operations, supervision of one enterprise is more time-consuming and a relatively steep hierarchy with small spans of control is called for. If, in addition, the technology is rapidly changing, then the supervision cannot be as easily routinized and a more elaborate structure is needed. Another factor is growth; if an industry is rapidly growing, this growth must be monitored in the proper directions. Again, more levels would be needed in such an industry.

Closeness of supervision is related to some of the factors already discussed. It also depends on the priority of the industry; in high priority industries close supervision is desirable. Given two industries with similar conditions (number and size of enterprises, geographical distribution etc.), the high-priority industry would demand closer supervision and therefore more administrative units. And as argued earlier more administrative units usually means more levels as well. In the low-priority industry there would be fewer intermediate units and enterprises would be left alone more.[30]

The discussion of variants of industrial reorganization has raised questions about the future of the ministerial system. One Soviet economist argues that reorganization plans along ministerial lines represent partial and isolated changes in individual branches, changes which cannot eliminate the existing irrationalities.[31] An overall approach is needed. Using such an approach the economy would be divided into

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[29] For examples of the Soviet discussions of these factors see Gostev, op. cit.; Seliunin, op. cit.; A. Odintsov, "V osnovegeneral'nye skhemy," Ekonomicheskaia gazeta, 1974, no. 38, p. 7; V. Golikov, "O printsipakh organizatsii vsesoiuznykh, respublikanskikh promyshlennykh i proizvodstvennykh ob"edinenii pri nerekhode na dvykh- i trekhzvennuiu sistemu upravlenila," Ekonomika Sovetskoi Ukrainy, 1973, no. 9, pp. 29–38.

[30] Essentially the argument is being made that steep hierarchies are more centralized than flat hierarchies. There is controversy over this question. Some western commentators interpret the simplification of the industrial hierarchies in the Soviet Union as a centralizing process. See Hans-Hermann Höhmann and Hans-Bernhard Sand, "The Soviet Union," The New Economic Systems of Eastern Europe, eds. Höhmann, Hans-Hermann, Michael Kaser, and Karl Thalheim (London: C. Hurst, 1975), p. 6. In this view, "the primary function of intermediary bodies is to allow some delegation of command authority, dictated by the limited span of control of the central body." See Richard D. Portes, "The Strategy and Tactics of Economic Decentralization," Soviet Studies, vol. XXIII, no. 4 (April 1972), p. 634. Thus a flat hierarchy, in which a single central body controls all subordinates, is characterized as highly centralized. This is a correct interpretation, so long as the central body's span of control is not exceeded. If its span of control is exceeded then there will, by default, be significant freedom of action on the part of subordinates because the center cannot make all decisions. In this case creation of an additional level to help supervise the enterprises would lessen their freedom of action and would be centralizing. Given similar conditions in two industries, in particular the same number of enterprises, the industry with more levels in its hierarchy is more centralized because supervision of subordinates is closer.

[31] Oznobin, op. cit., p. 92.

industrial complexes, each of which would be administered by a large (industrial) association. These large associations would be subordinate to ministries, but ministerial boundaries would be totally disregarded in their formation. Thus each ministry's powers would be somewhat tenuous. However, no matter how enterprises are merged into associations, it is impossible to internalize all horizontal links (unless, of course, all enterprises are merged into one giant association). Administration of remaining horizontal links would presumably be the responsibility of ministries.

IV. Analysis of Reorganization Plans

A. Reform Implementation

Although the original timetable for reform implementation was too ambitious, recent information indicates that all industrial ministries have drawn up reorganization plans and most of the plans have been approved.[32] However, since 1973, ministries and other organizations involved in reorganization planning have been subject to severe criticism in the press. Preliminary plans of many ministries were returned for additional work, being considered unsatisfactory by the Council of Ministers. Party organizations were called upon to fight the localism displayed in some plans. Some plans were criticized for attempting to preserve the existing system of management, with small enterprises and numerous glavki.[33] These problems are not surprising in view of the fact that the people in charge of drawing up plans are employees of glavki and ministries, many of whom stand to lose influence and even their jobs. The problems also indicate lack of a sound methodology. It is admitted, for example, that ministries in Georgia have no methods for calculating the economic effect of forming associations.[34]

Enterprise personnel frequently resist merger; executives of enterprises who become executives of associations often receive no raises even though their work load increases. Also, when trading partners merge, gross output falls due to internalization of some transactions.[35] The short-run orientation of Soviet managers affects their attitude toward mergers; they are criticized for unwillingness to look to the future.[36]

One economist observes that work on industrial reorganization is very secretive.[37] This is confirmed by the lack of detail in which plans have been published. Often methodology as well as specific changes

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[32] N. Drogichinskii, "Frontiers of the Tenth Five-Year Plan: How Associations Should Develop," CDSP, vol. XXVIII, no. 6 (March 10, 1976), pp. 8–9; translated from Pravda, February 7, 1976.

[33] "Improve Production Management," CDSP, vol. XXVI, no. 31 (August 28, 1974), p. 20; translated from Pravda, July 31, 1974. p. 1.

[34] V. Vukovich and S. Davitaya, "There's a Chart but Where's the Firm," CDSP, vol. XXV, no. 52 (January 23, 1974), pp. 15–16; translated from Izvestia, December 26, 1973, p. 3.

[35] G. Popov, "Science of Management: On Paths to Associations," CDSP, vol. XXV, no. 37 (October 10, 1973), pp. 6–7; translated from Pravda, September 12, 1973, p. 2.

[36] Pravda, January 14, 1974, p. 2; summarized in ABSEES, vol. V, no. 3 (July 1974), p. 47; Vyshka, January 14, 1974, p. 2; summarized in ABSEES, vol. V, no. 2 (April 1974), p. 38. An additional source of resistance is local agencies, which are criticized for not supporting plans to create large complexes which would presumably not be subject to any local jurisdiction. See "Improve the Management of Production," CDSP, vol. XXVI, no. 11 (April 10, 1974), p. 10; translated from Pravda, March 14, 1974, p. 1.

[37] G. Kh. Popov, "Problemy formirovaniia ob''edineniia v promyshlennosti na sovremennom etape," Metodologicheskie voprosy obrazovania ob''edinenii (Moscow, 1975), pp. 30–33.

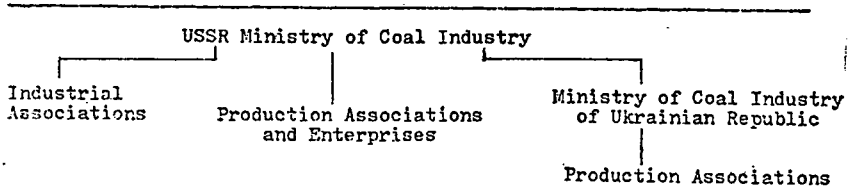
are discussed sketchily. For this reason only a few plans can be discussed in any detail.

B. Coal Industry

Before reorganization the coal industry had a five-stage hierarchy: coal mine- trust- combine- republican ministry- all-union ministry.[38] Reorganization created a two- or three-stage hierarchy (see Chart 2). Except for the Ukraine which, being a major coal-producing area, has its own ministry, the industry will be organized in the simple two-stage hierarchy. Six all-union industrial associations have been set up, but these are not part of the regular industry hierarchy. These associations are in charge of specialized problems such as coal mine construction, safety and geological exploration.[39] The all-union association in charge of machinery production represents an organizational innovation, since this machinery was formerly the responsibility of a machine-building ministry.

CHART 2

Organization of Soviet Coal Industry



Source, Bratchenko, *Ekonomicheskaia gazeta*, 1975, No. 22, p. 4.

Before reorganization there were 2,070 independent enterprises. Of that number, the coal mines are to be consolidated into 47 regional production associations, of which 38 have already been formed.[40] The production associations will not include all previously independent enterprises, since once reorganization is completed, there will be 300 independent enterprises in the branch (including the associations).[41] Before reorganization there were 58 middle-level units in the industry (trusts and combines); once reorganization is completed there will be only seven (the six all-union associations and the Ukrainian ministry).

The average association in the coal industry will contain 20 units. Employment per enterprise (including associations) will increase from 700 to 6,000.[42] One typical (although very large) association, Vorkutaugol, contains 14 coal mines, nine concentrating mills, a mechanical factory, a wood-processing combine, a factory producing ferro-concrete structures, transport organizations, a geological expedition, a project institute and a construction trust. Its output is 15 mil-

[38] Voprosy upravlenila ekonomikoi (Moscow: Politizdat, 1974), pp. 40–41.
[39] B. F. Bratchenko, "Vedushchee zveno upravlenila," Ekonomicheskaia gazeta, 1975, no. 22, p. 4.
[40] B. F. Bratchenko, "From Congress to Congress: High Yield," CDSP, vol. XXVII, no. 50 (January 14, 1976), pp. 34–35; translated from Izvestia, December 13, 1975, p. 3.
[41] Seliunin, op. cit.
[42] "Science of Management: The Branch's General Plan," CDSP, vol. XXVI, no. 22 (June 26, 1974), pp. 4, 26; translated from Pravda, May 31, 1974, p. 3.

lion tons of coal and it employs 43,000.[43] (No rationale is given for its size or composition.) It is claimed that the production associations have achieved performance indices higher than the branch average. Concentration of production has been increased, auxiliary processes have been specialized, and repair and mechanical operations have been consolidated.

Results of the reorganization are described in such a way that it is difficult to determine if they are actual or projected. An 11 percent reduction in administrative personnel (about 20,000 people) is claimed (including 180 ministry personnel). Estimates of total annual ruble savings due to reorganization range from 120 to 150 million rubles. The savings are attributed to centralization of auxiliary services (presumably in the associations) and reduction in personnel at all levels.[44] Nevertheless, in some associations there has been an increase in the number of managerial personnel in charge of services not yet centralized.[45]

It is not clear what will happen to the released personnel. Apparently they are to be given other work in the branch.[46] But then how can such a large savings be claimed? The relocation problem has not been openly dealt with in the literature.

C. Gas Industry

Gas industry reorganization envisages two- and three-stage hierarchies for the various stages of gas production.[47] Previously the four-stage hierarchy was common. The new scheme appears to have been carefully planned. The ministry tried to take into account various peculiarities of the industry, such as the large number of sub-branches (eight), the high rate of growth, the technology of the gas supplying system, the irregularity of demand, and the territorial dispersion of producers and their distance from managerial organs.

The reorganization envisages a number of all-union industrial associations, each in charge of a sub-branch of the industry. Subordinate to the industrial associations are production associations and enterprises. This is in contrast to the coal industry, where industrial associations are in charge of subsidiary activities only. The difference is explained by the greater complexity of the gas industry, which is reflected in the number and relationships among sub-branches (extraction, local transport and processing, exploratory drilling), the territorial dispersion of enterprises (some associations cover a 300 kilometer radius), and the large number of enterprises and organizations (some associations have 45 members).

Chart 3 summarizes the reorganization in the major sub-branches. The boundaries of some sub-branches have been changed. In gas extraction in particular, the all-union associations incorporate all stages

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[43] N. Drogichinskii, "Upravlenie promyshlennost'iu na sovremennom etape," Planovoe khoziaistvo, 1973, no. 12, p. 10.

[44] Bratchenko, Ekonomicheskaia gazeta, 1975, no. 22, p. 4; N. Drogichinskii, "Sovershenstvovanie organizatsii upravlenila proizvodstvom," Ekonomicheskie nauki, 1974, no. 10, p. 46.

[45] Bratchenko, CDSP, vol. XXVII, no. 50, pp. 34–35.

[46] "Improve the Management. . . ."

[47] For a detailed discussion of reorganization in this industry see A. F. Aksenenko, "Novial sistema upravlenila vvoditsia v deisvte," Gasovaia promyshlennost', 1974, no. 1, pp. 28–32.

from R. & D. to finished output. They also contain drilling organizations, some gas-processing enterprises, local transport organizations and repair organizations. The two-stage hierarchy exists only in interregional transport of gas. However, in extraction and processing two-stage hierarchies have been set up in regions producing a small output. With large output more levels are believed necessary.[48] Nevertheless, there is some expectation that the two-stage hierarchy will dominate in the future.

CHART 3

REORGANIZATION OF SOVIET GAS INDUSTRY

Before reorganization		After reorganization		
Subbranch	Hierarchy	Sub-branch	Hierarchy	Advantages
Extraction and condensation of gas.	4 levels	Extraction, local transport and drilling.	3 levels: ministry-all-union industrial association-enterprise.	Simpler hierarchy aids development of industry.
Gas processing	3 levels: ministry-glavk-factory.	Gas processing and condensation.	3 levels: ministry-all-union industrial association-factory.	Management closer to production; transition from extraction to processing is simpler.
Transport and delivery	3 levels: ministry-glavk-main gas pipeline (regionally organized).	Interregional transport of gas.	2 levels: ministry-production association for transport and delivery of gas.	Concentration increased; aids development of interregional systems; automation of management is more efficient.
Gas storage	4 levels: ministry glavk-administration of main gas pipelines-station for underground storage.	Gas storage	3 levels: ministry-all-union industrial association-enterprise.	Increased concentration.
Machine building	3 levels: ministry-glavk-factory.	Machine building	3 levels: ministry-all-union industrial association-factory.	Increased specialization in factories; automated systems of management introduced, improved quality.

Source: Aksenenko "Gasovaia promyshlennost'," 1974 No. 1 pp. 30-31.

Forty six associations (industrial and production) have been organized in the branch. The number of units at the bottom of the hierarchy has been reduced by more than 200 and the number of units at middle levels has been reduced by 25.[49] Although these are less dramatic changes than those which occurred in the coal industry, the the creation of associations has had positive effects on concentration, specialization and labor productivity. Concentration in the transport of gas has risen nine times. This is probably related to the separation of local and long-distance transport. In gas extraction concentration has increased 1.5 times; labor productivity has grown by 21.2 percent.[50]

Total employment in the ministry is expected to fall by about 8,000 (approximately 4 percent), of which more than 2,000 are managerial personnel. The total anticipated ruble savings are 100 to 110 million rubles a year, of which 28.5 million rubles are due to specialization and concentration, with the remainder attributed to personnel reductions.[51]

[48] S. Orudzhev. "Zvenia upravlenila." Trud, January 10, 1975, p. 2.
[49] "Introduce Scientific Principles into Branch Management," CDSP, vol. XXVII, no. 38 (October 15, 1975), p. 24; translated from Izvestia, September 18, 1975, p. 3.
[50] Orudzhev, op. cit.
[51] Aksenenko, op. cit.

Again these results are not as dramatic as those claimed for the coal industry.

Transition to the new scheme has not been altogether smooth in this industry. Some associations have not improved performance over the pre-reorganization period. The anticipated annual savings were not achieved in 1974, according to the report of a committee set up to investigate reorganization in this industry. Although reorganization was intended to reduce the proportion of managerial personnel in total employment, the opposite has occurred in a number of associations, which in 1974 overspent 762,000 rubles on compensation of managerial personnel.[52]

D. Oil Industry

The oil industry's reorganization plan replaces four- and five-stage hierarchies by a three-stage hierarchy.[53] Formation to regional associations is expected to reduce threefold the number of units at the bottom of the hierarchy.[54] A two-step hierarchy (ministry-production association) is planned for the future. As part of this further simplification of the administrative structure, 300 independent enterprises will be liquidated.[55]

Reorganization is expected to save the industry 27 million rubles per year, primarily through reduction in the administrative staff.[56] More than 18,000 employees have been released.[57] In addition, improvements in labor productivity are claimed, although in some associations the number of non-industrial personnel has grown at an alarming rate.[58]

E. Consumer Goods Industries

In contrast to the coal, gas and oil industries, which produce a relatively homogeneous product, consumer goods industries are characterized by highly differentiated output and a large number of widely scattered enterprises. The Soviet food industry has 20 sub-branches and its Ministry administers 5,417 enterprises and 1,125 state farms and state farm factories.[59] Light industry has 30-sub-branches and its Ministry administers more than 3,000 enterprises and associations.[60] According to Soviet thinking on administration, these industries need a more complex management structure. Reorganization plans call for three- and even four-stage hierarchies.

In light industry, sub-branches of major importance include textiles, sewing of ready-made clothing, fur products, footwear, knitwear, leather and leather tanning. Of the approximately 3,000 enterprises and associations subject to the jurisdiction of the Ministry, only 141 are directly subordinate to it. The rest are subordinate to republican ministries of light industry, to the Ministry of the Textile

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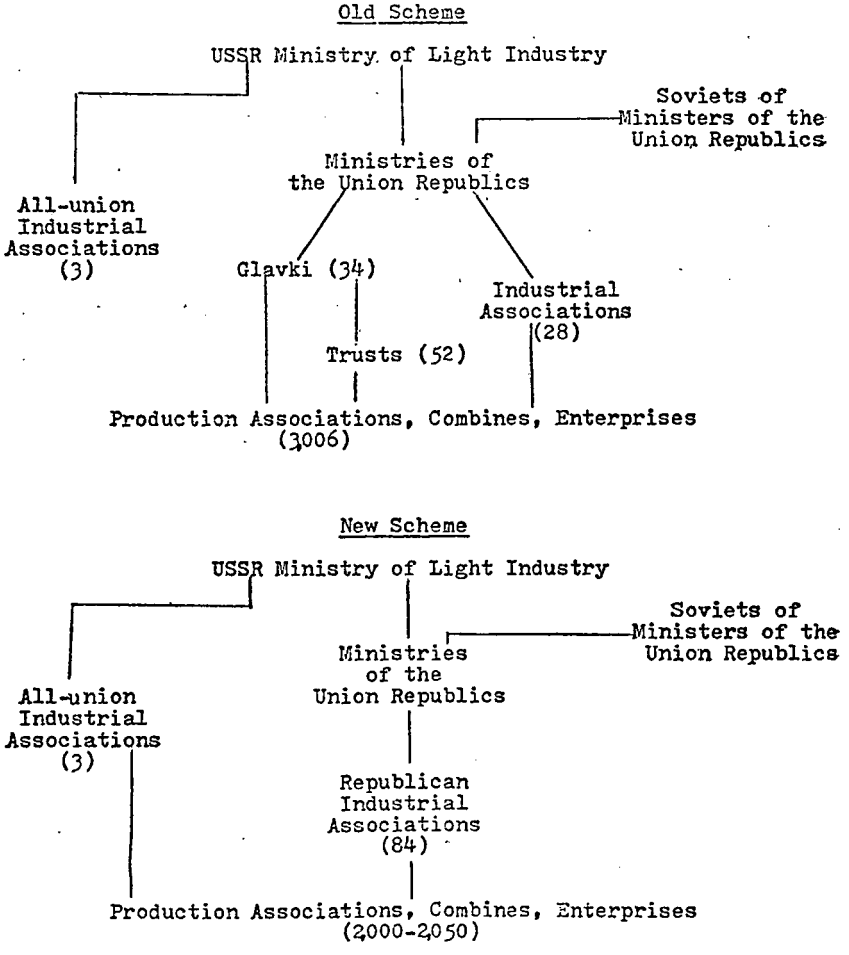
[52] "Introduce Scientific Principles. . . ."
[53] V. Shashin, "Strategy of Efficiency," CDSP, vol. XXVII, no. 41 (November 5, 1975), pp. 12–13; translated from Sotsialisticheskaia industriia, August 28, 1975, p. 2.
[54] Bachurin, Ekonomicheskaia gazeta, 1975, no. 35, p. 5.
[55] Odintsov, op. cit.
[56] *Ibid.*
[57] G. Kh. Popov, ed., Funktsii i struktura organov upravlenila, ikh sovershenstvovanie (Moscow: Ekonomika, 1973), pp. 168–169.
[58] Shashin, op. cit.
[59] Odintsov, op. cit.
[60] N. N. Tarasov, "V osnove- kontsentratsiia i spetsializatsiia," Ekonomicheskaia gazeta, 1975, no. 10, p. 5.

Industry of the Russian republic, or to the Ministry of the Cotton Industry of Uzbekistan. Republican ministries control 95 percent of total output. Before reorganization light industry had two-, three-, four-, and even five-stage hierarchies.[61]

Chart 4 illustrates the changes in management structure in light industry. The number of workers per basic production unit (enterprise or production association) will increase to 1,650 from a 1972 average of 970. More than 500 production associations will be in

CHART 4

Industrial Reorganization in Light Industry



Source: Tarasov, op. cit.

[61] Ibid.

operation.[62] Thirty intermediate administrative organs will be eliminated through liquidation of trusts and replacement of glavki by industrial associations. If all trusts had simply been liquidated the reduction in intermediate units would have been greater. Thus there must have been concern that the remaining intermediate units could not take on all the work of the liquidated trusts.

Concentration and specialization in associations are expected to increase output by 12 million rubles. Total savings of 85 million rubles are anticipated, of which 4.8 million rubles will be reduced administrative costs.[63]

Light industry's reorganization plan has come under criticism. It is implied that there are no fundamental differences between the old glavki and the new republican industrial associations. They are identical bodies with different names.[64] Also the planned reduction in number of units at the lowest level (16.2 percent) is believed insufficient.[65] In the coal industry the corresponding reduction was 85 percent.

It should be emphasized that the retention of four-level hierarchies in light industry is not an indication of high priority. The argument that many levels are associated with high priority assumes that everything else is equal. In light industry the number of levels is dictated primarily by the product mix and number of producers, not by the priority of the industry.

The food industry will be reorganized into three- and four-stage hierarchies, the latter of which will be more common than in light industry. The three-stage hierarchy will be set up in sub-branches producing simple and relatively few products: salt, tea, tobacco, margarine and others.[66] The Ministry's calculations indicate that reorganization in the food industry will increase the volume of output by 150 million rubles and profit by more than 60 million rubles a year.[67] It is still too soon to tell if these expectations will be fulfilled.

V. Evaluation of Industrial Reorganization

A. Impact of Associations on Industrial Performance

Whether industrial performance as a whole has improved due to the creation of some 1,500 associations cannot be determined, because of a lack of systematically published data. The Soviet literature contains many statements to the effect that associations have proven their superiority. Usually such statements are documented by examples of individual associations' accomplishments or other fragmentary data. Some Soviet economists admit that the data needed to evaluate the associations have not yet been collected.[68]

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[62] "Production Association Encompass Increasing Number of Light Industry Enterprises," CDSP, vol. XXV, no. 47 (December 19, 1973), pp. 23–24; translated from Pravda, November 20, 1973, p. 3.
[63] Tarasov, op. cit.
[64] "Improve the Management. . . ."
[65] Bachurin, Ekonomicheskaia gazeta, 1974, no. 35, p. 5.
[66] Odintsov, op. cit.
[67] Ibid.
[68] Subotskii, Voprosy ekonomiki, 1974, no. 6, p. 28; G. Ia. Kiperman, Ekonomicheskie pokazateli promyshlennykh predpriiatii i ob''edinenii (Moscow: Statistika, 1974), p. 14. Kiperman says that many unjustified conclusions have been made on the basis of sporadic data.

There is no doubt that there are a number of outstanding associations, for example the Leningrad machine-building associations and some older associations in light industry. Many of these successful associations were formed in the early 1960's, and it is possible that only relatively successful enterprises were chosen for the initial experiments. Thus there are many factors other than merger which could account for their good performance. It is often claimed that some recently created associations have not improved performance over the premerger period because they have not had time to develop concentration and specialization in their plants. Thus it is too soon to evaluate these associations.[69]

The most useful available data are comparisons of all associations with all industry (See Table 2). Assuming that the data in the table are based on two universes (all associations and all industry), then there is no sampling problem and its is justifiable to conclude that in the period 1969–72 the associations' performance was superior to overall industrial performance in these two areas. One can also test the null hypothesis that there are no differences in growth rates between associations and all of industry; then data for the four years represent a sample. Using such a test the hypothesis of equiprobable output growth rates can be rejected at the 90 percent confidence level but not at 95 percent; the hypothesis of equiprobable productivity growth can only be rejected at a 75 percent level of confidence.[70]

TABLE 2.—*Differences in growth rates of output and labor productivity between associations and all industry, 1969–72*

RATE OF GROWTH OF OUTPUT IN ALL ASSOCIATIONS—RATE OF GROWTH OF OUTPUT IN ALL INDUSTRY	
Year:	
1969	2.0
1970	.3
1971	1.8
1972	.2
RATE OF GROWTH OF LABOR PRODUCTIVITY IN ALL ASSOCIATIONS—RATE OF GROWTH OF LABOR PRODUCTIVITY IN ALL INDUSTRY	
Year:	
1969	2.0
1970	1.0
1971	1.6
1972	0

Source: Subotskii, Voprosy ekonomiki, 1974, no. 6, pp. 28–29.

The Soviet interpretation of these data shows some concern that the gap between associations and all of industry is narrowing. One explanation is exogenous events; the bad weather of 1972 curtailed supplies of raw materials to some sectors in which associations were more

[69] According to one analysis, associations formed three to five years ago show a greater superiority in performance and most of their growth is due to an increase in labor productivity. See Subotskii, Novyi etap . . ., p. 18.

[70] In the tests done $r_a - r_i$ (the difference in growth rates between associations and industry) is viewed as a random variable. The null hypothesis is: H_o: $r_a - r_i = 0$ (associations grew at the same rate as industry). If H_o is true, then the probability that $r_a - r_i$ would exceed zero for four years in a row (in the case of output growth) is .0625. The binomial distribution is used with $n = 4$ and $p = .5$ (equal chance of a positive or negative difference). Thus the null hypotheses can be rejected at $\alpha = .10$. In the case of productivity growth $r_a - r_i$ exceeds zero in only three years. The probability of this happening is .25. Here the null hypothesis can only be rejected at $\alpha = .25$. These tests are weak because they disregard the magnitude of the differences.

prominent than in industry as a whole. However, failure to make full use of (recently formed) associations' potential is also blamed.

Accounting conventions create an appearance of deteriorating performance by associations. According to one analysis, the efficiency of associations is declining if data for the past five years are examined. However, a major reason is that as an association becomes larger the number of enterprises belonging to it increases and it sells relatively less "to the outside," as compared to a group of independent enterprises. Intra-association sales are not counted in sales data. Thus new accounting procedures are needed before the true picture of associations' performance can emerge.[71]

One area of success for associations is reduction of managerial personnel in enterprises, chiefly through centralization of managerial functions. In general, the percentage of employees classified as administrative or managerial is smaller in associations than in single-plant enterprises.[72] Problems remain, however. In some associations member enterprises do not even have direct phone service with management! In such circumstances accounting and other functions cannot be centralized.[73] In general, expectations about possible reductions in managerial personnel may be too optimistic. For example, according to one Gosplan official,

> The halting of the growth of relations between enterprises, and even their considerable reduction, is possible on the basis of the planned concentration of production and the creation of production associations and combines. This makes possible a great reduction in the number of external relations by increasing relations within production associations and combines. As regards relations within the production association, their regulation does not require the creation of additional organs of management or an increase in the number of administrative personnel.[74]

The assumption that inter-enterprise relations are vastly simplified within the association is naive. Surely some additional personnel would be needed to regulate such relationships unless there was considerable slack in management before merger.

B. Decentralization of Decisionmaking

The industrial reorganization represents a movement of decision-making power to an intermediate level of the hierarchy, since associations have acquired functions previously performed by ministries as well as enterprises. Ministries and glavki have traditionally prepared detailed plans for the enterprises under their jurisdictions. Now plans are to be drawn up for associations which will in turn determine enterprise plans. Similarly, resources are allocated to the associations which distribute them among their members. Formulation of contractual relations among enterprises is also a responsibility of associations rather than higher levels. Thus associations have the right to change radically the production patterns of their members in order to develop

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[71] In. Lavrikov, "Problems of the Five-Year Plan: Formula for Efficiency," CDSP, vol. XXVIII, no. 6 (March 10, 1976), pp. 7–8; translated from Izvestia, February 10, 1976.

[72] See Alice C. Gorlin, "Management of Soviet Associations," Association for Comparative Economic Studies Bulletin, Spring 1976.

[73] I. V. Chernov and M. Khusainov, "O razvitii proizvodstvennykh ob''edinenii," Den'gi f kredit, 1973, no. 11, p. 11.

[74] N. Drogichinskii, "On Wholesale Trade in the Means of Production," Problems of Economics, vol. XVII, no. 6 (October, 1974), p. 90.

concentration, specialization and internal contracting. Ministries are freed of detailed planning and everyday supervision of enterprises, so that they can concentrate on long-term planning and formulation of a technical policy for the branch.

Associations represent a movement of decision-making power upward from enterprises, since member enterprises lose their independent status and become internal divisions of associations. Additional powers given to enterprises in the 1965 reform (reduction in the number of obligatory indicators, formation of funds in enterprises, limited powers over investment) now belong to the associations. Associations have complete freedom to plan as many indicators for their members as they wish. They can dictate the costs of individual products, the distribution of employees and the wage fund according to various categories, and other indices not usually planned for enterprises.[75] Thus from the enterprise's point of view a merger may be centralizing or decentralizing depending on the plan it receives. In the 1960's and early 1970's associations tended to draw up relatively simple plans for their members, because of the difficulty of calculating transfer prices, which are a prerequisite to calculation of profits for divisions of associations.[76]

It can of course be argued that associations represent centralization, since some decisions previously made by enterprises are now made at a higher level. However, the devolution of powers from ministries supports the opposite argument, which is more convincing because of the differences between associations and glavki. Although associations replace glavki in the industrial hierarchy, associations are more similar to enterprises than to glavki. First the typical association manages many fewer enterprises than the typical glavki. According to 1973 data on the glavki of two ministries, the number of enterprises per glavki varies from 7 to 185, whereas the typical association contains 3 or 4 enterprises.[77] Once the merger movement is completed there should be many more associations (about 12,500) than there were glavki previously (approximately 1,000). Thus the association is a relatively low, relatively small unit in the hierarchy, while the glavk is relatively high and large.

A second difference lies in how glavki and associations identify their interests. Glavki are often called departments or subdivisions of ministries. As such, they would tend to identify their interests with the ministries. Statements by association directors, on the other hand, indicate that they identify with their members; the director himself is usually the former director of one of the member enterprises. Association directors seem to have an adversary relationship with higher organs, similar to that of enterprise directors. Within the association, however, conflict is the exception. Complaints of enterprise personnel about arbitrary treatment by the association management are rarely found in the literature.

So far the association's major responsibility is enterprise planning and resource allocation. However, two other kinds of decisions have major importance; price setting and investment. In the former area

[75] Polozhenie o proizvodstvennom ob"edinenii (kombinate)," Ekonomicheskaia gazeta, 1974, no. 18, pp. 9–16.
[76] Gorlin, "Soviet Firms . . .," p. 99.
[77] Popov, ed., Funktsii i struktura, p. 150.

there is no evidence of decentralization to associations. In the latter the picture is unclear. Enterprises gained some discretion over investment in the 1965 reform, but most of it has been lost due to additional rules and regulations. Some associations have significant discretion over investment funds, although in no cases is this complete. Practice varies widely that no general conclusions can be drawn.

It must be emphasized that the associations represent decentralization in the limited sense of resource allocation at a micro level. No significant changes have occurred in resource allocation at the macro level. Investment and the supply system remain highly centralized. No markets have been introduced. So while associations can affect the allocation of resources to individual plants and products, they cannot affect the allocation of resources to their own industry or subbranch. For these reasons, the significance of the decentralization represented by mergers is limited. However, with operational matters being handled by the associations, administration should be more efficient since associations are closer to the information on which decisions must be based than ministries and glavki are. And yet, there is much anecdotal evidence of ministerial infringement on associations' rights; thus only time will tell if even the limited decentralization described is to be taken seriously.

C. Rationality of Industrial Reorganization Plans

The official explanation for inclusion of industrial reorganization plans in the Tenth Five-Year Plan is to introduce rationality into the merger process. The rationality of industrial reorganization varies from industry to industry. The coal industry's plan is praised for being carefully conceived and implemented. Already it has achieved concrete, positive results. Other industries, especially consumer goods and machine-building branches, come under criticism for their plans.

What accounts for these differences? Conditions in the coal industry seem especially well-suited to industrial reorganization. The industry's boundaries are well-defined, it produces a single, relatively homogeneous product and its technology is comparatively stable. It is also a slowly growing industry; in such an industry it is much easier to get rid of excess personnel and liquidate uneconomical production units.[78] Consumer goods industries, on the other hand, must contend with problems of many producers, many products and changing tastes. In addition, the regime is committed to a growth policy in consumer goods production, and this complicates efforts to release personnel and liquidate uneconomical production sites. Machinery branches share the problems of multiplicity of products and producers. In addition machine building is a rapidly growing sector, with complex and numerous ties to most other branches and a changing technology.[79]

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[78] The growth rate of production of coal products has declined since the 1950's: from 1951 to 1955 the average annual rate of growth was 8.4 percent, whereas by 1972 it was 2.2 percent and in 1973 was less than 2 percent. See Rush V. Greenslade and Wade E. Robertson, "Industrial Production in the USSR," Soviet Economic Prospects for the Seventies. A Compendium of Papers submitted to the Joint Economic Committee, Congress of the United States (Washington: U.S. Government Printing Office, 1973), p. 271; *Narodnoe khoziaistvo v 1973 godu*, p. 216.

[79] A suggestion to facilitate rationalization is automatic merger of all inefficient enterprises (those with costs exceeding the branch average) into associations. Without independent legal status such enterprises would have difficulty protesting shutdown or curtailed operations. See Lavrikov, op. cit.

Ministries supervising large numbers of enterprises are criticized for resistance to reduction in the number of personnel at the ministry level and for preservation of too many intermediate organs. Some of this criticism appears to reflect uncritical application of reorganization principles, such as minimization of the number of hierarchical levels. Given the desire to maintain tight control over enterprises and associations, two levels is probably unrealistic in an industry with several thousand enterprises. With more decentralization of decision making to enterprises and associations, of course, the hierarchies could be greatly simplified.

Other criticisms of industrial reorganization also reflect a rigid application of general principles. One finds the complaint that many associations are too small because they only contain two or three units. The food and meat and dairy industries are criticized because some of their associations have fewer than 500 employees; the fact that economies of scale are of less importance in these industries is not mentioned.[80] Although general principles of industrial reorganization dictate that each industry's plan must include a determination of the optimal size of an association in that industry, some of the criticism of the plans reflects a blind belief in unlimited scale economies.

Few specific guidelines for reorganization are given in the literature. One exception is a guideline on the number of subordinates a single ministry can supervise; the maximum is said to be 60 to 80 subordinates. Also, a single glavk can supervise 30 to 50 subordinates. For this reason the number of associations directly subordinate to a ministry cannot exceed 80.[81] These guidelines represent an attempt to account for span of control considerations. Without judging their rationality, it is clear that these guidelines have not been followed before or after reorganization. Some glavki administer 185 subordinates, and possibly more. And in the coal industry after its reorganization, the number of units directly subordinate to the ministry exceeds the guideline.

The Soviets have not yet formulated an overall criterion with which to judge the success of various reorganization schemes. One attempt in the theoretical literature formulates a quantitative criterion of the efficiency of the administrative organization, which is a function of administrative costs, employment in the industry, coefficients of concentration and cooperation in the industry, fixed and working capital, and net output.[82] The criterion does not make intuitive sense to this writer and furthermore has not been applied to the recent reorganization schemes.

D. Impact of Branch Approach to Reorganization

Although general directives stress that reorganization is an optimizing process, it is clear that political factors and interest group pressures play a role. An example is the frequent opposition of local governmental agencies to mergers. In the forestry industry opposition of

[80] Subotskii, Voprosy ekonomiki, 1974, no. 6, p. 30; Iu. V. Subotskii, "The Size and Structure of Associations," CDSP, vol. XXVII, no. 51 (January 21, 1976), pp. 8–9; translated from Ekonomika i organizatsiia promyshlennogo proizvodstva, 1975, no. 4 (July–August), pp. 35–42.

[81] N. K. Kalinin, ed., Organizatsiia upravleniia v sisteme ministerstva (Moscow: Moscow State University, 1974), p. 42.

[82] Kuznetsov and Tikhomirova, op. cit.

oblast (administrative unit similar in size to an American county) officials led to changes in the reorganization plan. The USSR Ministry of the Forestry Industry originally planned to form large associations containing enterprises from two or three oblasts. In response to opposition of local organs the ministry adopted another variant in which each association is confined to an oblast (and presumably is too small for efficiency).[83]

Optimization is also hindered by the branch-ministry approach. It is individual ministries which are responsible for drawing up reorganization plans for their subordinate enterprises. Ministerial boundaries are not supposed to prevent rational mergers but in practice there are no well-established procedures for ministerial cooperation, nor is there much encouragement for such cooperation.

> The associations that have been created bear the strong imprint of the pre-existing organizational forms of industrial production. They were put together primarily from compact groups of enterprises belonging to individual sub-branch chief administrations [glavki]. Little consideration was given to the possibility of including enterprises of other industrial branches in the associations or to the need to strengthen the branch and regional role of some plants in the associations and expand their service zones beyond these associations.[84]

Thus multi-branch mergers are the exception rather than the rule so far. Poor performance of some associations is blamed on failure to include enterprises of related branches. Particular attention is called to the lack of development of vertical associations, which, although they have shown their superiority in performance, are not expected to be fully developed for two or three more Five-Year Plans.[85]

An example of lack of ministerial cooperation is the failure of the USSR Ministry of the Motor Vehicle Industry and the USSR Ministry of the Electrical Equipment Industry to deal with the shortage of truck lifts and electric loaders. These ministries responded negatively to the suggestion that they discuss the formation of an association to produce internal combustion and electric loaders; they claimed merger would not be practical due to radical differences in the types of machinery used by the two ministries. They ignored the models proposed by a research institute for one- and two-ton leaders using standardized parts.[86] A western economist suggests that associations involving more than one ministry should be organized by the Council of Ministers.[87] So far the Council of Ministers has not taken such an active role, although it has vetoed proposals submitted by ministries.

Sometimes the ministry approach is a barrier to formation of associations whose members are confined to production of a single product or group of products. Autarkic behavior has created a situation in which ministries don't have jurisdiction over all the enterprises producing "their" product range. In 1973 there were 8,726 enterprises (in-

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[83] G. Popov, "Sovershenstvovanie organizatsionnoi struktury upravlenila proizvodstvom," Planovoe khoziaistvo, 1973, no. 2, p. 103.
[84] Subotskii, CDSP, vol. XXVII, no. 51, pp. 8–9.
[85] Subotskii, Novyi etap . . ., pp. 19, 35.
[86] V. Vukovich and I. Kasyukov, "Going Off in Different Directions," CDSP, vol. XXVII, no. 41 (November 5, 1975), p. 28; translated from Izvestia, October 14, 1975, p. 2. It is interesting to compare the Soviet situation with that in Hungary. There mergers of enterprises in different industries were always considered out of the question, precisely because of the ministerial system of management. See Marie Lavigne, "Economic Reforms in Eastern Europe: Ten Years After," Economic Development in the Soviet Union and Eastern Europe, vol. 1, ed., Zbigniew Fallenbuchl (New York: Praeger Publishers, 1975, p. 45.
[87] Leon Smolinski, "Towards a Socialist Corporation: Soviet Industrial Reorganization of 1973," Survey, vol. 20, no. 1 (Winter 1974), p. 34.

cluding associations) classified as belonging to light industry and 11,045 food industry enterprises.[88] But the Ministries of the Light and Food Industries had jurisdiction over approximately 3,000 and 5,000 enterprises respectively. This factor also explains why some reorganization plans leave small factories as independent units. The natural merging partners of such factories are not under the jurisdiction of the ministry.

Given that the branch approach will rule, ministries should at least reorganize all revelant enterprises, including those subordinate to other ministries and departments. But the legalities of accomplishing this are confusing. According to one legal analysis, all that is necessary to change the jurisdiction of an enterprise from one ministry to another is the consent of both ministries.[89] This has the virtue of being a simple procedure but for obvious reasons is unlikely to happen. According to another analysis the transfer of enterprises and organizations to new jurisdictions must be supported by special documents and must have Gosplan's approval.[90]

There are some small signs of a problem-oriented as opposed to an industry-oriented approach to reorganization. One example (still confined within an industry) is the coal industry's six industrial associations, each of which is oriented to a specific problem of the industry. Another example is the agricultural machinery industry, where an all-union industrial association was set up to be in charge of mechanization and automation of production processes, as well as production of tools for the industry.[91]

The industry in which the problem-oriented approach has most relevance is machine building. Some of this industry's output is used internally and some is produced for one or a few specific industries. But a significant proportion of machine building's output is of universal, industry-wide application (the Soviet term is "interbranch production"). But as of 1973 less than 5 percent of the industry's total output was produced by enterprises specialized on interbranch production.[92] There are numerous suggestions that production of these products of universal application (examples are castings, forgings, and metal parts) should be concentrated in a separate industry, where they can be produced on a more efficient scale, and where specialization and standardization may be better developed. This approach is unlikely to work if sellers' market conditions persist.

E. Manpower Implications

Dramatic reductions in administrative personnel are claimed in a number of industries. Since the claims are substantial, one would expect explicit consideration to be given to re-location of released personnel, especially employees of the liquidated glavki. The Soviet economist Katsenelinboigen estimates that glavki employees account for

[88] *Narodnoe khoziaistvo v 1973 godu*, p. 203.
[89] I. I'lin, "Pravovye voprosy razrabotki general'nykh skhem upravlenila otrasliiami promyshlennosti," Planovoe khoziaistvo, 1975, no. 5, p. 96.
[90] Golikov, op. cit., p. 38.
[91] I. Sinitsyn, "Science of Management: On the Scale of a Branch," CDSP, vol. XXVII, no. 44 (November 26, 1975), pp. 12–13; translated from Pravda, November 2, 1975, p. 2.
[92] V. Ogorodnikov, "Nekotorye ekonomicheskie problemy upravlenila otraslevoi differentsiatsiei proizvodstva v promyshlennosti," Nauchnye trudy Moskovskogo inzherno-ekonomicheskogo instituta, 1978, publication 65, p. 37.

two-thirds of the ministerial apparatus.[93] Nevertheless, for the most part the manpower problems posed by the reorganization are ignored. Although some redundant glavki employees have been transferred to associations, they have had difficulties making the transition. Their skills are not useful at the producer level.[94]

Katsenelinboigen believes that the ultimate aim of industrial reorganization is dissolution of the ministerial apparatus, with associations becoming the centers of operational, day-to-day management. However the opposite seems to be occurring, as glavki personnel are transferred to the ministries. As justification it is argued that ministries have attained greater rights and responsibilities in recent years (mainly at the expense of Gosplan) and need more specialized departments. A second argument is that associations cannot take over all the duties of the abolished glavki; ministries also will have more work to do.[95]

Soviet reformers may have been too optimistic about possible reductions in supervisory work and personnel to perform it. With most mergers restricted to a single industry, interindustry links must continue to be supervised by higher organs. Discussions of reorganization in the coal industry imply that the ministry may be overloaded with work as a result of liquidation of many intermediate units. Thus some expansion of ministries' central staffs may be justified, but some of it is doubtless related to the desire to prevent large-scale unemployment of bureaucrats with no transferable skills. Therefore claims about personnel reductions should be viewed with caution for the time being.

F. General Approach to Industrial Management

In the Soviet literature the claim is frequently made that associations, because they are able to make use of new, advanced methods of management, will be able to use the increased independence granted enterprises in the 1965 reform to greater advantage than smaller enterprises can. However, it is evident to students of the Soviet economy that the 1965 reform has been almost totally undermined. Furthermore, there is no real evidence of changes in the methods of operation and management. The literature contains frequent criticisms to the effect that some associations operate in the same way as glavki.[96]

One factor hindering the development of a new style of management is the status of association members. The majority of association members retain legal independence, although the stated intention of reorganization is that all members of associations should lose independence.[97] When association members retain their pre-merger status, the association is simply a transmission belt for communications between ministries and enterprises. Neither integration of production nor centralization of managerial functions is possible.[98] There is little scope for use of new management techniques.

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[93] Personal correspondence with Katsenelinboigen.
[94] L. Zhmyrov and V. Parfenov, "The Science of Management: Three Levels," CDSP, vol. XXV, no. 19 (June 6, 1973), pp. 4, 27; translated from Pravda, May 13, 1973, p. 3.
[95] I. Il'in, "Proizvodstvennoe ob"edinenie- osnovnoe zveno promyshlennosti," Planovoe khoziaistvo, 1974, no. 9, p. 78.
[96] Ibid., p. 79.
[97] V. V. Dementsev, "The Financial Mechanism of Associations," CDSP, vol. XXVII, no. 45 (December 3, 1975), p. 19; translated from Ekonomicheskaia gazeta, 1975, no. 25, p. 8.
[98] Subotskii, Novyi etap . . ., p. 61.

VI. Conclusion

A major theme throughout this paper has been the ability of the Soviet institutional structure itself to block attempts at simplification. The Soviet system is trying to defeat the reform, as it has successfully done before. In spite of these efforts reorganization plans have been formulated and to some extent implemented. But a lack of full commitment is reflected in some plans; merger patterns often do not make sense economically and little guidance in the form of operational principles is provided. This is also a consequence of the traditional lack of interest in administrative science. In such circumstances many mergers represent experiments; if the merged enterprises are unable to achieve true integration then they will be liquidated and other merger patterns will be tested.

In spite of these problems, industrial reorganization has already had positive results. Performance of associations is somewhat better than overall industrial performance, although the gap is narrowing. Superior performance of associations is attributed to development of concentration and specialization, as well as centralization of managerial functions. These accomplishments depend on initiative being exercised within the associations, and here performance is very uneven. It is clear that many associations represent integration in a formal, not real, sense. Genuine integration requires time; several years of accumulated experience will give a fuller picture of associations' accomplishments.

Significant and perhaps even extravagant claims have been made about personnel reductions at higher levels of the industrial hierarchies. It is clear that the Soviet leaders would not countenance large-scale unemployment of bureaucrats. Without knowledge of relocation of displaced personnel, the claims of personnel reductions must be viewed with caution. There is a need for large-scale retraining programs to qualify these people for management or production jobs in associations.

Elimination of duplication and increased concentration and specialization are for the most part one-time gains, which have short-run payoffs in terms of performance improvements. Continuous performance improvements require a new style of management. Currently in the Soviet Union there is a high degree of interest in western management science but little evidence of application at the enterprise (association) level. A major obstacle is lack of knowledge on the part of managers. This may prove to be a more serious drawback than it was when most managers were in charge of single-plant enterprises. With large associations at the base of the industrial structure, there are greater possibilities and also greater need for sophisticated management techniques.

Were Soviet managers and displaced bureaucrats trained in modern management techniques, their attitudes toward their roles would probably change. At present both industrial and production associations are criticized for operating like glavki. It is clear that mergers alone will not eliminate this bureaucratic style of management. Other problems associations will not solve include autarky, incompatibility of incentives at various levels and neglect of regional development. Their solution requires more profound changes in the operation of the economy.

Some western scholars see political implications in the merger movement.

> . . . in the process of the formation of associations, changes have occurred in the constellations of leading functionaries.[99]

In this interpretatiton the ministries are seen as the main losers; the expansion of ministries' staffs discussed earlier is an attempt to avoid losing power. Other potential losers are local Party and government officials and this explains their opposition to large associations. More time is needed for the political implications to become clear.

There is also a possible relationship between industrial reorganization and the international situation. The primary example is the Kama truck complex, which has the status of an association. Because construction at Kama involves much western equipment and technology, its director has been given wide discretion in negotiating with western firms.[100] Thus associations in high priority industries which have important commercial contacts with the west may come to represent a greater degree of decentralization than the ordinary association. In traditional, low priority industries multi-stage hierarchies will continue to be common and little will change. Again only time will tell if this is a realistic scenario.

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[99] The Soviet Union 1973, Domestic Policy, Economics, Foreign Policy (London: C. Hurst, 1975), p. 60.

[100] Herbert E. Meyer, "A Plant that Could Change the Shape of Soviet Industry," Fortune, November 1974, pp. 150–156, 229–232.

SOVIET ECONOMIC AID TO THE THIRD WORLD

ORAH COOPER

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I. INTRODUCTION

The U.S.S.R. has pledged $11 billion of economic assistance to the Third World since 1954 in a program that has reflected Soviet foreign policy interests and has responded to aid opportunities in target areas throughout the world. (See Table 1.) A narrow band of nations, extending from the Mediterranean to China's southwestern borders, have received 80 percent of the aid. The remainder has gone, in small amounts to 40 Less Developed Countries (LDCs) on almost every continent, irrespective of their political persuasions. Sub-Saharan Africa received only 8 percent of the Soviet aid total; Latin America little more than 5 percent. (See Figure 1.)

Despite year to year fluctuations in pledges, the character of Soviet aid and its focus have changed little throughout its 22-year history. Aid remains a political-economic instrument to influence and gain entree into strategically located areas and to develop markets and sources of supply for goods needed in the USSR.

(*a*) From the beginning, Soviet economic aid has focused on a few countries—mostly in the Near East and South Asia. India, Egypt, Afghanistan, and Turkey have been the most favored nations, followed by Iran, Pakistan, Iraq, Algeria, and Syria. The select roster has varied only slightly since the mid-60s, except for the addition in 1967 of Turkey—a nation on the U.S.S.R.'s border and thus well within the area of Soviet strategic interest.

(*b*) Aid has been allocated largely to highly visible heavy industrial projects for public sector development. Heavy industry has accounted for about three-fourths of total Soviet aid, a third for steel mills alone. Another 10 percent has gone for multi-purpose dams, irrigation projects, and hydro power facilities.

(*c*) Almost without exception, Soviet aid is tied to Soviet equipment purchases. Rarely are commodities or hard currency provided; at the end of 1975 Moscow had allocated only about $750 million of its aid to these categories.

(*d*) The Soviets have given about 5 percent of their aid as outright grants; most of the remainder has been under credits that require repayment over 12 years at 2½ percent to 3 percent interest. Since 1964, however, some Soviet credits have required a 10 percent to 15 percent downpayment, repayment over 5–10 years, and higher interest rates.

II. The Record: 1954–75

Soviet aid, a Khrushchev creation, was associated throughout the Khrushchev era (1954–64) with large unallocated "umbrella" credits for showy, public sector projects. The U.S.S.R. sought prestige for itself while it penetrated newly independent states that it hoped would take the non-capitalist path to development. About $3.4 billion of aid was committed in this period and $1.6 billion was delivered. The flamboyance of the offers was sobered by the realities of implementation, and early in the 1960s the Soviet Bureaucracy began to question the effectiveness of the program as an instrument of penetration.

Following Khrushchev's fall from power, the Kremlin adopted more conservative policies to improve its implementation record abroad and to mesh the aid program more closely with domestic economic plans. Commitments [1] were made only after careful study and protracted negotiations to make certain that funds were used for viable projects. Repayment terms were less uniform than before and depended more often on the kind of aid given. On the average, they were harder. Nevertheless, commitments in the second decade of the program were more than double those in the first decade. Conservative aid policies also led to heavier geographic concentration of offerings, with an even more pronounced emphasis on the Near East and South Asia.

Despite the cautious approach, more than three-fourths of total Soviet aid has been extended in the post Khrushchev era. Erratic year to year patterns have not affected the distinctly upward movement of commitments. Average annual pledges rose from $310 million in the first half of the program (1954–64) to $677 million in the second half (1965–75). Aid reached a new annual high when more than $1 billion was extended for the first time in 1966. Commitments exceeding $1 billion were repeated in 1971 and 1975. In each of these peak years, a few countries accounted for at least $1 billion of the total commitment: India, Iran, and Syria in 1966; Egypt, Iraq, Pakistan, and Algeria in 1971; and Turkey and Afghanistan in 1975.

Deliveries [2] have lagged commitments by about 7 years, on the average. The poor record stems mostly from: Administrative problems in both the U.S.S.R. and the LDCs; Long lead times required for Moscow's heavy industrial project assistance; The failure of Moscow to provide adequate amounts of commodities and balance of payments aid to increase procurement flexibility and fund local costs; and The

[1] Commitments and extensions are used interchangeably to denote the initialing of accords that constitute a formal declaration of intent to give aid on deferred payment terms or as grants.

[2] Deliveries and drawings are used interchangeably to denote the delivery of goods or the use of services.

dearth of human and natural resources in LDCs for carrying out their share of the program.

From the beginning, Moscow has provided extensive technical assistance to overcome the lack of local skills for implementing and operating aid projects. By 1975, the number of Soviet technicians in LDCs had risen to almost 18,000, double the number present a decade before. They were concentrated in countries where major Soviet aid programs were underway. Iran had the largest number in 1975, followed by Algeria, Iraq, and Egypt. Moscow had also trained about 23,000 technical personnel in the Soviet Union by the end of the 1975, in addition to the 450,000 trained on-the-job in the LDCs.

Less than $6 billion of Soviet aid had been delivered by the end of 1975, about 55 percent of the U.S.S.R.'s total commitments. The continuous growth pattern of the early years was not sustained, and deliveries levelled off after 1964, although at a higher level than before—$395 million a year, compared with an average of $140 million in 1954–64. India's importance in the program fell off after 1969. By 1972 its annual aid receipts had dropped by $100 million from the 1964 peak. Except for 1974–75 (when emergency wheat deliveries were made) aid deliveries to India have not recovered. Cyclical delivery patterns to large industrial projects have caused wide fluctuations in receipts by other major clients.

III. A Broader Program

In recent accords, Moscow has tried to allow greater latitude for its own economic plan by reducing specific commitments to long-range LDC programs. The U.S.S.R. hopes that flexible credit arrangements will expand its aid options while still offering LDCs assurance of future aid. About 40 percent of Soviet aid in 1974–75 was provided under "framework" agreements—agreements in principle to provide long-term project assistance. Follow-on negotiations will define the extent and character of the aid and set credit terms for each project or parts of projects. These credits are a compromise between early concessional umbrella credits and later specific project allocations which often carried harder terms. In 1974–75 Moscow signed framework agreements with Argentina, Indonesia, and Turkey, whose total value could reach $1 billion when final project allocations are made.

Soviet aid reached a 3-year high in 1973–75, with 1975 a record for a single year. The $2.5 billion extended in the 3-year period was almost a fourth of Moscow's 22-year aid total. A few large credits in each of the years to established clients—mostly for industrial programs already underway—were responsible for the record total. More than before, aid was concentrated in the Near East and South Asia, these countries receiving 90 percent of the total.

Pledges in 1975 included two of the largest aid commitments Moscow had ever made to an LDC: Afghanistan retained third place on the Soviet aid roster, with a $437 million credit, and Turkey moved from seventh to fourth place, with aid that eventually will total at least $650 million. Small credits also went to Bangladesh and Sri Lanka. Somalia, a continuing Soviet target and the only major African recipient in 1975, received its largest Soviet credit ($60 million).

Moscow's 1974 pledges were heavily weighted by a follow-on allocation of $216 million to the steel mill in Pakistan and $100 million to Syria for completing the Euphrates Dam and other projects. Soviet interest in selling power equipment to Latin America and correcting a large trade imbalance with Argentina resulted in open-ended credits to Argentina on which 1974 orders amounted to $200 million; they may eventually reach as much as $600 million. More than 80 percent of Moscow's $657 million of 1973 aid went to two countries—to Iran for expanding the Soviet built steel mill at Esfahan and to India for $350 million worth of grain. The U.S.S.R. also gave Pakistan $70 million of aid, partly to replace previously cancelled credits. Moscow's agreement to provide New Delhi with 2 million tons of grain was the most dramatic of its aid offerings in 1973. Despite relatively hard terms (five years to repay, after a 2-year grace period, and no interest) the grain supplied India is the largest amount of commodity assistance the U.S.S.R. has ever offered to a less developed country; it came in a year characterized by world-wide grain shortages.

IV. Spin-off of Soviet Aid

Closer Soviet economic ties with the Third World—an important underpinning of Moscow's foreign policy—often have been established and consolidated through the aid program. The growth in Soviet-LDC trade relations, for example, is one of the most important corollaries of Moscow's economic assistance program. Soviet aid was at first directly responsible for the sharp rise in trade with LDCs and now indirectly responsible for its continued growth. The U.S.S.R. has found aid recipients to be important capital goods markets and supplementary suppliers of raw materials and consumer goods. In the early years of the program, the rate of export growth on current account slackened while aid exports grew rapidly. Aid repayments have affected Soviet imports only marginally; in 1973–74 they accounted for about 10 percent of Soviet imports from LDCs.

By 1964 aid deliveries were almost half of Soviet exports to LDCs, falling off to a quarter of the total by 1973–74. Moscow's largest aid clients have become its major LDC trading partners. Egypt, India, Iran, and Iraq together accounted for more than half of Soviet 1973–74 trade with the Third World. Countries in the Near East and South Asia were largely responsible for the almost 100 percent increase in Soviet-LDC trade between 1972 and 1974.

Several new avenues of cooperation have grown out of improved Soviet-LDC economic relations established through the aid program. These include (a) Moscow's acceptance of its first development aid from an LDC in 1975, a credit from Iran for a paper plant. (b) Soviet sponsorship of multilateralization of some aid undertakings, (c) participation in an increasing number of intergovernmental commissions, and (d) Soviet joint-ownership ventures with LDCs.

In recent years, the U.S.S.R. has tried to portray the Council of Economic Assistance (CEMA), as a viable international economic entity, open to all interested nations. A one billion "transferable ruble" fund, which became operative 1 January 1974, was set up within CEMA's International Investment Bank (IIB) for economic and

technical assistance to LDCs. In 1975, CEMA signed general economic cooperation agreements with Iraq and Mexico—its first with the Third World.

Also as an outgrowth of the aid program, the U.S.S.R has ventured into joint ownership with LDCs. Thus far these ventures have been mostly in fishing, shipping, and trading companies. Joint ownership also has grown out of border project development, such as dams for hydro power and irrigation work. In several cases, Moscow has joined with LDC partners (especially India) to establish enterprises in third countries.

Closer economic relations have developed through intergovernmental commissions that review and coordinate Soviet-LDC aid. These commissions, established with all major LDC aid clients, are administrative bodies charged with responsibility for accelerating project activity by better synchronizing aid deliveries with Soviet production schedules. They also review LDC long term aid programs in relation to Soviet domestic plans.

V. The Aid Balance

Repayment obligations for Soviet aid equalled about 40 percent of the USSR's 1954–75 deliveries, 30 percent if only payments on principal are included. In the face of relatively stable deliveries and rapidly rising repayments of principal and interest, net aid to LDCs has narrowed significantly. (See Figure 2.) Repayments of principal and interest in 1975 were twice the 1969 level, or $300 million. Meanwhile, aid drawings rose less than 20 percent, resulting in a net aid transfer to LDCs in 1975 of only about $100 million. This compares with $225 million in 1969. Major long-time aid recipients are already feeling the pinch. In 1975, India and Egypt paid more for servicing their aid debt to the U.S.S.R. than they received as aid. The negative aid flow to India has persisted since 1969. Iran and Iraq in 1975 also approached zero aid.

Soviet aid has never competed on a global scale; it represents only about 1 percent of total official annual aid flows to the LDCs. The U.S.S.R. has contributed less than 0.05 percent of its GNP for aid, compared with an average of about 0.3 percent for Western industrial countries. The impact of Moscow's small program has been maximized, however, because of its focus on a few countries and its emphasis on showy industrial projects. In fact, because of this emphasis, Soviet aid has in some cases gained a competitive edge not warranted by its size.

Moscow is looked to by some countries as an important source of aid. For example, until recently when OPEC aid was made available, Afghanistan's development program was tied largely to Soviet aid. In several instances when the U.S.S.R. jumped in with aid offers for major installations turned down by other donors, Moscow gained extra prestige. The Aswan Dam in Egypt is the classic example; others include the Bokaro steel mill in India and the Esfahan steel mill in Iran. Moscow scored in some countries by helping to develop public sector industrial complexes: In Egypt and India, it contributed importantly to publicly-owned heavy industrial plant capacity; Moscow was responsible for developing national oil industries in Syria and Iraq and for national gas industries in Iran and Afghanistan. Moscow's terms,

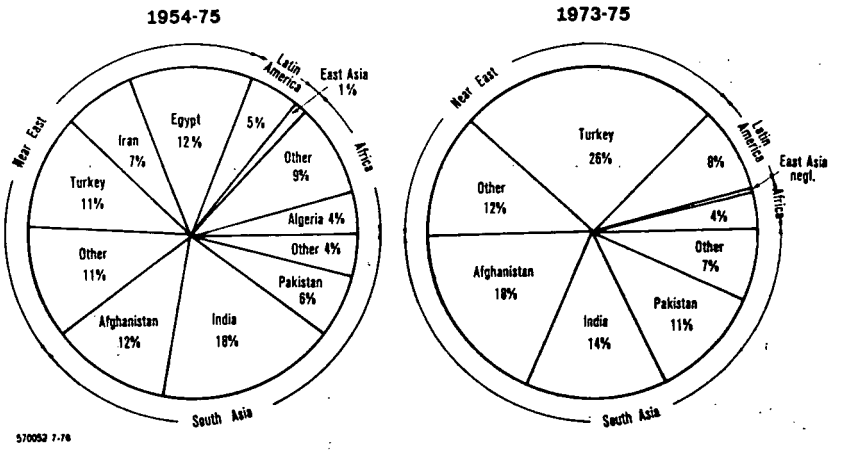
which usually allow repayment in goods, also gave the program preferred status for some countries short of foreign exchange whose goods might not be saleable elsewhere. For some less developed countries the USSR will continue as an important source of aid. Despite occasional setbacks, the small Soviet aid program continues to provide the U.S.S.R. some economic returns and in a few cases important political dividends.

TABLE 1.—SOVIET ECONOMIC CREDITS AND GRANTS EXTENDED TO LESS DEVELOPED COUNTRIES 1954–75 AND 1973, 1974, AND 1975

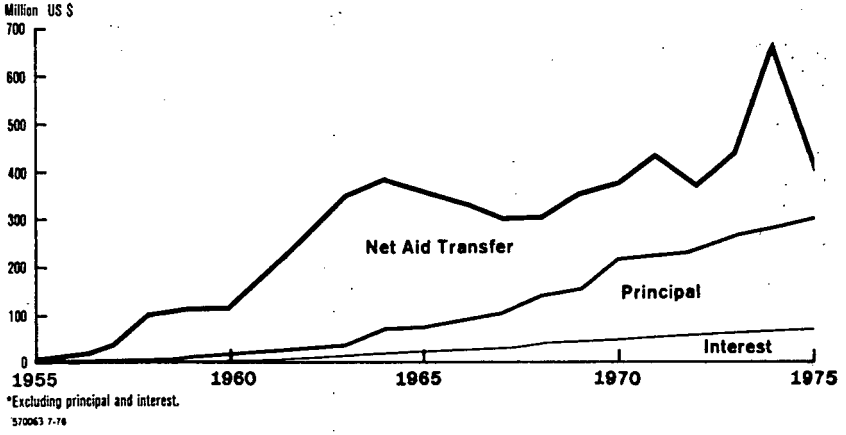
[In millions of U.S. Dollars]

	1954–75	1973	1974	1975
Total	10,859	657	575	1,264
Africa	1,435	10	17	73
Algeria	425			
Cameroon	8			
Central African Republic	2			
Chad	10	1		9
Congo	14	4		
Equatorial Guinea	1			
Ethiopia	104		1	1
Ghana	93			
Guinea	200		2	
Guinea Bissau	1			1
Kenya	48			
Mali	86		12	
Mauritania	4	1		
Morocco	98			
Niger	2	1	1	
Nigeria	7			
Rwanda	1	1		
Senegal	9	1	1	
Sierra Leone	28			
Somalia	153			62
Sudan	64			
Tanzania	20			
Tunisia	34			
Uganda	16			
Upper Volta	1	1		
Zambia	6			
East Asia	156	1		1
Burma	16	1		
Cambodia	25			
Indonesia	114			
Laos	1			1
Latin America	602		209	
Argentina	245		200	
Bolivia	31		1	
Brazil	30			
Chile	238			
Colombia	10		8	
Peru	28			
Uruguay	20			
Near East and South Asia	8,666	646	349	1,190
Afghanistan	1,263			437
Bangladesh	300	35	28	46
Egypt	1,300			
Greece	84			
India	1,943	350		
Iran	750	188		
Iraq	549			
Nepal	20			
Pakistan	652	71	216	
Sri Lanka	95			57
Syria	417		100	
Turkey	1,180			650
Yemen (Aden)	15	1		
Yemen (Sana)	98	1	5	

Soviet Economic Aid Extended to LDCs, by Recipient Figure 1



Net Transfer* of Soviet Economic Aid to LDCs Figure 2



Sources: *Soviet Economic Aid to LDCs.*—The detailed information on Soviet foreign aid contained in this study is drawn from numerous official and non-official publications available to the public. A primary source for data concerning the Soviet program in the LDCs—aid extensions, drawings on credits, and technical assistance—is the annual reviews of the Communist aid programs published by the Bureau of Intelligence and Research of the U.S. Department of State. The most

recent of the series, "Communist States and Developing Countries: Aid and Trade in 1974," was published in January 1976.

Official publications, journals, and newspapers from LDCs and the USSR also have been invaluable sources, particularly the USSR Ministry of Foreign Trade's foreign trade yearbook series and monthly foreign trade magazine. Other useful sources include publications of the United Nations and the Organization for Economic Cooperation and Development.

ASSESSMENT OF ALTERNATIVE LONG-RANGE SOVIET GROWTH STRATEGIES*

HOLLAND HUNTER, M. MARK EARLE, JR., AND RICHARD B. FOSTER

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I. THE STRATEGIC FRAMEWORK

This essay examines Soviet economic growth prospects over the next fifteen years, taking account of variation in both domestic and external conditions. Some of the possible broad political and military implications are touched on here and in our concluding section. We note initially that the status of the USSR as a superpower has been confirmed by their acquisition of rough nuclear parity with the United States. Recent external developments in Southeast Asia and the Middle East have dramatized the interaction of economic, political, and military aspects of rivalry between the USSR and the United States.

*This analysis makes use of the SRI–WEFA macroeconometric model of the Soviet economy designed by Donald W. Green and Christopher Higgins with the advice of Lawrence R. Klein, Herbert S. Levine and Ross S. Preston. The experiments were conducted by Raymond Kuo Fung Chien under Dr. Green's direction. Valuable help has also come from Charles Movit, Anne Lieberman, and Janet Andres. The usual asymmetries prevail; sound and persuasive aspects of the analysis should be credited to them while errors should be debited to the authors' account.

In particular, the October 1973 Arab-Israeli war, with the consequent oil embargo and the strengthening of OPEC to impose a producer price and output cartel, brought the political, military, and economic spheres into a single web of policy interactions: once again international economics is high policy.

The Soviet leadership has joined with two U.S. administrations in seeking to prevent all-out nuclear war through SALT and other agreements. Yet no agreements have been reached regarding limitations on conventional arms transfers and military forces. The recent victory of the MPLA in Angola, supported by Soviet-transferred arms and Cuban troops in 1976, gave further emphasis to the reach of Soviet influence through the indirect use of their conventional military power. The long-term competition in the ideological, political, sociological and economic spheres continues unabated. The Soviet leadership has shown considerable confidence in its ability to sustain such competition over the long term and has shown no interest in moderating the ideological conflicts. The idea of convergence of the two political-social-economic systems is regarded as heresy in the Communist Party of the Soviet Union, and they seem confident that they will prevail over the West in the long-term competition.

This long-term Soviet-American competition involves the complex interactions of numerous political, social, ideological, military, and economic factors.[1] Within the competition, the economic factor is particularly important because it broadly affects the capability of the two systems to implement their policies in the world arena. Thus, the West has an unquestioned interest in evaluating the degree to which each system can provide a high material standard of living for its citizens.

Unlike the Western profit-motive system, the Soviet system is directed by political criteria in setting its goals. Decisions regarding military buildup and allocation of economic resources, for example, are more a function of state power considerations than they are of economic considerations.[2] Given this more sweeping range of choice in decisionmaking, the Soviet command economy might be thought to have a potential advantage over the U.S. in the competition between the two countries.

In fact, however, Soviet authorities are tightly constrained in their choices among basic alternatives. Land, labor, capital, and system wide productivity are all under great pressure, even though input productivities are generally far below Western levels. This systemic inadequacy was exacerbated by the crop failure of 1975, which forced the USSR to make emergency foreign grain purchases, thereby diverting a large part of their hard currency reserves from the importation of highly productive Western machinery and technology. The downward impact on Soviet growth rates was significant but temporary.

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[1] Far more than Westerners, Soviet scholars are disposed to take a holistic view of the competition between the two systems. As the authoritative party theoretical journal has noted, "specific problems are not examined and solved in isolation from other problems, but in a complex manner—taking into account their multifaceted links and mutual dependence, and the possibilities of their development today and in the future." ("The Effective Force of the Leninist Principles of Party Leadership," Kommunist. No. 16 (November 1974), p. 6.)

[2] For example, commenting on the importance of "state power," one Soviet spokesman has remarked that the struggle between the two systems will be determined "by the interaction of the sum total of the elements constituting the actual power of the state: economic, political, social, and spiritual. (N. Lebedev, "On the Class Character of Peaceful Coexistence," Kommunist, No. 4 (March 1975), p. 57.)

Another complex area involves Soviet relations with the present market-oriented international economic order. In the last decade Soviet participation in the world market has greatly increased. The USSR can now have a marked impact in particular commodity markets (e.g., the world grain market), while at the same time the USSR is less insulated than before from external developments (e.g., recent Soviet export difficulties during the Western economic recession).

Soviet actions in conjunction with the Arab oil embargo of 1973 indicate a disposition to use the economic weapon to attain political advantage, given a favorable situation. Thus, growing U.S. dependence on foreign sources for oil and critical raw materials, as well as foreign dependence on U.S. agricultural exports create an interdependence, which will increasingly open the American economy to possible Soviet manipulation.

Such factors require the U.S. to have better understanding of the nature of the economic competition with the Soviet Union. To this end, our essay sketches four alternative economic situations for the next 15 years. It must be recognized that these scenarios are only a first approximation of the more detailed and realistic scenarios around specific issues that are now being formulated using the SRI/WEFA Soviet econometric model. Others will include examination of food and agricultural production, the energy situation, international trade relations, etc. At the end of this paper we note a series of fundamental strategic and foreign policy issues on which this kind of research can shed useful light.

II. Soviet Economic Policy Guidelines

Soviet economic policy has long been concerned with squeezing out the maximum flow of production from existing stocks of labor and capital. Output targets have always been predicated on higher labor and capital productivity than currently prevails, in hopes that pressure and exhortation will spur productivity increases. In recent years the policy stress on raising input productivity has grown steadily more urgent. Additions to the labor force are now less easily available, while additions to the capital stock have become less productive than they once were.

The most authoritative recent statement of Soviet economic policy runs in part as follows:[3]

> The Party's economic strategy begins with the posing of tasks and the identification of fundamental long-range goals. The highest of these goals has been and remains a steady rise in the people's material and cultural living standard. Economic strategy also includes the precise determination of means, of the paths that lead to the set goals. These means are the dynamic and proportional development of social production, an increase in its efficiency, the acceleration of scientific and technical progress, the growth of labor productivity and an all-round improvement in the quality of work in all units of the national economy. * * *
>
> The essence of the Party's economic strategy, permeating both the tenth five-year plan and the long-term plan, is a further buildup of the country's economic might, the expansion and fundamental renewal of production assets, and the insuring of stable, balanced growth for heavy industry—the foundation of the economy. * * *

[3] Leonid I. Brezhnev, Pravda, February 25, 1976. See Current Digest of the Soviet Press, Vol. XXVIII, No. 8 (March 24, 1976), pp. 16–17.

These remarks of General Secretary Brezhnev in his report for the Central Committee to the 25th Party Congress continue the orthodox tradition, even to putting consumer welfare as the primary goal, while focussing on continued growth of heavy industry as the means for reaching that goal. His theme was subsequently amplified by a Central Committee official in an article on "The Economic Strategy of the Party," which said in part:[4]

> The most important element in the Party's economic strategy is raising the effectiveness of production and the quality of work in all sectors of the economy. To improve the effectiveness of social production to the greatest extent possible is the fundamental economic policy of the Party; the successful fulfillment of our social-economic program, not only in the tenth Five-Year plan, but also in a long-term perspective, depends on the resolution of this key problem. * * *
>
> Today, raising the effectiveness of all social production is an objective necessity. This is especially important if such factors as the substantial aggravation in the 1980s of problems of labor resources, the opening up of new deposits of minerals in remote regions of the country for fuller satisfaction of the need for metal, fuel, and other resources, and the growth of expenditures for the protection of the environment, are taken into account.

Our main purpose in this essay is to throw some light on the ability of the present Soviet economy to draw on technological progress and improved productivity in order to make rapid progress toward these goals.

For almost a decade, the Soviet leadership has recognized a need to reduce the lag between Soviet technology and the more advanced methods employed in industry, agriculture, and other sectors of advanced Western economies. There has been a great drive to "master the advanced achievements of world science," and the volume of Soviet imports of high-technology plants and equipment from the West has risen very rapidly. Soviet leaders hope that imported plant and equipment embodying advanced Western technology will permit rapid growth of selected key outputs, raise the productivity of labor and capital, and provide spinoff examples that can spread widely throughout the Soviet economy.[5] This has been a principal purpose of Soviet foreign trade in recent years, along with an interest in improving the Soviet standard of living through importing consumer goods of types and qualities not available domestically.

Evidence is already available indicating that imported Western machinery can contribute substantially toward improving the performance of particular lines of industry. Where new advanced equipment has been installed and surrounding conditions have been favorable, broad econometric evidence indicates that capital productivity has risen markedly.[6] Results to date have been limited, however, to a few branches of heavy industry. Our second question in this essay will be to consider the prospects for the whole Soviet economy if the foreign trade sector is used as a channel through which technological progress can reach a broad range of economic activities.

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[4] See B. I. Gostev in Ekonomicheskaia Gazeta, April -976, No. 14, pp. 3–4.

[5] John P. Hardt, "The Role of Western Technology in Soviet Economic Plans" presented to NATO Directorate of Economic Affairs Colloquium on "East West Technological Cooperation," Brussels, 17–19 March, 1976, publication forthcoming.

[6] Donald W. Green and Herbert S. Levine, Implications of Technology Transfers for the USSR, Stanford Research Institute-Wharton Econometric Forecasting Associates' Soviet Econometric Model Project Working Paper No. 2, April, 1976.

Our third task is to look briefly at the relation between Soviet output growth and Soviet defense expenditures. In a reference to USSR-US talks on the further limitation of strategic arms, Secretary Brezhnev noted at the 25th Congress that, if limitations could be implemented ". . . both sides would receive an opportunity to save substantial sums of money and to use this money for productive purposes, for improving people's lives." Estimates of these potential savings are hard to make, given Soviet secrecy concerning military matters, but where changes in trend are at issue, even rough approximations can be informative. In some of the tests reported below, growth rates for Soviet defense expenditures are varied in order to indicate the nature of their impact on the surrounding economy.

III. The Model

The basis for our analysis is a macroeconometric model of the Soviet economy, fitted to its actual behavior over the last twenty years and adapted to carry its existing trends into the future. The model computes consistent annual estimates for income and product in real and monetary terms, providing substantial detail as to sector of origin and final end uses. It covers industry (sub-divided into 12 branches), agriculture, transportation and communications, construction, trade, and services (including government). The version employed for this essay is a very serviceable instrument for indicating trends but in two respects it must be interpreted with great caution. It was decided in building SOVMOD initially that the equations dealing with Soviet imports and exports should relate them to domestic supplies and prices (as well as to external phenomena), but not to domestic investment, in view of the intricate time lags involved. This means that the direct influence of changes in Soviet external trade on domestic Soviet investment is underestimated in the present version of the model. Subsequent revisions of SOVMOD will extend the foreign trade specification to include domestic investment.

The second caveat concerns the coverage of national defense. In the initial design of SOVMOD it was decided, in view of the competing methodologies for estimating defense outlays and a lack of firm evidence, to limit their treatment to using a readily available series for estimated outlays on military pay and allowances, plus the official series for defense in the budget. What results is a narrow measure of the defense claim on resources. Using this as the initial coverage for combination with the other national income aggregates, detailed relations between defense and industry were not estimated for this version of the model. Currently, SOVMOD is being respecified to enhance the treatment of the defense component. Moreover, the sample period estimates for the initial defense expenditure series are out of date. Recently, U.S. government estimates of Soviet defense expenditures have been substantially increased, reflecting in large part the impact of new ruble-dollar conversion ratios. This means that the current model understates the influence of changes in national defense outlays on the rest of the Soviet economy.

IV. The Baseline Projection

Our examination of the prospects for the 1980s builds on the projection for the latter half of the 1970s contained in the Green-Guill-Levine-Miovic paper in this volume. The assumptions and adjustments they have used continue to apply during the first five years of this projection. The economy adjusts to the bad harvest of 1975 and is more or less back on trend by 1980. Output levels in the terminal year of the tenth five-year plan are close to plan targets, while input use and labor productivity targets are generally met.

As the Soviet economy goes through the 1980s, the baseline projection ("Control Solution") shows output growth slowing down. The average annual growth rate for GNP during the second half of the 1970s is 4.6 percent; from 1980 to 1985, the average annual growth rate drops to 3.9 percent, and in the latter half of the decade it falls further to 3.2 percent (see Table 1). This declining rate of output growth harms consumers, whose share of the GNP falls from 57 percent to 55 percent and whose aggregate consumption grows in the second half of the 1980s at only 2.4 percent compared to 4.5 percent annually in the late 1970s. Consumers are residual claimants in the Soviet system, coming after national defense and heavy industry in their claim on resources. The design of SOVMOD accurately reflects these priorities and they are embedded in the baseline projection. The share of investment in GNP, by contrast, increases from 25 percent to over 26 percent, and the average annual rate of growth of investment outlays rises from 4.1 percent to 4.7 percent.

These output trends reflect a number of powerful underlying forces at work, especially the growing shortage of labor described in the paper by Feshbach and Rapawy in this volume. In agriculture, the labor force falls absolutely by some 4 million people and, though urban employment continues to grow, the expansion in the labor supply over the 15 years after 1975 is modest compared to the large increments that have supported earlier Soviet economic expansion. Tightness in the labor market results not only from a slow growth rate for total population, but also from a lower participation rate, in both agriculture and industry, over the next 15 years compared with the recent past, as shown in Table 2.

Our projection for agriculture assumes a normal sequence of good and bad weather, together with a stabilization of the ratio between actual and potential grain harvests at the favorable ratio of .9. Even under these conditions, there is very little growth in agricultural production during the 1980s. The shrinkage in the agricultural labor force is not offset sufficiently by improved efficiency, which means that in spite of the regime's intentions, the agricultural sector continues to lag behind the rest of the economy.

Our baseline projection assumes that Soviet economic relations with the outside world continue in their present form over the next 15 years. Under these assumptions, Soviet imports and exports expand smoothly along the lines that have developed in the last decade. We assume a constant level of Soviet grain imports from the West, placed at $1 billion per year. Further details are set forth for the period to 1980 in the paper by D. W. Green, *et al*, in this volume; precise projections for the 1980s would require intricate research going beyond the units of this essay.

TABLE 1.—BASELINE PROJECTION FOR MAJOR END USES OF GNP, U.S.S.R., SELECTED YEARS, 1975–90

[In billions of rubles at 1970 prices]

Year	Consumption [1]	Investment	Other uses [2]	Total GNP
1975	252.9	110.5	77.7	441.1
1980	315.6	135.4	104.1	555.1
1985	383.4	165.1	118.0	666.5
1990	432.7	208.0	141.4	782.1
Percent shares:				
1975	57.3	25.1	17.6	100
1980	56.9	24.4	18.7	100
1985	57.5	24.8	17.7	100
1990	55.3	26.6	18.1	100
Average annual growth rates:				
1975–80	4.5	4.1	6.0	4.7
1980–85	4.0	4.0	2.5	3.7
1985–90	2.4	4.7	3.7	3.3

[1] Civilian consumption.
[2] Includes capital repairs, State expenditures, (on education, health, "official defense," etc.), inventory change, net exports, military pay and allowances, and other miscellaneous end-use categories.

TABLE 2.—RURAL AND URBAN EMPLOYMENT IN THE U.S.S.R., SELECTED YEARS, 1975–90

[In millions of people]

	1975	1980	1985	1990
Urban employment	91.9	95.6	100.8	105.5
Rural employment	36.8	34.6	33.1	32.5
Total employment	128.7	130.2	133.9	138.0
Non-agricultural participation rate (percent)[1]	58.9	56.8	55.8	54.6
Agricultural participation rate (percent)[2]	36.9	34.7	33.0	32.5
Total able-bodied participation rate (percent)[3]	89.1	83.9	84.6	85.7

[1] Ratio of total nonagricultural employment to urban population.
[2] Ratio of total agricultural employment to rural population.
[3] Ratio of total employment to total able-bodied population.

V. Four Alternative Frameworks For Growth

Soviet economic expansion can easily deviate from the baseline projection if domestic and external conditions over the next 15 years change markedly. In order to provide a general impression of how the economy might respond, this section presents four alternatives, not as forecasts but as computations illustrating hypothetical possibilities. The dimensions of change seem modest, but in fact, sustained cumulative changes of the indicated magnitude represent substantial changes in trend. Even if the reader is prepared to contemplate more drastic shifts, the computations below will suggest relations that could be extrapolated. Four logical combinations of domestic and external economic conditions are examined, beginning with the case in which both are more favorable than in the baseline case.

A. Easy Conditions, Both Domestic and External

Since Soviet hopes and intentions for the next 15 years center on raising the rate of technological progress throughout the economy and improving the efficiency of the agricultural sector, the first of our alternative projections tests the impact of making generous allowances for success in both respects. We insert a parameter for technological progress in all producing sectors, including agriculture, and let it

improve productive effectiveness at the rate of 2 percent per year beyond what is already in the baseline production functions. For agriculture, in addition, we adjust upward the ratio of actual grain harvests to peak grain harvests from .9 to 1.0, thus giving an additional boost to agricultural effectiveness. Since the agricultural sector has a pervasive influence throughout the economy, these two adjustments combine to make domestic economic conditions cumulatively more favorable over the 15-year interval.

In order to make Soviet economic relations with the outside world more favorable, we have adjusted import prices and export prices to improve Soviet terms of trade. The baseline projection has prices for Soviet exports increasing at an average annual rate of 3 percent per year; for this projection of easy external conditions, they are assumed to rise at the rate of 5 percent per year. On the other hand, the baseline projection has prices for Soviet imports rising at the rate of 4 percent per year; the easy-conditions projection lowers this to 3 percent year year. The baseline projection has activity variables for the physical volume of world imports growing at the rate of 7 percent per year, LDC imports growing at 7 percent annually, and imports of the developed West growing at 6 percent annually; the adjustment for easy external conditions raises these percentages to 8, 8, and 7 respectively. How do these favorable conditions, both domestic and external, influence the level of Soviet output in the 1980s?

Faster technological progress and improved terms of trade enable the USSR to increase its output over the baseline projection by a good deal. The 1990 level of GNP is 139 billion rubles or 18 percent above the 1990 baseline level of 782 billion rubles, as shown in Table 3. The gains appear in both consumption and investment, with a slight rise in "other" categories of output. Consumption growth rates do not fall as they do under the baseline projection, while investment grows much more rapidly under these favorable conditions. The overall annual growth rate for GNP jumps in the early 1980s and then declines but remains above the levels of the late 1970s. Annual changes reflect both the cyclical pattern of Soviet growth and the assumption that the extra 2 percent annual productivity gains begin in 1981 (rather than starting gradually with 1976). Both consumption and investment increase their share of GNP by comparison with the baseline projection.

TABLE 3.—PROJECTION WITH EASY DOMESTIC AND EASY EXTERNAL CONDITIONS, U.S.S.R., SELECTED YEARS, 1975–90

[In billions of rubles at 1970 prices]

Year	Consumption	Investment	Other uses	Total GNP
1975	251.6	112.8	79.7	444.1
1980	311.5	141.1	102.4	555.0
1985	418.0	180.5	127.3	725.8
1990	517.7	247.0	156.4	921.1
Percent shares:				
1975	56.6	25.4	18.0	100
1970	56.1	25.4	18.5	100
1985	57.6	24.9	17.5	100
1990	56.2	26.8	17.0	100
Average annual growth rates:				
1975–80	4.4	4.6	5.1	4.6
1980–85	6.1	5.0	4.4	5.5
1985–90	4.4	6.5	4.2	4.9

TABLE 4.—PROJECTION WITH HARD DOMESTIC AND HARD EXTERNAL CONDITIONS, U.S.S.R., SELECTED YEARS, 1975–90

[In billions of rubles at 1970 prices]

Year	Consumption	Investment	Other uses	Total GNP
1975	253.9	108.8	76.1	438.8
1980	318.5	131.2	98.2	547.9
1985	349.3	154.2	114.4	617.9
1990	352.2	184.6	143.5	680.3
Percent shares:				
1975	57.9	24.8	17.3	100
1980	58.1	24.0	17.9	100
1985	56.5	25.0	18.5	100
1990	51.8	27.1	21.1	100
Average annual growth rates:				
1975–80	4.6	3.8	5.2	4.5
1980–85	1.9	3.3	3.1	2.4
1985–90	0.2	3.7	4.6	1.9

B. Hard Conditions, Both Domestic and External

The impact of unfavorable conditions on the Soviet economy can be illustrated through reversing the favorable assumptions listed above. In the next projection, we assume that a negative technological progress terms inserted in all production functions detracts cumulatively at 2 percent per year from the productivity gains in the baseline projection, and that the ratio of actual to potential grain crops in the 1980s is set at .8 rather than 1.0. In foreign trade, we set the average annual rise in Soviet export prices at 1 percent rather than 5 percent, while allowing import prices to rise at 5 percent rather than 3 percent. The physical volume of world imports and LDC imports is assumed to rise at 6 percent annually rather than 8 percent (5 rather than 7 percent for developed West imports). How much do these unfavorable developments change the picture?

Unfavorable domestic and external conditions have the effect, as one would expect, of reducing the growth rate of Soviet output. Under the specified conditions, GNP grows at 4.5 percent in the second half of the 1970s, falling to 2.4 and 1.9 percent in the 1980s, as shown in Table 4. The impact is especially severe on consumption, which grows at only 0.2 percent in the second half of the 1980s. Consumption in 1990 is 81 billion rubles less than under the baseline projection, while investment is 23 billion less. Services sector output is actually larger under these unfavorable conditions than in the baseline projection, since services are less affected by foreign trade. The combined impact of these unfavorable developments reduces the consumption share of GNP in 1990 to 52 percent, compared with 55.3 percent in the baseline projection.

C. Easy Domestic and Hard External Conditions

A mixed combination of easy conditions at home and difficult external trade conditions produces some unexpected results in the model's reactions. Because household consumption is residually determined, and because domestic investment is not sensitive (in the model) to external terms of trade, the downward impact from abroad is concentrated in consumption, which by 1990 is only 35 billion rubes above the baseline projection. Investment and other GNP end-uses, on the other

hand, react favorably to easy domestic conditions, and show higher levels than in the baseline projection. The result is to reduce the share of consumption in GNP to a stringent 52 percent, compared with 55 percent in the baseline projection. Food consumption rises as a result of favorable domestic conditions, but consumption of durables and services drops off markedly in response to the unfavorable developments assumed for foreign trade. In spite of all these shifts in the internal composition of GNP, the average growth rates for GNP are only slightly lower than with favorable conditions. (See Table 5.)

D. Hard Domestic and Easy External Conditions

A projection which gives effect to difficult conditions internally while allowing for favorabe conditions in foreign trade shows a sharp fall in overall GNP. One notes in Table 6, moreover, that again there are perceptible shifts in the internal composition of output, in this case protecting households. Aggregate consumption is lower than in the baseline projection by 33 billion rubles in 1990, while investment is off by 24 billion and other uses fall by 32 billion. This time the change in consumption reflects a sharp downward shift in the availability of food, while at the same time other consumption categories are higher than in the baseine test.

TABLE 5.—PROJECTION WITH EASY DOMESTIC AND HARD EXTERNAL CONDITIONS, U.S.S.R., SELECTED YEARS 1975–90

[In billions of rubles at 1970 prices]

Year	Consumption	Investment	Other uses	Total GNP
1975	251.6	112.8	79.7	444.1
1980	311.5	141.1	102.4	555.0
1985	401.8	180.5	139.1	721.4
1990	467.8	247.1	191.7	906.6
Percent shares:				
1975	56.6	25.4	18.0	100
1980	56.1	25.4	18.5	100
1985	55.7	25.0	19.3	100
1990	51.6	27.3	21.1	100
Average annual growth rates:				
1975–80	4.4	4.6	5.1	4.6
1980–85	5.2	5.0	6.3	5.4
1985–90	3.1	6.5	6.6	4.7

TABLE 6.—PROJECTION WITH HARD DOMESTIC AND EASY EXTERNAL CONDITIONS, U.S.S.R., SELECTED YEARS 1975–90

[In billions of rubles at 1970 prices]

Year	Consumption	Investment	Other uses	Total GNP
1975	253.9	108.8	76.1	438.8
1980	318.5	131.2	98.2	547.9
1985	365.2	154.2	102.7	622.1
1990	399.9	184.5	109.5	694.0
Percent shares:				
1975	57.9	24.8	17.3	100
1980	58.1	24.0	17.9	100
1985	58.7	24.8	16.5	100
1990	57.6	26.6	15.8	100
Average annual growth rates:				
1975–80	4.6	3.8	5.2	4.5
1980–85	2.8	3.3	.9	2.6
1985–90	1.8	3.7	1.3	2.2

VI. Six Policy Variations, Responding to Altered Conditions

With a research instrument like SOVMOD, we can not only sketch the forward path of the Soviet economy under various assumed domestic and external conditions, but also test the impact of hypothetical changes in policy that might occur in response to specified surrounding conditions. Again, these are not forecasts but answers to well-defined questions: what if . . .? The answers are provisional because our data are only approximate in some crucial respects, and because the model is still a crude one. With these reservations in mind, it is nevertheless useful to examine the sensitivity of the Soviet economy to several interesting policy variations.

A. Easy Conditions, Both Domestic and External

1. GREATER INVESTMENT

In the event that easy domestic and external conditions prevail in the early 1980s, Soviet authorities might well decide to take advantage of the favorable opportunities and direct more resources into investment. Suppose, for example, that the yearly growth rate for investment in industry is raised half a percentage point each year from 1983 on: what would this do to the size and distribution of the GNP? It turns out that the effect is to raise the level of GNP slightly, compared to the situation without the added investment, since the added investment spurs the economy on (see Table 7). The 1990 level of household consumption is slightly lower than without the policy change, while investment is 12 billion rubles higher. Stronger application of this policy would, however, tighten consumers' belts.

TABLE 7.—PROJECTION ADJUSTING TO EASY DOMESTIC AND EASY EXTERNAL CONDITIONS BY RAISING INVESTMENT, U.S.S.R., SELECTED YEARS, 1975–90

[In billions of rubles at 1970 prices]

Year	Consumption	Investment	Other uses	Total GNP
1975	251.6	112.8	79.7	444.1
1980	311.5	141.1	102.4	555.0
1985	414.9	184.0	127.4	726.3
1990	513.1	258.9	157.4	929.4
Percent shares:				
1975	56.6	25.4	18.0	100
1980	56.1	25.4	18.5	100
1985	57.1	25.3	17.6	100
1990	55.2	27.9	16.9	100
Average annual growth rates:				
1975–80	4.4	4.6	5.1	4.6
1980–85	5.9	5.5	4.5	5.5
1985–90	4.3	7.1	4.3	5.1

2. ADDED DEFENSE OUTLAYS

Another policy intervention that might be considered under favorable conditions would be increased attention to national defense. We illustrate this possibility by computing the consequences of raising the average annual rate of growth in military outlays from 4 percent to 6 percent from 1983 on. As shown in Table 8, the results are un-

attractive. By 1990, the level of household consumption is 2 billion less than without policy change and the level of investment is also 7 billion lower, while our narrow measure of defense purchases is up by 9 billion and the net impact, taking account of other changes, is to reduce GNP by 5 billion. In an economy structured this way, additional military spending is costly.

3. LEVEL DEFENSE OUTLAYS, 1982–1990

An opposite policy change, with fewer resources devoted to national defense, might arise if, for example, there were a successful international agreement to hold defense outlays constant. The result for the Soviet economy can be illustrated by supposing that the level of defense outlays reached in 1982 is then held constant for the rest of the 1980s. In this case, the 1990 GNP is 9 billion rubles larger than it would be without the policy change—an increase of about the same size as the one obtained by raising investment outlays (See Table 9). But holding defense outlays constant permits consumption to rise by 1 billion rubles (compared to the level without policy change) whereas the added-investment option reduces consumption by 1.6 billion rubles. These consequences are not surprising. What is notable, however, with the Soviet economy structured in this fashion, is that the policy of holding defense outlays constant after 1982 permits an even greater rise in investment by 1990 than if an added-investment option is deliberately chosen. The difference in investment is not marked but the leveling off of defense spending leads to an unambiguous gain of 6 billion rubles in 1990 consumption. If the actual dimensions of defense spending are larger than estimated here, the transfer benefits would be correspondingly increased. Thus the general implication is clear: reductions in Soviet defense outlays release resources that can then meet both of the objectives stressed by Secretary Brezhnev at the 25th Congress—greater consumption and greater investment in heavy industry.

TABLE 8.—PROJECTION ADJUSTING TO EASY DOMESTIC AND EASY EXTERNAL CONDITIONS BY RAISING DEFENSE, U.S.S.R., SELECTED YEARS, 1975–90

[In billions of rubles at 1970 prices]

Year	Consumption	Investment	Other uses	Total GNP
1975	251.6	112.8	79.7	444.1
1980	311.5	141.1	102.4	555.0
1985	418.2	178.6	128.6	725.4
1990	516.1	240.0	160.5	916.6
Percent shares:				
1975	56.6	25.4	18.0	100
1980	56.1	25.4	18.5	100
1985	57.7	24.6	17.7	100
1990	56.3	26.2	17.5	100
Average annual growth rates:				
1975–80	4.4	4.6	5.1	4.6
1980–85	6.1	4.8	4.7	5.5
1985–90	4.3	6.1	4.5	4.8

TABLE 9.—PROJECTION ADJUSTING TO EASY DOMESTIC AND EASY EXTERNAL CONDITIONS BY HOLDING DEFENSE OUTLAYS AT 1982 LEVELS, U.S.S.R., SELECTED YEARS, 1975–90

[In billions of rubles at 1970 prices]

Year	Consumption	Investment	Other uses	Total GNP
1975	251.6	112.8	79.7	444.1
1980	311.5	141.1	102.4	555.0
1985	417.6	184.2	124.8	726.6
1990	518.7	261.4	150.0	930.1
Percent shares:				
1975	56.6	25.4	18.0	100
1980	56.1	25.4	18.5	100
1985	57.5	25.3	17.2	100
1990	55.8	28.1	16.1	100
Average annual growth rates:				
1975–80	4.4	4.6	5.1	4.6
1980–85	6.0	5.5	4.0	5.5
1985–90	4.4	7.3	3.7	5.1

B. Hard Domestic and Easy External Conditions

1. GREATER INVESTMENT

In the event that domestic conditions prove less favorable than anticipated in the baseline case, a strong regime might feel it necessary to put more resources into investment in hopes of overcoming difficulties. The consequences are illustrated in Table 10. They are very similar to the results of adding more investment when conditions were especially easy; household consumption in 1990 is 3 billion less than without the policy change while investment is 11 billion larger and GNP as a whole goes up by 8 billion rubles. Again we see that there is a net stimulus to the economy, but that further policy shifts in this direction would be at the expense of household consumption. Favorable conditions in foreign trade do not permit the USSR to make up for difficulties in the domestic economy.

2. ADDED DEFENSE OUTLAYS

Another possible combination of circumstances might involve favorable external trade conditions but difficult domestic conditions inducing an increase in defense expenditures. Suppose that, instead of having defense outlays rise at 4 percent per year, they rose at 6 percent annually from 1982 to 1990; what would this policy change do to the GNP? Table 11 shows the results. Total GNP goes down by 3 billion rubles, compared to the projection without the defense increase. The added defense outlays lead to a 2 billion ruble fall in consumption and a 5 billion ruble fall in investment. Consumers' belts are tightened and industrial growth is slowed. This stern policy is costly in both directions. In this case, as in the case above, favorable conditions in foreign trade do not permit the USSR to insulate the civilian economy from unfavorable domestic developments.

TABLE 10.—PROJECTION ADJUSTING TO HARD DOMESTIC AND EASY EXTERNAL CONDITIONS BY RAISING INVESTMENT, U.S.S.R., SELECTED YEARS, 1975–90

[In billions of rubles at 1970 prices]

Year	Consumption	Investment	Other uses	Total GNP
1975	253.9	108.8	76.1	438.8
1980	318.5	131.2	98.2	547.9
1985	362.2	157.6	102.8	622.6
1990	396.7	195.0	110.5	702.2
Percent shares:				
1975	57.9	24.8	17.3	100
1980	58.1	24.0	17.9	100
1985	58.2	25.3	16.5	100
1990	56.5	27.8	15.7	100
Average annual growth rates:				
1975–80	4.6	3.8	5.2	4.5
1980–85	2.6	3.7	0.9	2.6
1985–90	1.8	4.4	1.5	2.4

TABLE 11.—PROJECTION ADJUSTING TO HARD DOMESTIC AND EASY EXTERNAL CONDITIONS BY RAISING DEFENSE, U.S.S.R., SELECTED YEARS, 1975–90

[In billions of rubles at 1970 prices]

Year	Consumption	Investment	Other uses	Total GNP
1975	253.9	108.8	76.1	438.8
1980	318.5	131.2	98.2	547.9
1985	365.2	152.6	104.0	621.8
1990	397.6	179.2	113.9	690.7
Percent shares:				
1975	57.9	24.8	17.3	100
1980	58.1	24.0	17.9	100
1985	58.7	24.6	16.7	100
1990	57.6	25.9	16.5	100
Average annual growth rates:				
1975–80	4.6	3.8	5.2	4.5
1980–85	2.8	3.1	1.2	2.6
1985–90	1.7	3.3	1.8	2.1

C. Easy Domestic and Hard External Conditions

1. DECELERATED DEFENSE SPENDING

An opposite kind of policy adjustment might arise if domestic conditions were easy but external economic trade relations were unfavorable. Would the situation be markedly improved if defense outlays were reduced? Suppose, for example, that from 1983 on, defense outlays rose at 2 percent per year instead of a baseline 4 percent. By 1990, Table 12 shows that the effect would be to raise consumption by 1 billion and investment by 7 billion compared to their levels without policy adjustment; GNP as a whole rises by 4 billion as the 7-billion reduction in defense outlays is more than offset. These modest responses in a model that is not finely tuned to defense variations suggest that actual responses in the USSR would be larger, and that more substantial defense reductions would have an even more beneficial effect on the civilian economy.

TABLE 12.—PROJECTION ADJUSTING TO EASY DOMESTIC AND HARD EXTERNAL CONDITIONS BY LOWERING DEFENSE, U.S.S.R., SELECTED YEARS, 1975–90

[In billions of rubles at 1970 prices]

Year	Consumption	Investment	Other uses	Total GNP
1975	251.6	112.8	79.7	444.1
1980	311.5	141.1	102.4	555.0
1985	401.6	182.3	137.9	721.8
1990	468.5	254.1	188.3	910.9
Percent shares:				
1975	56.6	25.4	18.0	100
1980	56.1	25.4	18.5	100
1985	55.6	25.3	19.1	100
1990	51.4	27.9	20.7	100
Average annual growth rates:				
1975–80	4.4	4.6	5.1	4.6
1980–85	5.2	5.3	6.1	5.4
1985–90	3.1	6.9	6.4	4.8

VII. Economic Implications

It should be evident that the use of a comprehensive macroeconomic model to sketch alternative futures is necessarily a speculative exercise. These are not, and cannot be, firm forecasts. While both the static structure and the dynamic properties of the Soviet economic system are remarkably stable, the projected evolution of the economy depends in large part on the assumptions we employ in assigning values to numerous exogenous variables. Within this framework, however, the exercises carried out for this essay permit us to draw a few general conclusions.

A. Soviet Output Growth Will Continue Slowing Down

Our major finding is that Soviet output expansion will continue to slow down. The gradual decline in achieved output growth rates since 1958 has been noted by many observers, both Soviet and Western; our tests show that it seems destined to continue in the future except under assumptions of extremely favorable surrounding conditions. The slacking off of labor-force increments, declining effectiveness of capital investment, and other forces underlying the tapering growth of the last 15 years, cast their influence forward into the baseline projection for the coming 15 years as well. Fairly strong assumptions about favorable domestic and external conditions barely generate enough upward responses to keep output growth rates at their present levels. The high rates of technological progress, sharp gains in agricultural efficiency, and drastic improvements in Soviet terms of trade that would be necessary to raise output growth rates back to the levels of 5 or 10 years ago are so extreme as to appear clearly implausible. One could, of course, describe the parameters for a far more flexible and sensitive economy that would respond very actively to fortunate conditions, but nothing in Soviet experience suggests that the present Soviet economy itself could be made to conform to such a flexible model.

B. The Soviet Economy Moves With Sluggish Stability

The Soviet economy, especially outside agriculture, has been expanding in stable, unswerving fashion—though at gradually declining rates—for a quarter of a century. An accurate model of this economy will, therefore, have these same properties, and will thus display the relatively sluggish responses noted in the exercises we have gone through. These are not just the artificial simplifications of a synthetic construct. The bureaucratic immobility of the Soviet decision-making mechanism smothers a great deal of the volatility present in a normal market economy. Established procedures regularly grind out standard forms of output, while conventional methods enlarge capital stocks embodying orthodox technology. This stability has, of course, its advantages, but it also means that unfavorable conditions and unsatisfactory performance are hard to remedy. Where new procedures are required in order to produce new forms of output involving altered capital stocks embodying unfamiliar technology, the Soviet system responds poorly. The rewards and penalties that motivate Soviet managers and workers serve admirably to replicate and enlarge the existing economy. These same rewards and penalties act negatively, however, with the effect of protecting the system against changes—even if the needed changes are improvements.

C. Foreign Trade Cannot Serve as a Panacea for Domestic Soviet Problems

While these limited computations can scarcely be considered conclusive, they suggest how hard it will be, in the absence of major institutional changes, for the Soviet economy to respond in any fundamental way to the benefits that can flow from large-scale participation in the world economy. Soviet exports and imports are only a small fraction of Soviet domestic economic activity. In spite of recent Soviet intentions, her domestic activities are still largely insulated from outside economic influences. Stubborn institutional barriers continue to hamper the incorporation of advanced foreign technology into Soviet industry and agriculture.

In particular processes where advanced foreign technology has been installed successfully, however, striking gains have resulted. In a recent application of the SRI–WEFA model to this question, Drs. Green and Levine have shown that imported high-technology equipment can raise capital productivity in Soviet industry several fold.[7] After a two- or three-year period for fitting the new equipment into the production process, output gains can be quite substantial.

The altered terms of trade used here to examine the consequences of broad improvements in Soviet external economic relations do not provide a really searching examination of the potentialities that lie in concentrated attempts to improve domestic Soviet productivity in a limited range of specific activities. This would require more detailed scenarios, along the lines noted above. These gains, in turn, could benefit other activities, especially if domestic institutional reforms make the economy more adaptable.

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[7] See Green/Levine, *Implications . . . , op. cit.*

We can nevertheless conclude by noting two major constraints on Soviet gains from foreign trade in the 1980s. The first relates to the dimensions of Soviet export capacity. Our baseline projection indicates absolute and relative magnitudes for the Soviet exports that are likely to be producible and absorbed by the world market over the years 1975–1990. The ratio of Soviet exports to Soviet GNP only rises from 5 percent in 1975 to 8 percent in 1990. Even a very active tail cannot move a large dog. The second relates to the internal flexibility of the Soviet system. Our projection combining easy external conditions with generous allowances for improved productivity in all sectors of domestic economic activity, acting cumulatively from 1975 to 1990, indicates that Soviet GNP in 1990 will rise to 921 billion rubles (in 1970 prices) rather than 790 billion in the baseline projection—a 17 percent increase, linked to 1990 imports of 87 billion, a gain of only 12 percent. If a detailed projection were carefully tailored to focus these imports on advanced-technology equipment for key industrial sectors, no doubt the gains for the Soviet economy would be larger, but probably not strikingly so.

D. Defense Outlay Variations Can Significantly Influence the Economy

Our examination of upward and downward shifts in defense spending serves to indicate how responsive the Soviet economy would be if such policy changes were made. Increased defense outlays cut heavily into both consumption and investment, while decreases release resources that enable both consumption and investment to increase. The slender evidence available does not permit much precision in this area and our methodology underestimates the potential consequences. Even these crude results, nevertheless, reinforce what common sense would say: policies that encourage reduced spending on national defense can directly raise living standards and stimulate economic growth.

Comparing the impact of changes in foreign trade conditions with the impact of changes in defense outlays, there is evidence here of a significant contrast. The broad impact of defense changes is prompt and unambiguous, while the consequences of changes in external trade conditions are less certain. The econometric evidence accords with our understanding of the institutional structure. Many Soviet manufacturing plants produce civilian consumer goods along with their defense-related output; they can presumably switch proportions fairly easily. By contrast, as we have noted, use of the foreign trade sector to update Soviet technology and raise domestic productivity is a slow and problematic process. The two approaches need not, however, compete; for maximum growth benefits, Soviet authorities could direct their policies toward both reduced defense outlays and large-scale imports of high-technology equipment to be imbedded in a reformed, more flexible domestic economy.

VIII. Political-Strategic Implications

The long-term outlook for Soviet economic performance presented in the preceding sections must appear rather bleak to the Soviet leadership. It is small wonder they have refrained from publishing their

Fifteen-Year Plan for the development of the economy, though they announced their intention to do so last year. Major obstacles lie in the path of economic growth—low agricultural productivity and future investment shortages. Apparently only the consumer and military sectors are available for the Soviets to draw upon in the hope of increasing investment and raising agricultural productivity. However, to do so would be to incur significant costs of another variety. It is politically infeasible for an advanced industrialized state like the USSR to retreat to a low level of meat production and consumption, although a drastic step in this direction, through direct human consumption of grain, might assuage the problem of low agricultural production. Yet even this alternative is complicated by the long-range weather outlook—colder winters with a drier climate and changed distribution of precipitation. This occurred in 1975 and may recur in a weather cycle almost predictable for the next several years. Should this be the case the hard domestic conditions examined in some of the preceding scenarios could be drastically changed for the worse.

Another strategic consideration is that the continued Soviet arms buildup, based on a fairly constant increase in annual defense expenditures (estimated at 4 percent in the baseline case), might become an intolerable burden on the Soviet economy as the aggregate growth rate slows and the demands of agriculture and investment increase. It is conceivable that such pressure on the Soviet leadership to reduce defense expenditures and military manpower might make them more amenable to possible negotiations concerning mutual defense expenditure reduction. Historical precedent, however, demonstrates clearly that the USSR has permitted consumer-related sectors to forego development in the interest of maintaining and increasing the commitment of scarce resources to heavy industry and defense. In a future environment of labor shortage, investment stringency, and falling agricultural productivity, this traditional stress on heavy industry and defense will not only freeze consumer sector development, but may also endanger the modest progress projected earlier in this essay.

The current revision of the baseline estimate (in rubles) of the USSR defense budget now underway in the U.S. intelligence community will provide an important input to the revision of the SRI/WEFA econometric model of the Soviet economy. When these figures become available for use in the model, a significant improvement will be made in our understanding of the burden of defense on the Soviet economy.

A third area of major concern for Soviet planners with important implications for the U.S. stems from the fact that Soviet extractive industries (i.e., energy and minerals) will require an increasingly higher proportion of the USSR's investment. (See the Soviet quote in section II, this paper). This, in turn, will further exacerbate the investment shortage expected in the Soviet economy during the 1980's.

These constraints on Soviet economic growth over the next fifteen years will require hard choices from Soviet decisionmakers. Our review of the interactions between Soviet growth rates, Soviet defense spending, and Soviet foreign trade implies that the U.S. may be able to exert significant leverage in negotiations with the Soviet Union

over political/military matters, influence reflecting inherent U.S. advantages in bilateral trade and economic relations. Certainly the leverage is largely indirect and may be weakened by the willingness of the Soviet Union to turn to other sources such as Western Europe for its needs. Nevertheless, the Soviets have shown a preference for U.S. trade and investment, in part, because of the larger scale on which these projects may be conducted. It is indeed possible that the U.S. capacity to offer immense grain exports, high technology turn-key plants, and long-term low interest loans to a Soviet Union beset by a stagnating economy will grant the U.S. political leverage should it desire to use it.

Recent Soviet international behavior has had a pronounced effect on altering the world's economic order, particularly with respect to the influence of selected Third World and developing nations. The degree to which Soviet encouragement and support for raw material producer cartels such as OPEC could be moderated as the USSR's economic situation becomes more strained is a vital long-term concern for the U.S. and other members of the OECD. A United States willing to exercise the leverage it has in economic relations could produce a Soviet Union more interested in cooperative efforts to resolve North-South world economic imbalances than in exploiting the anti-western feelings of LDCs.

Much work must be done on these political/strategic questions to clarify the implications of long-term Soviet economic problems. Such problems will undoubtedly have important consequences for international politics in the years to come. Accurately perceiving both the problems and opportunities this will pose for the United States is an urgent and challenging task.

SOVIET MILITARY AID TO THE MIDDLE EAST—AN ECONOMIC BALANCE SHEET*

GUR OFER

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I. INTRODUCTION

The first clouds over the bright prospects of the Soviet strong presence in the Middle-East began to appear quite a while before the October 1973 war. Somewhat paradoxically, or at least apparently so, the clouds seemed to gather into a storm exactly when for the first time the long, painstaking and ever frustrating Soviet effort to build credible Arab military capability against Israel achieved limited, but greater than expected, success. That success itself created conditions more favorable than ever for diplomatic negotiations aimed at settling the Arab-Israeli conflict, yet in this sphere, to cite President Sadat, 99 per cent of the cards are in the hands of the United States. The Soviet Union, which had been using the conflict as a major means of

*This paper is part of a larger forthcoming study on the Economic Aspects of Soviet Involvement in the Middle-East, prepared with the help of a grant from the Leonard Davis Institute for International Relations, as part of the research program of the Russian Research Center, both of the Hebrew University of Jerusalem. I would like to thank Dr. Amnon Sella for providing indispensable help on Soviet military matters. The responsibility on Soviet military matters as well as on the entire paper, is, of course, mine.

leverage to further its penetration into the area, found itself in an inferior position as a partner in the settlement efforts.

The peace efforts, however, constitute only one of the major changes in the region during the recent years; they may still prove to be the least durable of the lot. Most of the other changes are connected with the developments in the world oil economy: the tremendous boost to the economic position and thus military potential and political power of the oil producing Arab and non-Arab countries in the region. These changes are bound to alter drastically the balance of power within the region and the relations of the countries in the area with outside powers. They certainly alter the nature of the interests of many countries in the area and thus may create new patterns of relations.

These and other changes in the region definitely amount to a turning point in the region's history. They most probably change the nature of the region's relations with the Soviet Union which faces too the dangers and opportunities of the Middle-East becoming rich. The dangers may be symbolized by the revoking by Egypt, in 1975, of its friendship agreement with the Soviet Union, together with the special docking privileges for its navy. Potential opportunities shall be discussed later. But turning point or not, 1975 is also the 20th anniversary of the first Soviet arms deal with Egypt, the first of what turned into a stream of many billions of dollars' worth of military and economic aid agreements, growing trade relations, and ever increasing military presence and political involvement in the Middle East.

It certainly is a suitable time to review the past record of this involvement and evaluate its possible future course. This paper is aimed at evaluating only one aspect of the multi-faceted picture of Soviet relationship with the Middle-East: its supply of military aid (MA), and the economic burden that it imposed on the Soviet Union.[1] Since MA made up the bulk of all Soviet aid to third world countries, and an even greater proportion of Soviet aid to the Middle-East, and since until recently both the terms of MA agreements as well as the actual repayment rates involved higher costs to the Soviet Union than did economic aid, this study should capture most of the economic burden of the Soviet Union's Middle-East effort.[2]

In a paper on the same subject completed in 1971,[3] the economic burden of Soviet MA was evaluated as being very heavy. It was claimed that such a burden could have been justified only by the existence of a top priority Soviet strategic interest and not just by a natural attempt by a big power to increase its influence everywhere possible around the world. During the 1960's the Soviet Union engaged in a major effort to increase its naval and military presence in the Mediterranean and in the Middle-East in order to counter the strategic threat

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[1] A comprehensive picture on "Economic Aspects of Soviet Involvement in the Middle East" is presented in a study with this name and of which the present paper is a part.

[2] Over the entire 1954–74 period Soviet Economic Aid Extensions (of which only half to two-thirds was already drawn) to the wide Middle-East region amounted to 5.3 billion rubles, 2.9 and 2.2 billion rubles to the Arab countries, to Egypt, Syria and Iraq (The Main-three). These are to be compared with corresponding MA extensions (almost completely drawn) of 8.8, 7.9, and 7.2 billion rubles. During the period 1967–74, Economic Aid figures (and MA figures in parenthesis) are: 2.3 (6.3), 1.1 (5.4), and 0.8 (4.9), billion rubles, respectively. U.S., Department of State, "Communist States and Developing Countries Aid and Trade in 1974" [(Bureau of Intelligence and Research Report No. 298, Washington D.C., January 1976.) Henceforth SD 1976] and previous issues.

[3] Gur Ofer, "The Economic Burden of Soviet Involvement in the Middle East," in M. Confino and S. Shamir, eds., "The U.S.S.R. and the Middle East" (Jerusalem: Israel University Press, 1973), pp. 215–246.

posed by American aircraft carriers and Polaris submarines. Lacking the capability to rapidly increase its naval and open sea supporting units, the Soviet Union found MA granted in an effort to gain access to naval and air bases a relatively inexpensive substitute.[4] In this way estimating the economic costs of MA was used as one possible tool for gauging the intensity of other Soviet interests in the area. This way of approaching the problem of the economic aspects of the Soviet involvement in the region has certainly been the dominant one in the past: the Soviet Union did not have any significant economic interest in the region, and it gained very little economically from its relations with the various countries in it. This situation, however, may have changed recently as the region grew richer; the Soviet Union may now have developed direct economic interests, some of which are connected with its MA program. So in addition to trying to estimate changes in the MA burden since the early 1970's, we shall also try to investigate whether the nature and purpose of the program may have changed.

Section II reviews the development in size and geographical spread of the Soviet MA program. In Section III the various estimates of the economic burden involved are developed and then calculated, and in Section IV an attempt is made to understand and evaluate the findings and put them in a broader perspective of Soviet involvement in the region.

TABLE 1.—SOVIET MILITARY AID TO LDC'S—A COMPARISON OF 3 SERIES: 1955-74

Period	Export residual (ER) [1]		Current dollars [2] (millions)				
	Rubles (millions)		ACDA [3]	SD [4]	ACDA–ER (3)-(2)	SD–ER (4)-(2)	SD–ACDA (4)-(3)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
1955-74	8,644	11,133	----------	12,010	----------	741	----------
1955-60	470	1,176	----------	1,285	----------	109	----------
1961-66	1,465	1,628	2,875	3,220	1,140	1,456	345
1967-70	2,065	2,295	2,318	2,300	23	5	−18
1971-73	3,107	3,903	3,521	3,940	−382	37	419
1974	1,537	2,131	----------	1,265	----------	−866	----------

[1] The "export residual" (ER) is the difference between total reported Soviet exports to developing countries and the sum of exports reported for each of those countries separately.

[2] Ruble figures in col. (1) are converted to current dollar values in col. (2) by the official exchange rate prevailing in the respective years: in rubles per dollar: 1955-60: 0.4; 1961-71: 0.9; 1972: 0.829; 1973: 0.746; 1974: 0.721. It is assumed that this practice is also used in compiling the 2 other series.

[3] Soviet arms deliveries to LDC's as aid or cash sales.

[4] Soviet extensions of military supply as aid only, that is, excluding cash sales, downpayments and short-term high (commercial) interest credits (SD-1976, p. iii).

Source: Col. (1) Soviet Union. ER Ministerstvo Vneshney Torgovli S.S.S.R.: Vneshnyaya torgovlya S.S.S.R. za 19—god (The Foreign Trade of the U.S.S.R. for 19—) and similar compedia for groups of years. Col. (3) Based on U.S. Arms Control and Disarmament Agency: The International Transfer of Conventional Arms (Washington, D.C., 1973); Tables I–III, and World Military Expenditures and Arms Trade 1963-73 (Washington, D.C., 1974), tables III–IV. Col. (4) U.S. Department of State, Communist States and Developing Countries Aid and Trade in 1974 [(Bureau of Intelligence and Research Report No. 298. Washington, D.C., January 1976). Henceforth SD 1976], table 7.

II. The Development of Soviet MA to the Middle-East

A. Total MA

Table 1 presents three estimates, two American and one 'Russian', of total Soviet MA to Third-World (non-communist) countries over the period 1955–1974. The Soviet estimate is made up of the 'export re-

[4] Ibid., pp. 236–238.

sidual' (ER) to 'developing countries', that is, the difference between the total exports to these countries and the sum of exports reported for the individual countries. As claimed by Kostinsky, the bulk of this residual constitutes arms supplies.[5] The other two estimates, that of the State Department [6] (SD) and that of the US Arms Control Agency (ACDA) [7] differ in two aspects. The former lists only MA and refrains from reporting on direct sales of arms for cash and it lists MA at the date of agreement rather than at the time of actual supply which is what ACDA does. Apparently, there have been only limited direct cash sales up to 1973, so that the SD estimates should be generally higher and in advance of both the ACDA and Soviet estimates. It is assumed that the two American estimates are presented in current dollars and thus the export residual series is converted to dollars using the official exchange rates prevailing for the respective years.[8]

As such estimates go, the overall differences between the three series are not too wide. For the entire 1955–74 period the SD series exceed the ER series by about one billion dollars (in current prices) which is about 8 percent. The differences are somewhat wider for 1961–73 for which the ACDA series are also available. The differences between the SD and the ACDA estimates are concentrated in two periods: the SD surplus during 1971–73 can be explained by net 1973 commitments yet to be fulfilled in 1974 and afterwards.[9] On the other hand, I have no direct explanation for the SD surplus that appears during 1961–66. This period is also one in which both American estimates exceed, by substantial sums, the ER series. Only part of this surplus can be 'pushed' to later periods; the rest remains unexplained. This surplus is partly offset by an ER surplus over SD during 1974. That part of this surplus that is not stretched from the 1961–66 deficit could be explained by yet unreported agreements, by cash deals—one with Libya is a possibility—and of course by other items included in the ER series. Since in what follows the American series will be used a tentative conclusion may be drawn from Table 1: the extent of MA may be overestimated for the early 1960's and under-estimated for the past few years.

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[5] Barry L. Kostinsky, "Description and Analysis of Soviet Foreign Trade Statistics," U.S., Department of Commerce, Foreign Economic Reports FER—No. 5 (July 1974), pp. 66–69. The actual data come from: Ministerstvo Vneshney Torgovli S.S.S.R.: "Vneshnaya Torgovlya S.S.S.R. za 19 god" (The Foreign Trade of the U.S.S.R. for 19—), Moscow, and from similar statistical handbooks covering more than 1 year.

[6] "SD 1976, op. cit.," pp. 13–14 and Tables 7, 8. Also used were previous (annual) publications by the same office under similar names.

[7] U.S., Arms Control and Disarmament Agency: "The International Transfer of Conventional Arms" (Washington, D.C., 1973); and "World Military Expenditures and Arms Trade 1963–73" (Washington, D.C., 1974), various tables. (Henceforth ACDA 1973 and ACDA 1974, respectively.)

[8] In this paper we do not use the SIPRI estimates: "SIPRI Yearbook 1975" (and previous years) and "Arms Trade Registers 1975," Appendix 2, pp. 149–169. They are narrower in coverage—they cover only major weapon systems; and they value Soviet arms supply in American prices which while reasonable for some purposes do not fit ours. The estimates used here for Soviet MA are generally lower than the figures usually quoted in the international press, which run as high as 6–7 billion dollars for Egypt's debts on Soviet MA (and economic aid) alone. [See for example the discussion on that issue in Roger F. Pajak, "Soviet Arms to Egypt," Survival (July/August 1975) pp. 165–66; and International Reports XXVIII, No. 4 (January 1976), p. 85.] Much of the difference between these figures and those of the SD and ACDA seem to result from the fact that the higher figures are expressed in today's much devalued dollars while the latter are expressed, as explained in the text in historical dollars or actually in current rubles which at least officially kept their value much better. Other differences may result from the fact that the higher figures include cumulated interest. We have chosen in this paper to stay on the conservative side. As shall be seen, the findings are nevertheless quite remarkable.

[9] The ACDA series includes a $125 million cash arms sale to Libya during that period which is not reported in the SD series. SD 1976, op. cit., Table 9.

As stated, both the dollar and ruble series in Table 1 are in current prices; in order to appreciate the trend of the MA series over time they should be transformed into constant prices. The best that we can do in this respect is to transform all these series to rubles at the official exchange rates for the respective years and to proceed qualitatively from them. We have excluded the possibility of estimating a constant dollar series, using some dollar-price index as a deflator, on the ground that Soviet arms prices are determined in rubles and translated to dollars on the basis of the official exchange rates. The current ruble series differs from a constant ruble series to the extent that ruble prices of arms have been changing in the Soviet Union and that the prices at which arms were sold changed over time. The evidence regarding these two price indices is very scanty, and that which exists contains many disagreements. The best documented area is that of prices of Soviet civilian machinery, but there as well disagreements seem to be extreme. Thus, while the official Machine Building and Metal Working (MMW) index shows a price decline of some 30 percent over 1955–70, and of 15 percent over 1960–70, Becker claims that prices actually increased, by 15 percent over 1960–70, or 25 percent since 1958.[10] No one claims to know how changes of military prices correlate with civilian prices and how prices for military equipment sold abroad to LDC's relate to the latter.[11]

Thus, Table 2 presents yearly MA figures, and rates of growth based on current rubles. With all their limitations, the series all show a marked increase in total Soviet MA, with yearly growth rates ranging from 8–20 percent per year and more. Moreover, the rates of growth even accelerated in the 1970's as compared with earlier periods. This last conclusion, though not the previous one concerning the growth of MA is somewhat weakened if we assume, with Becker, that MMW prices increased by 15 percent during 1960–70, and by perhaps 20 percent over 1960–1972/3. Such growth rates are certainly higher than the growth rates for most relevant economic defense and budgetary categories of the Soviet economy and thus do point towards an increasing total burden of MA.

B. Regional Distribution

Table 3 summarizes available information on the distribution of Soviet MA by country, groups of countries, and regions. While the regional distribution of MA reflects the interests and preferences of the donating and recipient countries, the choice of country grouping here is designed to reflect mainly those of the Soviet Union. The diversity of Soviet interests within many of the countries in the region justifies the inclusion of most countries in more than one group. The main group of recipients of Soviet MA—Egypt, Syria and Iraq (The Main-3) represents both the focus of Soviet interests in the region as well as its biggest opportunity of involvement that is on the crest of the Arab-Israeli conflict.

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[10] Abraham S. Becker, "The Price Level of Soviet Machinery in the 1960s," Soviet Studies, XXVI, No. 3 (July 1974), pp. 365, 368.

[11] See Barry L. Kostinsky and Vladimir G. Treml, "Foreign Trade Pricing in the Soviet Union: Exports and Imports in the 1966 Output Table," U.S., Department of Commerce, Foreign Economic Reports FER—No. 8 (March 1976). For MA pricing see for example SD 1964, p. 44, and ACDA 1973, op. cit., pp. 37, 72.

TABLE 2.—SOVIET MILITARY AID TO LDC'S, 1955–74,[1] ANNUAL FIGURES AND RATES OF GROWTH BY COUNTRY, REGION, AND PERIOD

Region[2] and country	Military aid in millions of rubles[3] per year				Annual growth rates	
	1955–74	1955–66	1967–71	1971–74	(2) to (3)[4]	(3) to (4)[4]
	(1)	(2)	(3)	(4)	(5)	(6)
Total	481	284	518	1,033	7	19
Region	351	158	393	891	9	23
Main 3	286	144	292	708	8	25
Egypt	141	92	227	200	10	−3
Syria	81	24	25	331	0	191
Iraq	64	29	40	195	3	149
Arab countries	315	157	353	753	9	21
Oil countries	114	37	111	346	13	33
Persian Gulf	113	32	136	503	17	39
Central Asia	82	55	120	124	9	1

[1] Military aid figures are based on SD (see source). The source does not provide a full breakdown of Military aid received by each country for each year, but rather each year's report contains new cumulative figures for aid extended to each country covering one additional year. However, each new annual report contains, in addition to data for one more year also corrections, based on new information, for previous years (SD 1976, p. iii). Therefore, the arrival of yearly figures for each country involves adjustments based on other sources on arms deals and also some heroic assumptions. For this reason the figures should be looked upon with caution. Grouping of yearly figures into 4 yr period (since 1967) reduces significantly the potential mistakes.

[2] The region is a widely defined Middle-East ranging from Turkey and Iran in the north and northeast, to Somalia in the south, and Morocco in the west. The main 3 are Egypt, Syria and Iraq; North African countries include Morocco, Algeria, Tunisia, and Libya; Red Sea countries include South and North Yemen, Ethiopia, Sudan, and Somalia; oil countries are Iran, Iraq, Libya, and Algeria; the Persian Gulf includes Iran, Iraq, and the Red Sea countries; Arab countries are all the regional countries with the exception of Iran (Turkey), Ethiopia, and Cyprus; finally, Central Asia includes Afghanistan and countries in the Indian subcontinent.

[3] Current rubles, converted from dollar figures at the official exchange rates prevailing at the time, as in note 2 to table 1. Figures are rounded to the nearest million.

[4] Growth rates are calculated in col. (5) on the basis of 9 yr growth, which is (about) the distance between the midperiod dates, and col. (6) on the basis of 4 yr. All rates are rounded to full points.

Source: U.S. Department of State, Communist States and Developing Countries: Aid and Trade in 19 [1954–74] (Washington D.C., 1964–76). (Earlier issues had slightly different titles.) Adjustments were made with the aid of arms supply agreements reported in SIPRI Yearbooks; SIPRI, Arms Trade Registers 1975, and International Institute of Strategic Studies, The Military Balance (London, various years).

TABLE 3.—DISTRIBUTION OF SOVIET MA BY REGIONS, GROUPS OF COUNTRIES AND COUNTRIES: 1955–74

[In percent]

Country, group of countries	SD estimates[1]				ACDA estimates[2]		
	1955–74	1955–66	1967–70	1971–74	1961–66	1967–70	1971–73
Total[3]	100.0	100.0	100.0	100.0	[4] 100.0	[4] 100.0	[4] 100.0
Region[5]	73.0	55.4	75.9	86.8	48.3	77.0	83.3
Main 3	59.6	50.7	56.2	68.7	37.1	64.6	67.5
Egypt	28.7	32.3	43.9	18.9	22.6	44.0	30.0
Syria	17.5	8.3	4.7	31.0	3.4	8.2	26.9
Iraq	13.3	10.0	7.6	18.7	11.1	12.4	10.6
North Africa[6]	3.3	3.4	6.7	1.7	6.8	3.4	4.6
Red Sea	2.8	1.1	5.3	3.3	3.8	3.8	2.0
Iran	7.1		7.2	13.2		5.2	9.3
Arab countries	65.7	55.2	68.2	73.7	47.7	71.7	74.0
Oil countries	23.3	13.1	21.5	33.0	17.6	21.0	24.4
Persian Gulf	23.2	11.1	20.1	35.2	14.9	21.4	21.9
Central Asia	16.6	19.2	23.2	11.4	21.9	23.0	16.7
Others[7]	10.4	25.3	0.8	1.8	29.7	(4)	(4)

[1] See note 4, table 1 and note 1 and sources of table 2.

[2] The underlying figures for the distribution, as well as the totals for the LDC's for individual years and subperiods were estimated from information on (a) total MA received by each country from all suppliers every year over 1961–73, and (b) the total MA extended to each recipient country over the entire 1961–71 and 1964–73 periods. The "missing" link was filled by outside information on arms supply agreements (as explained in table 2 note 1 and sources, and by a "proportionality principle" that is dividing Soviet MA over the years in accordance with the proportion that Soviet MA had in total MA received by the given country over the relevant periods. See also note 3 in table 1.

[3] The percentage distribution is based on the dollar figures. Since the ruble/dollar exchange rates changed over the period (and also within subperiods), the distribution based on ruble figures could, in principle, be different. In fact, however, the differences are very small and seldom larger than 1 percentage point.

[4] Totals do not include aid to a few countries included under "other" which amount to 1 to 3 percent of the total.

[5] For the definitions of groups of countries, see note 2 of table 2.

[6] SD figures do not include cash deliveries of arms to Libya. During 1971–73, according to ACDA they amounted to $125,000,000, about 2.4 percent of total Soviet MA during 1971–74.

[7] "Other" includes Southeast Asia, sub-Saharan Africa (with few exceptions noted in note 2 of table 2) and Latin America.

Sources: See sources to table 2.

In addition, we have grouped together all the Arab countries, the North-African, the Red Sea and the Persian Gulf countries, and in view of the increasing importance of oil, also the oil producing countries. MA to important individual countries, are shown separately. As before, the sub-periods chosen follow mainly the major events of the Arab-Israeli conflict. Since the ER data is not available on a country basis, we have to rely here exclusively on the work of the two American series mentioned above. The percentage distribution is based on the current dollar, original, figures. Since it is very similar to the relative distribution based on the corresponding current ruble figures—the latter is not shown.

The main results revealed by the table, some of which are well known, are as follows. First, over the entire period 1955–74 three countries—Egypt, Syria and Iraq received about 60 percent of total Soviet MA, Egypt receiving almost half of that. The entire group of Arab countries received almost two thirds of total Soviet MA, and the widely defined (Middle Eastern) "Region" that also includes North Africa, the Red Sea Countries, and Iran collected almost three quarters of that aid.[12]

Second, in most respects the above mentioned concentration of Soviet MA intensified significantly over time. The ME increased its share from about half or less of the Soviet aid in the earlier periods up to 1966, to around 60 percent during 1967–70, and to more than two thirds during the last period reported, 1971–74. (The 1971–72 share was similar to the rates experienced during 1967–70, but during 1973–74 it reached 75 percent or more.) An exception to the general trend within the Main-Three group is the decline after 1970 in the share of MA to Egypt, a decline which was more than compensated for by increases in the shares of Syria and Iraq. The same increased concentration of Soviet MA is also apparent in the more widely defined groups: MA to the entire ME Region moved up from just above half the total in the earlier years to more than 85 percent during 1971–74 and to even higher levels during the latter part of the period. Likewise, the share of the Arab Countries climbed from about half to almost 75 percent of the total during 1971–74.

While some of these results pose questions to be discussed later, they are more or less in line with what are believed to be traditional interests of the Soviet Union: strengthening its hold in countries south of its "soft-belly", penetrating into the Mediterranean basin, and then the Indian Ocean, utilizing the Arab-Israeli conflict as a tool of penetration into the Middle-East.

A somewhat less traditional Soviet interest may be revealed by the increased concentration of MA (and arms-deals) with the group of oil countries. Data presented in the table show a very significant increase in the share of MA going to rich oil-producing countries in the region. According to SD data this share rose from a mere 13 percent during 1955–66 to more than 20 percent during 1967–70, and up to about a third during 1971–74. This last share is extremely underestimated,

[12] Those figures do not yet include the value of the latest (late in 1974 or early in 1975) arms deals with Libya (ranging by various sources from $0.5 and up to several billion) see note 14 below; and the Region, as here defined does not include MA to Afghanistan. With these two added, the regional share rises above 80 percent. This comment applies also to much of the discussion below.

since it does not include any Soviet-Libyan arms deals.[13] The small $125 million cash deals reported by ACDA for the years 1971–73 add about 25 percentage points to the share, which should increase to above 40 percent of the total, and that even if the lowest figures on the latest arms deals with Libya are taken into account.[14] During 1974, and on the basis of the scanty information for 1975, the share of the Oil Countries has risen lately to even higher levels.[15]

Rich oil countries exist in both North Africa and the Persian Gulf regions where also other Soviet interests had also developed. The exclusion of the Soviet-Libyan arm deals reduces of course the reported North-African aid shares. As to the other region, we have defined a Persian Gulf—Indian Ocean—Red Sea region, the reported new center for big-power interests. Soviet MA to this region increased from about 10 percent during 1955–66 to more than a third during 1971–74, and there are indications it has reached even higher proportions lately.

Two main conclusions emerge from this section. First, the real amount of Soviet MA to the region increased over the last twenty years at even higher rates than the rather high rates of growth in total Soviet MA to LDC's. Compared with a 3.6-fold increase of total aid from 284 (1955–66) to 1033 (in 1971–74) million (current) rubles, aid to the region increased from 158 to 891 million rubles over the respective periods—up by about 5.6 times.[16] Second, the pattern of distribution of MA within the region seem to have shifted geographically in a centrifugal fashion—taking Egypt as the traditional center—eastwards, north and south, and westwards—and functionally towards oil countries. Still, despite this centrifugal movement, the real amount of MA to the confrontation countries (Main-3) as a group has increased over time. Total aid to Egypt, Syria and Iraq increased from a yearly average of 144 million rubles during 1955–66 to 708 million rubles during 1971–74, almost 5 fold (4 fold after a 20 percent discount). As we shall see, the first conclusion poses some puzzles to be explained, while the second may contain the key to such explanations.

III. Estimating the Economic Burden

A. Introductory Comments

How heavy a burden on the Soviet economy is created by its MA commitments in general, and those to the Middle-East in particular? The answer involves a number of different considerations. First the MA process involves both give and take. Although the amount of arms shipped imposes a (*supply*) burden on the economy, any payments coming in for those shipments relieves part of that burden. Thus the terms of the military aid contracts as well as the extent to which such terms are eventually met is a very important element in determining

[13] The ADCA figures are somewhat lower since its data extend only to 1973 and thus exclude large 1974 arms deals with Iran, Libya, and Iraq.

[14] International Institute of Strategic Studies (IISS), "The Military Balance 1975–76," p. 90, mentions a deal worth $2 billion. "The New York Times" in 24.5.75, p. 5, quotes figures of $800 million and $1 billion from "communist sources" but also mentions $4 billion. Thomas Lippman (Washington Post, May 25, 1976) gives a $500 million figure. See also The Economist, June 21, 1975, pp. 67, 69.

[15] According to the SD data for 1974, 50 percent of all Soviet MA went to Oil Countries except for Libya. With Libya, the figure may go up to 70–75 percent or more.

[16] If a discount of 20 percent is applied to the 1971–74 figures, the increase in total yearly aid becomes 2.9 times that to the region—4.5 times.

the *net* economic burden of the MA program. Hard currency sales of arms differ, of course, completely from the free grant of arms—if not by ex-ante intentions then by sober ex-post realization. For the sake of analytical clarity, and because the repayment issue has assumed a very important role in the most recent years, we shall deal first with the supply-burden in isolation and add the repayment element later.

Second, the most difficult problem in evaluating the supply-burden of Soviet MA, or for that matter that of any economic expense, is the choice of the appropriate denominator; i.e., that economic category which is the real bearer of the burden. An example of an inappropriate denominator is the popular estimate of the MA burden as a percent of total Soviet GNP—clearly it amounts to only a fraction of one percent.[17] We do not believe that even in a reasonably long run the entire resources of the Soviet Union can be reshuffled so as to change the size of the MA commitments. An economic category chosen as a denominator should be one that on the one hand contains only elements that can be shifted to MA uses, and on the other does not exclude any available resources that can be turned into MA. But since shiftability or substitution between MA and other uses is a matter of degree, a number of appropriate denominators may be chosen. It should be borne in mind, however, that, as a general rule, the reduction in the arithmetically estimated burden achieved through the use of a wider denominator is at least partly offset by a decline in the shiftability of some of the categories included with MA. Thus, MA is a smaller percentage of the total Soviet defense budget than of its procurement component; at the same time it is much more difficult to shift resources—for economic, bureaucratic, and decision-making reasons—from military R&D or personnel payments to MA than it is within the procurement appropriation. On the other hand, a too narrowly defined denominator also misses its purpose; it may show a very high burden on a specific category, but at the same time the system can, with relative ease, shift more resources to this category and ease the burden. The above example also illustrates that the degree of substitution is determined not only by economic considerations but also by bureaucratic structures and the nature of the budgetary appropriation process. In view of all this we have decided to use as denominators a number of categories within the framework of the Soviet defense budget and capability and also one civilian category—the production of machinery and equipment, the technological base of Soviet arms production.

A closely related but still distinct problem in evaluating the burden is the well known phenomenon that even within a well-defined, highly substitutable denominator category, only a relatively small part is periodically up for reallocation, while the internal allocation of the bulk of the category is at any point in time, given by tradition and previous decisions. The burden imposed by the need to increase the appropriation to a certain category or introduce a new one is thus far heavier than what is implied by comparing the total amounts on both sides. This phenomenon, which I elsewhere dubbed as "the small-

[17] In 1974 for example, total Soviet MA of 912 (SD) to 1,537 (ER) million rubles amount to .2–.3 percent of Soviet GNP of about 470 million rubles.

share illusion" is especially relevant in cases where the MA rates of growth exceed those of its denominators.[18]

As always when Soviet ruble magnitudes are involved, the problem of whether they are valued at the right prices arises. As stated above, the relevant prices of Soviet MA items for the purpose of estimating the burden are those which represent the real costs to the Soviet Union. If indeed, Soviet official military equipment prices are artificially too low in this respect, as some students claim,[19] then all the burden estimates with denominators of non-military nature are underestimated; when military spending categories serve as yardsticks the problem does not arise. But even in such cases there remains the problem of whether MA prices are somewhat biased. On the one hand MA, being export goods, should be sold at "international prices," on the other it is known that political considerations also play a role in the decision on pricing.[20] Finally, there is the problem of evaluating the prices of second-hand equipment and of old vintages that is no longer in use by the Soviet armed forces. Since no systematic information is available on the biases involved in these problems, we shall have to treat the value-estimated burden magnitudes with some caution.

In order to check the value estimate, to avoid some of these difficulties, and also in order to obtain more narrowly defined denominators, the paper also presents physical estimates of the MA burden where quantities of arms supplied as MA, and stocks of Soviet arms at the disposal of the aid recipients are compared with Soviet stocks and production levels.

A different way of solving the problems of evaluating the significance of burden estimates is to use the comparative approach. Comparisons of consistent estimates over time can at least answer the question of whether the MA burden has increased or decreased. Similarly, comparisons of Soviet MA burden estimates with those of the U.S. in the same area and under similar circumstances are of considerable significance, even when it is not exactly possible to determine the absolute level of the burden on each.[21]

B. Value Estimates

Panel a of Table 4 presents the yearly, current ruble values of four different Soviet expenditure categories which are considered appropriate denominators by which to evaluate the extent of the MA burden. The ratios of the MA figures to these categories—for different sub-periods and groups of countries are given in panels b and e. Detailed notes on the derivation of the denominators' values are given in the notes to the table. Here let us warn the reader that while we believe that the figures are good enough for the function they are intended to serve here (as broad denominators to much smaller nominators) they are not accurate enough to be used otherwise. All the denominator categories are presented in current ruble prices, as are the MA series.

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[18] For example increasing a share from 4 percent to 5 percent may involve absorbing perhaps 20 percent of the 5 percent of the entire category which can be reallocated.

[19] See for example: Andrew W. Marshall, "Estimating Soviet Defense Spending," Survival, XVIII, No. 2 (March/April 1976), p. 75.

[20] SD 1964, p. 11, and ACDA 1973, op. cit., pp. 27, 37.

[21] Not included in this paper.

TABLE 4.—SOVIET MILITARY AID TO THE MIDDLE-EAST AS PERCENT OF SOVIET DEFENSE AND RELATED EXPENDITURES: 1955–74

	1955–74	1955–66	1967–70	1971–74
	(1)	(2)	(3)	(4)
(a) Soviet expenditures (billions of current rubles per year):				
Defense budget (D)	17.9	13.8	22.5	25.5
Defense less R. & D. and personnel (D–)	8.2	6.7	9.0	12.2
Defense production (DP)	5.9	3.5	8.4	10.4
Machinery production (MP)	28.9	18.8	37.7	50.3
(b) Military aid to region as percent of:				
D	2.0	1.1	1.7	3.5
D–	4.3	2.4	4.4	7.3
DP	5.9	4.5	4.7	8.6
MP	1.2	.8	1.0	1.8
(c) Military aid to main-3 as percent of:				
D	1.6	1.0	1.3	2.8
D–	3.5	2.1	3.2	5.8
DP	4.8	4.1	3.5	6.8
MP	1.0	.8	.8	1.4
(d) Military aid to Egypt as percent of:				
D	.8	.7	1.0	.8
D–	1.7	1.4	2.5	1.6
DP	2.4	2.6	2.7	1.9
MP	.5	.5	.6	.4
(e) Military aid to Arab countries as percent of:				
D	1.8	1.1	1.6	3.0
D–	3.8	2.3	3.9	6.2
DP	5.3	4.5	4.2	7.2
MP	1.1	.8	.9	1.5
(f) Military to oil countries as percent of:				
D	.6	.3	.5	1.4
D–	1.4	.6	1.2	2.8
DP	2.4	2.6	2.7	1.9
MP	.5	.5	.6	.4

NOTES

Panel (a): Defense budget (D): Following S. Cohn it is defined as the official Soviet defense budget and total All-Union official 'science' budget, in current rubles. The data are: For 1955–69, Stanley H. Cohn, "Economic Burden of Defense Expenditures," in U.S. Congress, Joint Economic Committee, Soviet Economic Prospects for the Seventies (93d Cong., 1st sess., Washington, D.C., 1973 (JEC—1973), appendix table A, p. 158. 1970–73, Tsentralnoye Statisticheskoye Upravleniye (TsSu), Narodnoye Khosyaystvo S.S.S.R. v1973 godu (henceforth Narkhoz) (The National Economy of the U.S.S.R. in 1973), Moscow, pp. 779–781. 1974: Defense budget: Ekonomicheskaya Gazeta, No. 52 (December 1975), p. 9, and science budget: IISS, The Military Balance 1975–76, op. cit., p. 10.

Defense less R. & D. and Personnel (D–): On the basis of Cohn's calculations in ibid. From the official Soviet defense budget figures are subtracted personnel costs in current rubles: 1955–69, Cohn, ibid., col. (7). For 1970–74, on estimates based on extrapolation of the above series made on the basis of data on the number of personnel in the Soviet military forces as given in IISS, The Military Balance 1975–76, op. cit., pp. 81, 8.

Defense production (DP): Production of equipment for defense and space purposes in current rubles was estimated by applying Boretsky's percentages of (DP) in total Soviet production of machinery (see below) to a series of Soviet production of machinery in current ruble prices (see below). For years for which Boretsky does not give the percentage figures, they were estimated by extrapolation [1955–75—10.9 percent; 1960—14.9 percent; 1961—16.4 percent; 1964—16.0 percent; 1969—16.3 percent; 1971–74—15 percent]. The given percentages are from Michael Boretsky, "The Technological Base of Soviet Military Power," in U.S. Congress, Joint Economic Committee, Economic Performance and the Military Burden in the Soviet Union (91st Cong., 2d sess., Washington, D.C., 1970), table A–3, p. 227 and p. 214 (for 1970).

Machinery Production (MP): Total production of machinery ("machine-building products commodity bases") less those used within the machine-building industry, in current rubles. A series of total production of machinery in 1955 rules is obtained by combining Boretsky's 1955 figures (11,193 million rubles, ibid. p. 227) to the Soviet official index (Narkhoz 1973, p. 276, and assuming a 13 percent increase in 1974). The constant ruble series is then inflated into current ruble series by the use of the Soviet official price index for the entire machine-building and metal-working sector. (A. Becker "The Price Level of Soviet Machinery in the 1960's," Soviet Studies, XXVI, No. 3 (July 1974), table 1, p. 365, and Narkho 1973, p. 252 and extrapolating for 1974.) Finally, the MP series are calculated by subtracting self-use production inside the machinery industries according to percentages given by Boretsky (ibid.) extrapolated for missing years.

Panels (b)–(f): Underlying data to tables 2 and 3.

Three defense budget categories are used as denominators; the entire defense budget, the defense budget less RDT&E and personnel costs (D minus)—both on the basis of Stanley Cohn's calculations and method; and the value of production of military equipment—procurement—based on Boretsky's figures and method. The only civilian category chosen as a denominator is total production of machinery (net of intra-sales to the machinery sector). The figure for this category is estimated by applying the Soviet official index of machinery production in constant prices to the absolute 1955 figure given by Boretsky, and by reflating it by the Soviet official price index for the

Machinery and Metalworking sector. As can be seen in panel a of the table, the D minus series which contains construction and operations in addition to procurement, is not consistent with the defense production series based on Boretsky. To be consistent, procurement (during 1967–70 and 1971–74) must become 85–93 percent of the D minus series which is unreasonable.[22] This is not the place to judge between the two series; only to note that MA burden ratios based on the D minus series for 1967–70 and 1971–74 may be upwardly biased and those biased on the procurement series downwardly biased.

The major findings are as follows:

1. Over the entire period of two decades the Soviet Union devoted to MA to the Region about 2 percent of its entire defense budget, more than 4 percent of its operations and procurement part, and almost 6 percent of its arms production (including its space effort). The burden in terms of the production of conventional weapons only (excluding expenditures on the space effort, nuclear weapons, and most of the production for the navy) could probably go up to 8–9 percent.[23] The respective percentages of MA given to any particular group of countries within the region correspond to the relative distribution of MA as shown in Table 3 and discussed above.

2. Most of the computed burden ratios increased very significantly over time; thus MA to the Region increased from 1.1 percent of the defense budget during 1955–66 to 1.7 in the late 1960's and up to 3.5 percent during 1971–74, that is a more than three fold increase. The corresponding figures for the burden on the D minus segment of the defense budget rose from 2.4 to more than 7 percent; the growth of the burden on military production was from 4.5 to 8.6 percent. The rapid increase (according to Boretsky) of military production in the Soviet Union during the late 1960's was enough to keep the MA burden almost unchanged during 1967–70, but, assuming our estimating assumptions not too erroneous, this ceased to be true during the early 1970's when the MA ratio reached 8.6 percent. If indeed Cohn's figures are closer to the mark, then MA as a share of Soviet military production may reach more than 10 percent. (The 1971–74 figures for conventional military production only may thus reach between 12 and 14 percent.) If so, then the military production burden in 1971–74 was at least twice that of earlier years but may have even climbed to three times as much.

3. Over the entire period MA consisted of more than 1 percent of all production of machinery in the Soviet Union. Here too, as with respect to the defense denominator, the burden increased more than two-fold from 0.8 at the beginning to 1.8 percent during the latest years.

4. The rapid increases in the various MA ratios reflect of course the much faster growth rate of MA as compared to that for the defense budget categories and machinery production. The outcome leads not only to very impressive MA ratios during 1971–74 but to even higher proportions of MA in the marginal additions to the denominator categories and thus, one presumes, signifies heavy pressures on the decision makers to release those resources for MA purposes.

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[22] In the U.S. in fiscal year 1973 and fiscal year 1975 procurement and military procurement made up about 45 percent of the "D minus" figure: James R. Schlesinger, "Annual Defense Department Report, fiscal year 1975" (Washington, D.C., 1974), Table 1, p. 235.

[23] This figure is based on the assumption that strategic-nuclear-space and major naval procurement consists of between a quarter and a third of total procurement.

C. Physical Estimates

Two complementary approaches are presented here. The first is based on comparing available stocks of conventional weapons for the Soviet Union and its major MA recipients; the second is a flow comparison of Soviet production rates for the main types of arms with their rates of supply as MA. All the information is based on open sources and thus suffers from obvious limitations.[24]

Table 5 presents comparisons of Soviet-Arab military stocks for mid to end of 1975 and for mid-1971. In both periods Soviet stocks are compared with those (of Soviet origin) of the three main recipients of MA—Egypt, Syria and Iraq—put together and with those of all Arab countries. In 1975 a third comparison is added with Arab materiel losses in the 1973 war added to their 1975 existing stocks.

As can be seen, the combined stock of the three confrontation countries amounts in 1975 to anywhere between 7 and 14 percent of the Soviet stocks of comparable items; when other Arab countries are added the figures climb to between 9 and 19 percent. Thus, Egypt, Syria and Iraq possess some 5,500 (Soviet) tanks, while all the Arab countries together have 7,500 compared to some 40,000 in the possession of the Soviet Union. The comparable figures for combat aircraft are 1,200 and 1,600 compared to 8,600 in all branches of the Soviet armed forces.

These percentages, as well as those for other items, like SAM launchers, helicopters, armored personnel carriers (APC's) and artillery pieces are all found to be higher than the still very impressive percentages for 1971. Already in 1971, Egypt, Syria and Iraq had some 900 combat aircraft and all Arab countries together had at least 1050, 11 and 12 percent respectively of the Soviet stock at the time. Within four years these figures climbed to 14 and 19 percent respectively—despite the heavy Arab losses during the October 1973 war. A very similar picture applies to tanks, where the figures of 11 and 13 percent in 1961 climbed to 14 and 19 percent in 1975 and this in addition to the approximately 1500 tanks lost by the Arabs in the war that were replenished by the Soviet Union.

The 1971–75 stock comparisons also demonstrated the shift in Soviet MA flow away from the main three to other countries—the most important one being Libya. More detailed data, not shown here, also demonstrate very strongly the shift within the main 3 group away from Egypt to Syria and Iraq.

The above comparison of stock ratios at two different points in time already shows, what a one time-comparison cannot, that the "net" rate of build-up of the Arab military manpower from Soviet sources has proceeded more quickly than the Soviet's own build-up and that the resulting MA supply burden on Soviet sources has increased.[25] This is not the entire picture, however, the "net" rate of build-up as presented here is related only to *net* additions to the Soviet and Arab stocks and thus ignores any differences between the two sets of figures in losses due to all reasons, and in replacement of new for old equipment.

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[24] The sources of this section are mainly publications of The International Institute of Strategic Studies (IISS), especially its annual "Military Balance," those of SIPRI, the "SIPRI Yearbooks" and its "Arms Trade Registers, 1975," op. cit. and John Erickson, Soviet Military Power (London: Royal United Service Institute for Defense Studies, 1971).

[25] It does not show, however, that the rate of buildup of the 1971 stock was slower than that of 1975. On that see below.

TABLE 5.—COMPARING SOVIET AND ARAB STOCKS OF VARIOUS WEAPONS

	Soviet stocks	Arab stocks				Percent			
		Main 3	All Arab	Main 3 plus 1973	All Arab losses	(2)/(1)	(3)/(1)	(4)/(1)	(5)/(1)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
A. 1971:[1]									
1. Tanks	[3] 30,000	3,400	4,000			11	13		
2. Armored personnel carriers	[3] 39,000	2,100	2,500			5	6		
3. Artillery pieces	[4] 30,000	2,900	3,000			10	10		
4. Combat aircraft	8,500	900	1,050			11	12		
5. Transport airplanes	2,000	90	110			5	6		
6. Helicopters	[5] 2,500	200	250			8	10		
7. SAM launchers	[6] 12,000	650	680			5	6		
B. 1975:[1]									
8. Tanks	[3] 40,000	5,500	7,500	7,000	9,000	14	91	18	23
9. Armored personnel carriers	[3] 43,000	5,200	6,100	6,000	6,900	12	14	14	16
10. Artillery pieces	[4] 40,000	3,500	4,700	4,100	5,300	9	12	10	13
11. Combat aircraft	8,600	1,200	1,600	1,500	1,900	14	19	17	22
12. Transport airplanes	1,700	110	145	110	145	7	9	7	9
13. Helicopters	[7] 3,500	240	325	295	380	7	9	8	11
14. SAM launchers	[8] 15,000	1,300	1,400	1,500	1,600	9	9	10	11

[1] Midyear.
[3] 80 percent of full strength.
[3] 90 percent of full strength.
[4] Assuming a 1 to 1 ratio with tanks.
[5] 2,000 reported by MB plus 500 in army divisions.
[6] 10,000 reported by MB plus 2,000 in army divisions.
[7] 2,750 reported by MB plus 750 in army divisions.
[8] 12,000 reported by MB plus 3,000 in army divisions.

General note and sources: Most figures on stocks come from IISS, The Military Balance 1971–72 and 1975–76 (London, 1972 and 1976). The "1973 lossess" figures are from IISS, Strategic Survey 1974 (London, 1975), p. 15. [Also SIPRI Yearbook 1974, p. 151.] The 2 major exceptions are first: To "all Arab" 1975 stocks we added some military Soviet supplies to Libya, reported to have arrived there sometime during 1975 ["Yediot Aharonot" (Israeli Daily) Dec. 12, 1975, Washington Post, May 25, 1976]. 2d, the Soviet Stocks were estimated on the basis of both stocks reported in the above source and on information on standard equipment in various Soviet military units as given in John Erickson, Soviet Military Power (London, 1971), pp. 52–82; John Erickson, Sunday Times, Feb. 8, 1976, Jeffrey Record, Sizing Up the Soviet Army (Washington, D.C.: The Brookings Institute, 1975), pp. 13, 29; and on information received from Amnon Sella. See also specific notes. It is generally believed that Arab stocks as repoted by The Military Balance are underestimates.

It is our claim that when losses are taken into account, the resulting Soviet MA supply ratios—as compared to self supply will be much higher; the difference between the corresponding gross build-up rates, including losses, will be wider than those shown in the net differentials through the table. The major factor which accounts for the widening of the differential is of course the Arab war materiel losses, which were added for this reason to the 1975 stock comparisons. As can be seen in Columns (8) and (9) of the table they add between 1 and 4 points to the Arab/Soviet stock ratios and thus widen the 1971–75 ratio differentials showing a much faster MA build-up rate as compared with that of the Soviet military power in comparable items. With the losses included, the Arab/Soviet stock ratio for tanks about doubles between 1971 and 1975, and that for combat aircraft almost doubles for all Arab countries and increases very significantly for the Main–3.

War materiel losses, however, are only one factor widening the gross build-up differential as compared with the net differential. The war itself, in addition to outright losses it caused, also accelerated the rate of wear and tear of weapons that were not lost, so that the replacement rates also rose; the war also created a need for much higher ammunition to arms ratios and relatively larger supplies of spare parts and maintenance materials in comparison with the number of weapons. For any implicit normal ratios of ammunition to weapons and parts to weapons that are assumed in conjunction with Table 5—the 1973 war, and the wars that preceded it created needs for higher than normal ratios for MA. Finally, it is claimed that the rates of wear and tear and of training accidents during non-hostile periods or operations are higher for the less well-trained Arab armies than they are for the Soviet forces—a factor working also to widen the gross MA/Soviet build-up rate for a given net differential. Working in the opposite direction is the fact that probably a larger percentage of Soviet production of armaments is devoted to replacing old models by new ones, rather than to net increase in stock. We come back to the implications of this factor shortly.

A very rough attempt to quantify some of the above mentioned factors and to present them in flow, rather than stock terms, is made in Table 6. Presented there (Column 3) are estimates of total and annual supply of a number of major weapons to the main three and to all the Arab countries combined since 1967. They are compared with (only) recent rates of Soviet total annual production of 'the same' items. The supply flow of Soviet arms to Arab countries are estimated by adding to net-stock increases, war losses, estimates for arms lost in training accidents, and weapons that went out of service due to obsolescence. The accuracy of these estimates declines as one goes down the items on the above list, but we believe that the orders of magnitude of the mistakes do not distort the findings. The periodization is also slightly different than in previous tables; it actually covers mid-year to mid-year, in line with the Military Balances of the IISS.

Most striking are the high ratios obtained between the annual flows of supply of Soviet arms as MA to the total annual (1973–75) Soviet production figures. As presented in the table, the ratios for combat-aircraft for the entire period 1967–75 for all Arab countries is about 25

TABLE 6.—SOVIET PRODUCTION AND SUPPLY AS MILITARY AID OF VARIOUS WEAPONS: 1967–75

	Soviet annual production 1973–75	1967–75		1967–71		1971–75		1973–75	
		Main-3	All Arab	Main-3	All Arab	Main-3	All Arab	Main-3	All Arab
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1. Combat aircraft: [1]									
Total	(2)	1,710	1,963	892	956	818	1,007	486	582
Annual	965	214	245	223	239	205	252	243	291
2. Tanks:									
Total	(2)	6,520	8,410	2,630	3,210	3,840	5,200	2,310	3,380
Annual	2,600	815	1,050	658	803	960	1,300	1,155	1,690
3. Armored personnel carriers:									
Total	(2)	5,470	6,100	1,430	1,540	4,040	4,560	1,700	2,020
Annual	3,700	684	763	358	385	1,010	1,140	850	1,010

[1] Data do not include 83 of a larger figure of MIG–23's reported as promised but not yet supplied (according to MB). Their inclusion increases the annual supply figures by 10 for 1967–75, by 20 for 1971–75, and by 40 during 1973–75.
[2] Not applicable.

Note: The Soviet supply figures [col. (2) to (9)] are calculated as follows:
1. Net stock increases from the initial date to the end of each period are acquired from IISS, The Military Balance (MB) of the relevant years. The figures include supply to Libya in 1974–75 above what is reported in MB as explained in the general note to table 5. These figures are usually for the middle of the year indicated.
2. War losses are added; 1973 losses are taken from IISS Strategic Survey 1972, op. cit., p. 15 and other losses (of the war of attrition) are roughly estimated.
3. Training losses are estimated at one aircraft a month in Egypt, Syria, and Iraq [based on an Iraqi report and on a testimony by Heikal to that effect. The Iraqi report appeared in 'al-Waga'i al-Iraqiyah' on Apr. 4, 1972, pp. 1–2 and reported the writeoff of 12 Soviet aircrafts that were destroyed in accidents during a period of less than 13 months; Heikal in The Road to Ramadan (Glasgow: Fontana/Collins, 1976), p. 179, reports on 68 aircraft crashes during 1971–72.]
4. Aircraft discarded or turned from combat to training missions added to the supply figures. The figures are estimated through the listing of al types of aircraft in the MB's of various years.
All the estimates are helped by information on stocks and on arms deals reported in SIPRI's Yearbooks for various years and Arms Trade Registers 1975, op. cit.
The Soviet annual production figures are from Aviation Week and Space Technology (AW), Jan. 26, 1976, p. 20. They are very similar to figures for 1975 given by the British Minister of Defense, Roy Mason, as quoted in AW, Apr. 12, 1976.
For data on Soviet production figures in previous years see note 27 in the text below.

percent.[26] While there is no question that these ratios are much above anything experienced in the period prior to mid-1967, the increase in the ratios from 1967–71 to 1971–75 are not that striking, especially for combat aircraft. The actual increase in the MA-to-production ratios is probably even lower than that shown in the table if Soviet production rates of the items listed also increased in 1973–75 as compared with earlier years, as indeed seem to be the case.[27] One explanation for the failure of these supply ratios to show 'striking' increases is that those increases in the production rates of planes, tanks, APC's etc., resulted, among other reasons, from the need to raise the supply flows of MA. In this way the burden on very specific production lines can be reduced, only at the expense of resources pulled in from other uses.[28] As computed here, however, the ratios of MA to production increased between the two four-year periods for planes from less than a quarter to closer to 30 percent (to almost a third in 1973–75), for tanks from 30 to 50 percent and for APC's from 10 to 30 percent. All the ratios shown here are significantly above the stock ratios of Table 5, thus underscoring the higher build-up rates noted for the Arab arsenals.

[26] The last ratio is an underestimate because of less than full coverage in reporting on Arab countries' stocks.
[27] On recent increases in production of aircraft, helicopters, tanks, troop carriers and other conventional military equipment, see: U.S., Congress, Joint Economic Committee, "Allocation of Resources in the Soviet Union and China 1975" (94th Cong., 1st. sess., Washington, D.C., 1975), p. 31; James R. Schlesinger, "Annual Defense Department Report fiscal year 1976" (Washington, D.C., 1975), pp. III–35; IISS, "The Military Balance 1975–75," op. cit., p. 4; "Aviation Week and Space Technology," April 12, 1976, pp. 12–13 (reporting on a talk by British Defense Minister Roy Mason). See also John Erickson's article in Sunday Times, February 8, 1976.
[28] See introductory discussion on pp. 19–20 above.

It must be emphasized however that the above-computed ratios do not mean that the indicated percentages of planes or tanks are being sent each year as MA directly from the production line. Obviously, a significant proportion of what is being sent consists of earlier models previously used by the Soviet armed forces and now being replaced by newer ones; many T-55 tanks, older vintages of Mig-21's, APC's, SAM or even SCUD missiles are still being supplied, so that the direct burden on the various assembly lines at any given time is much lower than what is implied from the table, as are also the total burden rates that include lower-line equipment. Moreover, since much of the own arms procurement of the Soviet armed forces is directed to improve the quality of its equipment by replacing old models with new ones, this build-up process creates from time to time surpluses of older model arms that may, for a reasonably low cost to the system, be sent as MA.

The burden ratios are also overstated because even when first line equipment is supplied as MA, it consists of the simpler less expensive items among the assortment of the items shown. In the table this exaggeration is felt especially with respect to aircraft, but it also applies to APC's.

These two last factors should of course also be taken into account in evaluating the stock burden ratios presented in Table 5. There too the actual burden implied by the various Arab/Soviet stock ratios is lower than that shown. But while reducing the burden levels at each point of time, these two factors contribute to the raising of the (lowered) burden levels over time. This increase results from secularly rising trends in the proportions of first line equipment within each arms group supplied, in the inclusion of more sophisticated and costly items in the MA, and from the constant narrowing of the time gap between development and first deployment of a new model by the Soviet forces and its appearance in the MA lists.[29] With respect to Table 6, these factors raise the actual supply/production ratios for recent periods as compared with earlier ones and thus strengthen the proposition that the MA supply burden on the Soviet Union indeed rose over time.

D. Concluding Comments

The value and physical estimates of the burden complement each other by covering to some extent different aspects of the entire problem. But they seem also to support each other by presenting together a reasonably consistent description of the MA burden. To summarize: the value-burden ratios for the Main-3 range from 3.5 percent in 1967–70 to almost 7 percent during 1971–74 (for all Arab-countries excluding Libya the figures are 4.2 and 7.2 percent respectively). For 'conventional' weapons only they should rise to a 6 to 9 range. The ratios are to be compared with physical burden stock ratios of 5–11 percent for the Main-3 in 1971 (6–13 for all Arab countries) and 9–14 (9–19) in 1975; and with 1975 specific flow ratios of 20–40 percent. That the levels of the burden ratios based on physical data are consistently higher than the value ratios, is explained first by the fact that the physical numerators (the MA components) account for larger pro-

[29] A. Sella, in his forthcoming "The Soviet Conduct in the Middle East, 1973–75," presents a detailed analysis that demonstrates this point. See also Pajak, op. cit., p. 165.

portions of the corresponding ruble numerators than do the physical denominaors with respect to their ruble counterparts. Thus, tanks, APC's, aircraft and SAM's constitute a higher proportion of MA than of total Soviet military production, which, in addition to the above includes strategic-nuclear arms, large naval units, etc. Second, the value burden ratios are lower also, because as emphasized above, the physical ratios fail to account for the supply of lower-line and less sophisticated equipment, while the value ratios, if MA is correctly priced, should reflect these factors. Our estimates of value and physical ratios for the burden at least do not reject the proposition that MA prices take account of the lower relative quality of MA. They also leave room for the question as to whether the MA value figures are not somewhat too low.

The physical and value ratios show mutually consistent results also in that according to both ratios during 1971–75 and certainly during the last two years, not only the real amounts of MA increased as compared with earlier periods but the relative burden went up as well for most of the relevant denominator categories considered.

The conclusion of this section is clear and unequivocal: both the absolute levels of burden ratios and the upward trends shown picture a heavy and ever increasing supply burden, an increase that creates even heavier claims on increments of new available resources. There is no question that the need to supply MA forced the Soviet periodically to plan for significantly higher production in runs of a relatively large number of weapon systems. While expanding the production base of specific weapons naturally reduces the corresponding burden ratios based on them, it clearly does not reduce the overall burden on military production or the defense budget. Any such increase in arms production in the tightly planned and heavily pressured Soviet economy poses a problem. The increase represents a much heavier burden when military production is expanded for MA purposes at the same time that a general effort is being made to raise the production of civilian (consumer) goods, with the help of the military (and heavy industrial) production capacity (in many cases within the premises of the same factories that produce military goods). The problem is heightened further when the military procurement plans call for increasing production to meet the needs of the Soviet armed forces (the build-up along the border with China, the bolstering of conventional capabilities in Europe, and a major effort to enlarge the functions and capabilities of the tactical air-power).

IV. The Heavy Supply Burden—Why?

In the introduction to this paper I presented the Hypothesis/Conclusion of my 1971 paper, i.e., that the heavy MA burden the Soviet Union took on itself up to 1970 could only be explained by the strategic-nuclear threat directed at the Soviet Union itself from the Mediterranean and by the paucity of direct Soviet means to counter it. Air and naval bases to support some kind of counter force were essential at the time.[30] That intensive Soviet efforts and pressure were

[30] Ofer 1973, op. cit., pp. 236–238. The thesis is based on Michael MccGwire, "The Background of Soviet Naval Developments," The World Today, XXVII (March 1971), pp. 93–103.

exerted on Egypt in order to achieve these goals is now much better documented.[31]

But the 1971 paper went on to infer from this conclusion probable future developments in Soviet involvement in the region and the direction of its MA (and other aid) programs. It was speculated that the center of gravity of the strategic-long-range-nuclear deployment would shift to the Indian Ocean, and that the Soviet Navy would increase its power and its ability to operate independently of shore bases. If so, and despite the existence of other Soviet interests in the area, it was expected that the Soviet Union would try to reduce the level of MA to the region thereby lowering the MA burden to fit its expected lower level of interests.[32] The deterioration of Soviet-Egyptian relations during 1971–72, which culminated in the explusion of most of the more than 20,000 military advisors and the closing of Soviet bases in July 1972, was taken as a clear sign that the Soviet Union indeed decided to reduce its MA and other commitments and was willing, at least to some extent, to pay the political and strategic price involved.

As is shown in this paper, however, the opposite of the above expectations is what actually occurred. Rather than declining Soviet MA to the region and even to the Main–3 kept right on climbing and by significant amounts; the supply burden became heavier and not lighter. Clearly there is need for some new explanations to be made. What can explain this continuing increase in the volume of MA?

First, it is generally agreed that during the past few years the strategic-nuclear importance of the Mediterranean has declined and that at least this kind of big-power competition is being shifted, concurrently with the development of longer range submarine-launched ballistic missiles (SLBM) and better detection and counter measures against them (and against aircraft carriers), in the general area of Africa-Asia to the Indian Ocean. This shift of emphasis from small water basins to the wide oceans is also in line with the general trend of development of the Soviet navy and its deployment. The specific shift in the importance of the Indian Ocean relative to the Mediterranean has resulted also from the increased strategic significance of the oil-producing Persian Gulf region. Furthermore, while in the past the role Soviet planners assign to naval passage through the Suez Canal has been extensively debated, the Soviet naval presence in the Indian Ocean is based now on its Far-Eastern bases, which further reduces the importance of the Eastern Mediterranean as a passage-way southward.

One development that did not materialize is that the pace of building self supporting naval capabilities was apparently slower than expected. Soviet dependence on naval (and air) land bases is still very strong,[33] and this may partly explain why MA did not actually decline. Specifically, it may account for some of the increasing Soviet MA efforts in Libya and Syria.

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[31] See as examples: Mohamed Heikal, "The Road to Ramadan" (Glasgow: Fontana/Collins, 1976), pp. 45–46, 137, 163–66, 175; and George S. Dragnich, "The Soviet Union's Quest for Access to Naval Facilities in Egypt Prior to the June War of 1967," in Michael MccGwire et. al. eds. "Soviet Naval Policy: Objectives and Constraints" (New York: Praeger Publishers, 1975), pp. 237–277.

[32] Ofer 1973, op. cit., p. 238.

[33] Michael MccGwire, "Current Soviet Warship Construction and Naval Weapons Development," and "The Evolution of Soviet Naval Policy 1960–74," in MccGwire et. al., op. cit. (pp. 422–45 and pp. 532–35, respectively).

Second, the major changes in the region during the last few years—with respect to the Arab-Israeli conflict and the price of oil—have weakened the Soviet position in the area and thus may have forced the Soviets to spend more, to pay a higher price, in order to secure some level of presence and influence, even one lower than that previously enjoyed or presently desired.

The shift in the focus of the Arab-Israeli conflict (at least for now) toward political efforts has weakened the Soviet position vis-a-vis its Arab counterparts, since it is clear, at least to most Arabs involved, that the Soviet Union is in an inferior position, compared with the US, to help them with a political option. A Soviet Union that used the conflict in the past to penetrate into the ME by offering the Arabs a military option can offer much less now; at least some Arab leaders and Sadat among them are willing to turn to the US for political, as well as economic and military, support.

The second major change, the rise in the price of oil made the Arab countries, as a group, much stronger politically and much less dependent economically. Their enhanced political and economic power affects of course all outside powers, but especially, it would seem, the Soviet Union, since its willingness to offer military and economic aid at comparatively low prices and easy terms—so crucial in the past—has now lost part of its importance. That neither Egypt nor Syria are direct beneficiaries of the new oil bonanza keeps some Soviet options open, however, but it also makes these countries easy targets for political pressures from the richest Arab countries, Saudi-Arabia and Kuwait, as well as Iran, to turn away from a Soviet orientation.

Finally, the increased American interests in the region, because of the oil crisis, as well as the new opportunities opened to the US to promote such interests raise the level of outside opposition to continued high-level Soviet presence and with it jack-up the price the Soviets will have to pay to hold their position.

It is very difficult to determine to what extent the Soviets, faced with higher prices in the above sense, are also willing to put up with them. They did (or at least partly so) in resupplying both Egypt and Syria with most, in the case of Egypt, and much more, in the case of Syria, of their 1973 losses. Statistically, these supplies contribute significantly to the observed increase in MA. Soviet behavior in the years before the war reflects an ongoing internal debate as to whether the increased economic and political price demanded for their continued presence was worth paying, and one has observed their attempts to keep the price down. During 1971 and 1972 the Soviets tried, by refusing to increase the supply of arms—including SCUD missiles and the newest MIG–23 planes—to reduce the MA burden and probably also to avoid or postpone the coming war. In late 1972 they had to give in, in order to keep their position.[34]

Even with its strategic interest in the area somewhat blunted, the Soviet Union still has many reasons for wanting to keep its presence in the ME. It thus may be willing to pay a somewhat higher unit price for it. I doubt though if it is really ready to spend so much more on

[34] Mohamed Heikal, op. cit., pp. 175–180; Yaacov Ro'i, "The U.S.S.R. and Egypt in the Wake of Sadat's 'July Decisions,'" The Russian and East European Research Center Slavic and Soviet Series No. 1 (Tel Aviv University, 1975), pp. 32–36.

MA to the region than before. More explanations are then required for the increasing MA supply burden.

Selling arms for hard currency, instead of trading for long-range, low-interest, soft-currency, repayment arrangements as in the past, can of course turn a high MA supply burden into a much lower net or overall burden. Moreover, it can amount to completely changing the MA picture. If selling of arms is possible, then clearly any burden is drastically reduced. But, even beyond that, instead of talking in terms of burden, one may consider whether a new Soviet positive economic interest toward the region is being developed.

That the export of Soviet arms to Middle Eastern countries is economically desirable to the Soviet Union hardly needs elaborate argumentation. First, there is no question that the Soviet Union has a decided comparative advantage in the production of arms. The military industry is by far the most efficient manufacturing industry in the Soviet Union; it may even be more efficient than some of the Soviet raw-material extracting industries. Second, the Soviet Union faces a long run hard currency deficit due to the gap between its demand for Western technology and Western grain and its ability to increase industrial, and raw-material exports directly to the West. Finally, the Middle East with its huge hard currency income is the only region in the world in which it is potentially possible to turn soft-currency goods, like arms, into hard currency. In 1971 Brezhnev encouraged the military and heavy industries to use their high scientific and technical ability to help elevate the technological level of civilian production.[35]

The transfer of resources and know-how from military to civilian production is one way to attack the problem of low efficiency, low quality, and low technology, but it involves some reduction in defense production capacity. Selling arms as exports, on the other hand, can contribute to solving the same problem without reducing that capacity; it may even be more efficient, since the extra hard currency proceeds can be used to buy new civilian technology in the West. Given the difficulties and the reluctance to shift resources out of the defense industry, and the economic advantages involved, the prospect of selling arms in the ME should have become the dream of the Soviet planners—their Eldorado. The Middle East as a whole has been buying arms worth many billions of dollars per year during the last few years.[36] It would be hard to believe that the Soviet Union would not develop a strong interest in obtaining a share of this market. Naturally, if indeed there is such an interest it can only be realized by reducing the intensity of other interests which the Soviets are apparently willing to do. True, the relations between supplier and buyer of arms cannot be limited to cold economic exchanges—some degree of long-run political understanding and cooperation is essential, but clearly the political and military price asked by the supplier must be much lower when the recipient pays cash.[37]

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[35] Pravda, Mar. 31, 1971, p. 5.

[36] IISS, "The Military Balance 1975–76," op. cit., pp. 90–92, reports on at least $5–6 billion worth of arms deals of regional countries (except Israel) only with the West over a period of approximately one year—late 1974 to mid-1975. American sales or arms to the region are put at least at $2.5 billion yearly during fiscal years 1975, 1976, and 1977 only to Iran and Saudi-Arabia, see "Aviation Week and Space Technology," April 17, 1976, p. 11. See also D. H. Rumsfeld, "Annual Defense Department Report fiscal year 1977," (Washington, D.C., 1976), pp. 186–190.

[37] See Donald H. Rumsfeld, "Annual Defense Department Report fiscal year 1977," op. cit., p. 187.

The assumed Soviet willingness to forgo some of its political demands on recipients of arms is one factor that may increase the attractiveness of buying Soviet arms. Other advantages include the much lower prices of Soviet weapons as compared with Western Equipment; the fact that Soviet weapon systems are usually simpler to operate than comparable Western systems—an important feature in view of the human capabilities of most of the countries in the region; and finally, the Soviet Union has large production capabilities and stocks, so that supplies can be delivered relatively quickly in case of emergency. On the other hand, countries in the region may be reluctant to buy Soviet arms or to finance the purchase of such arms with the help of other Arab countries for obvious political reasons, even if the political Soviet demands are somewhat muted.[38] Possessing hard currency, they will naturally try to acquire 'hard'-goods which they probably, and justifiably, consider to be better.[39]

In view of the above arguments and the unpredictability of future developments in the ME, it is hard to predict the chances of success of the Soviet arms trade with countries in the region. The prospects seem to be good enough for the Soviet Union to try hard to pursue this economic interest, which I believe it has already been doing with considerable vigor during the last few years. I thus suppose that at least part of the explanation for the increased Soviet MA supplies to the region perhaps since the early 1970's but certainly since 1973, lies in their ability to reduce the total burden involved by selling more arms for hard-cash or hard cash goods and in their readiness to give up part of their political, ideological and military demands.

There is no open source that sums up total Soviet hard currency income from arms sales to the region. From the number of fragmentary pieces of information available in the West it is clear that those concerned know the total so there is no point to try to estimate it here. It is now beyond doubt, however, that during 1973–75 such income may have reached a couple of billion dollars or even more. First, there is evidence that a considerable part of the arms supplied to Egypt and Syria since 1973 was paid for in hard cash by other Arab countries (Algeria, Libya, Saudi-Arabia, Kuwait and other countries). Secondly, it is quite clear that arms deals with oil countries, Iraq, Libya, and possibly Algeria and Iran are also payable in hard currency or in oil and gas—which are equivalent to it since they are reexported to the West.[40] The increased proportion of arms sales also explains, I believe, the shift in recent years in the distribution of Soviet MA to the region—towards higher proportions of such "aid" going to oil countries—Libya, Iraq, Iran.

In conclusion we must retreat a step and put things back in their right proportions. We still believe that political and strategic consid-

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[38] One recent example is the struggle on who will sell the air-defense system to Jordan. It is assumed that the Saudis—the potential financiers of the deal in case it goes to the U.S. are not willing to finance it for the Soviet Union. But Libya may. See also The Economist, June 21, 1975, pp. 67, 69.

[39] One example are Soviet problems with Iraq which reduced its oil shipments to the Soviet Union in 1974, and increased its orders for Western weapons. See A. Kelidar, "Iraq: The Search for Stability." Conflict Studies, No. 59 (July 1975), p. 18. On new arms deals with the West, see IISS, The Military Balance 1975–76, op. cit., p. 90.

[40] Cash, hard currency payments started apparently before the 1973 war: see Heikal, op. cit., p. 161 and Ro'i, op. cit., pp. 36, 40. On payments following the war, see Pajak, op. cit., pp. 170, 171; SIPRI Yearbook 1974, p. 152 ($2 billion); President Asad claimed that he paid for all Soviet supplies following the war (New York Times, March 3, 1974). See note 14 above on the size of the Libyan deal. The minimum amount given by T. Lippman (The Washington Post, May 25, 1976), is $500 million.

erations play a major role in Soviet policy in the Middle East and that economic considerations are of secondary importance, and that espeically when MA agreements are considered the political aspects are very crucial. But, when comparing the intensity of Soviet interests and resulting policy up to the early 1970's with what followed we have to conclude that the balance here shifted somewhat to give higher weight to economic considerations and lesser importance to political-strategic ones. It would be impossible of course to explain the shift of Soviet bilateral relations from Egypt to Libya, mainly on economic grounds. Clearly Egyptian interests and preferences play a big role here. Let us not rule out, however, that at least the second half of that shift—the move to Libya—had something to do with economics.[41] Finally, while this paper dealt only with the economic aspects of military aid, the larger study, which includes economic aid and commercial relations as well, seems to reinforce the same conclusion: the Middle East has become a unique place where Soviet (and East-European) soft-goods; arms, machinery, etc. may be turned into hard currency and hard-currency goods (like oil to East-Europe). In view of the general Soviet economic position, especially vis-à-vis the West, such prospects are bound not to be passed over.

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[41] The Libyans, for their part consistently insist that the arms deal with the Soviet Union is "strictly a commercial transaction, that Libya buys from the Soviet Union because there is no other willing supplier" and that no bases are offered to Russia nor are there any 'ideological strings attached' (Washington Post, May 25, 1976). This of course does not reveal all the Soviet intentions but must carry some weight. See also, The Economist, June 21, 1975, pp. 67, 69.

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Part II. ECONOMIC PERFORMANCE

SOVIET ECONOMIC POWER GROWTH—ACHIEVEMENTS UNDER HANDICAPS

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I. SUMMARY

Russia in its Imperial and Soviet guise has always been a great military power, strong-willed and proud of its martial tradition. Its economy has never matched its strategic capabilities; it is second in the world but a very secondary second.

This paper reviews the nation's development in the course of this century, in particular since the Second World War, and compares its economic strength with that of the United States. The yardstick used is the gross national product (GNP); its many statistical problems are acknowledged and call for a warning that the figures presented on the following pages should be considered approximations and illustrations rather than precise measurements (today's consumers must be coddled).

At this juncture there exists a special vexation: CIA has doubled its ruble estimate of Soviet national security expenditures for the past five years. While its previous assessments had definitely been

on the low side, its new figures may stray too far in the other direction. Certainty about the real Soviet defense burden is unobtainable in the face of the USSR's secretiveness; future research will have to examine whether the revised military statistics make sense in the context of the national accounts or whether the latter require changes in their level, growth, and structure.

The much higher costs of weapons and space equipment point to a lesser productivity of the armaments industries. The cost difference is likely to reduce the investment series. This, in turn, poses the question of either slightly higher productivity in the civilian capital goods industries or a lower growth rate for the economy as a whole. Extrapolating the new defense estimates backward in time produces the as yet unresolved problem of whether the Soviet defense burden was also much higher in earlier postwar years or the growth of defense outlays steeper than thought or whether a mixture of these possibilities prevailed.

Going even further back in history, the paper suggests that around 1860 Russia and the United States had a GNP of roughly the same size and, with 2.3 times as many Russians as Americans, a per capita GNP ratio of 40:100. By 1913 the ratio was 39:100 for the GNP totals. It dipped deeply during the war and revolution, and recovered to 27:100 in 1928 when the Soviet Union regained its prewar GNP level, while the U.S. was on the height of a boom. There followed Stalin's industrialization drive and the American depression. In 1940, on the eve of the German invasion, the Soviet-U.S. ratio was 42:100; it would have been 38:100 if in that year the United States had fully utilized its resources.

History now repeated itself. During the war the GNP ratio fell again sharply; it regained a proportion roughly that of 1928, namely 29:100, three years after victory. But several decades of violence has stunted the USSR's demographic growth; there were 162 Russians for 100 Americans in 1913, only 119 in 1948 (or now, for that matter). Consequently the GNP ratio per capita was 24:100 both in 1913 and in 1948. With a more normal population increase it would have been much lower in the latter year. A larger population would have provided the U.S.S.R. with more labor but labor was plentiful anyhow; it would have required large consumer supplies and would thus have reduced the capital funds available for economic growth, at least in the absence of a more efficient economic system than the one Stalin had created.

U.S.-Soviet relations deteriorated soon after the victory, and the USSR's rehabilitation, though it was fast, was slowed by a new arms race that diverted resources from civilian investment and also from consumption. Soviet history is characterized by a "seesaw" between investment growth and military proceurement; a rise in the latter depresses the rate of the former and vice versa (the critical magnitudes increase, of course, with the growth of the economy). Moreover fol-

lowing the death of Stalin, the population in the U.S.S.R. and even more so in Eastern Europe became restive. His successors therefore adopted for a few years a policy of "détente", kept military outlays fairly stable and pushed investment with a new emphasis on consumer-oriented branches (such as agriculture and housing). Khrushchev also inaugurated what could be called his New Deal, i.e., an income policy aimed at a less inegalitarian distribution. The result was rapid economic growth and in 1958 when the US had succumbed to another recession, this time a severe one, the Soviet-US GNP shot up to 44:100, i.e., beyond the 1940 level.

This was a triumph for Khrushchev, and he was foolhardy enough to challenge the United States to an economic and technical race and to embark on an aggressive foreign policy. New preparedness measures reversed the "seesaw", while the capital funds available were invested with little wisdom. Soviet growth, as a result, slowed. In 1964 Khrushchev was ousted and a new administration, increasingly Brezhnev's, began to act in what was meant to be a steadfast and decorous manner. Brezhnev and his colleagues were able to speed up Soviet economic growth in the later 1960s, though only moderately because it became more and more difficult to manage an overcentralized command economy of that size and also because increasing amounts of resources were allocated to the military establishment.

The Soviet challenge was taken up by the United States; Eastern hubris was answered by American growth policies combining bold welfare programs with a global political and military role and the conquest of space. Between 1958 and 1969 both superpowers expanded their GNPs at roughly the same rate and their ratio remained unchanged. But in 1970 another recession hit the US, whereas the USSR had a very good crop, with the result that the ratio jumped from 44 to almost 50:100 in one year.

The 1970s have brought troubles on both sides of the fence—slumpflation here—two severe crop failures there complicating economic conditions under a plan (for 1971–75) that deserved to be underfulfilled. Its implementation had been predicated upon greatly improved efficiency in utilizing capital goods and materials; actually factor productivity of the combined inputs of labor, capital, and land remained stagnant. In the current year 1976, with an American expansion under way and the U.S.S.R. under the weather both agriculturally and organizationally, the GNP ratio will not be much different from what it was in 1970. It is obvious that the Soviet economy continues to waste resources and resist innovation. Less obvious is the extent to which the investment volume has been curtailed in favor of military hardware procurement and a (demographically explicable) labor stringency has worsened by additions to the armed forces personnel.

TABLE 1.—LONG-TERM COMPARISON OF RUSSIAN/SOVIET AND UNITED STATES GNP[1]

Year	Midyear population (millions)[2]		GNP in toto (billion 1975 dollars)		Soviet-United States ratio (percent)	GNP per capita (in 1975 dollars)		Soviet-United States ratio (percent)
	Russia or U.S.S.R.	United States	Russia or U.S.S.R.	United States		Russia or U.S.S.R.	United States	
1860[3]	72.3	31.5	25–26	25–26	100	350	860	40
1913	157.9	97.2	95	243	39	600	2,500	24
1928	151.5	120.5	95	353	27	629	2,931	21
1940	195.1	132.1	176	420	42	904	3,182	28
1948	174.8	146.6	174	599	29	993	4,085	24
1950	180.1	152.3	218	657	33	1,213	4,315	28
1955	196.2	165.9	295	810	36	1,506	4,884	31
1956	199.7	168.9	323	825	39	1,616	4,886	33
1957	203.2	172.0	329	837	39	1,619	4,867	33
1958	206.8	174.9	364	827	44	1,762	4,731	37
1959	210.5	177.8	379	880	43	1,802	4,952	36
1960	214.3	180.7	394	902	44	1,838	4,993	37
1961	218.1	183.7	417	919	45	1,913	5,007	38
1962	221.7	186.5	433	980	44	1,954	5,255	37
1963	225.1	189.2	442	1,019	43	1,966	5,388	36
1964	228.1	191.9	476	1,075	44	2,088	5,602	37
1965	230.9	194.3	504	1,143	44	2,182	5,882	37
1966	233.5	196.6	539	1,218	44	2,307	6,193	37
1967	236.0	198.7	563	1,249	45	2,384	6,286	38
1968	238.3	200.7	598	1,307	46	2,510	6,513	38
1969	240.6	202.7	612	1,342	46	2,546	6,623	38
1970	242.8	204.9	661	1,337	49	2,722	6,523	42
1971	245.1	207.1	683	1,381	49	2,785	6,667	42
1972	247.5	208.9	695	1,466	47	2,810	7,018	40
1973	249.7	210.4	747	1,553	48	2,993	7,379	41
1974	252.1	211.9	771	1,519	51	3,058	7,168	43
1975	254.5	213.6	786	1,489	53	3,088	6,972	44

[1] GNP data were calculated with decimals but rounded off to full billions in this table to avoid the impression of preciseness. Decimals change often in the process of extrapolation and deflation. U.S. GNP data are taken from the BEA series in 1958 dollars. The latter were converted to 1975 dollars by multiplying with 185. The U.S. GNP for 1975 is obtained by reducing the 1974 value by 2 percent. I did not use the newly structured and 1972-based BEA series. Hub of the Soviet GNP series is a purchasing power equivalent of 36.4 for 1955. The 1955 value is continued up to 1975 with the aid of GNP growth indices. Extrapolation from 1955 backward to 1913 follows Bergson's calculations as explained in the text.

[2] Population: for 1860 and 1913 boundaries of Imperial Russia; for 1928 those of the interwar U.S.S.R.; from 1940 on postwarboundaries.

[3] Data for 1860: See literature on p. 248 FN. 4.

II. Introduction

A. Measuring National Power

On the eve of the First World War a Swedish Scholar Rudolf Kjellén wrote a book on the great powers. He was one of the fathers of geopolitics, a branch of historiography inclined toward wishful thinking, and Kjellén himself had a goodly store of prejudice. But he was also a man of insight and foresight. Speaking of the future he recognized three "planetary powers"; the United States, Russia, and China. He was uncertain of England and unsure about a Central Europe under the hegemony of Germany (his pet power). Comparing the two first-named nations, he called the United States "economically a great power without equal but militarily weak", while Russia, "judging by the statistics, appears as the greatest military power in the world but without a corresponding economic flowering." [1]

[1] Quoted after the German translation Die Grossmächte der Gegenwart, Leipzig-Berlin 1916, pp. 204 and 161. Swedish title: Stormakterna, Stockholm 1911–13.

Russia, now the U.S.S.R., continues to be the great military power it has been for two centuries or longer, though it is not quite a "planetary power." How shall we appraise its economic flowering? In less flowery terms: how did the country's economic capabilities grow and how do they compare with those of the United States? What or who profited from its growth? My survey concentrates on the development since the Second World War but I cannot avoid glancing back to the days when Kjellén wrote. The longer-term economic development of a country is measured not from boom to bust or bust to boom but for the business cycle as a whole; one should treat the political cycle similarly. The U.S.S.R. is now a supreme political power as was Russia in 1914, then as now "judging by the statistics"; when it emerged from the Second World War, victorious but shattered, it was far below its average capabilities.

Kjellén judged the power of nations by comparing—aside from area, population, and armed forces personnel—the size of budgets, foreign trade, and railroad mileage. We operate nowadays (until a better yardstick is found) with national income data and their components. They include figures for national security expenditures and thus provide an index for military preparedness. This article does not supply figures for outlays by branch of service or for military good and services in physical terms, either annually produced or available at a given moment; for the recent past John M. Collins and John S. Chwat have presented an excellent survey of U.S. and Soviet armed forces.[2]

B. Statistical Problems

Comparisons of Soviet national income over the decades and with any other country are confronted with difficult, if not insolvable problems. They are explained in a large and sophisticated literature and I limit myself to enumerating them:

1. Statistics of decades ago do not supply adequate materials for the extension of a modern national income system to the past.

2. Converting time series into constant monetary units presupposes correct deflators. The available deflators leave much to be desired. But those for Western countries are hi-fi models compared to the published Soviet price data.

3. Soviet statistics in general range from good to biased or even misleading; they contain many lacunae and few explanations.

4. The GNP concept has its shortcomings; it omits, for instance, nontraded goods and services except those that are imputed at a hazard. The real national income of a country in rapid development is understated; its growth correspondingly overstated as the scope of marketed goods and services expands.

5. The "index problem" complicates comparisons over time. In a dynamic economy, goods in increasing demand will be produced in larger series and their unit costs will decline in relation to items with slowly growing demand and output. Over a number of years, total production will appear to have grown more rapidly at the prices prevailing at the beginning of the period than at the end-of-period prices. Evidence of slower growth of groups of products (e.g., machinery)

[2] United States/Soviet Military Balance. A Frame of Reference for Congress. A Study by the Library of Congress, Washington, D.C., January 1976.

and the GNP at last-year prices (Paasche index) than at first-year prices was found by Alexander Gerschenkron of Harvard. The Gerschenkron Effect may be counteracted by the inclination of a country to use its increasing affluence on larger quantities of goods that rise in real price, namely services.

6. International comparisons suffer as much from the index problem as national comparisons over time do, and when they are extended over a quarter of a century or more, the difficulties are compounded. Suffice it to add that the dollar series for the U.S.S.R. in this paper represents purchasing power equivalents calcuated for a base year according to the method devised by Milton Gilbert and Irving B. Kravis and extrapolated backward and forward with the help of real growth indices (in constant dollars).

In view of the problems just touched upon, the following calculations should not be viewed as precise measurements but as approximations and illustrations in the hope that they evince a feel for a so-called reality. The decimals are presented with the compliments of the calculating machine.[3]

III. Violent Ups and Downs in GNP, 1913–55

A. Great Powers on the Eve of the First World War

Though my presentation begins with some figures for Imperial Russia, the reader is advised that the Russian-Soviet GNP series is extrapolated from a base-year 1955 applying growth indices; for the United States the BEA series is used but the 1958 dollars are converted to dollars with the purchasing power of 1975.

More than a hundred years ago, i.e. around 1860, the Russian GNP was the same as the American but since the Russian population was 2.3 times as large as the American, the per capita ratio was roughly 40:100 (in 1975 dollars 25–26 billion in toto and 350:860 dollars per capita).[4] (See table 1).

The 1913 Russian-U.S. GNP ratio is estimated at 39:100 for GNP as a whole and 24:100 for GNP per capita. In absolute terms the relation is 15.6 versus 39.9 billion 1913 dollars or 95.3 versus 243.1 billion 1975 dollars. In mid-1913 the Russian Empire had 157.9 million inhabitants and the United States 97.2 million, i.e. Russia had a population 62 percent larger than the United States.

Thus GNP per head of the population was 98:408 in 1913 dollars or 600:2,500 in 1975 dollars. The American 1913 GNP per capita has in the present time been reached by the Commonwealth of Puerto Rico and countries like Ireland and Poland; that of Imperial Russia is now matched by Turkey and Tunisia but such comparisons distract attention from the worldwide change in lifestyles over six truly revolutionary decades or from the different power status of the various nations mentioned. On the eve of the First World War Russia had an army of

[3] These and other statistical problems of international and intertemporal GNP comparisons are discussed in special sections in each issue of an annual series called "The Planetary Product" and prepared by the Department of State; these reports also contain some references to literature. The latest report is The Planetary Product in 1974. The Department of State, Bureau of Public Affairs, Special Report No. 22, November 1975.

[4] These comparisons owe much to the bold calculations of Raymond W. Goldsmith in his article "The Economic Growth of Tsarist Russia 1860–1913" in Economic Development and Cultural Change, April 1961, pp. 441 ff. and, of course to the work of Simon Kuznets, e.g., Modern Economic Growth, New Haven and London, 1966, p. 65.

1.4 million men and a naval personnel of 175,000. It spent much more on its military than the United States (with 99,000 men in the Army, 57,000 men in the navy, and 10,000 marines). Russian military expenditures of 400 million 1913 dollars (if not more through the extraordinary budget) indicate a share of only 2½ percent of GNP; at purchasing power equivalent the percentage would, of course be higher. The Russia of 1913 produced 4.3 million metric tons of steel, not much less than Great Britain with 7.8 million. What happened in the First World War can be explained in terms of two additional steel figures: The output of the German adversary was 17.7 million, that of Russia's later ally, the United States, 31.8 million m.t.

B. Soviet-U.S. GNP Ratio Dips and Recovers Between 1913 and 1940

On the eve of the First World War Otto Hoetzsch, in his lifetime Germany's preeminent specialist on Eastern Europe, judged that Russia was in transition "from an absolute state to a constitutional monarchy and the rule of law and in development toward full modern capitalism." [5] Hoetzsch was right and history, as so often, was wrong. Russia underwent a radical change of its political and economic system, and while the United States and the USSR were again allies in the Second World War, they have understood each other ever since as rivals. (This need not exclude another period of cooperation at some later date.) But there has always been "interdependence"—to use a fashionable expression—between them and between East and West in general, with an impact on the GNP and, consequently, the GNP ratio.

There was, first, the USSR's frantic drive to build up industries, particularly armament industries in order to be ready for the expected attack from the "capitalist" world and to strengthen its own defense by emulating American methods of organization and technology. There was, second, during the Great Depression and again in the late 1940s, when a new depression was feared, curiosity in the West to find out how the Soviets had attained what looked like full employment through economic planning. The vast lend-lease program was an obvious further case of political-economic-technological interdependence. Fourth, after the war the USSR again endeavored to overcome the inefficiency of its own economy with Western technology (it still does) and, as proclaimed by Khrushchev, to "catch up with and overtake" the United States in per capita consumption. There was, fifth, in the late 1950s, the American effort to counter the Soviet challenge in the military, space, and economic realm.[6] The interaction between the two nations, affecting on both sides growth policies and resource allocation, continues and will continue in the future.

In the 27 years from the outbreak of the First to the beginning of the Second World War American economic growth was sluggish. Between 1913 and 1928 the U.S. GNP increased by an annual 2.5 percent, from 1928 and 1940 by only 1.4 percent per annum. Business contrac-

[5] Russland. Berlin 1913, preface, pp. 4/5.

[6] See my paper on "The Role of Aspiration and Anticipation in Price Developments" in Commissioned Papers on Inflation/Recession, Energy and International Financial Structure, edited by Penelope Hartland-Thunberg, The Center for Strategic and International Studies. Washington, D.C., 1975, p. 6.

tion stimulates entrepreneurial and technological progress, as Schumpeter taught, but the Great Depression overdid it; the United States lost eight years of growth.

The Russian peoples, in turn, went through a long time of political and economic troubles. Even the New Economic Policy which was adopted early in 1921, was slow in restoring the economy because the regime continued to frown upon the market forces it had been compelled to reanimate. Abram Bergson "concluded that by 1928 the country had largely if not entirely recovered from the devastative losses suffered under the successive blows of world war, revolution, and civil war, and probably was producing a total output similar to that of Tsarist times." [7] This spells for the year 1928 a Soviet-U.S. GNP ratio of 27:100 in toto and 21:100 per capita.

There followed in the twelve years before the German invasion a further series of dramatic events: Stalin's system was imposed upon the USSR; the original of communist "great leaps" was undertaken; opposition, sometimes real, mostly invented, was "purged"; the economy was converted to an impending war; and many of the territories lost at the end of the first World War were reannexed in 1939-40. Surveying this cataclysm, one finds it difficult to concentrate on statistical problems but they are severe: Urbanization and industrialization meant monetization, i.e., a change in the ratio of purchased and untraded consumer supplies and even some investment goods. Investment was heavy in the socialized sectors with priorities; it went hand in hand with disinvestment in the suppressed private economy, in low-priority branches like agriculture and housing, and there was also the ill-use and ruin of highly valued industrial machinery, often imported at great sacrifice.

Productivity did improve once the workers were transferred from agriculture to industry and were trained; but there was also a wholesale waste of human and material resources in addition to the inherent inefficiency of the system even without Stalin's excesses. The period was one of inflation complicated by low subsidized rationing prices and exorbitant black market prices. Last but not least, the index problem exerted a strong influence on prices during a rapid change of the output mix; on principle, growth rates vary drastically depending on an early or late price base. Faced with different growth rates, each with some merit of its own, I decided in favor of Bergson's ruble factor cost of 1937 yielding an average annual rate of 5.3 percent for the years 1928–40, including regained territories in the latter year.[8] I used it, going back in time, to obtain values for 1928, but this narrative moves chronologically, and so I present for 1940 a Soviet-U.S. GNP ratio of 42:100 in toto and 28:100 per capita. If in 1940 the United States, still affected by the economic troubles of the 1930s, had regained full resource utilization, i.e., if the American GNP would not have been 9½ percent below its potential (to use the definition and calculation of actual and potential national income as worked out by Edward F. Denison [9]), the GNP ratio would have been 38:100.

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[7] Bergson, Abram. "The Real National Income of Soviet Russia Since 1928," Cambridge, Mass. 1962, p. 7.
[8] Ibid., table 51, p. 210.
[9] "Accounting For United States Economic Growth 1929–69," Washington, D.C., 1974, p. 88.

C. Another Dip and Another Comeback in the Forties

Now history repeated itself in a mad way: Germany again invaded its neighbors to the east and west; the Soviet GNP fell again sharply. But this time the U.S.S.R. was among the victors, and recovery was by far more expeditious than after the First World War. While the fighting was still going on, the U.S. Government began examining Soviet rehabilitation requirements after the war. The U.S.S.R. Division of OSS, under the direction of Abram Bergson and of Wassily Leontief, issued on September 9, 1944 a report (R. & A. No. 2060,) on "Russian Reconstruction and Postwar Foreign Trade Developments;" it was at that time confidential but was declassified in 1972. Its findings were remarkably farsighted. Despite their losses, stated the report, "The Russians should be able to reconstruct their economy in about three years after the cessation of hostilities. If the war ends late in 1944, the Russian national income could reach the 1940 level in 1948 * * * Russian involvement in the Japanese war is unlikely to retard markedly the rate of reconstruction of the Soviet economy * * * The tempo of total reconstruction might have to be slowed down if, in view of the international political situation, Russia feels constrained to maintain a high level of military preparedness. In such a case, consumption will be below that attainable under more favorable international political conditions * * * the sucess of Russian reconstruction will depend only to a very limited extent upon foreign loans * * * (pp. iv and vii).

Reconversion to a peacetime economy caused, inevitably, difficulties in the months following cessation of hostilities; moreover, labor morale began to slump when the population found out that in 1946 as little as in the mid-1930s life was to become "more joyous"—in fact, consumer supplies had to be increased temporarily when the plan proved to be too austere. But later research by Bergson showed that his forecast had been correct. The 1948 GNP had indeed regained the 1940 level. This yields a figure of 174 billion 1975 dollars for the Soviet GNP. Since in the course of the 1940s U.S. GNP, increasing strongly until 1944 and declining during reconversion, had reached $599 billion, the 1948 ratio was 29 : 100 in toto and 24 : 100 per capita.

The U.S.S.R. may have regained the 1940 GNP level by 1948 but the country was not yet fully rehabilitated. Reconstruction continued well into the 1950, and produced the high growth rates that characterize recovery from a destructive war anywhere. By 1955 the Soviet-GNP ratio was 36.4 :100 in toto and 31 :100 per capita.

At this point it is illuminating to engage in counterfactual history. If history had listened to Hoetzsch and if Russia, without wars and revolutions had experienced between 1913 and 1955 a population and income growth similar to that of the U.S., the GNP ratio would have been in the latter year something like 40 instead of 36.4 :100, while the per capita ratio, with possibly as many as 270 million Russians, would have been 24–25 :100, i.e., the same as 1913 and not 6–7 percentage points higher. The Russian showing would possibly have been better due to an influx of foreign capital and emigration. The annual growth rate of the GNP might have been more than 2.8 or 3 percent without a Great Depression in the entire world (probably also in a "capitalist" Russia) but there are limits to rewriting and recalculating

history. It is, however, reasonable to assume that Russia, without decades of demographic ravages, would at the present time have a population of 350 million.

If 1928 is used as the counterfactual starting point and abstraction is made of the combined ministrations of Hitler and Stalin, the 1955 population could still have numbered 230 million or more. A much larger population would have augmented the Soviet labor supply but manpower in general was not a constraint on Soviet development; unemployment (which affected at the beginning of Stalin's great leap 12 percent of the civilian labor force outside agriculture [10]) disappeared, but there existed (and still exists!) a significant underemployment in factories and offices and on farms, not to mention the atrocious waste of convict labor and their guards. The problem would have been capital and also land resources because a larger population (by 1955 about 20 percent larger than in reality) would have required additional consumer supplies with a corresponding pressure on the growth rate of the economy, disregarding the alternatives of either a more efficient economic system or less military expenditures. But enough of GNP fiction.

Rehabilitation in the late 1940s and the early 1950s profited from foreign contributions with the result that the national product exceeded the domestic product by unknown but probably considerable percentages.[11] Lend-lease equipment added to the Soviet capital stock long after its delivery. Lend-lease "pipeline" shipments (financed by a U.S. loan of more than a quarter billion dollars), UNRRA deliveries (some $200 million), reparations and restitutions from Soviet-occupied countries (also trade on terms highly favorable to the U.S.S.R.) provided annual supplements to the Soviet GDP until the mid-1950s, if not longer. With the exception of the U.S. long-term loan for lend-lease products in the "pipeline" and some Swedish credits the U.S.S.R. did not obtain foreign loan capital worth mentioning. Stalin's suggestion at the end of the war that the U.S. grant his country a $6 billion loan (this would be more than $17 billion at present prices)—the U.S. Government, in turn, pondered a $1 billion loan—came to nothing as American-Soviet relations worsened. Nor did Stalin, despite grievous shortages, part with one ounce of his gold treasure. (Khrushchev's dislike of gold—he even frowned on golden wedding bands in his family—can be explained by his aversion against the old tyrant: it may have contributed to his willingness to sell gold for grain after the 1963 crop failure).

The U.S.S.R.'s rapid postwar recovery took place otherwise under untoward political circumstances for which the regime itself was largely responsible. In the international arena the war had reduced all nations except the U.S. and U.S.S.R. to secondary or marginal status. U.S.-Soviet relations, not without friction even during the wartime coalition, became openly antagonistic soon after victory. Following a brief demobilization—less comprehensive in the U.S.S.R. than in the United States—, both nations began to rearm, this time

[10] See Alec Nove, "An Economic History of the U.S.S.R.," London and Baltimore, 1969, p. 115.

[11] Bergson, op. cit., p. 99. During the war the difference between national and domestic production was large. For the year 1944 Bergson calculated that Western aid may have constituted 10–12 of the Soviet GNP.

with each other in mind. In 1949 the Soviets exploded their first atomic bomb, in 1953 their first hydrogen bomb; missiles to carry such bombs were developed. At the time Walter Lippmann wrote The Cold War (1947) and in the years thereafter the U.S. faced policy options including a naval blockade and armed convoys to Berlin, if not open hostilities; under these conditions a cold war limited to diplomatic moves and commercial controls spelled moderation.

Eastern Europe, which French Foreign Minister Barthou (murdered 1934) had envisaged as a "sanitary cordon" against the U.S.S.R., has now become the Soviet sphere of influene,[12] but as early as 1948 Yugoslavia broke with Moscow; other Communist countries underwent gruesome purges, and after Stalin's death there occurred disorders and rebellions. The Soviet political climate was stifling until 1953. The despot petrified everybody but even his rule was not monolithic, and as soon as he was gone, his lieutenants began to quarrel among each other, while the population became restive. These political conditions and events produced fluctuations in investment, defense outlays, and consumption and, as a result, in the national income.

On a few occasions the regime was forced to show by word and even by deed its immediate concern for the consumer. This was the case in 1946 after labor morale had sagged alarmingly because little had been done to alleviate living conditions; a poor crop in 1946 added to the stringencies. The situation repeated itself more strongly when, after Stalin's death, his successors feared "panic and disarray." Malenkov, for a while the new leader, felt constrained to increase the purchasing power of the population as well as consumer supplies (a difficult task after another poor crop). Inventories were released and some imports financed. Malenkov even proposed to downgrade the sacred priority of heavy industry in favor of consumer manufactures. This issue was seized by his colleague Khrushchev; in the name of heavy industry he attacked and eclipsed Malenkov.

However, once firmly entrenched, Khrushchev changed his tune. Facing the discontent of the population, he began to correct inequalities in income distribution and to invest in consumption-oriented branches, i.e., agriculture, housing, and consumer industries. His dynamism and buoyancy helped the regime to overcome the unrest throughout the Soviet bloc (when sufficiently provoked, he relied on rifles and tanks), but they also made him underestimate the time required for improving living conditions. Moreover, he undertook prestige and power-oriented initiatives in the fields of space (missiles, including Sputnik) and foreign policy (Berlin crisis, Cuba, Sino-Soviet rift, aid to the Third World), and they proved to be costly. The country could not afford guns and butter and economic growth.

During the Second World War the United States was able to operate as "the great arsenal of democracy" because its machine-building industries had still been underutilized in the wake of the Great Depres-

[12] In March 1932 Die Neue Rundschau, Berlin, published an article of mine entitled "Die Tat gegen die Vernunft" (action against reason) attacking a quasi-Nazi political movement around a journal Die Tat (Action). I characterized its foreign policy plans in Europe as "a program of expansion that pales the imperialist visions of the [first world] war" and I continued: "The dreamers do not realize that such a breakup of Central Europe would give the Soviet Union [then in the midst of the collectivization crisis] the role France played at the time of Louis the Great in Europe, above all in the German Reich, while the confederated small states would become the satellites [Trabanten] of Moscow" (pp. 417–418).

sion; at the same time it was possible to convert large consumer durables industries to arms production. The U.S.S.R. has always been in a different situation. Soviet planning aims on principle at full utilization of all resources; the plans tend to exceed what is humanly possible because leaders and planners know that enterprise managers counter the plan's tautness by understating their capabilities and also by resisting innovations that could interrupt their efforts at plan fulfillment and bonus maximization. Consumer durables production, moreover, is still modest in scope and was practically non-existent in Stalin's and Khrushchev's days.

As a result, every time it was considered necessary to step up the production of military and space hardware, the rate of growth of civilian investment suffered. On the other hand, civilian investment began to boom once power-oriented procurement levelled off. This "seesaw" was plainly visible in the last years before the German invasion when the U.S.S.R. converted to a war emergency; according to the calculations of Richard Moorsteen and Raymond P. Powell, net investment in fixed capital declined from 27.9 billion (1937) rubles in 1936 to 19.5 billion for a larger territory in 1940.[13] A similar seesaw movement took place during mounting international tension (particularly during the Korean war) before Stalin's death. Bergson presents figures showing the share of gross investment in a GNP calculated at current ruble factor cost falling from 30.9 percent in 1949 to 28.7 percent in 1952, while the share of defense, as recorded in the official Soviet budget, rose from 10.6 to 12.7 percent.[14]

After the death of Stalin, his successors pursued for a while a policy of détente, and in July 1953 the Korean war came to an end. For a number of years Soviet military expenditures declined or remained more or less stable. Thus, after a short interlude, the seesaw began to operate with the rate of investment going up. The interlude took place in 1953/54 when, as mentioned earlier, consumption was given a temporary boost, chiefly by drawing down inventories. This explains the dip in the share of investment, to quote Bergson's calculations, from 28.7 percent in 1952 to 25.5 percent in 1954, while household consumption rose from 44.4 percent to 51.2 percent.

Bergson limits his use category "defense" to the amounts shown in the official Ministry of Defense (with a small exclusion of some pensions); he takes, of course, account of defense-related expenditures in his use categories "government administration, including NKVD" and "communal services" (the latter containing outlays for R. & D. and some military training). In 1950 the explicit defense budget was 8.3 billion (new) rubles, in 1955 10.7 billion. One can only guess at the real costs of the U.S.S.R.'s defense efforts (some of them were borne not by the Soviet people but by occupied or associated countries); they may have amounted to roughly 11–12 billion (new) rubles in 1950 and to 13–14 billion five years later. These figures are meant to include defense-related R. & D., the military police, and other items financed from funds outside the Ministry of Defense budget.

[13] "The Soviet Capital Stock, 1928–1962." Homewood, Ill., 1966, p. 358.
[14] Bergson, op. cit., p. 245.

IV. Digression on Defense Share in GNP

A. CIA's Revision of Ruble Spending for Defense

At this juncture I have to interrupt the chronological account in order to introduce the recent revision of a major national income component. I refer to CIA's recalculation of Soviet defense expenditures in and around 1970, a recalculation that is bound to affect the assessment of the Soviet economy over the past decades.[15]

In the absence of credible Soviet data on defense, Western scholars, both in academic and government positions, have made estimates of the real costs of the U.S.S.R.'s national security programs. In a paper on "Value and Burden of Soviet Defense", I called this research, somewhat facetiously, "an exercise in meta-Intelligence". The analysts, I added, "engage in the exegesis of obscure texts, guess at unexplained residues, hunt after analogues, and indulge in assumptions. Research on Soviet defense is the feast of the assumption".[16]

The most laborious effort at estimating Soviet defense spending has always been made by the CIA. On April 12, 1974, its Director, William E. Colby, summed up its findings as follows: " * * * Soviet expenditures * * * amounted to at least 25 billion rubles in 1973 * * * The trend in ruble expenditures [since 1960] has been generally upward—increasing at an average annual rate of about 3 percent." [17]

Since then the CIA, analyzing "new evidence", has carried out a "major upward revision". For the base year 1970 it estimates Soviet defense spending, as defined in U.S. budgetary accounts, at 40–45 billion (1970) rubles. In contrast to Colby's 1974 estimate, the figure excludes space activities not of a purely military character; they might add 3 billion rubles. CIA's revised estimate for 1975 ranges from 50–55 billion (1970) rubles; in current rubles, taking account of a mild inflation, the spending might be 10 percent higher. CIA also estimates how the Soviets themselves "might account for their defense effort" using "a broader definition," namely "45–50 billion rubles for 1970 and 55–60 billion rubles for 1975".[18]

CIA has also recalculated its series of Soviet defense activities expressed in dollars but this new appraisal is said not to alter previous estimates of the U.S.S.R.'s military forces in physical terms nor does it change more than marginally CIA's assessment of the dollar cost of reproducing in the U.S. Soviet defense programs at American prices.

There were good reasons for believing that CIA's previous estimates were low, though few specialists were inclined to go as high as the new figures. It will be necessary to carefully examine the assumptions on which the revision rests. Nobody needs to be ashamed of the remaining uncertainties for if the U.S.S.R. has mastered one technology, it is to keep facts secret. It is worth remembering that demographers all over the world were made to believe that the Soviet population was 15–20 million larger until the statistical handbook of 1956, breaking a

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[15] See two unclassified CIA reports, "A Dollar Comparison of Soviet and U.S. Defense Activities," February 1976, and "Estimated Soviet Defense Spending in Rubles," May 1976.

[16] Published in the preceding volume of this series "Soviet Economic Prospects for the Seventies," June 27, 1973, pp. 175–176.

[17] "Allocation of Resources in the Soviet Union and China," Hearing before the Subcommittee on Priorities and Economy in Government of the Joint Economic Committee, Washington, D.C., April 12, 1974, pp. 68–69.

[18] Estimated Soviet Defense Spending in Rubles, p. 1.

long silence, revealed the correct figure. Regarding defense spending, the U.S.S.R. publishes annually only one single figure, namely the budget total of the Ministry of Defense; it was 17.85 billion rubles in 1970 and 17.43 billion in 1975 with no distinction between planned and actual expenditures. These are the outlays the Soviet leadership wishes its own population and the world at large to believe, and it has probably this published portion of its defense outlays in mind when it proposes to effect international disarmament by reducing the defense budgets of all nations by 10–15 percent.[19] If the handful of Soviet leaders who are informed about the country's real military burden, views them indeed as ranging from 55–60 billion rubles in 1975, it would mean that they conceal no less than 70 percent of the total. Somebody who is capable of understating that much is, of course, also able to overstate statistics, if it serves a particular purpose.

The CIA has also revised the past growth rates for Soviet defense spending. Colby, in his 1974 statement, referred to a chart showing the ruble outlays for total Soviet defense (including civilian defense) from 1960–73 pointing to "an average annual rate of about 3 percent. You will note, however, that for the last few years ruble spending has remained at essentially the same level".[20] The new report says: "Defense spending in rubles is now estimated to have increased at an average annual rate of 4–5 percent over the period rather than 3 percent as previously believed. During 1973–1975 it grew about 5–6 percent per year . . ." [24] Expressed in dollars the average annual rate of increase from 1965–75 is given at about 3 percent.[22] These growth data lead back to the topic of this paper, namely the general development of the Soviet economy in the third quarter of the century.

B. The Rising Cost of Military Services

One reason supporting the estimated faster growth of Soviet defense spending at constant ruble prices is an increased personnel cost reflecting improved living conditions in the U.S.S.R. In the first several years after the war, Soviet soldiers were probably better off than the civilian population, which ascended only at a slow pace from the abyss of the war years. Between the death of Stalin and 1970, the base year of the new defense estimates, Soviet consumption per capita rose possibly by about 4 percent per annum; if this is true, real consumption per head of the armed forces must also have gone up considerably. CIA's previous calculations underestimated the rising cost of military pay and maintenance in the postwar period and, as the result, the personnel outlays in the new base year and afterwards.

The statistics of military service costs pose two complicated problems. One arises from the subsidization of the service by the conscripts. They are in general forced to serve at less than their opportunity pay; as civilians they would earn more. The degree of subsidization on the part of the draftee may change over time. In the US the price of the personnel rose substantially after 1968 as the result of the decision to

[19] The problems of financial verification of budget cuts for disarmament purposes are discussed in detail by Franklyn D. Holzman in "Financial Checks on Soviet Defense Expenditures." Lexington-Toronto-London, 1975.
[20] Allocation of Resources in the Soviet Union and China, p. 69.
[21] Estimated Soviet Defense Spending in Rubles, p. 1.
[22] A Dollar Comparison of Soviet and US Defense Activities, p. 2.

make federal pay comparable to pay in private sectors and later with the transfer to a volunteer force. Soviet conscripts perform their duties for little income (even considering some education they may receive during their service). This does not rule out a change in the ratio between their upkeep and what they would have earned in civilian life, though we may not be able to quantify the relationship adequately.

The second deflation problem is inherent in the valuation of those many services that do not permit an appraisal of their productivity. Output is simply determined by inputs. If a person who renders such a service receives a rising income, the increase is eliminated through deflation similarly to the increase in the price of a ton of wheat. In other words, throughout the period under consideration the price of a year of military service or of a ton of wheat is viewed statistically the same as in the base-year of the series. I am inclined to argue that while a ton of wheat is the same at all times (provided the grain dealer is an honest man), the soldier's services reflect the productivity gains that enable the population to improve their living conditions. In fact, the productivity of the armed forces (or shall we speak of their "destructivity?) is enhanced not only by their better equipment (as is the workers' performance with more or better capital goods) but also by the individual soldier's improved skill in handling weapons of rapidly increased sophistication. If it were possible to separate that part of the armed forces income that mirrors an inflation in the costs of their upkeep (i.e., in the prices of their food, their clothing, etc.) from the increase that results from a general uplift in living conditions, it would be possible to avoid what I consider an overdeflation of the armed forces personnel costs. In this sense I feel that the personnel deflator of American defense statistics overdeflates the personnel cost.[23] By applying this deflator to the personnel category in the dollar series of Soviet defense activities (i.e., by imputing a deflated cost of American personnel to their Soviet counterparts), CIA may have decelerated the growth of personnel expenditures in dollars. This may explain in part that in CIA's new dollar series the annual growth rate is only 3 percent in the average of 1965–75.

Correcting the ruble costs of the Soviet armed forces, CIA has increased the personnel costs in 1970 to 8–9 billion rubles, i.e. 20 percent of the total defense bill (adding civilian personnel in the armed forces would increase the share to roughly 30 percent, which compares with more than 50 percent in the U.S. Defense Department budget). These costs appear in the national accounts twice. They form, first, part of the consumption expenditures. The way the consumption total is calculated, the difference between the previous and the revised armed forces consumption should not increase overall consumption; it would be at the expense of the civilian population and would thus add to their defense burden, though only to a minute extent.

Personnel costs enter the national accounts a second time as services rendered by the members of the armed forces. The difference just mentioned would probably increase the service sector of the economy and thus the GNP as a whole, but the impact on the GNP would be

[23] US deflators are discussed in "Measuring Price Changes of Military Expenditures," US Department of Commerce, BEA, June 1975.

even smaller than the impact on civilian consumption. Thus it appears that revision of the personnel costs could be reconciled after minor changes with existing national income statistics.[24]

C. Efficiency Decline in Soviet Armament Industries?

A bigger problem are the "investments" of the military and space establishment, i.e., the equipment procured and the facilities built (these investments should not be mistaken for the investments in armament industries, which do not form a separate part of the defense outlay since they are or ought to be amortized through a charge included in the price of equipment and structures purchased). "Investments" are said to absorb about 40 percent of the total Soviet defense bill;[25] if the equipment and facilities bill of military and space R & D were added, the proportion might rise to 50 percent. (In the U.S. "investments" form 23 percent of the DOD budget.)

CIA's method of evaluating Soviet defense "investments" consists in listing the physical units observed or otherwise calculated and then converting them for its series of dollar values at American prices for corresponding items or, for its ruble series, by assessing their ruble costs either at Soviet ruble prices wherever available (these prices refer chieffly to civilian items of a similar character) or by translating the American prices into rubles with conversion rates for individual products. Such pricing efforts are hazardous; the ruble prices as well as the dollar-ruble conversion rates may be wrong or outdated. Recent evidence on ruble as compared to dollar prices seems to indicate that many Soviet procurement prices are higher, even much higher than previously assumed. This raises a problem going beyond the defense sector and affecting our assessment of the Soviet economy as a whole.

In my contribution to the previous JEC volume on the Soviet economy I wrote:

> We do not know whether in an economic sense Soviet output of defense and space goods is as efficient as American production; the record probably varies from industry to industry and may well be below U.S. standards in general (with cost overruns here and there). What counts in this context is the relative efficiency of the defense sector in comparison to the civilian economy. The defense and space sector is effective because its customers (i.e., the military) know what they want (although that does not necessarily mean that what they want is the right thing technically and strategically). The customers are also powerful enough to assure the producers a sufficient supply of managerial, scientific, and technical talent and skilled workers, as well as materials and equipment, and they watch the use of all these choice inputs with the aid of local representatives. Even with this outpouring of skilled men and expensive material, the share of defense in the GNP is as low as it is * * * because the civilian economy and, in particular, its consumer-oriented branches are extraordinarily wasteful and, therefore, absorb a large share of the total national product.[26]

Insofar as the new dollar-ruble conversion ratios are correct, they indicate that the gap in economic efficiency between Soviet civilian and military production was never as wide as previously assumed or, what is more likely, (as later calculations on Soviet defense expenditures during the past 15–25 years will show) that the gap has nar-

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[24] CIA has published a thorough study of "U.S.S.R.: Gross National Product Accounts, 1970." November 1975.

[25] Estimated Soviet Defense Spending in Rubles.

[26] Soviet Economic Prospects for the Seventies, p. 195.

rowed to the disadvantage of the armament industries. The latter alternative could be explained as a slow process due to the following circumstances:

First, the increasing sophistication of modern weaponry and of the methods used in their production has challenged Soviet industry to a competition that it seems to have met—not without difficulties—technologically but not economically. With little help from the advanced West, it has persisted in the arms race by spending inordinate amounts of resources.

Second, the regime has not been able up to now either to reduce the demands of its military men or to reform the armaments industries. And indeed, individual leaders depend on the tacit approval of the military leadership, which might shift its allegiance from one political figure to another. At the same time they are all united in their pursuit of planetary power status for their nation.

Third, in the days of Stalin, frugal ways were inevitable but with a modest degree of affluence and less repression, the stress on thrift must have weakened. In this context it may be recalled that Ustinov, who has recently become a Politburo member, had once been blamed by Khrushchev for permitting cost overruns.

Fourth, every command economy has a Siamese twin: a "second economy". The sibling lives by circumventing the commands of his brother, either illegally or extralegally. There are indications that the "second economy" has been growing throughout the last decades, and its modes of behavior may have influenced the spending habits of the military-industrial establishment.[27]

D. Implications of the Revised Defense Estimate for the National Accounts

While the impact of the revised personnel cost estimate on civilian consumption and GNP may be disregarded, a greatly increased bill for military and space "investments" is not easily reconciled with estimated Soviet national accounts or machinery output and allocation. The new figures imply a reduced volume of capital goods available for the entire economy, for civilian purposes in general, and for consumer-oriented purposes in particular. Either these civilian industries are slightly more productive than thought—offsetting the lower efficiency in the armament industries—, or the growth of industrial output was lower than calculated—and likewise the series representing the output use—, or revision of the military procurement prices has overshot the mark, possibly because of too drastically revised dollar-ruble conversion ratios.

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[27] In the context of this paper the question arises as to how the "second economy" affects the GNP level and its growth. GNP estimates are precarious under any circumstances; they would become even more brittle if illegal and extralegal activities were imputed. In 1973 Murray Seeger (writing in the Washington Post of October 21, 1973) reported "Western experts" as estimating that "the unofficial sector of the Soviet economy . . . amounts to at least 25 percent of the official economy—and perhaps as much as 50 percent of the total output." (See also my "Planetary Product in 1973", p. 16). This appears greatly exaggerated. Mere transfer payments have to be excluded from the GNP total in any case. Bribes may expedite transactions but do not add in themselves to the national product. However, the "second economy" also creates goods and services. But much of this output is already included in the first economy because as it is accomplished on time paid for by the government and by using plant, equipment, and materials meant for officially planned pursued. Output truly additional to the GNP as estimated may still be larger in size as a percentage of the official GNP in comparison with what we may call the disservice industries of the West (such as output of and traffic in, illegal narcotics).

National account estimates for the years preceding the new base year for the defense outlay are faced with the following alternative: if the defense totals for the past are increased in line with the figures for 1970, their share in the GNP must have been by far higher, probably at the expense of investments; if the defense values for past years are retained, the rate of growth of defense must have been much steeper. This statement refers to growth rates in rubles; there is no reason why ruble growth rates should not increase faster than growth rates derived from dollar prices. The latter reflect a fairly high capability of American industry to reduce unit costs (after deflation on purely monetary grounds), while the (deflated) ruble costs—if we adopt the new estimates—must have skyrocketed. A few rough calculations will illustrate this quandary.

Let us start with the 1970 defense estimate of 45 billion 1970 rubles, including civilian space, and work back to 1960 by applying to the 1960s the rate Colby mentioned in 1974 ("about 3 percent" for 1960–73, levelling off "in the last several years"; thus I will use an average rate of 3½ percent). This yields a 1960 defense total of 31.8 billion rubles at established 1970 prices or 28 billion at 1970 factor cost. GNP rose in the ten-year interval by close to 5½ percent per annum. The 1960 GNP would amount to 227 and 203 billion rubles at established 1970 prices and at factor cost. The share of defense in the GNP would be 14 percent. If we lower the defense total for 1960 by roughly 10 percent in order to deflate them from 1970 to 1960 prices and compare the result with Abraham S. Becker's GNP total in 1958 or 1964 prices, the share in GNP would climb to 15–16 percent. Becker himself "concluded * * * that the total military effort could not have absorbed more than about a tenth during the SYP [Seven-Year Plan] period, and one may reasonably assume that the period increase in relative weight was confined to a few percent of GNP".[28] William T. Lee, in turn, estimates the national security expenditures in 1960 at 15.5 billion rubles at established 1960 prices or 8.5 percent of a GNP of 178.9 billion rubles (the latter figure being very close to that of Becker).[29] Stanley H. Cohn's share of defense in the 1960 GNP ranges, depending on his assumptions, from 8.4–9.2 percent, ratios similar to CIA's former estimates.[30] In sum, if the level of defense spending in the 1960s is increased in line with CIA's new estimate, the share of defense in the GNP rises considerably.

If, on the other hand, we adopt the defense estimates of the three authors quoted above (Becker roughly 18½, Lee 15.5, Cohn 11.3 billion all at established prices of 1960 or thereabouts) and compare them with 45 billion for 1970, we arrive at annual growth rates for defense spending of more than 9 percent for Becker, 11 percent for Lee, and up to 15 percent for Cohn. Ruble deflation would reduce these rates by slightly over 1 percent per annum. The rate of increase would still be much higher than CIA's 3–4 percent.

Extrapolating the series through the 1950s, we arrive at the following figures: CIA's new defense estimate carried back to 1960 as indi-

[28] "Soviet National Income 1958–1964," Berkeley and Los Angeles 1969, p. 267 and Tables K–1 and K–2.
[29] "Soviet Defense Expenditures for 1955–1975," draft report for GE "Tempo", July 31, 1975, Table 2–4.
[30] "Economic Burden of Defense Expenditures", in Soviet Economic Prospects for the Seventies, pp. 158 and 160.

cated above and reduced by 15 percent to obtain a 1950 defense total, implies a share of 22 percent of a GNP calculated along the lines of CIA's 1970 estimate. The share would rise to 36 percent if we were to substitute Bergson's figure for 1950.

Bergson's 1950 defense estimate, limited to the explicit defense budget, was less than 8 billion rubles at factor cost (75.6 billion old rubles) or 10.9 percent of his GNP figure.[31] Assuming an overt and covert defense outlay (including the funds spent on nuclear bombs etc.) of 11–12 billions rubles, we would arrive at a share in Bergson's GNP of 16 percent (remembering, however, that some of the cost was borne by Eastern Europe). The real growth from this defense total to the one for 1960 derived with the help of CIA's new estimate would be 8.3 percent per annum. In other words, much work remains to be done to fit the revised data into existing national account series.

Bringing out the arithmetic implications of much higher defense figures for recent years does not invalidate the new evidence for the revision, and even if the evidence should have produced an overstatement, the old series was definitely too low. A degree of revision of the dollar-ruble conversion ratios, however, has under any circumstances implications for the calculation of the GNP in dollars (and here one must add that these dollars are geometric mean dollars in contrast to the dollar used to value Soviet defense at straight American prices). Lowering the value of the ruble as compared to the dollar for a large portion of the U.S.S.R.'s GNP (it is now believed that Soviet defense "investment" is absorbing not 10 percent but almost 20 percent of the output of Soviet industry" [32], i.e. not less than 8 percent of the GNP at established prices), reduces the Soviet-U.S. GNP ratio. For this reason as well as for others that I set forth in the latest issue of my "Planetary Product" [33], I have decided to stay with my GNP series in dollars. For recent years its level is about 11 percent lower than the corresponding series of CIA; the growth rates are also slightly lower.

V. Fast Growth and Deceleration, 1955–75

A. Successes Breeding Their Own Reversals

In 1954, the year of Khrushchev's ascent, the Soviet-U.S. GNP ratio was close to 36 : 100 [34]; it grew to 44 : 100 by 1958 and remained in this neighborhood until the late 1960s. Between 1954 and 1958 the United States increased its GNP by an average annual 2.4 percent, the U.S.S.R. by an estimated 7.8 percent. The difference in growth had to do (leaving aside the particularly good harvest weather favoring the U.S.S.R. in 1958) with policies.

The United States, after minor recessions in 1949 and 1954, slid into an intense contraction between 1956 and 1958. The U.S.S.R., after

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[31] Bergson, op. cit., p. 150.
[32] Estimated Soviet Defense Spending in Rubles, p. 16.
[33] "The Planetary Product in 1974", pp. 38–39. (On p. 39, lines 6 and 14 USSR should read US, as the context makes obvious.)
[34] As mentioned before, the base year for the Soviet series is 1955 with a Soviet-US ratio of 36.4 : 100. Bergson, using slightly different methods, arrived at a geometric mean of 34.5 : 100 for the same year (in "International Comparisons of Prices and Output," edited by D. J. Daly, Studies in Income and Wealth, National Bureau of Economic Research, New York and London, 1972). Morris Bornstein ("Comparisons of the U.S. and Soviet Economies," JEC, 1959) had a 37.8 : 100 ratio. Given the problems inherent on both sides of the comparison, the difference is small indeed.

completing its reconstruction in the early 1950s and enduring changes in leadership, entered a boom period sparked by accelerating investments, by an expansion of the crop acreages, and by a better labor morale resulting from slowly improving living and working conditions. The increase in fixed gross investments between 1954 and 1958 is estimated at 13–14 percent per year. The seesaw operated in those years in favor of the civilian side; a curtailment in real defense outlays up to 1959 enabled the economy to step up its investments and to grow by large percentages (reduction of the armed forces in the second half of the 1950s helped increase the civilian labor force). If during those years military activities were camouflaged as investments, the amounts could not have been large. Value added in agriculture increased between 1954 and 1958 by almost 9 percent per annum, remarkable even though we compare a mediocre and a good crop year.

The achievement in agriculture was due to a small degree only to a larger input of manpower (the rural population—actually growing between 1954 and 1957—still comprised more than half of the population). It was chiefly the result of greatly increased investments in agriculture (they grew by an average 8.8 percent from 1954–58) and of a unique expansion of the acreage under crops. The acreage increased from 1953 to 1958 by about 95 million acres or one fourth of the land cultivated at the beginning of the campaign; the addition represents almost one third of the land now under crops in the United States. Khrushchev's hopes were high indeed; for 1960/61 he promised a meat production of 20–21 million metric tons; the official output figure for 1961 was 8.8 million! But the leadership was keenly aware of the population's desire for a diet in a line with modern standards, and Brezhnev made Khruschev's meat program his own. Output in 1975, including some emergency slaughtering after a poor crop, was about 15.2 million tons.

The successes during the mid-1950s bred their own reversals. The Virgin Lands District in the East, Tselinnyy Krai, proved to be a far cry from what Khrushchev had expected. The transfer of machinery and labor from Western to Eastern areas was not only costly in itself but opened resource gaps in factories and on farms thus despoiled. Worse still, after a few good crops, the virgin lands, as had been predicted, began to suffer from erosion and weed infestation. Khrushchev's crash program in the chemical industries, aiming above all at larger farm supplies, deprived other industries suddenly of vital investment funds, while chemical equipment—often imported at the cost of scarce foreign exchange—went to waste in plants unfit to absorb it. (Eastern Europe was induced to imitate this "orgy in investment", as a Polish economist put it.)

Thus Stalin's great leap was emulated in Khrushchev's little leap. The rapid growth of those years—in stark contrast to American recessions—and the sensational launching of the two Sputniks in 1957 made Khrushchev "dizzy with success." He discovered the propagandist value of "growthmanship" on the domestic and international scene and challenged the United States to an economic and technological race. He also embarked on a series of assertive and aggressive

moves in foreign policy (from Berlin to Cuba), and they, together with the worsening conflict with China, required additional military preparations. Larger defense procurement, becoming noticeable in 1959, reversed the seesaw. The rate of investment increase declined to about 7 percent in the last six years of Khrushchev's stewardship, i.e., half the rate achieved in the first years of his rule, and here one cannot suppress the suspicion that some of the new investment was in reality "investment" in the military sense.

B. Common Features of the Khrushchev and Brezhnev Administrations

The developments of the Khrushchev era, aside from their historical interest, are relevant for the post-Stalin time as a whole, both in omission and commission. Khrushchev's successors have made him an "unperson", but they have followed his policies. Khrushchev did not alter the inherited economic system; on a trip to India he said (on November 24, 1955) in his inimitable style: "We tell the gentlemen who are expecting the Soviet Union to change its political program: Wait for pigs to fly". Nor have his successors tampered with the essentials of the economic system; this would not only run counter to their ideology but would have stirred up political and economic troubles until a new setup, whatever it might be, had proven itself.

The market has remained out of favor as a guide to resource allocation (though it is quite lively in the "second economy"). "Moral incentives" are extolled (if only because they are not inflationary), but "material incentives" cannot be avoided since they appeal to the old Adam Smith in the Soviets. Planning without the benefit of market prices is usually overambitious and sometimes overcautious; the recent Ninth Five-Year Plan (1971–75) was not much better than Khrushchev's plans. Khrushchev rooted for corn and chemicals; Brezhnev and Kosygin campaign for computers; there is nothing wrong with either product except when forced upon the economy. The specific incentives operating in the Soviet economy induced waste of capital, labor, land, and materials in the days of Khrushchev; they still do.[35] Khrushchev—in the spirit of Lenin and Stalin—expected technology to cure the system's shortcomings; he entertained the naive belief that technical and organizational innovations created in Western societies to answer their requirements, would enable the U.S.S.R. to "catch up and overtake" the United States; his successors take the same approach. Khrushchev replaced economic reform with administrative reorganization; his successors do the same, though with less abandon. Khrushchev amalgamated farms and industrial enterprises, as do his successors; bigger is better in Khrushchevian as in Brezhnevian philosophy.

But while the system has been preserved, there has been a major change both in research allocation and in income distribution ever since Khrushchev took over. The new allocational policies are evident not so much in the overall use pattern of the GNP as in the direction of investments. The share of household incomes, including benefits from

[35] The late Finance Minister Zverev, to mention just one complaint, demanded in December 1955 "stricter controls over investments . . . to put an end to the squandering of material and financial resources." In 1961 Khrushchev made Kosygin a special trouble shooter to prevent further dispersal of investment funds"; they are still dispersed.

public funds for education, health care, etc., has remained in the postwar U.S.S.R. between 55 and 60 percent (it fluctuates in the United States between 65 and 70 percent of GNP).

The share is kept low by appropriations to the military and also by the lobbying of those who advocate growth in the interest of the country's and their own power (Khrushchev talked of "steel eaters") and of ideologists who oppose "consumerism" for everybody except themselves and their equals. However, with a twenty-year GNP growth by 5½ percent per annum and a population growth of only 1.4 percent, real per capita consumption must have risen by approximately 4 percent a year, even though the share of consumption as a whole in the GNP may have declined some. (Monetary incomes have increased more rapidly, producing the problems of suppressed inflation in the form of fast growing savings deposits and cash holdings, of waiting lines and lists for consumer supplies, and of funds circulating in the "second economy".)

The only effective way to provide consumers with more supplies (aside from an occasional release of government stocks or imports) was through investments in sectors producing consumer goods and services and industries building machinery for the production of consumer goods. This was done throughout the Khrushchev and Brezhnev administrations by investing in agriculture and farm supply industries, in residential construction, and—to a lesser degree—in consumer durable industries and in service industries.

Khrushchev's major achievement in the economic field was his income policy. Peter Wiles said of "the statistical record since Stalin . . . I doubt if any country can show a more rapid and sweeping progress toward equality".[36] This appears somewhat overdrawn, but Khrushchev's measures amounted indeed to what may be called his New Deal. He released large numbers of labor camp inmates; he raised the incomes of the peasants who, convicts apart, had been the underdogs of Stalin's rule; he bettered the miserable lot of the pensioners; he improved the very low wages of unskilled workers as compared to the worker aristocracy; and he endeavored to put a lid on the elite incomes. His initatives were dictated, above all, by political and social necessity. A narrowing of the wage differentials made also sense in a population which by then had reached a modern level of general and technical education (in fact, such a wage reform was initiated shortly before Stalin's death). Brezhnev and his associates have continued Khrushchev's social policies. The question must be raised but cannot be answered whether in recent years affluence at the top has increased, perhaps in the context of the "second economy," or whether repression of dissidents has added to the number of penal workers. This is another area of Soviet secretiveness.

In the United States the 1960s opened and ended with a contraction; otherwise they were economically good years with the available resources on the whole fully utilized, if not overutilized. Whatever had been taught in the 1930s about the "mature economy" and its tendency toward stagnation, the decades thereafter have brought an intense material progress (which is continuing). This expresses itself in the indices used to compare the GNP at the beginning and the end

[36] "Distribution of Income: East and West," Amsterdam, Oxford, New York, 1974, p. 25.

of a time series In this report the American GNP is deflated in 1958 dollars. The average annual growth rate from 1960–70 was 4 percent p.a. If we apply the new deflator using 1972 dollars, the rate dips to 3.8 percent. This reflects the Gerschenkron Effect, namely the slower growth of groups of products such as machinery as well as of the GNP if expressed at last-year prices (i.e., with a Paasche index) instead of first-year prices (i.e., a Laspeyres index). The intensity of the effect (two tenths of 1 percent per annum [37]) in such a short period—indicating rapid innovation—is the more remarkable as it is counteracted by the inclination of the country to use its increasing affluence on larger quantities of products that rise in price, namely services.

If the Communist campaign for economic and political supremacy—astir not only in the USSR but also in the PRC and other countries of the same type—was hubris, the "interdependent" American reaction was also hubris. It attempted to carry out bold welfare programs in combination with a global political and military role and the conquest of space. Between 1961 and 1966 the GNP grew at an average rate of close to 6 percent. Toward the end of the decade growth came temporarily to a standstill.

Khrushchev was at his pinnacle in 1958. This was also a good crop year; the Soviet GNP grew by more than 10 percent. Five years later, with a rather poor crop, despite—or perhaps because—of his exertions, the GNP growth rate was little more than 2 percent. Khrushchev's agricultural policy was only one of what his successors called his "hare-brained schemes", and in 1964 he fell from power. The two years just mentioned were, of course, exceptional. But while growth had been 7.8 percent in the yearly average between 1954 and 1958, it was only 4 percent between 1958 and 1963. Or, if we insist on five-year intervals, 5.9 percent in the second half of the 1950s and 5.1 percent in the first half of the 1960s.

The slowdown had many causes. International tension increased both between the U.S.S.R. and NATO and the U.S.S.R. and the PRC. Military and space expenditures rose signfiicantly; the official Soviet defense budget mirrored the increase, if not accurately, yet on purpose; it rose from 1957 to 1963 by an annual 7.3 percent per annum (from 9.1 to 13.9 billion rubles). Cohn estimates the annual increase of 7.8 percent, Lee at 10.2 percent.

At that time the seesaw was in full swing: the growth rate for investment in fixed assets fell from 13–14 percent between 1954–58 to less than 7 percent 1958–63, or, if there was an as yet undetected transfer from investment to defense, by an even smaller percentage. At any rate, capital inputs decelerated. Land inputs had already levelled off when the virgin lands program had been carried through; in later years land had to be withdrawn from grain production. Labor input was under the pressure of several developments: the low birth rates of the war years reduced temporarily entries into the labor market; agricultural employment, which had risen during the virgin lands campaign, declined but slowly; the armed forces were strengthened in the years of international tension; and just in 1960 Khrushchev felt obliged to order a further reduction of the workweek. Comparing the

[37] See John Musgrave's illuminating article "Alternative Calculations of Constant-Dollar GNP" in "Survey of Current Business," September 1974, p. 6.

second half of the 1950s with the first half of the 1960s (and keeping in mind that the figures are not precise), we find that the annual growth rates of the capital stock (not to be confounded with investment) fell from 11 to 8.6 percent and of the hours worked from 2.3 to 1.9 percent; the increase of land was insignificant; and the combined factor productivity dipped from below 2 percent to little more than 1 percent. Crop troubles aside, the acute disappointment of the leadership (with or without Khrushchev) was caused by the military-civilian seesaw, which complicated planning and management, or, on a more general plane, by vagaries and inconsistencies of Khrushchev's domestic and foreign policy which worsened the perennial shortcomings of the Soviet economy.

Each Soviet leader features a peculiar style. It is influenced by his character and by the circumstances he encounters, including the personality of his predecessor from whom he may wish to differ. Khrushchev faced restive subjects at home and in the Soviet orbit and saved the day for the regime by moving toward less despotism, greater legality, consumer-oriented measures, and a degree of income redistribution. His flamboyant folksiness, in sharp contrast to Stalin's remote-control regime, helped him and his task for a while. Zigzagging between innovative and standpat policies, he went as far as he dared and, as his disgrace shows, farther than advisable.

The Brezhnev administration, increasingly Brezhnev's own show, has tried to act deliberately in a decorous and steadfast manner; in its first years the new administration was almost drab. But, as mentioned before. Brezhnev and his colleagues and lieutenants have followed Khrushchev's basic design. They tinker with the system but do not change it; they hope to overcome its obvious shortcomings through the latest (read: U.S.) technology; they provide the wherewithal for Soviet superpower; but, directly and indirectly, they have also done much to push consumer supply, particularly in their expensive agricultural policies; and they have continued Khrushchev's income policies.

C. The Combined Effects of an Inefficient System and a Heavy Defense Burden

The endeavors of the new administration resulted in a minor increase of the GNP growth rate during the second half of the 1960s: about 5.6 percent per annum as compared to 5.1 percent in the preceding five years, but not quite the 5.9 percent of the years 1955–60. There was a slight increase (to 2 percent per annum) in man-hour inputs (reflecting the higher birth rates after the soldiers had returned from the great war), a temporary withdrawal of land from crop cultivation (minus 0.3 percent), and a levelling off of capital stock accretions from 8.6 to 7.5 percent p.a. The growth rate for new investment in fixed capital assets accelerated from little over 6 percent to 7.6 percent p.a. and the share of investment rose by another 2 percentage points (fixed investment to 24 percent, total investment to 27 percent of GNP). Factor productivity appears to have increased from a low 1.2 percent to a still mediocre 1.5 percent increase per year.[38]

[38] See the very useful CIA publication "Handbook of Economic Statistics 1975," August 1975, pp. 45–47.

The year 1970 brought the USSR a good crop (after three years of modest results), while the United States was again in recession. Soviet GNP grew by perhaps 7.9; U.S. GNP, depending on the deflator, by 0.4 or 0.3 percent. The GNP ratio, which had remained around 44:100 throughout the 1960s, increased to almost 50:100. In the following five years, marked by inflation, currency troubles, the "oil crunch", and recession, the American GNP rose by only 2.5 percent p.a. Soviet growth during those years is estimated (perhaps overestimated) at 3½ percent p.a. The difference spells a 1975 Soviet-U.S. GNP ratio of close to 53:100. With business improving in the U.S. and the crop outlook mediocre in the U.S.S.R., the ratio is bound to dip in 1976.

Soviet planning has always been tempted to magnify the leadership's goals and to substitute excessive enterprise targets for what is lacking in the Soviet system, namely the incentives of market competition. The Ninth Five-Year Plan 1971–75 was among the more ambitious plans; in fact, it was somewhat "hare-brained". The plan predicated its fulfilment on very high productivity gains, in particular on a by far more economical utilization of capital and materials, to compensate for small increases in manpower. In the end factor productivity in the economy as a whole improved hardly at all during the years of the plan. Gregory Grossman, by calling his sagacious analysis of the Ninth and Tenth Plans "An Economy at Middle Age" [39] suggests a "slowing down" of "the whole economic organism", but I feel uncomfortable with such metaphors. Economies are not organisms; they do not age and, what is worse, they do not mature. They may operate under inefficient institutions; they may experience bad luck (two poor Soviet harvests in five years); they may also endanger their expansion by growth-hampering changes of the original policies. This takes us back to the defense issue. The U.S.S.R. claims to have fulfilled (or almost fulfilled) under the 1971–75 Plan its programs for fixed investment with the planned growth of 7.2 percent p.a. and for heavy industry output with a 7.7 percent increase. Both rates are probably price-inflated but the investment volume may also be overstated on account of investment in military hardware procured from the output of heavy industry. Furthermore, it is possible that labor stringency was worsened as a result not only of foreseeable demographic developments but also because of unanticipated military demands.

D. Long-Term Record of the Soviet Economy

Looking at the economic growth of the U.S. and U.S.S.R. over periods of varying length, I must refer again to the intrinsic difficulties of comparisons between countries and periods with different economic structure. I wish to express in particular the suspicion that estimates of American growth may understate, of Soviet growth overstate the real rates. To mention one single reason: services, understated because for most of them output is determined by inputs with insufficient attention to productivity gains, have expanded as a share of U.S. GNP from 31 percent in 1950 to 47 percent in 1975; in the U.S.S.R. the 1970 share was 25–30 percent at factor cost, 15–20 percent in established

[39] In "Problems of Communism," March–April 1976, p. 18.

prices with only moderate changes in the share over the years. The difference in weight of the service sectors tends to depress the United States growth figure relative to the Soviet rate.

These caveats counsel that the persistent and increasing growth advantage of the U.S.S.R. over the U.S. may to a degree be purely statistical. Nevertheless, a difference remains in reality and must be attributed to the more massive application of labor, capital, and land in the Soviet economy not withstanding their lower productivity in the U.S.S.R.

Between 1913 and the present (over some sixty years the fluctuations of recent years do not influence the rates) U.S. GNP growth was about 3 percent per annum as against 3.4 percent on the other side. The result was a change in the Soviet-U.S. GNP ratio from 39:100 in 1913 to about 53:100 in 1975. Both countries experienced times of troubles but there is no doubt that invasions and civil war did more damage to the U.S.S.R. than the Great Depression to the U.S. Growth interruptions lead, of course, to correspondingly rapid recoveries afterwards.

Such an upswing took place in the U.S.S.R. in the years after the Second World War. Between 1948 and 1974 (here I leave out the unusual year 1975), the Soviet annual growth rate was an annual 5.9 percent; it was 3.6 percent in the U.S. Making 1950 the base year reduces the rates to 5.3 and 3.5 percent. In later years Soviet growth decelerated and U.S. growth accelerated: in the period from 1960-74 the U.S.S.R. experienced a growth of 4.9 percent p.a. and the U.S. of 3.8 percent (1960–69 alone: 5.1 versus 4.6 percent). The first half of the 1970s were problem years in both countries with a growth of 3.5 percent there and 2 percent here.

Turning to labor inputs and keeping in mind that between 1950 and 1974 the populations rose by 1.4 percent in both countries, civilian employment increased by 1.9 percent in the U.S.S.R. and by 1.5 percent in the United States. Since output rose faster in the U.S.S.R., real output per person engaged in production moved up by about 3.3 percent in the U.S.S.R., by 2.9 percent in the United States. Growth in fixed capital per person employed is most difficult to compare. The growth rate for the United States is 2 percent p.a., for the U.S.S.R. tentatively 6–7 percent p.a., with gross capital data on the lower, net capital data on the higher end of the range. Land under crops increased from 1950 to 1971 (the latest U.S. census year) by an average annual 1.7 percent in the U.S.S.R.; it declined in the United States by 0.5 percent (but has been on the rise again in recent years). All these estimates are precarious but all of them point to the fact—and this is a fact—that the Soviet output performance is the result of very heavy inputs with a worsening relation between Soviet output and input.

THE REAL GROSS NATIONAL PRODUCT OF THE U.S.S.R., 1950–1975

RUSH V. GREENSLADE

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I. Introduction

This paper presents indexes of GNP of the USSR, constructed by the Office of Economic Research (OER) of the CIA.[1] They are the preliminary results of a major revision of the indexes which OER/CIA has calculated and used for many years. The indexes follow the US definition of GNP and are based on component indexes that are, for the most part, base year weighted quantity indexes.[2] The index of GNP is broken down by both sector of origin and by end use.

II. Soviet GNP From 1950 to 1975 in 1970 Prices

A. GNP Excluding Weapons

The indexes of GNP and its components (excluding weapons production) by sector of origin are shown in Table 1 below and average annual rates of growth by five year periods are shown in Table 2. The industrial component excludes production of strictly military goods, that is, weapons, weapons systems, and their components, but includes items of common use, e.g., trucks, tractors, fuel, and uniforms sold to the Ministry of Defense. Defense services, the cost of military manpower, is included in the services component, military research and development is assumed to be mostly included in the science index, and various other purchases by Defense are presumed to be included in transportation, education, health, etc. However, the production of prototype equipment, of which new military equipment would be by far the most important, carried out by industrial enterprises of R&D institutes, is not included in the aggregate. Thus, the growth index purports to measure aproximately all production except military equipment, both prototype and procurement models.[3] The weight for machinery production and industry is correspondingly reduced.

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[1] The number of analysts who have contributed to the construction of the indexes is too large to list. However, Douglas Whitehouse and Ray Converse, who have borne the main burden of assembling the indexes and estimating many of the components deserve special mention. The agricultural index is taken from the paper on agriculture by David Carey in this volume and is an update of the index published by Douglas Diamond and Constance Krueger in past Joint Economic Committee volumes. The consumption index and its components are those presented by Gertrude Schroeder and Barbara Severin in this volume.

[2] The 1970 GNP weights have been published in CIA, U.S.S.R.; Gross National Product Accounts, 1970, Research Aid, A(ER) 75–76, November 1975.

[3] The indexes are, to various degrees, incomplete. In particular, the industry index is based in part on sample data, with the least complete coverage in chemicals and machinery, see Rush V. Grenslade, Industrial Production Statistics in the U.S.S.R. in Treml and Hardt, Soviet Economic Statistics, Duke University Press, 1972.

TABLE 1.—U.S.S.R.: GNP INDEXES BY SECTOR OF ORIGIN (FACTOR COST) EXCLUDING MILITARY

[1970=100]

	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962
Industry	21.6	23.8	26.0	28.8	31.8	35.2	38.3	41.5	45.7	49.9	53.8	57.6	61.9
Ferrous metals	21.5	24.6	27.6	30.1	33.3	36.6	39.6	42.0	44.7	49.5	53.3	57.9	62.5
Nonferrous metals	18.2	20.7	23.3	26.0	28.5	33.4	35.4	37.4	39.4	42.6	46.5	50.7	54.9
Coal	39.5	42.8	45.6	48.1	52.4	59.0	64.6	69.6	74.6	76.9	78.8	78.9	80.9
Oil and gas	12.1	12.5	15.1	16.9	19.0	20.9	25.4	29.6	33.5	38.0	42.8	47.6	53.4
Electric power	12.5	14.2	16.2	18.3	20.5	23.1	26.0	28.5	32.0	36.0	39.6	44.5	50.2
Civilian machinery	17.8	17.8	19.7	23.6	25.2	28.5	31.5	34.9	39.1	43.3	49.0	54.1	59.6
Chemicals	14.2	15.7	17.0	18.7	21.0	24.0	26.7	29.1	32.3	34.7	38.0	41.8	46.1
Forest products	38.3	43.7	44.5	45.8	51.5	54.2	56.0	60.2	65.8	72.6	72.7	73.0	75.4
Paper and paper products	22.1	24.7	27.3	30.9	34.0	35.5	38.3	41.7	44.5	46.5	48.6	51.5	55.2
Construction materials	15.7	18.0	20.3	23.3	26.8	31.2	34.4	39.9	47.0	53.6	59.7	63.9	67.2
Light industry	25.3	29.8	32.0	35.3	40.1	43.0	46.4	48.6	52.7	56.8	60.4	63.0	65.5
Food industry	25.8	29.3	31.9	35.3	37.8	40.6	44.0	46.4	49.8	54.0	56.8	60.8	65.2
Construction	21.9	24.8	27.2	29.7	32.8	36.9	40.2	45.0	50.4	56.8	60.4	63.1	66.0
Agriculture	48.3	45.3	47.2	50.0	51.9	59.0	66.2	68.5	73.3	72.7	72.1	78.8	75.6
Transportation	16.0	17.9	19.9	21.2	23.9	28.5	31.4	37.9	39.5	43.7	47.8	51.3	55.3
Communications	22.4	24.5	26.7	28.4	30.8	33.0	35.6	38.4	40.6	43.2	46.4	49.2	52.2
Trade	23.3	25.8	28.4	31.3	34.6	38.2	41.9	45.9	50.1	54.0	57.4	59.6	63.2
Services [1]	51.5	54.2	56.5	56.7	57.1	57.8	58.2	59.5	61.5	63.6	64.6	67.4	70.8
Gross national product	34.7	36.0	38.2	40.2	42.3	46.0	49.3	52.3	55.9	58.8	60.9	64.8	67.0

	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
Industry	65.4	69.5	74.0	78.6	84.3	89.4	93.7	100	106.1	111.5	118.4	125.8	133.3
Ferrous metals	66.5	71.6	76.5	82.2	87.7	92.1	94.6	100	103.9	107.6	112.2	116.8	122.5
Nonferrous metals	59.1	63.6	67.5	73.9	81.2	88.8	94.8	100	106.7	111.3	116.0	121.6	127.8
Coal	83.4	86.7	90.5	92.4	94.5	95.3	97.7	100	102.5	104.7	106.9	109.5	112.0
Oil and gas	59.1	63.5	68.7	74.5	81.2	87.0	92.5	100	106.9	114.6	122.9	131.7	141.1
Electric power	55.8	62.0	68.3	73.5	79.1	86.1	92.9	100	108.1	115.8	123.6	131.9	140.2
Civilian machinery	63.7	68.3	71.6	76.9	82.2	88.3	93.6	100	109.3	118.3	129.4	141.9	153.3
Chemicals	51.0	57.9	66.0	72.4	79.6	85.3	90.0	100	107.8	115.2	125.7	137.5	153.0
Forest products	79.4	83.0	84.2	84.8	89.7	92.8	94.8	100	103.8	107.1	111.6	115.2	120.0
Paper and paper products	58.3	62.6	70.6	78.1	84.4	88.7	93.6	100	105.5	100.4	116.9	122.2	128.1
Construction materials	69.0	72.3	76.8	82.4	88.0	90.9	92.6	100	105.9	110.8	117.1	122.4	128.1
Light industry	65.9	67.2	67.9	73.1	80.3	87.3	93.6	100	104.4	105.0	107.9	110.8	113.4
Food industry	68.0	71.2	79.4	81.9	87.5	91.2	94.1	100	103.0	106.7	110.1	116.3	119.8
Construction	68.2	71.4	75.3	78.9	84.7	89.1	92.7	100	105.6	110.3	116.2	121.9	131.2
Agriculture	63.4	77.3	81.3	87.3	85.6	90.1	87.0	100	99.1	90.4	105.3	102.2	90.4
Transportation	59.6	64.9	72.4	77.3	83.6	89.4	93.9	100	106.2	111.9	120.1	127.8	135.7
Communications	55.3	59.2	65.4	72.3	79.7	85.5	92.9	100	107.2	115.1	123.4	132.4	141.8
Trade	65.0	68.3	72.9	78.6	83.9	89.0	93.4	100	105.9	109.8	117.3	122.8	127.9
Services [1]	73.9	77.6	81.3	85.2	88.8	92.8	96.4	100	103.7	106.4	110.3	115.1	119.1
Gross national product	66.8	72.9	77.3	82.1	85.6	90.3	92.8	100	103.9	105.4	113.4	117.6	120.0

[1] Including military personnel costs.

TABLE 2.—U.S.S.R.: GNP BY SECTOR OF ORIGIN EXCLUDING WEAPONS (FACTOR COST)

AVERAGE ANNUAL RATES OF GROWTH

[Percent]

	1951–55	1956–60	1961–65	1966–70	1971–75
Industry	10.3	8.9	6.6	6.2	5.9
Ferrous metals	11.3	7.8	7.5	5.5	4.2
Nonferrous metals	12.9	6.8	7.7	8.2	5.0
Coal	8.4	6.0	2.8	2.0	2.3
Oil and gas	11.6	15.4	9.9	7.8	7.1
Electric power	13.1	11.4	11.5	7.9	7.0
Civilian machinery	9.9	11.4	7.9	6.9	8.9
Chemicals	11.1	9.6	11.6	8.7	8.9
Forest products	7.2	6.1	3.0	3.5	3.7
Paper and paper products	9.9	6.5	7.8	7.2	5.1
Construction materials	14.7	13.9	5.2	5.4	5.1
Light industry	11.2	7.0	2.4	8.0	2.6
Food industry	9.6	6.9	7.0	4.7	3.7
Construction	11.0	10.4	4.5	5.8	5.6
Agriculture	4.1	4.1	2.4	4.2	−2.0
Transportation	12.2	10.9	8.7	6.7	6.3
Communications	8.1	7.0	7.1	8.9	7.2
Trade	10.4	8.5	4.9	6.5	5.0
Services [1]	2.4	2.2	4.7	4.2	3.6
Gross national product	5.8	5.8	4.9	5.3	3.7

[1] Including military personnel costs.

B. GNP Including Weapons

No reliable index of military equipment is available for use in these indexes. A publication of the CIA gives the estimated trend in total defense expenditures in rubles from 1970–1975.[4] However, a series for machinery and equipment purchased is not shown separately.

For the purpose of illustrating what difference weapons production might make, an estimate of the trend of total machinery production is shown in table 3, along with the total industry and GNP indexes that would result.[5] The corresponding average annual rates of growth for five year periods are in Table 4. These rates of growth were not used on direct evidence of weapons production, and no separate weapons index was calculated. Instead, an index of overall machinery production was estimated from Soviet input-output data and official gross value (GVO) indexes with adjustments for double counting and price distortion, and the results were extrapolated to years earlier than 1959 and later than 1972 (see the Appendix for a fuller explanation). Given the deficiencies of the Soviet GVO index and the arbitrariness of the adjustments, the results are only illustrative.

[4] CIA, Estimated Soviet Defense Spending in Rubles, 1970–1975, SR 76–10121, U, May 1976.

[5] This total machinery index is the sole responsibility of the author and does not represent the position or estimates of the CIA.

TABLE 3.—U.S.S.R.: ESTIMATED PRODUCTION AND GNP INDEXES INCLUDING WEAPONS
[1970=100]

	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959
Total machinery	13.6	15.6	17.7	20.1	22.9	26.5	29.5	32.7	36.4	38.8
Total industry	19.8	22.5	24.6	27.2	30.3	33.8	36.9	40.1	44.1	47.7
Total gross national product	33.8	35.2	37.4	39.3	41.5	45.2	48.6	51.6	55.1	57.8
	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
Total machinery	42.8	47.9	53.6	58.8	62.4	66.3	72.0	78.5	85.4	92.6
Total industry	51.3	55.2	59.6	63.6	67.5	72.0	76.8	82.9	88.3	93.4
Total gross national product	59.9	63.9	66.2	66.2	72.2	76.6	81.4	85.2	90.0	92.7
	1970	1971	1972	1973	1974	1975				
Total machinery	100.0	107.8	117.0	127.4	138.0	149.6				
Total industry	100.0	106.0	111.8	118.9	126.2	134.1				
Total gross national product	100.0	103.9	105.7	113.7	117.9	120.7				

TABLE 4.—U.S.S.R.: PRODUCTION AND GNP, INCLUDING WEAPONS (FACTOR COST) AVERAGE ANNUAL RATES OF GROWTH

[Percent]

	1951–55	1956–60	1961–65	1966–70	1971–75
Total machinery	14.2	10.1	9.1	8.6	8.4
Total industry	11.3	8.7	7.0	6.8	6.0
Total gross national product	6.0	5.8	5.0	5.5	3.8

The difference between the coverage of the civilian machinery index and the total machinery index is not only weapons. The most important categories missing from the civilian sample but covered in the Soviet GVO are industrial communications equipment, civil aircraft, capital repair of machinery, and metal working products. A comparison of the rates of growth of civilian machinery with those of the estimated total reveals an implied rate of growth of the difference considerably greater than civilian machinery production in 1951–55, somewhat less than civilian production in 1956–60 greater than civilian in 1961–70 and less again in 1971–75. For the whole period, 1951–75, the growth of machinery including weapons is 10.1 percent and excluding weapons 9.0 percent. These results seem plausible. They are, however, not claimed to be realistic, especially for individual years. On the other hand, they can serve as a sensitivity test. Substantial changes in machinery trends do not radically affect the growth in GNP.[6] For purposes of international comparisons of growth or productivity, the difference between the two GNP indexes is not fatally large. On the other hand, for analysis of the burden of defense or the relative efficiency of defense industries, the difference is crucial. For the latter purposes, the estimated GNP indexes are inadequate.

The indexes of GNP by end use, and its components are shown in Table 5 and the average annual rates of growth by five year periods in Table 6. The overall rate of growth is controlled by the sector of origin index including weapons. Thus, the GNP total index in Table 5 is the same as the total GNP index in Table 3 above.

[6] For those observers who think that weapons production has grown more slowly than indicated above, the GNP series excluding weapons could provide an illustrative rate of growth. If the indexes in Tables 1 and 2 are assumed to include weapons, the implied rate of growth of weapons production would be equal to that of GNP as a whole, or 5.1 percent per year over 1951–75—Substantially less than the growth implied by the machinery index including weapons, shown above.

[1970=100]

	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962
Consumption	36.9	36.9	40.1	42.2	46.5	49.1	51.8	55.8	58.4	61.2	64.0	65.9	68.6
Household consumption	36.4	36.2	39.3	41.4	46.1	48.6	51.3	55.7	58.5	61.3	63.9	65.8	68.5
Consumer goods	35.2	34.3	37.9	40.1	45.9	48.7	51.7	56.5	59.5	62.4	64.6	65.9	68.2
Food	41.1	39.3	43.6	45.9	52.7	55.0	57.6	61.9	64.4	67.3	68.4	69.7	72.2
Soft goods	24.4	26.4	28.5	30.3	33.8	36.2	41.0	47.1	51.6	54.2	58.6	60.0	61.9
Durables	9.9	8.8	10.8	13.2	16.2	24.4	26.4	32.4	35.7	39.3	44.9	45.9	48.5
Household services	39.2	40.9	42.6	44.4	46.3	48.4	50.3	53.6	56.0	58.5	62.5	65.7	69.1
Communal consumption	39.6	41.8	44.2	46.6	49.3	52.0	54.7	56.6	58.3	61.1	64.0	66.3	69.1
Health	36.7	39.6	42.6	45.9	49.5	53.3	58.0	60.2	62.9	67.0	71.1	72.6	72.1
Education	41.4	43.2	45.1	47.1	49.1	51.3	52.7	54.3	55.4	57.5	59.7	62.5	67.3
Fixed Investment	18.5	22.1	21.5	24.8	26.9	32.5	36.8	41.7	45.9	50.7	52.9	59.2	60.9
New fixed investment	17.9	21.9	20.7	24.4	26.6	32.8	37.6	42.9	47.4	52.0	53.5	60.0	61.6
Machinery and equipment	13.4	13.8	14.2	15.0	19.0	22.9	28.1	30.8	35.6	38.7	41.5	45.9	51.8
Construction and other	20.8	23.9	26.3	28.9	32.1	36.4	39.8	44.8	50.4	56.7	59.9	62.2	65.2
Net addition to livestock	3.1	38.2	−15.6	17.0	−3.4	39.3	61.3	82.3	71.2	61.7	35.8	106.7	69.2
Capital repair	22.0	23.6	25.3	27.0	28.9	30.9	32.5	35.4	38.2	44.2	50.0	54.9	57.2
Research and development	17.5	19.2	20.9	22.1	24.0	26.2	29.2	33.3	37.6	41.3	47.5	52.3	57.8
Administrative and other services	81.5	81.9	82.3	79.1	73.7	66.0	66.3	64.7	65.8	65.5	67.1	70.1	71.5
Outlays, not elsewhere classified [2]	51.4	55.4	60.1	58.4	50.5	58.9	64.2	57.2	64.9	61.6	58.0	67.5	68.0
Gross national product	33.8	35.2	37.4	39.3	41.5	45.2	48.6	51.6	55.1	57.8	59.9	63.9	66.2

	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
Consumption	70.6	73.4	78.0	82.7	87.1	91.0	95.5	100	104.5	106.8	112.7	116.6	120.7
Household consumption	70.1	72.6	77.2	82.0	86.5	90.7	95.3	100	104.6	106.9	113.1	117.0	120.9
Consumer goods	69.1	71.2	76.1	81.1	85.8	90.1	95.0	100	105.0	106.5	113.7	117.2	120.8
Food	73.2	75.1	79.4	84.0	89.1	92.7	96.2	100	104.1	103.1	110.8	112.9	114.9
Soft goods	62.8	64.4	70.6	76.4	79.1	84.1	93.0	100	105.0	109.6	113.8	119.2	124.8
Durables	48.3	53.2	59.9	67.3	73.6	82.3	89.5	100	113.7	130.6	141.4	153.1	166.9
Household services	72.4	76.1	80.0	84.0	88.3	92.2	96.0	100	103.8	107.7	111.7	116.4	121.2
Communal consumption	73.2	77.5	82.1	86.8	89.9	92.7	96.7	100	103.4	106.6	110.6	114.4	119.3
Health	75.4	78.9	82.6	87.1	89.2	91.2	94.8	100	102.5	105.2	108.2	111.3	115.2
Education	71.9	76.7	81.8	86.6	90.3	93.6	97.8	100	104.0	107.5	112.0	116.2	121.9
Fixed Investment	54.7	68.1	73.8	74.8	77.4	82.5	88.2	100	103.7	107.3	116.5	124.1	131.0
New fixed investment	52.8	67.9	73.6	73.7	75.7	80.6	87.4	100	102.6	105.0	113.8	120.8	126.5
Machinery and equipment	57.3	64.8	69.2	73.1	78.7	85.0	88.9	100	105.1	113.8	122.9	134.8	149.4
Construction and other	66.7	69.6	73.3	76.8	82.6	86.8	92.5	100	105.4	109.9	115.6	121.1	130.5
Net addition to livestock	−147.2	61.8	101.3	38.7	−27.2	−21.5	14.2	100	53.6	−4.1	42.8	43.2	−45.2
Capital repair	64.3	69.2	74.7	80.4	86.5	92.4	92.5	100	109.4	119.1	130.2	141.4	153.9
Research and development	63.3	68.6	72.4	78.5	81.5	87.0	92.4	100	106.1	104.7	113.3	127.3	134.7
Administrative and other services	72.2	75.0	79.4	83.6	88.8	93.4	97.7	100	103.5	107.6	112.2	116.7	121.1
Outlays, not elsewhere classified [2]	72.2	77.2	77.2	92.5	95.9	104.7	87.9	100	100.9	94.7	112.2	105.9	87.0
Gross national product	66.2	72.2	76.6	81.4	85.2	90.0	92.7	100	103.9	105.7	113.7	117.9	120.7

[1] Total GNP (including weapons production).

[2] Includes defense, net exports, change in inventories and reserves, unidentified outlays, and statistical discrepancy.

TABLE 6.—U.S.S.R.: GNP BY END USE (FACTOR COST), AVERAGE ANNUAL RATES OF GROWTH[1]

[Percent]

	1951–55	1956–60	1961–65	1966–70	1971–75
Consumption	5.9	5.4	4.0	5.1	3.8
Household consumption	6.0	5.6	3.8	5.3	3.9
Consumer goods	6.7	5.8	3.3	5.6	3.9
Food	6.0	4.5	3.0	4.7	2.8
Soft goods	8.2	10.1	3.8	7.2	4.5
Durables	19.4	13.3	5.9	10.8	10.8
Household services	4.3	5.3	5.1	4.6	3.9
Communal consumption	5.6	4.2	5.1	4.0	3.6
Health	7.7	5.9	3.1	3.9	2.9
Education	4.4	3.1	6.5	4.1	4.0
Fixed Investment	12.2	10.3	7.1	6.3	5.4
New fixed investment	12.6	10.3	6.8	6.4	4.5
Machinery and equipment	11.3	12.6	10.8	7.6	8.4
Construction and other	11.4	10.4	4.3	6.5	5.0
Net addition to livestock	65.9	−1.8	23.1	−.2	−14.7
Capital repair	9.8	10.3	8.9	6.0	9.4
Research and development	8.4	12.6	8.8	6.7	6.1
Administrative and other services	−4.1	.3	3.4	4.7	3.9
Outlays n.e.c.[2]	3.3	−.3	6.3	3.2	−3.7
Gross national product	6.0	5.8	5.0	5.5	3.8

[1] Total GNP (including weapons production).
[2] Includes defense, net exports, change in inventories and reserves, unidentified outlays, and statistical discrepancy.

C. Growth Trends

The revised indexes confirm our previous understanding of the postwar development of the USSR. After a rapid recovery in the postwar decade, economic growth slowed somewhat after 1955 and then sharply after 1960. Nearly all the sectors of origin, especially industry, construction, agriculture, and transportation contributed to the slowdown. Agriculture was affected by the poor harvest in 1963 and, in turn, affected light and food industry. However, civilian machinery production, construction and investment were also significantly reduced in growth. The period 1966–70 was a period of favorable weather and growth, but in 1971–75, growth was again retarded. The most serious annual slowdowns in growth since 1960 were the result of bad weather and reduced agricultural production. Serious crop failure occurred in 1963, 1972, and 1975. GNP growth in those years was negligible or slow. GNP growth in those years was 1963=0.1 percent, 1972=1.7 percent, and 1975=2.2 percent.

The agricultural fluctuations, obscure the overall growth trend since 1960. However, there is a suggestion of further slowdown. Dropping out the bad harvest year 1975, the growth rate of 1971–74 is 4.1 percent. This is noticably slower than the average of 1961–70, 5.2 percent. The tenth five year plan projects a continuation of this slowdown but more time must elapse in order to confirm the trend. (See the report by Green, Guill, Levine, and Miovic in this volume.).

The trends in end uses record a substantial shift in priorities after 1960. The growth of investment has dropped from over 10 percent per year before 1960 to 7.1 percent in 1961–65 and has continued to slow down since then. Household consumption suffered in 1961–65 from the bad harvests (3.8 percent per year) but recovered in 1966–70 to a 5.3 percent growth rate. Since 1970, poor weather has again restricted food consumption (3.9 percent per year in 1971–75), but the government and party have pushed the growth of consumer soft goods and durables vigorously. The leadership has attempted to maintain the growth in consumption, and the Tenth Five-Year Plan suggests a continuation of this attempt.

D. End Use Shares

End use shares as indicators of priorities should properly be measured in current prices. In those periods when Soviet authorities rather arbitrarily change retail price levels as in the 1950s, constant price shares may be more indicative. In the absence of a consistent series for GNP in current prices, the trend of shares in 1970 prices is shown in Table 7.

Even though the growth of investment slowed after 1960, the share of investment continued to grow at the expense of consumption, until 1965. After that consumption nearly holds its own. The most rapidly growing share is R&D, in large part because of the requirements of advanced weapons development.

TABLE 7.—U.S.S.R.: SHARES OF GNP BY END USE (FACTOR COST)

[Percent]

	1950	1955	1960	1965	1970	1974
Consumption	62.4	62.1	61.1	58.2	57.2	56.5
Household consumption	52.1	52.0	51.2	48.8	48.4	48.1
Communal consumption	10.3	10.1	9.9	9.4	8.8	8.4
Fixed Investment	14.8	19.4	23.9	26.0	27.0	28.4
New fixed investment	11.9	16.4	20.2	21.7	22.6	23.2
Capital repair	2.9	3.0	3.7	4.3	4.4	5.2
Research and development	1.8	2.0	2.8	3.3	3.5	3.7
Administrative and other services	6.2	3.7	2.9	2.6	2.6	2.5
Outlays n.e.c.[1]	14.8	12.8	9.3	9.9	9.7	8.9
Gross national product	100.0	100.0	100.0	100.0	100.0	100.0

[1]Includes defense, net exports, change in inventories and reserves, unidentified outlays, and statistical discrepancy.

A noteworthy item in Table 6 is administration and other government services. The Soviet budget item for administration has been small and generally flat or only slowly rising over the last 15 years. This has been a source of wonder to Western observers and of gratifying propaganda for the Russians. A recent study of Soviet Government services carefully estimates the expenses of Soviet government activities that would be counted as government service in the West.[7] These estimates indicate a much larger and more rapidly growing expenditure by government than the official budget, 8.7 billion rubles against 1.7 billion in the budget in 1970. This category has grown approximately as fast as GNP since 1960, nearly maintaining its share of the total. The radical decline between 1950 and 1960 perhaps represents the pruning of Stalin's overblown security apparatus and Khruschev's efforts to reduce the party apparat.

E. The Defense Share

The category outlays n.e.c. includes most of defense other than R. & D., but also, net exports, changes in inventories and reserves, and a statistical discrepancy. The statistical discrepancy, as in GNP accounts for any country, is prone to sizable fluctuation. In addition, the trend in GNP depends on the estimated total machinery index which can only be described as illustrative. So the trend in outlays n.e.c. is not a reliable indicator of defense trends. This is particularly true

[7] Gertrude Schroeder, *A Critique of Soviet Statistics on Administration*, ACES Bulletin, spring 1976, pp. 23–44.

of short periods and even more so of single years. The decline in 1975 probably reflects a drawdown in inventories, and negative net exports resulting from large grain imports.

The trend in defense spending for 1970–75 is estimated by CIA to be 4 to 5 percent per year including R. & D.[8] This is a faster trend than the trend in outlays, n.e.c., but the difference may be accounted for by the possible faster trend of defense R. & D. not included in outlays, n.e.c., and slower growth of components of outlays, n.e.c.

For 1970 the CIA estimate of defense spending is 40–45 billion rubles including R. & D. Of this total, about 20 percent is said to be R. & D. We can test the consistency of this estimate against the independently estimated base year GNP in established prices in 1970.

In 1970, an estimated 26 billion rubles in outlays, n.e.c., is available to cover defense expenditures not included in other end use accounts such as science, investment, education, and health.[9] A range of error in the GNP total and in the outlays, n.e.c. of minus 8 billion rubles and plus 5½ billion rubles is estimated.

The defense expenditures excluding R. & D. are 32–36 billion rubles. I assume that all of military R. & D. is included in the R. & D. category of GNP—the Soviet science allocation. Allowing that defense purchases of common use items such as trucks, tractors, construction, transport ships and aircraft, may be counted in investment, and that defense provided health and education are likely to be counted in the corresponding totals, the defense allocations chargeable against outlays, n.e.c., should be significantly reduced. If the reduction is 10 percent then the range of defense expenditures is approximately covered by outlays only if the outlays, n.e.c. range of error is added; that is 28.8 to 32.4 billion rubles of defense against 31½ billion rubles of outlays, n.e.c.

This comparison suggests three possible alternative hypotheses:[10]

1. That the GNP is too low in 1970 (by about the estimated range).

2. That estimated defense is too high, or estimates of other elements of outlays, n.e.c. are too high.

3. Or that more of defense than the 10 percent allowed above is counted in investment and other announced non-defense categories.

In the light of uncertainties in all of these respects, the defense numbers are not demonstrably inconsistent with the GNP estimate, and therefore the weights are not revised on this account.

The CIA defense estimate for 1970 including R. & D., is about 12–13 percent of GNP at factor cost.

F. Factor Productivity

Trends in labor and capital inputs, and factor productivity for GNP and industry are shown in Tables 8 and 9.

These trends in productivity underline the slowdown in growth and point to the efficiency with which factors are combined as a major source of retardation. The growth of factor inputs slowed much less than factor productivity after 1960, both for GNP and industry.

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[8] CIA. Soviet Defense Spending, 1970–1975, op. cit.
[9] CIA. USSR: GNP Accounts in 1970, op. cit.
[10] These are the opinions of the author and do not represent the position of the CIA.

There has been a great deal of discussion in both Western and Soviet literature on the difficulties of introducing new technology into the bureaucratic Soviet economy. These difficulties are consistent with the slow growth of factor productivity.

Another hypothesis has also been proposed to account for the slowdown. The rapid increase in the capital-labor ratio should have brought on diminishing returns in the conventional economic sense. Rapidly diminishing returns are indicative of an elasticity of substitution of capital and labor of less than one. This hypothesis can be represented in a constant elasticity of substitution (CES) production function. [11] No doubt both these factors are at work in the Soviet economy.

TABLE 8.—U.S.S.R.: AVERAGE ANNUAL RATES OF GROWTH OF TOTAL GNP PRODUCTION, FACTOR INPUTS, AND FACTOR PRODUCTIVITY, 1951-75[1]

[Percent]

	1951–55	1956–60	1961–65	1966–70	1971–75
Total GNP	6.0	5.8	5.0	5.5	3.8
Inputs:					
Labor (man-hours), capital, and land[2]	4.5	3.9	4.1	3.9	4.1
Man-hours	1.9	.6	1.6	2.0	1.9
Capital	9.0	9.8	8.7	7.5	7.9
Land	4.0	1.3	.6	−.3	.9
Factor productivity:					
Labor (man-hours), capital, and land	1.4	1.8	.9	1.5	−.2
Man-hours	4.6	5.1	3.4	3.4	1.8
Capital	−2.7	−3.6	−3.3	−1.9	−3.8
Land	1.9	4.4	4.4	5.8	2.9

[1] The GNP growth rates are taken from table 4 (including weapons.)
[2] Inputs have been combined using a Cobb-Douglas (linearly homogeneous) production function with weights of 60.2, 36.7, and 3.1 percent for labor, capital, and land, respectively.

TABLE 9.—U.S.S.R.: AVERAGE ANNUAL RATES OF GROWTH OF INDUSTRIAL PRODUCTION, FACTOR INPUTS, AND FACTOR PRODUCTIVITY, 1951–75

[Percent]

	1951–55	1956–60	1961–65	1966–70	1971–75
Total industrial production	11.3	8.7	7.0	6.8	6.0
Inputs:					
Labor (man-hours) and capital[1]	7.4	5.3	6.4	5.5	4.5
Man-hours	4.2	1.1	2.9	3.1	1.5
Capital	12.0	11.3	11.2	8.7	8.7
Factor productivity:					
Labor (man-hours) and capital	3.6	3.2	.6	1.3	1.5
Man-hours	6.9	7.6	4.0	3.6	4.5
Capital	−.6	−2.3	−3.8	−1.8	−2.4

[1] Inputs have been combined using a Cobb-Douglas (linearly homogenous) production function with weights of 57 and 43 percent for labor and capital respectively.

It is noteworthy, that agriculture seems to be a major locus of continuing difficulties. In agriculture, the effects of diminishing returns to a lavish investment input, difficulties in applying new methods of agronomy and animal husbandry, an indifferent and unmotivated labor force, and not least, chronic and perhaps increasing managerial ineptness, are all observable.

[11] See Weitzman, M., "Soviet Postwar Economic Growth and Capital-Labor Substitution" in American Economic Review, September 1970, p. 676.

G. Comparisons With Other Measures of Soviet Growth

1. COMPARISON WITH SOVIET NATIONAL INCOME

The coverage of U.S.S.R. GNP and official Soviet national income are quite different, but they can be made approximately comparable by adjusting GNP to Soviet national income coverage. In CIA, U.S.S.R.: GNP, Accounts in 1970, op. cit., GNP in established prices is adjusted by subtracting nonproductive services and depreciation on productive fixed capital and by other small adjustments to approximate national income produced. From this base, weights can be derived to apply to appropriate sectors of origin of GNP, and the resulting aggregate index compared with Soviet national income. The results are shown in Table 10 below:

TABLE 10.—U.S.S.R.: INDEXES OF OFFICIAL NATIONAL INCOME AND GNP, 1951–75

	Average annual rates of growth (Percent)			
	1951–60	1961–65	1966–70	1971–75
Soviet national income	10.2	6.8	7.4	5.7
GNP in established prices, excluding services	7.6	5.3	6.1	4.0

The OER measure is significantly slower. The reasons for mistrusting the official measures are discussed in Section III. A. below. However, since the components of the official measure are not given, more detailed quantitative comparisons are not feasible.

2. COMPARISON WITH OTHER WESTERN MEASURES

The GNP indexes for the U.S.S.R. are similar in form and structure to those that have been constructed by Stanley Cohn and presented in previous Joint Economic Committee volumes. The rates of growth for adjusted periods up to 1970 are compared in Table 11, below. The overall rates are in fairly close agreement, although Cohn's are faster for 1951–55 and a little slower for the period since 1960, and particularly for the period 1966–70. The difference in growth in 1951–55 is probably due mostly to differing estimates of military production. The base year for Cohn's indexes is 1959. Furthermore, the component indexes and the weights in the OER GNP have been comprehensively revised as compared to the data from which Cohn constructed his indexes. However, a careful comparison by sector has not yet been carried out.

TABLE 11.—U.S.S.R.: COMPARISON OF OER AND COHN ESTIMATES OF TOTAL GNP, AVERAGE ANNUAL RATES OF GROWTH

	OER	Cohn
1951–55	6.0	6.9
1956–60	5.8	6.0
1961–65	5.0	5.0
1966–70	5.4	5.1

Source: Stanley H. Cohn, "Analysis of Growth Model," in Bornstein and Fusfeld, "The Soviet Economy: A Book of Readings," 4th ed., Richard D. Irwin Inc., Illinois, 1974.

III. Methods of Construction of the GNP Indexes

A. The General Design

The indexes follow as nearly as possible the definitions and procedures of the Department of Commerce for the U.S. GNP. The indexes for the U.S.S.R. are constructed when possible from physical data rather than from Soviet deflated value series, but some use of the latter was unavoidable.

The reasons for mistrusting the Soviet official indexes and deflated value series have been stated many times, but a brief recapitulation is in order.[12] Soviet official national income adheres to the Marxist concept of net material product whose coverage is quite different than the Western concept of national income. Most services are omitted, including the services of government and its component, defense personnel costs. The differences between net material product and Western national income are well enough known that a reconciliation and conversion from one to the other could be calculated given a reasonably complete account of the procedures employed in constructing official Soviet national income. Therein lies the major drawback to Soviet official national accounts and other value data. Explanations of methods are over-generalized, conflicting, and unaccompanied by detailed disaggregations. Furthermore, the reliability of the original reporting of economic data by enterprises cannot be checked. By the testimony of many Soviet economists widespread misreporting and improper measurement occur. This is surely to be expected when the statistical reports are also used to judge and reward the enterprise managers. Incentives for misleading reporting, primarily overstatement, affect both quantity and value data. However, it is generally agreed that the opportunities for manipulating value data are rather better.

For the United States, the Department of Commerce can rely on comprehensive price indexes almost continuously updated, and based on large and representative samples, to deflate reliably reported end use categories. No such comprehensive price data are available for the U.S.S.R. The alternative is to make representative quantity indexes with base year value weights. OER has tried to do this both for end use categories and producing sectors, or sectors of origin. The component indexes of GNP by sector of origin are weighted by 1970 value added on a factor cost basis. The factor cost weights exclude the turnover taxes and profits and include subsidies and an imputation of interest on capital. But a rent on agricultural land is no longer estimated as it was formerly. The indexes of end use are weighted by 1970 value of sales also adjusted to a factor cost basis.[13]

As it happens, the most complete data appear to be for the sectors of origin. So the overall rate of growth is taken from the sector of origin indexes. On the other hand, the end use indexes provide a cross check for the origin indexes. Defense spending is, of course, an uncertain factor on both sides. With the aim of reducing this uncertainty,

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[12] See Treml, V. and Hardt, J. (ed), Soviet Economic Statistics, Duke U. Press, 1972—especially articles by A. Becker, M. Bornstein, S. Cohn, G. Schroeder, and R. Greenslade. See also Becker, A., Ruble Price Levels and Dollar-Ruble Ratios of Soviet Machinery in the 1960s, RAND Corp., January 1973.

[13] See CIA, USSR: GNP Accounts, 1970, Research Aid, A (ER) 75-76, November 1975.

a strenuous effort was made to construct quantity indexes for as much of total end use as possible and to rely as little as possible on deflated value indexes constructed by the Soviet government. In some cases however, some deflated Soviet series must be used because an appropriate physical sample is non-existent, too small or too unrepresentative. The most important of the Soviet deflated series used in GNP are investment equipment and R. & D.

The intended use of these indexes is comparison with Western economies, primarily the US. Comparisons both of growth and of end use shares are in order. The priorities of the Soviet leadership with regard to consumption and investment can be shown in terms of resources allocated by the shares in factor cost. Even though the accounting is not the same as that used by the Soviet government, and hence is not the set of data used in making decisions, it is nevertheless a more accurate indicator of the allocation of resources than the Soviet official national income.

The exception to the statement about allocation of resources is the allocation to defense. The problem is simply the absence of an accurate series of current ruble expenditures on defense. In particular, the ruble cost of procurement is very successfully hidden in Soviet economic reporting. The announced defense expenditure in the annual national budget is known to be incomplete and unreliable even as the trend. Even though a plausible estimate of the dollar cost of procurement can be made, this is not sufficient information to calculate a ruble series either in constant or current prices. A tentative approach to this problem and its implications for the estimated growth of GNP are presented in the text above.

B. The Main Revisions

The GNP indexes presented here are the preliminary results of a major revision of the indexes which have been calculated and used by CIA for many years. These revisions are: (a) to incorporate 1970 base year weights, (b) to replace deflated value indexes with base year weighted quantity indexes where possible, and (c) to make the indexes comparable and consistent with the 1970 base year weights. Some of the revisions are not yet completed. The revisions represent a change in the indexes as compared to those underlying the GNP growth rates in testimony before Congress in 1974. Some of the revisions were introduced into the GNP appearing in the 1975 testimony and in the CIA/OER Handbook of Economic Statistics of 1975.[14] The methodology of construction of the indexes is given in the Appendix.

The following paragraphs merely highlight the main revisions.

END USE REVISIONS

1. Nearly all of household consumption is now based on quantity indexes, with the exception of consumer durables and miscellaneous goods, where Soviet deflated retail sales are used, because the sample of physical items formerly used is unrepresentative.

[14] Hearings before the Subcommittee on Priorities and Economy in Government of the Joint Economic Commission, Allocation of Resources in the Soviet Union and China, 1975, April 12, 1974, and July 1975. CIA, Handbook of Economic Statistics, Research Aid, A (ER) 75–65, August 1975.

2. The construction component of investment, formerly represented by the Soviet announced index for "construction-installation work" in constant estimate prices, is now measured by the net consumption of material inputs used in construction (excluding capital repair). This change slows down the growth of construction substantially.[15] The machinery part of investment is still the constant price series announced by the Soviets.

SECTOR OF ORIGIN REVISIONS

1. Construction is revised in the same way as in end use, except that capital repair is included.

2. The producer durables part of industrial production is now weighted by value added weights for the various machinery industries. Formerly the sample series were simply added by value (price times quantity).

3. The consumer durables production is still represented by a Soviet constant price series for consumer durables and household goods. A Soviet writer has claimed that this series in recent years is inflated by double counting,[16] but no representative substitute has been found.

4. For the index of trade, the official index of deflated retail sales has been replaced by a constructed index of goods traded—retail, wholesale, industrial supply, and procurement—a much slower-growing series, but one that now also matches the base-year weight.

5. For the many services which were moved by employment, manhours are used instead.

6. As a general rule the services are moved by manhours for sector of origin and by manhours weighted by wage rates plus materials purchases for end use. In the case of science, the origin index is also wage-weighted manhours and materials. A large part of R. & D. activity consists of manufacturing prototypes, especially for military equipment, or unique, custom-built equipment, e.g., for testing. Some of the employment so engaged is reclassified in industry. But much of it evidently is not, considering the size of science employment, 3.2 million in 1970. The inclusion of materials in the science index captures some of this manufacturing activity.

7. The revised index for transportation covers all transportation and is a composite index of physical series aggregated with 1970 average price weights separately for seven modes of freight transport and nine modes of passenger transport. The previous index covered only freight transport.

The revisions are preliminary and incomplete. Further work is underway. In particular, construction of net sector indexes, net of inputs from other sectors, has not been carried out yet except for agriculture. Secondly, the difficult job of reconciling these indexes by sector of origin and end use with the successive input-output tables published, or rather partly published,[17] by the Russians has not been carried out yet. It does not seem likely that the revisions will change the results significantly, except possibly with respect to defense.

Current plans call for a full description of the construction of the indexes to be published by CIA/OER later.

[15] This procedure was pioneered by Richard Moorsteen and Raymond Powell. See "The Soviet Capital Stock," Yale Press. Also see the Appendix for a fuller explanation and comparison with the US.

[16] Lokshin, P. A., Spros, proizvodstvo, torgovlya, Moscow, 1975, p. 187.

[17] See Treml, Vladimir G., in this volume.

APPENDIX

DERIVATION OF GNP INDEXES

This appendix sets out a brief description of the sources and methods used to derive the indexes used to move the 1970 sector-of-origin and end-use GNP weights. The following comments concentrate on recent revisions which have been made in these indexes. A more detailed documentation of each index will be published in a future report.

Sector of Origin and End Use Weights

Tables A–1 and A–2 show the value added weights in 1970 for each of the sectors of origin and end uses of GNP. A detailed description of their derivation is given in CIA, A (ER) 75–76, U.S.S.R.: Gross National Product Accounts, 1970, November, 1975.

TABLE A–1.—*U.S.S.R.: GNP value added weights by sector of origin (factor cost), 1970*

	Billion rubles
Industry [1]	97.479
Ferrous metals	6.773
Nonferrous metals	3.659
Coal	5.372
Oil and gas	3.310
Electric power	6.748
Total machinery [2]	31.311
Chemicals	6.273
Forest products	6.071
Paper and paper products	1.138
Construction materials	6.561
Light industry	8.701
Food industry	9.305
Construction	30.064
Agriculture	69.405
Transportation	26.455
Communications	2.568
Trade	20.673
Services [3]	81.278
Gross national product [4]	340.219

[1] Includes 2.257 billion rubles of value added by "other industry." This value is moved to other years by the index of total industrial production.
[2] It should be noted that when only civilian machinery is considered, as in text table 1, the machinery weight shown here is reduced by about one-third.
[3] Includes military personnel.
[4] Includes 12.297 billion rubles of unallocated value added which is moved to other years by the index of total GNP.

TABLE A–2.—*U.S.S.R.: GNP weights by end use (factor cost), 1970*

	Billion rubles
Consumption:	
Household consumption:	
Consumer goods:	
Food	81.982
Soft goods	25.204
Durables	8.382
Subtotal	115.568
Household services	49.163
Total, household consumption	164.731
Communal consumption:	
Health	11.284
Education	18.547
Total, communal consumption	29.831
Total, consumption	194.562

Investment:	
New fixed investment:	
Machinery and equipment	21.413
Construction and other	51.491
Net addition to livestock	4.055
Subtotal	76.959
Capital repair	14.924
Total, investment	91.883
Research and development	11.815
Administrative and other services	8.687
Outlays n.e.c.[1]	33.270
Gross national product	340.219

[1] Includes defense, net exports, change in inventories and reserves, unidentified outlays, and statistical discrepancy.

Sector-of-Origin Indexes

A. INDUSTRY

The index of industrial production is patterned after the Federal Reserve Board index of U.S. industrial production; a sample of products for each of 13 branch indexes using 1 July 1967 enterprise wholesale prices as weights. The branch indexes are then aggregated into an index of total industrial production using value-added weights for base-year 1970. The use of 1 July 1967 prices with 1970 weights should not distort the growth shown by the index of industrial production since the official index of prices did not change significantly between 1967 and 1970. The sample used in deriving the index is composed of over 250 products. For most products, data on physical volume of production is taken directly from annual Soviet statistical handbooks. This index has previously been reported in Rush Greenslade and Wade Robertson, "Industrial Production in the U.S.S.R.," Soviet Economic Prospects for the Seventies, June 27, 1973, p. 270.

Revisions to this index include: (1) a new index for construction materials and (2) a new producer durables index based on 1970 value-added weights for the various machinery branches.

Construction materials index.—The new construction materials index eliminates the intra-branch uses of construction materials and, thus, much of the double-counting which was present in the previously used quantity series. The new index is based on a 4 × 4 input-output table derived from the 1972 Soviet input-output table. This 4-sector input-output table includes four major product groups of the construction materials branch: cement, precast concrete, glass and porcelain, and other construction materials. The 4-sector table is used, together with the GVOs of the 4 product groups for each year, to derive deliveries of construction materials to all sectors except construction materials (i.e., output net of intra-branch uses of construction materials). The results of indexing these net output values are compared with the previously used quantity index in Table A–3. As expected, the new construction materials index grows more slowly than the quantity series.

Producer durables index.—A comparison of the new producer durables index with the previously used series (see Table A–4), shows a generally slower trend associated with the new index. This reflects three significant revisions, which have been incorporated into the producer durables index reported in Greenslade and Robertson, op. cit. First, the machinery branches (shown in Table A–4) have been adjusted to conform more closely to the machinery sectors in an unpublished 1966 input-output table in 1970 prices, derived by V. Treml. Second, the motor vehicle index has been expanded to include spare parts production, a relatively slow growing component. Finally, the weights used to aggregate the machinery branches are based on 1970 value-added instead of the previously used gross onput weights. The value-added for each sector was derived from a 1966 input-output table in 1970 producers' prices. Since some machinery branches in the input-output table also reflect the production of consumer durables it was necessary to adjust total value-added in these machinery branches. For each machinery branch, the share of value-added by consumer durables production was assumed equal to the share of GVO delivered to private consumption.

The resultant value-added by producer durables in each machinery branch in 1966 was moved to a 1970 base by the appropriate machinery branch index.

TABLE A-3-1.—U.S.S.R.: CONSTRUCTION MATERIALS INDEXES

[1970=100]

	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962
Old construction materials index	10.89	12.84	14.77	16.82	19.48	23.22	26.38	31.70	38.40	45.11	51.79	56.98	61.34
Revised construction materials index	15.71	17.95	20.30	23.36	26.81	31.16	34.35	39.91	46.97	53.57	59.68	63.94	67.16
	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
Old construction materials index	65.00	67.80	73.96	80.89	87.15	90.28	92.51	100.00	106.08	111.02	117.46	122.93	128.65
Revised construction materials index	68.96	71.21	76.85	82.44	87.97	90.92	92.58	100.00	105.86	110.81	117.08	122.40	128.10

TABLE A-3-2.—AVERAGE ANNUAL RATES OF GROWTH

[Percent]

	1951–55	1956–60	1961–65	1966–70	1971–75
Old construction materials	16.4	17.4	7.4	6.2	5.2
Revised construction materials	14.7	13.9	5.2	5.4	5.1

TABLE A-4.—U.S.S.R.: MACHINERY PRODUCTION INDEXES BY BRANCH, 1950–74

[1970=100]

	1970 value added weights	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962
Energy and power M. & E.	.051	16.98	19.83	23.03	31.11	34.67	37.10	38.62	36.24	43.05	48.10	57.57	66.42	73.99
Electrotechnical M. & E.	.095	12.97	15.33	16.86	18.80	19.12	22.50	26.17	29.73	33.15	40.35	46.98	56.05	64.56
Machine tools	.050	9.68	11.56	13.80	16.48	19.68	23.52	26.50	29.87	33.66	37.94	42.84	49.80	53.58
Forge press machine tools	.012	6.46	8.62	11.46	15.24	20.28	27.40	31.22	35.57	40.53	46.18	52.44	57.32	59.76
Precision instruments	.095	2.44	3.13	3.99	5.10	6.49	8.36	10.88	14.13	18.36	21.78	25.84	30.10	35.11
Mining and metallurgy M. & E.	.129	39.96	46.00	57.62	67.29	59.49	53.19	55.17	57.87	63.77	70.33	77.48	78.27	87.37
Pumps and compressors	.055	5.23	6.98	9.16	12.25	14.26	16.59	18.25	21.87	24.42	37.66	48.63	52.95	58.07
Consumer industry M. & E.	.042	13.21	13.32	14.13	16.49	19.27	22.73	26.85	30.49	34.16	36.29	40.11	44.69	48.98
Hoist transport M. & E.	.033	18.26	21.89	23.89	29.95	32.43	34.62	33.19	39.14	46.20	39.75	41.89	47.88	52.64
Construction M. & E.	.029	19.45	19.31	19.40	20.60	23.25	25.65	29.96	36.37	40.39	41.95	48.59	56.96	62.00
Transportation M. & E.	.113	51.85	37.89	30.96	36.96	39.76	48.06	50.19	50.79	66.10	74.48	82.30	89.18	92.63
Motor vehicles	.113	12.88	12.40	14.13	16.88	20.26	23.81	27.24	31.90	39.06	47.61	50.86	52.72	55.83
Agriculture M. & E.	.141	15.12	15.07	15.77	17.12	20.60	26.40	33.85	43.00	39.46	34.81	40.14	49.28	57.60
Sanitary engineering products	.042	12.54	15.57	18.07	20.12	22.36	25.24	28.62	33.14	38.28	45.40	53.20	59.87	66.27
Producer durables	1.000	20.03	20.07	21.95	25.85	27.08	29.85	33.13	37.03	42.02	46.62	52.71	58.36	64.37
Old series of producer durables [1]		14.32	14.07	15.15	17.65	20.62	24.29	28.47	33.47	35.88	38.35	43.51	45.67	56.11

	1970 value added weight	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974
Energy and power M. & E.	.051	75.56	84.04	91.40	96.00	94.43	101.09	96.22	100.00	99.92	91.04	93.43	104.42
Electrotechnical M. & E.	.095	71.42	76.00	81.51	82.67	89.11	93.17	96.92	100.00	106.93	114.63	119.18	122.18
Machine tools	.050	56.95	62.07	65.24	72.80	80.78	88.04	93.35	100.00	107.67	116.56	129.14	141.82
Forge press machine tools	.012	71.14	65.45	65.45	71.54	78.86	87.40	94.31	100.00	110.98	120.73	133.73	150.81
Precision instruments	.095	39.72	41.34	45.87	52.47	60.29	70.05	82.86	100.00	114.69	137.00	164.83	199.75
Mining and metallurgy M. & E.	.129	85.16	92.06	92.82	97.42	101.99	102.17	99.83	100.00	105.34	110.15	113.93	117.10
Pumps and compressors	.055	63.02	75.01	83.52	90.28	92.46	96.60	99.14	100.00	113.79	122.20	136.00	152.31
Consumer industry M. & E.	.042	53.09	57.69	61.04	69.62	78.53	83.48	90.00	100.00	105.34	113.80	126.48	141.20
Hoist transport M. & E.	.033	56.66	60.04	66.58	72.91	79.78	84.79	89.52	100.00	107.60	114.02	119.41	126.18
Construction M. & E.	.029	65.53	72.98	77.69	83.82	90.52	95.18	103.42	100.00	109.65	115.82	119.87	124.49
Transportation M. & E.	.113	96.13	97.39	96.58	97.52	94.49	94.39	93.88	100.00	104.50	109.12	107.94	109.47
Motor vehicles	.113	60.57	65.61	67.34	73.97	82.13	89.13	94.77	100.00	115.58	130.52	149.64	166.38
Agriculture M. & E.	.041	66.76	69.75	74.03	78.55	81.48	86.68	94.79	100.00	108.88	118.42	133.48	151.76
Sanitary engineering products	.042	73.17	77.52	82.71	86.62	90.01	91.61	95.35	100.00	104.69	108.91	113.94	119.71
Producer durables	1.000	68.75	73.35	76.80	81.60	86.01	90.47	94.53	100.00	108.49	117.02	127.45	139.63
Old series of producer durables [1]		61.79	65.56	68.81	74.30	79.36	85.81	92.63	100.00	112.47	124.62	141.95	161.61

[1] Based on the index presented in Greenslade & Robertson, Industrial Production in the U.S.S.R. in JEC compendium Soviet Economic Prospects for the Seventies, Washington, June, 1973.

The new producer durables series, when combined with the index for consumer durables[18] yields the index of civilian machinery production shown earlier in the text (Table 1).

Investment goods make up the major portion of producer durables, so the trend of the producer durables index may be compared with that of the official Soviet data on investment in equipment. These series are compared in Table A–5 where the official Soviet data on investment in equipment is lagged one year (on the assumption that equipment invested this year was produced last year) and reduced by the amount of net imports of equipment and change in uninstalled equipment. The general similarity of the growth of the two indexes especially after 1955 is apparent. This is encouraging since the adjusted investment series is comprehensive with each individual product valued at its own price while the producer goods index is a sample. Thus, the producer durables sample index would appear to reflect accurately the growth of this part of the machinery sector. However, investment data could also be affected by the "new product pricing problem"; if so, the general alignment of the trends in the producers' durables sample index with those of Soviet investment in equipment may indicate that the growth of producer durables is still overstated.

[18] The index of consumer durables is based on the value of output of *tovary kul'turno-bytovogo naznacheniye i khozyaystvennogo obikhoda.* Consumer durables make up 19 percent of civilian machinery.

TABLE A-5.—U.S.S.R.: COMPARISON OF THE SAMPLE INDEX OF PRODUCER DURABLES WITH A SOVIET INDEX OF INVESTMENT IN EQUIPMENT, 1950–74

[1970=100]

	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962
Producer durables sample	20.03	20.07	21.95	25.85	27.08	29.85	33.13	37.03	42.02	46.62	52.71	58.36	64.37
Official Soviet series on investment in equipment adjusted to a production basis [1]	14.01	14.01	14.40	17.51	21.01	27.63	29.96	34.24	37.74	40.08	45.53	49.81	55.25
	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	
Producer durables sample	68.75	73.35	76.80	81.60	96.01	90.47	94.53	100	108.49	117.02	127.45	139.63	
Official Soviet series on investment in equipment adjusted to a production basis [1]	60.70	66.54	70.82	75.88	83.66	86.77	94.55	100	107.78	117.12	127.55	138.91	

[1] Assumes a lag of 1 year between production and investment; that is, investment shown here for 1950 is actually investment in 1951; also, the value of the official Soviet investment series was reduced by the amount of net imports of equipment and changes in uninstalled equipment.

The index of total machinery production shown in Table 3 in the text is derived from the official gross value of output indexes (GVO) for MBMW with adjustments for the double counting and new product pricing biases. It is an attempt to approximate a net output for MBMW, including the production of military hardware.

The adjustments are different for the period 1950–60 and the period since 1960, because of the change in method of construction of the official price index for MBMW. For the early period the price index was obtained from the constant and current price GVO series. Following 1960 the official price index was constructed from a sample of machinery items. For the first period, but not the second, the constant price GVO times the official price index gives the current price GVO.

For the period 1950–60, the value of MBMW in current prices was calculated as follows. According to the Central Statistical Administration, the total value of machinery production on an establishment basis in 1963 was 50.9 billion 1955 rubles.[19] The official Soviet MBMW index in constant prices was applied to this benchmark to derive a value of GVO for every year in 1955 prices. These values were then converted to current rubles by the official Soviet machinery price index given in the Soviet statistical handbook, Narodnoye khozyaystvo.

The upward bias in the GVO measure resulting from increasing double counting of inputs is shown below by changes in the ratio of MBMW deliveries outside the MBMW branch to GVO for the branch, as given in the input-output tables for 1959, 1966, 1972.[20]

Ratio of MBMW Deliveries

[Net of intra-branch deliveries to MBMW GVO]

1959	0.823
1966	.775
1972	.715

The declining trend in the ratio was extrapolated to 1950 at the rate of 0.0015 points per year to 0.837 in 1950. The estimated ratios were multiplied by the values of GVO in current prices for 1950–60 to arrive at an estimated net value of MBMW output. The rate of price inflation was assumed to be one percent per year except in years when the official price index dropped more than five percentage points. In those years it was assumed that all of the drop was real, except for 2½ perentage points. This assumption, while somewhat arbitrary, is consistent with the general belief that the official price index reflects price movements for only a sample of commodities; excluding for the most part newer products which in the aggregate would reflect an upward trend in prices. This procedure surely does not yield precise results—only plausible trends for illustrative purposes. The resulting machinery index grows at an average annual rate of 12.3 percent per year in 1951–60 compared with 15.7 percent for GVO, a difference of 3.4 percent per year.

For 1961–1966 and 1967–1972 the trend of net output of MBMW in current prices taken from the input-output tables was deflated by the price deflator suggested by Becker.[21] He estimated that machinery prices rose by two percent in the 1960's and one percent in the 1970's. The deflator gives average annual rates of growth which are compared to official rates of growth in the following tabulation.

AVERAGE ANNUAL RATES OF GROWTH IN PERCENT

	Official index of GVO of MBMW	Net output in current prices (from I–O tables)	Net output in constant prices	Col. (1)—col. (3)
	(1)	(2)	(3)	(4)
1960–66	12.7	11.4	9.4	3.3
1967–72	11.6	9 4	8 4	3.2

[19] N. M. Oznobin, et. al., Sovershenstvovaniye struktury promyshlennova proizvodstvo, Moscow, 1968, p. 67.

[20] Treml, et. al., in this volume.

[21] Abraham Becker, Ruble Price Levels and Dollar-Ruble Ratios of Soviet Machinery in the 1960's, RAND–1063–DDRE, January 1973, p. 21.

The average discount of the deflated net index from the official gross index is 3.3 or 3.2. These discounts are applied to the official index to obtain adjusted indexes for the intervening years.

For the period 1973–1975 the adjusted rate of growth is assumed to be the official annual rate of growth minus 3.2 percentage points.

B. CONSTRUCTION

The index of construction activity represents a major revision of the previously used index. Formerly, the index of construction activity was the weighted sum of two indexes: (1) An index of construction-installation work; and (2) an index of capital repair activity. The index of construction-installation work was the officially reported Soviet ruble series on construction-installation work expressed in constant "estimate" prices of 1 January 1969. The index of capital repair activity was derived from reported capital repair outlays, in current rubles, for 1959–63. A time series was created by moving this data for 1959–63 by an index of deductions for capital repair as reported in the annual Soviet statistical handbook. The resulting series in current prices was deflated to constant 1970 prices using reported indexes of price changes in machine-building and wage changes of industrial workers. The indexes of construction-installation work and capital repair activity were aggregated using as weights the shares of employment in these activities in 1970.

The revised index of construction activity is based on the hypothesis that an index of materials inputs into construction is the best measure of the real volume of construction activity. This index reflects inputs from 17 sectors of the 1966 input-output table which collectively represent 90 percent of the total purchases of the construction sector from other sectors.[22] Production indexes (adjusted by indexes of deliveries to construction) for the 17 input sectors were weighted together by their respective shares of total purchases by construction in 1970.

The adjustment of the production indexes by indexes of deliveries to construction was necessary to account for changes in the share of each input's production delivered to the construction sector. Accordingly, these indexes of deliveries were based on changes in the share of each input's GVO delivered to construction as reflected in input-output tables (in producers' prices) for 1959, 1966, 1970, and 1975.[23] In cases where comparability between the 1959 and 1966 input-output tables was suspect, the 1966 ratio of deliveries was used for 1959. For years prior to 1959, the ratios were assumed constant at the 1959 level.

As shown in Table A–6, the resultant index of materials inputs into construction generally grows slower than the previously used construction index. It should be noted that Moorsteen and Powell's index of construction materials also grew more slowly than the official index of construction-installation work.[24]

Indexes of materials inputs into construction are available for the United States using methods similar to those described above. The results can be compared with the U.S. index of "new construction put in place" in constant prices. Table A–7 gives the results of these comparisons, which show that in contrast to the Soviet pattern, materials inputs into construction in the U.S. increased at about the same rate as the overall index of construction activity, or even faster by some measures.

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[22] The inputs include: ferrous metals, refined oil, electric power, electro-technical machinery and equipment, cables, sanitary engineering products, other metalware, metal structurals, paints and lacquers, logging, sawmills and woodworking, construction materials (including glass and porcelain), sewn goods, industry n.e.c., transportation and communications, trade and distribution, and other branches.

[23] The 1970 and 1975 tables were from James Noren and F. Douglas Whitehouse, "Soviet Industry in the 1971–75 Plan", in Soviet Economic Prospects for the Seventies, p. 206. For 1975, actual GVOs were substituted for planned GVOs.

[24] See Richard Moorsteen and Raymond Powell, "The Soviet Capital Stock," Yale Press, for pioneering work on this approach to construction.

TABLE A-6-1.—U.S.S.R.: INDEXES OF CONSTRUCTION ACTIVITY

[1970=100]

	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962
Old construction index	17.24	20.32	22.81	23.99	27.90	30.66	34.15	38.82	45.22	52.01	56.65	58.32	59.41
Revised construction index	21.87	24.83	27.20	29.70	32.83	36.93	40.17	45.03	50.44	56.85	60.45	63.10	65.99

	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	Preliminary 1975
Old construction index	61.86	66.09	71.70	76.82	82.91	88.57	90.55	100.00	109.06	116.43	120.78	128.10	137.84
Revised construction index	68.23	71.38	75.31	78.88	84.74	89.11	92.71	100.00	105.60	110.30	116.21	121.90	131.16

TABLE A-6-2.—AVERAGE ANNUAL RATES OF GROWTH

[Percent]

	1951–55	1956–60	1961–65	1966–70	1971–75	1951–75
Old construction index	12.2	13.1	4.8	6.9	6.6	8.7
Revised construction index	11.0	10.3	4.5	5.8	5.6	7.4

TABLE A-7.—UNITED STATES: VARIOUS INDEXES OF CONSTRUCTION ACTIVITY IN 1958, 1963, AND 1967

	1958	1963	1967
1. New construction put in place:			
(a) in current prices	100.0	121.3	146.2
(b) in constant (1957–59) prices	100.0	115.5	122.1
2. Output of construction materials, composite index	100.0	112.8	121.2
3. Sales of construction materials:			
(a) current prices	100.0	119.8	142.1
(b) constant prices	100.0	120.3	133.6

SOURCES

(1) "Construction Review," January 1968, p. 16, and December 1969, p. 6.
(2) "Construction Review," December 1963, p. 50, and December 1968, p. 58. This index is largely a value-of-shipments weighted index of a variety of materials used in construction, including stone and clay products, lumber and millwork, iron and steel products, paints and plumbing heating equipment.
(3) Sales of 10 categories of material inputs to "new construction" as given in U.S. input-output tables. "Survey of Current Business," No. 9, 1965, pp. 34–39; No. 11, 1969, pp. 34–39; No. 11, 1969, pp. 30–35; No. 2, 1974, pp. 38–43. Current dollar values were deflated with a composite index of wholesale prices for construction materials given in "Construction Review," November-December 1963, p. 42; December 1966, p. 41; and December 1969, p. 52.

C. AGRICULTURE

The index of agricultural production is based on the farm output index described in Appendix D of Diamond and Krueger, "Recent Developments in Output and Productivity in Soviet Agriculture," in Soviet Economic Prospects for the Seventies, Washington, D.C., June 1973. The major difference is the current use of price weights for 1970 instead of 1968 in aggregating the output of farm products expressed in physical terms.

This index of agricultural production is adjusted to remove purchases by agriculture from other sectors. This adjustment is necessary to avoid double counting, since the output of the other sectors delivered as final product to agriculture has already been counted as part of the output of these other sectors. A base year estimate of agriculture's purchases from other sectors is taken from the 1966 reconstructed Soviet input-output table (Research Analysis Corporation. McLean, VA, August 1971). The base year figure is moved by an index of current purchases of materials from other sectors of the economy based on seven series: (1) Deliveries of fertilizer to farms; (2) use of electric power for productive purposes; (3) fuels and lubricants; (4) current repairs of machinery and buildings including repair activity carried out by farms on their own accounts; (5) production of rubber products for agriculture; (6) production of processed feeds (millfeed, oilcake, skim milk, sugar beet pulp) by industry; and (7) use of lime. These series are derived from data in the annual Soviet statistical handbooks and specialized Soviet sources on agriculture. The sample of goods and services included in the index covers 85 percent of the total ruble outlays for current purchases in the base year 1966.

D. TRANSPORTATION

Previously, the index covered only freight transport. The new index covers all transportation (freight and passenger) and is a composite index of 7 physical series for freight transport and 9 physical series for passenger transport aggregated with 1970 average price weights. The procedure used to construct the new index for the U.S.S.R. is comparable to that used by Kendrick for the United States.

The physical series for each mode of freight transport[25] represents total ton-

[25] The modes of freight transport include: (1) rail, (2) river, (3) maritime, (4) oil pipeline, (5) gas pipeline, (6) motor, and (7) air.

kilometers of freight transported, and are taken directly from Soviet official statistical handbooks. The seven indexes are aggregated using, in some cases, average rates in rubles per ton-kilometer in 1970 and, in other cases, average cost (sebestoimost') in rubles per ton-kilometer in 1970. Some of the price weights do not reflect the full coverage of the physical series, however, and further adjustments are currently being made. These refinements, while relatively minor, will be reported in a future publication.

The physical series for the nine modes of passenger transportation[25] reflect passenger-kilometers or numbers of passengers and are also taken from Soviet official statistical handbooks. The price weights are mainly 1970 average revenues per passenger kilometer or per passenger.

While the coverage of the composite index for transportation appears to be quite complete, there are evidently some omissions. This is suggested by the fact that the total of the revenue weights for 1970 is 24.680 billion rubles, while value-added in the transportation sector in 1970 is 26.455 billion rubles.[27] From various checks that can be made, the coverage of rail, river, maritime, motor, and urban electric transit is quite complete. Omitted entirely, however, are water pipelines, road maintenance and construction, loading and unloading operations, warehousing and a variety of transport-related service activities, timber rafting, and tug service. Evidently, these activities account for a significant share of transport employment. Available data permit the identification of about 60 percent of total transport employment as being in rail, water, motor common carrier, and urban transport. The rest are in air, pipeline, road transport other than common carriers, and in all other transport and transport service activities.

E. COMMUNICATIONS

The index of communications activity constitutes a major departure from the previously used index. The latter was simply an index of total revenue in communications as reported in Transport i Svyaz' and the Soviet statistical handbooks. The present procedure measures physical activity in four branches—postal, telephone, telegraph, and radio and television broadcasting. The branch indexes are aggregated by their relative shares in the total revenues of the Ministry of Communications in 1970. The relevant data for 1950–70 are taken from Transport i Svyaz' SSSR, 1972, and for subsequent years from the annual statistical handbooks, Narodnoye khozyaystvo. The physical units used to measure activity in each branch and its relative weight in the total are given in the following tabulation.

Branch and physical units:	*Weight (percent)*
Postal: Number of letters, parcels, money orders, newspapers, and magazines mailed	40.7
Telephone: Number of telephones in urban and rural areas and number of intercity telephone calls	36.8
Telegraph: Number of telegrams	9.8
Radio and television: Number of receivers	12.7

While it may appear improper to measure "output" of radio and TV services by number of receivers, there are no data for any other suitable measure. Nevertheless, it has been a fast-growing sector, whose output should be included somehow. The measure that is used shows a nearly ten-fold expansion during 1950–70, compared with a nearly five-fold growth in postal activity and a three-fold growth in telephone services.

F. TRADE

The index for trade also represents a major departure from previous procedures, which used a measure for retail sales in constant prices to represent the sector. The sector weight, however, has four components: retail trade, wholesale trade, material-technical supply and procurement of agricultural products. Accordingly, the new index for the trade sector is a weighted index of indexes in constant prices derived separately for each component, as follows.

Retail trade.—The index measures the value of goods moving through the retail trade network. It is calculated from the end use index of consumption of goods, minus the value of consumption in kind and collective farm market sales. See the paper by Schroeder and Severin in this volume.

[25] The nine modes include: (1) rail, (2) sea, (3) river, (4) air, (5) bus, (6) streetcars, (7) trolleys, (8) subways, and (9) taxies.
[27] CIA, USSR: GNP Accounts, 1970, op. cit., p. 9.

Wholesale trade.—The index measures the volume of goods moving through the wholesale network. It is calculated as a composite index for output of light industry, food industry and consumer durables; the three indexes are components of the index of industrial production, the derivation of which is explained above.

Material-technical supply.—The index measures the volume of goods handled by industrial supply agencies. It is a composite index of output in all branches of civilian industry except light and food industries, consumer durables, and electric power.

Procurement.—The index measures the volume of products handled by procurement agencies. It is a physical index of quantities of agricultural products procured by the state. The data are published regularly in Soviet statistical handbooks.

The weights used to aggregate the four indexes are value added weights calculated, for the most part, directly from officially published data. The weights are as follows:

Sector:	*Percent*
Retail trade	60.82
Wholesale trade	7.37
Material-technical supply	19.92
Procurement	11.89

G. SERVICES

The indexes and rates of growth for each of the sector of origin services are presented in tables A–8 and A–9 below. The household and communal services which include housing; utilities; repair and personal care; recreation, art, and physical culture; education; and health are described in Schroeder and Severin, "Soviet Consumption and Income Policies in Perspective," in this volume.

Science.—The index for science is a composite of wages and social insurance deductions plus materials purchases deflated by a weighted index of industrial wholesale prices. The inclusion of materials is intended to represent otherwise uncounted prototype production (see text section III B).

General administration and miscellaneous services and credit and State insurance.—General Administration Miscellaneous Services is the composite of estimates derived separately for (1) general agricultural programs, (2) forest economy, (3) state administration, (4) culture, (5) municipal services, (6) civilian police, and (7) administrative organs of social organizations. The 1970 weights are moved by indexes of employment. No separate employment series has been developed for "administrative organs of social organizations." A series can be obtained from *Trud* v. *U.S.S.R.*, pp. 28–29. Employment in State administration would then be obtained as the total "apparat" employment, less employment in social organizations. Parallel to the General Administration and Miscellaneous Services indexes, the Credit and State Insurance index series is based on reported employment.

TABLE A-8.—U.S.S.R.: SECTOR OF ORIGIN SERVICE INDEXES (FACTOR COST)

[1970=100]

	1970 value added weights (billion rubles)	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961
Services	45.926	44.9	46.4	48.0	49.2	50.5	51.5	53.1	55.1	57.7	60.5	63.5	66.7
Housing	3.162	47.3	48.9	50.5	52.1	53.9	55.6	57.2	59.7	62.9	66.7	70.6	74.1
Utilities	2.017	22.2	23.3	24.5	25.7	27.0	28.3	30.4	32.7	35.3	38.0	41.0	47.0
Repair and personal care	3.304	42.2	42.7	43.1	43.6	44.1	44.6	45.8	47.0	48.1	52.1	49.6	45.9
Recreation, art, and physical culture	1.194	32.8	36.1	39.8	43.9	48.4	53.3	57.8	61.4	66.0	68.4	71.0	75.6
Education	9.939	47.5	49.2	51.0	52.9	54.8	56.8	57.4	58.4	59.9	61.1	62.8	65.5
Health	5.664	44.0	46.2	48.5	50.9	53.4	56.1	57.6	60.2	63.5	66.4	69.4	72.2
Science	5.608	17.5	19.2	20.9	22.1	24.0	26.2	29.2	33.3	37.6	41.3	47.5	52.3
Credit and insurance	2.219	68.0	68.1	68.1	68.2	68.2	68.3	68.6	67.3	67.0	67.0	68.3	71.4
Administration and miscellaneous services	6.634	76.8	77.4	77.9	75.2	70.6	64.1	64.5	63.4	64.5	64.5	66.2	69.4
General agricultural programs	.754	56.9	61.7	66.3	60.6	62.9	45.3	49.4	47.4	56.2	58.3	72.1	74.1
Forest economy	.548	102.5	104.6	106.7	96.1	92.8	89.8	90.1	87.1	84.8	81.3	82.9	87.3
Apparat and social organizations	2.912	97.2	96.0	94.8	91.7	82.0	72.3	71.3	68.7	68.7	67.6	66.1	68.8
Culture	.903	41.3	42.8	44.3	45.5	47.6	49.6	51.1	53.0	54.6	56.7	59.8	64.3
Municipal services	.475	45.0	46.8	48.8	49.8	50.8	51.8	54.5	56.2	57.5	59.5	63.0	66.5
Civilian police	1.042	96.3	95.6	94.7	91.4	81.6	71.8	71.0	68.6	68.6	67.0	66.1	68.6
Military personnel and statistical discrepancy	6.185	116.8	130.9	140.6	130.3	123.1	120.3	109.2	103.9	99.0	94.6	74.5	74.1

	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
Services	70.2	73.5	77.3	81.2	85.1	88.6	92.5	96.3	100	103.8	106.5	110.6	115.6	119.8
Housing	77.4	80.5	83.3	86.0	88.8	91.7	94.5	97.3	100	102.8	105.5	108.2	111.4	114.4
Utilities	53.0	59.1	65.3	71.6	77.1	82.5	87.8	93.8	100	105.7	111.4	117.6	126.0	137.1
Repair and personal care	45.9	47.9	53.6	61.2	69.1	76.7	82.2	90.0	100	107.7	116.0	125.4	135.2	145.6
Recreation, art, and physical culture	78.1	79.3	83.9	87.6	88.3	93.5	97.4	98.2	100	101.8	102.9	104.9	106.3	106.7
Education	70.0	73.9	78.8	83.4	87.4	90.7	94.6	97.6	100	103.0	105.6	108.1	110.8	113.2
Health	75.0	77.2	80.3	83.8	87.0	89.4	93.5	97.1	100	103.4	106.4	109.0	111.6	114.3
Science	57.8	63.3	68.6	72.4	78.5	81.5	87.0	92.4	100	106.1	104.7	113.3	127.3	134.7
Credit and insurance	73.0	74.5	76.3	77.3	80.7	84.8	89.2	93.6	100	105.9	113.1	119.8	127.1	134.0
Administration and miscellaneous services	71.2	72.3	75.2	79.7	83.9	88.8	93.4	97.6	100	103.8	108.0	112.7	117.4	122.0
General agricultural programs	72.9	72.2	75.0	77.5	83.0	90.5	99.0	101.0	100	106.0	110.7	114.8	119.4	124.4
Forest economy	89.8	92.2	93.3	92.8	94.5	95.2	97.2	98.4	100	99.8	102.3	102.5	103.7	103.9
Apparat and social organizations	69.9	69.5	71.9	77.5	82.1	87.7	92.2	97.4	100	102.8	106.6	110.8	115.1	119.0
Culture	68.7	72.7	77.3	82.2	85.9	89.3	93.5	96.9	100	106.3	111.0	117.0	123.1	128.6
Municipal services	68.8	71.5	74.8	78.2	81.5	87.5	91.8	96.0	100	105.2	110.5	115.5	120.0	125.0
Civilian police	69.3	69.3	71.8	76.7	81.6	87.4	91.4	97.2	100	102.4	106.2	113.3	118.8	125.2
Military personnel and statistical discrepancy	75.9	78.3	80.5	82.9	86.0	90.1	95.5	97.3	100	103.0	105.2	107.6	109.5	111.6

TABLE A-9.—U.S.S.R.: SECTOR OF ORIGIN SERVICES (FACTOR COST), AVERAGE ANNUAL RATES OF GROWTH

[Percent]

	1951–55	1956–60	1961–65	1966–70	1971–75
Services	2.8	4.3	5.0	4.3	3.7
Housing	3.3	4.9	4.0	3.1	2.7
Utilities	5.0	7.7	11.8	6.9	6.5
Repair and personal care	1.1	2.2	4.3	10.3	7.8
Recreation, art, and physical culture	10.2	5.9	4.3	2.7	1.3
Education	3.6	2.0	5.9	3.7	2.5
Health	5.0	4.4	3.8	3.6	2.7
Science	8.4	12.6	8.8	6.7	6.1
Credit and insurance	.1	0	2.5	5.3	6.0
Administration and miscellaneous services	−3.6	.7	3.8	4.6	4.1
General agricultural programs	−4.4	9.7	1.5	5.2	4.5
Forest economy	−2.6	−1.6	2.3	1.5	.8
Apparat and social organizations	−5.8	−1.8	3.2	5.2	3.5
Culture	3.7	3.8	6.6	4.0	5.2
Municipal services	2.8	4.0	4.4	5.0	4.6
Civilian police	−5.7	−1.7	3.0	5.4	4.6
Military personnel and statistical discrepancy	.6	−9.1	2.2	3.8	2.2

H. MILITARY PERSONNEL AND STATISTICAL DISCREPANCY

Military personnel consisting of pay and subsistence in the base year, is moved by an index of military manpower combined with subsistence in constant prices. The military personnel index is included in services. Since personnel pay and subsistence estimates are currently being revised, the index is not shown separately, but is combined with the statistical discrepancy of services. The statistical discrepancy is the implied difference in employment between the total of services in the State reported wage bill and the employment estimates for the individual services.

The End-Use Indexes

A. CONSUMPTION

The component physical indicators in consumption are those assembled by Schroeder and Severin elsewhere in this volume. However, the component weights and some of the indexes are adjusted from an established price basis to factor cost. In the absence of detailed wholesale prices for farm products and their respective intermediate and finished products, approximate factor cost adjustments are estimated for the food index and the soft goods index. Food consumption is divided into processed foods and other foods, and the factor cost adjustment is applied to each separately. Since processed food bears the turnover tax and is generally more rapidly growing, the adjusted index generally grows slower than food in established prices. Similarly, soft goods are divided into light industry and technical crops not subject to turnover tax, and an adjusted factor cost index is calculated.

The consumer services indexes are identical to those of Schroeder and Severin and are shown here in Tables A–10 and A–11.

B. INVESTMENT

Machinery and equipment.—This index is the Soviet official machinery and equipment component of investment in constant prices.

TABLE A-10.—U.S.S.R: GNP INDEXES OF END USE SERVICES (FACTOR COST)

[1970=100]

	1970 weights (billion rubles)	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961
Household services	26.021	39.2	40.9	42.6	44.4	46.3	48.4	50.3	53.6	56.0	58.5	62.5	65.7
Housing	3.429	47.3	48.9	50.5	52.1	53.9	55.6	57.2	59.7	62.9	66.7	70.6	74.1
Utilities	3.478	22.2	23.3	24.5	25.7	27.0	28.3	30.4	32.7	35.3	38.0	41.0	47.0
Personal transportation	7.200	16.0	18.0	19.8	22.0	24.4	27.7	29.2	39.2	36.1	39.1	42.8	46.6
Personal communications	1.200	22.4	24.5	26.7	28.4	30.8	33.0	35.6	38.4	40.6	43.2	46.4	49.2
Repair and personal care	4.674	42.2	42.7	43.1	43.6	44.1	44.6	45.8	47.0	48.1	42.1	49.6	45.9
Recreation, art, and physical culture	3.948	32.8	36.1	39.8	43.9	48.4	53.3	57.8	61.4	66.0	68.4	71.0	75.6
Trade union and other dues	2.092	36.9	38.7	40.9	42.8	44.3	45.9	48.6	51.5	54.4	57.5	60.9	64.7
Communal services	26.262	39.6	41.8	44.2	46.6	49.3	52.0	54.7	56.6	58.3	61.1	64.0	66.3
Health	10.164	36.7	39.6	42.6	45.9	49.5	53.3	58.0	60.2	62.9	67.0	71.1	72.6
Education	16.098	41.4	43.2	45.1	47.1	49.1	51.3	52.7	54.3	55.4	57.5	59.7	62.5
Administrative and other services	9.971	81.5	81.9	82.2	79.1	73.7	66.0	66.3	64.7	65.8	65.5	67.1	70.1
General agricultural programs	1,130	56.9	61.7	66.3	60.7	62.9	45.3	49.4	47.4	56.2	58.3	72.1	74.1
Forest economy	.822	102.5	104.6	106.7	96.1	92.8	89.8	90.1	87.1	84.8	81.3	82.9	87.3
Apparat and social organizations	4.366	97.2	96.0	94.8	91.7	82.0	72.3	71.3	68.7	68.7	67.6	66.1	68.8
Culture	1,379	41.3	42.8	44.3	45.5	47.6	49.6	51.1	53.0	54.5	56.7	59.9	64.3
Municipal services	.712	45.0	46.8	48.8	49.8	50.8	51.8	54.5	56.2	57.5	59.5	63.0	66.5
Civilian police	1.562	96.3	95.6	94.7	91.4	81.6	71.8	71.0	68.6	68.6	67.0	66.1	68.6

	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
Household services	69.1	72.4	76.1	80.0	84.0	88.3	92.2	96.0	100.0	103.8	107.7	111.77	116.4	121.2
Housing	77.4	80.5	83.3	86.0	88.8	91.7	94.5	97.3	100.0	102.8	105.5	108.2	111.4	114.4
Utilities	53.0	59.1	65.3	71.6	77.1	82.5	87.8	93.8	100.0	105.7	111.4	117.6	126.0	137.1
Personal transportation	52.1	56.8	60.8	66.0	73.1	80.1	87.8	93.8	100.0	106.6	114.0	120.3	129.2	138.0
Personal communications	52.2	55.3	59.2	65.4	72.3	79.7	85.5	92.9	100.0	107.2	115.1	123.4	132.4	141.8
Repair and personal care	45.9	47.9	53.6	61.2	69.1	76.7	82.2	90.0	100.0	107.7	116.0	125.4	135.2	145.6
Recreation, art, and physicial culture	78.1	79.3	83.9	87.6	88.3	93.5	97.4	98.2	100.0	101.8	102.9	104.9	106.3	106.7
Trade union and other dues	68.6	72.3	76.3	80.6	86.2	91.2	94.3	97.2	100.0	102.3	104.7	106.8	108.9	111.2
Communal services	69.1	73.2	77.5	82.1	86.8	89.9	92.7	96.7	100.0	103.4	106.6	110.6	114.4	119.3
Health	72.1	75.4	78.9	82.6	87.1	89.2	91.2	94.8	100.0	102.5	105.2	108.2	111.3	115.2
Education	67.3	71.9	76.7	81.8	86.6	90.3	93.6	97.8	100.0	104.0	107.5	112.0	116.2	121.9
Administrative and other services	71.5	72.2	75.0	79.4	83.6	88.8	93.4	97.7	100.0	103.5	107.6	112.2	116.7	121.1
General agricultural programs	72.9	72.2	75.0	77.5	83.0	90.5	99.0	101.0	100.0	106.0	110.7	114.8	119.4	124.4
Forest economy	89.8	92.2	93.3	92.8	94.5	95.2	97.2	98.4	100.0	99.8	102.3	102.5	103.7	103.9
Apparat and social organizations	69.9	69.5	71.9	77.5	82.1	87.7	92.2	97.4	100.0	102.8	106.6	110.8	115.1	119.0
Culture	68.7	72.7	77.3	82.2	85.9	89.3	93.5	96.9	100.0	106.3	111.0	117.0	123.1	128.6
Municipal services	68.8	71.5	74.8	78.2	81.5	87.5	91.8	96.0	100.0	105.2	110.5	115.5	120.0	125.0
Civilian police	69.3	69.3	71.8	76.7	81.6	87.4	91.4	97.2	100.0	102.4	106.2	113.3	118.8	125.2

TABLE A-11.—U.S.S.R.: GNP SERVICES BY END USE (FACTOR COST), AVERAGE ANNUAL RATES OF GROWTH

[Percent]

	1951–55	1956–60	1961–65	1966–70	1971–75
Household services	4.3	5.3	5.1	4.6	3.9
Housing	3.3	4.9	4.0	3.1	2.7
Utilities	5.0	7.7	11.8	6.9	6.5
Personal transportation	11.5	9.1	9.0	8.7	6.6
Personal communications	8.1	7.1	7.1	8.9	7.2
Repair and personal care	1.1	2.2	4.3	10.3	7.8
Recreation, art, and physical culture	10.2	5.9	4.3	2.7	1.3
Trade union and other dues	4.5	5.8	5.8	4.4	2.2
Communal services	5.6	4.2	5.1	4.0	3.6
Health	7.7	5.9	3.1	3.9	2.9
Education	4.4	3.1	6.5	4.1	4.0
Administrative and other services	−4.1	.3	3.4	4.7	3.9
General agricultural programs	−4.4	9.7	1.5	5.2	4.5
Forest economy	−2.6	−1.6	2.3	1.5	.8
Apparat and social organizations	−5.8	−1.8	3.2	5.2	3.5
Culture	3.7	3.8	6.6	4.0	5.2
Municipal services	2.8	4.0	4.4	5.0	4.6
Civilian police	−5.7	−1.7	3.0	5.4	4.6

Construction and other capital outlays.—Since the construction portion of new fixed investment reflects only new construction, the sector of origin index of construction activity (adjusted to exclude the materials inputs used in the construction portion of capital repair activity) was used as an index of new construction. The adjustment consisted of first separating construction repair from total capital repair on the basis of (1) a series of total capital repair in current prices and (2) the share of machinery repair in total capital repair derived from the Soviet Input-Output tables; and second, subtracting construction repair from total construction activity.

A value of machinery repair was derived for each year in current prices and subtracted from the value of total capital repair in current prices. The residual was assumed to reflect construction repair in current prices, and was deflated to a 1970 price base by an implicit price deflator for construction. The latter was based on an index of current price construction GVO from Soviet I–O tables and the index of constant price construction activity derived for the sector of origin accounts. The resulting construction repair series in 1970 prices was subtracted from a series of construction GVO derived by moving the value of GVO given in the 1966 input-output table in 1970 prices by the sector of origin construction activity index. The result was assumed to represent a constant price series for new construction.

Net additions to livestock.—This index represents change in livestock herds reflected in the OER agricultural index presented in D. Carey, "Soviet Agriculture: Recent Performance and Future Plans," in this volume.

Capital repair.—The index of capital repair activity is a composite of machinery repair and construction repair, each deflated to a 1970 price base. Deflated machinery repair was based on (1) the share of machinery repair in total capital repair in current prices, derived from Soviet I–O tables; (2) a series of total capital repair in current prices; and (3) Becker's price deflator for machinery described earlier. Total capital repair in current prices was based on the 1970 value of capital repair given in CIA, USSR: GNP Accounts, 1970, *op. cit.*, and an index of Soviet official allocations for capital repair. Deflated construction repair was derived as explained above for the index of "construction and other capital outlays."

C. RESEARCH AND DEVELOPMENT

This index is the same as that used for "Science" on the sector-of-origin side of the accounts.

D. GENERAL ADMINISTRATION AND MISCELLANEOUS SERVICES

These indexes are the same as those reported for the sector-of-origin services.

E. OUTLAYS N.E.C.

This index reflects the residual calculated by subtracting the other end-use categories from the sector-of-origin GNP control total. Conceptually, it includes defense, net exports, change in inventories and reserves, unidentified outlays, and a statistical discrepancy.

AN EVALUATION OF THE 10TH FIVE-YEAR-PLAN USING THE SRI-WEFA, ECONOMETRIC MODEL OF THE SOVIET UNION

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I. Introduction: The Use of an Econometric Model in the Evaluation of Soviet Five-Year Plans

Evaluation of the Soviet Five-Year Plans (FYPs) has become an increasingly important task for Western economists. Given the greater availability of Soviet economic statistics and the utilization of quantitative methods, the 9th FYP was subjected to more rigorous scrutiny than were previous Plans. Western skepticism regarding the feasibility of the 9th Plan was eventually confirmed by the actual performance of the economy. Presented now with the 10th FYP, we have a new analytical tool, the SRI–WEFA Econometric Model, to help in the assessment of the feasibility of a Soviet FYP and its macroeconomic consequences. SOVMOD II, the current version of the model, has been developed over the past two years by economists from Stanford Research Institute and Wharton Econometric Forecasting Associates, University of Pennsylvania. This medium-scale econometric model, while similar in scope and potential application to models of Western market economies, was designed to reflect Western understanding of Soviet economic institutions and bureaucratic behavior.

There are many advantages in using an econometric model for forecasting the probable development of the Soviet economy and for evaluating official Soviet Plans. First, since the model is an interdependent system of technical and behavioral relations, the analyst is able to consider indirect effects as well as direct effects, i.e., the total system impact, in quantitative terms. Second, since this macromodel is concerned with income flows and expenditures throughout the Soviet economy, one may explore the consequences of a Plan in areas not treated extensively in the published document. For example, we will consider the consequences of the Plan for household income and consumption, the State budget, controlled and market prices, the composition of foreign trade, and the Soviet balance of payments. Third, the establishment of the model with supporting software allows the analyst to construct a variety of alternative projections, encompassing total system effects, based upon variations in Soviet policy, the world economy, and the weather.

At the same time, the problems and limitations associated with the use of econometric models should be recognized and acknowledged by all model users and consumers of model analysis.

First, the model itself is only one ingredient in the forecasting process. Forecasting is an interactive process between the model and the analyst. Frequently, the skill and judgment of the analyst are the most important factors in a valid projection. The model serves as a framework for imposing regularities observed in the past upon the future and for preserving a certain degree of consistency. The analyst must judge when certain past regularities should be relaxed and where additional consistency should be imposed upon the model solution. The term "control" as defined below designates this degree of analyst participation.

Second, one should be careful not to attribute excessive precision to the quantitative results of econometric forecasts. All projections with an econometric model are subject to certain prediction errors and such errors typically increase with the length of the projection. Even

where the prediction error for levels of output are one percent or less, errors in the prediction of rates of growth are naturally much larger.

Third, issues of data methodology and accuracy, which are quite important for Western economies, are crucial for the scientific analysis of the Soviet economy. Soviet and Western methods of output measurement and national income accounting differ for both practical and ideological reasons. In building the SRI–WEFA Econometric Model, the decision was made to use Western estimates of sector output and Soviet GNP. In contrast to Soviet measures of gross value of output, Western estimates of Soviet production are based upon commodity samples (measured in physical or value terms) which are aggregated using prices and value-added weights for a base year. Thus, the output measures used in our model are roughly comparable to statistics constructed for Western market economies. Without concerning ourselves here with the difficult issues of relative "bias," growth rates for the Soviet economy invariably appear lower when using Western methodology than when using Soviet methodology. For presentation purposes in this report, in order to make the projections of the model comparable with official Soviet Plan data, growth rates computed by Western measurement have been adjusted upward using adjustment factors observed in the past.[1]

In the next section, a brief overview of the 10th FYP will be presented.[2] Then, a Control Solution developed using SOVMOD II will be introduced, along with a discussion of the assumptions underlying this projection and an evaluation of the macroeconomic consequences of the 10th FYP. In the next section, three scenarios will be presented as illustrations of the capacity of the SRI–WEFA Model to evaluate the economic impact of alternative Soviet policies, world economic conditions, and the weather. In the final section, the new input-output component introduced in the SRI–WEFA Model will be described and applied to the 10th FYP. The details of the SOVMOD II Control Solution to 1980, including assumptions and adjustments, are provided in Appendix A to this paper.

II. An Overview of the 10th FYP

The agricultural setback in 1975 occurred at a critical time for the Soviet Union, both economically and politically. The USSR had been enjoying its relative immunity from the inflation and recession which had beset Western capitalism in the early 1970's, and its political leaders were confident in the prospects of the Brezhnev strategy of agricultural independence and the purchase of Western technology. The 1975 grain harvest indicated once again the vulnerability of Soviet agriculture to weather disturbances. Large purchases of Western grain strained Soviet hard currency reserves, reserves which had already been depleted by declining Soviet exports to a recession-ridden West and by previously ordered Soviet purchases of Western machinery and equipment.

[1] This assumes, of course, a stability in the degree of "bias." In fact, one might argue that the relative gap between Soviet and Western measures may decline slowly in the future.

[2] More detailed studies are available in this volume.

A reduction of aspirations for the domestic economy was first signalled in the Annual Plan and Budget announced for 1976.[3] Planned rates of growth for industrial production, agricultural output and national income were scaled down from the levels of previous Plans; State financing of centralized investments, industry and construction, transport and communications, and agriculture were budgeted to grow cosiderably less than in recent years. The preliminary report on the 10th FYP, published two weeks later, acknowledged the underfulfillment of the 9th FYP and projected rates of growth through 1980 which were much less ambitious than those of the 9th Plan.[4] In Table 1 we have presented the major indicators for the 9th Plan, official estimates of realized growth, and preliminary draft targets for the 10th Plan. The two bad harvests of 1972 and 1975 certainly were a major factor in the underfulfillment of the Plan, but it is clear that the 9th Plan was unrealistic in its anticipation of productivity gains. Official figures published recently indicate that the only area of Plan overfulfilment was in foreign trade.[5] This was related primarily to the rapid expansion of East-West trade associated with the policy of *détente*, an expansion in trade motivated at least in part by Soviet concern with lagging productivity.

The preliminary plan targets of the 10th FYP are significant in two respects. First, they are substantially more modest than those of the 9th Plan, an indication of an acceptance of less ambitious goals by the political leadership. Second, they are very much in line with official estimates of performance during the 9th FYP; this suggests that Soviet planners may be using recent experience as a test of Plan reasonableness more than they have in the past.

The 10th FYP, even more than previous plans, acknowledges the severity of the constraint represented by diminishing growth in the supply of labor and a diminishing effectiveness of capital investment. The stress in the plan is on efficiency of production, improvement in quality, and the acceleration of technical progress. As is stated in the Basic Guidelines on the 10th FYP:

> It is necessary to develop on a still broader basis nationwide socialist competition for the achievement of high labor indices and the fulfilment of national-economic plans and to do everything to make the 10th Five-Year Plan a five-year plan of efficiency, a five-year plan of quality in the name of a further increase in the people's well-being.[6]

The Plan calls for labor productivity in industry to rise 30–34 percent even though capital investment is projected to rise by only 24–26 percent. Since the Plan does not appear to anticipate major gains from organizational changes, its fulfillment may well depend upon the purchase and financing of machinery imports from the Developed West.

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[3] Pravda, December 3, 1975, pp. 1–3.
[4] Pravda, December 15, 1975, pp. 1–6. A translation of the full text has appeared in The Current Digest of the Soviet Press, 27 (Jan. 14, 1976), pp. 1–26.
[5] Ekonomicheskaia gazeta, May 5, 1976.
[6] Current Digest, op. cit., p. 26.

TABLE 1—MAIN INDICATORS OF THE 9TH AND 10TH FYP's

[Percent]

Indicator	9th FYP (1971–75)		10th FYP (1976–80), basic guidelines [2]
	Plan target [1]	Actual [2]	
5-yr growth rates:			
National income	38.6	28.0	24–28.
Real income per capita	31.0	24.0	20–22.
Industrial output	47.0	43.0	35–39.
Industrial labor productivity	39.0	34.0	30–34.
Industrial employment	5.9	6.7	3.8
Agricultural output (5-yr average)	21.7	13.0	14–17.
New capital investment (5-yr total)	41.6	41.3	24–26.
Retail trade turnover	40.0	36.0	27–29.
Foreign trade turnover	33–35.0		30–35.

[1] N. K. Baybakov (general ed.), "Gosudarstvennyy pyatiletniy plan razvitiya narodnogo khozyaystva SSSR na 1971–75 gody," Moscow, 1972.
[2] "Pravda," Mar. 7, 1976.

III. A Control Solution for the Soviet Economy, 1973–1980

In using an econometric model for projective analysis, it is important to differentiate the factors which contribute to a projective solution and the various modes of projections. First, the major elements involved in computing a model projection are as follows:

The specification and estimation of the model itself, particularly the implicit assumptions concerning future technology and behavior;

The assumptions made concerning the future of exogenous variables, those not determined in the model solution; and

The intervention of the analyst to compensate for deficiencies of the model and to impose additional information on model solutions.

Second, with these distinctions in mind, one may define a hierachy of projective exercises:

A solution of the model, which might not involve user intervention beyond the specification of the model and the selection of assumptions for exogenous variables;

A control solution which indicates a judgment of conditional plausibility and internal consistency by the analyst; and

A forecast which, in our usage, represents further discrimination among plausible control solutions, i.e., the selection of the solution which appears most likely, given available information and expert opinion.

As this discussion suggests, good forecasting procedure will usually involve extensive discussion of alternative assumptions and alternative control solutions by experts both involved in and independent of the project.

The projections reported in this paper were all computed using SOVMOD II, the second-generation SRI–WEFA Soviet Econometric Model.[7] The version of the model used calculates total consumption as

[7] This model is described and documented in Donald W. Green, Lawrence R. Klein, and Herbert S. Levine, The SRI–WEFA Soviet Econometric Model: Phase Two Documentation, Stanford Research Institute Technical Note SSC–TN–2970–4, October 1975.

a residual category of GNP end-use, and determines Soviet grain imports and gold sales by exogenous assumption. The most important aspect of model specification is the functional form of the production functions. They are assumed to be Cobb-Douglas with all technical progress being factor-augmenting rather than disembodied, i.e., no increase in factor productivity will occur unless factors are increased. This is a particularly important assumption when one is projecting for a period when the rate of factor accumulation (labor and capital) is expected to decline.[8]

The major assumptions used in the determination of a control solution for 1973–80 are presented in Appendix A. For the important financing variables, we have projected a moderate growth rate of 3 percent (slightly higher for agriculture), somewhat less than the observed growth rate for 1966–75. The projection assumes "normal" weather for the period 1976–80. For the world economy, we have projected real trade growth at 7 percent and world trade inflation at 7 percent (1976–80). Raw material prices are expected to grow at a lower rate, as are CMEA foreign trade prices. We have projected a stable exchange rate for the ruble and stable gold prices (at $120 per ounce). Variations in these assumptions for world trade variables would primarily affect the composition and level of Soviet foreign trade.

In establishing a control solution for 1973–80, there have been several types of adjustments introduced:

Actual data available for the period 1973–75 were imposed on the model's solution path for those years;

Certain trends embedded in estimated equations of the model were modified or suppressed given additional information from the Tenth Five-Year Plan and elsewhere; and

Adjustments were made to certain other variables in response to analysis of important balances in the State budget, household accounts, and foreign trade.

Since 1973 data for some variables in the model were not available, our model projection must begin in that year. Solution values for that year, however, may be adjusted to conform to the actual data in hand. Similar adjustments were made to solution values in 1974 given new Soviet and Western data. For 1975, the most important adjustments involve the 140 m. metric ton grain harvest and its impact upon total agricultural output and light industry.[9]

Several trend coefficients estimated in the model over a sample period 1958–1972 were modified for use in longterm projections. The major modifications in this regard involved the equations determining the urban share of total population and the participation rate for the urban population. Our adjustments downward for these variables result, for example, in a 4.2 percent growth in industrial employment over the period 1976–80 rather than the 12–14 percent for an initial

[8] The model has been designed, however, so that the analyst may introduce disembodied technical change into the various production functions for alternative projections.

[9] These adjustments have been described in an earlier informal note: Donald W. Green, "The 1975 Soviet Grain Harvest, the Tenth Five-Year Plan and the U.S./USSR Grain Agreement," published in United States-Soviet Grain Agreement, S. 2492 and Other Matters, U.S. Senate Hearings, Subcommittee on International Finance of the Committee on Banking, Housing and Urban Affairs, 9–10 December 1975, U.S.G.P.O., Washington, D.C., 1976.

projection. Besides reducing the rates of growth of employment to the neighborhood of those implied by the Basic Guidelines, the volume of investment during the 10th FYP was also restricted to the Guideline's 25 percent increase over the 9th FYP period.

The final category of user intervention in the derivation of a control solution involves the recognition of inconsistency and the imposition of plausible adjustments to lessen inconsistency in the projection. For example, the initial experiments resulted in very large Soviet trade deficits with the CMEA in the late 1970's (nearly $4 billion annually). Such deficits arose from rapid growth in Soviet imports of machinery and raw materials (15–18 percent per year). We judged that such deficits and growth rates in imports were not feasible, for both economic and political reasons, and adjusted those growth rates downward to a 12–13 percent level. A similar problem arose for Soviet hard currency trade and we chose here to adjust upward Soviet hard currency exports and increase credit drawings and gold sales in order to reduce the deficit in hard currency to manageable levels. We also adjusted certain categories of revenue in the State budget to new tax rates implied by the 1973–74 data in order to close the projected deficit in the State budget.

The main indicators of the 10th FYP are compared with those generated in the SOVMOD II Control Solution in Table 2 below. The aggregate output targets in the Plan for industry and agriculture appear to be feasible by the standards of the estimated macromodel. The growth in real income per capita projected in the Plan is not, however, attained in the model solution. Furthermore, the model projects a much lower growth in the real volume of Soviet foreign trade, approximately the growth rate projected for Soviet GNP of 23–24 percent rather than the 30–35 percent anticipated in the Plan. However, if the sample period used for estimating the foreign trade equations in SOVMOD II had included 1974 and 1975, the model projection for foreign trade turnover might exceed 30 percent. This would not necessarily mean that such a further expansion in Soviet foreign trade is either feasible or likely.

In Table 3, the differences between the Control Solution and the 10th FYP are indicated at the level of industrial branches. The labor allocation system in the model has been adjusted to correspond more closely to the pattern implied in the 10th FYP, though not constrained to exact correspondence. This table may indicate certain reallocations of capital investment from the pattern projected in the model. Since the actual planned allocation of capital investment has not been published yet, any conclusions must be tentative. However, the fulfillment of the output target for light industry (soft goods) would appear to depend upon greater capital investment than projected by the macromodel. Similarly, the modest output target for petroleum products may indicate that Soviet planners will restrict the growth of investment from historical rates or that they anticipate diminishing capital effectiveness in this branch.

A major advantage in using an econometric model to evaluate a FYP is the information generated in model solution which is generally not published in the Plan document. In the following sections, the Control Solution results will be used to indicate the macroeconomic consequences of the 10th FYP.

TABLE 2.—COMPARISON OF THE 10TH FYP WITH THE SOVMOD II CONTROL SOLUTION

[In percent]

Indicator: 5-yr rates of growth	Basic guidelines targets [1]	SOVMOD II control [2]
GNP		24.9
National income	24–28	
Industrial output	35–39	[3] (30.7) 39.4
Industrial labor productivity	30–34	[3] (25.4) 33.8
Industrial employment	3.8	4.2
Agricultural output (5-yr average)	14–17	[3] (12.5) 14.5
Real income, per capita	20–22	18.3
New capital investment (5-yr total)	24–26	25.0
Total consumption		24.4
Foreign trade turnover	30–35	23.3

[1] "Pravda," Mar. 7, 1976.
[2] SOVMOD II control: May 5, 1976.
[3] Model projections converted to Soviet GVO projections using adjustment factors computed for 1966–70. The unadjusted SOVMOD II projections are given in parentheses. The adjustment factor is a standard approximation: [1+g (official)]/[1+g (Western)], where g equals rate of growth.

TABLE 3.—THE GROWTH OF INDUSTRY, 1976–80

Industrial category	Percentage growth from 1975 to 1980					
	10th FYP			SOVMOD II control projection		
	Output	Labor productivity	Employment	Output [1]	Labor productivity [1]	Employment
Total industry	35–39	30–34	3.8	39.4	33.8	4.2
A goods (producer's goods)	38–42					
B goods (consumer's goods)	30–32					
Electroenergy	34–38	27–29	6.3	33.0	29.1	3.0
Petroleum:						
Crude	26–30	28–30	−.8			
Refined products	25–30	39–41	−8.9	43.4	44.4	−.7
Natural gas	38–50	43–45	0			
Coal	13–16	22–24	−6.9	11.9	30.4	−14.2
Ferrous metallurgy: Steel	13–21	23–25	−5.6	19.7	24.4	−3.8
Nonferrous metallurgy: Rare metals	30	23–25	4.8	36.0	30.8	4.0
Chemicals and petrochemicals	60–65	59–61	1.6	53.9	52.7	.8
Machine-building and metalworking	50–60	50	3.3	51.8	40.3	8.2
Construction materials	30	24–26	4.0	34.9	30.6	3.3
Forest products	22–25	25–27	−1.2	{23.5	28.5	−3.9
Paper and pulp		23–25		{37.8	35.9	1.4
Light industry	26–28	23–25	2.4	18.8	15.3	3.0
Processed food	23–25	24–26	−.8	23.6	25.2	−1.3

[1] Model projections are converted to Soviet GVO projections using adjustment factors computed for 1966–70.

A. Household Income, Consumption and Retail Prices

The model projects a 24 percent rise in real household disposable income compared with a 24.4 percent rise in real consumption (private and public). Thus, the current degree of income-expenditure imbalance is expected to persist through 1980. Among categories of consumption, the most rapid growth over the period 1976–80 is projected for durables (38 percent), followed by services (27 percent), soft goods (26 percent) and food (20 percent). The model projects a very mild rate of domestic inflation with the price deflator for consumption only rising 4 percent over the five years. Virtually all of this increase derives from a projected 33 percent increase in "free market" agricultural prices (6 percent per annum). In the past, such a growing discrepancy between administered and free prices has often led the bureaucracy to institute a "price reform" to restore rough parity between the two price systems.

B. The State Budget

It is interesting to note that the USSR will face similar problems with its State Budget in the late 1970's that Western governments now face in a period of economic recession. Even with the upward adjustments in State revenues indicated by the 1973–74 budget data, SOVMOD II projects a growing deficit in the State Budget through 1980. From a surplus in 1974 of 6 b. rubles, a deficit of 2 b. rubles appears in 1976 and rises to 10 b. rubles by 1980. Expenditure growth rates will need to be adjusted downward or tax rates adjusted upward in order to restore balance in the late 1970's. Frequently such increases in tax rates have been packaged together with price reforms.

C. Agriculture

Barring some startling technological breakthrough or dramatic changes in farm organization, agriculture is expected to remain the lagging sector of the economy during the 10th FYP. This appears to have been recognized by the Party leadership itself in its moderation of the growth target for agriculture in the Plan. Whereas the agricultural sector will be producing approximately 12 percent of GNP (in established prices) during this period, it will be employing 27 percent of the total labor force and absorbing 27 percent of total capital investment. In the control solutions, it has been assumed that Soviet grain imports will continue at $1 b. per year from 1977 to 1980 under terms of the U.S.-USSR Grain Agreement and such imports will be necessary to sustain even modest growth in the livestock herd.

D. Foreign Trade and the Balance of Payments

The Basic Guidelines of the 10th FYP provide very little statistical information regarding the planned expansion of Soviet foreign trade. Fortunately, SOVMOD II provides considerably more insight into the likely evolution of that trade, providing detailed information by commodity and geographical area. Table 4 lists a variety of summary indicators for the area composition of trade and the balance of payments situation of the USSR. The model projects a relative increase in Soviet trade with developed industrial economies, both CMEA and the West, with a relative decline in trade with the Third World.

The hard currency position of the USSR has been hit hard by the necessity of grain imports and sluggish Western demand for Soviet raw materials exports. In our Control, where the model determines Soviet imports from the West without restriction, the gold-import ratio falls sharply and the debt-export ratio rises substantially through 1976.

TABLE 4.—FOREIGN TRADE CONSEQUENCES OF THE 10TH FYP

1. COMPOSITION BY AREA, IMPORTS AND EXPORTS

Area	Share of total imports		Share of total exports	
	1973	1980	1973	1980
CMEA	0.518	0.528	0.464	0.455
Other Socialist	.072	.042	.109	.077
Developed West	.294	.351	.237	.345
LDC's	.115	.078	.090	.060
Unspecified	.001	.001	.100	.063

2. MEASURES OF HARD CURRENCY LIQUIDITY

Year	Gold-import ratio [2]	Debt-export ratio [3]
1973	1.116	0.669
1974	1.663	.489
1975	.778	.896
1976	.679	1.223
1977	.822	1.013
1978	.741	.803
1979	.667	.612
1980	.599	.442

[1] The estimates of Soviet gold reserves, hard currency reserves and indebtedness used in the model were published in J. T. Farrell, "Soviet Payments Problems in Trade with the West," in Joint Economic Committee, "Soviet Economic Prospects for the Seventies," Washington, 1973.
[2] Gold-import ratio equals value of gold reserves at market price/total imports from the developed West.
[3] Debt-export ratio equals total debt less hard currency stock/total exports to the developed West.

IV. Some Scenario Experiments With SOVMOD II

In this section, several scenarios relating to the period of the 10th FYP will be discussed. These scenarios have been designed to illustrate various properties of SOVMOD II as well as to indicate plausible alternative paths for the Soviet economy to 1980.

A. Scenario I: Import Restrictions

In the derivation of the Control Solution to 1980, Soviet exports to the Developed West were determined by a model equation which responds to both Western market demand and Soviet hard currency deficits. Even so, Table 4 indicated the sharp rise in the international debt ratio for the USSR through 1976, a measure which does not return to the 1974 level until 1980. The projections for Soviet foreign trade in the Control Solution may be unreasonably large for two reasons. First, the 121 percent increase in nominal Soviet exports to the Developed West may not be feasible given Soviet supply limitations and world demand conditions. Second, the succession of Soviet hard currency deficits may be unacceptable to the Soviet leadership, Western bankers, or both.

In the mid-1960's when the USSR faced a similar balance-of-payments dilemma after the 1963 harvest, its response was to reduce imports of machinery and raw materials from the Developed West. Consequently, Scenario I was based upon a restriction of Soviet imports from the West and the CMEA. Restrictions were imposed on all nongrain categories of Soviet imports from the Developed West and further restrictions were imposed upon machinery and raw material imports from the CMEA as indicated in Table 5 below. The main indicators for Scenario I are compared with the Control Solution in Table 6. Because of the reduction in machinery imports from the Developed West, the rate of growth of industrial output during the 10th FYP falls by one percentage point (from 39.4 percent to 38.4 percent). Total consumption and real household income are correspondingly reduced.

TABLE 5.—*Definition of Scenario I: Import Restriction*

Imports of machinery and equipment from CMEA.	2.5 billion ruble reduction beyond Control distributed over 1976–80 (represents approximately a 5 percent reduction in those flows).
Total non-grain imports from the Developed West.	$8 billion reduction over 1976–80 (14 percent of Control total).
Imports of machinery and equipment from Developed West.	$3.5 billion reduction over 1976–80 (4.6 percent of Control total). Similar proportional reductions made for various categories of machinery imports.
Credit drawings in Western markets	Reduction 1977–80 of $500 million per year from Control assumption of $1,500 million.

TABLE 6.—SCENARIO RESULTS: MAIN INDICATORS FOR 1976–80

[Indicator: Rates of growth; in percent]

	Control Solution	Scenario I: Import restriction	Scenario IIa: 1966–70 weather	Scenario IIb: 1961–65 weather
GNP	[1] 23.5	[1] 23.0	[1] 24.5	[1] 23.3
Industrial output	[2] 39.4	[2] 38.4	[2] 39.5	[2] 39.5
Agricultural output (5-yr average)	[2] 14.5	[2] 14.5	[2] 17.5	[2] 12.1
Real income, per capita	18.3	17.8	19.4	17.6
New capital investment (5-yr total)	25.0	25.0	26.2	23.8
Total consumption	24.4	23.5	23.9	25.3
Foreign trade turnover (real)	23.3	16.1	23.5	23.2

[1] Since GNP in 1975 is depressed because of the poor harvest, we have related a GNP 5-yr average (1973–77) of the Control Solution to the level of GNP in 1980.
[2] Model projections were converted to Soviet GVO projections using adjustment factors computed for 1966–70.

The major differences between the Control and Scenario I appear in hard currency trade and indebtedness. The gold-import ratio falls less in Scenario I because of the slower expansion in Soviet imports from the Developed West, while the debt-export ratio does not rise as high in 1976–77. However, this ratio remains above the 1974 level through the period of the 10th FYP.

B. Scenario II: Variations in Weather Conditions

In the Control Solution to 1980, weather conditions were assumed to be "normal" for each year of the 10th FYP period, normality being defined as the sample mean for the two weather variables over the period 1959–1972. To illustrate the responses to weather conditions estimated in SOVMOD II, two weather scenarios were constructed: (1) Scenario IIa with the above-normal weather conditions observed in 1966–70 imposed on the 10th FYP, and (2) Scenario IIb with the below-normal weather conditions observed in 1961–65 imposed on the 10th FYP. The main indicators for Scenarios IIa and IIb are compared with the Control Solution in Table 6, but greater detail concerning the solution paths is needed for a true comparison. This detail is provided in Table 7 below.

TABLE 7.—SCENARIO IMPACT OF WEATHER ON SOVIET GROWTH, 1976–80

[Scenario IIa: 1966–70 weather pattern—Scenario IIb: 1961–65 weather pattern]

Variable (units)	Scenario	Control value, 1976	Scenario less control value					Sum, 1976–80
			1976	1977	1978	1979	1980	
Gross national product	IIa	469.30	3.50	−0.82	1.52	1.10	5.42	10.72
(B. 1970 rubles)	IIb	469.30	−.49	.61	−6.85	−1.52	−0.70	−8.95
New capital investment (total)	IIa	114.54	.73	.58	.96	1.32	2.69	6.28
(B. 1969 rubles)	IIb	114.54	−.12	−.02	−1.61	−2.05	−2.34	−6.14
Food consumption	IIa	133.24	.52	.10	.26	1.00	1.64	3.52
(B. 1970 rubles)	IIb	133.24	−.05	.08	−.81	−1.24	−1.14	−3.16
Durables consumption	IIa	21.15	−.05	−.27	−.41	−.80	−1.24	−2.77
(B. 1970 rubles)	IIb	21.15	.01	.05	.23	.89	1.57	2.75
Agricultural production	IIa	74.77	3.53	−.98	1.47	1.07	5.31	10.40
(B. 1965 rubles)	IIb	74.77	−.50	.64	−6.95	−1.23	−.52	−8.56

In the last column of Table 7 the five-year impacts of these weather patterns are indicated. Above-normal weather such as occurred in 1966–70 could add over 10 billion rubles to the Control Solution GNP during the 10th FYP, while below-normal weather as in 1961–65 could reduce GNP by nearly as much. SOVMOD II distributes these supply effects in a manner which may be quite surprising to Western specialists on the Soviet economy. Approximately 60 percent of the weather-induced impacts fall upon new capital investment, with most of the remaining impact falling upon inventories and the residual category of end-use (grain reserves among other items). The impact upon food consumption, which has the expected sign, is nearly compensated by variations in durables consumption. Through such compensatory movements in durables and services, total household consumption (in established prices) actually grows more rapidly in Scenario IIb than in Scenario IIa.

Another surprising result in these weather scenarios is that industrial growth exceeds the Control under both above-normal and below-normal weather conditions. Because of the impact on new capital investment, this is not surprising for Scenario IIa; in fact, one might have expected a larger effect on industrial growth. The impact in Scenario IIb is clearly unexpected. These results arise from movements in population and labor allocation. Above-normal weather raises agricultural incomes relative to industrial incomes and thereby restrains rural outmigration and the growth of industrial employment; this effect was dominated, however, by the positive investment effect indicated in Table 7. Below-normal weather reduces agricultural incomes relative to industrial incomes, increases rural outmigration and industrial employment, and therefore boosts industrial output by 1980.

C. Scenario III: The "Burden" of the Western Recession on the Soviet Economy

As was noted earlier, part of the USSR's hard currency problems may be attributed to deficient demand for Soviet exports because of domestic recessions in the Developed West. In another scenario experiment with the macromodel, the recession which occurred in world trade in 1975 was replaced by a steady growth in real trade of 7 percent per year for 1975–1980. Soviet drawings of Western credit were also reduced by $4 billion over that period given the boost in Soviet exports

to the West and Less-Developed Countries. In SOVMOD II, this improvement in the USSR's debt position stimulates imports of Western machinery and equipment which in turn raise Soviet industrial production. Because of the lags involved in import response and machinery installation, the impact on industrial output is negligible until 1979–80 but continues for several years after 1980.

The major contrasts between Scenario III and the Control Solution are presented in Table 8. The removal of the Western recession increases the cumulated value of Soviet industrial production by 3.85 b. 1970 rubles over the period of the 10th FYP. In addition, the international position of the USSR is improved in 1980 on the Scenario path with more than $2 billion gained in hard currency reserves together with a much lower debt ratio.

TABLE 8.—THE IMPACT OF THE WESTERN RECESSION ON THE SOVIET ECONOMY, 1976–80

[Scenario III: Recession in world trade, 1975–76, replaced with steady 7 percent growth]

Variable	Units	Control	Scenario III
Growth in GNP, 1975–80	Percent	[1] 23.5	[1] 23.9
Growth in industrial output, 1975–80	do	[2] 39.4	[2] 40.3
Nominal growth of Soviet imports of machinery and equipment from the Developed West, 1974–80.	do	137	143
Nominal growth of Soviet exports to the Developed West, 1974–80	do	158	170
Hard currency reserves, 1980 (end year)	M. current dollars	−798	1,541
Debt-export ratio, 1980 [3]		.442	.194

[1] 5-yr average (1973–77) used for 1975 level of GNP.
[2] Model projection converted to Soviet GVO basis.
[3] Debt less hard currency reserves divided by total exports to the Developed West.

V. The Application of the Input-Output Component in SOVMOD II to the 10th FYP

One of the major objectives in developing SOVMOD II was the determination of a sequence of balanced input-output tables for the period 1959–72 and the integration of such an I–O component within the macromodel. The basis for the derivation of this sequence of tables is provided by Soviet Input-Output tables for 1959, 1966 and 1972, reconstructed by Western economists in current producers' prices.[10] The objective was to determine a plausible movement of the material requirements matrix, the A Matrix, for unobserved years. Using the actual tables and time-series for gross value of output and value-added by sector in current prices, intervening tables were determined by a modified RAS technique using a weighted minimization algorithm for coefficient movement.[11] The particular problem posed by the 1967 price reform was handled by revaluing the 1966 table in post-reform prices. This revalued 1966 table was then used in the interpolation between 1966 and 1972.

The integration of this sequence of balanced I–O tables in current prices with the macromodel in constant 1970 prices posed several prob-

[10] The 1972 table was a preliminary version (June 1975) provided for our research by Professor Vladimir G. Treml and analysts at the Foreign Demographic Analysis Division, U.S. Department of Commerce.

[11] This methodology was developed by Gene D. Guill and Ross S. Preston and is described by Guill. "The RAS Method of Coefficient Adjustment and Soviet Input-Output Data," SRI–WEFA Working Paper No. 34 (Revised version: September 1975).

lems, both conceptual and computational. The principal concern in the construction of SOVMOD II was to utilize the I–O component to determine intersectoral deliveries and thereby determine a consistent vector of gross outputs by sector. From the current price series for gross value of output and value-added, we derived measures of total material inputs for each sector. These series were deflated and were introduced in the production functions for industrial branches, expanding the specification from two factors (labor and capital) to three (labor, capital and material inputs).[12] Because of collinearity between material inputs and labor, we found it necessary to constrain the estimation of production functions for several branches of industry. The general procedure in such cases was to constrain the labor elasticity to be equal to the restricted labor share in value-added for 1970 multiplied by the ratio of value-added to gross value of output in 1970.[13] These three-factor production functions were generally acceptable in statistical terms though simulation problems arose in branches with large diagonal coefficients (large intrabranch transactions). Such problems with dynamic simulations resulted in the rejection of the three-factor equation for the branch of chemicals and petrochemicals.

A. I–O Alternative I: An Initial Experiment With the Input-Output Component

The introduction of material inputs series in the estimation of branch production functions usually changes the output elasticities for labor and capital. These shifts in factor elasticities, indicated in Table 9, would change the projections of branch output to 1980 even without any consideration of interindustry consistency. As an initial experiment, SOVMOD II was applied to the 10th FYP period under I–O Alternative I where material inputs are determined by exogenous assumption and the three-factor production functions are used. In this projection, all assumptions and adjustments made for the Control Solution were retained and material inputs were assumed to grow at the same rate as the output growth projections of the Control Solution. This Alternative I experiment thus demonstrates the projective impact of the shifts in factor elasticities for capital and labor. The branch series for material inputs are not consistent in any input-output sense since their growth rates are imposed from the Control projections for branch output. This experiment therefore assumes *ex ante* no change in the ratio of material inputs to gross value of output; since the new growth projections for output will depart from the Control projections there will be a shift in the material intensity of branch production *ex post.*

[12] Provisionally, a single deflator was adopted for all material deliveries and applied in all branches except soft goods and processed foods (major deliveries to these branches are from agriculture where prices did not rise significantly in the 1967 Reform). Eventually, improved Soviet price data will be used to derive a sector specific deflator for material inputs.

[13] The restricted labor share is the sum of total wages, other money income and social security divided by total value-added, all measured in established prices in U.S. Government estimates of Soviet GNP in 1970.

TABLE 9.—COMPARISON OF ELASTICITIES IN 2-AND 3-FACTOR PRODUCTION FUNCTIONS

Branch	2-factor macro production functions			3-factor-production-functions			
	Labor	Capital	Trend	Labor	Capital	Materials	Trend
Electroenergy	0.4046	0.6196	----------	[1] 0.0800	0.6262	0.0959	----------
Coal products	[2] .2155	.3998	----------	[1] .3350	.5376	.0093	----------
Petroleum products	[1] .0657	[2] .8683	----------	[1] .0400	[2] .6408	.0330	----------
Ferrous metallurgy	.3682	.5337	----------	.4482	.3929	.1142	----------
Nonferrous metallurgy	.8188	.2092	0.0450	.4058	----------	.0741	0.0610
Construction materials	.1.2983	.0849	.0270	[1] .3000	.4126	.2624	----------
Chemicals and petrochemicals	[1] .3410	[2] .7149	----------	[1] .3410	[2] .7149	----------	----------
Machine building and metalworking	.1709	[2] .6681	----------	[1] .2520	[2] .3238	.2556	----------
Forest products	[1] .648	.4347	----------	[1] .2830	.1684	.3232	----------
Paper and pulp	.5618	.1157	.041	.4044	.4788	.3155	----------
			[3] XAT_{-1}				
Soft goods	.9222	.1983	.2706	.9896	1.208	.0805	----------
Processed foods	.4198	.4110	.2110	.4248	.0550	.4297	----------

[1] Imposed on the estimation: Share in value-added for 2-factor estimation; share in value-added times value-added share in gross output for 3-factor estimation.
[2] In the branches where labor or capital is disaggregated further, we have reported the sum of elasticities over the disaggregation.
[3] Lagged agricultural output as a proxy for raw material inputs.

The results of the Alternative I projection are compared with the Control Solution in Table 10. Again, these differences arise from shifts in capital and labor elasticities (and technical progress rates) between the two sets of production functions. The more significant impacts (greater than 10% of the Control growth rate) will be explained in reference to Table 9. The projection for coal output falls in Alternative I because of the higher labor elasticity (since employment in this branch is falling over the 10th FYP). Projected growth rates for ferrous metallurgy, machine-building, forest products, and processed foods decline because of the lowered capital elasticity in the three-factor equations. The branch of non-ferrous metallurgy grows more rapidly in Alternative I because of the increase in the estimated trend coefficient from 4.5% to 6.1% (dominating the fall in labor and capital elasticities). The projected growth of paper and pulp is less in Alternative I largely because of the absence of the trend term in the three-factor equation.

Generally, the Alternative I experiment projects lower branch growth rates over the 10th FYP because of reduced output elasticities for capital. These estimated elasticities fall usually for two reasons. First, the positive elasticity for material inputs usually reduces the capital elasticity from its two-factor level. Second, imposing a labor elasticity on the estimation often results in an increase over the estimated labor elasticity for the two-factor equation (three exceptions being electroenergy, construction materials and forest products). The experiment with Alternative I has served one major purpose. It clearly indicates the sensitivity of production function estimation for Soviet data to variations in specifications. Econometric technique cannot alone determine the most plausible production function for projections: considerable judgment and experimentation are required. The three-factor equations for electroenergy and construction materials appear more plausible than the two-factor equations. However, in the branches of machine-building and processed foods the two-factor equations appear to generate more plausible projections. This type of experimentation is essential in the selection of production functions for the final version of the SRI–WEFA Model.

TABLE 10.—GROWTH RATES OF INDUSTRIAL BRANCH OUTPUTS, 1975–80 [1]—COMPARISON OF CONTROL SOLUTION WITH I–O ALTERNATIVE I

[In percent]

Branch	Control Solution (1)	Input-Output Alternative I (2)	Change [2] (3)
Electroenergy	24.8	26.8	8.1
Coal products	7.3	6.2	−15.1
Petroleum products	37.5	37.9	1.1
Ferrous metallurgy	19.2	16.0	−16.7
Nonferrous metallurgy	35.6	40.1	12.6
Chemicals and petrochemicals	32.6	32.6	0
Machine building and metalworking	31.1	22.8	−26.7
Construction materials	21.8	21.9	.5
Forest products	12.8	9.5	−25.8
Paper and pulp	28.6	23.5	−17.8
Soft goods	15.0	13.5	−10.0
Processed food	16.7	9.2	−44.9

[1] Growth rates presented are based upon Western indexes used in SOVMOD II and not converted to Soviet GVO growth rates.
[2] Computed as follows: (Col. 2—Col. 1)/Col. 1.

B. I–O Alternative II: An Experiment with the Endogenous Determination of Material Inputs

As a second experiment, SOVMOD II was applied to the 10th FYP period under an I–O alternative in which material inputs are determined endogenously through the interaction of the input-output system and the three-factor production functions. In this exercise, all of the assumptions and adjustments which were made for the Control Solution were again retained. Thus, I–O Alternative II differs from the Control Solution in its use of the three-factor production functions with different factor elasticities for labor and capital, and differs from I–O Alternative I in that material inputs are now determined endogenously.

This version of the I–O component introduces the material input interdependencies between sectors into the macro model through the use of a B matrix. This matrix is formed from the 1972 input-output table by dividing each entry in the flow matrix by its row total: that is,

$$b_{ij}=\frac{x_{ij}}{X_i}$$

In the solution process this B matrix is first converted into flows by premultiplying it by the first-iteration vector of gross outputs obtained from the production functions. Material inputs delivered to each sector are next computed from this flow matrix by aggregating over each column. The vector of material inputs derived in this manner is consistent with the distributional pattern for material inputs (the B matrix) that existed in 1972 and the gross output statistics derived from production functions. It will not necessarily be the case, however, that the vector of material inputs derived from the B matrix will be equal to the vector of material inputs used in the three-factor production functions from which the initial estimates of gross output were derived. Consequently, it is necessary to iterate between the produc-

tion functions and the input-output system until a solution for sectoral gross outputs and material is obtained.[14]

I–O Alternative II results are presented and compared with I–O Alternative I in Table 11. Since the differences in these two projections arise from the endogenous determination of material inputs, attention is first directed to the percentage change in those rates of growth which is recorded in the next to last column of Table 11. The endogenous determination of material inputs in I–O Alternative II resulted in significant increases in the growth of material inputs into coal products, forest products, and paper and pulp; on the other side, the growth of material inputs decreased most significantly in electroenergy, petroleum products, machine-building and metal working, and soft goods.

TABLE 11.—GROWTH RATES OF INDUSTRIAL BRANCH OUTPUTS AND MATERIAL INPUTS 1975–80[1]

COMPARISON OF I–O ALTERNATIVE I AND I–O ALTERNATIVE II

Branch	Gross outputs			Material inputs			
	Alternate I	Alternate II	Percent change[2]	Alternate I[3]	Alternate II	Percent change[2]	(3)/(6)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Electroenergy	26.8	26.5	−1.1	26.6	24.1	−9.4	0.117
Coal products	6.2	6.3	1.6	7.9	15.0	89.9	.018
Petroleum products	37.9	37.8	−.2	37.9	34.3	−9.5	.021
Ferrous metallurgy[4]	16.0	15.8	−1.3	25.1	23.8	−5.2	.250
Nonferrous metallurgy[4]	40.1	40.0	−.3				.058
Chemicals and petrochemicals	32.6	32.6	0	0	[5] 27.8		
Machine-building and metalworking	22.8	20.3	−11.0	33.1	22.9	−30.8	.357
Construction materials	21.9	21.7	−.9	26.4	25.7	−2.7	.333
Forest products[4]	9.5	10.9	14.7	15.0	19.7	31.3	.470
Paper and pulp[4]	23.5	25.1	6.8				.217
Soft goods	13.5	13.3	−1.5	19.5	16.9	−13.3	.113
Processed foods	9.2	9.6	4.3	19.2	20.4	6.3	.683

[1] Growth rates presented are based upon Western indexes used in SOVMOD II and not converted into Soviet GVO growth rates.

[2] Defined as (Col. 2—Col. 1)/Col. 1 or (Col. 5—Col. 4)/Col. 4.

[3] Differences in the growth rates of material inputs in I–O Alternative I and the growth rates of branch outputs in the Control Solution arise from the difference in the period over which these statistics were calculated—The growth rates in material inputs being calculated over the period 1973–80 while the growth rates of branch outputs were calculated over the period 1975–80.

[4] The sectors ferrous metallurgy and nonferrous metallurgy, and forest products and paper and pulp are aggregated respectively to form the 2 input-output sectors metallurgy, and forest products and paper. Since material inputs are calculated as columns sums of the input-output flow matrix, the material input statistics are presented according to the input-output sectoral classification.

[5] Since the branch production functions for chemicals and petrochemicals do not contain material inputs as an explanatory variable, the material inputs statistic for this branch does not have any effect upon production but is determined endogenously in the solution process as the column sum of the flow matrix.

These changes in material inputs then affect the growth rates of branch outputs through the three-factor production functions. As expected, the endogenous determination of material inputs had its most significant impacts upon those industrial branches with the largest output elasticities for material inputs.

A comparison of the ratios of the percentage change in gross output to the percentage change in material inputs (presented in the final column of Table 11) with the partial elasticities of output with respect to material inputs (shown in column 6 of Table 9) reveals a close cor-

[14] It should be noted that the B matrix is based upon the assumption that the inputs of a particular commodity delivered to a sector are a function only of the level of output or availability of that commodity. In this setting, the total inputs purchased by a sector are not determined by the level of output of that sector but instead by the availability of each of the products in its input listing. This relationship causes the material inputs delivered to a sector to be affected by the output levels of other sectors in the economy.

respondence across the industrial branches. Thus we find that the endogenous determination of material inputs in processed foods, forest products, paper and pulp, and machine-building and metal-working resulted in noticeable differences in the projected growth of output; however, the projections of the growth rates of outputs in coal products, petroleum products, and soft goods were very similar between the two I–O Alternatives.

As noted earlier, I–O Alternative II imposes an endogenous determination of material inputs under the assumption of a constant pattern of distribution of output over the forecast period. This assumption is expected to be most plausible under stable conditions and for use in short-term forecasting. For use in medium-or-long-term forecasting, such an assumption is less acceptable since material inputs change only in response to variations in the growth of delivering branches. Consequently, those sectors whose projected growth rates were less than the economy average experience greater growth rates of material inputs under I–O Alternative II; those sectors whose growth rates exceeded the economy average experience lower growth rates of material inputs. In other words, sectoral interdependencies, as recorded in the input-output table, impose a "leveling" effect on sectoral growth rates which renders an unbalanced or disproportional development path more difficult to maintain in the macromodel. Such constraints are partially valid, but our current research is directed toward the endogenization of the input-output relationship themselves. This work should provide the SRI–WEFA Model with flexibility to allow for gradual changes in the inter-sectoral relationships of the Soviet economy.

VI. Conclusions

This evaluation of the Soviet 10th FYP using the SRI–WEFA Model leads to a conclusion of Plan feasibility, at least for the main indicators released in the Basic Guidelines. This conclusion, it should be noted, depended upon the Plan itself for only indications of the employment constraints and Soviet investment intentions. From there, the Model's projections rest basically on the past performance of the Soviet economy as captured in the system of estimated equations. In a sense then, Soviet planners appear to have adjusted their expectations to past experience, rather than rely on the adjustment of experience to excessive expectations.

The Model suggests certain areas of likely Plan underfulfillment as, for example, in the somewhat strained Plan targets for growth in incomes and foreign trade. There is also some divergence between the Plan and the Control Solution in the targets for individual industrial branches. It is possible, however, that these divergencies have appeared because the (unpublished) Plan allocation of investment differs from the Model's projections.

The Model also generates, in a system-wide consistent way, substantial detail which appears in the Control Solution (presented in the Appendix). While only reporting on a small portion of this detail, we have indicated continuing difficulties in the agricultural sector and a potential realignment of internal prices. Pressure for such a realignment stems from three sources of strain in the system: a model-

predicted divergence between administered and free prices, a widening deficit in the state budget, and continued pressures of world inflation through the foreign trade sector. All three strains could be "eased" by implementing another "price reform."

Scenario analysis is a useful way of demonstrating the sensitivity of econometric forecasts to various shocks. These may be under the direct policy control of Soviet planners, as in the restriction of imports. Or, they may be outside planners' direct control as in the case of weather conditions or the business-cycle of the Western industrial economies. In three scenario experiments, we obtained interesting quantitative results which illustrate the behavioral properties of the Soviet economy. Thus, in a policy-type import restriction we observed a negative impact on industrial output, real household income and consumption and a positive effect on the gold reserve-import and debt-export ratios. Dual weather-impact scenarios demonstrated the importance of the weather factor for Soviet agriculture and, consequently, for the whole economy. In a third experiment, by a counter-factual imposition of normal world trading climate for the recession years 1974–75, we examined the negative impact of the Western recession on the Soviet economy.

Finally, we have reported on an important area of current and future development of the Model: the embodiment and full endogenization of input-output tables into the macromodel. As a first step, this requires the use of production functions that have material inputs as a factor of production in addition to labor and capital. Secondly, the allocation of these material inputs over time must be modeled in an internally consistent manner imposed by the input-output relationships. Our initial results in this direction are promising. They confirm our expectations in two ways. First, where partial elasticities of output with respect to material input are large, output growth rates are more seriously affected by material allocations. Second, where industrial branch growth rates diverge widely from the overall industry average, the unchanging materials input technology, imposed on the macromodel in one alternative, will pull them back towards the average. In reality, the rates of growth of the different branches are bound to vary; yet, they also cannot move outside of the consistency of the input-output framework. This points toward our current research in designing a flexible input-output framework that captures the technology and scarcity-induced shifts in interbranch relations.

SRI-WEFA ECONOMETRIC MODEL OF THE U.S.S.R. CONTROL SOLUTION FOR THE SOVIET ECONOMY, 1973–80

Description	Mod. var.	Lagged, 1972	Forecast data							
			1973	1974	1975	1976	1977	1978	1979	1980
GNP, sector-of-origin, B, 1970R	961	387.86	413.97	432.53	445.92	469.30	494.82	515.32	537.53	557.17
Percentage growth in GNP		3.20	6.73	4.48	3.10	5.24	5.44	4.14	4.31	3.65
GNP per capita, 1970 BR/person		1,560.19	1,649.96	1,707.70	1,743.97	1,818.15	1,898.99	1,959.03	2,024.20	2,078.46
Growth in GNP per capita		2.24	5.75	3.50	2.12	4.25	4.45	3.16	3.33	2.68
GNP, sector-of-origin, B, 1970R:										
Agriculture	951	53.75	63.18	60.12	52.32	59.06	61.11	61.57	65.36	64.39
Growth		−9.84	17.54	−4.84	−12.97	12.89	3.46	.75	6.15	−1.48
Industry		197.83	209.13	223.47	236.78	248.62	266.31	280.41	294.04	309.50
Growth, total		5.66	5.72	6.85	5.96	5.00	7.12	5.29	4.86	5.26
Growth, by branch:										
Electroenergy		7.11	3.65	4.93	6.19	7.26	3.52	3.35	3.69	4.91
Coal products		2.14	.59	1.95	1.69	2.09	1.03	1.09	1.25	1.65
Petroleum products		7.26	7.36	6.99	6.58	6.92	6.57	6.67	6.47	6.26
Ferrous metallurgy		3.62	2.43	4.07	3.90	3.49	3.29	3.34	3.71	4.07
Nonferrous metallurgy		4.94	8.69	6.65	4.92	8.36	4.54	5.80	6.41	6.36
Construction materials		4.64	4.48	5.50	8.03	3.47	3.17	3.47	4.32	5.71
Chemicals and petrochemicals		6.93	1.36	8.13	8.21	7.89	4.77	5.61	6.09	4.66
Machine building, and metal working		7.72	7.28	6.65	6.79	6.60	5.81	5.15	5.06	5.19
Forest products		3.27	.77	2.95	.84	2.42	2.57	2.11	2.21	2.92
Paper and pulp		4.50	6.36	6.94	6.56	4.56	4.37	5.21	5.69	5.99
Soft goods		.58	−.04	6.72	4.53	−.66	4.55	2.84	2.75	4.82
Processed foods		3.53	1.31	6.89	2.56	.81	4.28	3.32	3.11	4.18
Construction		30.45	31.14	32.60	34.31	34.83	34.74	33.87	32.46	31.12
Growth		6.72	2.27	4.66	5.27	1.51	−.26	−2.50	−4.19	−4.12
Transport/communication		39.01	42.34	45.32	48.37	50.50	54.03	58.05	61.49	64.99
Growth		6.33	8.55	7.03	6.74	4.39	7.00	7.44	5.93	5.69
Domestic trade		19.53	19.31	20.27	21.57	22.10	22.79	23.88	24.81	25.98
Growth		6.88	−1.08	4.96	6.41	2.47	3.08	4.78	3.93	4.72
Services/government		47.31	48.86	50.76	52.56	54.19	55.84	57.55	59.38	61.19
Growth		3.95	3.28	3.87	3.54	3.10	3.06	3.06	3.17	3.06
Net material product, B, 1970R		340.55	365.11	381.77	393.36	415.11	438.98	457.77	478.15	495.98
Percentage growth in NMP		3.10	7.21	4.56	3.04	5.53	5.75	4.28	4.45	3.73
Grain output (million metric tons)	337B	108.45	144.42	127.86	91.08	141.41	146.32	149.44	152.75	155.99
Growth in grain output		−12.15	33.17	−11.47	−28.76	55.25	3.48	2.13	2.22	2.13
Shares of sectors in GNP:										
Agriculture		.139	.153	.139	.117	.126	.124	.119	.122	.116
Industry		.510	.505	.517	.531	.530	.538	.544	.547	.555
Construction		.079	.075	.075	.077	.074	.070	.066	.060	.056
Transport/communication		.101	.102	.105	.108	.108	.109	.113	.114	.117
Domestic trade		.050	.047	.047	.048	.047	.046	.046	.046	.047
Services/government		.122	.118	.117	.118	.115	.113	.112	.110	.110

Consumption, total	1341	227.49	244.46	258.44	268.52	283.56	293.46	307.87	322.47	334.13
Food	135B	108.15	116.86	123.64	126.78	133.24	138.05	142.99	148.57	152.41
Soft goods	136B	53.22	56.80	60.39	63.56	67.37	69.83	73.84	77.44	80.35
Durable goods	137B	16.11	17.44	18.75	19.93	21.15	22.19	23.83	25.62	27.47
Personal services	138B	50.01	53.35	55.66	58.25	61.80	63.40	67.21	70.87	73.92
Investment, total		126.51	130.80	137.02	144.52	149.01	159.35	164.75	171.04	178.25
Total new fixed	191	94.26	98.32	105.12	110.51	114.54	120.08	125.61	130.53	135.37
Agriculture	13B	18.10	19.98	21.76	23.06	23.73	24.86	25.91	27.16	28.28
Industry	1B	33.09	34.92	37.63	41.24	43.87	46.51	49.30	52.31	55.47
Construction	14B	3.60	3.67	3.90	3.99	3.86	3.90	3.93	3.81	3.66
Transport/communications	15B	9.62	10.05	10.61	11.17	11.54	12.21	12.93	13.30	13.68
Housing	16B	14.63	15.12	15.58	16.10	16.64	17.18	17.74	18.33	18.93
Services and trade	17B	15.22	14.58	15.65	14.95	14.90	15.41	15.79	15.63	15.35
Capital repairs, level		19.74	21.46	22.91	24.42	25.95	27.47	29.01	30.60	32.22
Nonagricultural, inventory change:										
Wholesale and retail trade	159B	1.41	2.10	1.67	1.52	2.17	2.60	1.72	2.13	2.09
Other	158B	11.10	8.92	7.31	8.07	6.34	9.19	8.41	7.78	8.58
Government, total		33.04	34.31	34.46	34.89	35.30	36.23	37.27	38.38	39.50
Administration		1.45	1.47	1.45	1.46	1.46	1.43	1.42	1.41	1.40
Sociocultural, excluding science		6.37	6.75	6.96	7.27	7.47	7.54	7.67	7.82	7.97
Science		6.94	7.39	7.64	7.93	8.20	8.42	8.67	8.93	9.19
Defense		18.28	18.69	18.41	18.23	18.18	18.83	19.51	20.21	20.94
Net exports		−8.03	−8.84	−10.26	−14.22	−12.72	−8.61	−8.08	−7.92	−8.06
Total exports		19.08	21.43	22.15	23.61	24.95	26.91	29.09	31.42	33.86
Total imports		27.11	30.27	32.41	37.83	37.67	35.52	37.17	39.35	41.92
End-use residual [1]	191B	8.45	13.24	12.92	12.22	14.14	14.44	13.52	13.55	13.40
Shares of end-use categories in GNP:										
Consumption		.59	.59	.60	.60	.60	.59	.60	.60	.60
Investment		.33	.32	.32	.32	.32	.32	.32	.32	.32
Government		.09	.08	.08	.08	.08	.07	.07	.07	.07
Net exports		−.02	−.02	−.02	−.03	−.03	−.02	−.02	−.01	−.01
End-use residual		.02	.03	.03	.03	.03	.03	.03	.03	.02
Growth in GNP, end-use		3.20	6.73	4.49	3.09	5.24	5.45	4.13	4.31	3.66
Percent growth in end-use categories										
Consumption, total		3.74	7.46	5.72	3.90	5.60	3.49	4.91	4.74	3.61
Food		2.09	8.06	5.80	2.54	5.10	3.60	3.58	3.90	2.59
Soft goods		5.47	6.73	6.31	5.25	6.00	3.64	5.75	4.86	3.76
Durable goods		5.90	8.29	7.49	6.28	6.13	4.93	7.40	7.50	7.21
Personal services		4.88	6.69	4.33	4.66	6.09	2.59	6.01	5.44	4.31
Investment, total		7.18	3.39	4.76	5.47	3.11	6.94	3.39	3.82	4.21
Total new fixed		7.14	4.31	6.92	5.12	3.65	4.84	4.61	3.92	3.70
Agriculture		9.49	10.43	8.88	5.99	2.91	4.77	4.21	4.82	4.12
Industry		7.14	5.51	7.77	9.58	6.37	6.02	6.00	6.11	6.05
Construction		6.29	2.06	6.24	2.14	−3.22	1.23	.69	−3.18	−3.98
Transport/communications		13.46	4.50	5.52	5.36	3.28	5.80	5.90	2.83	2.87
Housing		3.82	3.29	3.06	3.33	3.36	3.27	3.27	3.27	3.27
Services and trade		4.19	−4.21	7.32	−4.44	−.32	3.38	2.50	−1.03	−1.78
Capital repairs		5.00	8.74	6.76	6.58	6.26	5.86	5.60	5.48	5.28
Nonagriculture inventory change		11.13	−11.91	−18.44	6.68	−11.15	38.51	−14.17	−2.13	7.64
Wholesale and retail trade		−45.98	48.70	−20.20	−9.00	42.80	19.80	−34.00	24.12	−2.27
Other		28.37	−19.61	−18.03	10.27	−21.34	44.92	−8.56	−7.50	10.36

SRI-WEFA ECONOMETRIC MODEL OF THE U.S.S.R. CONTROL SOLUTION FOR THE SOVIET ECONOMY, 1973-80—Continued

Description	Mod. var.	Lagged, 1972	Forecast data 1973	1974	1975	1976	1977	1978	1979	1980
Government, total		2.40	3.83	0.44	1.25	1.18	2.62	2.88	2.98	2.92
Administration		−2.78	1.31	−1.30	.32	.06	−1.63	−.96	−.70	−.93
Sociocultural excluding science		4.07	6.02	3.02	4.50	2.66	.98	1.71	2.02	1.83
Science		5.79	6.59	3.33	3.87	3.39	2.68	2.94	3.03	2.92
Defense		1.04	2.22	−1.50	−.98	−.27	3.60	3.61	3.61	3.61
Net exports		70.49	10.04	16.11	38.57	−10.59	−32.30	−6.13	−1.95	1.70
Total exports		7.47	12.32	3.34	6.62	5.69	7.84	8.10	8.01	7.75
Total imports		20.69	11.64	7.07	16.74	−.43	−5.71	4.65	5.85	6.53
End-use residual		−22.89	56.65	−2.40	−5.41	15.70	2.11	−6.37	.25	−1.15
GNP, income side, B, 1970R	961I	387.86	413.97	432.53	445.92	469.30	494.82	515.32	537.53	557.17
Growth		3.20	6.73	4.48	3.10	5.24	5.44	4.14	4.31	3.65
Implicit price deflator (temporarily consumption price)	124I	99.85	99.87	99.98	100.19	100.03	100.53	101.27	102.31	103.67
Growth		−0.25	0.02	0.11	0.21	−0.16	0.50	0.73	1.03	1.32
GNP, income side, current rubles		387.28	413.44	432.45	446.76	469.44	497.45	521.86	549.97	577.62
Growth		2.94	6.75	4.60	3.31	5.08	5.97	4.91	5.39	5.03
Incomes, current rubles:										
Total money income, household	114I	206.50	211.01	229.33	241.28	248.43	265.82	280.05	293.55	309.43
Growth		6.12	2.18	8.68	5.21	2.96	7.00	5.36	4.82	5.41
Urban workers gross earnings	111B	135.94	142.41	154.24	163.06	171.31	183.14	192.99	202.11	212.36
Growth		6.13	4.76	8.31	5.72	5.06	6.91	5.38	4.73	5.07
State and collective farm wages	112I	27.67	24.82	28.94	27.88	25.00	27.62	28.65	29.50	31.34
Growth		5.63	−10.29	16.60	−3.68	−10.32	10.46	3.72	2.97	6.26
Inc. from sale of farm products	113B	10.04	10.11	10.17	11.86	11.49	12.09	12.97	13.85	14.85
Growth		2.14	0.72	0.52	16.67	−3.14	5.21	7.28	6.85	7.21
Profits distribution to co-op members	180E	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Growth		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Military pay and allowances	181E	3.58	3.68	3.77	3.87	3.97	4.13	4.29	4.47	4.64
Growth		2.87	2.79	2.45	2.65	2.58	4.00	4.00	4.00	4.00
Transfer payments	241B	27.12	29.83	32.06	34.46	36.51	38.69	41.01	43.47	46.08
Growth		0.97	9.98	7.48	7.48	5.97	5.98	5.99	6.00	6.01
Agricultural income in kind, household	115B	15.46	17.36	16.81	14.99	16.88	17.67	18.04	19.27	19.31
Growth		−5.23	12.29	−3.16	−10.86	12.64	4.66	2.08	6.83	0.19
Social sector revenues [2]	141B	44.40	53.48	55.66	57.27	58.92	60.83	62.55	64.49	66.11
Growth		5.97	20.44	4.08	2.90	2.87	3.26	2.82	3.11	2.51
Amortization funds	117B	35.29	38.89	42.84	47.20	51.99	57.25	63.04	69.40	76.39
Growth		10.01	10.18	10.18	10.17	10.15	10.12	10.10	10.09	10.08
Gross profit, national economy	118B	93.45	98.03	102.63	106.03	108.77	112.04	114.84	118.09	120.61
Growth		3.66	4.91	4.70	3.31	2.58	3.01	2.50	2.83	2.13
Residual [3]		−7.82	−5.32	−14.84	−20.01	−15.55	−16.16	−16.66	−14.83	−14.23
Growth		−770.67	−31.87	178.62	34.86	−22.30	3.95	3.08	−10.96	−4.07

Disposable income, households (current rubles)		206.88	212.29	228.60	238.01	246.52	263.32	276.88	290.65	305.41
Growth		5.16	2.61	7.68	4.12	3.58	6.82	5.15	4.97	5.08
Total money income	114I	206.50	211.01	229.33	241.28	248.43	265.82	280.05	293.55	309.43
Plus Agricultural income in kind	115B	15.46	17.36	16.81	14.99	16.88	17.67	18.04	19.27	19.31
Less total State deductions	144I	15.08	16.08	17.54	18.26	18.79	20.16	21.20	22.17	23.33
Consumption price	124I	99.85	99.87	99.98	100.19	100.03	100.53	101.27	102.31	103.67
Real disposable income	116I	207.19	212.57	228.64	237.56	246.45	261.93	273.42	284.08	294.60
Growth		5.42	2.59	7.56	3.90	3.74	6.28	4.38	3.90	3.70
Budget balance in current rubles:										
Revenues, total	145I	175.10	188.74	201.23	209.41	215.43	225.31	235.21	244.38	254.02
Growth		5.48	7.79	6.62	4.06	2.88	4.59	4.39	3.90	3.95
Deductions from gross profits	139B	60.00	60.41	63.98	64.93	66.04	67.97	69.63	71.55	73.07
Growth		7.91	.69	5.90	1.49	1.71	2.92	2.45	2.76	2.11
Turnover tax	140B	55.60	58.68	63.95	68.85	71.59	76.25	81.73	86.07	91.42
Growth		2.02	5.53	8.98	7.66	3.97	6.52	7.18	5.31	6.22
Other revenue from social sector (excluding social insurance)		35.10	43.61	44.88	46.05	47.37	48.45	49.52	50.88	51.79
Growth		5.97	20.44	4.08	2.90	2.87	3.26	2.82	3.11	2.51
Social insurance deduction	142B	9.30	9.87	10.78	11.22	11.54	12.39	13.02	13.61	14.32
Growth		5.68	6.09	9.25	4.12	2.87	7.30	5.16	4.52	5.21
Taxes on population	143B	15.10	16.17	17.64	18.35	18.89	20.26	21.30	22.26	23.42
Growth		7.86	7.12	9.07	4.04	2.91	7.25	5.15	4.52	5.21
Outlays, total	151I	173.20	183.98	195.25	207.33	217.17	228.14	239.63	251.73	264.48
Growth		5.48	6.23	6.12	6.19	4.75	5.05	5.04	5.05	5.06
Financing of national economy	146B	84.90	90.94	97.42	104.35	109.68	115.29	121.18	127.37	133.89
Growth		5.60	7.11	7.12	7.12	5.11	5.11	5.11	5.11	5.11
Social and cultural measures (excluding science)		56.20	60.41	64.93	69.78	73.95	78.37	83.06	88.04	93.33
Growth		7.05	7.49	7.48	7.48	5.97	5.98	5.99	6.00	6.01
Science	148B	7.30	7.67	8.05	8.45	8.87	9.32	9.78	10.27	10.79
Growth		5.80	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Administration	149B	1.80	1.85	1.90	1 96	2.03	2.09	2.16	2.23	2.30
Growth		0	2.71	2.98	3.18	3.27	3.24	3.20	3.17	3.14
Defense expenditures	152F	17.90	17.60	17.60	17.40	17.40	18.10	18.82	19.57	20.36
Growth		0	0	−1.68	−1.14	0	4.00	4.00	4.00	4.00
Expenditure residual	150H	5.10	5.22	5.35	5.38	5.24	4.98	4.63	4.25	3.82
Growth		8.51	2.26	2.51	.62	−2.53	−5.00	−7.00	−8.36	−10.07
Budget surplus		1.90	4.76	5.98	2.07	−1.74	−2.83	−4.42	−7.35	−10.46
Growth		5.56	150.43	25.71	−65.33	−184.09	62.03	56.35	66.41	42.21
Total exports (millions of U.S. dollars)	273I	15,416	21,408	23,718	27,837	30,993	35,095	39,835	45,179	51,112
Growth		11.66	38.87	10.79	17.37	11.34	13.24	13.51	13.41	1,313
Total imports (millions of U.S. dollars)	290I	16,105	20,841	24,064	30,901	33,820	33,802	37,497	42,071	47,506
Growth		29.06	29.40	15.47	28.41	9.44	−.05	10.93	12.20	12.92
Total net exports (millions of U.S. dollars)		−689	567	−346	−3,064	−2,827	1,293	2,338	3,108	3,606
Growth		−151.92	−182.36	−161.06	784.36	−7.74	−145.72	80.89	32.92	16.02

SRI-WEFA ECONOMETRIC MODEL OF THE U.S.S.R. CONTROL SOLUTION FOR THE SOVIET ECONOMY, 1973–80—Continued

Description	Mod. var.	Lagged, 1972	Forecast data							
			1973	1974	1975	1976	1977	1978	1979	1980
CMEA (millions of rubles): [6]										
Exports, total	258I	6,727	7,361	7,963	9,729	10,691	12,032	13,570	15,329	17,242
Raw materials	254B	3,715	3,915	4,360	5,538	6,133	6,871	7,744	8,724	9,823
Machinery	255B	1,689	1,965	2,158	2,934	3,326	3,812	4,387	5,032	5,755
Grain	256B	204	201	202	0	0	0	0	53	30
Consumption goods	257B	224	238	242	206	132	173	179	173	191
Unspecified	312E	895	1,042	1,000	1,050	1,100	1,177	1,259	1,348	1,442
Imports, total	279I	7,687	7,990	8,954	10,750	12,148	13,405	14,754	16,498	18,580
Raw materials	275B	897	897	950	1,175	1,293	1,445	1,508	1,615	1,802
Machinery	276B	3,395	3,679	4,453	5,891	6,986	7,980	9,084	10,458	12,084
Food	277B	663	717	783	831	894	951	1,007	1,067	1,117
Consumption goods	278B	1,718	1,682	1,768	1,803	1,875	1,874	1,943	2,085	2,241
Unspecified	311E	1,014	1,015	1,000	1,050	1,100	1,155	1,213	1,273	1,337
Net exports	259I	−960	−629	−991	−1,021	−1,457	−1,373	−1,185	−1,169	−1,338
Developed, west:										
Exports, total	263I	2,884	5,068	6,850	7,990	9,133	10,825	12,826	15,073	17,642
Nonfood	260B	2,778	4,935	6,700	7,847	9,017	10,681	12,672	14,913	17,464
Grain	261B	2	1	0	0	0	0	0	0	0
Other food	262B	104	131	150	142	116	143	155	160	177
Imports, total	285I	4,097	6,131	7,199	11,651	12,609	10,798	12,437	14,374	16,673
Other than grain	280B	3,626	5,130	6,699	10,651	9,609	9,798	11,437	13,374	15,673
Machinery	281B	1,368	2,076	2,543	4,138	3,438	3,764	4,400	5,157	6,020
Consumer goods	282B	285	646	859	1,382	1,211	1,306	1,738	2,167	2,654
Raw materials	283I	1,354	1,952	2,597	4,530	4,460	4,212	4,769	5,503	6,437
Unspecified	313E	619	456	700	600	500	515	530	546	563
Grain	284E	471	1,001	500	1,000	3,000	1,000	1,000	1,000	1,000
Net exports	265I	−1,213	−1,063	−349	−3,661	−3,476	27	389	699	969
Developing countries, (millions of U.S. dollars):										
Exports, total	266B	1,426	1,928	2,115	2,178	2,296	2,455	2,635	2,832	3,045
Imports, total	286B	1,669	2,391	3,160	2,957	2,936	3,047	3,217	3,435	3,692
Net exports		−243	−463	−1,045	−779	−640	−593	−582	−603	−648
Other Socialist countries (millions of U.S. dollars):										
Exports, total		1,880	2,334	2,603	2,735	2,930	3,152	3,393	3,651	3,929
Imports, total		1,007	1,510	1,600	1,751	1,775	1,810	1,874	1,940	2,008
Net exports		873	824	1,004	984	1,155	1,342	1,518	1,711	1,921
Unspecified, world (millions of U.S. dollars):										
Exports	308E	1,154	2,142	1,400	1,800	2,200	2,420	2,662	2,928	3,221
Imports	317E	108	23	18	30	100	50	50	50	50
Net exports		1,046	2,119	1,382	1,770	2,100	2,370	2,612	2,878	3,171

Machinery imports:										
Machinery and equipment (excluding transportation equipment), West (millions of U.S. dollars)	211B	1,276	1,805	2,133	3,945	3,383	3,068	3,635	4,381	5,146
Machinery and equipment, chemical, West (millions of U.S. dollars)	342B	271	389	424	666	467	630	774	619	743
Machinery, metal working, total (millions of current rubles)	343B	373	395	636	864	705	646	764	928	1,076
Machinery, mining, metal, and petroleum, total (millions of current rubles)	314B	212	329	586	844	775	647	754	1,073	1,296
Hard currency balances (millions of U.S. dollars):										
Inflows:										
Net balance of trade	321B	−1,356	−1,602	−484	−4,496	−4,272	−28	411	787	1,113
Net balance of services and transfers	320E	−44	6	−10	−20	−50	−40	−30	−20	−10
Credit drawings	330E	1,030	1,690	1,700	3,000	3,500	1,500	1,500	1,500	1,500
Gold sales	327E	300	1,000	750	1,000	700	700	700	700	700
Outflows:										
Interest payments	324B	122	167	217	290	394	431	405	391	384
Credit repayments	322B	451	657	925	1,111	1,604	2,082	1,843	1,680	1,569
Net inflows	325I	−643	270	814	−1,917	−2,121	−380	333	896	1,350
Hard currency holdings (millions of U.S. dollars)	326I	−43	227	1,042	−876	−2,996	−3,377	−3,044	−2,148	−798
Debt outstanding (millions of U.S. dollars)	323I	2,583	3,616	4,391	6,280	8,176	7,594	7,251	7,071	7,002
Gold reserves (tons)	328I	1,950	1,896	1,999	2,010	2,078	2,154	2,236	2,326	2,424
Gold production (tons)	198E	217	223	228	233	238	245	252	260	268
Gold sales (tons)		162	277	125	222	170	170	170	170	170
Price of gold (millions of U.S. dollars per ton)	319E	1.85	3.61	5.99	4.51	4.12	4.12	4.12	4.12	4.12
Price of gold (U.S. dollars per ounce)		57.54	112.22	186.47	140.21	128.12	128.15	128.15	128.15	128.15
Liquidity ratio	329I	.2501	.5261	1.0548	.2388	.1000	.1185	.1578	.1749	.1791
Gold reserves—Debt outstanding		1,024	3,225	7,594	2,783	385	1,279	1,962	2,514	2,987
Gold reserves—Import ratio		.8805	1.1159	1.6648	.7779	.6789	.8218	.7408	.6668	.5991
Debt—Export ratio		.9105	.6687	.4889	.8956	1.2232	1.0135	.8026	.6116	.4421
Debt service ratio		.1987	.1625	.1667	.1754	.2188	.2321	.1753	.1374	.1107
Population, total (millions)	68E	248.60	250.90	253.28	255.69	258.12	260.57	263.05	265.55	268.07
Growth		.93	.93	.95	.95	.95	.95	.95	.95	.95
Urban population	70B	146.10	149.13	152.23	155.98	158.42	161.17	164.19	166.27	168.52
Growth		2.53	2.07	2.08	2.46	1.56	1.74	1.87	1.27	1.36
Rural population	71I	102.50	101.77	101.05	99.71	99.70	99.40	98 86	99 28	99.55
Growth		−1.25	−.71	−.71	−1.33	−0	−.31	−.54	.42	.27
Population, able-bodied (16-59/54)		136.52	139.03	141.65	144.36	146.48	148.63	150.82	153.04	155.29
Growth		1.81	1.83	1.88	1.91	1.47	1.47	1.47	1.47	1.47
Shares of population:										
Urban		.588	.594	.601	.610	.614	.619	.624	.626	.629
Rural		.412	.406	.399	.390	.386	.381	.376	.374	.371
Able-bodied		.549	.554	.559	.565	.567	.570	.573	.576	.579
Employment, total (millions)		122.44	124.38	126.90	128.69	130.00	130.58	130.36	130.46	130.24
Growth		1.55	1.59	2.03	1.40	1.02	.45	−.17	.08	−.17
Agricultural	67B	36.84	36.98	37.04	36.75	36.72	36.35	35.55	35.25	34.58
Growth		−1.14	.38	.17	−.80	−.07	−1.01	−2.21	−.84	−1.91
Nonagricultural		85.59	87.40	89.86	91.94	93.28	94.23	94.81	95.21	95.66
Growth		2.76	2.11	2.81	2.31	1.46	1.02	.61	.43	.47

SRI-WEFA ECONOMETRIC MODEL OF THE U.S.S.R. CONTROL SOLUTION FOR THE SOVIET ECONOMY, 1973-80—Continued

Description	Mod. var.	Lagged, 1972	Forecast data 1973	1974	1975	1976	1977	1978	1979	1980
Participation rates:										
Total employment/ total population		0.493	0.496	0.501	0.503	0.504	0.501	0.496	0.491	0.486
Total employment/able-bodied population		.897	.895	.896	.891	.887	.879	.864	.853	.839
Agricultural employment/rural population		.359	.363	.367	.369	.368	.366	.360	.355	.347
Nonagricultural employment/urban population		.586	.586	.590	.589	.589	.585	.577	.573	.568
Agricultural:										
State and collective farms		−.58	−.09	.11	−.46	−1.59	−.69	−1.97	−1.88	−1.75
Private		−2.43	1.49	.30	−1.57	3.48	−1.73	−2.75	1.52	−2.26
Nonagricultural:										
Industrial—Growth, by branch		1.35	1.21	2.07	1.34	.70	.47	.57	.92	1.45
Electroenergy		1.55	.86	1.82	3.38	4.59	−2.66	−.40	.59	.95
Coal products		−3.12	−4.59	2.97	−2.43	1.92	−7.11	−4.43	−3.18	−2.06
Petroleum products		.76	4.17	3.53	.98	−3.39	−.79	.66	1.19	1.76
Ferrous metallurgy		.15	.37	1.09	.06	−1.17	−1.07	−.90	−.62	−.12
Nonferrous metallurgy		1.06	1.96	.99	−1.10	3.35	−1.50	.19	.98	.94
Chemical and petrochemical		1.75	2.33	3.08	3.32	−2.03	−.39	.78	1.11	1.38
Machine, building and metalworking		2.82	2.57	3.16	1.84	.69	1.44	1.68	1.85	2.25
Forest products		−.39	−1.00	.13	−3.03	−.67	−.70	−1.15	−1.05	−0.40
Paper and pulp		.77	1.41	3.37	2.71	−.70	−1.10	.41	1.20	1.59
Construction materials		1.52	.98	1.14	3.83	.53	−.05	.18	.80	1.81
Soft goods		−.04	.13	.98	3.97	.66	−.02	.09	.63	1.57
Processed foods		.59	.48	2.23	1.07	.64	−1.95	−71	.08	1.62
Residual branch		2.43	.95	−.65	−7.80	7.38	14.56	2.84	1.52	1.26
Construction		4.58	.88	2.49	2.50	.15	−1.31	−3.38	−5.10	−5.30
Transport and communication		2.96	2.85	2.58	2.72	1.31	−.12	−2.10	−4.19	−5.94
Domestic trade		3.63	3.60	3.28	2.19	1.38	.87	.77	1.24	2.11
Services		3.54	3.20	3.48	3.09	2.58	2.60	2.67	2.91	2.82
Forestry		−2.55	−.60	1.12	2.37	3.31	−3.41	−7.71	−11.22	−13.78
Other		3.82	.726	5.94	4.46	13.23	11.63	15.87	15.85	13.00
Strategic policy variables:										
Financing (billions of current rubles):										
Industry and construction	20E	67.00	70.50	77.30	85.40	88.30	90.95	93.68	96.49	99.38
Growth		7.72	5.22	9.65	10.48	3.40	3.00	3.00	3.00	3.00
Transportation and communication	21E	14.50	15.80	17.60	18.80	19.60	20.19	20.79	21.42	22.06
Growth		9.02	8.97	11.39	6.82	4.26	3.00	3.00	3.00	3.00
Agriculture	22E	27.60	31.00	33.00	37.10	37.20	39.06	41.01	43.06	45.22
Growth		15.48	12.32	6.45	12.42	0.27	5.00	5.00	5.00	5.00
Defense	152E	17.90	17.90	17.60	17.40	17.40	18.10	18.82	19.57	20.36
Growth		0	0	−1.68	−1.14	0	4.00	4.00	4.00	4.00
Defense nonpersonnel exp	153E	12.20	12.20	12.50	12.80	13.10	13.62	14.17	14.74	15.33
Growth		−3.17	0	2.46	2.40	2.34	4.00	4.00	4.00	4.00
Military pay and allowance (1973 figures) br	181E	3.58	3.68	3.77	3.87	3.97	4.13	4.29	4.47	4.64
Growth		2.87	2.79	2.45	2.65	2.58	4.00	4.00	4.00	4.00

Population and education variables:										
Total population (millions)	68E	248.60	250.90	253.28	255.69	258.12	260.57	263.05	266.55	268.07
Growth		.93	.93	.95	.95	.95	.95	.95	.95	.95
Able bodied population (millions)		136.52	139.03	141.65	144.36	146.48	148.63	150.82	153.04	155.29
Growth		1.81	1.83	1.88	1.91	1.47	1.47	1.47	1.47	1.47
Enrollment, higher education (thousands):										
All industrial categories	74E	1,546.40	1,548.20	1,555.00	1,562.00	1,569.00	1,576.84	1,584.73	1,592.65	1,600.61
Growth		−.34	.12	.44	.45	.45	.50	.50	.50	.50
Transport	75E	134.10	138.70	141.00	143.00	145.00	146.45	147.91	149.39	150.89
Growth		.75	3.43	1.66	1.42	1.40	1.00	1.00	1.00	1.00
Mining	333E	57.00	56.30	57.00	57.00	57.00	57.00	57.00	57.00	57.00
Metallurgy	334E	54.60	55.30	55.00	55.00	55.00	55.00	55.00	55.00	55.00
Income variables (billions of rubles):										
Planned gross profit, national economy	119E	98.00	105.84	114.31	123.45	132.10	140.03	148.43	157.33	166.77
Profits distributed to coop members, 1973 figures	180E	.15	.15	.15	.15	.15	.15	.15	.15	.15
Domestic prices:										
Index of wholesale prices, heavy industry, 1970=100	126E	96.97	93.94	93.94	93.94	94.41	94.88	95.36	95.83	96.31
Growth		−1.54	−3.12	0	0	.50	.50	.50	.50	.50
Price deflator, construction, 1972=100	172E	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Dummy and trend variables:										
QT50: time variables, 1950=1,1973=24	160E	23.00	24.00	25.00	26.00	27.00	28.00	29.00	30.00	31.00
QL728: long time trend 1928=0	161E	3.81	3.83	3.85	3.87	3.89	3.91	3.93	3.95	3.97
Q690N: Dummy variable for 1969 on	202E	1.00	1.00	1.00	1.0	1.00	1.00	1.00	1.00	1.00
DPL51 5-year plan dummy (1954–57, 1963–66, 1969–71, 1974–76, etc.)	203E	0	0	1.00	1.00	1.00	0	0	1.00	1.00
GFYP: 5-year-plan cycle (1954–57, 1962–64, 1969–71, 1974–76, etc.)	23E	0	0	1.00	1.00	1.00	0	0	1.00	1.00
QSH68: Shift variable for 1968 on=1	222E	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Weather and agricultural variables:										
Sum of development from monthly precip value	98E	.094	.715	.614	0	0	0	0	0	0
Winter temperature index for southern Ukraine	99E	−.058	.017	.032	0	0	0	0	0	0
Index of agricultural inputs, sown area 165=100	100E	99.00	100.00	101.00	102.00	103.00	104.00	105.00	105.00	105.00
Value of livestock feed (M1968R)	103E	9,896	10,983	10,969	11,341	11,800	12,036	12,277	12,522	12,773
Growth		4.31	10.98	−.13	3.39	4.05	2.00	2.00	2.00	2.00
Percent of Working capital in agricultural: livestock being fattened and young livestock.	104E	43.70	43.00	43.00	43.00	43.00	43.00	43.00	43.00	43.00
Foreign trade:										
Price valiables (1963=100):										
Unit value price of exports to CMEA of raw materials and pre-fabs.	190E	88.23	88.87	88.90	97.50	102.50	107.62	113.01	118.66	124.59
Growth		3.76	.72	.03	9.67	5.13	5.00	5.00	5.00	5.00
World market price of primary products	193E	130.00	188.00	295.00	292.00	295.00	303.85	312.97	322.35	332.02
Growth		13.04	44.62	56.91	−1.02	1.03	3.00	3.00	3.00	3.00
Prices of total world imports	194E	128.00	154.00	216.00	231.00	248.00	265.36	283.93	303.81	325.08
Growth		7.56	20.31	40.26	6.94	7.36	7.00	7.00	7.00	7.00
Unit value P'S of sugar imports from Cuba	314E	115.33	234.31	281.00	281.00	281.00	286.62	292.35	298.20	304.16
Growth		17.04	103.17	19.93	0	0	2.00	2.00	2.00	2.00
World sugar prices	316E	97.00	127.00	254.00	204.00	204.00	210.12	216.42	222.92	229.60
Growth		29.33	30.93	100.00	−19.69	0	3.00	3.00	3.00	3.00

SRI-WEFA ECONOMETRIC MODEL OF THE U.S.S.R. CONTROL SOLUTION FOR THE SOVIET ECONOMY, 1973-80—Continued

Description	Mod. var.	Lagged, 1972	Forecast data 1973	1974	1975	1976	1977	1978	1979	1980
Foreign trade—Continued										
Price variables (1963=100)—Continued										
World imports P'S weighted by Soviet exports	296E	127.87	156.88	223.00	245.00	245.00	262.15	280.50	300.14	321.14
Growth		2.01	22.69	42.15	9.87	0	7.00	7.00	7.00	7.00
World market P'S manufactured goods	298E	134.00	156.00	187.00	200.00	214.00	228.98	245.01	262.16	280.51
Growth		8.06	16.42	19.87	6.95	7.00	7.00	7.00	7.00	7.00
Index of world market grain prices	299E	107.00	206.00	268.00	246.00	268.00	273.36	278.83	284.40	290.09
Growth		15.05	92.52	30.10	−8.21	8.94	2.00	2.00	2.00	2.00
Unit value price of imports of raw materials from CMEA	310E	104.20	104.33	104.30	112.00	112.00	117.60	123.48	129.65	136.14
Growth		−.21	.12	−.03	7.38	0	5.00	5.00	5.00	5.00
Price variables (1970=100):										
Soviet trade with world, exports, official price index	309E	101.00	111.00	119.00	131.00	138.00	144.90	152.14	159.75	167.74
Growth		−3.81	9.90	7.21	10.08	5.34	5.00	5.00	5.00	5.00
Soviet trade with world, imports, official price index	318E	99.00	102.00	110.00	121.00	133.00	140.98	149.44	158.40	167.91
Growth		−1.00	3.03	7.84	10.00	9.92	6.00	6.00	6.00	6.00
Export price index, Germany, SITC 7, 1, nonelectrical machinery	344E	118.67	143.95	153.00	169.00	180.83	193.49	207.03	221.52	237.03
Growth		5.30	21.30	6.29	10.46	7.00	7.00	7.00	7.00	7.00
Price defl, intermediate material and services	393E	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Imports P defl, manufactured goods (1958=100)	213E	130.30	158.00	197.00	226.00	242.00	258.94	277.07	296.46	317.21
Growth		5.34	21.26	24.68	14.72	7.08	7.00	7.00	7.00	7.00
Official exchange rate of ruble in dollars	212E	1.20	1.35	1.35	1.35	1.35	1.35	1.35	1.35	1.35
Price of gold (millions of U.S. dollars per ton)	319E	1.85	3.61	5.99	4.51	4.12	4.12	4.12	4.12	4.12
Activity variables:										
Sugar products of Cuba (metric tons)		4.50	6.00	6.00	6.00	6.00	6.18	6.37	6.56	6.75
Growth		24.97	33.33	0	0	0	3.00	3.00	3.00	3.00
Grain products in CMEA (metric tons)	293E	73.94	77.00	80.00	83.00	86.00	88.58	91.24	93.97	96.79
Growth		8.01	4.14	3.90	3.75	3.61	3.00	3.00	3.00	3.00
Grain products in W Europe (metric tons)	300E	148.32	150.00	154.00	158.00	162.00	166.86	171.87	177.02	182.33
Growth		−.04	1.13	2.67	2.60	2.53	3.00	3.00	3.00	3.00
Grain products in LDC-S (metric tons)	303E	367.31	380.00	385.00	390.00	395.00	410.80	427.23	444.32	462.09
Growth		−2.92	3.45	1.32	1.30	1.28	4.00	4.00	4.00	4.00
Gold production (tons)	198E	217.16	223.42	228.00	233.00	238.00	245.14	252.49	260.07	267.87
Growth		31.61	2.88	2.05	2.19	2.15	3.00	3.00	3.00	3.00
Net material production in construction PIS, CMFA (1963=100)	192E	175.00	184.63	194.78	205.49	218.00	232.17	247.26	263.33	280.45
Growth		6.71	5.50	5.50	5.50	6.09	6.50	6.50	6.50	6.50
GNP of China $1963=100)	306E	138.00	148.00	164.00	180.00	198.00	213.84	230.95	249.42	269.38
Growth		7.81	7.25	10.81	9.76	10.00	8.00	8.00	8.00	8.00
Total imports of world (1963=100)	305E	213.00	245.00	270.00	276.00	294.00	314.58	336.60	360.16	385.37
Growth		9.79	15.02	10.20	2.22	6.52	7.00	7.00	7.00	7.00
Total imports of LDC-S (1963=100)	302E	5,939.0	6,795.0	7,480.0	7,480.0	7,930.0	8,485.1	9,079.0	9,714.6	10,394.6
Growth		12.27	14.41	10.08	0	6.02	7.00	7.00	7.00	7.00
Total imports of DW (1963=100)	297E	221.00	250.00	290.00	287.00	304.00	325.28	348.05	372.41	398.48
Growth		9.41	13.12	16.00	−1.03	5.92	7.00	7.00	7.00	7.00

Population variables (millions):										
Population in Africa, South America, South Asia	304E	1,849.00	1,900.00	1,950.00	2,000.00	2,050.00	2,101.25	2,153.78	2,207.62	2,262.81
Growth		2.67	2.76	2.63	2.56	2.50	2.50	2.50	2.50	2.50
Population in European CMFA	294E	105.00	105.70	106.40	107.10	107.80	108.34	108.88	109.42	109.97
Growth		.96	.67	.66	.66	.65	.50	.50	.50	.50
Population in Western Europe	301E	365.00	368.00	371.00	374.00	377.00	379.64	382.30	384.97	387.67
Growth		.83	.82	.82	.81	.80		.70	.70	.70
Population and employment:										
Population, urban (M)	70B	146.10	0	0	0	−1.00	−2.00	−3.00	−4.00	−5.00
Employment, agricultural, State and collective farms (M)	65B	25.85	0	0	0	−.69	−.79	−.91	−1.05	−1.21
Employment, industrial (thousands)	45B	32,461	40	200	50	−100	−250	−400	−550	−600
Employment, coal products	47B	1,056.00	0	0	0	66.00	72.60	79.86	87.85	96.63
Electroenergy	46B	655.00	0	−10.00	0	33.00	36.30	39.93	43.92	48.32
Petroleum products	49B	1,354.00	0	0	0	−11.00	−12.10	−13.31	−14.64	−16.11
Ferrous metallurgy	48B	265.00	0	0	0	−11.00	−12.10	−13.31	−14.64	−16.11
Nonferrous metallurgy	50B	760.00	0	10.00	0	33.00	36.30	39.93	43.92	48.32
Chemicals and petrochemicals	51B	1,626.00	0	−10.00	0	−33.00	−36.30	−39.93	−43.92	−48.32
Machine building and metal working	52B	12,718	−10	30	0	−88	−97	−106	−117	−129
Forest products	53B	2,559.00	0	20.00	0	0	0	0	0	0
Construction materials	54B	2,070.00	−10.00	−60.00	0	−55.00	−60.50	−66.55	−73.20	−80.53
Light industry	55B	5,034.00	10.00	−120.00	0	0	0	0	0	0
Processed food	56B	2,920.00	20.00	10.00	0	44.00	48.40	53.24	58.56	64.42
Residual	57B	1,182.00	−10.00	130.00	0	22.00	24.20	26.62	29.28	32.21
Employment, forestry (thousands)	58B	443.00	20.00	−10.00	0	30.00	30.00	30.00	30.00	30.00
Employment, construction (thousands)	60B	9,986.00	−30.00	−120.00	0	30.00	30.00	30.00	30.00	30.00
Employment, transportation and communication (thousands)	61B	9,881.00	60.00	−100.00	0	40.00	40.00	40.00	40.00	40.00
Employment, trade, etc. (thousands)	62B	8,100.00	50.00	50.00	0	0	0	0	0	0
Employment, Government and services (thousands)	63B	23,663	−40	−50	−50	0	150	300	450	500
Employment, other (thousands)	59B	1,061.00	−100.00	−30.00	0	0	0	0	0	0
Employment, all nonagriculture sectors (thousands)	64B	85,595.50	0	−80.0	0	−800.00	−2,000.0	−3,200.0	−4,40.00	−5,600.0
Wage and income variables:										
Wages, industry, C, RB	105A	1,705.20	0	30.00	0	0	0	0	0	0
Wages, construction, C, RB	107B	1,912.80	30.00	−30.00	−30.00	−30.00	−30.00	−30.00	−30.00	−30.00
Actual gross profits, national economy B, Curr, rub	118B	93.45	−4.00	−3.50	0	−3.18	−3.37	−3.57	−3.79	−4.01
Revenue variables (B. Rub):										
Population (income, tax, State bonds, etc.)	143B	15.10	0.80	0.80	0.80	0.84	0.88	0.93	0.97	1.02
Social insurance deductions	142B	9.30	0.30	0.30	0.30	0.31	0.33	0.35	0.36	.38
Other social sectors	141B	44.40	7.00	7.00	7.00	7.35	7.72	8.10	8.51	8.93
Deductions from profit, St entrp	139B	60.00	2.00	4.00	4.00	4.20	4.41	4.63	4.86	5.11
Turnover tax	140B	55.60	0.80	−1.00	0	0	0	0	0	0
Expenditure variables (B. Curr, R):										
Financing the national economy, total	146B	84.90	0	0	0	−2.10	−2.20	−2.32	−2.43	−2.55
Social and cultural measures (including science)	147B	63.50	0	0	0	−1.05	−1.10	−1.16	−1.22	−1.28

SRI-WEFA ECONOMETRIC MODEL OF THE U.S.S.R. CONTROL SOLUTION FOR THE SOVIET ECONOMY, 1973–80—Continued

Description	Mod. var.	Lagged, 1972	Forecast data							
			1973	1974	1975	1976	1977	1978	1979	1980
Capital investment variables:										
Industry (B72R)	1B	33.09	−0.90	−0.50	0	−0.50	−0.50	−0.50	−0.50	−0.50
Electroenergy (B70R)	2B	3.42	0	−.30	0	0	0	0	0	0
Coal products (B70R)	3B	1.71	−.02	−.10	0	0	0	0	0	0
Petroleum products (B70R)	4B	4.23	0	−.24	0	0	0	0	0	0
Ferrous metals (7B0R)	5B	2.37	.09	.10	0	0	0	0	0	0
Chemicals and petrochemicals (B70R)	6B	2.76	.13	0	0	0	0	0	0	0
Machine-Building and metal-working (B70R)	7B	6.98	−.14	.30	0	0	0	0	0	0
Forest products (B70R)	8B	1.64	−.08	−.20	0	0	0	0	0	0
Construction materials (B70R)	9B	1.98	−.10	0	0	0	0	0	0	0
Light industry (B70R)	10B	1.48	−.11	−.14	0	0	0	0	0	0
Processed food (B70R)	11B	2.50	.02	.09	0	0	0	0	0	0
Agriculture (B72R)	13B	18.10	−.28	.20	0	−.20	−.20	−.20	−.20	−.20
Construction (billions of rubles)	14B	3.60	−.10	−.10	0	−.20	−.20	−.20	−.20	−.20
Transportation and communications (billions of rubles)	15B	9.62	−.40	−.10	0	−.20	−.20	−.20	−.20	−.20
Housing, adjusted to 1970 prices (billions of rubles)	16B	14.63	0	−.04	0	0	0	0	0	0
Services (B,72R)	17B	15.22	−.90	1.00	0	1.00	1.00	1.00	1.00	1.00
Change in inventory stock, end year (B70R)	58B	443.00	20.00	−10.00	0	30.00	30.00	30.00	30.00	30.00
Production variables:										
Industrial output index, total 1970=100	76B	112.00	0	0	−.30	−2.00	−.50	0	0	0
Construction materials, 1970=100	85B	110.65	−4.40	−4.00	−5.00	−6.00	−6.30	−6.61	−6.95	−7.29
Trans-Comm index, 1970=100	91B	113.43	0	0	0	−3.00	−2.00	0	0	0
Agricultural products, total (billions of rubles)	88B	66.40	0	−1.30	−5.00	0	2.00	2.50	4.00	3.50
Potential agriculture output (billions of rubles)	89B	74.00	0	−3.50	−3.50	−3.00	−3.00	−2.00	0	0
Grain (metric tons)	337B	108.45	3.30	−17.30	−44.00	0	0	0	0	0
Second peak grain output (metric tons)	295B	131.50	0	−5.00	−5.00	−3.24	−3.50	−3.78	−4.08	−4.41
Domestic price variables (1970=100):										
Index of St retail prices for food	121B	100.66	0	.40	0	0	0	0	0	0
Price of food sold to consumer coops at negotiated prices	122B	102.00	−1.80	0	0	0	0	0	0	0
Foreign trade variables:										
Imports:										
DW, machinery, and equipment (less transportation equipment).	211B	1,276	300	0	800	400	0	0	0	0
From DW. other than grain	280B	3,628	450	0	2,000	1,000	0	0	0	0
From DW, machinery	281B	1,368	400	0	1,000	500	0	0	0	0
From west, chemical equipment	342B	271	13	0	0	0	0	0	0	0
From CMEA, raw materials	275B	897	0	0	0	−100	−200	−400	−600	−800
From CMEA, machinery	276B	3,395	0	0	0	−700	−1,000	−1,500	−2,000	−2,500
Total from LDC	286B	1,669	25	0	0	0	0	0	0	0
From Yugoslavia and Far Eastern Socialist countries	287B	621	100	0	0	0	0	0	0	0
From Cuba	289B	252	−24	0	0	0	0	0	0	0

Exports:										
To CMEA, raw materials	254B	3,715	−100	0	0	0	0	0	0	0
To CMEA, machinery	255B	1,689	100	0	0	0	0	0	0	0
To CMEA, grain	256B	204	47	0	0	0	0	0	0	0
To CMEA, food and consumer goods	257B	224	54	0	0	0	0	0	0	0
To DW, food	262B	104	18	0	0	0	0	0	0	0
To DW, other than food	260B	2,778	400	−2,400	−300	330	363	399	439	483
To DW, grain	261B	2	9	0	0	0	0	0	0	0
To LDC, grain	267B	82	78	0	0	0	0	0	0	0
To Yugoslavia and Far Eastern Socialist countries	268B	1,020	27	0	0	0	0	0	0	0
To Cuba	272B	739	19	0	0	0	0	0	0	0
Hard currency (millions of U.S. dollars):										
Balance of payments, hard currency	321B	−1,356	−253	0	0	0	0	0	0	0
Credit repayments in hard currency	322B	451	58	0	0	0	0	0	0	0
GNP end-use residual (B1970R)	191B	8.45	0	0	4.00	3.00	2.00	1.00	0	0
Net change in basic funds: Chemicals and petrochemicals (B1955R)	172B	1.70	−.70	.30	.40	0	0	0	0	0

[1] Grain reserves, livestock accumulation, and other agricultural inventories, statistical discrepancies.
[2] Excluding deductions from profit of state enterprises, turnover tax, and taxes on population.
[3] Nonzero only in forecasts when gross profits are not determined as a residual.
[4] Multiply by 1.35 to convert to U.S. dollars.

THE SOVIET 1966 AND 1972 INPUT-OUTPUT TABLES

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I. INTRODUCTION

As in earlier Joint Economic Committee compendiums on the Soviet economy the purpose of this paper is to present Soviet input-output tables for 2 years, 1966 and 1972, in a comparable format and with the necessary brief methodological and explanatory notes.[1]

Soviet economic statistics have been improving steadily in terms of both reliability and coverage, and every year yet another formerly hidden part of the iceberg (as Western specialists have termed the Soviet statistical system) becomes visible. However, there still are numerous gaps, distortions, and ambiguities in the available data, and the input-output tables that are constructed in the U.S.S.R. are no exception. The tables are published in a form that makes them almost useless for any meaningful analysis; for example, the relevant final-demand and value-added data are not published at all, and the available transactions matrixes omit several key sectors. The two tables presented in this study have been "reconstructed" by the authors, i.e., they have been prepared in the standard complete three-quadrant form, with the reconstruction being based on the published fragments of input-output data as well as other statistics. In this process, it was necessary to estimate some 20 percent of all the entries shown in the tables.

[1] The 1973 compendium of the Joint Economic Committee, "Soviet Economic Prospects for the Seventies," contained a paper by three of the present authors presenting their reconstruction of the Soviet 1959 and 1966 input-output tables (pp. 246–269). The 1966 table given in the present study has been revised in several important aspects on the basis of data that have become available since the 1973 publication.

To place Soviet input-output tables in proper perspective, a few words are in order about the development and use of input-output techniques in the U.S.S.R.

The Soviet Union was a latecomer in accepting and using a number of mathematical and econometric methods developed by Western economists, such as linear programming, game theory, and input-output analysis. Large-scale empirical work in the development and use of input-output techniques began in the U.S. in the late 1940's and was soon adopted and expanded by a number of Western countries.[2] Until the late 1950's Soviet economists dismissed input-output analysis as a fruitless attempt to introduce some measure of order into market economies and denied any utility of the new technique for a planned economy such as the Soviet.

For a number of reasons the objections to the use of Western econometric techniques began to dissolve in the late 1950's, and in a few years input-output tables became one of the most fashionable analytical tools in the U.S.S.R. In the early 1960's Soviet statisticians completed the first large-size ex post input-output table for the national economy for 1959, and followed this with a still larger table for 1966 and another for 1972. By the late 1960's, numerous research, academic, statistical, and planning agencies were competing in producing a variety of input-output tables—ex post and planning national tables, regional and inter-regional tables, static and dynamic tables; tables were prepared in constant and current values, in producers' and in purchasers' prices, and in physical units. The funds allocated to input-output analysis, the number of specialists working in the field, and the empirical and theoretical literature grew rapidly.[3]

There has also been extensive development of regional and inter-regional input-output modeling. The 1966 ex post national table was followed by similar tables for all 15 of the constituent republics, each of which was constructed from original republic data. The 1972 national table is also supposed to be supplemented by tables for the 15 republics.[4]

For a long time, economic planning in the U.S.S.R. has been effected essentially on the national level, and integration of regional and national plans existed only in political economy textbooks. One can conjecture that the great effort devoted to input-output analysis in the republics signals increasing independence for local statistical and planning agencies and the gradual emergence of an operational system of regional planning.

In terms of number of tables and studies based on them, the U.S.S.R. today can probably claim the leading position in the world. Certain

[2] The second enlarged edition of Wassily Leontief's seminal book "The Structure of the American Economy, 1919–1939" was published in 1951 (New York, Oxford University Press) and the first large-scale input-output table for the U.S. economy for 1947 was completed in the same year (see Evans and Hoffenberg, "The Interindustry," 1952, pp. 97–142). By the late 1950's some 30 countries were constructing and using input-output tables.

[3] A bibliography on Soviet input-output prepared by one of the authors 2 years ago listed some 900 titles and 600 authors. Since then both lists have grown considerably (see Treml, "Input-Output," 1975).

[4] The quality of republican tables varies from republic to republic. Thus, the three Baltic republics have produced some excellent tables, whereas the 1966 tables for some of the republics with weaker statistical apparatus were produced only after considerable delay and their statistical quality is probably rather poor. It also seems that, contrary to an earlier statement, the 1972 national table is not truly integrated with republican tables, since some of the republics have still not completed their tables and there are still some methodological and classification inconsistencies among those that have been completed.

aspects of Soviet tables also make them superior to most tables produced by other countries. For example, the key Soviet tables include such additional information as the number employed in each sector, working capital in each sector, and data on fixed capital stocks by sector broken down into some 25 categories of assets. Compared to most other input-output tables, Soviet tables as a rule contain more detailed information in the value-added and final-demand quadrants. In other respects, however, Soviet tables are decidedly inferior to most tables produced outside the U.S.S.R.

First of all, most Soviet tables are constructed in terms of purchasers' prices, i.e., prices that include distribution and transportation charges as well as highly differentiated turnover taxes. Thus, the distribution of a given commodity (the row of the table) is in most instances quite different when measured in value terms than when measured in physical units. Differences in the values in which transactions are recorded extend to foreign trade: exports are shown net of turnover taxes, while imports are shown in values which include turnover taxes. Another bothersome feature of Soviet ex post value tables is the lack of identification of defense-related industries. The tables are fully integrated with national income and product accounts and thus cover all industrial activities. However, such industries as aircraft manufacture and production of military hardware are completely absent from the available commodity listings.[5] It must be concluded that defense-related industries have been hidden in some way in the reported transactions. One can think of several ways in which this might have been done, but, whichever method was used, the true technological relations must have been distorted to some degree or another.

Although the extent of input-output work in the U.S.S.R. has been impressive, the practical application of input-output models and techniques does not appear to be commensurate with the level of effort expended, the number of specialists working in the field, and the vast quantities of data generated. Input-output tables have been used for a variety of purposes such as calculating average sectoral prices that balance supply with demand, assessing the efficiency of foreign trade flows by measuring the full (direct and indirect) labor and capital "content" of the commodities being traded, and making various projections with alternative mixes of final demand or capital and labor constraints. At the republic and local levels, where both planning and analysis have long been handicapped by a lack of consistent data, the applications have been more diversified and more sophisticated. However, input-output analysis remains on the fringes of the planning system and plays a much more modest role than envisaged by its advocates in the early 1960's, who pictured dynamic input-output models as the central core of the national plan. For the last 10 years or so we find repeated statements to the effect that input-output is just about to be integrated with the central planning mechanism, but these are invariably followed by a description of the use of input-output tech-

[5] Some defense-related sectors such as radio-electronics are identified in the listing of sectors included in the transactions matrix but the data for them have been omitted from published versions of the tables. However, the aircraft and other defense industries are not identified either in the published data or in the detailed commodity descriptions of the full tables.

niques in planning as "experimental." [6] Different segments of the Soviet planning and statistical professions apparently have divergent opinions as to the utility and applicability of input-output techniques in planning.

The Chairman of the U.S.S.R. State Planning Committee recently stated that the input-output model is only one of a large and varied array of models used in the national system of economic balances. In fact, he clearly tried to downgrade input-output techniques, noting that "Regrettably, in recent years theoretical and methodological work on national economic balances has become weaker. One of the reasons for this, apparently, has been an exaggeration of the role of input-output models by some scientists who have tried to present the latter as an alternative to national balances." [7]

Whatever the present and prospective utility of input-output techniques may be, the tables and related supporting data are indispensable for a variety of analytical purposes both within and outside the U.S.S.R.

II. Principal Features of Soviet Input-Output Tables [8]

All Soviet ex post input-output tables in value terms produced to date are of the conventional static, open, Leontief type. The basic flow tables are composed of three principal quadrants: a square matrix of so-called interindustry transactions, which depicts the commodity flows among all the producing sectors in the economy; [9] a final-demand quadrant, which shows the distribution of output among various categories of "final" or end users; and a value-added quadrant, which shows depreciation and factor payments (labor income, profits, taxes) originating in each of the producing sectors. The flows in these tables are measured in current purchasers' prices of the respective years, i.e., the prices paid by the purchasers of the products, including transportation and distribution charges and excise (turnover) taxes when applicable, as well as producers' costs and profits.

Soviet input-output tables conform to the material product definition of national income adhered to in the U.S.S.R. Thus, only those activities that are related to the production of material goods are represented in the interindustry quadrant. With few exceptions, all services are considered "nonproductive" and are reflected only in the final-demand quadrant as claimants against end output. However, a few service activities—freight transportation, communications serving production, various trade and distribution activities, and equipment repair service—are deemed to add to the value of material goods

[6] One of the leading Soviet specialists in input-output analysis divides the Socialist countries into two groups with respect to the utilization of input-output techniques. According to him, Hungary, Romania, Poland, and Czechoslovakia "use input-output models more or less regularly as the basis of planning decisions." In the U.S.S.R., East Germany, and Bulgaria, input-output techniques "are considered only a part of a larger evolving system of planning." (Kossov, "Metodotraslevyye," 1973, p. 64.)

[7] Baybakov, "Dal'neysheye," 1974, p. 12.

[8] A more detailed description of Soviet ex post input-output tables in general, and the 1966 table in particular, is given in Treml, Gallik, Kostinsky, and Kruger, "The Structure," 1972, chap. 3. Various aspects of the 1972 table are discussed in Gol'denberg, "Obsledovaniye," 1973, pp. 44–49; Eydel'man, "Novyy," 1972, pp. 3–15; Gol'denberg, "Obsledovaniye," 1972, pp. 36–42; and Sofiyev, "Yedinovremennyy," 1972, pp. 52–54.

[9] Conventionally, the format of the interindustry quadrant is used to designate the size of the entire table, regardless of the format of either of the other two quadrants. Thus, the flow tables presented with this report are usually referred to as 56-sector tables.

and are shown in the interindustry quadrant. Certain consumer services—clothing and shoe repair, repair and maintenance of furniture, appliances, and vehicles, and chemical dry cleaning—are also considered productive and are reflected in the interindustry quadrant.

Also as a result of the material product concept, transportation and distribution costs are shown only in the interindustry quadrant and the entries for the transportation and trade sectors in the final-demand quadrant are zero. On the other hand, all construction activities are by definition considered as contributing only to the investment category of final demand, and the interindustry-quadrant entries for the construction row are all zero.

The producing sectors in Soviet input-output tables are supposed to be "pure," i.e., each sector reflects the production of only those commodities that come within its defined scope. Since in practice the enterprises included in any given sector usually also produce some output that by definition belongs in some other sector, the data in both the rows and columns of all ex post tables (outputs and inputs) are adjusted to reflect only the proper activities of each sector.

The treatment of foreign trade in Soviet input-output tables is also different from that in their Western counterparts. Exports are given in the conventional manner as a column in the final-demand quadrant. Imports, however, are not separated into competing and noncompeting categories or into imports used in production and imports going directly into final demand, as is done in the United States and some other countries. Instead, all imports are treated as competing and are shown as an adjunct to the value-added quadrant, i.e., as if they were purchased by the industry producing the same products domestically and were distributed with that industry's output; no imports are separately identified in the final-demand quadrant.

In the reconstructed tables presented with this report, both exports and imports are included in the final-demand quadrant. In the 1966 table, they are separately identified; in the 1972 table they are incorporated in the "other final demand" column as a net balance, i.e., exports minus imports.

A relatively recent development in the Soviet economy—one that affects primarily the 1972 table—is the rise of agricultural subsidies. The use of subsidies is, of course, not a new phenomenon in Soviet economic life. For years, the coal and ore mining industries, among others, were heavily subsidized because the sales prices set for their products did not cover the cost of production. The treatment of such subsidies in Soviet input-output accounting is straightforward; they are recorded in the value-added quadrant as negative profits of the industry concerned. Since the 1967 price reform, the industrial subsidy has virtually disappeared. Agricultural subsidies are significantly more important in respect to magnitude, and more complex in terms of accounting. There are, in fact, two principal forms of these subsidies. One pertains to purchases of manufactured goods by agricultural organizations: the other involves sales of agricultural products to processing industries. In the 1967 reform, wholesale industry prices on mineral fertilizers, processed animal feeds, and certain kinds of machinery were increased substantially, but agricultural purchasers continue to pay the lower pre-1967 prices. For 1972, the amount of this type of subsidy has been estimated at some 2.4 billion rubles. The

other type of subsidy is a result of several rounds of increases in the procurement prices paid to agricultural producers for their products, which amounted to a total of about 30 percent between 1965 and 1972. However, the prices paid by processing industries for these same products have not been adjusted since the mid-1960's and are now considerably below the procurement level. The difference between these two sets of prices is covered by the state budget, and in 1972 it amounted to some 17.2 billion rubles. The two types of subsidies together thus amounted to about 19.6 billion rubles in 1972, constituting some 18 percent of gross agricultural output and 6 percent of national income in that year.[10]

The treatment of these agricultural subsidies in Soviet input-output accounting differs from that of the pre-reform industrial subsidies and from standard Western practice. Purchases of manufactured goods by agriculture are recorded in the lower prices paid by agriculture. It is not quite clear how the differences between these and the higher prices received by industry are recorded in the table. On the other hand, sales of agricultural products to processing industries are recorded in the higher prices received by agricultural producers, and the subsidy is incorporated in the value-added entry of the appropriate industrial sector. Thus, what clearly represents a subsidy to agriculture is treated as though it were a subsidy to industry. In the tables presented with this report, Soviet accounting practice has been followed.

Although all three of the major national ex post tables (1959, 1966, and 1972) are comparable in format and structure, there are qualitative differences between them. In terms of overall accuracy the 1966 table was generally superior to the 1959 table,[11] and the data base of the 1972 table appears to be improved over that of 1966.

It must be noted that most Soviet ex post tables do not make use of existing census and reporting statistics, as is the case with the U.S. and most Western tables, but require special data collections. In the construction of the 1959 table, Soviet statisticians obtained the necessary data for transactions within industry and construction by a sample survey covering some 20 percent of all enterprises, with the remaining transaction and national income data being provided by census statistics. Subsequent studies indicated certain deficiencies in the data so collected; hence in the preparation of the 1966 table the scope of the sample survey was expanded to include agriculture, and in some individual machinery, metallurgical, and chemical sectors a complete survey replaced sampling.

The data collection system was further improved in the preparation of the 1972 table. Sampling was abandoned in most industrial sectors, where all enterprises had to fill out special forms, and was used only in agriculture and some light and food industries. The collection and processing of final-demand data were also expanded and improved.

The improvement in the data base of the 1972 table is manifested in the higher density of the table, i.e., in the proportion of non-zero entries in the transactions matrix. The 1966 matrix, with 110 producing

[10] These estimates were derived in a forthcoming working paper on agricultural subsidies by Vladimir G. Treml.

[11] The differences between the 1959 and 1966 tables are described in Treml, Kostinsky, and Gallik, "Interindustry," 1973, pp. 257–259.

sectors had a density of 82 percent; in the 1972 matrix, with the same number of sectors, the density increased to 88 percent.[12]

A change in the proportion of non-zero entries in an input-output table can be explained partially by technological change and increasing diversification in the use of inputs, but the change from 82 to 88 percent clearly cannot be explained by this factor alone and must be attributed to improvement in the data base.[13]

Another important improvement in the 1972 table compared with 1966 is the manner in which the transactions were adjusted for commodity-establishment differences. The matter is too involved for a complete discussion in this report.[14] Briefly, in the earlier Soviet tables for 1959 and 1966, the transfer of nonsectoral products (the transfer of inputs and outputs for an activity from a sector for which it is secondary to a sector for which it is primary) was effected by a mechanical proportional increase in the inputs of the primary sectors. With much better data collected by the 1972 surveys, which provided the necessary information on the structure of the costs of producing nonsectoral products, the transfers were effected in a much more realistic way with the columns of material costs of the primary sectors being adjusted to reflect the true costs of production of the products being transferred.

III. The Format of the Reconstructed 1966 and 1972 Tables

Since neither the 1966 nor the 1972 table has ever been published in complete form, it has been necessary to "reconstruct" them from the published blocks of input-output data and other data from a wide variety of sources. The principal sets of data that have been published are :

1. A truncated version of the interindustry quadrant for each table, with some sectors omitted and others aggregated; [15]
2. A small sample of material input coefficients for each table; [16]
3. For 1966, a matrix of "embodied" labor corresponding to the published version of the interindustry quadrant and giving the interindustry flows in terms of man-years of labor; [17] this matrix has not been published for 1972.
4. Values of fixed capital stock in input-output format [18] and some capital output coefficients [19] for each table.

Considerations of space prevent giving a detailed description of the reconstruction process in this report. Only a brief summary of the major steps can be given here.[20]

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[12] These densities were measured on the basis of the published 85 x 85 segments of the 1966 and 1972 tables, but there is no reason to expect that those for the complete matrices would be significantly different.

[13] The density of the 1959 table was 62 percent.

[14] The problems and methods involved in this "commodity-establishment" adjustment are discussed in detail in Treml, Gallik, Kostinsky, and Kruger, *The Structure,* 1972, pp. 123–146.

[15] "Nar. khoz. 73," pp. 67–115, and "Nar. khoz. 67," pp. 63–111.

[16] "Nar. khoz. 73," pp. 117–123, and "Nar. khoz. 67," pp. 113–117.

[17] "Nar. khoz. 68," pp. 73–121.

[18] "Nar. khoz. 74," pp. 61–81, and "Nar. khoz. 68," pp. 51–71.

[19] "Koeffitsienty," 1976, pp. 84–91, and "Nar. khoz. 69," pp. 47–61.

[20] The reconstruction of the 1966 table is described in detail in Treml, Gallik, Kostinsky, and Kruger, "The Structure," 1972. Details of the 1972 reconstruction are available in various working papers and notes at the Foreign Demographic Analysis Division, Bureau of Economic Analysis, U.S. Department of Commerce.

The most important element in the reconstruction process is the estimation of gross values of output (GVO) for individual sectors. It is primarily a lack of data for making some of these estimates that made it necessary to reduce the number of sectors in the reconstructed tables from the number in the original tables. Most of the GVO estimates were based on direct material or capital input coefficients and the corresponding ruble flow or stock value. Others were estimated by various methods, using both input-output and non-input-output data.

The next major step in the reconstruction was estimation of the flows omitted from the published versions of the interindustry quadrants. This was accomplished by first constructing an aggregated 17-sector table representing major industry groups and estimating the flows between the omitted sectors and these groups. These values were then distributed among the disaggregated sectors according to the pattern of flows displayed by a published sector or combination of sectors that was chosen as a surrogate. Different alternative surrogate patterns were devised and tested for each of the omitted sectors.

The various elements of the final-demand and value-added quadrants were estimated in a variety of ways, largely on the basis of non-input-output data. More relevant data are available for 1966 than for 1972, and for this reason both the final-demand and the value-added quadrants are presented in more disaggregated form in the 1966 table.

Although condensed in comparison with the original Soviet tables, the reconstructed 1966 and 1972 tables presented in this report are complete in that they encompass the entire economy, that is, each table comprehends all productive activities (Soviet definition) in the given year. The values in the tables are expressed in current purchasers' prices of the respective years. In each table the economy is divided into 56 producing sectors. A brief description of the products or activities encompassed in each sector in the 1972 table is given in table 1. The Soviet compilers of the 1972 table made a number of changes in the commodity composition of some sectors, shifting products or groups of products from one sector to another. Differences in commodity composition between the 1972 and the 1966 tables are listed in table 2.

The complete three-quadrant tables for 1966 and 1972 are presented in tables A–I and A–II, respectively. Problems of data availability preclude disaggregation of the final-demand and value-added quadrants in the 1972 table to the same extent as in the 1966 table. The totals in these quadrants are, however, comparable. For the same reason, no employment vector is given for the 1972 table. For reasons of space, only the flow tables are presented here; the respective coefficient matrixes can easily be calculated from these, or they can be obtained upon request from the Foreign Demographic Analysis Division, Bureau of Economic Analysis, U.S. Department of Commerce.

TABLE 1.—PRODUCT DESCRIPTION OF THE 56 PRODUCING SECTORS

Sector No.:	Sector title	Description
1	Metallurgy	Ferrous ores and nonmetallic raw materials for ferrous metallurgy; pig iron, steel, and ferroalloys; rolled ferrous plate, sheet, bars, beams, rails, and pipe; nonferrous, rare, and precious metal ores; natural diamonds; nonferrous metals, alloys, and powders; semiconductor materials; carbon and graphite electrode products; chemical products of nonferrous metallurgy; coke, coke oven gas, coal oil, coal tar, and other products of coke chemistry; refractory brick, powder, and other products from refractory materials.
2	Industrial metal products	Steel wire, rod, tape, rope; wire nails, metal cloth, welding electrodes, chains, springs, screws, bolts, pins, rivets, keys, other industrial metal fasteners and hardware.
3	Coal	Coal and lignite; coal briquets; raw liquid fuels from coal; other products of coal processing.
4	Oil extraction	Crude oil and byproduct gas.
5	Oil refining	Refined petroleum fuels and lubricants; other products of oil refining (except carbon black).
6	Gas	Natural and manufactured gas; natural gasoline; other products of gas processing.
7	Peat and oil shales	Peat and peat briquets; shale oil and other products of shale processing.
8	Electric power and steam	Generation and transmission of electric power and steam.
9	Energy and power M. & E.[1]	Steam boilers and boiler equipment; steam, gas, and hydraulic turbines and equipment; nuclear power reactors; diesel engines (except auto, tractor, combine, and aircraft engines); steam engines; windmills.
10	Electrotechnical M. & E.[1] and cable products,	Electric motors and generators; transformers, rectifiers, and condensers; high- and low-voltage apparatus; electrical transportation equipment; electric furnaces, electric welding equipment; lighting equipment, fixtures, and bulbs; wet and dry batteries; electric insulating materials and products; electrical household appliances (except refrigerators); all types of cable, including conducting wire, cord, and cable.
11	Metalworking M. & E.[1]	All types of metalcutting and woodworking machine tools; sawmill frames; metal forging, pressing, stamping, and cutting machinery; molding and casting machinery and equipment.
12	Tools and dies	Cutting tools, dies, chucks, jigs, and other fixtures for metalworking and woodworking machinery; measuring tools; mechanic's hand tools; woodworking tools; chain saws.
13	Precision instruments	Electronic computers and data processing equipment; calculators; cash registers; copying machines, typewriters; office equipment; automatic control equipment; control, regulating and measuring instruments (including scales); laboratory instruments; electrical and radio instruments; optical, astronomical, geodesical, meteorological, geophysical, navigational, biological, and medical instruments; X-ray apparatus; materials testing equipment; drawing instruments, slide rules, mechanical pens and pencils; cameras, film projectors, and other photographic equipment; eyeglasses and other consumer optical devices; clocks and watches of all types.
14	Mining and metallurgical M. & E.[1]	Iron and steel smelting and rolling equipment; coking equipment; equipment for nonferrous metallurgy; oil and gas drilling, extraction, and refining equipment; ore and coal mining and concentration machinery and equipment; peat mining equipment.
15	Pumps and chemical equipment	All types of pumps and compressors, fans and ventilators; refrigeration equipment (including household refrigerators); oxygen and rare-gas apparatus; equipment for gas-flame metalworking; centrifuges, filter presses, autoclaves, mixing and drying drums, calenders, vulcanizers, heat exchangers, and other chemical equipment.
16	Specialized M. & E.[1]	Logging and lumbering equipment; pulp and papermaking equipment; equipment for the textile, chemical fiber, knitting, sewing, footwear, leather, fur, and cable industries; household sewing machines; cotton ginning equipment; equipment for flour mills, grain elevators, and grain storage facilities; food processing equipment; printing presses, typesetting machinery, and other equipment for the printing industry; equipment for the production of lime, cement, prefabricated concrete, brick, insulating materials, and other construction materials; cranes, conveyors, elevators, escalators, hoists, winches, and other hoisting, loading, and materials handling machinery.
17	Construction M. & E.[1]	Dredges, excavators, bulldozers, graders, pile drivers, power rollers, and other machinery for construction and road building; electric and pneumatic construction tools.
18	Transportation M. & E.[1]	Railroad, subway, and streetcar rolling stock and operating equipment; ships and boats of all types; horse-drawn vehicles.
19	Automobiles	Trucks, passenger cars, autobuses, auto tractors and trailers; motorcycles, scooters, and bicycles; automobile, motorcycle and scooter engines and components.
20	Tractors and agricultural M. & E.[1]	Tractors (including industrial and logging tractors); tractor and combine engines; all types of agricultural machinery and equipment.
21	Bearings	All types of ball and roller bearings (including those made of plastics) and appurtenances.

Footnotes at end of table.

TABLE 1.—PRODUCT DESCRIPTION OF THE 56 PRODUCING SECTORS—Continued

Sector No.	Sector title	Description
22	Radio and other machine-building	Radio communications apparatus and equipment; telephone and telegraph equipment; consumer radio and television receivers; tape recorders; electro-vacuum and semi-conductor devices; special materials and equipment for the electronic industry; medical, surgical, dental, and veterinary tools and equipment; equipment for retail trade, public dining, hospitals, and sanatoriums; glass industry equipment; firefighting, safety, sanitation, laundry, and dry cleaning equipment; castings, forgings, and stampings; parts and fittings in general machine-building use.
23	Sanitary engineering products	Heating and air-conditioning equipment; plumbing fixtures and fittings; cast iron sewer pipe; wood, coal, and gas stoves.
24	Other metal wares	Metal building components; metal containers; shoemakers', and gardeners' tools, metal furniture parts; metal kitchen utensils, tableware, and cutlery; barbering tools; metal lamps and lanterns; metal sporting goods; knitting and sewing machine needles.
25	Metal structures	Metal frames for buildings and structures; metal sheds; metal bridgework; utility poles and masts; water towers.
26	Repair of M. & E.[1]	All repair of machinery, equipment, vehicles, and instruments, including consumer appliances, performed in specialized enterprises.
27	Abrasives	Abrasive powders, pastes, and tools; synthetic diamonds.
28	Mineral chemistry products	Extraction and concentration of apatite, phosphorite, natural potassium salts, native sulfur and boron, mineral pigments, and other mineral materials for chemistry.
29	Basic chemistry products	Inorganic acids, alkalis, salts, and compounds; mineral fertilizers; sorbents and catalyzers; pesticides, herbicides, and disinfectants; explosives.
30	Paints and lacquers	Paints, lacquers, varnishes; mineral pigments; wax compounds; polishing pastes; brake fluid.
31	Synthetic rubber	All kinds of synthetic rubber.
32	Rubber and asbestos products	Rubber tires, hoses, belts, machine parts; rubberized fabrics; rubber toys, sporting goods, and other rubber consumer goods (except rubber footwear); medical and hygienic rubber goods; asbestos fiber, cord, sheet, and other products (except asbestos-cement construction materials).
33	Other chemicals	Synthetic dyes and pigments; textile assistants; rubber and plastic additives; synthetic resins and plastics; synthetic fibers; synthetic alcohols; ketone and acetone; organic acids; synthetic detergents and cleaning agents; pharmaceutical preparations and medications; chemical reagents; photographic film and paper, photochemicals; carbon black; household chemicals; plastic household articles, machinery parts, and building accessories; phonograph records; polymer film, sheet, and pipe; glass fiber and products; activated charcoal.
34	Logging	Timber, firewood, natural resin.
35	Sawmills and lumber products	Lumber of all kinds; railroad ties; plywood; wooden containers; wood building components.
36	Furniture and other woodworking	Wooden and woven furniture, furniture parts, and furniture repair; wood machinery and wagon parts; hothouse frames; wooden household and sporting goods; matches; preservative treatment of lumber and wood products.
37	Paper and pulp	Wood pulp and cellulose; paper and cardboard of all types; paper boxes, bags, and other containers; wallpaper, notebooks, writing tablets, and other paper products.
38	Wood chemistry products	Products of wood distillation; wood alcohol; charcoal.
39	Construction materials	Cement; prefabricated concrete; block and brick; building stone; roofing and drainage tile; asbestos-cement and slate products; soft roofing materials; ceramic wall and floor tile and pipe; crushed stone, gravel, and sand; lime, gypsum, and other binding materials; plaster and products; insulation materials; linoleum and polymer wall and floor coverings; asbestos, graphite, mica, talc, and other nonore materials.
40	Glass and porcelain products	Glass and glass products; fiberglass and glass wool; porcelain housewares, art goods, laboratory supplies, plumbing fixtures and fittings.
41	Textiles	Cotton, silk, wool, and linen yarn, thread, cloth, and fabrics; cotton seed; hosiery products and knit goods; jute and hemp fiber, yarn, rope, and fabrics; fish nets; felt products; umbrellas; textile notions and haberdashery.
42	Sewn goods	Clothing and apparel; industrial sewn goods; clothing repair.
43	Other light industry products	Natural and artificial leather and products; rubber, leather, and textile footwear; natural and synthetic furs and products from natural and synthetic fur; tanning agents; bristle and brush products; buttons; shoe repair.
44	Fish products	Fishing and whaling; fresh and processed fish and seafood; fish flour and meal; other fish products.
45	Meat products	Meat and meat products; gelatin and glue; powdered eggs.
46	Dairy products	Milk, butter, cheese, casein, and other milk products.
47	Sugar	Refined and granulated sugar; refined molasses and sirup; beet pulp.
48	Flour, bread, and confections	Flour and cereals; flour milling byproducts; bread and bakery products; macaroni and related products; all types of confectionery products.

Footnotes at end of table.

TABLE 1.—PRODUCT DESCRIPTION OF THE 56 PRODUCING SECTORS—Continued

Sector No.:	Sector title	Description
49	Other foods	Vegetable oils; margerine and mayonnaise; laundry soap and candles; canned, frozen, and processed fruits and vegetables; fruit juices and extracts; tobacco and products; cosmetics and perfumes; raw and refined alcohol; alcoholic and carbonated beverages; yeast; tea and coffee; table salt.
50	Industry not elsewhere classified	Natural precious and semiprecious stones (except diamonds); printing and bookbinding; musical instruments and appurtenances; games and toys (except rubber toys); pencils, pens, ink, and general office supplies; jewelry and art products; commercial laundering and dry cleaning; movie and still film printing and processing; water supply systems; feather and down products; processed animal feeds.
51	Construction	Industrial, commercial, transportation, agricultural, and residential construction—new and maintenance; design and survey work for construction; drilling for gas and oil.
52	Agriculture	All grain, vegetable, fruit, berry, technical (cotton, hemp, flax), and other field and horticultural crops; livestock and poultry raising, apiculture, sericulture; unprocessed animal products (meat, raw milk, eggs, honey, raw wool, raw silk, raw hides, etc.).
53	Forestry	Planting, care, and maintenance of forests.
54	Transportation and communications.	Freight transportation, including pipelines; communications serving production, including postal services.
55	Trade and distribution	Wholesale and retail trade, including public dining; supply and distribution services; procurement of agricultural products.
56	Other branches of material production.	Collection of ferrous and nonferrous metal scrap; motion picture production; publishing; noncommercial hunting, fishing, and trapping; gathering of wild fruits, nuts, herbs, etc.

[1] Machinery and equipment. Note that all machine-building sectors include spare parts.

Source: Tsentral'noye, "Instruktsiya," 1971, pp. 9–24.

TABLE 2.—CHANGES IN COMMODITY COMPOSITION OF SECTORS IN 1972 AS COMPARED TO 1966

1972 sector number (56-order)	Commodity	1966 sector number (56-order)
13	X-ray apparatus	10
13	Copying machines	16
13	Typewriters	22
13	Drawing instruments, slide rules, mechanical pens and pencils	50
15	Equipment for gas-flame metalworking	10
17	Electric and pneumatic construction tools	12
22	Tape recorders, record players	10
22	Glass industry equipment	16
32	Medical and hygenic rubber goods	33
33	Activated charcoal	29
33	Household chemicals	30
33	Plastic parts and components for industry and construction	50
35	Railroad ties	34
36	Hothouse frames, wooden parts and components for industry, preservative treatment of railroad ties, and other wood products	35
37	Paper and cardboard products (bags, boxes, wallpaper, notebooks, writing tablets)	50
39	Mica and graphite products	27
39	Extraction and primary processing of asbestos, graphite, mica, and other nonore materials	50
41	Cotton seed	52
43	Synthetic furs	41
43	Buttons	50
50	Precious and semiprecious stones (except diamonds)	1

Source: Tsentral'noye, "Instruktsiya," 1971, pp, 9–24, and Tsentral'noye, "Instruktsiya," 1966, pp, 18–51,

Appendix A

Flow Tables

List of Abbreviations Used in Flow Tables A–I and A–II

ABRASV	Abrasives
AGRIC M+E	Tractors and agricultural machinery and equipment
AUTOS	Automobiles
BASIC CHEM	Basic chemistry products
BEARNG	Bearings

CONST MAT	Construction materials
CONST M+E	Construction machinery and equipment
DAIRY PROD	Dairy products
ELEC POWER	Electric power and steam
ELTECH+CABLE	Electrotechnical machinery and equipment and cable products
EN+POW M+E	Energy and power machinery and equipment
FISH PROD	Fish products
FLOUR+BREAD	Flour, bread, and confections
FOREST	Forestry
FURN +OTH WD	Furniture and other woodworking
GLASS + PORC	Glass and porcelain products
GROSS INV	Gross investment
GVO	Gross value of output
IND NEC	Industry not elsewhere classified
INDMET PROD	Industrial metal products
INTIND USE	Interindustry use
LOGGNG	Logging
MEAT PROD	Meat products
METAL STRUCT	Metal structures
METLWK M+E	Metalworking machinery and equipment
MI+MET M+E	Mining and metallurgical machinery and equipment
MINERL CHEM	Mineral chemistry products
OIL EXTRAC	Oil extraction
OIL REF	Oil refining
OTH LT IND	Other light industry products
OTH NET INC	Other net income
OTHER BRANCH	Other branches of material production
OTHER CHEM	Other chemicals
OTHER FD	Other final demand
OTHER METWRS	Other metal wares
PAINT + LAC	Paints and lacquers
PEAT +SHALE	Peat and oil shales
PRECIS INST	Precision instruments
PRIVAT CONSUM	Private consumption
PUBLIC CONSUM	Public consumption
PUMPS+CHEM E	Pumps and chemical equipment
RADIO+OTH MB	Radio and other machine-building
REPAIR	Repair of machinery and equipment
RUBBER PROD	Rubber and asbestos products
SANIT ENG PR	Sanitary engineering products
SAW + LUM PR	Sawmills and lumber products
SPECL M+E	Specialized machinery and equipment
SYN RUBBER	Synthetic rubber
TEXTLS	Textiles
TOTAL FD	Total final demand
TOTAL PURCH	Total purchases
TRADE + DIST	Trade and distribution
TRANS + COM	Transportation and communications
TRANSP M+E	Transportation machinery and equipment
WOOD CHEM	Wood chemistry products

TABLE A-I. THE RECONSTRUCTED SOVIET 1966 INPUT-OUTPUT TABLE IN PURCHASERS PRICES
(IN MILLIONS OF RUBLES, EMPLOYMENT IN THOUSANDS OF MAN-YEARS)

SEQ NO.	110 ORDER NO.		METALL URGY 1	INDMET PROD 2	COAL 3	OIL EXTRAC 4	OIL REF 5	GAS 6	PEAT + SHALE 7	ELEC POWER 8
1	1-4,6,7	METALLURGY	7582.4	526.9	32.8	2.7	19.2	.9	2.3	12.0
2	5	INDMET PROD	60.2	18.7	20.8	1.1	1.1	.1	1.6	6.7
3	8	COAL	1415.7	3.5	1289.1	.1	.3	1.1	3.1	1542.4
4	9	OIL EXTRAC	.0	.0	.0	9.4	1208.5	22.1	.0	11.2
5	10	OIL REF	223.0	9.0	12.2	19.0	490.1	8.7	13.4	450.4
6	11	GAS	245.8	4.7	.8	2.9	21.8	15.3	.0	444.1
7	12,13	PEAT +SHALE	6.3	.0	.6	.1	.9	7.5	69.3	208.0
8	14	ELEC POWER	755.7	25.8	211.3	78.3	244.8	10.5	14.6	11.5
9	15	EN+POW M+E	2.5	.0	.4	.3	.0	.0	.2	13.1
10	16,17	ELTECH+CABLE	60.4	2.2	42.5	2.9	2.5	.4	2.3	11.5
11	20-22	METLWK M+E	5.2	.3	.2	.0	.0	.0	.1	.0
12	23	TOOLS + DIES	11.9	.8	5.2	.6	.5	.1	.6	1.0
13	24	PRECIS INST	8.1	.1	2.7	.5	1.9	.1	.1	3.6
14	25-27	MI+MET M+E	174.7	2.1	82.4	8.4	11.9	.7	8.6	.0
15	28,29	PUMPS+CHEM E	4.5	.0	.4	1.1	1.3	.2	.0	.9
16	30-34,36	SPECL M+E	4.1	.1	1.2	.0	.0	.0	.2	.3
17	35	CONST M+E	9.5	.0	1.5	.0	.0	.0	.4	.0
18	37,38	TRANSP M+E	7.1	.1	1.0	.0	.0	.0	.9	.2
19	39	AUTOS	17.1	.2	.9	.7	.5	.2	1.0	1.2
20	40	AGRIC M+E	6.1	.0	1.5	.6	.1	.1	5.7	.6
21	41	BEARNG	10.6	.5	1.3	.2	.2	.0	.7	.7
22	18,19,42,43	RADIO+OTH MB	34.1	1.2	7.1	1.0	1.7	.2	.6	2.7
23	44	SANIT ENG PR	2.9	.1	.7	.0	.1	.0	.1	.2
24	45	OTHER METWRS	38.3	2.8	13.5	1.0	1.7	.3	1.3	2.3
25	46	METAL STRUCT	2.2	.0	.9	.0	.0	.0	.0	.0
26	47	REPAIR	172.1	3.4	20.9	2.9	9.0	.6	1.3	40.1
27	48	ABRASV	20.9	.9	.4	.2	.1	.0	.1	.5
28	49	MINERL CHEM	7.8	.5	.4	.0	.5	.0	.0	.5
29	50	BASIC CHEM	245.5	12.8	50.6	3.4	77.1	6.0	7.3	13.9
30	56	PAINT + LAC	11.9	.5	2.1	.5	1.2	.1	.4	2.2
31	54	SYN RUBBER	.2	.0	.0	.0	.0	.1	.0	.0
32	57	RUBBER PROD	68.0	.9	30.9	1.5	2.5	.4	2.3	3.0
33	51-53,55,58,59	OTHER CHEM	21.3	.7	8.2	3.6	40.2	3.2	.1	3.9

TABLE A-I. THE RECONSTRUCTED SOVIET 1966 INPUT-OUTPUT TABLE IN PURCHASERS PRICES
(IN MILLIONS OF RUBLES, EMPLOYMENT IN THOUSANDS OF MAN-YEARS)

SEQ NO.	110 ORDER NO.		METALL URGY 1	INDMET PROD 2	COAL 3	OIL EXTRAC 4	OIL REF 5	GAS 6	PEAT + SHALE 7	ELEC POWER 8
34	60	LOGGNG	41.6	1.6	293.8	.5	.6	.0	3.3	.8
35	61,62	SAW + LUM PR	33.7	13.2	67.0	.8	4.0	.1	1.6	1.7
36	63,64	FURN +OTH WD	6.6	.6	2.1	.3	.6	.1	.3	1.1
37	65	PAPER + PULP	8.5	1.8	.4	.1	1.7	.0	.1	.7
38	66	WOOD CHEM	6.1	.0	.0	.1	5.3	1.1	.0	.0
39	67-73	CONST MAT	31.8	1.6	27.2	.8	2.1	.3	1.1	3.3
40	74	GLASS + PORC	9.2	.6	.8	.2	1.9	.1	.1	1.2
41	75-80	TEXTLS	30.7	43.2	5.0	1.2	2.3	.2	1.0	2.8
42	81	SEWN GOODS	78.4	4.9	43.2	2.2	4.7	.6	4.2	5.0
43	82	OTH LT IND	15.0	.4	6.7	.7	1.0	.2	.8	1.4
44	83	FISH PROD	.0	.0	.0	.0	.0	.0	.0	.0
45	84	MEAT PROD	.7	.0	.0	.0	.1	.0	.0	.0
46	85	DAIRY PROD	28.3	.3	.7	.7	4.1	.4	.1	2.1
47	86	SUGAR	.1	.0	.0	.0	.0	.0	.0	.0
48	87-89	FLOUR+BREAD	.4	.0	.0	.0	.0	.0	.0	.0
49	90-94	OTHER FOODS	12.8	3.6	3.6	.4	9.4	.1	.2	3.3
50	95	IND NEC	679.6	31.3	47.4	2.1	11.1	1.0	1.2	30.5
51	96-100	CONSTRUCTION	.0	.0	.0	.0	.0	.0	.0	.0
52	101,102	AGRICULTURE	2.0	.0	.7	.1	.0	.0	.1	.0
53	103	FOREST	.0	.0	.0	.0	.0	.0	.0	.0
54	104-106	TRANS + COM	1813.3	66.8	1539.4	536.8	1607.5	722.6	68.8	4.1
55	107-109	TRADE + DIST	484.8	32.8	208.5	137.8	660.8	.0	.0	.4
56	110	OTHER BRANCH	317.4	2.4	.0	.0	.1	.1	.0	.8
57		TOTAL PURCH	14837.1	823.9	4091.0	827.8	4457.0	805.8	221.5	2847.9
58		DEPRECIATION	1535.8	41.8	878.0	439.2	248.4	57.0	64.4	1159.4
59		WAGES	2980.8	172.1	2786.5	118.3	148.3	27.2	177.9	836.4
60		TURNOVER TAX	112.5	42.5	.0	.0	2703.0	580.0	.0	1458.0
61		OTH NET INC	2464.8	121.7	-1026.5	509.9	705.3	184.0	100.1	1225.6
62		VALUE ADDED	7093.9	378.1	2638.0	1067.4	3805.0	848.2	342.4	4679.4
63		TOTAL OUTLAY	21931.0	1202.0	6729.0	1895.2	8262.0	1654.0	563.9	7527.3
64		EMPLOYMENT	1747.1	111.2	1189.0	92.3	115.7	21.2	138.8	615.7
65		CAPITAL	20804.3	589.3	9145.4	5779.3	2823.2	803.1	840.1	23661.4

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TABLE A-I. THE RECONSTRUCTED SOVIET 1966 INPUT-OUTPUT TABLE IN PURCHASERS PRICES
(IN MILLIONS OF RUBLES, EMPLOYMENT IN THOUSANDS OF MAN-YEARS)

SEQ NO.	110 ORDER NO.		EN+POW M+E 9	ELTECH +CABLE 10	METLWK M+E 11	TOOLS + DIES 12	PRECIS INST 13	MI+MET M+E 14	PUMPS+ CHEM E 15	SPECL M+E 16
1	1-4,6,7	METALLURGY	295.8	1277.0	106.1	140.1	126.9	334.3	221.2	260.1
2	5	INDMET PROD	7.7	59.6	7.6	2.2	18.1	13.7	9.0	22.5
3	8	COAL	2.6	14.3	2.2	.6	3.8	5.8	2.7	4.4
4	9	OIL EXTRAC	.0	.0	.0	.0	.2	.0	.0	.0
5	10	OIL REF	8.3	29.8	4.5	2.1	5.2	10.3	6.7	8.5
6	11	GAS	8.2	13.5	2.7	.4	3.3	11.5	3.7	5.6
7	12,13	PEAT +SHALE	.1	1.9	.2	.0	.2	.2	.2	.4
8	14	ELEC POWER	33.4	84.2	25.5	11.2	22.3	36.0	27.5	34.5
9	15	EN+POW M+E	23.0	37.2	.1	.0	2.0	1.5	1.4	4.2
10	16,17	ELTECH+CABLE	101.5	763.3	91.8	7.9	88.0	16.8	170.8	135.1
11	20-22	METLWK M+E	.4	3.8	16.8	1.0	1.2	1.4	.7	1.7
12	23	TOOLS + DIES	3.1	13.1	10.8	2.8	13.5	5.9	5.5	7.9
13	24	PRECIS INST	11.7	37.8	7.1	.2	135.4	2.5	21.3	7.9
14	25-27	MI+MET M+E	.1	.0	.1	.0	.1	44.7	.0	.0
15	28,29	PUMPS+CHEM E	6.8	3.1	7.2	.1	.5	10.0	31.5	7.3
16	30-34,36	SPECL M+E	.1	1.7	1.1	.0	.0	2.4	.3	60.9
17	35	CONST M+E	.0	.0	.0	.0	.0	.2	.0	1.2
18	37,38	TRANSP M+E	.2	.2	.0	.0	.0	3.8	.0	2.0
19	39	AUTOS	9.4	28.9	.5	.1	11.1	27.8	7.9	113.9
20	40	AGRIC M+E	1.7	2.1	.3	.0	.1	14.7	2.8	14.0
21	41	BEARNG	3.9	18.4	11.4	2.9	5.5	20.7	4.2	19.1
22	18,19,42,43	RADIO+OTH MB	142.1	62.0	84.4	4.4	185.2	105.8	83.2	115.3
23	44	SANIT ENG PR	.7	.9	.1	.1	.2	.3	.6	.8
24	45	OTHER METWRS	6.6	24.9	17.3	7.5	3.3	18.4	13.7	16.1
25	46	METAL STRUCT	1.1	.9	.8	.0	.0	.7	.1	3.1
26	47	REPAIR	3.1	9.0	2.3	1.0	1.9	5.4	1.9	4.6
27	48	ABRASV	1.8	74.0	3.3	4.1	3.4	2.1	2.4	2.6
28	49	MINERL CHEM	.1	.6	.1	.0	.1	.1	.0	.2
29	50	BASIC CHEM	3.4	43.8	2.1	1.2	10.7	4.7	8.2	3.8
30	56	PAINT + LAC	4.2	50.5	7.4	.7	7.2	4.8	7.4	13.1
31	54	SYN RUBBER	.0	50.5	.0	.0	.0	.5	.0	.6
32	57	RUBBER PROD	3.6	76.2	4.9	.8	6.0	16.0	10.1	33.6
33	51-53,55,58,59	OTHER CHEM	2.5	262.6	3.8	1.6	26.6	3.2	19.6	9.7

TABLE A-I. THE RECONSTRUCTED SOVIET 1966 INPUT-OUTPUT TABLE IN PURCHASERS PRICES
(IN MILLIONS OF RUBLES, EMPLOYMENT IN THOUSANDS OF MAN-YEARS)

SEQ NO.	110 ORDER NO.		EN+POW M+E 9	ELTECH +CABLE 10	METLWK M+E 11	TOOLS + DIES 12	PRECIS INST 13	MI+MET M+E 14	PUMPS+ CHEM E 15	SPECL M+E 16
34	60	LOGGNG	2.0	2.1	1.7	.2	2.7	2.4	2.1	2.5
35	61,62	SAW + LUM PR	8.1	53.2	9.5	2.7	17.3	5.3	9.6	24.5
36	63,64	FURN +OTH WD	2.0	5.3	.9	.4	5.8	.7	3.1	15.0
37	65	PAPER + PULP	1.1	44.4	1.0	1.0	6.1	.8	1.8	2.1
38	66	WOOD CHEM	.2	6.4	.2	.0	.6	.1	.1	.4
39	67-73	CONST MAT	2.2	7.8	2.0	.6	3.3	2.7	3.1	4.0
40	74	GLASS + PORC	.9	83.3	.8	.1	16.5	1.3	4.9	1.9
41	75-80	TEXTLS	3.9	96.0	2.9	1.2	14.3	3.1	3.4	19.2
42	81	SEWN GOODS	3.9	19.3	3.2	1.1	5.9	4.1	3.8	6.3
43	82	OTH LT IND	1.2	6.0	.8	.9	8.1	1.0	.8	2.9
44	83	FISH PROD	.0	.0	.0	.0	.0	.0	.0	.0
45	84	MEAT PROD	.0	.2	.1	.0	.4	.0	.0	.2
46	85	DAIRY PROD	1.2	9.9	1.3	.3	9.1	3.9	1.9	2.4
47	86	SUGAR	.0	.0	.0	.0	.0	.0	.0	.0
48	87-89	FLOUR+BREAD	.0	.1	.0	.0	.0	.0	.0	.0
49	90-94	OTHER FOODS	.9	9.3	.6	.2	1.9	.7	.8	1.4
50	95	IND NEC	9.0	104.7	14.8	2.7	39.2	13.4	7.9	8.7
51	96-100	CONSTRUCTION	.0	.0	.0	.0	.0	.0	.0	.0
52	101,102	AGRICULTURE	.0	.1	.0	.1	.1	.1	.0	.0
53	103	FOREST	.0	.0	.0	.0	.0	.0	.0	.0
54	104-106	TRANS + COM	30.3	301.6	88.4	37.4	148.5	121.3	69.5	114.5
55	107-109	TRADE + DIST	15.7	113.8	26.5	20.2	68.2	21.0	19.7	28.0
56	110	OTHER BRANCH	2.2	3.5	2.6	.1	1.8	4.3	2.7	5.2
57		TOTAL PURCH	772.0	3912.8	579.8	262.2	1031.8	912.4	799.8	1153.9
58		DEPRECIATION	74.2	168.2	73.1	22.1	76.6	99.7	61.6	90.6
59		WAGES	303.9	933.1	308.8	130.7	642.7	498.3	259.6	406.9
60		TURNOVER TAX	.0	183.2	.0	.0	311.6	.0	158.2	47.0
61		OTH NET INC	335.9	1610.7	265.4	151.0	717.3	1189.6	520.8	572.0
62		VALUE ADDED	714.0	2895.2	647.3	303.8	1748.2	1787.6	1000.2	1116.5
63		TOTAL OUTLAY	1486.0	6808.0	1227.1	566.0	2780.0	2700.0	1800.0	2270.4
64		EMPLOYMENT	237.8	730.1	241.6	102.3	502.9	389.9	203.1	318.4
65		CAPITAL	976.6	2213.4	962.3	290.6	1007.3	1311.3	810.2	1191.8

TABLE A-I. THE RECONSTRUCTED SOVIET 1966 INPUT-OUTPUT TABLE IN PURCHASERS PRICES
(IN MILLIONS OF RUBLES, EMPLOYMENT IN THOUSANDS OF MAN-YEARS)

SEQ NO.	110 ORDER NO.		CONST M+E 17	TRANSP M+E 18	AUTOS 19	AGRIC M+E 20	BEARNG 21	RADIO+ OTH MB 22	SANIT ENG PR 23	OTHER METWRS 24
1	1-4,6,7	METALLURGY	77.3	409.5	607.6	747.6	113.6	294.4	283.2	649.1
2	5	INDMET PROD	7.5	41.4	51.2	39.4	10.8	17.5	7.2	50.4
3	8	COAL	1.7	6.4	11.6	8.9	.3	8.9	4.2	9.4
4	9	OIL EXTRAC	.0	.0	.0	.0	.0	.0	.0	.0
5	10	OIL REF	3.7	17.3	28.1	22.6	4.1	44.6	4.2	7.8
6	11	GAS	2.1	13.4	17.8	14.4	.8	25.8	4.8	2.8
7	12,13	PEAT +SHALE	.2	.6	1.0	.5	.5	2.2	.4	.8
8	14	ELEC POWER	12.9	68.4	62.8	92.1	15.9	153.2	20.2	41.8
9	15	EN+POW M+E	7.5	263.7	1.1	3.1	.0	22.6	.4	1.6
10	16,17	ELTECH+CABLE	25.1	307.1	91.5	74.8	1.6	537.0	8.4	22.9
11	20-22	METLWK M+E	1.1	4.6	8.3	10.9	1.8	11.0	1.4	2.3
12	23	TOOLS + DIES	2.9	14.2	14.6	24.1	2.9	59.7	1.3	5.0
13	24	PRECIS INST	2.2	60.4	4.3	7.0	.1	937.5	1.6	2.1
14	25-27	MI+MET M+E	.0	1.0	.0	.0	.0	.1	.4	3.2
15	28,29	PUMPS+CHEM E	5.5	111.9	6.6	5.8	.0	34.5	.8	.5
16	30-34,36	SPECL M+E	3.8	29.1	2.3	.5	.1	10.7	.0	2.6
17	35	CONST M+E	20.0	.1	.1	.0	.0	.0	.0	.0
18	37,38	TRANSP M+E	.0	79.8	.3	.3	.0	.0	.0	.0
19	39	AUTOS	37.5	9.0	962.3	51.8	.1	151.1	.5	6.6
20	40	AGRIC M+E	210.4	1.1	1.4	896.1	.1	117.2	.3	6.5
21	41	BEARNG	8.2	24.1	45.1	82.0	5.5	42.1	.5	2.0
22	18,19,42,43	RADIO+OTH MB	58.5	340.7	150.6	212.3	.0	2203.7	24.2	9.6
23	44	SANIT ENG PR	.2	3.8	1.1	3.6	.0	14.5	106.1	4.5
24	45	OTHER METWRS	6.4	28.2	30.3	44.5	3.5	247.1	6.7	75.4
25	46	METAL STRUCT	.1	2.1	.0	.0	.0	3.1	.0	.1
26	47	REPAIR	1.6	9.3	5.4	7.3	1.1	26.2	2.3	5.8
27	48	ABRASV	.7	11.2	5.7	9.3	6.7	34.8	1.3	5.9
28	49	MINERL CHEM	.0	.1	.2	.1	.0	.9	.3	.8
29	50	BASIC CHEM	1.8	13.8	10.9	8.4	.9	80.2	11.9	9.4
30	56	PAINT + LAC	3.8	23.0	37.7	29.8	.2	71.1	11.1	14.6
31	54	SYN RUBBER	.0	.0	.0	.0	.0	.0	.0	.0
32	57	RUBBER PROD	35.7	17.5	461.2	179.9	2.2	336.6	6.2	25.0
33	51-53,55,58,59	OTHER CHEM	1.5	17.6	19.6	11.3	1.1	281.3	4.5	12.8

TABLE A-I. THE RECONSTRUCTED SOVIET 1966 INPUT-OUTPUT TABLE IN PURCHASERS PRICES
(IN MILLIONS OF RUBLES, EMPLOYMENT IN THOUSANDS OF MAN-YEARS)

SEQ NO.	110 ORDER NO.		CONST M+E 17	TRANSP M+E 18	AUTOS 19	AGRIC M+E 20	BEARNG 21	RADIO+ OTH MB 22	SANIT ENG PR 23	OTHER METWRS 24
34	60	LOGGNG	.6	5.3	3.9	2.7	.2	5.7	.5	.9
35	61,62	SAW + LUM PR	3.0	34.6	33.0	48.1	3.0	65.8	8.8	31.2
36	63,64	FURN +OTH WD	.4	8.2	3.0	2.3	.9	13.8	.4	7.4
37	65	PAPER + PULP	.5	2.1	9.3	5.1	2.0	57.6	1.8	24.0
38	66	WOOD CHEM	.1	.6	.3	.5	.1	7.0	.1	.2
39	67-73	CONST MAT	1.7	19.1	7.3	4.0	.5	48.3	2.6	4.5
40	74	GLASS + PORC	.7	10.2	21.1	3.5	.1	13.1	5.6	16.0
41	75-80	TEXTLS	1.8	20.6	33.3	14.1	2.3	83.5	4.4	26.8
42	81	SEWN GOODS	2.1	23.0	14.1	14.3	1.7	36.9	4.4	16.2
43	82	OTH LT IND	.5	4.7	16.7	6.8	.6	20.9	1.3	19.8
44	83	FISH PROD	.0	.0	.0	.0	.0	.0	.0	.0
45	84	MEAT PROD	.0	.2	.2	.1	.0	.5	.0	.3
46	85	DAIRY PROD	.6	25.8	2.4	6.1	.1	14.5	.6	3.6
47	86	SUGAR	.0	.0	.0	.3	.0	.0	.0	.0
48	87-89	FLOUR+BREAD	.0	.0	.0	.0	.0	.0	.0	.0
49	90-94	OTHER FOODS	.2	3.4	3.1	1.7	.4	7.2	.9	2.8
50	95	IND NEC	4.9	140.9	24.5	26.0	.0	.0	3.1	28.8
51	96-100	CONSTRUCTION	.0	.0	.0	.0	.0	.0	.0	.0
52	101,102	AGRICULTURE	.0	.1	.1	.2	.0	.0	.0	.9
53	103	FOREST	.0	.0	.0	.0	.0	.0	.0	.0
54	104-106	TRANS + COM	47.7	51.4	292.1	302.1	70.6	176.7	15.3	122.9
55	107-109	TRADE + DIST	6.5	19.7	120.1	36.2	17.9	231.5	3.1	137.1
56	110	OTHER BRANCH	4.1	3.0	6.7	16.5	.0	6.6	.9	2.9
57		TOTAL PURCH	615.3	2303.3	3231.9	3079.0	274.3	6559.2	568.2	1427.6
58		DEPRECIATION	27.3	155.8	146.9	189.0	30.3	420.4	40.4	79.9
59		WAGES	132.1	534.5	691.1	833.4	145.7	1920.2	192.3	618.3
60		TURNOVER TAX	.0	.0	591.7	.0	.0	711.4	.0	.0
61		OTH NET INC	223.5	806.4	703.4	658.6	97.7	992.3	200.1	1174.2
62		VALUE ADDED	382.9	1496.7	2133.1	1681.0	273.7	4044.3	432.8	1872.4
63		TOTAL OUTLAY	998.2	3800.0	5365.0	4760.0	548.0	10603.5	1001.0	3300.0
64		EMPLOYMENT	103.4	418.2	540.8	652.1	114.0	1502.5	150.5	483.8
65		CAPITAL	359.7	2050.5	1932.4	2487.2	398.5	5532.2	531.9	1050.8

TABLE A-I. THE RECONSTRUCTED SOVIET 1966 INPUT-OUTPUT TABLE IN PURCHASERS PRICES
(IN MILLIONS OF RUBLES, EMPLOYMENT IN THOUSANDS OF MAN-YEARS)

SEQ NO.	110 ORDER NO.		METAL STRUCT 25	REPAIR 26	ABRASV 27	MINERL CHEM 28	BASIC CHEM 29	PAINT + LAC 30	SYN RUBBER 31	RUBBER PROD 32
1	1-4,6,7	METALLURGY	331.6	501.3	26.9	3.8	189.5	112.4	19.1	12.7
2	5	INDMET PROD	8.1	41.4	.3	4.1	4.9	.5	.0	26.9
3	8	COAL	1.4	53.1	1.5	3.3	22.2	2.2	.0	3.8
4	9	OIL EXTRAC	.0	.0	.0	.0	1.2	.0	.0	.2
5	10	OIL REF	2.7	78.2	3.0	14.7	40.5	19.0	96.8	17.3
6	11	GAS	1.7	14.4	1.0	3.1	47.7	2.0	.0	3.8
7	12,13	PEAT +SHALE	.0	1.6	.1	.0	.9	1.1	.0	.4
8	14	ELEC POWER	13.5	114.3	12.1	22.4	334.3	7.4	69.3	66.0
9	15	EN+POW M+E	.1	95.0	.0	.0	.2	.0	.0	.0
10	16,17	ELTECH+CABLE	4.5	207.5	1.1	3.0	7.9	.5	.1	3.2
11	20-22	METLWK M+E	.2	13.5	.0	.1	.1	.0	.1	.2
12	23	TOOLS + DIES	1.0	21.4	.3	.2	2.2	.2	.0	1.4
13	24	PRECIS INST	.1	35.8	.1	.2	1.9	.1	.0	.6
14	25-27	MI+MET M+E	.0	36.2	.0	2.0	.3	.0	.0	.8
15	28,29	PUMPS+CHEM E	.0	24.9	.1	.5	7.2	.2	.7	5.0
16	30-34,36	SPECL M+E	.2	12.9	.0	.2	.2	.0	.0	.5
17	35	CONST M+E	.0	77.6	.0	.4	.2	.0	.0	.0
18	37,38	TRANSP M+E	.0	127.3	.0	.2	.1	.0	.0	.1
19	39	AUTOS	.4	336.8	.1	1.6	1.3	.1	.2	.9
20	40	AGRIC M+E	1.3	687.2	.0	.5	.2	.0	.0	.1
21	41	BEARNG	.6	60.8	.2	.2	.6	.1	.1	.4
22	18,19,42,43	RADIO+OTH MB	5.3	356.8	.0	.0	291.7	12.5	.0	13.9
23	44	SANIT ENG PR	3.2	6.3	.1	.1	.4	.1	.1	.2
24	45	OTHER METWRS	2.5	59.1	1.7	.5	6.8	11.4	.0	10.9
25	46	METAL STRUCT	4.4	38.5	.0	.1	.0	.0	.0	.0
26	47	REPAIR	1.5	37.1	.8	1.5	15.4	2.4	2.0	6.0
27	48	ABRASV	.2	18.1	102.1	.0	.4	.1	.1	.3
28	49	MINERL CHEM	.1	.1	.0	3.7	194.9	9.7	.8	3.7
29	50	BASIC CHEM	2.4	21.9	2.1	21.4	303.4	24.4	69.9	30.0
30	56	PAINT + LAC	3.5	55.9	.2	.3	5.4	170.3	29.6	14.6
31	54	SYN RUBBER	.0	.0	3.8	.0	.0	.0	.9	1002.5
32	57	RUBBER PROD	1.1	63.2	.3	2.7	10.3	.7	18.2	70.7
33	51-53,55,58,59	OTHER CHEM	.5	23.4	8.8	7.8	69.3	200.8	104.1	409.4

TABLE A-I. THE RECONSTRUCTED SOVIET 1966 INPUT-OUTPUT TABLE IN PURCHASERS PRICES
(IN MILLIONS OF RUBLES, EMPLOYMENT IN THOUSANDS OF MAN-YEARS)

SEQ NO.	110 ORDER NO.		METAL STRUCT 25	REPAIR 26	ABRASV 27	MINERL CHEM 28	BASIC CHEM 29	PAINT + LAC 30	SYN RUBBER 31	RUBBER PROD 32
34	60	LOGGNG	.2	12.0	.1	1.3	2.2	.6	.0	.2
35	61,62	SAW + LUM PR	.8	95.2	.7	.8	31.7	7.1	.0	4.8
36	63,64	FURN +OTH WD	.2	3.2	.3	.2	1.4	.4	.0	.8
37	65	PAPER + PULP	.1	6.3	1.0	.7	34.2	5.8	.0	3.2
38	66	WOOD CHEM	.0	2.0	.0	.8	8.0	42.4	107.6	7.7
39	67-73	CONST MAT	1.0	27.9	1.3	.9	10.7	1.1	.1	1.4
40	74	GLASS + PORC	.3	10.4	.3	1.4	4.9	11.0	.4	1.1
41	75-80	TEXTLS	.4	55.8	6.8	1.3	14.9	1.2	.0	410.9
42	81	SEWN GOODS	3.2	23.7	.8	1.6	12.3	1.6	2.2	7.7
43	82	OTH LT IND	.4	14.3	.1	.5	1.7	.4	.0	1.2
44	83	FISH PROD	.0	.0	.0	.0	.3	.8	.0	.0
45	84	MEAT PROD	.0	.4	.9	.3	5.3	1.8	.0	.6
46	85	DAIRY PROD	.4	11.5	.4	1.8	10.7	3.4	.0	3.9
47	86	SUGAR	.0	.0	.0	.0	.0	.0	.0	.0
48	87-89	FLOUR+BREAD	.0	.0	.0	.0	.0	.2	.0	.0
49	90-94	OTHER FOODS	.9	6.2	1.0	.7	14.2	368.9	81.6	11.4
50	95	IND NEC	1.7	63.9	.0	2.7	67.8	4.0	.0	1.8
51	96-100	CONSTRUCTION	.0	.0	.0	.0	.0	.0	.0	.0
52	101,102	AGRICULTURE	.0	.7	.0	.0	.2	.7	.0	.0
53	103	FOREST	.0	.0	.0	.0	.0	.0	.0	.0
54	104-106	TRANS + COM	42.4	12.3	28.8	83.8	296.5	71.6	70.7	137.3
55	107-109	TRADE + DIST	4.7	.0	.5	1.4	30.4	11.9	11.7	16.1
56	110	OTHER BRANCH	.0	14.8	.0	.1	.0	.0	.0	.5
57		TOTAL PURCH	448.8	3582.2	209.7	198.9	2109.0	1113.1	686.4	2317.1
58		DEPRECIATION	38.4	470.9	14.3	66.8	287.8	15.4	36.7	61.7
59		WAGES	123.2	2557.8	70.3	75.0	420.7	61.8	48.2	269.1
60		TURNOVER TAX	.0	.0	.0	.0	12.0	22.0	.0	205.6
61		OTH NET INC	75.5	1615.1	80.6	82.3	593.5	223.7	141.1	761.5
62		VALUE ADDED	237.1	4643.8	165.2	224.1	1314.0	322.9	226.0	1297.9
63		TOTAL OUTLAY	685.9	8226.0	374.9	423.0	3423.0	1436.0	913.0	3615.0
64		EMPLOYMENT	96.4	2001.4	55.0	56.8	318.7	46.8	36.5	203.9
65		CAPITAL	505.5	6195.4	188.2	884.6	4046.3	217.0	510.6	883.9

TABLE A-I. THE RECONSTRUCTED SOVIET 1966 INPUT-OUTPUT TABLE IN PURCHASERS PRICES
(IN MILLIONS OF RUBLES, EMPLOYMENT IN THOUSANDS OF MAN-YEARS)

SEQ NO.	110 ORDER NO.		OTHER CHEM 33	LOGGNG 34	SAW + LUM PR 35	FURN + OTH WD 36	PAPER + PULP 37	WOOD CHEM 38	CONST MAT 39	GLASS + PORC 40
1	1-4,6,7	METALLURGY	201.4	5.4	99.5	5.9	10.6	1.6	610.3	42.4
2	5	INDMET PROD	3.9	17.1	17.8	27.4	2.7	.3	86.8	4.5
3	8	COAL	28.2	4.8	23.0	12.2	67.3	12.3	244.3	7.9
4	9	OIL EXTRAC	9.3	.0	.0	.0	.0	.0	.0	.0
5	10	OIL REF	152.2	152.7	27.3	10.3	12.7	3.0	225.2	24.9
6	11	GAS	48.1	.0	5.4	4.8	5.3	2.7	150.8	25.2
7	12,13	PEAT +SHALE	1.8	.9	4.8	1.8	4.4	.3	24.3	9.5
8	14	ELEC POWER	234.7	17.0	90.1	32.4	71.4	9.6	386.9	28.9
9	15	EN+POW M+E	.1	1.6	.2	.0	.2	.1	1.7	.0
10	16,17	ELTECH+CABLE	7.5	4.8	8.8	3.2	2.7	.5	32.2	3.4
11	20-22	METLWK M+E	.9	1.0	6.2	1.7	.0	.0	1.6	.2
12	23	TOOLS + DIFS	1.2	5.1	2.3	1.7	.7	.1	8.6	.8
13	24	PRECIS INST	2.9	.4	.4	.1	.6	.1	2.4	2.2
14	25-27	MI+MET M+F	.2	.0	.0	.0	.0	.0	6.3	.0
15	28,29	PUMPS+CHEM E	9.2	.1	.3	.0	.4	.2	1.2	.6
16	30-34,36	SPECL M+E	13.5	25.8	3.5	.3	3.5	.1	65.2	1.1
17	35	CONST M+E	.0	1.3	.0	.0	.0	.0	13.3	.1
18	37,38	TRANSP M+E	.0	5.8	.1	.0	.1	.0	1.5	.0
19	39	AUTOS	.8	55.1	5.3	1.1	.6	.2	17.1	.9
20	40	AGRIC M+E	.1	44.5	2.4	.4	.1	.1	8.4	.2
21	41	BEARNG	.8	2.7	2.0	.3	.5	.1	5.3	.4
22	18,19,42,43	RADIO+OTH MB	43.3	2.1	5.3	2.1	2.2	.4	1.6	.3
23	44	SANIT ENG PR	.5	.1	1.4	.5	.2	.0	9.8	7.8
24	45	OTHER METWRS	10.7	10.9	29.5	75.9	1.8	.3	38.8	3.3
25	46	METAL STRUCT	.0	.0	9.3	.9	.0	.0	1.3	.0
26	47	REPAIR	17.5	12.2	12.3	5.6	5.3	.9	46.3	12.2
27	48	ABRASV	1.0	.7	2.3	13.8	.3	.0	1.4	3.5
28	49	MINERL CHEM	8.2	.0	.0	.1	14.3	.2	5.9	8.8
29	50	BASIC CHEM	310.3	.8	13.1	8.3	26.4	8.4	32.3	47.2
30	56	PAINT + LAC	17.8	1.6	21.0	82.8	1.0	.2	7.4	3.7
31	54	SYN RUBBER	.0	.0	.0	3.3	.0	.0	.7	.0
32	57	RUBBER PROD	14.2	36.1	9.7	10.1	1.8	.4	46.7	2.0
33	51-53,55,58,59	OTHER CHEM	1141.0	.6	64.8	61.6	6.1	11.6	69.9	24.3

TABLE A-I. THE RECONSTRUCTED SOVIET 1966 INPUT-OUTPUT TABLE IN PURCHASERS PRICES
(IN MILLIONS OF RUBLES, EMPLOYMENT IN THOUSANDS OF MAN-YEARS)

SEQ NO.	110 ORDER NO.		OTHER CHEM 33	LOGGNG 34	SAW + LUM PR 35	FURN + OTH WD 36	PAPER + PULP 37	WOOD CHEM 38	CONST MAT 39	GLASS + PORC 40
34	60	LOGGNG	2.3	230.5	2117.7	94.8	328.1	152.2	19.3	12.0
35	61,62	SAW + LUM PR	24.7	18.7	836.7	439.1	5.4	13.7	89.0	30.2
36	63,64	FURN +OTH WD	4.2	3.7	3.6	44.9	.5	.1	6.0	3.3
37	65	PAPER + PULP	163.4	.3	4.3	12.3	202.5	.3	63.2	7.4
38	66	WOOD CHEM	56.9	.5	4.5	1.8	16.9	26.2	3.4	.3
39	67-73	CONST MAT	4.8	6.0	12.1	3.0	5.0	1.8	1937.4	18.3
40	74	GLASS + PORC	56.1	.7	9.5	87.9	2.3	.5	46.4	37.8
41	75-80	TEXTLS	113.3	8.2	17.0	231.7	34.7	.4	34.9	7.7
42	81	SEWN GOODS	15.6	40.0	16.9	7.2	2.4	.7	43.9	5.8
43	82	OTH LT IND	3.1	9.9	4.3	11.2	2.1	.3	12.9	1.0
44	83	FISH PROD	12.2	.0	.0	.0	.2	1.0	.2	.0
45	84	MEAT PROD	14.3	.0	7.6	9.7	1.5	.2	.2	.0
46	85	DAIRY PROD	16.8	.2	13.3	4.6	7.3	.3	12.9	1.0
47	86	SUGAR	21.9	.0	.0	.0	.0	.4	.0	.0
48	87-89	FLOUR+BREAD	8.6	.0	.0	1.0	.0	.1	.0	.0
49	90-94	OTHER FOODS	82.1	.7	3.5	1.7	2.7	.8	47.1	.8
50	95	IND NEC	21.5	2.4	16.3	24.4	3.2	1.1	111.7	12.5
51	96-100	CONSTRUCTION	.0	.0	.0	.0	.0	.0	.0	.0
52	101,102	AGRICULTURE	34.1	7.8	1.4	.4	1.0	.5	1.2	.2
53	103	FOREST	.0	192.4	.0	.0	.0	.0	.0	.0
54	104-106	TRANS + COM	364.3	1394.6	559.9	152.4	133.0	22.7	3861.4	133.2
55	107-109	TRADE + DIST	316.6	68.7	263.8	157.3	92.8	.8	135.6	71.8
56	110	OTHER BRANCH	7.3	.0	.0	.4	46.1	.0	22.7	2.3
57		TOTAL PURCH	3625.4	2396.5	4360.5	1654.4	1130.9	277.8	8604.9	611.9
58		DEPRECIATION	265.8	419.0	205.8	92.1	120.0	25.1	781.7	55.5
59		WAGES	507.5	1649.3	1129.7	545.5	191.0	37.5	2067.1	328.4
60		TURNOVER TAX	209.0	.0	.0	316.6	16.0	.0	38.5	195.5
61		OTH NET INC	1382.9	481.2	340.0	145.3	195.1	51.7	1479.8	560.7
62		VALUE ADDED	2365.2	2549.5	1675.5	1099.5	522.1	114.3	4367.1	1140.1
63		TOTAL OUTLAY	5990.0	4946.0	6036.0	2753.9	1653.0	392.1	12972.0	1752.0
64		EMPLOYMENT	384.5	1170.7	1003.3	484.6	149.9	29.7	1651.6	284.5
65		CAPITAL	3653.9	2831.1	2638.6	940.7	1621.7	256.1	9894.7	750.2

TABLE A-I. THE RECONSTRUCTED SOVIET 1966 INPUT-OUTPUT TABLE IN PURCHASERS PRICES
(IN MILLIONS OF RUBLES, EMPLOYMENT IN THOUSANDS OF MAN-YEARS)

SEQ NO.	110 ORDER NO.		TEXTLS 41	SEWN GOODS 42	OTH LT IND 43	FISH PROD 44	MEAT PROD 45	DAIRY PROD 46	SUGAR 47	FLOUR+ BREAD 48
1	1-4,6,7	METALLURGY	11.3	.7	17.4	49.7	49.3	37.8	16.8	8.7
2	5	INDMET PROD	10.7	.5	5.9	9.7	1.2	1.2	1.3	2.9
3	8	COAL	25.4	4.5	10.1	10.0	14.2	29.5	35.2	46.1
4	9	OIL EXTRAC	.0	.0	.0	.0	.0	.0	.0	.0
5	10	OIL REF	22.1	2.4	15.6	205.0	8.0	18.2	69.9	12.6
6	11	GAS	14.3	.8	6.8	.5	6.9	4.0	9.5	16.0
7	12,13	PEAT +SHALE	6.5	.5	1.8	1.4	.6	2.1	3.3	2.7
8	14	ELEC POWER	180.9	29.4	39.2	10.3	30.4	36.1	20.2	55.1
9	15	EN+POW M+E	.6	.0	.0	6.6	.1	.2	.1	.1
10	16,17	ELTECH+CABLE	17.6	3.6	4.2	7.9	2.6	2.5	2.7	5.0
11	20-22	METLWK M+E	.3	.1	.4	.0	.0	.0	.0	.0
12	23	TOOLS + DIES	3.0	1.7	2.8	4.7	.9	1.1	.7	1.7
13	24	PRECIS INST	1.2	.1	.4	1.0	.4	.5	.6	.7
14	25-27	MI+MET M+E	.0	.0	.0	.0	.0	.0	.0	.0
15	28,29	PUMPS+CHEM E	.2	.0	1.6	.9	.5	.6	.3	.1
16	30-34,36	SPECL M+E	83.6	6.2	8.7	11.0	2.9	9.2	4.5	10.9
17	35	CONST M+E	.0	.0	.0	.0	.0	.0	.0	.0
18	37,38	TRANSP M+E	.0	.0	.0	1.3	.0	.0	.1	.0
19	39	AUTOS	1.6	1.0	.6	2.6	1.1	4.2	1.4	.5
20	40	AGRIC M+E	.5	.0	.3	.3	.1	.2	2.1	.1
21	41	BEARNG	1.8	.1	.3	.2	.2	.2	.5	.4
22	18,19,42,43	RADIO+OTH MB	1.7	.3	.4	1.9	.8	.9	.9	1.7
23	44	SANIT ENG PR	1.0	.2	.4	.1	.3	.2	.1	.5
24	45	OTHER METWRS	19.4	13.9	31.4	40.9	6.9	9.0	1.9	11.5
25	46	METAL STRUCT	.1	.0	.0	.0	.0	.8	.0	.1
26	47	REPAIR	12.8	4.5	6.2	59.8	5.7	8.2	5.4	10.3
27	48	ABRASV	.8	.1	2.1	.1	.1	.1	.1	.1
28	49	MINERL CHEM	.2	.0	2.0	.0	.1	.0	1.6	.1
29	50	BASIC CHEM	32.9	.2	25.1	5.4	3.3	4.8	3.7	1.5
30	56	PAINT + LAC	5.8	1.3	11.0	4.2	1.5	1.6	1.4	2.3
31	54	SYN RUBBER	.0	.0	111.9	.0	.0	.0	.0	.0
32	57	RUBBER PROD	27.9	11.5	35.2	5.1	1.4	2.7	2.1	3.2
33	51-53,55,58,59	OTHER CHEM	1049.9	9.1	128.1	3.6	4.6	2.0	.7	2.4

TABLE A-I. THE RECONSTRUCTED SOVIET 1966 INPUT-OUTPUT TABLE IN PURCHASERS PRICES
(IN MILLIONS OF RUBLES, EMPLOYMENT IN THOUSANDS OF MAN-YEARS)

SEQ NO.	110 ORDER NO.		TEXTLS 41	SEWN GOODS 42	OTH LT IND 43	FISH PROD 44	MEAT PROD 45	DAIRY PROD 46	SUGAR 47	FLOUR+ BREAD 48
34	60	LOGGNG	4.9	1.2	35.3	2.8	3.7	5.2	1.1	2.6
35	61,62	SAW + LUM PR	17.7	2.9	18.7	148.6	24.8	22.4	2.8	73.1
36	63,64	FURN +OTH WD	11.5	2.9	3.4	3.1	2.8	1.4	.2	3.3
37	65	PAPER + PULP	27.8	5.8	26.9	9.7	9.4	17.5	5.1	43.5
38	66	WOOD CHEM	3.5	.0	9.5	.3	.3	.2	.1	1.2
39	67-73	CONST MAT	7.5	1.4	3.4	3.5	3.4	3.5	22.9	4.4
40	74	GLASS + PORC	5.4	.4	2.4	4.7	1.2	11.4	.3	.8
41	75-80	TEXTLS	16863.4	6802.8	678.9	152.0	7.5	6.9	12.4	16.1
42	81	SEWN GOODS	18.5	12.3	8.7	29.9	7.9	6.4	4.8	28.2
43	82	OTH LT IND	19.4	214.2	2340.4	11.2	2.1	1.9	1.3	3.6
44	83	FISH PROD	1.3	.0	7.6	1959.0	1.3	.1	.0	7.8
45	84	MEAT PROD	1.7	.0	620.3	1.1	3656.8	2.0	.7	26.1
46	85	DAIRY PROD	5.4	.1	8.8	.3	5.7	686.1	.2	217.5
47	86	SUGAR	.0	.0	1.5	5.4	2.4	158.5	934.1	1033.1
48	87-89	FLOUR+BREAD	2.2	.0	.2	2.5	18.5	14.9	.0	4626.1
49	90-94	OTHER FOODS	35.4	.7	16.2	110.6	26.3	20.6	1.4	705.7
50	95	IND NEC	147.0	7.6	39.6	.6	7.7	35.0	36.0	63.3
51	96-100	CONSTRUCTION	.0	.0	.0	.0	.0	.0	.0	.0
52	101,102	AGRICULTURE	4965.3	.3	475.9	6.5	12430.5	6093.6	2413.4	6211.6
53	103	FOREST	.0	.0	.0	.0	.0	.0	.0	.0
54	104-106	TRANS + COM	268.2	95.2	69.9	152.4	106.1	118.9	183.3	235.1
55	107-109	TRADE + DIST	858.1	501.2	320.1	275.9	1055.7	824.5	559.0	1394.4
56	110	OTHER BRANCH	.6	.3	24.5	.5	11.2	.0	.0	1.3
57		TOTAL PURCH	24798.9	7742.0	5182.1	3324.8	17529.4	8208.9	4366.2	14896.1
58		DEPRECIATION	274.2	94.9	71.3	273.4	72.5	114.7	130.1	137.6
59		WAGES	1804.3	1390.8	672.8	620.8	338.8	303.5	150.7	794.8
60		TURNOVER TAX	8065.0	.0	2804.3	432.9	.0	.0	3850.2	4455.0
61		OTH NET INC	2693.6	1512.3	6.5	322.1	-3380.7	371.9	-634.2	-915.5
62		VALUE ADDED	12837.1	2998.0	3554.9	1649.2	-2969.4	790.1	3496.8	4471.9
63		TOTAL OUTLAY	37636.0	10740.0	8737.0	4974.0	14560.0	8999.0	7863.0	19368.0
64		EMPLOYMENT	1794.3	1523.0	658.8	285.5	326.1	308.7	154.9	808.7
65		CAPITAL	4153.9	1416.1	1033.6	3255.2	1317.4	1366.0	1646.5	2074.7

TABLE A-I. THE RECONSTRUCTED SOVIET 1966 INPUT-OUTPUT TABLE IN PURCHASERS PRICES
(IN MILLIONS OF RUBLES, EMPLOYMENT IN THOUSANDS OF MAN-YEARS)

SEQ NO.	110 ORDER NO.		OTHER FOODS 49	IND NEC 50	CONSTR UCTION 51	AGRICU LTURE 52	FOREST 53	TRANS + COM 54	TRADE + DIST 55	OTHER BRANCH 56
1	1-4,6,7	METALLURGY	55.0	287.0	1869.8	29.7	.4	61.7	10.5	.4
2	5	INDMET PROD	5.2	21.9	169.3	20.5	.3	41.0	11.7	1.3
3	8	COAL	41.9	51.8	71.3	128.7	.1	247.0	60.5	1.3
4	9	OIL EXTRAC	.0	.9	.9	.0	.0	.0	.0	.0
5	10	OIL REF	64.9	86.4	585.5	1286.7	10.2	1516.1	98.2	4.7
6	11	GAS	14.9	38.4	8.3	.0	.0	2.1	50.7	.0
7	12,13	PEAT +SHALE	4.8	5.5	12.7	84.3	.0	.8	5.4	.0
8	14	ELEC POWER	72.5	177.6	297.6	185.9	.9	457.7	154.0	9.2
9	15	EN+POW M+E	.5	70.2	20.5	.0	.0	2.1	.0	.0
10	16,17	ELTECH+CABLE	6.6	348.9	1005.0	39.4	.0	32.3	45.8	1.8
11	20-22	METLWK M+E	.2	14.1	5.0	.0	.0	1.1	.0	1.1
12	23	TOOLS + DIES	1.5	28.1	51.1	28.0	.4	20.6	7.0	.6
13	24	PRECIS INST	.7	56.2	51.0	5.3	.0	7.3	8.0	.2
14	25-27	MI+MET M+E	.0	14.1	111.7	.0	.0	.0	.0	.0
15	28,29	PUMPS+CHEM E	.6	39.8	11.1	.0	.0	.6	13.4	.0
16	30-34,36	SPECL M+E	7.5	47.1	38.0	.0	.0	21.1	16.0	.2
17	35	CONST M+E	.0	18.7	99.7	.0	.0	1.1	.1	.0
18	37,38	TRANSP M+E	.1	35.1	8.5	.0	.0	128.5	.0	.0
19	39	AUTOS	2.4	266.9	118.9	204.5	7.5	276.8	20.8	2.9
20	40	AGRIC M+E	.5	299.7	62.8	712.4	4.6	10.6	1.9	.0
21	41	BEARNG	.5	51.5	6.5	15.5	.0	12.0	3.9	.0
22	18,19,42,43	RADIO+OTH MB	2.1	857.0	165.4	12.6	.0	56.2	14.9	.0
23	44	SANIT ENG PR	.4	23.4	713.8	.0	.0	.0	2.9	.1
24	45	OTHER METWRS	64.1	89.0	374.0	209.1	1.2	22.1	76.0	1.1
25	46	METAL STRUCT	.1	9.4	590.1	.0	.0	.0	.0	.0
26	47	REPAIR	17.2	37.5	199.8	511.5	.0	125.8	.0	.0
27	48	ABRASV	.2	44.5	10.0	5.9	.0	1.2	.2	.0
28	49	MINERL CHEM	.4	8.1	.0	67.5	.0	.0	.0	.0
29	50	BASIC CHEM	46.9	31.6	44.3	839.6	1.2	17.6	3.4	8.1
30	56	PAINT + LAC	5.9	19.2	419.0	13.1	.0	38.4	39.8	1.2
31	54	SYN RUBBER	.1	.0	.0	.0	.0	.0	.0	.0
32	57	RUBBER PROD	5.4	27.2	138.5	208.6	.0	457.9	52.1	2.2
33	51-53,55,58,59	OTHER CHEM	62.7	307.3	67.8	135.3	.0	8.6	4.5	15.6

TABLE A-I. THE RECONSTRUCTED SOVIET 1966 INPUT-OUTPUT TABLE IN PURCHASERS PRICES
(IN MILLIONS OF RUBLES, EMPLOYMENT IN THOUSANDS OF MAN-YEARS)

SEQ NO.	110 ORDER NO.		OTHER FOODS 49	IND NEC 50	CONSTR UCTION 51	AGRICU LTURE 52	FOREST 53	TRANS + COM 54	TRADE + DIST 55	OTHER BRANCH 56
34	60	LOGGNG	3.3	.5	646.1	82.8	3.6	83.6	35.4	.4
35	61,62	SAW + LUM PR	116.9	89.7	2312.7	138.5	1.4	68.4	137.5	1.4
36	63,64	FURN +OTH WD	13.2	173.0	12.0	18.6	.0	6.4	30.7	3.3
37	65	PAPER + PULP	96.4	268.1	23.1	4.9	.0	6.9	177.1	167.1
38	66	WOOD CHEM	12.7	2.7	3.7	9.6	.0	2.0	.1	.0
39	67-73	CONST MAT	8.3	62.6	9656.1	183.2	1.2	35.0	60.0	1.0
40	74	GLASS + PORC	97.1	11.0	501.1	22.8	.0	7.5	66.1	.3
41	75-80	TEXTLS	218.7	349.7	188.7	128.5	.0	50.9	94.2	21.6
42	81	SEWN GOODS	14.7	58.6	347.0	100.2	3.0	77.2	124.1	2.7
43	82	OTH LT IND	3.1	72.1	39.7	64.0	.0	24.5	9.5	25.6
44	83	FISH PROD	43.6	.9	.0	88.7	.0	.0	21.0	.0
45	84	MEAT PROD	213.0	2.8	.0	69.9	.0	.0	156.1	.0
46	85	DAIRY PROD	53.9	9.8	.0	162.6	.0	.0	29.0	.0
47	86	SUGAR	848.1	1.4	.0	116.1	.0	.0	13.7	.0
48	87-89	FLOUR+BREAD	81.4	285.8	1.3	322.9	.0	.1	40.2	.0
49	90-94	OTHER FOODS	6608.6	35.5	146.8	138.5	.0	14.0	81.3	.2
50	95	IND NEC	178.5	154.5	608.2	655.0	1.3	29.8	217.8	286.5
51	96-100	CONSTRUCTION	.0	.0	.0	.0	.0	.0	.0	.0
52	101,102	AGRICULTURE	4033.0	615.5	30.5	17581.0	1.5	6.2	81.4	.0
53	103	FOREST	.0	.0	.0	.0	12.9	.0	.0	15.9
54	104-106	TRANS + COM	659.0	260.1	47.7	915.7	9.1	53.6	144.1	47.1
55	107-109	TRADE + DIST	2877.2	357.9	.0	2816.9	.0	.0	.0	264.7
56	110	OTHER BRANCH	23.2	59.0	529.5	58.2	.0	.0	93.0	12.6
57		TOTAL PURCH	16689.7	6285.3	22422.1	28422.7	60.8	4034.4	2314.0	902.4
58		DEPRECIATION	230.3	1163.8	1837.9	4627.7	1.8	2846.3	1186.0	35.0
59		WAGES	883.8	4263.2	15800.0	31957.5	409.4	6039.0	6549.6	1163.6
60		TURNOVER TAX	11681.9	382.3	.0	.0	.0	.0	.0	.0
61		OTH NET INC	4573.3	650.0	3300.0	18342.1	-32.0	6160.3	5650.4	1679.0
62		VALUE ADDED	17369.3	6459.3	20937.9	54927.3	379.2	15045.6	13386.0	2877.6
63		TOTAL OUTLAY	34059.0	12744.6	43360.0	83350.0	440.0	19080.0	15700.0	3780.0
64		EMPLOYMENT	899.1	3326.5	9470.0	33372.5	427.5	4583.9	6882.7	977.5
65		CAPITAL	3472.7	14439.4	11838.0	67110.0	21.5	41444.0	19382.0	537.5

TABLE A-I. THE RECONSTRUCTED SOVIET 1966 INPUT-OUTPUT TABLE IN PURCHASERS PRICES
(IN MILLIONS OF RUBLES, EMPLOYMENT IN THOUSANDS OF MAN-YEARS)

SEQ NO.	110 ORDER NO.		INTIND USE 57	PRIVAT CONSUM 58	PUBLIC CONSUM 59	EXPORT 60	IMPORT 61	GROSS INV 62	TOTAL FD 63	GVO 64
1	1-4,6,7	METALLURGY	18803.6	4.6	577.0	2191.2	-728.4	1083.0	3127.4	21931.0
2	5	INDMET PROD	1027.4	14.4	81.0	26.6	-10.0	62.6	174.6	1202.0
3	8	COAL	5608.2	166.0	681.0	222.9	-168.5	219.4	1120.8	6729.0
4	9	OIL EXTRAC	1263.9	.0	.0	585.7	.0	45.6	631.3	1895.2
5	10	OIL REF	6320.6	180.0	770.0	362.5	-60.0	688.9	1941.4	8262.0
6	11	GAS	1355.4	139.0	72.0	6.6	.0	81.0	298.6	1654.0
7	12,13	PEAT +SHALE	486.4	.0	92.0	.0	.0	-14.5	77.5	563.9
8	14	ELEC POWER	5361.7	1161.0	963.0	16.5	.0	25.1	2165.6	7527.3
9	15	EN+POW M+E	586.1	.0	.0	78.6	-41.6	862.9	899.9	1486.0
10	16,17	ELTECH+CABLE	4385.1	1017.0	381.0	59.2	-121.0	1086.7	2422.9	6808.0
11	20-22	METLWK M+E	122.3	.0	.0	66.4	-77.7	1116.1	1104.8	1227.1
12	23	TOOLS + DIES	409.1	.0	25.0	4.4	-1.3	128.8	156.9	566.0
13	24	PRECIS INST	1437.7	651.0	41.0	53.7	-68.6	665.2	1342.3	2780.0
14	25-27	MI+MET M+E	510.1	.0	.0	148.9	-94.5	2135.5	2189.9	2700.0
15	28,29	PUMPS+CHEM E	360.8	287.0	88.0	34.9	-186.0	1215.3	1439.2	1800.0
16	30-34,36	SPECL M+E	515.4	113.0	.0	89.6	-279.0	1831.4	1755.0	2270.4
17	35	CONST M+E	245.5	.0	.0	61.3	-14.2	705.6	752.7	998.2
18	37,38	TRANSP M+E	404.7	.0	41.0	47.1	-509.5	3816.7	3395.3	3800.0
19	39	AUTOS	2776.5	1154.0	248.0	218.2	-91.9	1060.2	2588.5	5365.0
20	40	AGRIC M+E	3125.1	.0	.0	143.3	-50.1	1541.7	1634.9	4760.0
21	41	BEARNG	478.5	.0	9.0	21.2	-3.8	43.1	69.5	548.0
22	18,19,42,43	RADIO+OTH MB	5684.9	1682.0	530.0	47.6	-171.3	2830.3	4918.6	10603.5
23	44	SANIT ENG PR	915.8	.0	55.0	.1	-3.4	33.5	85.2	1001.0
24	45	OTHER METWRS	1846.7	865.0	305.0	5.1	-13.2	291.4	1453.3	3300.0
25	46	METAL STRUCT	670.3	.0	.0	.0	.0	15.6	15.6	685.9
26	47	REPAIR	1522.2	.0	28.0	.0	.0	6675.8	6703.8	8226.0
27	48	ABRASV	402.2	.0	.0	1.8	-3.5	-25.6	-27.3	374.9
28	49	MINERL CHEM	343.8	.0	.0	99.0	-6.4	-13.4	79.2	423.0
29	50	BASIC CHEM	2623.7	97.0	92.0	129.0	-122.2	603.5	799.3	3423.0
30	56	PAINT + LAC	1286.5	21.0	201.0	11.1	-67.8	-15.8	149.5	1436.0
31	54	SYN RUBBER	1186.2	.0	.0	42.2	-202.2	-113.4	-273.2	913.0
32	57	RUBBER PROD	2594.2	163.0	477.0	36.6	-39.4	383.6	1020.8	3615.0
33	51-53,55,58,59	OTHER CHEM	4755.6	676.0	630.0	76.6	-332.8	184.8	1234.4	5990.0

TABLE A-I. THE RECONSTRUCTED SOVIET 1966 INPUT-OUTPUT TABLE IN PURCHASERS PRICES
(IN MILLIONS OF RUBLES, EMPLOYMENT IN THOUSANDS OF MAN-YEARS)

SEQ NO.	110 ORDER NO.		INTIND USE 57	PRIVAT CONSUM 58	PUBLIC CONSUM 59	EXPORT 60	IMPORT 61	GROSS INV 62	TOTAL FD 63	GVO 64
34	60	LOGGNG	4263.7	137.0	333.0	227.0	-1.3	-13.4	682.3	4946.0
35	61,62	SAW + LUM PR	5255.9	59.0	122.0	400.4	-56.7	255.4	780.1	6036.0
36	63,64	FURN +OTH WD	439.9	2255.0	51.0	2.7	-174.6	179.9	2314.0	2753.9
37	65	PAPER + PULP	1568.3	.0	97.0	103.9	-103.5	-12.7	84.7	1653.0
38	66	WOOD CHEM	354.4	.0	.0	11.0	-15.8	42.5	37.7	392.1
39	67-73	CONST MAT	12272.1	153.0	288.0	29.7	-21.4	250.6	699.9	12972.0
40	74	GLASS + PORC	1197.6	425.0	44.0	5.3	-8.5	88.6	554.4	1752.0
41	75-80	TEXTLS	26948.7	11541.0	498.0	641.0	-2718.4	725.7	10687.3	37636.0
42	81	SEWN GOODS	1333.3	9726.0	372.0	6.2	-1178.5	481.0	9406.7	10740.0
43	82	OTH LT IND	3015.2	6482.0	87.0	83.2	-985.7	55.3	5721.8	8737.0
44	83	FISH PROD	2146.0	2397.0	266.0	61.8	-36.7	139.9	2828.0	4974.0
45	84	MEAT PROD	4796.3	8973.0	531.0	23.4	-54.5	290.8	9763.7	14560.0
46	85	DAIRY PROD	1388.3	5900.0	891.0	48.4	-19.2	790.5	7610.7	8999.0
47	86	SUGAR	3137.0	4671.0	244.0	50.9	-377.3	137.4	4726.0	7863.0
48	87-89	FLOUR+BREAD	5406.5	13644.0	528.0	33.0	-129.9	-113.6	13961.5	19368.0
49	90-94	OTHER FOODS	8635.0	25874.0	304.0	162.2	-730.0	-186.2	25424.0	34059.0
50	95	IND NEC	4036.2	3463.0	609.0	57.5	-140.1	4719.0	8708.4	12744.6
51	96-100	CONSTRUCTION	.0	.0	.0	.0	.0	43360.0	43360.0	43360.0
52	101,102	AGRICULTURE	54999.0	21341.0	494.0	340.0	-1213.4	7389.4	28351.0	83350.0
53	103	FOREST	221.2	.0	.0	.0	.0	218.8	218.8	440.0
54	104-106	TRANS + COM	19080.0	.0	.0	.0	.0	.0	.0	19080.0
55	107-109	TRADE + DIST	15700.0	.0	.0	.0	.0	.0	.0	15700.0
56	110	OTHER BRANCH	1292.0	2208.0	214.0	38.2	-16.6	44.4	2488.0	3780.0
57		TOTAL PURCH	256902.8	127640.0	12360.0	7213.6	-11454.9	88098.5	223857.2	480760.0
58		DEPRECIATION	22234.5	5560.0	4440.0				10000.0	32234.5
59		WAGES	99023.9							
60		TURNOVER TAX	39585.8							
61		OTH NET INC	63013.0							
62		VALUE ADDED	223857.2							
63		TOTAL OUTLAY	480760.0							
64		EMPLOYMENT	84496.4							
65		CAPITAL	298080.0							

TABLE A-II. THE RECONSTRUCTED SOVIET 1972 INPUT-OUTPUT TABLE IN PURCHASERS PRICES
(IN MILLIONS OF RUBLES)

SEQ NO.	110 ORDER NO.		METALL URGY 1	INDMET PROD 2	COAL 3	OIL EXTRAC 4	OIL REF 5	GAS 6	PEAT + SHALE 7	ELEC POWER 8
1	1-4,6,7	METALLURGY	16226.3	986.3	69.1	6.0	28.9	2.0	5.2	26.0
2	5	INDMET PROD	92.0	30.5	31.1	1.6	1.6	.3	1.8	9.2
3	8	COAL	3209.1	6.6	3417.9	.0	.0	.0	.3	2378.3
4	9	OIL EXTRAC	2.7	.1	.5	104.4	4749.3	107.3	.0	38.0
5	10	OIL REF	451.4	20.4	39.1	12.8	394.7	11.5	20.4	1581.6
6	11	GAS	560.9	12.6	.8	21.7	81.3	101.5	.2	1082.2
7	12,13	PEAT +SHALE	.9	.0	5.3	.0	.0	5.3	91.2	253.7
8	14	ELEC POWER	1577.4	46.2	362.7	159.1	429.6	45.5	17.5	166.3
9	15	EN+POW M+E	7.8	.2	.8	.3	.3	.0	.4	36.2
10	16,17	ELTECH+CARLE	99.2	4.0	58.8	6.3	4.7	1.1	3.8	39.3
11	20-22	METLWK M+E	12.3	.3	.2	.2	.2	.0	.1	.2
12	23	TOOLS + DIES	35.4	4.5	10.1	3.0	1.6	.6	.9	6.9
13	24	PRECIS INST	11.4	.3	2.8	.9	3.0	.3	.2	8.5
14	25-27	MI+MET M+E	341.1	3.3	157.3	13.3	12.3	1.7	9.2	.0
15	28,29	PUMPS+CHEM E	11.8	.1	1.9	1.0	4.7	1.3	.2	2.1
16	30-34,36	SPECL M+E	11.7	.3	1.7	.1	.1	.0	.2	.7
17	35	CONST M+E	20.8	.0	1.8	.0	.0	.0	.2	.4
18	37,38	TRANSP M+E	16.3	.1	1.5	.0	.0	.0	.9	.3
19	39	AUTOS	37.5	1.0	2.5	1.0	2.3	.4	.9	7.1
20	40	AGRIC M+E	11.7	.0	2.2	.5	.2	.0	5.0	1.5
21	41	BEARNG	17.0	.9	2.1	.3	.5	.0	.7	1.4
22	18,19,42,43	RADIO+OTH MB	169.0	6.8	40.7	9.7	12.9	2.1	5.3	76.7
23	44	SANIT ENG PR	4.2	.3	1.2	.1	.3	.0	.1	1.1
24	45	OTHER METWRS	37.9	2.0	10.8	.9	2.0	.5	.4	4.5
25	46	METAL STRUCT	6.8	.8	3.7	.0	.1	.0	.0	.2
26	47	REPAIR	457.4	10.4	48.5	19.6	38.4	3.1	1.4	152.2
27	48	ABRASV	33.7	1.6	.6	.1	.2	.1	.1	.7
28	49	MINERL CHEM	17.8	.1	1.3	.1	1.5	.0	.5	.4
29	50	BASIC CHEM	344.0	14.5	83.0	10.2	112.8	3.0	13.7	44.6
30	56	PAINT + LAC	22.1	1.3	4.6	1.6	2.2	.3	.4	5.1
31	54	SYN RUBBER	.0	.0	.0	.0	.0	.0	.0	.0
32	57	RUBBER PROD	129.6	1.5	45.2	2.6	3.3	.6	2.3	9.7
33	51-53,55,58,59	OTHER CHEM	47.3	3.0	7.1	10.2	86.3	13.0	2.3	13.2

TABLE A-II. THE RECONSTRUCTED SOVIET 1972 INPUT-OUTPUT TABLE IN PURCHASERS PRICES
(IN MILLIONS OF RUBLES)

SEQ NO.	110 ORDER NO.		METALL URGY 1	INDMET PROD 2	COAL 3	OIL EXTRAC 4	OIL REF 5	GAS 6	PEAT + SHALE 7	ELEC POWER 8
34	60	LOGGNG	54.7	1.6	273.7	.7	.6	.1	2.0	4.2
35	61,62	SAW + LUM PR	90.7	22.1	90.0	1.0	5.0	.3	2.0	6.2
36	63,64	FURN +OTH WD	11.4	3.5	4.8	.8	1.0	.1	1.6	8.6
37	65	PAPER + PULP	27.7	3.6	2.2	8.9	3.9	1.6	.1	2.0
38	66	WOOD CHEM	17.5	.2	.0	.0	3.0	.3	.1	.2
39	67-73	CONST MAT	57.2	3.3	56.2	1.7	3.7	.4	.9	12.6
40	74	GLASS + PORC	11.5	1.4	1.0	.5	1.8	.1	.1	1.8
41	75-80	TEXTLS	40.9	87.5	5.9	2.9	4.2	.4	1.0	6.3
42	81	SEWN GOODS	59.8	3.4	38.9	4.3	3.7	.7	2.4	12.1
43	82	OTH LT IND	12.5	.8	8.3	1.2	1.0	.3	.6	3.6
44	83	FISH PROD	.5	.0	.0	.0	.1	.0	.0	.0
45	84	MEAT PROD	2.1	.0	.0	.0	.1	.0	.0	.0
46	85	DAIRY PROD	19.5	.9	2.0	.8	18.0	6.6	.1	3.5
47	86	SUGAR	.1	.0	.3	.0	.0	.0	.0	.0
48	87-89	FLOUR+BREAD	1.0	.0	.0	.0	.0	.0	.0	.0
49	90-94	OTHER FOODS	23.5	3.1	4.3	.6	11.2	.2	.2	4.2
50	95	IND NEC	404.1	34.0	174.9	17.9	62.4	7.0	10.3	74.9
51	96-100	CONSTRUCTION	.0	.0	.0	.0	.0	.0	.0	.0
52	101,102	AGRICULTURE	2.7	.1	.9	.1	.0	.0	.1	.1
53	103	FOREST	.0	.0	.0	.0	.0	.0	.0	.0
54	104-106	TRANS + COM	2852.9	138.4	1843.9	1608.3	2021.9	1452.3	50.5	26.6
55	107-109	TRADE + DIST	684.6	37.5	335.1	.0	874.5	77.0	.0	.0
56	110	OTHER BRANCH	776.1	10.2	2.4	.3	.1	.2	.1	9.3
57		TOTAL PURCH	29175.5	1511.6	7261.7	2037.6	8991.5	1849.1	257.9	6124.5
58		DEPRECIATION	2476.6	82.3	1316.9	780.3	425.0	132.3	83.9	2141.0
59		VALUE ADDED	10468.1	473.2	3910.3	3254.4	6675.2	2042.8	265.8	5764.9
60		TOTAL OUTLAY	42120.2	2067.1	12488.9	6072.3	16091.7	4024.2	607.6	14030.4
61		CAPITAL	32863.3	989.5	12740.7	10056.7	4830.3	1901.3	923.3	40552.1

TABLE A-II. THE RECONSTRUCTED SOVIET 1972 INPUT-OUTPUT TABLE IN PURCHASERS PRICES
(IN MILLIONS OF RUBLES)

SEQ NO.	110 ORDER NO.		EN+POW M+E 9	ELTECH +CABLE 10	METLWK M+E 11	TOOLS + DIES 12	PRECIS INST 13	MI+MET M+E 14	PUMPS+ CHEM E 15	SPECL M+E 16
1	1-4,6,7	METALLURGY	341.3	1986.1	184.3	250.2	244.6	598.0	384.1	511.0
2	5	INDMET PROD	7.7	88.4	10.8	3.9	17.6	21.3	14.2	37.0
3	8	COAL	1.3	11.7	1.8	1.2.	3.9	8.0	3.3	5.8
4	9	OIL EXTRAC	.0	.1	.1	.0	.1	.2	.0	.0
5	10	OIL REF	12.1	55.0	9.0	5.3	14.5	21.3	11.9	21.6
6	11	GAS	8.3	23.6	6.1	1.5	8.5	17.5	9.6	12.7
7	12,13	PEAT +SHALE	.1	.9	.3	.1	.2	.2	.2	.1
8	14	ELEC POWER	35.8	142.0	43.3	25.0	62.0	64.7	44.8	62.9
9	15	EN+POW M+E	51.5	40.9	.3	.0	1.1	10.1	8.3	16.8
10	16,17	ELTECH+CABLE	73.4	1280.3	151.8	14.5	182.0	110.5	245.1	242.7
11	20-22	METLWK M+E	3.6	7.0	43.6	2.0	3.3	2.4	1.8	3.4
12	23	TOOLS + DIES	6.0	23.5	32.9	16.3	32.3	19.9	20.1	22.6
13	24	PRECIS INST	19.1	41.9	20.8	2.6	645.4	4.3	34.0	16.3
14	25-27	MI+MET M+E	.2	.5	.0	.0	.4	79.5	.0	.1
15	28,29	PUMPS+CHEM E	6.7	3.8	8.7	.2	2.7	18.7	154.2	7.7
16	30-34,36	SPECL M+E	.8	2.4	1.6	.1	.5	1.6	.5	138.2
17	35	CONST M+E	.1	.1	.1	.0	1.0	.4	.0	1.3
18	37,38	TRANSP M+E	.3	.4	.0	.0	.4	2.6	.7	2.4
19	39	AUTOS	12.5	45.5	1.0	.4	21.7	44.7	15.8	167.8
20	40	AGRIC M+E	.9	18.3	.1	.1	.3	25.3	11.4	45.7
21	41	BEARNG	5.7	31.1	22.0	3.3	21.6	31.0	6.7	40.7
22	18,19,42,43	RADIO+OTH MB	62.1	493.0	95.4	17.7	302.4	119.0	164.3	235.0
23	44	SANIT ENG PR	1.1	1.8	.6	.1	1.2	.9	.6	1.5
24	45	OTHER METWRS	1.2	24.7	5.5	3.8	17.5	8.8	10.7	17.4
25	46	METAL STRUCT	.2	.6	1.8	.4	1.2	.7	.9	1.4
26	47	REPAIR	8.9	17.9	3.4	1.7	9.7	8.6	3.3	7.6
27	48	ABRASV	2.9	8.0	5.5	10.3	7.4	3.7	2.2	4.3
28	49	MINERL CHEM	.6	1.8	.0	.0	.8	.2	.0	.1
29	50	BASIC CHEM	2.7	56.2	2.4	2.7	20.8	6.3	12.8	5.8
30	56	PAINT + LAC	3.8	84.1	9.8	1.1	16.6	7.3	13.6	21.2
31	54	SYN RUBBER	.0	44.7	.0	.0	.0	.0	.0	.0
32	57	RUBBER PROD	4.9	70.0	6.3	1.0	8.6	21.4	18.6	66.5
33	51-53,55,58,59	OTHER CHEM	4.0	466.8	6.3	4.3	67.4	6.3	59.2	19.3

TABLE A-II. THE RECONSTRUCTED SOVIET 1972 INPUT-OUTPUT TABLE IN PURCHASERS PRICES
(IN MILLIONS OF RUBLES)

SEQ NO.	110 ORDER NO.		EN+POW M+E 9	ELTECH +CABLE 10	METLWK M+E 11	TOOLS + DIES 12	PRECIS INST 13	MI+MET M+E 14	PUMPS+ CHEM E 15	SPECL M+E 16
34	60	LOGGNG	1.6	4.8	11.5	.9	1.2	3.6	2.3	3.5
35	61,62	SAW + LUM PR	11.3	77.2	28.6	10.3	48.0	15.6	26.7	40.2
36	63,64	FURN +OTH WD	1.8	9.6	2.2	1.3	11.2	1.6	5.5	35.3
37	65	PAPER + PULP	3.1	93.8	2.6	4.6	32.5	4.8	6.8	4.6
38	66	WOOD CHEM	.1	5.6	.2	.0	.9	.1	.1	.3
39	67-73	CONST MAT	2.3	110.3	4.4	1.0	9.0	4.7	4.4	6.3
40	74	GLASS + PORC	.7	53.2	.6	.2	23.3	2.1	8.6	2.4
41	75-80	TEXTLS	4.1	108.3	4.2	5.3	21.1	3.9	8.6	17.4
42	81	SEWN GOODS	3.0	16.1	4.8	2.3	9.7	6.6	6.0	9.4
43	82	OTH LT IND	.9	5.5	1.5	.7	8.9	1.5	1.4	12.9
44	83	FISH PROD	.0	.0	.0	.0	.0	.0	.0	.0
45	84	MEAT PROD	.0	.2	.0	.0	.4	.1	.0	.1
46	85	DAIRY PROD	.8	17.7	3.4	.6	6.3	4.8	3.3	3.8
47	86	SUGAR	.0	.0	.0	.0	.0	.0	.0	.0
48	87-89	FLOUR+BREAD	.0	.1	.0	.0	.0	.0	.0	.0
49	90-94	OTHER FOODS	.6	10.0	.8	.4	6.3	.8	1.1	1.3
50	95	IND NEC	2.5	28.0	4.0	.9	12.7	4.8	7.1	10.1
51	96-100	CONSTRUCTION	.0	.0	.0	.0	.0	.0	.0	.0
52	101,102	AGRICULTURE	.1	.3	.0	.0	.2	.2	.2	.1
53	103	FOREST	.0	.0	.0	.0	.0	.0	.0	.0
54	104-106	TRANS + COM	83.3	532.3	145.5	72.7	279.9	171.8	112.0	139.6
55	107-109	TRADE + DIST	9.0	169.6	43.3	39.7	157.0	27.5	87.9	52.9
56	110	OTHER BRANCH	4.5	5.6	5.3	.3	6.9	8.9	2.8	4.5
57		TOTAL PURCH	809.5	6321.3	938.5	511.0	2353.2	1528.8	1537.7	2081.6
58		DEPRECIATION	84.7	243.8	129.4	50.0	196.6	133.4	103.3	142.5
59		VALUE ADDED	690.5	3341.1	1023.5	550.8	3774.2	1437.8	1283.0	1492.4
60		TOTAL OUTLAY	1584.7	9906.2	2091.4	1111.8	6324.0	3100.0	2924.0	3716.5
61		CAPITAL	1062.7	3256.7	1509.5	559.2	2403.8	1679.3	1338.2	1820.3

TABLE A-II. THE RECONSTRUCTED SOVIET 1972 INPUT-OUTPUT TABLE IN PURCHASERS PRICES
(IN MILLIONS OF RUBLES)

SEQ NO.	110 ORDER NO.		CONST M+E 17	TRANSP M+E 18	AUTOS 19	AGRIC M+E 20	BEARNG 21	RADIO+ OTH MB 22	SANIT ENG PR 23	OTHER MFTWRS 24
1	1-4,6,7	METALLURGY	140.1	647.7	1135.5	1364.6	168.9	1880.5	418.2	1168.8
2	5	INDMET PROD	10.1	46.9	106.6	62.9	17.5	88.0	10.4	96.6
3	8	COAL	1.4	7.0	5.5	10.0	.3	28.2	3.7	16.0
4	9	OIL EXTRAC	.0	.3	.2	.2	.0	.5	.0	.0
5	10	OIL REF	9.1	35.7	73.9	58.3	11.1	113.5	6.9	19.9
6	11	GAS	5.1	18.2	48.1	30.1	2.9	63.3	7.4	6.9
7	12,13	PEAT +SHALE	.0	.1	.3	1.0	.0	1.2	.6	.5
8	14	ELEC POWER	24.7	96.7	165.6	182.8	28.5	253.7	25.9	62.4
9	15	EN+POW M+E	10.4	386.6	7.9	6.8	.0	187.9	1.4	.5
10	16,17	ELTECH+CABLE	38.6	313.1	121.9	160.6	4.3	1048.3	37.8	90.8
11	20-22	METLWK M+E	2.7	4.1	12.6	13.4	3.0	36.2	2.3	4.7
12	23	TOOLS + DIES	6.7	19.7	65.0	71.4	6.6	128.2	4.2	29.5
13	24	PRECIS INST	6.2	98.0	13.3	10.0	.6	311.1	7.7	16.0
14	25-27	MI+MET M+E	.1	.1	.3	.2	.0	36.6	.0	.3
15	28,29	PUMPS+CHEM E	9.3	100.1	6.2	22.1	.3	128.1	3.9	2.7
16	30-34,36	SPECL M+E	5.0	46.3	2.4	1.5	.0	68.7	.9	1.5
17	35	CONST M+E	52.4	.6	.2	.0	.0	41.3	.1	.3
18	37,38	TRANSP M+E	.7	364.5	.1	.3	.0	154.1	.0	.1
19	39	AUTOS	98.3	15.1	2472.6	63.0	.3	1137.1	1.4	38.0
20	40	AGRIC M+E	380.9	1.5	41.7	1707.5	.3	1030.7	.1	13.7
21	41	BEARNG	12.7	40.6	99.5	113.6	11.9	169.3	.8	3.2
22	18,19,42,43	RADIO+OTH MB	202.0	458.7	932.0	732.7	16.0	3572.7	50.9	102.2
23	44	SANIT ENG PR	.9	6.4	1.6	1.0	.1	34.2	83.4	4.1
24	45	OTHER METWRS	4.8	21.4	63.3	84.1	6.8	153.3	10.2	97.8
25	46	METAL STRUCT	.2	1.0	.0	6.2	.0	6.4	.2	1.2
26	47	REPAIR	3.3	17.2	9.1	24.6	1.8	58.4	4.5	7.6
27	48	ABRASV	1.2	4.4	9.5	15.0	14.4	60.8	1.0	9.1
28	49	MINERL CHEM	.1	.4	.2	.2	.0	3.6	.2	.4
29	50	BASIC CHEM	2.8	18.6	28.3	12.0	1.7	104.9	9.6	20.4
30	56	PAINT + LAC	5.5	38.8	70.6	60.7	.8	103.7	10.2	23.7
31	54	SYN RUBBER	.0	.0	12.4	.0	.0	.0	.0	.0
32	57	RUBBER PROD	49.9	34.0	756.8	320.8	3.0	91.2	8.0	36.5
33	51-53,55,58,59	OTHER CHEM	3.2	36.4	53.2	18.2	3.0	482.1	10.7	55.7

TABLE A-II. THE RECONSTRUCTED SOVIET 1972 INPUT-OUTPUT TABLE IN PURCHASERS PRICES
(IN MILLIONS OF RUBLES)

SEQ NO.	110 ORDER NO.		CONST M+E 17	TRANSP M+E 18	AUTOS 19	AGRIC M+E 20	BEARNG 21	RADIO+ OTH MB 22	SANIT ENG PR 23	OTHER METWRS 24
34	60	LOGGNG	.8	8.9	8.6	3.6	.3	9.5	1.7	4.5
35	61,62	SAW + LUM PR	7.6	66.6	86.2	71.0	9.5	231.6	40.1	62.2
36	63,64	FURN +OTH WD	1.0	21.2	7.8	8.7	1.6	40.3	1.6	24.1
37	65	PAPER + PULP	1.4	16.1	21.6	15.3	3.0	224.0	2.4	34.7
38	66	WOOD CHEM	.0	.5	.1	.3	.0	4.8	.4	.5
39	67-73	CONST MAT	6.6	21.1	10.1	7.4	1.3	234.3	4.2	7.9
40	74	GLASS + PORC	1.7	6.2	37.7	6.9	.4	155.0	7.0	13.6
41	75-80	TEXTLS	2.9	27.4	38.4	28.6	4.5	144.0	2.8	38.8
42	81	SEWN GOODS	3.3	14.2	25.4	20.6	3.3	47.9	5.5	17.7
43	82	OTH LT IND	2.7	6.2	48.5	7.0	.7	28.6	1.4	30.6
44	83	FISH PROD	.0	.1	.0	.0	.0	.1	.0	.0
45	84	MEAT PROD	.0	.3	.2	.1	.0	1.1	.0	.8
46	85	DAIRY PROD	3.9	4.2	7.1	8.4	3.7	47.5	5.0	4.0
47	86	SUGAR	.0	.0	.0	.1	.0	.0	.0	.0
48	87-89	FLOUR+BREAD	.0	.0	.0	.0	.0	.2	.0	.0
49	90-94	OTHER FOODS	.4	4.0	2.5	8.1	.5	28.0	.9	4.2
50	95	IND NEC	7.4	18.0	42.2	29.6	.9	79.1	2.8	7.2
51	96-100	CONSTRUCTION	.0	.0	.0	.0	.0	.0	.0	.0
52	101,102	AGRICULTURE	.0	.0	.1	.1	.0	.9	.1	.5
53	103	FOREST	.0	.0	.0	.0	.0	.0	.0	.0
54	104-106	TRANS + COM	71.8	151.4	453.8	370.8	77.9	374.2	64.1	127.6
55	107-109	TRADE + DIST	14.9	10.3	284.8	339.4	28.9	779.9	17.8	230.7
56	110	OTHER BRANCH	2.1	17.9	3.8	20.9	.4	24.9	1.7	13.5
57		TOTAL PURCH	1216.9	3274.8	7395.3	6102.7	441.0	14033.7	882.1	2554.2
58		DEPRECIATION	48.2	232.7	423.3	320.8	80.2	939.8	45.6	121.0
59		VALUE ADDED	380.2	1792.5	3654.2	1542.1	373.0	13780.8	529.8	1724.8
60		TOTAL OUTLAY	1645.3	5300.0	11472.8	7965.6	894.2	28754.3	1457.5	4400.0
61		CAPITAL	621.0	3105.3	5130.6	3754.2	841.7	26151.4	631.4	1590.4

TABLE A-II. THE RECONSTRUCTED SOVIET 1972 INPUT-OUTPUT TABLE IN PURCHASERS PRICES
(IN MILLIONS OF RUBLES)

SEQ NO.	110 ORDER NO.		METAL STRUCT 25	REPAIR 26	ABRASV 27	MINERL CHEM 28	BASIC CHEM 29	PAINT + LAC 30	SYN RUBBER 31	RUBBER PROD 32
1	1-4,6,7	METALLURGY	809.6	978.9	40.5	6.5	339.3	213.7	55.4	18.0
2	5	INDMET PROD	25.4	88.0	.6	6.8	12.4	.8	.6	45.8
3	8	COAL	1.6	86.4	2.1	.4	23.9	3.9	.6	2.9
4	9	OIL EXTRAC	.0	.4	.0	.0	.4	.0	.0	.1
5	10	OIL REF	10.8	230.5	4.7	24.3	71.2	15.6	68.0	44.6
6	11	GAS	3.9	30.3	1.4	6.9	168.6	4.6	47.0	8.5
7	12,13	PEAT +SHALE	.0	.3	.0	.0	3.0	.0	.0	1.5
8	14	ELEC POWER	45.4	291.6	21.1	44.9	635.3	13.2	228.2	109.3
9	15	EN+POW M+E	.2	85.7	.0	.5	11.8	.0	.0	.1
10	16,17	ELTECH+CABLE	8.2	429.8	1.4	4.8	45.5	.9	.0	6.3
11	20-22	METLWK M+E	1.0	10.2	.1	.1	1.2	.1	.0	.6
12	23	TOOLS + DIES	2.3	48.7	1.2	.8	5.6	.6	.0	7.6
13	24	PRECIS INST	.5	103.7	.2	.3	14.3	.2	.0	1.0
14	25-27	MI+MET M+E	.1	40.4	.2	6.7	1.2	.1	.0	4.1
15	28,29	PUMPS+CHEM E	.4	80.8	.2	.9	21.4	.6	.2	16.4
16	30-34,36	SPECL M+E	2.0	24.2	.1	.3	1.2	.1	.0	1.0
17	35	CONST M+E	.6	80.8	.0	.6	.3	.0	.0	.0
18	37,38	TRANSP M+E	.5	142.3	.0	.5	.8	.0	.0	.1
19	39	AUTOS	2.9	802.4	.2	2.2	6.0	.6	.0	5.7
20	40	AGRIC M+E	5.3	1194.8	.1	.8	7.0	.0	.0	.2
21	41	BEARNG	.8	121.0	.2	.5	16.1	.1	.0	.8
22	18,19,42,43	RADIO+OTH MB	12.0	1074.1	32.4	33.2	426.5	4.8	1.0	56.2
23	44	SANIT ENG PR	3.4	5.5	.1	.2	1.7	.1	.0	.3
24	45	OTHER METWRS	4.4	130.1	.3	.4	19.1	14.6	.0	18.9
25	46	METAL STRUCT	.9	4.7	.0	.0	.4	.0	.0	.0
26	47	REPAIR	3.3	58.5	4.1	4.2	50.8	6.8	7.8	7.4
27	48	ABRASV	.9	10.1	93.6	.1	1.0	.1	.0	.3
28	49	MINERL CHEM	.0	2.3	.6	7.7	362.2	11.9	44.0	5.3
29	50	BASIC CHEM	7.0	45.8	3.2	28.7	704.4	38.0	93.2	31.7
30	56	PAINT + LAC	12.4	98.0	.6	.7	26.8	367.9	8.6	26.2
31	54	SYN RUBBER	.0	33.0	.0	.0	.0	.0	1.8	1632.9
32	57	RUBBER PROD	2.3	208.1	.6	10.0	34.9	.6	119.9	104.3
33	51-53,55,58,59	OTHER CHEM	1.9	57.2	7.6	18.3	286.0	239.9	239.5	888.0

TABLE A-II. THE RECONSTRUCTED SOVIET 1972 INPUT-OUTPUT TABLE IN PURCHASERS PRICES
(IN MILLIONS OF RUBLES)

SEQ NO.	110 ORDER NO.		METAL STRUCT 25	REPAIR 26	ABRASV 27	MINERL CHEM 28	BASIC CHEM 29	PAINT + LAC 30	SYN RUBBER 31	RUBBER PROD 32
34	60	LOGGNG	.9	18.5	.1	1.1	2.3	.4	2.0	.6
35	61,62	SAW + LUM PR	26.6	75.7	1.0	1.3	57.4	14.4	13.3	14.0
36	63,64	FURN +OTH WD	2.1	24.3	.2	1.3	6.7	1.7	3.5	1.6
37	65	PAPER + PULP	.8	16.5	3.6	1.2	86.2	8.0	70.2	8.6
38	66	WOOD CHEM	.0	.4	.0	.6	38.4	46.9	42.2	12.8
39	67-73	CONST MAT	4.3	59.1	1.4	.8	70.8	3.8	.0	25.3
40	74	GLASS + PORC	.6	12.4	1.8	1.3	7.9	6.4	.0	1.7
41	75-80	TEXTLS	1.4	61.6	31.8	1.4	96.7	1.2	.0	424.6
42	81	SEWN GOODS	6.2	51.7	1.7	1.7	29.7	1.4	1.4	16.4
43	82	OTH LT IND	1.5	29.8	1.4	.5	7.2	.3	.4	11.7
44	83	FISH PROD	.0	.1	.0	.0	9.5	.0	.0	.0
45	84	MEAT PROD	.0	.3	7.3	.0	5.8	.4	.0	.1
46	85	DAIRY PROD	.6	15.1	.4	5.9	20.0	1.3	1.3	8.6
47	86	SUGAR	.0	.0	.0	.0	.7	.0	.0	.0
48	87-89	FLOUR+BREAD	.0	.0	.1	.0	1.4	.1	.0	.1
49	90-94	OTHER FOODS	1.3	6.3	1.5	.7	62.8	547.9	59.9	12.1
50	95	IND NEC	1.1	42.4	1.7	8.4	167.4	103.9	1.8	131.3
51	96-100	CONSTRUCTION	.0	.0	.0	.0	.0	.0	.0	.0
52	101,102	AGRICULTURE	.0	.3	.0	.0	2.7	.2	.0	.1
53	103	FOREST	.0	.0	.0	.0	.0	.0	.0	.0
54	104-106	TRANS + COM	82.6	31.7	14.7	148.5	525.7	134.5	126.0	179.8
55	107-109	TRADE + DIST	2.9	.0	.7	.0	287.4	63.1	19.8	61.4
56	110	OTHER BRANCH	.3	54.3	.1	.2	6.0	2.4	.0	3.7
57		TOTAL PURCH	1103.2	7099.1	286.9	387.2	4793.0	1878.1	1257.6	3960.6
58		DEPRECIATION	63.7	785.6	18.3	95.7	681.7	29.0	95.7	122.8
59		VALUE ADDED	672.6	7148.2	121.6	315.1	1592.5	369.6	446.7	1380.1
60		TOTAL OUTLAY	1839.5	15032.9	426.8	798.0	7067.2	2276.7	1800.0	5463.5
61		CAPITAL	961.4	11247.4	241.4	1352.1	9038.1	407.3	1152.0	1546.2

TABLE A-II. THE RECONSTRUCTED SOVIET 1972 INPUT-OUTPUT TABLE IN PURCHASERS PRICES
(IN MILLIONS OF RUBLES)

SEQ NO.	110 ORDER NO.		OTHER CHEM 33	LOGGNG 34	SAW + LUM PR 35	FURN + OTH WD 36	PAPER + PULP 37	WOOD CHEM 38	CONST MAT 39	GLASS + PORC 40
1	1-4,6,7	METALLURGY	341.6	15.4	64.1	43.0	21.2	.6	1183.2	46.5
2	5	INDMET PROD	4.7	22.3	37.8	58.7	4.2	.1	164.3	3.6
3	8	COAL	14.6	3.5	17.9	18.4	98.4	2.4	378.6	4.8
4	9	OIL EXTRAC	.0	1.9	.0	.0	.0	.0	.7	.0
5	10	OIL REF	260.9	287.7	83.5	28.9	47.8	4.8	633.8	61.1
6	11	GAS	162.2	.0	10.7	10.8	13.2	.5	361.1	51.4
7	12,13	PEAT +SHALE	2.6	.0	17.1	11.3	3.6	.3	17.1	.9
8	14	ELEC POWER	534.2	38.9	174.7	60.8	149.7	2.7	667.3	49.1
9	15	EN+POW M+E	.2	3.0	1.2	.3	.5	.0	3.9	.1
10	16,17	ELTECH+CABLE	18.3	7.9	17.2	8.0	6.4	.2	58.2	5.2
11	20-22	METLWK M+E	2.7	.9	13.1	2.8	.7	.0	3.9	.2
12	23	TOOLS + DIES	6.1	8.5	16.8	7.8	2.2	.1	16.9	2.6
13	24	PRECIS INST	9.5	.5	1.4	.6	1.2	.0	5.5	1.0
14	25-27	MI+MET M+E	.5	.0	.0	.0	.0	.0	15.6	.0
15	28,29	PUMPS+CHEM E	34.9	.6	1.4	.9	1.2	.1	6.4	.2
16	30-34,36	SPECL M+E	17.6	36.8	11.8	1.7	16.8	.0	117.0	2.2
17	35	CONST M+E	.1	1.8	.1	.0	.0	.0	29.9	.1
18	37,38	TRANSP M+E	.1	7.3	.3	.1	.2	.0	2.8	.1
19	39	AUTOS	2.8	69.2	13.6	5.0	1.2	.1	36.4	1.5
20	40	AGRIC M+E	.3	48.6	4.2	1.5	.2	.0	13.0	.3
21	41	BEARNG	1.7	2.6	2.5	.7	1.5	.0	9.5	.5
22	18,19,42,43	RADIO+OTH MB	219.5	9.9	27.2	9.3	12.1	.4	86.5	10.1
23	44	SANIT ENG PR	1.5	.3	2.9	.8	.4	.0	17.0	9.9
24	45	OTHER METWRS	29.6	13.9	60.9	113.3	4.2	.1	49.7	2.9
25	46	METAL STRUCT	.0	.1	2.4	.8	.0	.0	5.9	.0
26	47	REPAIR	79.4	47.6	23.0	6.8	18.1	1.0	161.6	28.2
27	48	ABRASV	1.5	.5	4.5	20.0	.6	.0	5.0	4.6
28	49	MINERL CHEM	65.5	.0	.1	.1	27.4	.0	1.9	14.2
29	50	BASIC CHEM	521.8	1.3	15.5	4.8	78.3	6.3	97.7	96.3
30	56	PAINT + LAC	53.8	2.7	44.5	146.8	3.5	.2	48.9	5.6
31	54	SYN RUBBER	.0	.0	.0	.0	.0	26.8	7.7	.0
32	57	RUBBER PROD	32.5	43.3	14.5	14.3	4.5	.1	101.5	4.3
33	51-53,55,58,59	OTHER CHEM	2550.4	2.5	114.7	113.9	29.1	18.1	129.9	39.2

TABLE A-II. THE RECONSTRUCTED SOVIET 1972 INPUT-OUTPUT TABLE IN PURCHASERS PRICES
(IN MILLIONS OF RUBLES)

SEQ NO.	110 ORDER NO.		OTHER CHEM 33	LOGGNG 34	SAW + LUM PR 35	FURN + OTH WD 36	PAPER + PULP 37	WOOD CHEM 38	CONST MAT 39	GLASS + PORC 40
34	60	LOGGNG	2.0	209.6	2969.6	173.5	570.8	160.3	46.3	6.9
35	61,62	SAW + LUM PR	34.5	57.5	1313.4	1045.2	18.3	1.8	156.2	51.9
36	63,64	FURN +OTH WD	28.5	6.5	29.6	58.6	6.0	.8	20.3	7.3
37	65	PAPER + PULP	404.5	1.1	25.7	26.0	652.5	1.3	104.1	19.5
38	66	WOOD CHEM	32.2	.2	2.5	.7	44.4	29.5	6.7	.3
39	67-73	CONST MAT	18.2	12.6	36.6	6.4	17.9	.3	3631.6	26.2
40	74	GLASS + PORC	103.4	1.1	11.2	134.1	3.7	.4	28.1	70.3
41	75-80	TEXTLS	325.5	7.2	28.4	373.9	73.1	.1	61.3	10.2
42	81	SEWN GOODS	21.2	42.6	22.7	13.7	4.2	.3	67.8	6.7
43	82	OTH LT IND	10.3	12.1	4.4	13.5	17.6	.1	16.3	1.5
44	83	FISH PROD	11.4	.0	.1	.0	.0	.0	.3	.1
45	84	MEAT PROD	19.2	.1	6.2	3.7	7.3	.0	1.6	.3
46	85	DAIRY PROD	31.2	.6	7.5	6.9	4.8	.1	24.8	4.2
47	86	SUGAR	18.5	.0	.0	.0	.0	.0	.0	.0
48	87-89	FLOUR+BREAD	5.7	.1	.3	.4	.1	.0	.2	.0
49	90-94	OTHER FOODS	198.1	.8	5.5	2.2	6.2	.2	26.3	1.0
50	95	IND NEC	370.2	51.4	380.9	182.2	128.1	17.5	404.5	33.6
51	96-100	CONSTRUCTION	.0	.0	.0	.0	.0	.0	.0	.0
52	101,102	AGRICULTURE	26.9	5.4	9.3	.6	.0	.0	3.8	.3
53	103	FOREST	.0	436.4	.0	.0	.0	.0	.0	.0
54	104-106	TRANS + COM	406.1	1537.7	1100.8	212.4	245.4	11.6	5881.1	164.3
55	107-109	TRADE + DIST	609.2	93.0	310.6	216.6	201.1	1.4	232.6	153.1
56	110	OTHER BRANCH	52.1	3.1	2.0	4.1	66.1	.2	46.4	3.7
57		TOTAL PURCH	7700.0	3158.6	7066.9	3166.9	2616.0	290.8	15198.7	1008.1
58		DEPRECIATION	589.8	529.7	345.1	110.3	270.0	8.0	1432.3	96.0
59		VALUE ADDED	4604.8	2652.6	1888.0	1614.8	968.5	15.4	6096.9	1208.8
60		TOTAL OUTLAY	12894.6	6340.9	9300.0	4892.0	3854.5	314.2	22727.9	2312.9
61		CAPITAL	7636.3	3481.2	4251.1	1563.1	3367.1	101.1	16207.0	1165.0

TABLE A-II. THE RECONSTRUCTED SOVIET 1972 INPUT-OUTPUT TABLE IN PURCHASERS PRICES
(IN MILLIONS OF RUBLES)

SEQ NO.	110 ORDER NO.		TEXTLS 41	SEWN GOODS 42	OTH LT IND 43	FISH PROD 44	MEAT PROD 45	DAIRY PROD 46	SUGAR 47	FLOUR+ BREAD 48
1	1-4,6,7	METALLURGY	19.3	2.2	25.5	53.2	37.8	45.9	31.1	14.7
2	5	INDMET PROD	19.5	1.5	10.2	12.6	2.6	2.5	1.9	3.2
3	8	COAL	35.3	11.6	12.6	19.7	21.0	54.5	21.7	64.9
4	9	OIL EXTRAC	.1	.0	.2	.1	.3	.0	1.2	.0
5	10	OIL REF	47.0	8.1	28.2	319.0	24.5	40.4	86.7	33.0
6	11	GAS	31.1	2.6	8.6	.9	17.9	10.5	16.5	33.8
7	12,13	PEAT +SHALF	5.5	.6	1.7	.1	.3	1.9	.9	.9
8	14	ELEC POWER	345.3	46.8	64.1	25.9	96.4	82.7	22.8	99.1
9	15	EN+POW M+F	1.7	.1	.1	11.1	.2	.6	.4	.5
10	16,17	ELTECH+CABLE	24.4	5.7	6.1	9.2	4.3	4.3	4.1	8.2
11	20-22	METLWK M+F	.3	.0	.4	.2	.1	.1	.1	.3
12	23	TOOLS + DIES	7.7	2.9	3.9	12.6	1.7	1.9	1.6	5.2
13	24	PRECIS INST	2.6	.3	.7	3.6	.6	1.1	1.4	1.2
14	25-27	MI+MET M+E	.0	.0	.0	.0	.0	.0	.0	.0
15	28,29	PUMPS+CHEM E	.6	.1	.8	5.1	4.2	2.6	1.2	.7
16	30-34,36	SPECL M+E	111.2	16.2	12.2	8.9	4.1	20.5	7.3	20.7
17	35	CONST M+E	.0	.0	.0	.0	.0	.0	.1	.0
18	37,38	TRANSP M+E	.1	.0	.0	42.5	.1	.1	.1	.0
19	39	AUTOS	3.8	3.6	1.5	3.6	5.9	5.4	1.9	2.1
20	40	AGRIC M+E	.8	.1	.1	.9	.3	.3	2.2	.2
21	41	BEARNG	2.7	.2	.5	1.0	.4	.5	.7	.8
22	18,19,42,43	RADIO+OTH MB	43.3	10.4	11.1	22.0	6.6	8.0	8.6	15.6
23	44	SANIT ENG PR	1.5	.4	.8	.3	.5	.8	.2	.5
24	45	OTHER METWRS	21.9	21.0	28.6	65.0	11.0	10.1	1.4	10.7
25	46	METAL STRUCT	.1	.0	.2	.1	.0	.0	.0	.0
26	47	REPAIR	27.9	8.5	9.1	107.7	8.2	13.6	7.7	20.3
27	48	ABRASV	1.0	.3	2.1	.2	.2	.2	.2	.2
28	49	MINERL CHEM	.6	2.2	1.5	.0	.1	.1	1.2	.0
29	50	BASIC CHEM	47.5	.4	46.9	5.8	22.5	10.0	4.2	2.6
30	56	PAINT + LAC	8.7	3.5	22.7	7.2	3.8	3.2	3.0	5.3
31	54	SYN RUBBER	.0	.0	157.1	.0	.0	.0	.0	.0
32	57	RUBBER PROD	32.3	47.5	32.4	13.2	2.7	6.3	2.8	3.8
33	51-53,55,58,59	OTHER CHEM	2056.7	89.6	366.8	12.7	28.4	11.3	3.1	7.8

TABLE A-II. THE RECONSTRUCTED SOVIET 1972 INPUT-OUTPUT TABLE IN PURCHASERS PRICES
(IN MILLIONS OF RUBLES)

SEQ NO.	110 ORDER NO.		TEXTLS 41	SEWN GOODS 42	OTH LT IND 43	FISH PROD 44	MEAT PROD 45	DAIRY PROD 46	SUGAR 47	FLOUR+ BREAD 48
34	60	LOGGNG	4.9	1.1	49.5	6.5	4.7	3.2	1.5	2.8
35	61,62	SAW + LUM PR	17.0	12.0	29.3	140.2	75.6	25.8	5.4	97.0
36	63,64	FURN +OTH WD	41.3	8.5	18.2	16.0	7.4	2.9	2.5	7.2
37	65	PAPER + PULP	62.3	29.9	73.1	63.4	27.0	64.1	9.5	118.1
38	66	WOOD CHEM	2.0	.1	15.7	2.2	.3	.2	.1	.1
39	67-73	CONST MAT	16.7	4.5	6.8	7.6	9.4	6.2	31.1	7.1
40	74	GLASS + PORC	3.1	9.5	3.4	2.0	2.8	29.4	.8	2.4
41	75-80	TEXTLS	24123.1	11598.4	1245.8	158.5	17.3	10.5	19.5	18.0
42	81	SEWN GOODS	26.1	26.0	11.4	30.6	30.9	10.0	9.6	32.4
43	82	OTH LT IND	76.6	970.1	3339.4	9.2	6.9	3.2	1.2	5.2
44	83	FISH PROD	.5	.0	12.8	3201.0	5.4	.1	.0	12.4
45	84	MEAT PROD	1.7	.0	369.8	3.7	6312.8	3.4	.7	63.9
46	85	DAIRY PROD	7.8	.7	7.6	3.4	35.3	1613.6	.3	357.9
47	86	SUGAR	.6	.0	2.1	7.7	4.1	181.5	1201.5	1227.9
48	87-89	FLOUR+BREAD	3.4	.0	.2	5.4	29.9	14.8	.0	5423.6
49	90-94	OTHER FOODS	32.5	2.2	21.3	119.1	50.0	38.3	8.7	1062.8
50	95	IND NEC	128.9	61.9	27.6	19.7	32.3	10.1	6.4	41.1
51	96-100	CONSTRUCTION	.0	.0	.0	.0	.0	.0	.0	.0
52	101,102	AGRICULTURE	7985.5	.8	948.7	14.3	23436.7	9442.6	2412.6	9114.7
53	103	FOREST	.0	.0	.0	.0	.0	.0	.0	.0
54	104-106	TRANS + COM	561.3	190.2	121.6	468.8	115.8	197.3	149.1	443.6
55	107-109	TRADE + DIST	1331.2	876.6	662.3	338.3	1902.8	1158.3	859.1	2210.2
56	110	OTHER BRANCH	17.4	3.1	91.1	2.1	11.3	4.0	1.9	60.5
57		TOTAL PURCH	37344.4	14082.0	7914.4	5384.1	32425.4	13158.9	4957.8	20665.2
58		DEPRECIATION	495.8	150.9	111.1	772.2	118.6	158.9	169.1	221.9
59		VALUE ADDED	17452.0	4857.8	5529.8	1543.7	-9297.6	-328.2	2753.0	5289.8
60		TOTAL OUTLAY	55292.2	19090.7	13555.3	7700.0	23246.4	12989.6	7879.9	26176.9
61		CAPITAL	7163.2	2061.7	1538.5	6328.9	2005.2	2310.9	2136.3	3351.4

TABLE A-II. THE RECONSTRUCTED SOVIET 1972 INPUT-OUTPUT TABLE IN PURCHASERS PRICES
(IN MILLIONS OF RUBLES)

SEQ NO.	110 ORDER NO.		OTHER FOODS 49	IND NEC 50	CONSTR UCTION 51	AGRICU LTURE 52	FOREST 53	TRANS + COM 54	TRADE + DIST 55	OTHER BRANCH 56
1	1-4,6,7	METALLURGY	81.1	1135.0	3806.7	55.0	.8	78.6	13.7	1.2
2	5	INDMET PROD	6.8	88.4	375.7	42.6	.9	66.8	7.6	2.1
3	8	COAL	50.4	30.4	139.7	198.6	.9	153.9	98.6	3.9
4	9	OIL EXTRAC	1.0	.2	18.3	.0	.0	22.1	.0	.0
5	10	OIL REF	90.6	84.1	1492.4	2240.0	19.8	2672.0	126.2	15.1
6	11	GAS	33.2	35.3	40.0	12.6	.0	55.0	21.9	1.4
7	12,13	PEAT +SHALE	1.5	2.2	15.7	103.2	.0	1.8	5.1	1.2
8	14	ELEC POWER	135.2	153.1	517.5	317.3	2.3	820.0	270.5	20.5
9	15	EN+POW M+E	.4	8.5	38.0	.0	.0	3.7	.0	.1
10	16,17	ELTECH+CABLE	8.6	48.3	1534.3	66.8	.0	63.3	33.8	2.1
11	20-22	METLWK M+E	.2	1.9	14.2	6.1	.0	.5	.0	.5
12	23	TOOLS + DIES	7.3	7.0	101.3	55.5	5.6	24.0	9.6	1.7
13	24	PRECIS INST	4.4	14.0	55.7	6.0	.0	12.2	5.0	1.7
14	25-27	MI+MET M+E	.2	1.9	261.0	.0	.0	.0	.0	.0
15	28,29	PUMPS+CHEM E	1.6	6.8	38.0	5.4	.0	6.7	11.5	.2
16	30-34,36	SPECL M+E	18.2	8.4	94.3	.0	.0	21.6	16.6	2.1
17	35	CONST M+E	.0	2.2	209.1	5.4	.0	4.3	.6	.0
18	37,38	TRANSP M+E	.1	7.3	8.2	.0	.0	171.8	.0	.0
19	39	AUTOS	5.5	51.1	350.3	311.4	7.1	389.9	42.1	9.5
20	40	AGRIC M+E	.8	45.3	164.3	996.6	10.2	10.7	14.8	.0
21	41	BEARNG	1.1	7.8	16.2	19.3	.0	17.9	1.5	.0
22	18,19,42,43	RADIO+OTH MB	20.7	85.6	495.4	127.1	.0	122.1	63.3	7.1
23	44	SANIT ENG PR	.9	2.0	1188.8	.0	.0	3.1	3.7	.1
24	45	OTHER METWRS	64.9	13.8	558.4	556.8	1.0	26.5	101.5	.2
25	46	METAL STRUCT	.1	.4	1797.1	.0	.0	.0	.0	.0
26	47	REPAIR	26.6	11.0	916.2	1841.6	.0	192.6	123.7	.0
27	48	ABRASV	.2	3.2	16.7	12.6	.0	2.5	.1	.0
28	49	MINERL CHEM	2.5	20.2	.0	59.6	.0	.0	.0	.0
29	50	BASIC CHEM	74.8	82.6	146.6	1722.9	3.8	27.8	11.8	7.1
30	56	PAINT + LAC	12.5	50.3	652.1	27.1	.0	56.1	42.0	2.0
31	54	SYN RUBBER	.0	.0	.0	.0	.0	.0	.0	.0
32	57	RUBBER PROD	8.7	84.0	328.2	326.9	.0	571.4	20.1	1.3
33	51-53,55,58,59	OTHER CHEM	152.6	316.6	243.2	320.1	.0	15.0	28.7	50.4

TABLE A-II. THE RECONSTRUCTED SOVIET 1972 INPUT-OUTPUT TABLE IN PURCHASERS PRICES
(IN MILLIONS OF RUBLES)

SEQ NO.	110 ORDER NO.		OTHER FOODS 49	IND NEC 50	CONSTR UCTION 51	AGRICU LTURE 52	FOREST 53	TRANS + COM 54	TRADE + DIST 55	OTHER BRANCH 56
34	60	LOGGNG	4.8	111.3	599.7	180.9	2.8	48.5	21.9	4.6
35	61,62	SAW + LUM PR	208.1	378.3	3770.4	276.4	2.0	89.7	89.3	1.9
36	63,64	FURN +OTH WD	12.5	100.1	227.6	88.3	.0	58.8	41.6	3.5
37	65	PAPER + PULP	193.9	500.6	88.5	15.7	.3	14.5	138.0	324.4
38	66	WOOD CHEM	4.9	22.3	4.2	7.6	.0	1.4	1.0	.2
39	67-73	CONST MAT	11.9	32.4	17213.7	211.1	3.1	36.9	88.9	1.7
40	74	GLASS + PORC	142.8	21.6	450.9	26.0	.0	10.5	85.0	.1
41	75-80	TEXTLS	405.9	926.4	176.0	159.9	.0	83.5	95.9	2.3
42	81	SEWN GOODS	20.3	14.9	384.1	185.6	5.7	97.9	143.2	2.5
43	82	OTH LT IND	5.0	109.9	69.8	71.1	.0	28.6	34.0	58.6
44	83	FISH PROD	19.1	207.5	.0	398.0	.0	.0	30.7	.0
45	84	MEAT PROD	451.9	460.4	7.3	191.8	.0	.0	158.5	.1
46	85	DAIRY PROD	71.5	146.3	5.8	608.7	.0	.0	62.8	.1
47	86	SUGAR	831.8	220.4	.0	151.6	.0	.0	33.5	.0
48	87-89	FLOUR+BREAD	82.4	353.0	1.1	2758.1	.0	.1	127.6	.0
49	90-94	OTHER FOODS	7541.5	620.8	103.0	168.3	.0	13.5	250.7	.9
50	95	IND NEC	50.1	910.0	406.5	3472.4	.0	410.0	39.8	302.3
51	96-100	CONSTRUCTION	.0	.0	.0	.0	.0	.0	.0	.0
52	101,102	AGRICULTURE	5993.8	2383.6	49.9	23937.3	10.9	5.1	250.7	.0
53	103	FOREST	.0	.0	.0	.0	.0	.0	.0	46.3
54	104-106	TRANS + COM	959.8	269.8	93.9	1362.2	15.5	25.9	195.5	303.3
55	107-109	TRADE + DIST	4396.8	631.6	.0	4555.2	.0	.0	.0	512.2
56	110	OTHER BRANCH	20.5	84.8	178.9	130.3	.0	.0	129.2	6.5
57		TOTAL PURCH	22242.0	10914.9	39464.9	48393.0	92.7	6538.8	3091.8	1703.0
58		DEPRECIATION	409.9	1468.3	3280.3	7057.0	25.7	4558.0	2032.0	37.3
59		VALUE ADDED	26548.1	7829.6	34644.8	59260.0	581.6	18403.2	20866.0	3007.9
60		TOTAL OUTLAY	49200.0	20212.8	77390.0	114710.0	700.0	29500.0	25989.8	4748.2
61		CAPITAL	5327.8	9458.4	23674.0	112665.0	478.4	64118.0	31135.0	694.6

TABLE A-II. THE RECONSTRUCTED SOVIET 1972 INPUT-OUTPUT TABLE IN PURCHASERS PRICES
(IN MILLIONS OF RUBLES)

SEQ NO.	110 ORDER NO.		INTIND USE 57	CONSUM PTION 58	OTHER FD 59	TOTAL FD 60	GVO 61
1	1-4,6,7	METALLURGY	38353.0	1281.0	2486.2	3767.2	42120.2
2	5	INDMET PROD	1929.0	106.0	32.1	138.1	2067.1
3	8	COAL	10699.4	1590.0	199.5	1789.5	12488.9
4	9	OIL EXTRAC	5051.0	.0	1021.3	1021.3	6072.3
5	10	OIL REF	12216.3	1164.0	2711.4	3875.4	16091.7
6	11	GAS	3333.4	582.0	108.8	690.8	4024.2
7	12,13	PEAT +SHALE	562.5	51.0	-5.9	45.1	607.6
8	14	ELEC POWER	10211.0	3728.0	91.4	3819.4	14030.4
9	15	EN+POW M+E	949.4	.0	635.3	635.3	1584.7
10	16,17	ELTECH+CABLE	6774.7	1037.0	2094.5	3131.5	9906.2
11	20-22	METLWK M+E	222.1	.0	1869.3	1869.3	2091.4
12	23	TOOLS + DIES	945.2	36.0	130.6	166.6	1111.8
13	24	PRECIS INST	1525.1	694.0	4104.9	4798.9	6324.0
14	25-27	MI+MET M+E	988.5	.0	2111.5	2111.5	3100.0
15	28,29	PUMPS+CHEM E	750.6	1142.0	1031.4	2173.4	2924.0
16	30-34,36	SPECL M+E	881.9	89.0	2745.6	2834.6	3716.5
17	35	CONST M+E	457.1	.0	1188.2	1188.2	1645.3
18	37,38	TRANSP M+E	931.1	44.0	4324.9	4368.9	5300.0
19	39	AUTOS	6332.4	3625.0	1515.4	5140.4	11472.8
20	40	AGRIC M+E	5823.5	.0	2142.1	2142.1	7965.6
21	41	BEARNG	865.7	13.0	15.5	28.5	894.2
22	18,19,42,43	RADIO+OTH MB	10941.4	3794.0	14018.9	17812.9	28754.3
23	44	SANIT ENG PR	1394.5	67.0	-4.0	63.0	1457.5
24	45	OTHER METWRS	2545.5	1932.0	-77.5	1854.5	4400.0
25	46	METAL STRUCT	1847.2	.0	-7.7	-7.7	1839.5
26	47	REPAIR	4741.9	617.0	9674.0	10291.0	15032.9
27	48	ABRASV	379.3	.0	47.5	47.5	426.8
28	49	MINERL CHEM	661.5	.0	136.5	136.5	798.0
29	50	BASIC CHEM	4925.1	130.0	2012.1	2142.1	7067.2
30	56	PAINT + LAC	2255.8	221.0	-200.1	20.9	2276.7
31	54	SYN RUBBER	1916.4	.0	-116.4	-116.4	1800.0
32	57	RUBBER PROD	3869.6	843.0	750.9	1593.9	5463.5
33	51-53,55,58,59	OTHER CHEM	9917.7	3056.0	-79.1	2976.9	12894.6

TABLE A-II. THE RECONSTRUCTED SOVIET 1972 INPUT-OUTPUT TABLE IN PURCHASERS PRICES
(IN MILLIONS OF RUBLES)

SEQ NO.	110 ORDER NO.		INTIND USE 57	CONSUM PTION 58	OTHER FD 59	TOTAL FD 60	GVO 61
34	60	LOGGNG	5618.5	449.0	273.4	722.4	6340.9
35	61,62	SAW + LUM PR	9150.9	142.0	7.1	149.1	9300.0
36	63,64	FURN +OTH WD	1042.0	4038.0	-188.0	3850.0	4892.0
37	65	PAPER + PULP	3674.4	313.0	-132.9	180.1	3854.5
38	66	WOOD CHEM	355.3	.0	-41.1	-41.1	314.2
39	67-73	CONST MAT	22175.7	435.0	117.2	552.2	22727.9
40	74	GLASS + PORC	1512.5	897.0	-96.6	800.4	2312.9
41	75-80	TEXTLS	41148.8	17087.0	-2943.6	14143.4	55292.2
42	81	SEWN GOODS	1641.7	17115.0	334.0	17449.0	19090.7
43	82	OTH LT IND	5104.7	10785.0	-2334.4	8450.6	13555.3
44	83	FISH PROD	3909.8	3133.0	657.2	3790.2	7700.0
45	84	MEAT PROD	8083.8	15115.0	47.6	15162.6	23246.4
46	85	DAIRY PROD	3231.0	9681.0	77.6	9758.6	12989.6
47	86	SUGAR	3882.4	5796.0	-1798.5	3997.5	7879.9
48	87-89	FLOUR+BREAD	8809.4	18137.0	-769.5	17367.5	26176.9
49	90-94	OTHER FOODS	11083.6	41066.0	-2949.6	38116.4	49200.0
50	95	IND NEC	8988.3	9144.9	2079.6	11224.5	20212.8
51	96-100	CONSTRUCTION	.0	.0	77390.0	77390.0	77390.0
52	101,102	AGRICULTURE	86043.6	29076.1	-409.7	28666.4	114710.0
53	103	FOREST	482.7	.0	217.3	217.3	700.0
54	104-106	TRANS + COM	29500.0	.0	.0	.0	29500.0
55	107-109	TRADE + DIST	25989.8	.0	.0	.0	25989.8
56	110	OTHER BRANCH	1909.0	3000.0	-160.8	2839.2	4748.2
57		TOTAL PURCH	438536.7	211252.0	126085.4	337337.4	775874.1
58		DEPRECIATION	37074.3	14148.0		14148.0	51222.3
59		VALUE ADDED	300263.1				
60		TOTAL OUTLAY	775874.1				
61		CAPITAL	498478.0				

Appendix B

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ECONOMIC RESTRICTIONS ON SOVIET DEFENSE EXPENDITURE—A MODEL APPROACH

LARS CALMFORS AND JAN RYLANDER*

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INTRODUCTION

Forecasting defense expenditure requires, in addition to security policy analysis, a study of the relationship between the defense sector and other parts of the economy. The aim of this paper is to analyse such relationships for the Soviet Union. We intend to discuss, by means of a simple growth model, to what extent the defense expenditures are compatible with different goals for growth of production and consumption.

Ideally, one should estimate on the basis of historical data how various factors have influenced economic growth and then use these relationships in the analysis of future development paths. However, existing empirical data being both incomplete and unreliable, do not easily lend themselves to an analysis in such a way. We have instead chosen a procedure (using a Cobb-Douglas production function) which relies partly on some statistical series, partly, on assumptions concerning the relative importance of capital and labor for the growth of the total GNP. The Cobb-Douglas function is rather simple, but it nevertheless produces useful insights when applied to Western economies. It has also been used for discussing economic development in the Soviet Union by, among others, Professor Abram Bergson.[1]

It is of course possible that some other production functions could explain the Soviet growth experience better than the Cobb-Douglas function, but as long as no satisfactory evidence of a particular aggregate production function for the Soviet economy has been presented, it seems reasonable to use as simple a model as possible in order to make

*Acknowledgements: We are grateful to Professor A. Bergson, Professor S. Cohn, Docent R. Färe, and Mr. L. Jansson for valuable discussions when this paper was in preparation. Mr. S. Carlsson did the computer work. This paper was originally a part of a Swedish study prepared at FOA in 1974–1975; Ekonomiska restriktioner på försvarssatsningar i Sovjetunionen och Östeuropa.

[1] Bergson, A., "Soviet Economic Perspectives—Towards A New Growth Model". Problems of Communism, March 1973.

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some numerical illustrations of various trade-off possibilities. According to the Cobb-Douglas function, the rate of growth of GNP can be expressed as the sum of the three following components: [2]

1. The rate of growth of the capital stock multiplied by a weighting factor.[3]

2. The rate of growth of the labor force multiplied by a weighting factor.

3. The rate of growth of the total factor productivity. (The total factor productivity can be seen as a measure of the efficiency with which the production factors capital and labor are used—this variable thus registers the effects of e.g. education and research.)

In the Cobb-Douglas case the weighting factors for the rates of growth of the capital stock and the labor force are made to add up to 1, which means that there are constant returns to scale. In his work, referred to above, Professor Bergson has calculated weighting factor of 0.4 for the growth rate of the capital stock and of 0.6 for the growth rate of the labor force in the case of the Soviet Union. In most studies of economic growth in Western countries a somewhat smaller weighting factor for the rate of growth of the capital stock has been used (and consequently a somewhat larger weighting factor for the rate of growth of the labor force). A weighting factor as high as 0.4 for the rate of growth of capital stock moreover implies a net marginal return on capital of more than 10 percent, which may seem unreasonably high.[4] Therefore we have made alternative calculations

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[2] A Cobb-Douglas function can mathematically be written in the following way:

$$Y(t)=e^{\lambda t}\cdot K(t)^{\alpha}\cdot L(t)^{\beta}$$

where:
Y=GNP.
K=capital stock.
L=hours worked.
λ=the rate of increase of the total factor productivity.
t=time index.
α and β are weighting factors.

Differentiation with respect to time and division by Y then gives:

$$\dot{Y}=\lambda+\alpha\cdot\dot{K}+\beta\cdot\dot{L}$$

where $\dot{Y}=\frac{dY}{dt}\cdot\frac{1}{Y}$ and hence $\dot{Y}$ is the rate of growth for the GNP etc.

[3] In the terminology of economics this weighting factor is usually called the elasticity of GNP with respect to the capital stock. It refers to the percentage increase of GNP resulting from a 1 percent increase of the capital stock. In the text we shall solely use the term weighting factor.

[4] If Y=gross national product and Y_N=net national product, then $Y_N=Y-\delta K$ (where δ=the rate of depreciation).

Differentiation with respect to K gives:

$$\frac{\partial Y_N}{\partial K}=\frac{\partial Y}{\partial K}-\delta \qquad (1)$$

From note 2 above:

$$\frac{\partial Y}{\partial K}=\alpha\cdot\frac{Y}{K} \qquad (2)$$

Consequently:

$$\frac{\partial Y_N}{\partial K}=\alpha\cdot\frac{Y}{K}-\delta \qquad (3)$$

Bergson uses the values $\frac{Y}{K}=\frac{1}{2,9}$ and $\delta=\frac{10}{290}$ in the case of the Soviet Union. Thus if:

$$\alpha=0,4 \text{ then } \frac{\partial Y_N}{\partial K}\approx 0,1$$

A weighting factor for the rate of increase of capital stock of 0.4 thus means that net marginal return on capital would be about 10 percent.

with, on the one hand, the weighting factors 0.4 and 0.6 respectively, and, on the other hand, the weighting factors 0.3 and 0.7.[5] The calculations are rather sensitive to which assumptions are made about these weights. This is illustrated in table 1, where it is shown how the estimates of the contributions of different factors to the total growth of GNP in the period 1950–67 are influenced by variations in these assumptions.

TABLE 1

	1950–58 weighting factors		1958–67 weighting factors	
	0.4 resp 0.6	0.3 resp 0.7	0.4 resp 0.6	0.3 resp 0.7
Growth of GNP	6.4	6.4	5.3	5.3
Growth of capital stock	9.0	9.0	9.0	9.0
Growth of GNP due to the increase of the capital stock	3.6	2.7	3.6	2.7
Growth of labor force	1.8	1.8	1.7	1.7
Growth of GNP due to the increase of labor force	1.1	1.3	1.0	1.2
Growth of GNP due to increased total factor productivity	1.7	2.4	.7	1.4

Note: All figures are average percentage changes per year.
Source: Bergson, A., ibid.

When analyzing the economic consequences of various changes in defense expenditure, we have employed two different methods. In the first case we have studied the consequences for the growth of consumption under varying assumptions as to the rate of growth of the capital stock and the increase of the total factor productivity. In the second case we have examined the effects on the rate of growth of GNP under varying assumptions as to the growth of consumption (corresponding to different policy goals). Our calculations do not presuppose any absolute values of GNP since our discussion is entirely in terms of relative rates. We have merely proceeded from the following relations between capital stock, GNP and its various components (1970), and assumed that other government expenditures will also in the future make up the same share of GNP, and that the capital stock depreciates at the same constant rate:

TABLE 2[1]

Consumption	56.5
Defense expenditure	10.0
Other Government expenditure	3.3
Net investment	20.2
Depreciation	10.0
GNP	100.0
Capital stock (Dec. 31)	190.4

[1] An adjustment for 1975 of Professor Bergson's figures for the 1970 GNP distribution have been undertaken by Dr. K Bush (Radio Liberty Research Supplement, Sept. 12, 1975). The following GNP vector was obtained: Consumption (55.1)—Government + Defense (12.9)—Net investment (20.8)—Depreciation (11.2). The changes in the shares of the various components of GNP are too small to alter the projections of this paper. Rather, it suggests that the projections made in this study could well be extended up to 1990.

Source: Bergson, A., ibid. The defense estimate of 10 percent used by Bergson is accepted. As noted by Bergendorff and Strangert in this volume the use of either 10 or 15 percent does not change the outcome materially.

[5] A weighting factor for the growth rate of capital stock of 0.3 would, with the same method of calculation as in the earlier footnote, give a net marginal return on capital of about 7 percent.

The Relation Between Consumption and Defense Expenditure

The results of the calculations according to the first method are shown in figures 1 and 2. The consumption in the year of 1985 [6] is depicted on the y-axis and the yearly changes of defense expenditure on the x-axis. (These changes are assumed to be the same from year to year.) On the y-axis we also show the levels of consumption in 1985 that correspond to various average rates of growth of consumption. By making different assumptions on the growth rate of the capital stock (6 and 9 per cent per annum), the growth rate of the total factor productivity (1 and 2 percent per annum), and the weighting factors for the growth rate of the capital stock and the labor force (0.4/0.6 in fig. 1 and 0.3/0.7 in fig. 2) we have been able to describe (using nomograms) eight different relations between consumption in 1985 and the changes in defense expenditure. We have then assumed that the annual average growth of the labor force is 1.2 percent.

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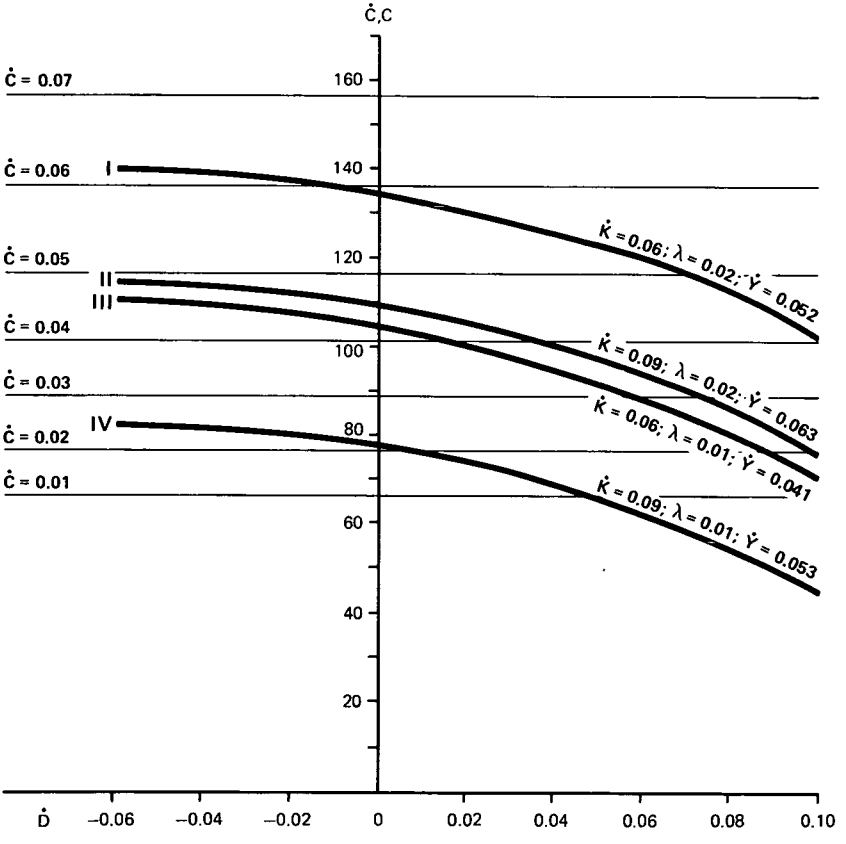
[6] Expressed as $\frac{\text{consumption}}{\text{GNP (in 1970)}} \cdot 100$

Fig. 1

The relation between consumption and defense expenditure (weights 0.4 and 0.6)

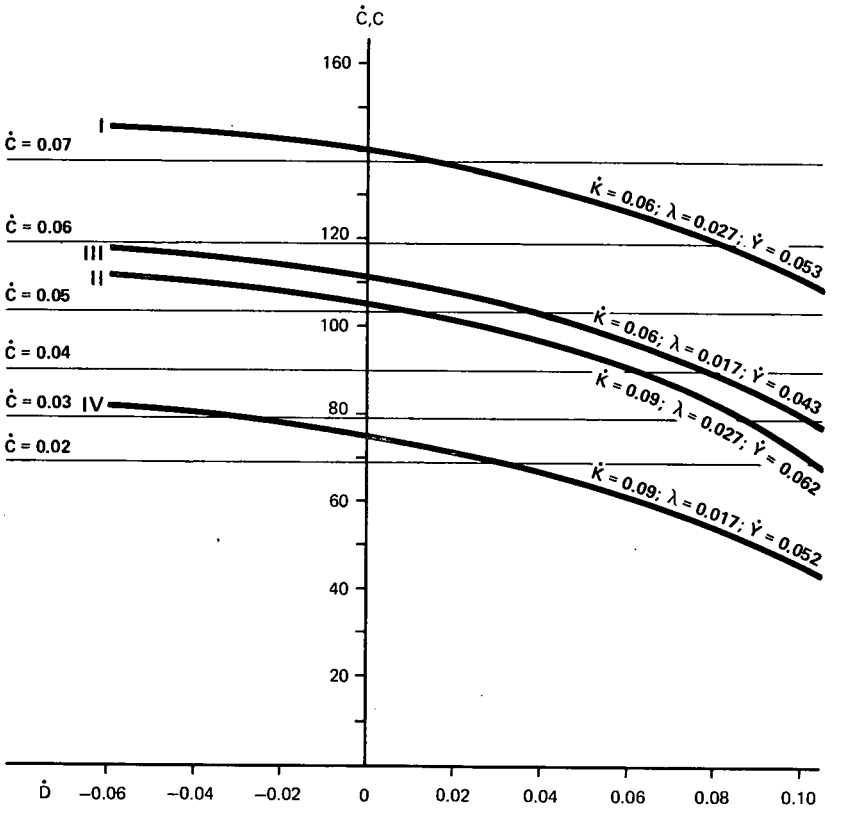


NOTATION

$\dot{C}$ = rate of growth of consumption
C = consumption 1985
$\dot{K}$ = rate of growth of the capital stock
$\dot{Y}$ = rate of growth of GNP (Y(1970) = 100)
$\dot{D}$ = rate of growth of defense expenditure
λ = rate of growth of total factor productivity
Y = GNP 1985

Fig. 2

The relation between consumption and defense expenditure (weights 0.3 and 0.7)



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We examined average yearly changes in defense expenditure varying from −6 to 10 percent. The end-point alternatives are of course very extreme. Even an average decrease of 2 percent per year would require a considerable improvement in the relations between east and west. In the same way an average annual increase of 4–5 percent will reflect in our opinion a rather frosty international situation. We have nevertheless chosen a wider range of variation in order to render the discussion more complete. More possibilities could of course be examined, but the alternatives chosen should be sufficient.

Let us first assume that the weighting factors used by Bergson (0.4 for the growth rate of the capital stock and 0.6 for that of the labor force) are correct. Then the total factor productivity should have increased by 0.7 percent annually in 1958–67 according to table 1. There is in the Soviet Union much discussion about the possibilities of achieving faster technological progress, but in spite of the reforms of the sixties, there is little evidence that improved results have been attained. Hence we have chosen as the most probable alternative an average future increase of the total factor productivity of about 1 percent per annum.

In earlier post-war years the capital stock increased by an average of some 9 percent a year. We see, however, from fig. 1 that with such a growth rate of the capital stock and with an increase of the total factor productivity of 1 percent per annum the average annual increase of consumption would be below 3 percent annually within the range of defense expenditure changes studied (graph IV in fig. 1). Considering that the average annual increase of consumption between 1956 and 1972 was over 5 percent, it does not seem likely that such low increases of consumption would be tolerated. It therefore seems reasonable to assume that the growth rate of the capital stock will be kept lower than 9 percent in the future.

Let us therefore also study an alternative in which, instead, the capital stock increases by an average of only 6 percent per annum. The total factor productivity is still assumed to increase by 1 percent annually. In this case consumption could increase by 4.7 percent per annum (graph III in fig. 1) assuming that defense expenditure decrease by 6 percent per year. With unchanged defense expenditure, the annual increase of consumption would be just over 4 percent. Assuming an annual increase of defense expenditure of 10 percent, the growth rate of consumption would fall to some 1.5 percent per annum. This growth of consumption would undoubtedly be considered too slow. With regard to the effects on consumption there are consequently strong pressures in favor of restricting the increases of defense expenditure. It should be noted, however, that there only is a slight difference as to the possible increases of consumption between an average annual reduction of defense expenditure by 6 percent and unchanged defense expenditures. The marginal effect on consumption will in fact be greater the larger the increase of defense expenditure. It is hence unlikely that there would be strong consumer pressures in favor of significant defense expenditure reductions (that is assuming some relevance of the model).

In the alternative most favourable to consumption the capital stock would increase by an average of 6 percent per annum and the total

factor productivity by 2 percent per annum (graph I in fig. 1). Such a high rate of increase of the total factor productivity seems quite improbable, but if it should nevertheless be accomplished—for instance due to extensive administrative reforms or technological transfers in connection with a rapidly increasing foreign trade—then there are no reasons to expect that the expansion of defense expenditure to any larger extent would be checked by the unfavourable effects on consumption. Even at a growth rate of defense expenditure as high as 10 percent annually, consumption could increase by 4 percent per annum. At a rate of increase of defense expenditure of 6 percent per year, the annual increase of consumption could be over 5 percent per annum.

With an average annual rate of increase of 2 percent for the total factor productivity it should also be possible to let the capital stock increase by 9 percent a year with the purpose of achieving a faster GNP growth without the increases of consumption becoming low (graph II in fig. 1). The effects of varying changes of defense expenditure would then be approximately the same as in the case when the capital stock increased by 6 percent per annum and the total factor productivity by 1 percent per annum.

In fig. 2 it is shown how the results change, if we, instead, use the weighting factors 0.3 (for the growth rate of the capital stock) and 0.7 (for the growth rate of the labor force). Graphs I and III (corresponding to an average annual increase of the capital stock of 6 percent) move somewhat upwards, while graphs II and IV (corresponding to an average annual increase of the capital stock of 9 percent) move downwards.[7] If the assumptions on the weighting factors made in fig. 2 are correct, an average annual increase of the capital stock by 9 percent would thus result in an even lower consumption than under the assumptions in fig. 1. Consequently, if such a capital-intensive development is chosen, the pressure to keep defense costs down will be even stronger than was suggested previously. At a rate of increase of the capital stock averaging 6 percent per annum, the room for defense expenditure would on the other hand be somewhat larger.

It is evident that our conclusions are dependent on the specific assumptions made on the rate of growth of the capital stock and the total factor productivity, and on the weighing factors for the rates of increase of the labor force and the capital stock. In the most probable alternatives there ought, however, to be a strong desire to keep the average rate of growth of defense expenditure down to some 2–3 percent a year. But any significant reduction of defense expenditure could hardly be expected for economic reasons, since the marginal increases in consumption seem to be rapidly diminishing when defense expenditures are cut.

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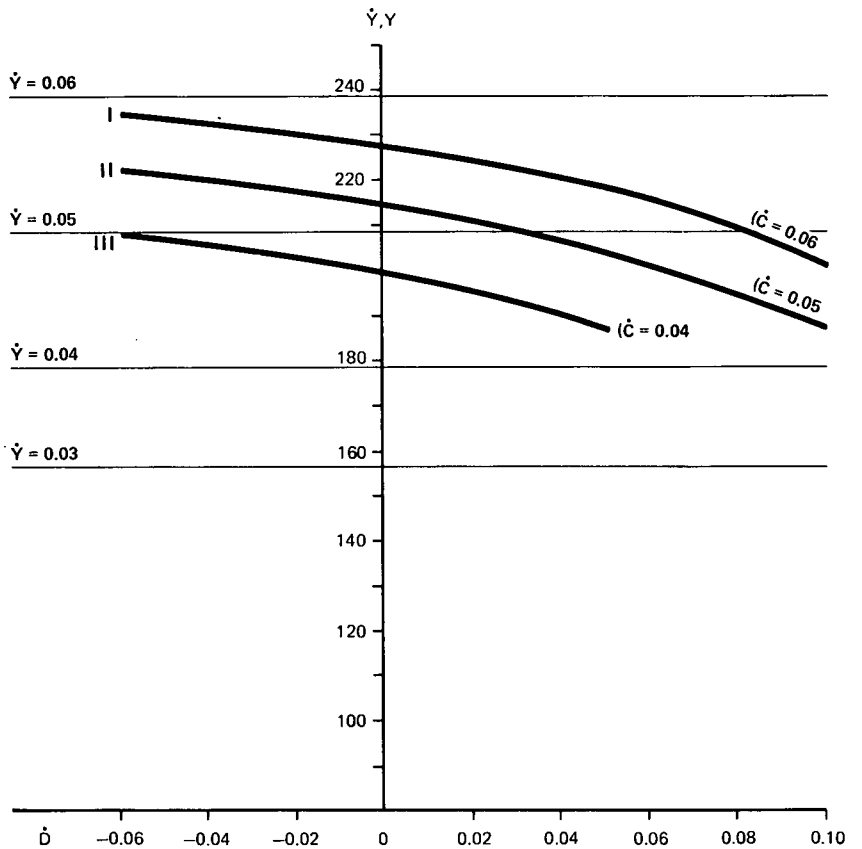
[7] When the assumptions on the weighting factors of the growth rates of capital stock and labor force are altered, the estmate of the increase in total factor productivity will also be influenced. An average annual increase of the total factor productivity in fig. 1 by 1 percent corresponds to an increase by 1.7 percentage points in fig. 2. This is explained by the fact that the increase of total factor productivity according to table 1 for the time period 1958–67 is 0.7 percentage points higher with the weighting factors 0.3 and 0.7 than when using the weighting factors 0.4 and 0.6.

The Relation Between GNP and Defense Expenditure

For the purpose of further illustrating the economic consequences of various changes of defense expenditure, a different kind of calculation has been made. In this method it is assumed that the Soviet government, to begin with, determines the rate of growth of consumption. Alternatives representing annual increases of consumption of 4, 5, and 6 percent respectively were examined. We are still using the same assumptions regarding other government expenditure, depreciation and rate of growth of the labor force as before. If the rates of change of defense expenditure and consumption for the first year of the prognosis are specified, net investment can thus be determined as a residual (GNP is then assumed to be influenced by the capital stock at the end of the previous year). The capital stock at the end of the year is then also known. Consequently, GNP in the next year can be calculated. By way of an iterative process, it is then possible, for each given rate of growth of consumption, to construct a relationship between the growth rate of GNP and the annual average change of defense expenditure. This has been done in figure 3, where GNP in the year 1985 (and the corresponding average annual growth rates) are shown on the vertical axis and the yearly changes of defense expenditure on the horizontal axis. The weighting factors of the growth rate of the capital stock and the labor force are in this diagram assumed to be 0.4 and 0.6 respectively. The total factor productivity is assumed to increase by 1.5 percent each year. As mentioned before this is a somewhat higher figure than probably could be expected.

Fig. 3

The relation between GNP and defense expenditure (weights 0.4 and 0.6; $\lambda = 0.015$)



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- $\dot{D}$ = rate of growth of defense expenditure
- λ = rate of growth of total factor productivity
- Y = GNP 1985

From fig. 3 we see that if the annual change of defense expenditures varies between −6 percent and +10 percent, the growth rate of GNP will lie between 5.8 percent and 4.7 percent with an increase of consumption of 4 percent per year (graph I in fig. 3). This is approximately the same yearly rate of increase of GNP as has been achieved for the last decade.

However, as mentioned before, consumption increases of 4 percent per annum might be regarded as unsatisfactory in comparison with past achievements. With a yearly consumption increase of 5 percent the rate of increase of GNP would instead be—within the relevant interval for changes of defense expenditure—between 5.4 percent and 4.3 percent per annum (graph II in fig. 3). It thus seems reasonable to except somewhat slower GNP increases than in earlier periods. At least in the case of annual increases of consumption of 5 percent there ought thus to exist considerable pressures to hold down the increases of defense appropriations, since these rather rapidly seem to lead to a substantial dampening of the GNP growth. This will be more obvious still, if an annual consumption increase of say 6 percent should be aimed at. In that case the net investments will be zero around 1985, which obviously is completely unrealistic.[8]

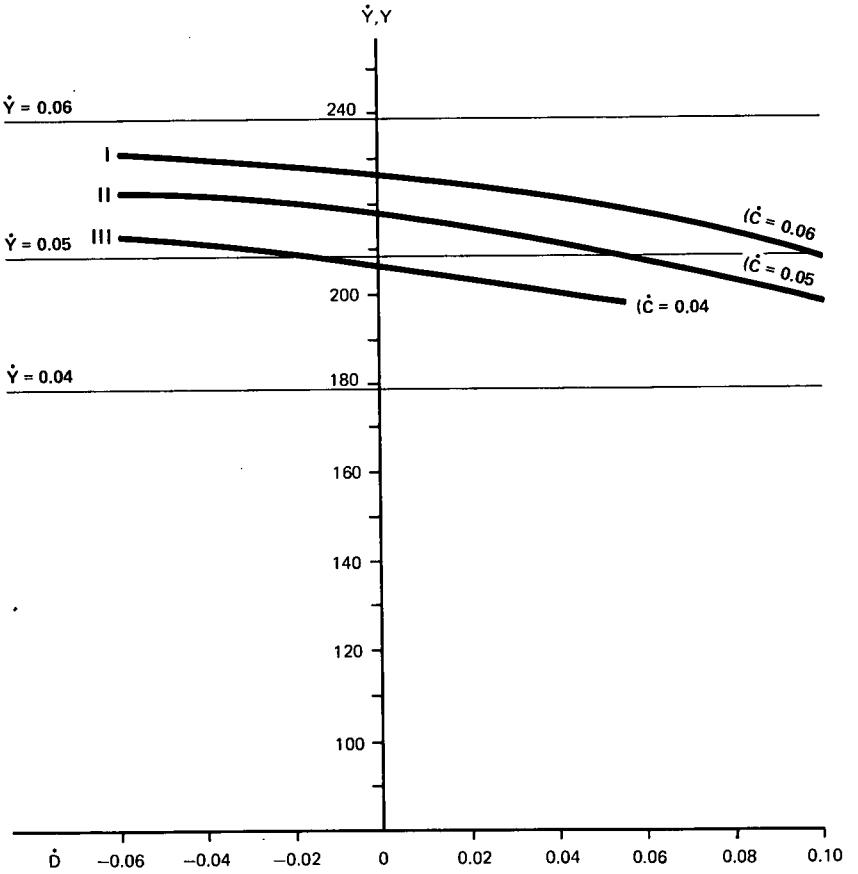
As with the method first used we have also repeated these calculations using alternative values of the weighting factors. The results are shown in fig. 4. Graphs II and III (consumption increases of 5 and 6 percent per year) are shifted upwards, which means that GNP grows faster than with the initially assumed weighting factors. Graph I, which represents an annual increase of consumption of 4 percent, does, however, remain almost at the same height. But the slopes of all the curves change to lower values in absolute terms. The reason is that with a smaller weighting factor than before for the rate of increase of the capital stock (and hence, with our assumptions a larger weighting factor for the rate of increase of the labor force), each given reduction of the capital stock increases will cause a smaller reduction of the GNP growth rate than earlier. Consequently the rate of increase of GNP will decrease less than before (cf fig. 3) at a given increase of the growth rate of defense expenditure.

With these latter weighting factors it will be somewhat easier to reach GNP increases of approximately the same size as in the last decade without having to cut down on consumption increases. This should render the defense budget less interesting as an action parameter to be used in controlling the growth rate of GNP in relation to given consumption goals. If these assumptions regarding the weighting factors are correct, the conflict between defense expenditure and GNP increases would be considerably mitigated.

[8] Graph III in fig. 3 ends at the point where net investments fall to zero in 1985.

Fig. 4

The relation between GNP and defense expenditure (weights 0.3 and 0.7; $\lambda = 0.022$)



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λ = rate of growth of total factor productivity
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Conclusions

In some respect our analysis may seem to ignore essential factors, but this is almost inevitable, if quantitative estimates are to be possible. Our discussion can perhaps therefore be seen as a complement to the more usual qualitative discussions of the Soviet defense burden. We would however in this context like to point out some critical aspects of the assumptions controlling our analysis.

1. We have assumed constant returns to scale, i.e. that e.g., a doubling of the input of production factors will also double the output. One might perhaps claim that most advantages of large scale production have already been exploited in the Soviet Union and that therefore decreasing returns to scale should be expected. This possibility ought to be tested in a more extensive analysis, preferably using a multi-sectoral model.

2. A Cobb-Douglas function presupposes a certain degree of substitutability between production factors. In more technical terms it is assumed that the elasticity of substitution equals 1.[9] It has sometimes been alleged that this substitution elasticity should be lower in the Soviet economy.[10] This would mean that the continuing increase of capital intensity would yield gradually lower returns. This case, too, should be examined in a more thorough analysis. Attempts to estimate statistically a so-called CES-function without specifying in advance the value of the elasticity of substitution ought to be made.[11]

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[9] The substitution elasticity gives a measure of how easily a production factor can be substituted for another.

[10] See for instance Weitzman, M. L., "Soviet Postwar Economic Growth and Capital—Labor Substitution", *American Economic Review*, Sept. 1970 or P. Desai, "The Production Function and Technical Change in Postwar Soviet Industry: A Reexamination," American Economic Review, June 1976.

[11] A CES function is a production function with a constant elasticity of substitution. If the elasticity of substitution is denoted by δ a CES function with constant returns to scale can be written in the following way:

$$Y(t)=e^{\lambda t}[\delta K(t)^{-\rho}+(1-\delta)\cdot L(t)^{-\rho}]^{-1/\rho}$$

where

$$\rho=\frac{1-\sigma}{\sigma},\ 0\leq\delta\leq 1 \text{ and } -1\leq\rho$$

After logarithmation and differentiation with respect to time we get:

$$\dot{Y}=\lambda+n_K\cdot\dot{K}+n_L\cdot\dot{L}$$

where

$$n_K=\frac{\delta}{\delta+(1-\delta)K^{\rho}L^{-\rho}}$$

$$n_L=\frac{1-\delta}{(1-\delta)+\delta K^{-\rho}L^{\rho}}$$

Now

$$\frac{\partial n_K}{\partial\left(\frac{K}{L}\right)}=\frac{-\rho\delta(1-\delta)\cdot K^{\rho-1}}{[\delta+(1-\delta)K^{\rho}L^{-\rho}]^2\cdot L^{\rho-1}}$$

But

$$0<\sigma<1\rightarrow\rho>0$$

$$\rho>0\rightarrow\frac{\partial n_K}{\partial\left(\frac{K}{L}\right)}<0$$

An elasticity of substitution that is smaller than 1 (but still positive) hence implies that an increase of the capital stock by 1 percent contributes less to the percentage increase of GNP the higher the capital intensity (the ratio between capital and labor). In the Cobb-Douglas function this contribution was constant. This function can hence be regarded as a special case of the CES function.

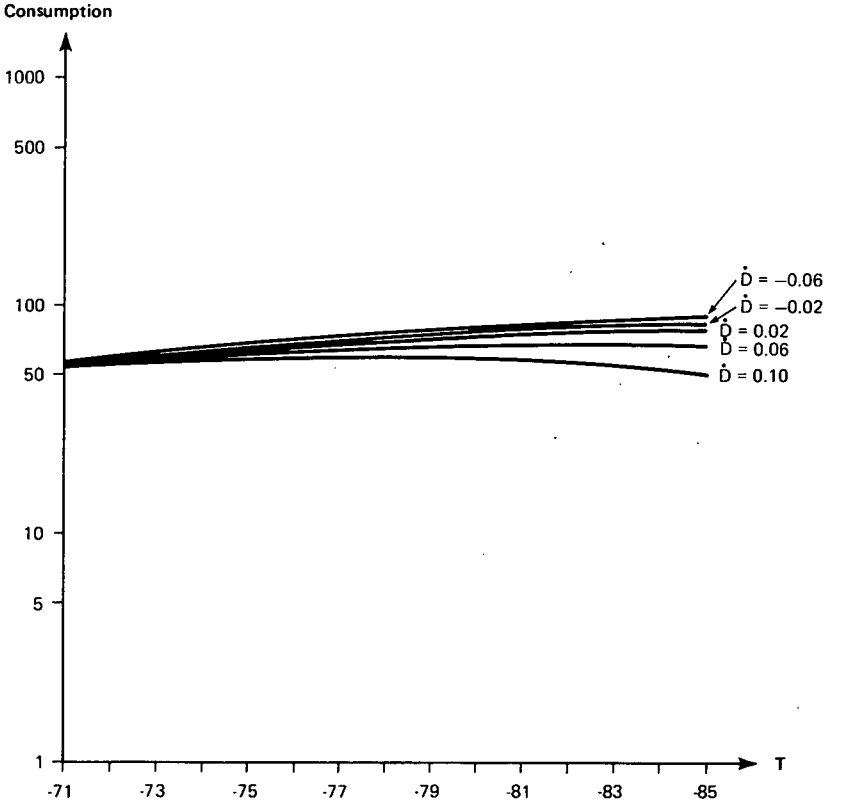
3. We have made our growth analysis for the entire economy. A valuable extention would be to make a classification into different production sectors, which should then be analysed separately. A great deal might be gained by a separation into industrial, agricultural, and service production, since the development trends in these sectors are rather divergent.

4. We may in our analysis have underestimated the potential profits from restricting the increase of defense expenditures. Since the defense sector probably uses resources of higher quality than other sectors, a simple production function analysis may not take into account all possible gains from a transfer of resources. Hence we may to some extent have underestimated the economic pressures to keep defense expenditure down.

5. Our discussion has been unrealistic in the sense that we have used a strictly limited time horizon and mean values for a whole period of time for several variables. In a more refined analysis one should also take into account the time profiles of various variables. As appears from fig 5, consumption would for instance decrease towards the end of the period examined, if the capital stock and defense expenditure are allowed to increase annually at an average rate of 9 and 10 percent respectively (with the weighting factors 0.4 and 0.6 respectively and an increase of the total factor productivity by 1 percent per annum). It is further shown in fig 6 that under certain conditions net investments will decrease even at an early stage of the period assuming certain consumption increases. This would of course lead to severe consequences in the long run. Such development paths are therefore not to be expected, since a reorientation of policy would be necessitated very soon. Such extreme alternatives can nevertheless give a good idea of the scope available in ten to fifteen years for different decisions on production, consumption, and defense expenditure.

Fig. 5

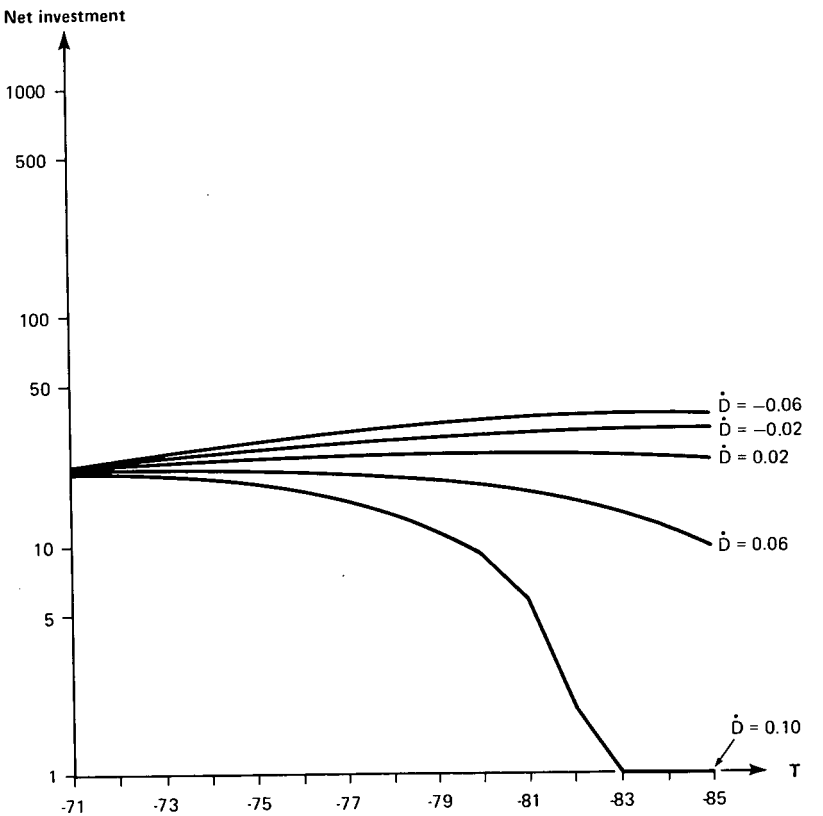
Paths of consumption for different rates of growth of defense expenditure (capital stock at 9%, weighting factors 0.4 and 0.6)



λ = 0.01
$\dot{D}$ = Rate of growth of defense expenditure.

Fig. 6

Paths of net investment for different rates of growth of defense expenditure (yearly rate of consumption of 5%, weighting factors 0.3 and 0.7)



λ = 0.022
$\dot{D}$ = Yearly average change in defense expenditure.

6. A more sophisticated analysis should also explicitly take into account that investments in education increase the productivity of labor and that some technical progress is "embodied," i.e., that certain increases of the total factor productivity are connected with new investments.

Summary

In spite of these reservations we feel justified in drawing the conclusion that if consumption and GNP shall increase by 4 to 5 percent per annum (which cannot be considered as too ambitious goals for the Soviet leadership), the defense expenditure must then not increase by more than some 2–3 percent a year. Strong economic pressure to keep down the rate of increase of defense expenditure must therefore be assumed. On the other hand a major reduction of Soviet defense expenditure can hardly be expected for economic reasons alone since the implied consumption and/or production gains seem insignificant.

These conclusions are likely to be modified, only if the increase of efficiency in the use of production factors should be significantly higher than before. However, this would require an unlikely and very advantageous combination of developments: efficiency promoting economic reforms, a higher rate of innovation, an extensive transfer and absorption of foreign technological know-how, and better results in the agricultural sector.

73-720—76——28

PROJECTIONS OF SOVIET ECONOMIC GROWTH AND DEFENSE SPENDING

HANS BERGENDORFF AND PER STRANGERT

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SUMMARY

Projections are made for the Soviet economic growth 1975–1985 based upon production relationships observed since the fifties. The method used is based upon a six sector dynamic model with production levels determined through Leontief assumptions and capital/labor requirements obtained by estimated production functions. The scope for the growth of defense and consumption over the same period is studied. The sensitivity to data and assumptions is studied by variations of model specification, the interpretation of the observed declining rate of technological progress, and estimates of current defense burden. The results presented are an elaboration of earlier work at FOA (by Rylander, J. and Calmfors, L.) with respect to the data base and to the level of disaggregation.

1. INTRODUCTION

Forecasting defense expenditures requires in addition to security policy analysis a study of the relationship between the defense sector and other parts of the economy.

The aim of this paper is to analyze such relationships for the Soviet Union using growth models of varying degree of sophistication.

The work presented in this paper is an extension of the work done by Calmfors and Rylander.[1] These authors used a simple Cobb-Douglas growth model originally developed by professor Abram Bergson.[2] Bergson's analysis was extended by them to include defense so that the trade-off between the growth rate of defense expenditures and the growth rate of consumption could be derived for any given growth rate of capital stock.[3] They also introduced a second version of Bergson's model where the trade-off between GNP growth and defense growth could be derived for any given growth rate of consumption.[4] These two approaches while certainly relevant have the drawback that in the long run they may imply very unbalanced growth patterns of the economy.

In the first version, investments and defense spending have given growth rates, and consumption is a residual. If investments or defense spending grows faster than GNP, consumption being the residual item will sooner or later have to be reduced to zero.

---

[1] Calmfors, L. and Rylander, J., Economic Restrictions on Soviet Defense Expenditure (mimeo), National Defense Research, Stockholm, Sweden, 1974.

[2] Bergson, A., "Soviet Economic Perspectives—Towards a New Growth Model". Problems of Communism, March 1973.

[3] In Bergson's original model the growth rate of capital stock is predetermined at a value g_k. Thus

$$K_t = (1+g_k)^t \cdot K_o$$

and consequently investments

$$I_t = (1+g_k)^t \cdot I_o$$

Bergson also assumes constant growth rate of the labor force and a Cobb-Douglas production function. This means that also GNP will grow by a constant rate g_y and

$$Y_t = (1+g_y)^t \cdot Y_o$$

Calmfors and Rylander now assume also a constant growth rate for defense expenditures g_d. Thus

$$D_t = (1+g_d)^t \cdot D_o$$

Finally consumption is determined as a residual

$$C_t = Y_t - I_t - D_t$$

and the average growth rate of consumption is determined as

$$\frac{1}{10} \log (C_{10}/C_o).$$

Then tradeoff curves between the growth of defense expenditures and the growth of consumption are drawn up by Calmfors and Rylander.

In the second extension of Bergson's model Calmfors and Rylander reverse the order of causality. Consumption growth is now predetermined at a constant rate g_c as well as the growth of defense expenditures, g_d. Thus,

$$C_t = (1+g_c)^t \cdot C_o ; \; D_t = (1+g_d)^t \cdot D_o$$

At any time the GNP is determined by the production function and the available capital stock K_t and the labor force L_t and investments are determined as a residual

$$I_t = Y_t - C_t - D_t$$

The capital stock at time $t+1$ is then determined as

$$K_{t+1} = (1-d)\, K_t + I_t$$

where d is the capital retirement rate.

The average growth rate of GNP is determined as

$$\frac{1}{10} \log (Y_{10}/Y_o)$$

and tradeoff curves between the growth of defense expenditures and the growth of GNP are finally drawn up by Calmfors and Rylander.

[4] See footnote 3.

In the second approach, consumption and defense spending have given growth rates and investment is determined as a residual. If consumption and defense spending grows faster than GNP, investments being the residual will sooner or later have to be reduced to zero. Even though such drastic shifts in the use of GNP will normally not happen within the 10-year projection period (1975–85) there are realistic cases when it happens in the model runs, and quite frequently in the runs growth rates of the residual item decline significantly toward the end of the period.

Average growth rates over the 10-year projection period may then give a misleading representation of the feasibility of alternative growth rates of defense spending. To avoid this problem a third approach is added to the two previously defined. Recapitulating, the first approach assumed that increases in defense spending came entirely at the expense of consumption while the second approach assumed that only the investment level was affected by defense spending. The third approach instead assumes that changes in defense spending affect both consumption and investment in such a way that they maintain their initial (1973) relative shares of nondefense GNP. This approach has much better stability properties than the two others, and growth rates tend to vary less over the 10-year projection period. Empirical data tend to support the third approach. During the last decade the shares of GNP that have been devoted to investment, consumption and defense have started to stabilize.

Another argument that supports the third alternative is that under certain conditions it is optimal to devote a fixed share of GNP to investment. For example if an economy is assumed to be represented by a Cobb-Douglas production function then both the golden rule [5]

---

[5] Assume that $Y_t = F(e^{-\lambda t}K_t, e^{gt}\overline{L}_t)$ and that the economy has a balanced growth at the rate g i.e. Y_t C_t, I_t and K_t all grow at the rate g. Then the absolute value of GNP, Y_t, becomes a function of the investment ratio, I_t/Y_t, henceforth called s and of time.

Thur $I_t = f(s)e^{gt}$

But then $C_t = (1-s)\,f(s)\,e^{gt}$ and to maximize C_t we require

$$\frac{\partial C_t}{\partial s} = 0$$

or

$$\frac{s}{1-s} = \frac{f'(s)s}{f(s)}$$

If one expresses the right hand side in terms of the production function F it turns out that one can write

$$\frac{f'(s)s}{f(s)} = \frac{a}{1-a}$$

where

$$a = \frac{\frac{\partial F}{\partial K_t}}{Y_t} \cdot K_t$$

Thus the optimality condition says that s=a and one can now formulate the golden rule which says that the investment share of GNP=profit share of GNP. For a Cobb-Douglas function the profit share is a, the weight on the capital factor.

and a maximization of the sum of discounted consumption prescribe that a constant share of GNP should be devoted to investment.[6]

Bergson and later Calmfors and Rylander all rely on a Cobb-Douglas production function with hypothetical parameters that were not estimated. In this work Cobb-Douglas as well as some other types of production function is were estimated on empirical data. Especially interesting are such with a capital-labor substitution elasticity [7] less than one since there is evidence that the Soviet economy has reached a point where it is becoming increasingly difficult to maintain GNP

[6] Assume that one wants to maximize a utility function of type

$$\sum_{t=0}^{T-1} \frac{1}{(1+r)^t} \cdot C_t + \frac{1}{(1+r)^T} \cdot \frac{C_T}{r-g}$$

(sum of present value of future consumption) and that T is very large.
Then at any time t sufficiently far away from the planning horizon T the intertemporal optimality criterion is $mpc=r$ where mpc is the marginal productivity of capital.

If the economy is represented by a Cobb-Douglas production function $Y(t)=e^{kt} \cdot K(t)^{\alpha} \cdot L(t)^{1-\alpha}$ then the

$$mpc=e^{kt}\alpha \cdot K(t)^{\alpha-1} \cdot L(t)^{1-\alpha}-d=\alpha\frac{Y(t)}{K(t)}-d$$

where d is the capital retirement rate.

Thus the intertemporal optimality condition can be written as $Y(t)/K(t)=(d+r)/\alpha$

Then $K(t)$ and $I(t)$ must grow at the same rate as $Y(t)$ which implies that $I(t)/Y(t)=\text{Constant}=$

$$\alpha \cdot \frac{g+r}{d+r}$$

where g is the equilibrium growth rate of the economy.
For a CES production function the marginal productivity of capital can be written as

$$\frac{dY}{dk}=\delta \cdot \left(\frac{Y}{K}\right)^{\zeta+1} \cdot e^{-\zeta\lambda t}-d$$

and the intertemporal optimality criterion becomes

$$\delta \cdot \left(\frac{Y}{K}\right)^{\zeta+1} \cdot e^{-\zeta\lambda t}=d+r-\frac{\zeta}{1+\zeta}\lambda$$

or

$$\frac{K}{Y}=\left(\frac{\delta}{d+r}\right)^{\frac{1}{\zeta+1}} \cdot e$$

Thus, the capital intensity should decline at a constant rate

$$\frac{\zeta}{1+\zeta}\lambda$$

and if GNP grows by g, the capital stock should only grow by

$$g-\frac{\zeta}{1+\zeta}\lambda$$

Where λ is the technical progress rate and $\frac{1}{1+\zeta}$ is the elasticity of substitution

[7] Let η stand for the marginal rate of substitution between K and L (the ratio of the marginal product of L to that of K). Then the elasticity of substitution σ is defined as the elasticity of K/L with respect to η, along an isoquant.

growth rates by relying on high growth rates of capital stock. Especially CES [8] with the WDI-assumption [9] (Weak Disposability of Inputs) and its special cases CD with WDI-assumption and ordinary CES are then particularly interesting.

2. Structure of the Model

One of the guiding principles of model construction is to avoid unnecessary complexity. Therefore several attempts to estimate production functions for an aggregated model of the Bergson type were made. It is well known that Soviet data on aggregate NMP are an unreliable indicator of Soviet GNP and Western estimates of aggregate growth rates are usually lower. Therefore aggregate data from Soviet sources could not be utilized. Some western estimates have been made available to us covering the period 1950–71 and production functions were estimated on the basis of this data.

In addition to the standard Cobb-Douglas production function also a standard CES as well as CD and CES with the WDI-assumption (Weak Disposability of Inputs) have been estimated assuming Hicks-neutral technical progress.

However, economic aggregates such as GNP, capital stock and labor force exhibits very regular growth in the Soviet economy. This leads to problems with multicollinearity and high variance in parameter estimates and also makes it difficult to discriminate statistically between the different production functions. This is rather bad since the projected potential for consumption growth will depend more on the choice of production function than on the assumed growth rates of capital stock and defense spending. Furthermore, the weights that are attached to capital growth are very low (less than 0.1) in all the estimated production functions [10] and much of the GNP growth is in fact explained by the residual, the technical progress factor.

---

[8] A Constant Elasticity of Substitution production function with the elasticity of substitution σ, and constant returns to scale can be written in the following way:

$$Y(t)=[\delta K(t)^{-\rho}+(1-\delta)L(t)^{-\rho}]^{-1/\rho}$$

where

$$\rho=\frac{1-\sigma}{\sigma} \text{ and } 0\leq\delta\leq 1,\ -1\leq\rho<\infty$$

The CES function has the property that an elasticity of substitution that is smaller than 1 (but still positive) implies that an increase of the capital stock by 1 percent contributes less to the percentage increase of GNP the higher the capital intensity (the ratio between capital and labor). In the Cobb-Douglas function this contribution was constant. Cobb-Douglas is the special case of CES when substitution elasticity +1.

[9] The Weak Disposability of inputs assumption is presented by Färe-Jansson (IER 1976). The usual Strong Disposability of Inputs assumption is that $\emptyset(x)\geq\emptyset(y)$ whenever $x\geq y$.

The WDI assumption is instead $\emptyset(\lambda x)\geq\emptyset(x)$ if $\lambda\geq 1$. WDI is a more flexible specification of a production function which allows one to model cases where increases in the supply of a factor may decrease total output. Such situations are easy to conceive of in agriculture where overwatering or overfertilizing is possible.

The CES–WDI used in this study has the structure

$$Y=A[\delta K^{-\rho}+(1-\delta)(L-bK)^{-\rho}]^{-\nu/\rho}$$

and CD–WDI being a special case has the structure

$$Y=A\cdot K\alpha(L-bK)^{1-\alpha}$$

[10] Weight to capital or capital share is defined as $\frac{K}{Y}\cdot\frac{\partial Y}{\partial K}$

or verbally as the percentage increase in output caused by a one per cent increase of the capital stock. The weight to capital is a constant α in an economy represented by a Cobb-Douglas production function. In an economy represented by a CES production function with capital-labor substitution elasticity less than 1 the weight to capital declines as the capital intensity increases.

This failure to estimate aggregate production functions probably does not indicate any errors in the basic data. It is more likely to be a consequence of the fact that the aggregate economy consists of a number of very disparate sectors. In fact by disaggregating to six sectors it is possible to estimate economically acceptable production functions and it is also possible to reduce the projection uncertainty somewhat.

2.1 *Structure of the Disaggregated Model*

The model is a fairly standard, disaggregated input-output based projection model. Since Soviet data refers to material production the computations are in terms of material production [11] only. On the productive side six sectors are differentiated, namely industry, agriculture, construction, transport and communication, trade and distribution, and other. The advantage of using this breakdown is that a reconstructed six sector input-output table for 1966 is available in Treml (1972).[12] Of these the four main sectors industry, agriculture, construction and transport and communication represent 94 percent of the output of material production and 94 percent of capital stock employed in material production. For this reason production functions have only been estimated for the four main sectors.[13] For all the sectors a Cobb-Douglas production function is estimated.

Only for industry, the most important sector, time series are long enough to estimate reliably other types of production function than a Cobb-Douglas. As a sensitivity analysis a CES production function is estimated.

Capital stock and labor force in non-material production and in the minor two sectors are linked to the capital stock and labor force in the four major sectors by assuming a continuation of previous trends. GNP is assumed to grow at the same rate as value added in the material sectors of the economy. Thus, only a multiplicative factor differentiates GNP from value added in the sectors of material production. Therefore the term GNP is in many cases used in the following text, for the sake of brevity, as a proxy for value added in the material sector of the economy.

Thus one assumes that capital stock in the non-material sector and in the minor sectors is 72.8 percent of the capital stock in the four major productive sectors and that this share declines by 0.4 percent per year. It is also assumed that 55 percent of the increments in labor force is allocated to the four major sectors. Total labor force growth projections up to 1990 have been supplied by Dr. Murray Feshbach.

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[11] By far the most important way in which communist national accounting systems differ from their Western counterparts is in the restriction of the concept of production to material product.

Production by Marxist light is the product of social labor in material form. The labor is "social" if the result is reproducible (as works of art are supposed not to be) and if the activity is performed regularly and gainfully (as recreational fishing is not). The product is "material" if it involves a physical good, but the term also embraces energy produced from nonhuman resources.

By type of activity, the material-production sphere is customarily divided into ten composite branches: industry, agriculture, forestry, construction, freight transportation, communication serving production, trade, material supply (literally, material-technical supply), agricultural procurement, public catering, and a miscellaneous branch. (Abraham Becker in Treml and Hardt, Soviet Economic Statistics, p. 71).

[12] Treml, Gallik, Kostinsky and Kruger: "The Structure of the Soviet Economy. Analysis and Reconstruction of the 1966 Input-Output Table". Praeger, 1972.

[13] The trade sector is about as important as the transport and communication sector in terms of manpower. However, in terms of capital and value added it is only a minor sector and considering the data problems and the time limits for the study it was decided not to estimate production functions for the trade sector.

Within the four major sectors labor is allocated in the following way. According to labor force projections by Dr. Feshbach total agricultural labor force may decline by about 1.75 percent per year in the 1975–85 period. Following historical trends labor force in transport and communications is assumed to grow by 2 percent per year over the 1975–85 period. Labor force in construction is determined from output growth [14] and from the production function assuming that capital stock continues to grow at the historically recorded 12 percent per year.

Industrial labor force is a residual. If the output of the construction sector grows by 6 percent/year in real terms, then the industrial labor force will grow by about 2 percent/year over the 1975–85 period which can be compared with the historical growth 1963–73 of 2.2 percent/year. On the demand side three sectors are differentiated namely consumption, investment and defense.

The model then operates in the way described below and in the flow diagram. Given a capital stock it determines by iteration the level of GNP that uses this amount of capital stock [15] as follows. From a tentative level of GNP it determines the levels of consumption, investment and defense expenditures by rules which vary between the three types of projection. (See Figure 1.) Then these levels are transformed by the input-output model into sectoral production levels and by the sectoral production functions into capital need. The GNP is then iteratively adjusted so that capital needs equal available capital. Then capital stock for next year is computed by adding net investment to existing capital stock.

ALLOCATION RULES

1. Consumption vs. defense spending

$K_{t+1}=(1+g_k)K_t$ (prespecified growth rate of capital stock, 6 percent or 8 percent)
$I_t=K_{t+1}-K_t+dK_t$ (d=rate of depreciation)
$D_t=(1+g_D)D_{t-1}$ (prespecified growth rate of defense expenditures)
$C_t=Y_t-I_t-D_t$

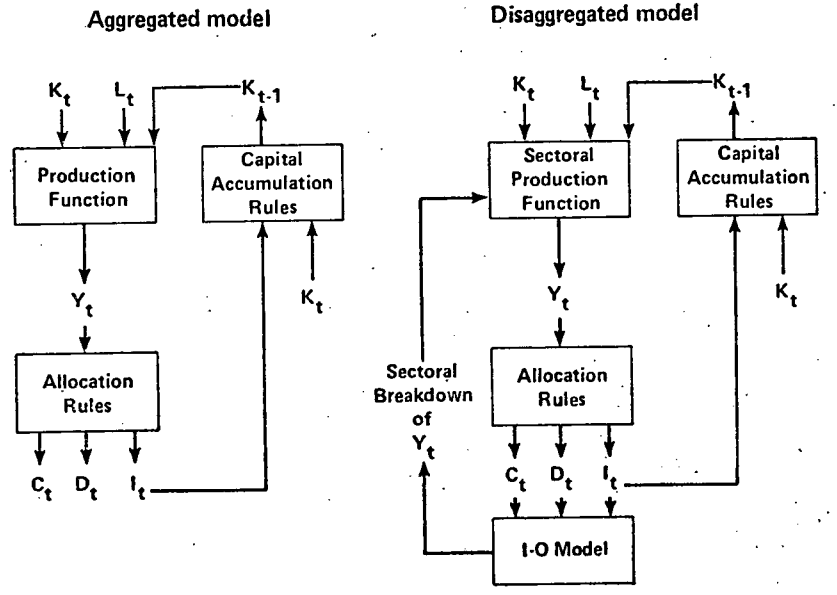
[14] The reason for treating construction in a different way than other sectors is that capital has a very low weight in the estimated production function for construction. If labor force growth rates were to be specified exogenously rather small variations in the endogenously specified growth rate of construction output would require unrealistically large variations in the growth rate of capital stock in construction.

[15] The model is solved in the following iterative way. A trial level of GNP Y_t is guessed or derived from earlier iterations. Defense spending D_t is determined by $D_t=(1+g_D)^t \cdot D_o$. Then C_t and I_t are determined by either of the following three alternatives

$$C_t=(1+g_c)^t \cdot C_o \quad I_t=Y_t-C_t-D_t$$
$$I_t=(1+g_k)^t I_o \quad C_t=Y_t-I_t-D_t$$
$$I_t=k_I(Y_t-D_t) \quad C_t=(1-k_I)(Y_t-D_t)$$

Then the sectoral outputs are computed by using the input-output matrix, the labor force is allocated between sectors and an aggregate capital requirement is computed from the production functions $\hat{K}_t$. $\hat{K}_t$ is now compared with the available capital stock K_t. If $\hat{K}_t$ is larger than K_t, the guessed level of GNP, $\hat{Y}_t$, is adjusted downwards and the calculations repeated. If $\hat{K}_t$ is lower than K_t, the guessed level of GNP, $\hat{Y}_t$, is adjusted upwards and the calculations repeated. The iterations continue until the difference between $\hat{K}_t$ *and* K_t is smaller than a specified tolerance level (in this case usually 0.05 percent of $\hat{K}_t$).

FIG. 1. A COMPARISON OF THE DISAGGREGATED MODEL AND THE AGGREGATED MODEL



2. GNP vs. defense spending

$C_t=(1+g_c)C_{t-1}$ prespecified consumption growth rate (4 percent or 5 percent)

$D_t=(1+g_D)D_{t-1}$

$I_t=Y_t-C_t-D_t$

3. Consumption and Investments vs. defense spending

$D_t=(1+g_D)D_{t-1}$

$I_t=k_I(Y_t-D_t)$ (k_1 constant relative share of investment in non-defense GNP)

$C_t=(1-k_I)(Y_t-D_t)$

To give an idea of the aggregate behaviour some aggregate results are quoted from runs that assume that the shares of GNP that are devoted to defense, consumption and investment remain constant.

In what is henceforth called the basic case, Cobb-Douglas production functions are assumed for all sectors. In the basic case the capital share stays fairly constant around 0.5 and the rate of technical progress declines slowly from 0.5 percent per year toward 0 percent per year. This may seem low, but one has to keep in mind that the capital share is fairly high.[16] Assuming a capital share of 0.4, the technical progress that has been empirically estimated is also low and declining.

[16] See footnote 10.

In fact the aggregate behavior is consistent with the historical performance of the Soviet economy. This is shown by Cohn's data which indicate a 5.6 percent yearly growth rate of GNP 1966–1971 with a 8.2 percent per year growth rate of capital stock and a 1.5 percent per year growth rate of the labor force.

If a CES production function is used for industry but everything else is identical with the basic case, the capital share starts at 0.4 and technical progress at 0.9 percent per year. Over time the capital share declines to 0.3 and the rate of technical progress to 0.3 percent per year.

3. Results

3.1 *Basic Case*

The basic case uses a Cobb-Douglas production function for all sectors (Cf. Appendix II). For industry, the growth factor not explained by labor and capital growth seems to suggest a declining rate of technical progress. A Cobb-Douglas production function with exponentially declining Hicks-neutral technical progress was fitted with very good results. The rate of technical progress starts at 4 percent per year in 1950 and declines by a factor 0.9 every year and thus reaches 0.5 percent in 1973, while the weight on capital is fairly high, 0.5.

The parameters and data for the basic case are given in the appendix II.

3.1.1 *Defense versus consumption (consumption as residual)*

As indicated in the previous chapter, three types of runs have been made. In the first type the trade-off between the growth of consumption (private as well as public) and that of defense expenditures was investigated assuming a growth rate of either 8 percent or 6 percent per year of the capital stock. The growth rate given for consumption is the average over the study period (1975–1985), i.e. it equals the (constant) rate that would yield the same consumption in the last year as in the model run. The results from model runs with varying growth rates of defense expenditures are displayed in Figure 2.

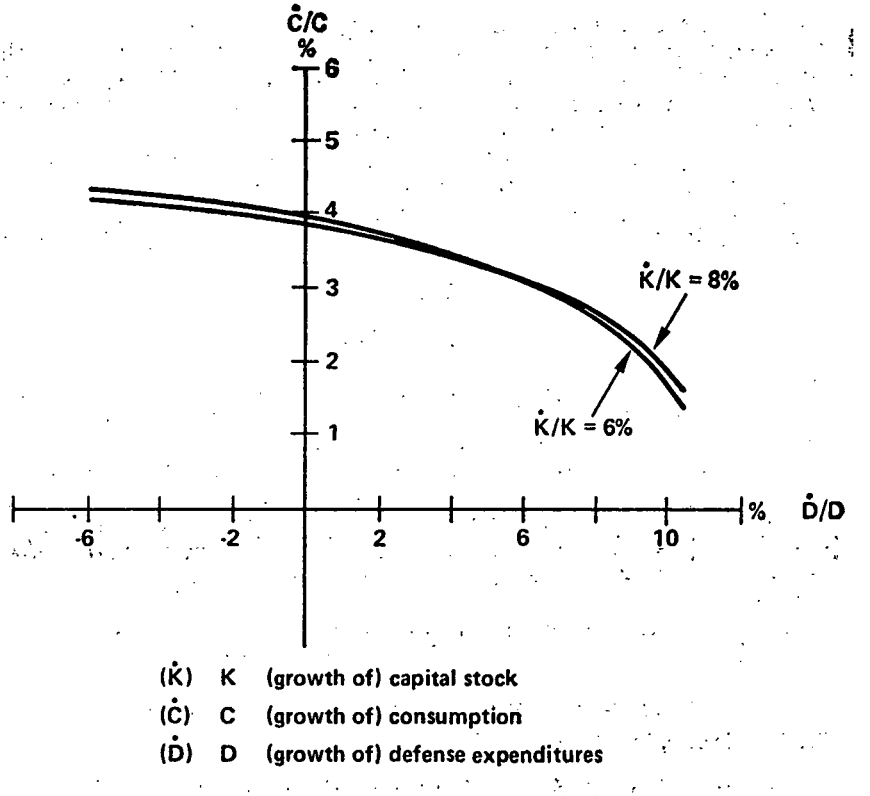


Fig. 2 Basic Case. Consumption as residual.

A zero growth of defense expenditures would admit a four per cent per year growth of consumption, and even a 7 percent per year growth of defense is still compatible with 3 percent per year growth of consumption. The sensitivity to the variation of the capital stock growth rate is small, indicating that the increased growth due to the emphasis on investment is approximately offset by the cost of investment itself over the period covered. Bergson's study assumed a capital weight of 0.4 and gave the result that increasing the capital accumulation rate up to 9 percent is counterproductive. The higher estimated capital weight of 0.50 used here evidently makes capital build-up relatively more profitable. Another factor contributing to the difference in results is also that in a disaggregated model increases in consumption require more investment than the capital buildup, mainly due to production relations in agriculture. In a longer time perspective the scope for consumption growth would be affected negatively by the maintenance of an 8 percent growth rate of capital stock.

3.1.2 *Investment as an endogeneously determined residual*

In an alternative model specification, consumption is determined exogenously, at 4 or 5 percent growth per year from the base year, with investment as a residual. The trade-off between the growth of defense expenditures and the average growth rate of GNP is shown in figure 3.

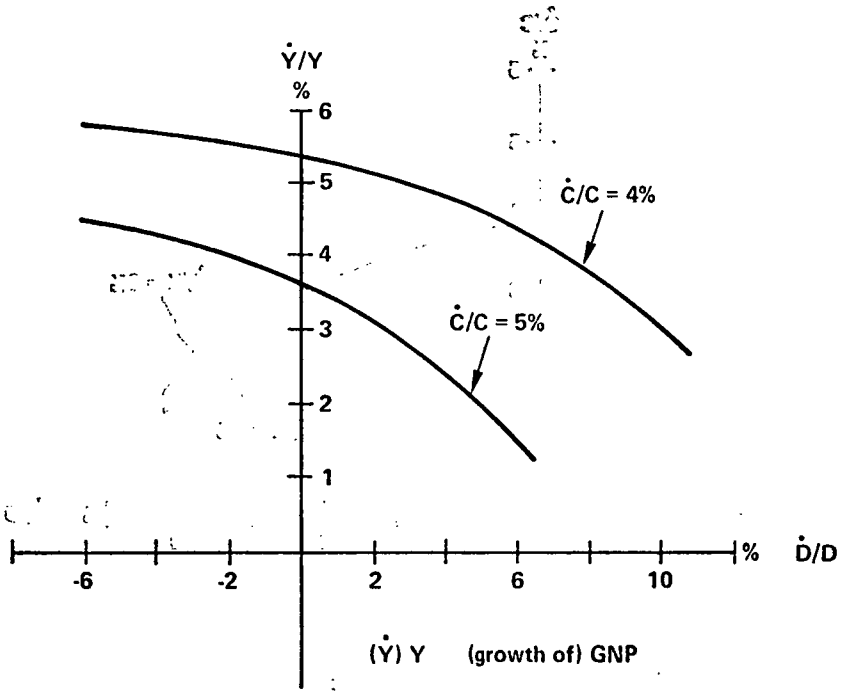


Fig. 3. Basic case. Investment as residual.

If consumption grows at 5 percent per year, investment becomes negative at the end of the period studied, and generally speaking the sensitivity to consumption growth is pronounced. The unstable properties of this model makes it necessary to interpret the results with caution. The average GNP growth rate is sensitive to the choice of end year and decreases if the study period is extended.

A possible explanation of the sensitivity of GNP growth rate to consumption (at 4 percent defense growth, 1 percent increase in the growth rate of consumption costs about 2.5 percent of average GNP growth) is that consumption is assumed to draw substantially from agriculture which requires a considerable, but fairly ineffective accumulation of capital.

3.1.3 *Constant investment and consumption shares*

The third model specification used is supported by the observed long-run behavior of Soviet resource allocation and assumes that, after subtracting an exogeneously determined defense share, the remainder is divided between consumption and gross investment in constant proportions. The resulting average growth rates of GNP and consumption for varying defense growth rates are shown in Figure 4.

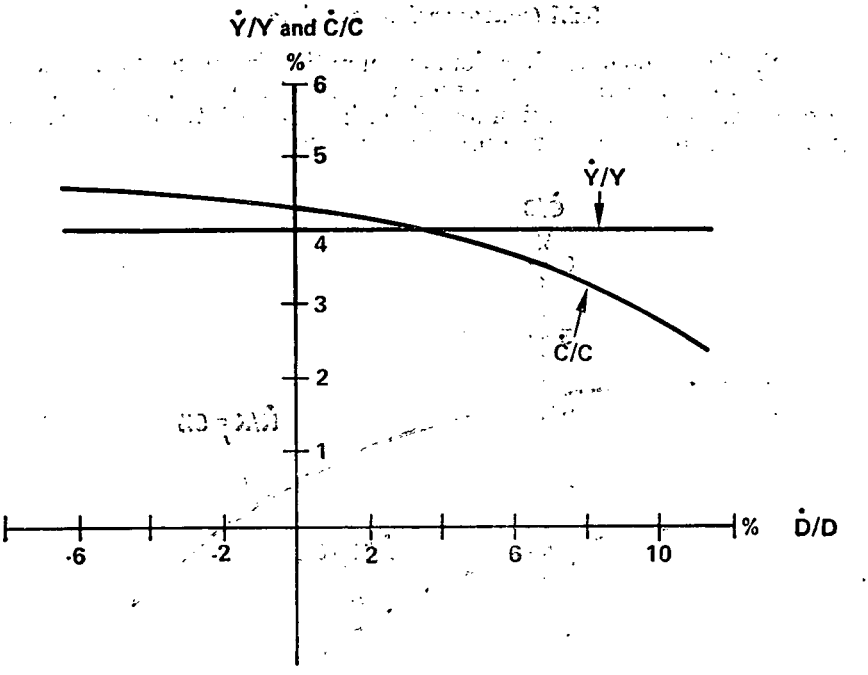


Fig. 4. Basic case. Constant shares.

When the defense growth is increased, resources are taken partly from consumption which primarily diminishes the growth of the latter. However, in a dynamic perspective this frees resources from the capital-requiring agriculture and so makes for a compensation in the long run GNP growth, and so secondarily counteracts the decrease of consumption growth.

Even without this compensation, GNP growth would be little affected by changes in defense growth rate, since only about one third of this change will be conveyed to investment.

3.2 *CES Production Function For the Industry Sector*

A more pessimistic interpretation of the behavior of the technical growth factor (growth not explained by capital and labor force increase) is that a CES production function is a proper functional form rather than Cobb-Douglas. Such a function was fitted with even better results. It is more pessimistic than the special Cobb-Douglas specification used in 3.1 in a long run projection, since in the latter, most of the decline in technical progress rate has already occurred up to 1973. With the CES specification there is still room for the capital share (=capital elasticity of output) to decrease (1973 value=0.4), and such a decline, affecting the input factor that grows fastest, reduces the overall growth rates.

3.2.1 *Consumption as residual*

In the first model specification, consumption is taken as a residual in GNP after subtracting investment and defense cost. The average growth rates of consumption are given in Figure 5 for capital stock growth rates of 6 percent or 8 percent per year.

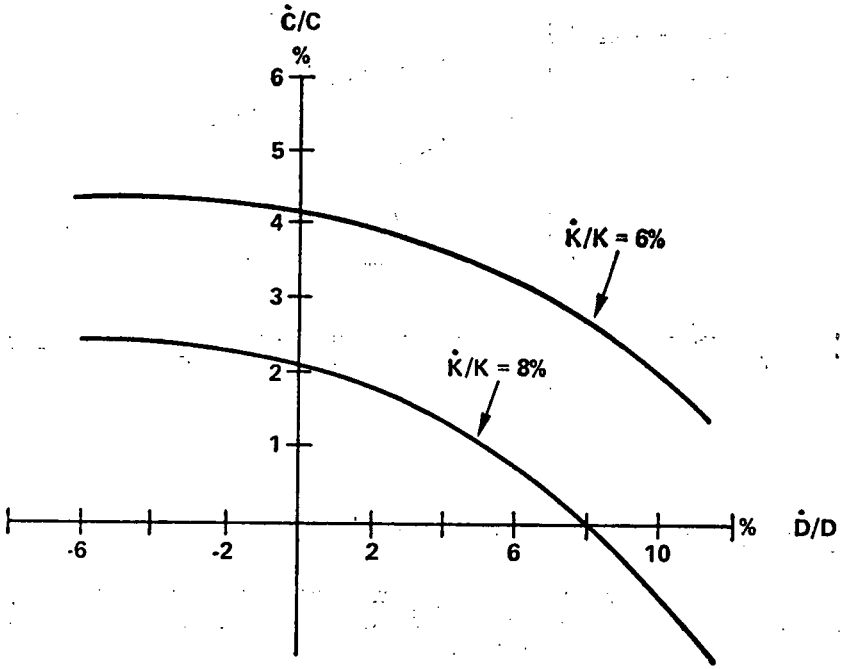


Fig. 5. CES production function. Consumption as residual.

In contrast to the corresponding Cobb-Douglas based model, there is an apparent sensitivity of consumption growth to capital stock growth. This reflects the worse future GNP growth pay-off from increased investment in the CES model. The increase from 6 percent to 8 percent per year capital growth is counterproductive. On the lower of these levels, the consumption growth rate at 4 percent defense cost growth is 3.7 percent per year which is comparable to that in the Cobb-Douglas model.

3.2.2 *Investment as residual*

Taking investment as endogeneously determined, and fixing consumption growth at either 4 percent or 5 percent per year, the trade-off between the growth of defense cost and GNP is as in figure 6.

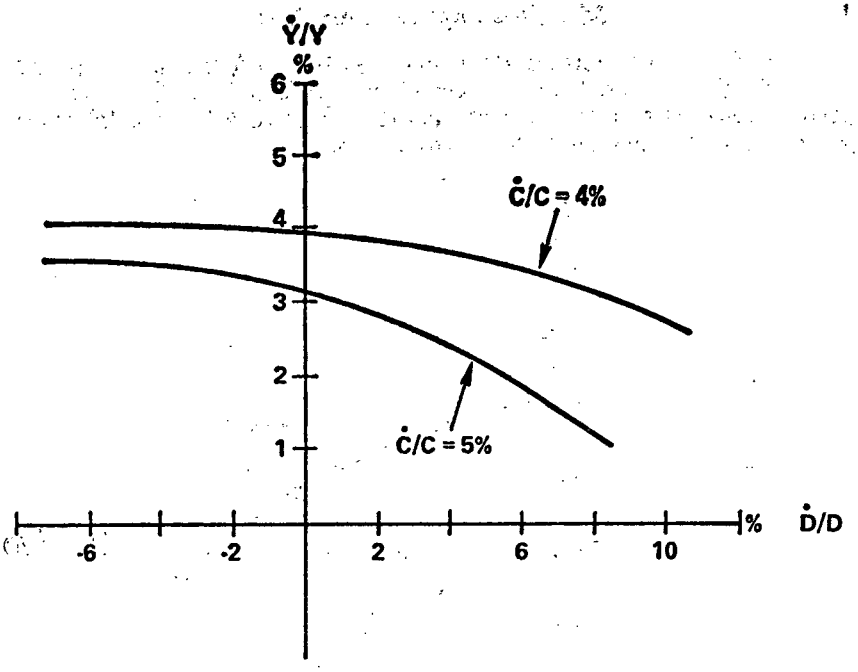


Fig. 6. CES production function. Investment as residual.

Again, the two curves are fairly wide apart, although not as much as in the Cobb-Douglas case. Differences in consumption lead to differences in the opposite direction in investment and consequently in capital stock. Since the CES specification is not as sensitive to changes in the already large capital stock, the qualitative difference is understandable. At 4 percent growth of defense expenditures and of consumption, GNP would grow on average at 3.7 percent year which is more than 1 percentage unit lower than in the corresponding Cobb-Douglas model.

3.2.3 *Constant shares*

The relation between average GNP or consumption growth and defense expenditure growth is given in figure 7 for the model specification where the investment and consumption proportions of GNP minus defense cost are constant.

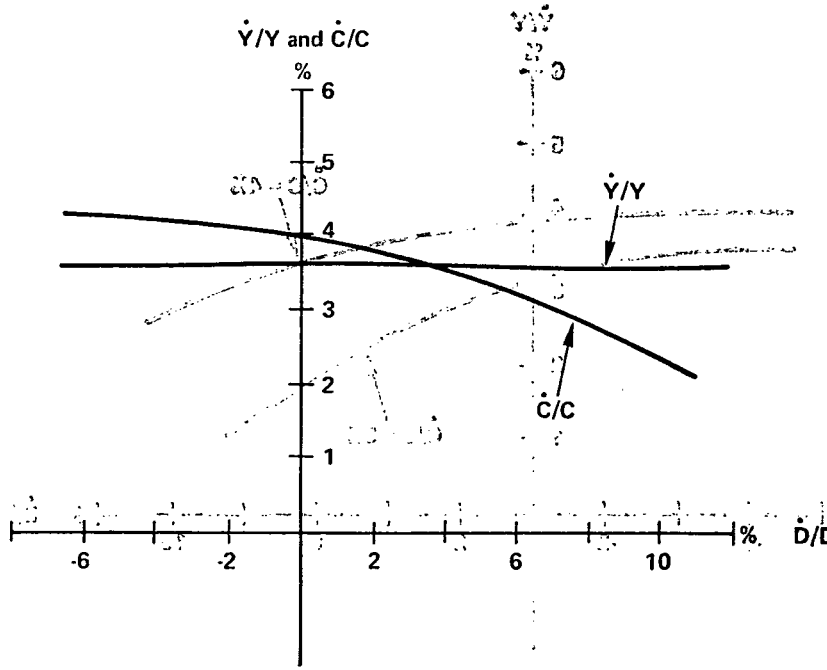


Fig. 7. CES production function. Constant shares.

The same general shapes are repeated as in Figure 4 with the corresponding Cobb-Douglas model. There is a slight shift downwards with both curves about 0.3 percentage units lower in the CES case, reflecting the continuing effects of the pessimistic interpretation of technological progress.

3.3 *Improved Productivity Assumption*

A more optimistic view of the future technological progress may be modeled with a Cobb-Douglas production function with a prescribed rate of Hicks-neutral change. The following variations assume that efforts are made, by improved organization, import of technology or other means, to a technical progress factor in the industry sector that grows by 2 percent per year, which is the average over the years 1950–70.

The same three model specifications have been used as in 3.1 and 3.2. The results should in the first place be compared to those in the basic case, 3.1, since the same type of production function was used.

In the first case (consumption—as—residual), shown in Figure 8, there is no qualitative difference but a substantial right-upward shift, so that at 4 percent defense expenditure growth an almost two percent-

age units higher growth rate of consumption can be sustained. Alternatively, the shift can be interpreted as giving more room for defense growth for the same development of consumption. In fact, this increase is considerable because of the relatively small sensitivity of consumption to defense growth. It amounts to 5–10 percent depending on the level of consumption growth rate.

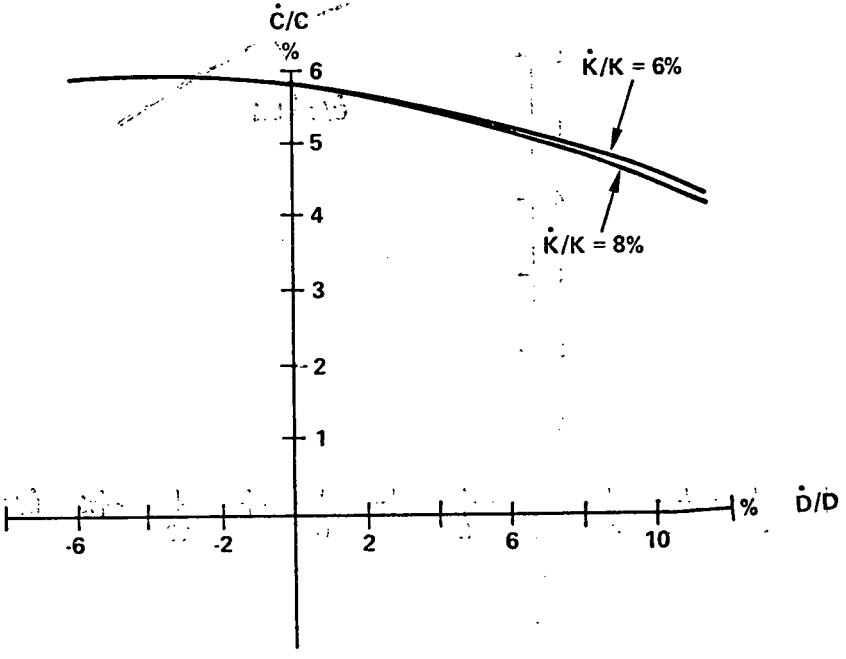


Fig. 8 Improved Productivity. Consumption as Residual.

When investment is seen as a residual, the increased GNP gives more investment, which further accelerates overall growth, and so on. As a result, the upward shift from the basic case, as measured at 4 percent year defense cost growth, is nearly 3 percent. At faster defense growth rates, the difference is even greater (Figure 9).

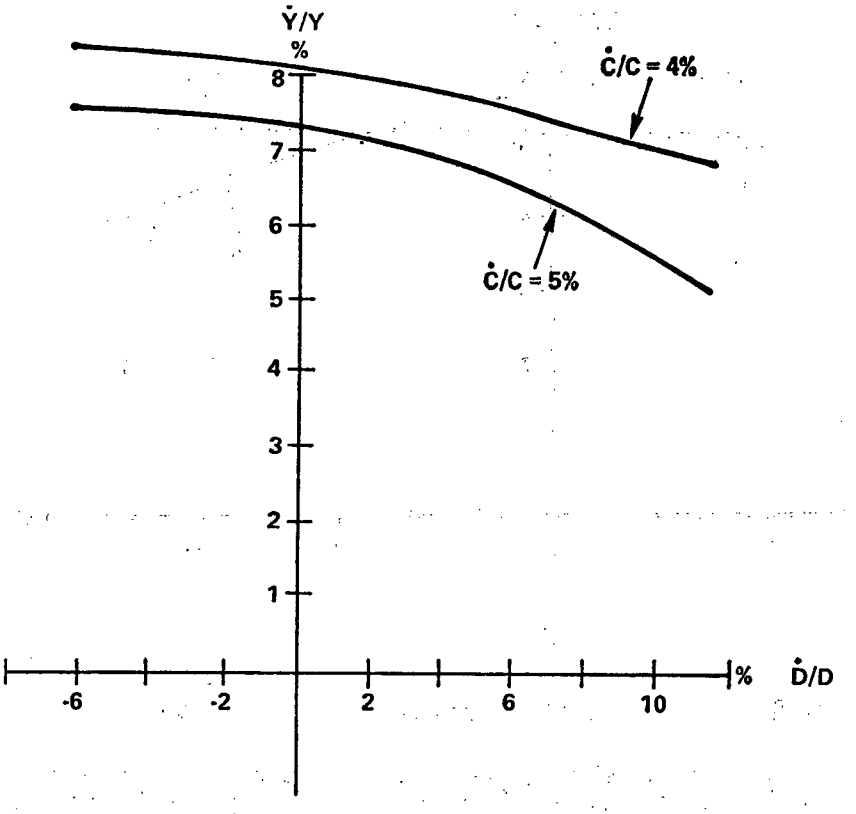


Fig. 9. Improved productivity. Investment as residual.

For the model specification with constant shares of GNP minus defense cost going to investment and consumption, the upward shift is uniformly about 1.3 percentage units. Alternatively, if consumption growth is fixed at 4 percent year on average, defense expenditure growth can be increased from about 3 percent per year to 12 percent per year. See Figure 10.

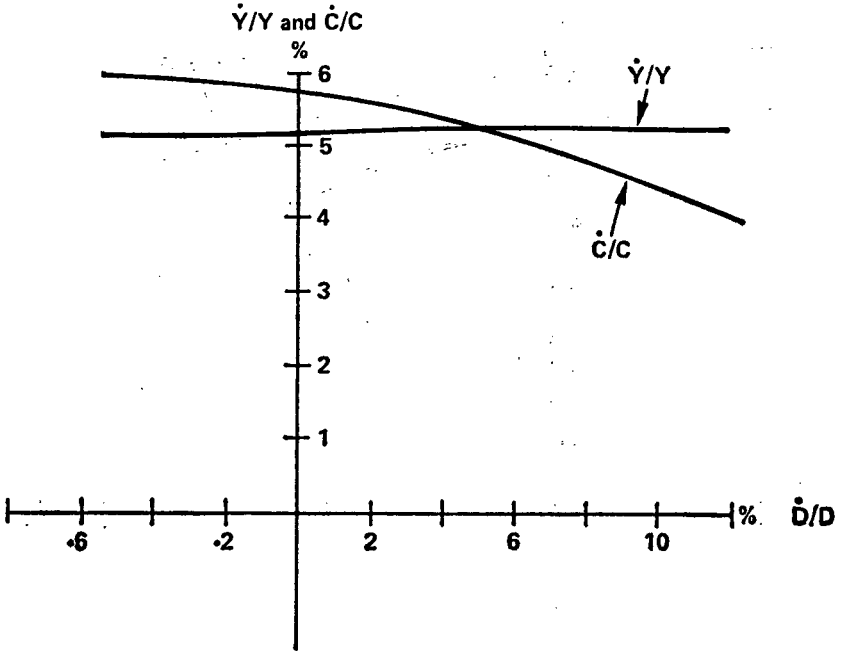


Fig. 10. Improved productivity. Constant shares.

In summary, considering the pronounced effects of an increase of technological progress rate from its trendwise projection back to the earlier average level of 2 percent per year, it stands out as a significant leverage for the future increase of defense.

3.4 *Variation of Defense Demand*

Two further series of sensitivity analyses have been performed, aiming at studying variations of the actual mix of final demand from defense and of the total size of defense expenditures in the year 1973. The assumptions were in the basic case that defense had an 11 percent share of GNP which is distributed with 90 percent taken from industry and 10 percent from construction. The first variation is that the defense share is set to 15 percent. The second one assumes 80 percent industry, 20 percent construction distribution of demand.

The first case is with consumption as a residual, figure 11.

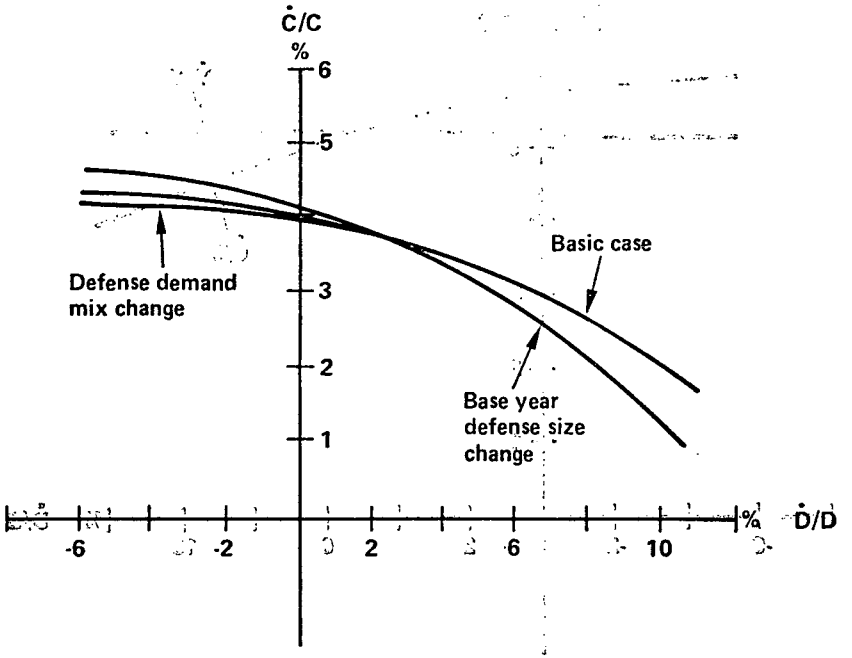


Fig. 11. Variation of defense demand. Consumption as residual.

The effect of varying the defense demand mix is very small. Increasing the total size in the base year has, at growth rates above 3 percent, the effect of reducing the growth of consumption.

Next, investment is taken as residual (figure 12).

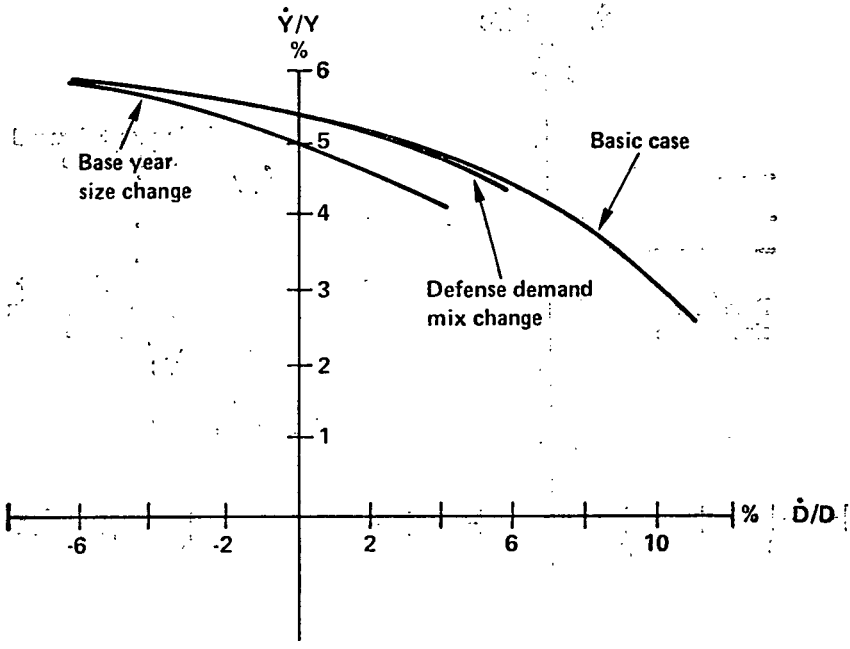


Fig. 12. Variation of defense demand. Investment as residual.

The important variation is that of the total size of defense cost. Even at low or negative growth rates, the loss of investment incurred in the first years causes a drop in the attainable GNP growth rates of 0.5–1.0 percentage units.

The model with constant shares (see Figure 13) shows results in good agreement with the two previous ones.

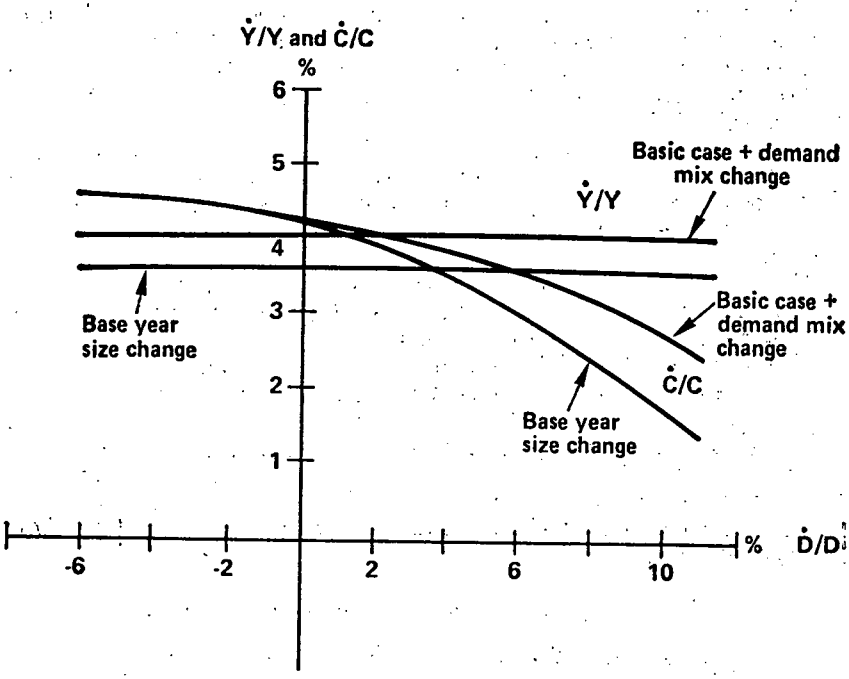


Fig. 13. Variation of defense demand. Equal shares.

In summary, one finds that if the actual share of defense cost in GNP is 15 percent rather than 11 percent, the prospects for the future growth of consumption are worsened for given growth rates of defense expenditures, particularly so for rates over, say, 4 percent. This should probably be interpreted as a limitation to the possibilities of sustaining the higher defense share for an extended period of time. Of course, this conclusion has to be viewed in the light of sec. 3.3 also: If a higher rate of technological progress can be restored, defense can continue to grow fast even from a higher present level.

3.5 *Allocation of Labor and Capital Between Sectors*

Any projection of labor allocation between sectors is by necessity uncertain and it would therefore be interesting to investigate how much potentially could be gained by an optimal allocation of the available labor force and capital stock between the sectors. This will give some indication of whether the projections are too pessimistic due to badly chosen labor allocation.

Fortunately, it turns out that this is not the case. In the basic run, the maximum that could be gained by a different capital-labor allocation is 0.7 percent of GNP in 1975 and 0.9 percent in 1985.

This would be achieved by reallocating labor from industry and transport and communication to agriculture and construction and by moving capital in the opposite direction.

The magnitudes would be small. Industry would lose 1 Million people, transport and communication would lose 3 Million while agriculture would gain 3 Million and construction 1 Million. This can be put in perspective by comparing it with a total civilian labor force of around 140 Million 1985.

It is interesting to see that with the Cobb-Douglas production function for industry the labor release from agriculture seems to be faster than optimum and the optimum rate of release would only be 0.75 percent per year instead of the 1.75 percent per year assumed in the projections.

This of course has to be interpreted rather cautiously since there is considerably uncertainty on production functions and this can affect the optimum labor allocation significantly.

This is demonstrated by a run with a CES production function for industry. In that case the optimum rate of labor release over the 10-year period would be 2.5 percent per year. Even in that case the gains in GNP from changing capital-labor allocation are very small.

The conclusion from these sensitivity analyses would then be that on the level of aggregation used in this model the gains that can be derived from a better capital-labor allocation to produce a given output mix are very limited.

3.6 *Sensitivity Analysis on Consumption Specification*

When one compares the results of this model with those of Bergson's model the most striking difference is that in this model it does not seem that counterproductive to increase the growth rate of capital stock above 6 percent per year. In this section it will be shown that this is primarily a consequence of the disaggregation which in general means that different uses of GNP can not be exchanged on a one unit for one unit basis. In particular the linkage of very inefficient agricultural production to consumption makes increases in consumption more resource demanding than increases in investment. However, arguments could be made that the Soviet government has considerable possibilities to steer consumption in whatever direction is desired and for example away from processed agricultural goods. To test the impact of this we tested a specification where the intermediate deliveries from agriculture to industry were defined as in an ordinary input-output model i.e. linked to industrial output through an input-output coefficient instead of being linked to consumption as in the basic case. The results are shown in figure 14.

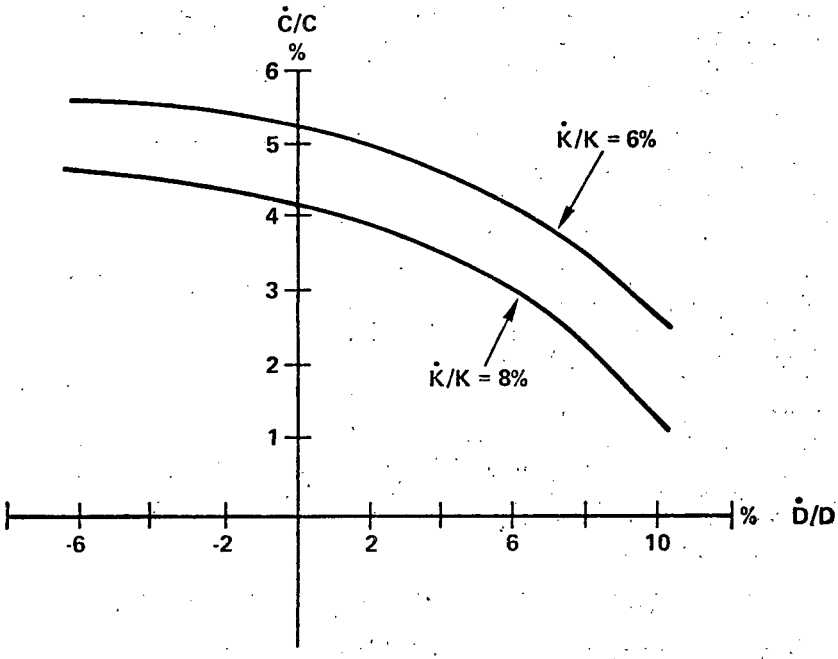


Fig. 14. Agriculture separate from consumption.

It appears that in this case it is indeed counterproductive to have a growth rate of capital stock as high as 8 percent per year.

3.7 *Conclusions*

If investments maintain their present share of GNP then only a 4 percent rate of growth of GNP would seem to be feasible over the 1975–1985 period unless drastic productivity improvements are achieved. The decline from the present 5+ percent growth rate is due to a slower growth of both capital stock and of the labor force.

A growth rate of GNP close to 5 percent could be achieved by maintaining the growth rate of capital stock close to the present value of 8 percent. However, nothing would be gained in terms of resources for consumption or defense by maintaining this high growth rate of GNP since the increase in GNP would be consumed by the higher investment necessary to maintain the high growth rate of capital stock. It could even be highly counterproductive to maintain the 8 percent growth rate of capital stock if a CES production function holds for industry or if agricultural production is essentially independent of the level of consumption.

It is impossible to give very precise restrictions on the growth of the, relatively speaking,[17] small defense sector due to the unavoidable

[17] Defense in comparison to say consumption or investment claims a small share of the economy. However, the share of GNP devoted to defense in the Soviet Union, is certainly high in comparison to that of most other countries.

projection uncertainty. A 0.1 percent error in the projection of the average GNP growth rate would roughly translate into a 1 percent error in the possible growth rate of defense spending, if the defense cost is 10 percent of GNP.

The most stable and the most credible case for judging acceptable average growth rates of defense spending would be the one where consumption and investment would maintain their shares in base year non-military GNP. In the most pessimistic extrapolation of historical trends (a CES production function for industry) defense spending would not be allowed to grow at all over the next 10 years if a consumption growth rate of 4 percent per year is to be maintained. In the basic case (CD production function for industry) defense spending could grow at an average 3 percent per year over the next ten years without reducing the average growth rate of consumption below 4 percent.

The analysis also shows the key importance of the productivity growth. A range of productivity growth rates appear possible. The basic case and the CES case represented more or less pessimistic extrapolations of a downward trend. Another extreme would be to assume that the productivity growth rate in industry could be restored to the average over the 1950–1970 period. In that case defense expenditures could grow by 12 percent per year over the 1975–85 period. However, if such a productivity growth could be attained the growth target for consumption may well be adjusted to 5 percent per year in which case defense expenditures could only grow by an average growth rate of 5 percent per year over the 1975–85 period.

In addition to the uncertainty as to what production function to use, there is a very considerable uncertainty on the size and the mix of defense demand. Sensitivity analysis showed that errors in estimating the mix do not matter much. If the size is not correctly estimated there will be a definite effect on the growth rates of defense expenditures that can be sustained. A 4 percent higher share of GNP going to defense in 1973 would imply that the acceptable rate of growth is reduced by 2–3 percent over the 10-year period. This in fact means that the acceptable level of defense spending in 1985 is fairly insensitive to the the initial size of defense expenditures. A higher initial estimate is compensated by lower acceptable growth rates. The consequences of an erroneous estimate of the present defense burden for the estimate of future build-up of defense capital may be small both in the long run and in the short run.

The results of the two other tradeoffs, namely those where consumption or investment is treated as residual, have to be treated with caution since acceptable average growth rates in these cases may often be combined with unacceptable growth rates close to the end of the period.

If capital stock is assumed to grow at 8 percent per year and consumption is a residual, then the basic case (Cobb-Douglas production function for industry) a 0 percent growth rate of defense expenditures is compatible with a 4 percent growth rate of consumption. At the lower end of the range of productivity growths (represented by the CES) a 4 percent growth rate of consumption cannot be reached while at the higher end a 12 percent growth rate of defense expenditure is compatible with a 4 percent growth rate of consumption over the 1975–85 period. If capital stock is assumed to grow at 6 percent

per year and consumption is required to grow at 4 percent per year over the 1975–85 period, the basic case allows a zero percent growth rate of defense spending, the CES and the higher productivity growth assumption allow for a 2 percent and 13 percent growth rate of defense spending respectively.

If instead consumption is predetermined at an even 4 percent growth rate over the 1975–85 period and investment is the residual, the tradeoff is between GNP-growth and defense spending. It is harder to specify a target for GNP growth but less than 4.5 percent may not easily be accepted by the Soviet government. A 4.5 percent growth rate of GNP is compatible with a 5 percent growth rate of defense spending in the basic case.

It is not possible to attain it in the CES case while in the improved productivity case defense can growth even faster than 10 percent per year.

Summarizing it appears that unless substantial improvements in productivity are achieved growth rates of defense spending would have to be held below the growth rate of GNP.

It is important to note that there are many elements of reality which are not captured by the model and that these may affect the conclusions.

For example, it has been maintained that while the defense sector may claim no more than 10 percent of GNP it uses up a much higher share of very qualified resources such as R. & D. It is very hard to quantify such relationships, but some sensitivity analyses have been made using reasonable assumptions to link civilian technical progress to the size of the defense sector. Introducing this linkage predictably made the growth rate of GNP much more sensitive to the size and growth of the defense sector although the maximum acceptable growth rates of defense spending were not much affected.

4. Long Term Growth Potential for the Soviet Economy

Already in the 10-year perspective, growth rates of GNP decline toward the end of the period. It is therefore interesting to study the long-term growth potential for the Soviet Economy which turns out to be much smaller than could be expected from results in a 10-year perspective. In that context it is also interesting to investigate questions such as that of the optimum investment ratio.

Let us first assume that the economy can be represented by a Cobb-Douglas production function with technical progress λ percent per year, and weights on capital and labor α and $1-\alpha$ and an increase of labor force l percent per year. If the capital stock increases by k percent per year the GNP will increase by $\lambda+\alpha k+(1-\alpha)l$. If capital stock grows faster than GNP in the long-run then the share of GNP that has to be devoted to investments in the long-run will increase beyond 100 percent. Thus capital stock cannot grow faster than GNP over long periods of time. Growth rate of capital stock is then also in the long-run limited to $\lambda+\alpha.k+(1-\alpha)l$.[18]

Thus

$$k=\lambda+\alpha\cdot k+(1-\alpha)l \text{ or } k=l+\frac{\lambda}{1-\alpha}$$

[18] By maximum long run growth rate of a variable K_t we mean

$$100 \lim_{t\to\infty} \frac{1}{t} \log (K_t/K_o)$$

(%/year)

The maximum growth rate of GNP in the long run is thus also

$$l+\frac{\lambda}{1-\alpha}.$$

If instead the more general CES-production function is assumed, that is

$$Y=e^{0.01\lambda t}[\delta K^{-\zeta}+(1-\delta)L^{-\zeta}]^{-1/\zeta}$$

two cases will have to be separated namely $\zeta>0$ and $-1\leq\zeta<0$.

For the case $\zeta>0$ the long run growth rate is bounded by $\lambda+l$.

If K grows faster than L the second term will become dominating provided that ζ is positive and the bracketed expression will grow like $L^{-\zeta}$ only. Even if the long run growth rate is maximized by $(\lambda+l)$ percent per year the capital stock does not need to grow by more than l percent per year in the long run to achieve the performance, and the maximum long run growth rate could thus be maintained by an investment share which in the long run tends to zero.

As ζ approaches zero the production function approaches a Cobb-Douglas production function. For negative values there is no limit to the long-term growth rate. Empirically observed values of ζ are usually positive.

The basic case of the model behaved in 1975 approximately as a Cobb-Douglas function with a capital share of 0.5 and a technical progress parameter of 0.5 percent, i.e. each increment of 1 percent of the capital stock or of the labor force increases output by 0.5 percent and if capital stock and labor force are kept unchanged the output anyway increases by 0.5 percent per year. If the economy were well represented by a Cobb-Douglas production function with the parameters indicated above, and if the labor force were to grow by 1 percent per year then the maximum long-term growth rate of GNP, defense and consumption would only be 2 percent. This is even an optimistic view of the economy since the growth rate of labor force is projected to decline to about 0.5 percent per year by 1990 and the Hicks-neutral technical progress factor also in the basic case seems to decline over time.

If the CES-variant of the model is studied, maximum long-run growth rate seems to be even lower or 1.8 percent assuming a 1 percent growth rate of the labor force.

4.1 *Optimality*

4.1.1 *Cobb-Douglas production function*

Determining the maximum long-term growth rate (also called the natural rate of growth by Phelps and Solow)[19] does not suffice to determine uniquely the growth curve for the Soviet economy. The maxi-

[19] Phelps, E. S.: "The Golden Rule of Accumulation: A Fable for Growthmen", American Economic Review, vol. 51, 1961 and Solow, R. M.: "A Contribution to the Theory of Economic Growth", Quarterly Journal of Economics, vol. 7, 1956.

mum growth rate can be reached for any level of investment ratio. Phelps and Solow [20] among others have treated this problem and formulated a so called golden rule which leads to the optimum growth curve assuming a constant growth rate. The golden rule is applicable to a Cobb-Douglas case and yields the simple result that the investment share should be the same as the weight on capital in the production function.[21] From that point of view the present investment ratios at least do not seem to be too high since the weight on capital seems to be around 0.4–0.5.

However the golden rule assumes a constant growth rate. It is simple to show that if the optimality criterion is maximum value of a consumption stream discounted to present value, a constant growth rate is not in general optimal. In this case it can easily be shown [22] that for those years which are unaffected by initial values and by horizon effects the optimum is to have a fixed share of GNP going to investments namely

$$\frac{g+d}{d+r}\alpha$$

where g is the natural growth rate of economy r is the discount rate and d is the depreciation rate. Thus unless g and r differ much this share would tend to be close to α. As an example assume

$\alpha=0.5$ $g=0.05$ $d=0.03$ $r=0.10$. Then the optimal share is 0.31.

4.1.2 *CES-production function*

Golden rule arguments do not apply to this type of production function. Maximization of a discounted consumption stream gives the following result for those years that are unaffected by initial conditions and horizon effects [23].

It is optimal to let the capital stock grow by

$$g-\frac{\zeta}{1+\zeta}\lambda.$$

For non-negative values of ζ [24] this implies that the capital stock will grow slower than GNP.

As an example assume $\zeta=1$. $g=1.8\lambda=0.8$. The optimal growth rate for capital stock would be 1.4 percent per year.

5. Acknowledgement

We wish to express our gratitude to the following persons who have been particularly helpful during the preparation of this paper. We thank Mr. Färe (University of Lund, Sweden) for his assistance with production functions, Mr. Jansson (previously with the National Defense Research Institute, Sweden) for providing us with the non-

[20] Ibid.
[21] See footnote 5.
[22] See footnote 6.
[23] See footnote 6.
[24] Empirically most often ζ is non-negative.

linear estimation program, Mr. Rylander (National Defense Research Institute, Sweden) for providing material and communicating his insights from previous work in this field, Mr. Hardt (Library of Congress, Washington, D.C.) for arranging our contacts with U.S. researchers, and Mr. Green and Mr. Levine (both from the Wharton School of Economics) and Mr. V. Treml (Duke University) for providing access to data and for helpful comments on an early version of this paper.

Appendix I

Structure of the model

1. Balance equations

$$(I-A_t)X_t=C_t+D_t+I_t+F_t+W_t$$

where I *is an identity matrix*
A_t is a time dependent input-output matrix
X' is a vector of sectoral production levels
C_t is a vector of consumption by sector
D_t is a vector of defense resource use by sector
I_t is a vector of resources used for investment by sector
F_t is a vector of net trade by sector
W_t is a vector of wasteage by sector
K_t is a vector of capital stock by using sector

2. Accelerator relationships

$$I_t=NI_t+R_t$$

and

$$NI_t=B(K_{t+1}-K_t)$$

where
R_t is a vector of reinvestments (by sector of origin)
NI_t is a vector of net investment (by sector of origin)
B is a matrix relating investments by sector of destination to investments by sector of origin.

Implicit in this formulation lies an assumption of uniform investment lags of the same length as the time period (1 year).

3. Reinvestments

In I–O models reinvestments are usually specified as a constant ratio of existing capital stock. This ratio may vary between different sectors and/or between different types of capital goods (buildings depreciate much slower than machinery). In this model reinvestments R_t are determined by

$R_t=BGK_t$ where G is a diagonal matrix which gives the depreciation rate for capital by sector of destination. Implicitly, one assumes by this formulation that the age structure of capital stock either does not matter or does not change.

4. Consumption function

Several alternative specifications are possible here. Aggregate consumption C_t is determined by any one of the following specifications.

A. $C_t=(1+g)^t \cdot C_o$ where g is a politically determined growth rate i.e. a goal that should be tested for consistency.

B. $C_t=k_c Y_t+\overline{C}$

This approach is formally equivalent to a Keynesian approach and may seem irrelevant to the Soviet economy.

In a planned economy such as that of the Soviet Union the investment ratio and the savings ratio are determined on the government level rather than by individual preferences. However, the private consumption share of GNP has stabilized in the 1960's at 51 percent after a decline from the 55 percent recorded

in the early 50's (Cohn, JEC 1973, p. 151). Public consumption and administration has shifted slightly upwards, and thus the formula

$C_t = k_c Y_t + \bar{C}$ would fit empirical data well if

$k_c = 0.59$ and $\bar{C} = 0$.

C. C^t is determined freely to optimize some utility function or is a residual item.

For all the alternatives the following standard specification is suggested relating consumption by sector to total consumption.

$$C_t^i = f_i \cdot D_t + \bar{f}_i$$

where $\bar{f}_i$ is some kind of subsistence consumption vector with components that add to zero (for most countries it would have positive components for goods such as agriculture and processed food, negative for car, TV etc.) Sometimes a population growth factor is applied to $\bar{f}_i$ but since the data base is weak we have chosen to use as simple a formulation as possible.

5. *Defense spending*

D_t is to be determined exogenously.

Usually $D_t = (1+d)^t D_0$ where d is an exogenously specified growth rate that is parametrically varied. Sectoral defense demands are determined as

$$D_t^i = d_i D_t.$$

6. *Trade*

Foreign trade is in numerical terms a very small sector in the Soviet economy. Therefore an extremely simple modeling approach has been used. Net trade by sector F_{it} is determined as a fixed proportion f_i of GNP, Y_t. Thus, $F_{it} = f_i Y^t$ where f_i in no case is larger than 0.02.

7. *Wasteage*

Wasteage is also a very small item, which is determined as a fixed proportion of Y_t.

Thus $W_{it} = w_i Y_t$

8. *Net investments*

Investments are determined as a residual unless consumption is determined as a residual.

In that case investments are determined so that a given growth rate of capital stock is attained. Then $NI_t = r \cdot K_t$ where r is the specified growth rate of capital stock.

9. *Production function*

$$X_t^i = F(K_t^i, L_t^i, t)$$

where X_t^i denotes gross production, or

$$\left(1 - \sum_j a_{ji}\right) X_t^i = F(K_t^i, L_t^i, t)$$

where the left hand side denotes value added.

10. *Sectoral allocation of labor*

There are two methods utilized to allocate labor between sectors. The first one used, in all runs but one, assumes a continuation of existing trends.

The second one, which is used only in a sensitivity analysis to test the effects of different allocations of labor among the sectors, assumes an optimal allocation of labor and capital among the sectors to produce a given output mix with as little capital as possible.

FIRST METHOD

$$L_t^i = L_o^i\ (1+g_i)^t \quad i=3,4$$

(Trends for labor force in sectors 3 and 4, i.e. agriculture and transport and communications)

$$K_t^2 = K_o^2\ (1+g_{2K})^t$$

$$\bar{Y}_t^2 = F_2(K_t^2,\ L_t^2,\ t)$$

(For sector 2, construction, the employed labor is determined from the production function assuming that capital stock in construction follows a growth trend)

$$L_t^1 = L_t - L_t^2 - L_t^3 - L_t^4$$

(Labor force in sector 1, industry, is determined as a residual)

SECOND METHOD

$$\text{Define } \eta_i = \frac{\frac{\partial Y_t^i}{\partial L_t^i}}{\frac{\partial Y_t^i}{\partial K_t^i}}$$

Then L_t^i, K_t^i are determined by the following set of equations.

$$\Sigma L_t^i = \bar{L}_t$$

$$\eta_1 = \eta_2 = \eta_3 = \eta_4$$

$$F_i(K_t^i,\ L_t^i,\ t) = \bar{Y}_t^i$$

Then

$$K_t = \sum_{i=1}^{4} K_t^i$$

is the minimum amount of capital stock that is needed to reach production targets $\bar{Y}_t^i$ with an available labor force $\bar{L}_t$.

11. Objective function

In the case that one uses the model as a simulation device one still needs a criterion function. A proper criterion function regardless of the consumption function specification could be the growth of GNP. In the optimizing case we suggest the straight-forward objective function

$$\sum_{t=0}^{J} \frac{1}{(1+r)^t} C_t$$

12. Availability of data and simplifications

We have available input-output matrices for 1959, 1966 and in preliminary form for 1972. These also give the structure of public consumption, private consumption, and investment but not of defense. However, based on international comparisons we believe that one can probably, at least with the rather low level of disaggregation we utilize, take US data as representative for defense.

For capital stock a complete destination-to-origin matrix is available but is probably affected by the usual statistical problems associated with such matrixes. For a number of reasons we have instead chosen to assume that the destination-to-origin matrix consists of a number of equal rows, that is that the composition of investment is independent of its destination. The following three reasons should suffice.

1. By using this assumption together with the assumption of freely shiftable capital goods between using sectors (the later assumption is not necessary if no sector shrinks by more than its depreciation rate) one can describe the capital stock and its development over time by a one-dimensional variable. This simplifies immensely the calculating routines especially if optimizing over time is contemplated. In fact it would probably have been impossible to program this flexible model within the time that was available without this assumption.

2. The model, as specified, with a general matrix B, would normally, although not always, be unstable, i.e. some sectors would grow faster than the balanced growth rate and some would shrink and become negative.

The assumption of uniform capital structure and freely shiftable capital guarantees stability unless the sum of aggregate private and public consumption and defense spending grow faster than the GNP in which case total investments will become negative.

3. Numerical evidence is that the capital structure by origin is not all that different for the major sectors, at least not on an aggregate level.

The average values seem to be 60 percent construction, 32 percent machinery and equipment and 8 percent other.

Appendix II

Data and Assumptions

1. *Relationship between the four major sectors and the entire economy*

1.1 *Capital stock*

Total capital stock by Jan. 1, 1974 has been taken as 1082 Bn Rubels (from Narkhoz). From the same source productive capital is given as 675 Bn Rubel and productive capital in the four major sectors, industry, agriculture, construction, and transport and communications as 625 Bn Rb.

A trend can be clearly seen from Narkhoz time series of total capital stock and total unproductive capital stock in 1955 prices for the period 1960–73. If total capital stock is denoted K_{tot} and total unproductive capital stock up K_{up} then $\frac{K_{up}}{K_{tot}}$ declines by a factor 0.996 each year. This is equivalent to an assumption that $\frac{K_{tot}}{K_{prod}}$ declines by a factor 0.996 each year where K_{prod} denotes productive capital stock. The two minor sectors, trade and distribution and other branches of material production have small capital requirements which could be expected to increase at about the same rate as unproductive capital. Therefore, if capital stock in the four major sectors is denoted by K_{4p} the assumption would be that $\frac{K_{tot}}{K_{4p}}$ declines by a factor 0.996 each year from its value 1.732 in 1973.

1.2 *Labor force*

A historical trend for labor allocation between the four major productive sectors on one hand and the rest of the economy on the other hand can be derived from labor statistics published in Soviet Economic Prospects for the Seventies (JEC 1973 p. 520–521).

During the 1950–1971 period 56 percent of the increment of the civilian labor force was allocated to the four major productive sectors while 44 percent was allocated to the productive and non-productive service sectors. We assume a continuation of this trend slightly modified to 55 percent and 45 percent.

1.3 *Production*

Total value added in material production is computed in the model. By definition this has to be equal to the sum of final demand for products produced in the material sphere.

Data in JEC 1973 p. 124 combined with depreciation data indicate that at least over the 1965–1970 period growth rates of GNP and of value added in ma-

terial production do not differ substantially. This impression is strengthened by longer time series compiled by the OER for the Wharton-EFA model. These indicate that the difference between the growth rates of GNP and of value added in material production is only about 0.1 percent over the 1960–1973 period. Therefore, the assumption used in the model was that the growth rate of GNP was the same as that of value added in material production.

2. *Capital formation*

In this context one has to define the links between gross investment, gross fixed investment and net fixed investment. Investment in stocks is given by Narkhoz in current prices and average 8.5 percent of value added in material production. This is then the adopted specification of investment in stocks.

Soviet depreciation rates are inconsistent with time series over net fixed investment and over capital stock. This suggests that the depreciation rates are pure accounting concepts used to calculate NMP from value added in material production. Nevertheless, increases in capital stock are consistently smaller than gross fixed investment. The difference would represent capital retirement and was estimated as a percentage of capital stock from time series over capital stock and gross fixed investment. The percentage that gave the best fit turned out to be 2.2 percent.

Data for capital stock in 1955 prices were taken from Narkhoz and adjusted to 1973 price level by multiplication with 1.166 which is the ratio between 1973 investments in 1973 prices and 1973 investments in 1955 prices. Similarly investment in fixed capital were taken from Narkhoz in current prices.

3. *Labor force*

The following estimate of the increase in civilian labor force over its 1973 levels has been provided by Dr. Murray Feshbach of the FDAD.

TABLE

[Increment in labor force since 1973]

	Millions
1974	2.889
1975	4.797
1976	6.978
1977	9.140
1978	11.148
1979	13.113
1980	14.944
1981	16.596
1982	18.075
1983	19.387
1984	20.425
1985	21.366
1986	22.152
1987	22.803
1988	23.574
1989	24.349
1990	25.170

As earlier stated it is assumed that 55 percent of the increment will be allocated to the four major productive sectors.

Agricultural labor force is projected to decrease by 1.75 percent per year* while that in transport and communication is projected to grow by 1.5 percent per year. Capital stock in construction is projected to increase by its historical rate 12 percent and the labor force is determined from the production function. Finally, the labor force available to industry is determined as a residual. In the basic projection industrial labor force grows by about 2 percent per year.

The base value for the four sectors together is 90.3 Million in 1973. Other assumptions about e.g. rate of labor release from agriculture might easily be tested.

*Source: Preliminary projection supplied by Dr. Murray Feshbach of the FDAD.

4. *Use of material value added*

Cohn (J.E.C., 1973, p. 160) and Bergson give estimates of the proportion of GNP used for various purposes. One cannot from these figures directly infer similar proportions for the use of material value added. However, since value added in the material sector of the economy represents more than 80 percent of GNP, the proportions should not differ too much. Treml et al.[1] estimate investment and other as 38.9 percent of the material value added and consumption as 61 percent.

Defense is not separately identified but is included partly among consumption, partly among investment.

Private communication with Treml has indicated one possible breakdown of defense expenditures. One half of defense resource use could be included in the investment account. There is an 18 Bn Rb discrepancy in 1972 between stock investments and actual increase in stocks of enterprises. This could be interpreted as defense and might amount to 5.5 percent of value added in material production. Additional items of defense expenditures would include the explicit defense budget and some part of the science budget. The explicit defense budget in 1972 was only 18 Bn Rb and the science budget was 7 Bn Rb. Estimates vary on the percentage of science that should be allocated to defense. Alternatives mentioned are 50 percent and close to 100 percent. If one assumes that 50 percent of science is defense related and that 80 percent of the defense budget and the science budget represent a burden on material production, then about 5.5 percent of value added in material production would be defense included with consumption in the I–O table.

Assuming that the "investments and other" item in the input-output table also includes the waste, the use of value added in material production would be distributed in the following way in 1972:

investment—32 percent (of which 3 percent to stocks) [2]
consumption—56 percent
defence—11 percent
waste—1 percent

It should be noted that all these calculations by necessity contain a large element of guess work and the margin for error especially on the defence seems to be large. In fact, estimates of the size of the defense have varied between 6 percent and 15 percent of GNP.

The analysis in this section disregards one of the problems usually encountered when Soviet defence burden is estimated. Shadow pricing of personnel is not necessary since personnel is not delivered from material production. It is however easy to check the impact of increasing military personnel requirements since the model uses total civilian labor force as an input.

5. *Trade and waste*

There is some trade to be accounted for although the Soviet economy is an unusually closed economy. Since the trade is small in financial terms only very simplistic assumptions were utilized. Thus we have assumed that net imports to industry and to agriculture is 2 percent and 0.5 percent respectively of material value added, while net export of trade and distribution is 2.5 percent of material value added.[3] Similarly wasteage is assumed at 1 percent of material value added and is assumed to come mainly from the construction sector.[4]

6. *Input-output table*

Three six-sector input-output tables have been available namely 1959, 1966 and a preliminary 1972 matrix (source FDAD) all in purchaser's prices. Usable input-output matrices in producers prices were only available for 1959 and for 1966. Therefore, the projections have been made in purchaser's prices despite the distortions that are introduced in this way. The difference between purchaser's

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[1] The Structure of the Soviet Economy, p. 185.

[2] Thus the share of investment in material value added would be higher than in GNP. There are other indicators that also point in this direction. An investment share of 33 percent and a share of investments coming from construction of 65 percent is consistent with the 1973 output from the construction sector. Also one would suspect that the part of investment that comes from material production is higher than that of consumption.

[3] Treml, p. 185.

[4] Inferred from Treml and Hardt, p. 72, Treml, p. 216.

and producer's prices is due to different allocation of the costs of transportation and trade and distribution as well as to the impact of the turnover tax. Soviet data on GVO seem to be a hybrid in that they are in producer's prices but with turnover tax added. (A. Becker in Soviet Economic Statistics p. 101). Thus the linking of input-output data with national accounting data and production functions will necessarily introduce some distortion and in fact it appears that the distortion may be smaller if a purchaser's priced matrix is utilized since the turnover tax rate seems to be more variable than the input coefficients of transport and of trade into the other sectors.

6.1 *The 1973 matrix*

The principles listed below have been followed to construct the elements in the 1973 matrix taking into account that the 1972 matrix is still preliminary.

1. If a coefficient fluctuates without a trend and the 1972 value is not far out, the average value of the coefficient in the 1959, 1966, and 1972 matrices is assumed to represent the coefficient in the 1973 matrix.
2. If there is a trend the 1972 value is used.
3. If 1972 value is completely out of bounds, the average of 1959 and 1966 values is used.
4. The coefficient agriculture to industry is subject to special treatment and set to zero. The deliveries from agriculture to industry are handled outside the input-output matrix to model more properly the linkage between the growth of consumption and the growth of agricultural production. This will be further described in the section on consumption functions.

THE 1973 MATRIX

	Industry	Construction	Agriculture	Transport and communication	Trade and distribution	Other branches
Industry	0.4377	0.4992	0.0986	0.2194	0.0877	0.1343
Construction	0	0	0	0	0	0
Agriculture	0	.0013	.2382	0	.0027	0
Transport and communication	.0544	0	.0106	0	0	0
Trade and distribution	.0413	0	.0336	0	0	0
Other branches	.0021	.0117	.0008	0	.0027	0

6.2 *Projection of the 1973 matrix*

Only the industry to industry coefficient shows a persistent trend that is important enough to be included in the modeling. Thus from 1959 to 1972 this coefficient increased by 0.91 percent/year and it is assumed that it will continue along this trend.

7. *Sectorial structure of demand*

7.1 *Investment*

This is assumed to be 65 percent construction, 27 percent machinery and 8 percent other. Most of the "other" item would be delivered from industry but a small part will come from agriculture. The small part from agriculture is disregarded and the proportions used are 0.65 construction and 0.35 industry. The breakdown given in Narkhoz 1973 is actually 60 percent construction, 32 percent machinery and 8 percent other but that includes the parts of defense spending that are included under the investment label. Defense investments are usually much more machinery oriented. It would also be hard to explain the volume of the construction sector if the share of capital formation delivered from construction is less than 65 percent.

7.2 *Defense*

Defense.—Comparisons between the distribution of defense demand in different countries and at different times shows a surprising stability on the aggregation level chosen in this model. Therefore we have simply chosen some round numbers that are close to US and to Swedish data, namely 90 percent from industry and 10 percent from construction.

7.3 *Consumption, private and public, and deliveries from agriculture to industry*

We want to estimate sectoral consumption functions of the following form

$$C_i = \overline{C_i} + k_i C,$$

where C_i denotes consumption goods delivered from sector i and C total consumption from material production. Two sources for consumption data were available namely JEC 1973 p. 398–401 and the 1959, 1966 and 1972 input-output tables.

The JEC source does not give the breakdown between direct consumption from agriculture (unprocessed food stuff) and consumption of industrial goods (including processed foods). However, the I–O tables can be used to derive the consumption of non-processed agricultural goods deflated to 1968 constant prices by the price index for agricultural GSP that can be derived from Narkhoz.

The JEC source gives total non-service consumption in 1968 constant prices for 1959, 1966 and 1972 and after deducting the consumption of non-processed agricultural goods, consumption of industrial goods remains as a residual. However, consumption of non-processed agricultural goods is a very small and declining item and one may get the impression that agricultural production would be almost independent of the level of consumption. This would not be true in most economies, since the consumption of processed foods depends on the level of consumption. To capture the dependence of agricultural production on the level of consumption in a standard input-output model, one would have to disaggregate industry into two sectors; textiles and foods and the rest. With that disaggregation changes in consumption level would affect the consumption of textiles and food significantly which in turn has a large input coefficient from agriculture. As this disaggregation was not possible to make with reasonable efforts we used a different specification which also should be able to capture the linkage.

We assume that the input of agriculture to industry is directly related to the level of consumption and independent of the industrial production volume. Thus if X_{iag} denotes the input of agriculture to industry and C_{tot} the consumption level we assume that $X_{iag} = \overline{X}_{iag} + k_x \cdot C_{tot}$ for some k_x.

But then one can aggregate the direct consumption of agricultural goods, which is also specified as $\overline{C}_2 + c_2 \cdot \overline{C}_{tot}$ and the intermediate deliveries from agriculture to industry.

Before the aggregation one of course has to deflate also the intermediate deliveries to 1969 prices. Define C'' as the sum of private and public consumption and the intermediate deliveries from agriculture to industry.

Then $C''_i = a_i C_{tot} + \overline{C''}_i$ where i denotes the sector number.

After correction for price changes[5] between 1968 and 1972 the following coefficients could be estimated from 1959, 1966 and 1972 data

	a_i	$\overline{C''}_i$
Industry	1.0164	−31.156
Agriculture	.2773	32.277
Other branches	.032	0

8. *Production function*

8.1 *Industry*

The following time series were used to estimate production functions for industry.

For labor the employment series from Narkhoz are multiplied by the annual manhour per worker estimates produced by Rapawy.

For capital the Cohn estimates of capital stock in industry in constant 1955 prices were used with values per July 1 each year interpolated from his time series.

[5] The adjustment of total consumption from 1968 to 1972 prices was easy because for 1972 total consumption in 1972 prices is available from the I–O matrix while total consumption in 1968 prices is available from the JEC source.

For output an index of total industrial production compiled by the OER was made available to us by the Wharton-EFA. This is superior to the Greenslade-Robertson index published in the JEC 1973 volume in that it includes military hardware production. There is not that much difference however between the OER and the Greenslade-Robertson indices, and production function estimation on the Greenslade-Robertson index would probably have yielded similar results. However, the difference is larger between the OER series and the Weitzman hybrid index.

Two types of production functions were estimated, namely

1. Cobb-Douglas with time-dependent[6] Hicks-neutral technical progress

$$Y_t = A \cdot e^{\int_0^t \lambda(t)dt} \cdot K_t^{\alpha} \cdot L_t^{1-\alpha}$$

where

$$\lambda = \lambda_0 \cdot e^{-\nu t}$$

Estimated parameters:

$$\underset{(0.0188)}{A = 0.9325} \quad \underset{(0.0218)}{\lambda_0 = 0.0412} \quad \underset{(0.039)}{y = 0.1053} \quad \underset{(0.0905)}{\alpha = 0.5126}$$

$$R^2 = 0.9963 \qquad D-W = 1.18$$

2. CES with Hicks-neutral technical progress

$$Y_t = A \cdot e^{\lambda t} \cdot [\delta K^{-\zeta} + (1-\delta) L^{-\zeta}]^{-1/\zeta}$$

Estimated parameters:

$$\underset{(0.0159)}{A = 0.9763} \quad \underset{(0.0619)}{\delta = 0.7974} \quad \underset{(0.152)}{\zeta = 0.976} \quad \underset{(0.0078)}{\lambda = -0.00451}$$

$$R^2 = 0.9983 \qquad D-W = 1.32$$

All time series are 1950–72 and are indices with 1950 values 100.o.

8.2 *Agriculture*

Estimates on time series over aggregated agricultural production have not had much success mainly because of the high correlation between capital growth and time. This means that it is hard to separate the effects of a productivity change from those of a capital stock change and there is usually a very high correlation between the productivity growth factor λ and the capital share α. Fortunately, there are disaggregated data available. Production, capital stock and labor are available for selected years for the state sector, the kolchoz sector and although with doubtful reliability for the private sectors in H. J. Wagner.[7] There has been a radical difference in the treatment of these three sectors and if one assumes that the production functions for the three sectors can be written

$$Y_{it} = A_i K_{it}^{\alpha} \cdot L_{it}^{1-\alpha} \cdot e^{\lambda t}$$

then the following estimate is derived

$$\underset{(0.058)}{A_{stat} = 1.097} \quad \underset{(0.026)}{A_{kol} = 0.989} \quad \underset{(0.059)}{A_{priv} = 2.243}$$

$$\underset{(0.063)}{\alpha = 0.298} \quad \underset{(0.004)}{\eta = 0.005} \quad R^2 = 0.948$$

[6] Cobb-Douglas with time-independent Hicks-neutral technical progress did not fit the data well.

[7] Osteuropa Institut München, Forschungsbericht 1973, p. 45–77.

The capital elasticity is fairly reasonable considering the low values that have been found by others. It is not as high though as the 0.45 found by the Wharton-EFA in a much more complex specification.

8.3 *Construction*

We failed to estimate a reasonable production function with acceptable variance in parameters with capital and labor as the only explanatory variables. Therefore we adopted a production function estimated by Wharton-EFA with inputs of construction material as the additional explanatory variable. Then we assumed that inputs of construction material would continue to grow at 6%/year or the rate recorded during the last few years and the following production function resulted

$$Y_t = A \cdot e^{\lambda t} \cdot K^{\alpha} L^{\beta}$$

where $\lambda = 0.0148$, $\alpha = 0.066$ and $\beta = 1.0767$

$$R^2 = 0.999 \quad D\text{-}W = 2.71$$

The sample period was 1958–72, the time series used were:

for output—index of state construction (Narkhoz)
for employment—Rapawy—75
for capital—Narkhoz

8.4 *Transport and Communication*

The following time series were used to estimate a production function for transport and communications.

For output—an output index for transport and communications constructed by Mr. Green of the Wharton-EFA using Kaplan's methodology.
For labor—an employment series compiled by Rapawy.
For capital—time series from Narkhoz.

A Cobb-Douglas production function with Hicks-neutral technical progress of the following form was estimated.

$$Y_t = A \cdot e^{\lambda t} \cdot K_t^{\alpha} L_t^{1-\alpha}$$

with the following parameters resulting

$$A = \underset{(0.017)}{1.047} \quad \lambda = \underset{(0.0115)}{0.0233} \quad \alpha = \underset{(0.238)}{0.574} \quad R^2 = 0.997 \quad D-W = 1.302$$

8.5 *Adjustment of the constant factor*

For all the production functions the constant A is adjusted so that the 1973 output is exactly produced with 1973 inputs of capital and labor.

PROSPECTS FOR TECHNOLOGICAL PROGRESS

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I. PROSPECTS FOR TECHNOLOGICAL PROGRESS

The structure of the Soviet economic system was designed with a particular strategy of industrial growth in view. That strategy was the maximal rate of mobilization of labor and capital into industrial production. The structure adopted was that of centralized economic planning, and the historical record supports the conclusion that it was a reasonably successful structure. It enabled the Soviet government to generate very high rates of investment, to manage the transfer to unparalleled millions of workers from agriculture to industry, and to attain an impressive rate of economic and industrial growth during the first 35 years of the plan period.

However successful that growth strategy had been in the past, its appropriateness to the conditions of the present-day Soviet economy has been increasingly called into question by the Soviet leadership. The principal stimulus to reconsideration is, of course, the decline in the rate of the growth that dates from about a decade ago. The Ninth Five Year Plan set a target annual growth rate of 6.7 percent, but the economy managed to achieve a rate of only 5.1 percent. The Tenth Five Year Plan [1] now sets the target at the annual rate of 4.4–5.1 percent, which is unprecedently low for the USSR.

II. DEMISE OF THE CLASSICAL GROWTH STRATEGY

In addition to the concern that the classical growth strategy is not working as well as it did in the past, there is evidence that it is becoming increasingly difficult to implement that strategy on the same levels as it was implemented in the past. The signs of that difficulty are evident in the pages of the Tenth Plan. The annual increase in the supply of labor is expected to diminish during the next five years, con-

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[1] The Tenth Five Year Plan refers, in this paper, to the "Basic Guidelines for the Development of the National Economy in 1976–80," in Pravda, March 7, 1976, as translated in the "Current Digest of the Soviet Press," vol. XXVIII, Nos. 15, 16, and 17 (May 12, 19, and 26, 1976).

tinuing a trend that has been operating for some time. Hence if nothing else changed, the rate of growth would be expected to decline on that account. Moreover, the agricultural sector no longer contains a large reservoir of labor that could be drawn off into industry to maintain the growth of the industrial labor force, as had been the practice in the past.

The classical strategy could nevertheless be maintained if the rate of investment could be augmented sufficiently to offset the decline in the growth of the labor force. Far from increasing, however, the growth rate of investment is also expected to decrease during the next 5 years, and by an astonishingly large amount. Capital investment, the volume of which grew during the last 5 years at the annual rate of 6.9 percent, is scheduled to grow during the next 5 at only 4.4–4.7 percent. Since the growth rate of investment has been declining for some time, though not at this sharp rate, the growth rate of the capital stock must be expected to decline as well.

Unlike the growth rate of the labor force, which is determined largely by demographic factors that are outside the control of the government, the growth rate of investment is a policy decision of the government. The decision to reduce the growth rate of investment reflects the pull of other claimants on the nation's output, particularly defense and consumption. The Tenth Plan reveals very little directly about the government's intentions with respect to defense expenditures, but there are a number of indications of the pressures upon the government to maintain consumption. Among the "basic tasks" set forth for the next five years is the intention "to increase the incentive role of pay and the dependence of each worker's income on his personal labor contribution."

The classical growth strategy was originally designed for a society in which levels of living were extremely low and the coercive apparatus of the state was overpowering. While monetary incentives have been employed since the inception of the plan period, in the conditions of the time relatively small annual increases in consumption levels were thought to be adequate to the task. Labor discipline was maintained by such coercive means as imprisonment for excessive absenteeism or lateness to work. With the diminution of the extent of coercive controls following the end of the Stalin's rule, the incentive system was obliged to bear a greater burden in controlling the behavior of the labor force. The smaller the stick, the larger the carrot has got to be. And indeed, per capita living levels have been increasing steadily in the past two decades, following a long period in which they were virtually unchanged. The shift in the relative importance of coercion and incentives may well have been the beginning of the decline in the potency of the classical growth model, although it was probably not recognized as that at the time. For when the population becomes accustomed to expect increases in income as the reward for effort and risk-taking, the regime is increasingly constrained in the extent to which it can channel resources into investment instead of consumption. The Polish food riot of 1970 is widely regarded as the event that drove home to the leaders of the U.S.S.R. the limits within which they now have to operate in deciding on the distribution of output between investment and consumption.

The pressures for increasing consumption are compounded by another feature of recent economic policy that finds sharp reflection in the Tenth Plan—the accelerating development of the Eastern regions of the U.S.S.R. The document specifies that the Eastern regions are to provide "the entire five-year-plan increment in the extraction of petroleum and gas and in aluminum production, more than 90 percent of the increment in coal extraction, roughly 80 percent of the increment in copper production," and so forth. To provide the labor to man these extensive increases in production facilities, the government will have to continue the process of inducing large numbers of workers to leave their homes and migrate to the cold and relatively underdeveloped frontier communities scattered throughout Siberia. To attract the required labor force, the government has found it necessary to pay the moving costs of workers and their families, and to offer premium wage rates, substantially higher than those in other parts of the country. Thus, to the general increase in the consumption requirements of the population, there has been added the supplementary consumption requirements of inducing the labor force migration to the East. That supplementary cost itself is now to be further increased. The Tenth Plan provides for the introduction of "length of service pay increments for workers and office employees in the regions of the Far East." The reason for this new measure is that high as the premium wage rates have been, they have not been sufficient to compensate for the harsh frontier living conditions experienced by the migrants, and many of them returned to their original homes after their first contract was ended. The length-of-service increments should help to hold some of the migrants in their jobs for a longer period of time, but it represents one more obligation assumed by the government to provide the necessary flow of consumer goods.

III. Toward a New Growth Strategy

The signs of the growing ineffectiveness of the classical growth strategy began to emerge toward the end of the nineteen-fifties. At about the same time there began to develop in the West a body of economic research that called into question the foundations upon which that strategy had been built. The classical strategy sought to promote economic growth by bringing into production each year larger and larger quantities of the factors of production—land, labor, and capital. That method of expanding output had, of course, always been practiced by nations that had experienced economic growth. It had always been known, however, that the economic growth of nations was due not only to the annual increase in the quantities of the factors of production but also to the steady improvement of their quality; and particularly by improvement in the quality of the materials, equipment and technological processes; that is, by technological progress. What was new in the research referred to was not the fact that technological progress had always accomplished factor-of-production increases, but the discovery that technological progress accounted for a much larger proportion of the growth that had been achieved than had previously been imagined, and that factor-of-production increases were a less important source of growth than had been thought. The discovery was followed by a veritable explosion of research designed to measure the

contribution of various forms of technological progress to economic growth and to understand the social and economic forces that promote technological progress.

The general conclusion of Western research on Soviet growth is that technological progress has proceeded considerably more slowly there than in the advanced capitalist countries. In the period 1950–1962, for example, in the United States and in all the countries of Western Europe technological progress was a more important source of growth, and in many cases much more important, than increases in labor and capital inputs. In France technological progress was the source of 79 percent of the achieved growth of output, while in Italy and Norway it accounted for 78 and 77 percent. In none of the major countries did it fall below 50 percent. In the USSR, by contrast, technological progress accounted for only 42 percent of the growth of output during that period. The USSR alone depended on the classical growth strategy—additions of labor and capital—for over half of its economic growth.[2]

The new appreciation of the significance of technological progress in the promotion of economic growth offered the Soviet leaders an alternative strategy to the increasingly less effective classical strategy. If it was no longer possible to generate new annual supplies of labor and capital at the rates of the past, the rate of economic growth need not decline if the rate of technological progress could be increased. That is, growth would be generated not primarily by more and more machines but by better and better machines. Quality of inputs would substitute for quantity, with no less output resulting, it may be hoped. The classical Soviet growth strategy would be replaced by what may be called the modern strategy.

About a decade ago the Soviet literature began to devote growing attention to the analysis of what is called the scientific-technical revolution. Official pronouncements began increasingly to stress the importance of technological progress in the management and planning of the economy. The Tenth Five Year Plan is the capstone of this trend. Mr. Kosygin has referred to it as the Plan of Quality, a formulation that has been widely picked up and used to encapsulate the main thrust of the plan.

How does one implement a strategy of accelerating technological progress beyond the rates achieved in the past? Two approaches may be identified. One is to import large quantities of foreign technology in those fields in which it is most superior to domestically produced technology. The other is to find ways of augmenting the domestic rate of technological progress beyond that achieved in the past. Both approaches have in fact been adopted.

IV. The Role of Imported Technology

The import of advanced foreign technology is, of course, the foundation of the policy of detente. In view of the wide publicity given to this policy in the West, it is remarkable how little reflection one finds of it in the text of the Tenth Plan. The plan does call for "measures aimed at the broader participation of the Soviet Union in the international division of labor and at enhancing the role of foreign eco-

[2] Paul R. Gregory and Robert C. Stuart. "Soviet Economic Structure and Performance" (New York: Harper & Row, 1974), p. 389. The percentages reported here were obtained by dividing "output per unit of combined input" (column 5) by "output" (column 1).

nomic ties in the accomplishment of national economic tasks and the acceleration of scientific and technical progress." It foresees an increase of foreign trade turnover by 30–35 percent, and calls for measures to improve the efficiency with which foreign economic ties are conducted. One does not get the impression that the import of foreign technology is the dominating approach adopted by the Soviets for implementing the new strategy of economic growth.

If that is indeed so, the Soviets have probably made a wise choice. Foreign technology can certainly make a contribution both to the level of Soviet technology and to the rate of growth. All countries gain from trade based on comparative advantage. The Soviets as well as the other centrally planned economies have tended to "undertrade", in the sense that their volume of trade has been less than that of market economies at equivalent levels of economic development.

They have sought to produce by their own effort a much larger range of products than have market economies, and as a consequence they have denied themselves some of the benefits of the international specialization of labor. Even if the technological level of Soviet production were on a par with that of the advanced capitalist countries, it would have paid them to import more than it was their policy to do in the past. The growing volume of Soviet trade with those countries is therefore bound to provide the Soviets with benefits in the form of the gains from trade that they had formerly foregone. Imported technological equipment will also contribute to the general elevation of the quality of the Soviet capital stock and therefore to an increase in the rate of technological progress.

It is nevertheless to be doubted that as an approach to the adoption of the new growth strategy, the import of foreign technology could prove to be satisfactory. If the domestic economy should remain no more capable than in the past of generating its own technological progress, it is hardly likely that the economy could generate in the future the rate of technological progress required by the new growth strategy. For one thing, the economy is so large that the overall impact of imported technology is likely to be marginal. The overwhelming proportion of the nation's annual increments in capital equipment will have to be of domestic manufacture. Hence unless the general level of domestic technology improves, the contribution of technological progress to overall growth is likely to remain small. Secondly, the technology of the advanced capitalist countries is adapted to the level of technological and managerial skills and knowledge of their own or of equivalent countries. Unless the broad level of technological and managerial skills and knowledge in the USSR attains that level, the imported equipment is likely to operate at a lower level of productivity than is found in the host country, thus losing some of the gains from trade.

But third, and most important, a country that relies on imports for a broad range of its advanced technology cannot expect to project itself by that means into the ranks of the leaders in the generation of new technology. Particularly in the fields of the most advanced and rapidly changing technology, the lead times are such that by the time a new enterprise outfitted with imported equipment is in full production, that equipment and its products have already begun to obsolesce. In short, the import of foreign technology cannot serve as a substitute

for a technologically innovative economic system. Only the second approach, the augmentation of the domestic innovativeness of the economy, can provide a suitable basis for the new strategy of economic growth.

V. Organizational Structure

In all systems, social no less than physical, the structure bears a certain relationship to the functions that the system performs. If an engine is designed to attain a maximum speed, a certain structure is appropriate; but if it is designed to minimize fuel consumption, a different structure would be employed.

The function that the Soviet economic system was designed to support was the classical strategy of economic growth. The structure that was designed for this purpose was that of centralized economic planning. Now the system is being called upon to perform a different function, to generate a high rate of technological progress. The old structure, however successful it was in supporting the function for which it was designed, is simply not well designed for carrying out the new function. If the Soviets are serious about shifting to the new growth strategy a new economic structure will have to be designed, appropriate to the new task. The process of economic reform, initiated by Mr. Khrushchev, is the term applied to the search for this new economic structure.

The Tenth Plan is replete with references to the importance of accelerating the rate of technological progress and of improving the effectiveness of the R. & D. (research and development) institutes and the other organizations whose work is crucial to that goal. Section VII of the Plan, for example, which is titled "The Development of Science", proposes "to increase the efficiency and improve the quality of scientific research.* * * To accelerate the introduction of scientific achievements in the national economy.* * * To improve the system of management of research and design organizations and the planning and financing of scientific research." These are statements of aspiration, however, and not programs. The Plan does, however, allude to a number of specific reforms in economic structure that are designed to help attain those aspirations. The question is whether they are equivalent to the new type of economic structure that is required to support the new strategy of promoting growth through technological progress.

Soviet analysts have devoted a great deal of attention in recent years to the subject of technological innovation. The obstacles to innovation have been discussed fairly candidly in the published sources and we have a reasonably firm understanding of where the problems lie. They may be grouped into three categories that constitute the basic structural elements of the economic system; organizational structure, price structure, and the structure of incentives.[3] Each of these three elements exerts a strong influence on the kinds of decisions made by Soviet managerial officials as they conduct the daily business of the production units for which they are responsible. The crucial decision with respect to technological progress is the innovation decision—whether to introduce a new product or process, or to continue produc-

[3] The following analysis of the relationship between economic structure and innovative performance relies heavily on Joseph S Berliner, "The Innovation Decision in Soviet Industry" (Cambridge: MIT Press, 1976).

ing an established product by means of an established manufacturing process. The general problem with the old economic structure is that it gave maximal encouragement to decision makers to favor established products and processes, and to discriminate against innovations "as the devil shies away from incense," in Mr. Brezhnev's words.[4]

The nature of the anti-innovation bias may be illustrated in the case of each of the three elements of economic structure. Consider first the organizational structure of the economy, which refers to the kinds of organizations (enterprises, R. & D. institutes, ministries, state planning committee) that have been established to conduct the nation's economic activity, and the range of responsibilities assigned to each of them. It is the organizational structure that governs the process whereby the production units receive the inputs of goods and services required for their production activity and dispose of the products they produce. Consistent with the principle of centralized economic planning, the organizational structure is such that the central government agencies bear the major responsibility for providing the enterprises with their inputs and disposing of their outputs; in contrast to a market economy, for example, in which the enterprises bear the responsibility for carrying out these two functions. The government says to its enterprises, in effect, "We will give you the things you need with which to produce, and we will take care of selling the things you produce. Your job is to concentrate on the task of producing the maximal output of the things we instruct you to produce." That way of organizing the inter-enterprise flow of goods and services makes a great deal of sense in a centrally planned economy, and it deserves much of the credit for the high rates of output that the economy has achieved in the past. The trouble with it, however, is that it orients managerial officials to concentrate on doing those things they have learned to do well and to shy away from doing new things. Many reasons for this anti-change bias may be set forth, but two will serve.

First, it is inevitable that the effort to plan centrally the supply of all the inputs needed by all enterprises cannot be entirely successful. In fact, it has been done rather badly, and most enterprise managers regard the problem of getting the supplies they need to be the most difficult aspect of running a Soviet enterprise. It is perhaps the principal reason that enterprises often run into difficulty meeting the production targets that are assigned to them. Consequently enterprises seek out ways of minimizing the risk of failure due to supply shortages, like hoarding labor and materials, or producing their own components at high cost rather than relying on the uncertainties of subcontracting. In view of the centrality of the supply problem, it is understandable that any decisionmaker contemplating an innovation will ask how the decision to innovate will affect his supply situation. Unfortunately, the decision to innovate is likely to increase the intensity of the supply problem. The innovation of new products or processes often requires the enterprise to use new materials with which it is not familiar, to be assigned to new suppliers who are not yet familiar with the enterprise's quality requirements and with whom no personal relations have yet been established. Changes always involve unanticipated difficulties, a certain amount of wastage until the new

[4] Pravda, Mar. 31, 1971.

technology is mastered, and sudden needs for supplies that could not have been foreseen a year earlier when the enterprise's supply plan was first forecast. Hence the risk-minimizing decision is to avoid changes. Supply problems are minimized by producing the same product by means of the same process as long as possible.

The second problem of organizational structure also involves the matter of supply. The decision to innovate obliges the enterprise to provide itself with a supply of something that is not required at all by non-innovators—the supply of R. & D. services. That greatly expands the range of supply problems with which the enterprise must cope, and compounds the risk of failure. There are many reasons for the peculiar set of difficulties associated with the supply of R. & D. services, but one has commanded central attention. When the organizational structure of the Soviet economy was established a half century ago, it was designed with the purpose, among other things, of avoiding what were regarded as the wastefulness and irrationality that characterized the anarchy of the capitalist marketplace. One such element of waste was the commercial secrecy of capitalism, and the consequent duplication of R. & D. facilities in competing enterprises. The abolition of private property made it possible to avoid the waste of duplication and secrecy and to benefit from the economies of scale. The organizational form that incorporated this view was the establishment of centralized R. & D. facilities, one for each branch of technology. All R. & D. work on mining machinery, for example, would be concentrated in a single large institute, which would establish a uniform technological policy for the industry. The new products and processes developed by that institute would be submitted for approval to the ministry, which would then assign them to the appropriate enterprises to be put promptly into production.

Again, this organizational device has been responsible for a good proportion of the new products and processes that have over the years made their way through the R. & D. process into final production. Yet it has long been known that the process suffered from many defects, largely due to the dissociation of the R. & D. institutes from the producing enterprises. The responsibility of the R. & D. people tended to end when a new design was officially approved by the ministry; what happened to it thereafter was the responsibility of the ministry people and the enterprises. Enterprises, for their part, often found that the design work had to be redone, because it was originally executed without knowing which enterprise eventually would be assigned the task of first introducing it. The institutes developed an unfortunate reputation of producing shoddy work and enterprise managers exchanged horror stories of the troubles they ran into after having been assigned the task of introducing a new technological process designed by the people in the R. & D. institute who had no knowledge of their own production and technological conditions. In an interesting analysis of the problem, Academician Trapeznikov concluded that the central issue was the "monopolistic" nature of the R. & D. organizations.[5]

"If scientific and technological monopoly takes shape, the result is the stagnation of ideas. The customer can only say to the design orga-

[5] Pravda, Jan. 18, 1967.

nization, "Please, do at least slightly better." And the monopolistic design organization will answer, "We can do no better; if you don't like it, do it yourself!" And the enterprise will have to content itself with this answer."

If the objective of accelerating technological progress is to succeed, features of the old organizational structure like these will have to be changed. The Tenth Plan provides some clues about the kinds of structural changes that the government is relying upon to accomplish the desired result. With respect ot the general problem of supply, the Plan calls for the completion of a program to establish "direct and continuous ties based on long-term economic contracts" between suppliers and purchasers of mass-produced commodities. This refers to an effort to end the past practice in which the suppliers assigned to an enterprise would be changed frequently and arbitrarily by the central planners, leading to interruptions in the flow of supplies and to changes in the quality of materials supplied. The purpose of the new measure is to introduce greater stability in the flow of inputs and to reduce the risks associated with supply.

This is to be done by building into the central planning system a network of long-term planned flows of supplies between specified suppliers and purchasers, which the central planners are obliged to honor. The measure may improve the supply situation for enterprises that require a large and steady supply of a mass-produced commodity, like an electric powerplant that requires a steady flow of coal. It is not likely to have much impact on innovating enterprises, particularly in the machinery industry, which do not deal in such mass-produced inputs to the same extent. Moreover, the very stability of the direct ties established between suppliers and users may have the effect of discouraging change. If an enterprise has established a satisfactory long-term relationship with a supplier of a copper part, it will be relatively riskier to undertake an innovation substituting a cheaper plastic part for that copper part, especially if the plastics supplier has already established a set of long-term contracts with large users of plastics who are most important to his business than the prospective new purchaser. This reform will provide some improvement in the supply situation of enterprises producing established products with the same inputs year after year, but by reducing the degree of flexibility in the system, may actually increase the riskiness of innovation.

The Plan also anticipates the continuation of "work on the development of wholesale trade." This passage alludes to a reform that is designed to introduce a genuine degree of flexibility into the supply system and may therefor significantly encourage innovation. Under the old organizational structure the supply system operates by a materials-allocation method. Virtually all important materials and equipment are handled by the central agencies of government, who issue materials allocation certificates to the enterprises that are entitled to receive specified quantities of that material or that piece of equipment. If an enterprise happens not to possess such a certificate, it is extremely difficult to obtain an allocated commodity legally. One applies for these certificates during the process of making up the plan for the following year, based on a guess about what the output targets would be and how much of each type of input would be required during the year to produce that output.

It is evident that under such a system, the greater the degree of uncertainty about the future, the greater the possibility of having incorrectly forecast future requirements, and therefore of encountering difficulties in obtaining allocated materials. The system gives strong support to stability of production, and correspondingly strongly discourages innovative change. The wholesale-trade reform is designed to ease the problem of obtaining supplies without the possession of an allocation certificate. A number of stores and distribution centers have been established throughout the country that are stocked with allocated supplies that may be purchased by enterprises without having to present official allocation certificates. The notion of wholesale trade, it should be noted is an extremely radical one in the Soviet context. It brings the middleman back into the economic structure, and conceptually it denies the value of centralized planning of supply for a certain range of commodities, relying instead on a kind of market. Perhaps that is the reason that this reform appears not to have gotten very far. The Tenth Plan for the "continuation" of work on this reform, not for its "completion."

With regard to the supply of R. & D. services, the Plan directs the industrial ministries "to complete the creation of associations in accordance with the general plans of management * * *." This instruction alludes to a massive merger movement first mandated by the government in 1973.[6] Groups of previously independent enterprises are to be merged into larger corporate organizations called production associations. The typical association is a merger of perhaps a half-dozen to a dozen enterprises in a related line of production. In most cases the merger is a form of vertical integration. The general director of the new association, who is often the former director of the largest of the merged enterprises, has virtually full authority over the constituent units. The broad objective of the movement is to improve the efficiency of the inter-enterprise transactions. These transactions were formerly managed by the ministry and the government planning organs, which dealt with each of the enterprises separately. Now the ministry and the planners deal only with the general director, and the latter bears the responsibility for the individual production and other activities of the merged units. In addition to the general objective of improving efficiency, however, the reform is designed to stimulate technological progress.

To accomplish that, many of the production associations have been given R. & D. facilities of their own. The most interesting feature of the reform is that many of the largest of the R. & D. institutes have lost their independent status and have been merged into associations along with a cluster of producing enterprises, experimental plants, and so forth. These mergers are referred to a "science-production associations." The general director of a science-production association is usually the head of the merged R. & D. institute.

The science-production association represents the abandonment of the original notion upon which the organizational structure of Soviet R. & D. was founded. A substantial portion of all R. & D. is now to be conducted "in-house," in the manner of the large high-technology industrial corporations of the capitalist world. Instead of a single all-

[6] See the paper in this compendium by Alice Gorlin.

union R. & D. institute in each field of technology, which was the original ideal, all the large corporate associations are to be provided with their own R. & D. facilities of varying sizes. By placing science and production under a single corporate administration, it is hoped that much of the previous resistance to innovation will vanish and technological advance will accelerate. The science-production association is strikingly similar in structure to the capitalist arrangement, the putative wastefulness of which inspired the Soviets to reject it a half century ago.

These organizational reforms upon which the Tenth Plan is based are by and large in the direction required for an economic structure that will support the new strategy of economic growth. The question is whether they go far enough. It is one thing to mitigate some of the organizational impediments to innovation that characterized the classical economic structure. It is another to adopt a structure sufficiently hospitable to innovation to support the new function that the economy is being called upon to perform—to generate a rate of technological progress equal to that attained by the most progressive capitalist countries. One cannot be dogmatic about such a forecast, but my judgment is that these reforms do not get to the heart of the matter. The central issue is the locus of autonomy in economic decision making. In the centrally planned economy autonomy must reside primarily in the agencies of government—the Council of Ministers and the central planning organs.

The producing units correspondingly require relatively little autonomy particularly when the planning system operates well. That distribution of autonomy works reasonably well when an economy is undergoing relatively little technological change. The promotion of change however, appears to require a greater degree of autonomy by the producing units themselves because of the greater uncertainty involved in the process. The central planners can be counted on to perform reasonably well in supplying the enterprise with the inputs required when those inputs consist of familiar commodities with which they have had long experience. But the newer the products involved, the greater the necessity to depend on one's own resources to bring the innovation to successful conclusion. One needs to work directly with one's suppliers, to have sources of supply to which one could turn quickly when required, to be able to drop suppliers who cannot meet the new specifications required and to seek out other suppliers in their stead. One must also have direct contact with one's customers, for unlike standard products, new products require a certain amount of promotion to overcome user resistance which is to be found in any economy. One needs control over the technological process itself, and cannot submit all the many technological choices that have to be made to the ministry for their approval. The greater the autonomy of the producing units over their operations, the less the risk involved in trying something novel, and therefore the greater the willingness to undertake innovation. But to take on the risks of doing something new without a corresponding expansion of the authority to accomplish it is to court trouble.

The organizational reforms discussed above do go some distance in extending the autonomy of the production units beyond that which the typical enterprise director enjoyed in the past. But the associa-

tions are still enmeshed in the apparatus of central economic planning. They will have plans to fulfill, and will be evaluated on the basis of the success with which they meet their production quotas. All significant decisions will continue to require the approval of the central government agencies. The general manager of a Soviet production association may preside over a set of operations as large or larger than the modern capitalist giant corporation. But unlike the latter, there is no major decision about which he has the final say. The Soviet organizational structure will continue to manage a certain volume of "innovation by order" as in the past. But unless the production units are given a much greater degree of autonomy than is contemplated during the next five years, with a corresponding diminution of the scope of authority of the central planners, the organizational structure will continue to bias management generally against change.

VI. Price Structure

Organizational structure is but one of the elements of economic structure that influences the decision to innovate. But it is not the only one. A second is the structure of prices. The organizational structure may be such as to cause the introduction of new products to be very risky to the innovator. But if the price of that product is very high relative to that of an older product, managers may nevertheless be induced to take the risk. The people who manage Soviet industry are not, after all, allergic to risk-taking; they would not have sought out such jobs if they were. But they are sensible men, and when they must choose between a fairly certain alternative like continuing the production of a familiar product, or a risky alternative like undertaking the production of a new one, they must have some assurance that if they succeed in the latter, the reward will be worth the risk they bore. One such reward is the profit that the enterprise earns. The higher the price of a new product relative to that of the older one, the greater the potential profit from product innovation.

In the classical economic structure, however, the people who set the prices of products do not distinguish new products from old. All products are priced by adding a standard profit markup to the average cost of production. This principle of determining prices was derived from Marx's labor theory of value, which was interpreted to mean that in a socialist state it is proper that a product which contains, say, twice the labor content of another should be assigned a price twice that of the other. Assuming that the average cost of production is a satisfactory approximation of the labor content of a product, the principle of cost-plus-standard-profit became the approved basis of product pricing generally.

When economists began a decade ago to study critically the effect of various elements of economic structure on innovation, it was quickly discovered that that principle of pricing exerted a strong discriminatory effect against product innovation. Suppose an enterprise introduces into production a new model of a tractor that costs the same to produce as an older model but is twice as productive. Since the average cost of production is the same, the new tractor will be assigned the same price as the older one. All the benefit of the technical advance is therefore captured by the purchaser of the new trac-

tor and none by the innovator. The innovator who bore all the risk and who exerted the additional effort required by the innovative process gains nothing. He would have been better off had he simply continued the production of the older model.

This discriminatory effect of the pricing principle on product innovation led to the recommendation that new products be exempted from the general pricing rule. In particular, they should be assigned a price higher than the normal cost-plus-standard-profit, so that the innovator could enjoy a higher profit rate for his pains and thus share in the gains from the technical advance. At first this proposal met with considerable opposition on ideological grounds. It was thought to imply a denial that labor alone was the source of value, and the introduction of such considerations as utility and productivity into Soviet pricing was regarded as an anti-Marxist deviation. Good sense eventually prevailed over such ideological fundamentalism, and official sanction was eventually given to the inclusion of productivity considerations into the pricing of new products.

The Tenth Plan takes very brief note of the influence of price structure on innovation. With respect to prices the Plan instructs officials "to increase their role in stimulating the growth of the production of new and progressive items and in improving output quality." But no new reforms appear to be in the offering. The adoption of "productivity" in the case of new products, and a variety of other pricing reforms in the last decade, have eliminated some of the cruder discriminatory effects of the classical price structure on the innovation decision. Beyond that, there is a limit to how far pricing policy can be used to encourage innovation.

Prices are important to the Soviet enterprise for many reasons, among them their influence on the volume of profit earned. The earning of large profits is taken to be a sign of successful management and is therefore a good thing. Profits also play a role in determining the incomes of management. But they are not the decisive factor in incomes. The role of incomes introduces the third and last of the elements of economic structure to be discussed, the incentive structure.

VII. Incentive Structure

A great many personal rewards are available to the successful manager: prestige, promotion, various prerequisites of office, and income. The incomes of managerial personnel consist of the salary plus bonuses of various kinds which may amount to a third or more of the total income. The size of the bonuses depends on the enterprise's performance with respect to the specific tasks for which each one is offered.

In the original structure of the economy there was only one bonus. Consistent with the requirements of a centrally planned economy, the bonus was proportional to the enterprise's success in fulfilling its plan. And in line with the classical strategy of economic growth, it was the plan target for total value of output that was the prime basis of the bonus. The bonus proved to be so powerful an incentive, however, that management tended to stress output at the expense of other facets of enterprise performance. Production alternatives would be selected that contributed greatly to the value of output even though they increased production cost unreasonably. To redirect management's attention to these other facets, special bonuses were introduced for vari-

ous specific tasks, such as reducing average cost of production, reclaiming scrap metal, and so forth. The incentive structure that evolved consisted of the original basic bonus that was tied to the value of output, plus a variety of other smaller bonuses specified for particular tasks.

It is an interesting reflection of the dominance of the classical growth strategy that throughout the classical period no special incentive was introduced for the act of innovation. Bonuses were introduced for conserving fuel, for producing consumer goods from waste products, and so forth, but none for the introduction of technological change. Perhaps it was simply assumed that "innovation by order" was sufficient; that the innovation decision in the centrally planned economy was the responsibility of the central planners and that the task of the enterprises was simply to carry out instructions regarding the introduction of new products or processes. Or perhaps it was not recognized that the act of innovation competed with the act of production and that the manager who concentrated on the latter would neglect the former.

Whatever the reason, when the demise of the classical growth strategy turned attention to the possibilities of accelerating technological progress, it was quickly realized that the old incentive structure contained a strong bias against innovative activity. The reason is that the changeover to a new product or a new manufacturing process always results in a slowdown in the current rate of output. In all economic systems new products and processes involve a period of time during which various bugs have to be ironed out, labor has to be retrained, spoilage and downtime tend to be higher than normal until the new equipment is shaken down and labor and management skills accumulate. Hence the manager who undertakes innovation must expect a decline in the current rate of output for some period of time. It may indeed take months or even years, depending on the magnitude of the innovation, before the new equipment is brought up to its rated output capacity.

The greater the pressure brought to bear on management to maximize the current rate of output, the stronger the resistance to innovation. Hence, precisely because the old incentive structure was highly successful in motivating managers to concentrate on the fulfillment of their output plans, it proved to be highly discriminatory against change. Managers would, of course, introduce new products or processes when instructed to do so by the ministry. But Soviet managers are masters of the bureaucratic techniques of finding excuses, procrastinating, and dragging their feet on matters that are defined by the incentive structure to be of lesser importance. We would often read that when the production rate was falling behind the schedule required for fulfilling the output plan, management would pull labor and materials out of the shop that was engaged in introducing a new product insisted upon by the ministry, and reassign them to work on the main production tasks of the enterprise. More important, there was very little incentive for self-initiated innovative activity at the enterprise level, which under appropriate conditions could provide a significant innovative thrust in an economy.

It was not until the mid-fifties that a special bonus was first introduced specifically for the act of innovation (fond dlia premirovaniia za

sozdanie i vnedrenie novoi tekhniki—the bonus fund for the creation and introduction of new technology). The size of the bonus depends on the social value of the innovation, which is measured by the reduction in production costs that the innovation entails. The innovating enterprise then receives a bonus equal to a certain percentage of the annual cost savings. An innovation that saves the economy one million rubles a year, for example, will yield a one-time bonus to the enterprise of about 50,000 rubles. That enterprise bonus is then divided among the persons who are credited with the success in having brought the innovation to completion.

The original innovation bonus was followed by a number of other bonuses for various activities related to innovation. The present day incentive structure is therefore more consistent with the new strategy of economic growth. The question to be asked is, again, whether the transformation of the incentive structure has gone far enough. Are the incentives for innovative activity large enough, relative to the rewards for other activities, to support fully the objectives of the new growth strategy?

Detailed quantitative data on the structure of incentives are not abundant. Some data are available however, on the size of the bonuses earned for various activities in some individual enterprises. It is clear that the major source of managerial bonuses continues to be the basic bonus that is earned primarily for fulfilling the basic enterprise plan targets. Since innovation continues to have a negative effect on the enterprise plan performance, the innovating enterprise earns somewhat smaller basic bonuses than the equally well-managed but non-innovative enterprise. But the former receives a certain volume of innovation bonuses that are not available to the latter. It appears, however, that the overall difference is not great. The special innovation bonuses are of such magnitude that they do little more than compensate for the loss of some portion of the basic bonus.[7]

If these tentative quantitative judgements are correct, one must conclude that the current incentive structure does not lend very strong support to the new growth strategy. Consider the manager evaluating a choice between introducing a new product recently announced as completed by the R. & D. people, or continuing the production of an item that has long been part of the enterprise's standard output. If the enterprise does not innovate, management is highly likely to fulfill its plan assignments and to earn the maximal basic bonuses. If the manager decides to undertake the innovation, he faces the risk that the product will fail to perform as well as its sponsors in the R. & D. institute claim, that its cost of production will be higher than forecast, that there will be an indefinite period of shakedown and uncertainty until the production process is fully mastered, that new supply problems will arise, that the price set for the product by the price administrators in Moscow will provide for a very small profit, that the basic production plan targets will not be met for some period of time, and that his income will therefore decline during that period. If the innovation is ultimately successful, however, he will receive an innovation bonus. But after all the risk, effort and energy, he ends up with an income that is not much larger than he would have earned had he avoided trouble and stuck to the production of his familiar line of products.

[7] For the details of the quantitative estimates, see Berliner, chapter 16, op. cit.

If this is a fair description of the alternatives presented by the incentive structure, then all one can say of the reforms in incentives is that they have removed some measure of the anti-innovation bias of the past. But the incentive structure in its present form must still be regarded as discriminatory against change. What seems to be required is a set of rewards for innovation that is sufficiently larger than the rewards available to the competent but minimally innovative manager to make the innovation decision a highly attractive one.

The Tenth Plan alludes to the structure of incentives for technological change but gives no clues about any major forthcoming reform. The task is "To enhance the role of economic incentives in increasing production efficiency, improving output quality, accelerating scientific and technical progress and improving the use of labor resources." There is no reference to specific measures, however, that are to be taken to accomplish that enhancement of the role of incentives in promoting technological progress.

To summarize the discussion, the Tenth Plan is a milestone in the change in Soviet economic policy from the classical growth strategy based on increases in factor inputs, to the modern growth strategy based on high rates of technological progress. Parallel to this change in the function that the economic system has been called upon to perform is a set of changes in the structure of the economy designed to support this new function. The Plan notes such changes in each of three fundamental elements of economic structure: organization, prices, and incentives. By and large, however, the changes noted and endorsed in the Tenth Plan consist largely of the elimination of some of the grosser sources of anti-innovation bias that characterized the classical economic structure. Moreover most of the changes noted have already been introduced. The exception is the production association merger movement, which has been under way for some time but is to be completed during the period of the Tenth Plan. With that exception, the benefits of the cited reforms in economic structure should already have been reaped, and should have been reflected in the rate of technological progress attained in the recent past. The Tenth Plan signals no new initiatives in the reform of economic structure that might be expected to lead to an acceleration of the rate of technological progress. Some benefit may be expected from the policy of importing foreign capital, but that policy cannot substitute for domestically generated technological progress. The conclusion is that the abandonment of the classical growth strategy and the adoption of the new strategy based on the promotion of technological progress was a positive move on the part of the Soviet leadership. The desired outcomes from that change in strategy will not be forthcoming, however, unless the fundamental economic structure continues to change in a direction more consistent with the new function the system is now called upon to perform.

DEFICIENCIES IN SOVIET INVESTMENT POLICIES AND THE TECHNOLOGICAL IMPERATIVE

STANLEY H. COHN*

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I. KEY ROLE OF INVESTMENT IN SOVIET ECONOMIC PROGRESS

Anyone even remotely familiar with the teaching of Karl Marx will readily acknowledge the central role of capital in his theory of economic development. It is no coincidence that the principal work of the father of Communist doctrine bore the title of "Das Kapital." In the Soviet economy, the major laboratory for the implementation of Marxist theory, capital and investment have been the key ingredients in Soviet economic progress, along with the ability of the regime to draw upon a vast underemployed manpower reservoir to man its rapid burgeoning industries.

In the quarter of a century which has elapsed since 1950 the annual average rate of increase in capital stock exclusive of residences in the Soviet Union has been nearly 9 percent. This rate is considerably above that of the other major industrial economies, with increases of about 6.5 percent in Japan and Germany, 4.8 percent in France, 4.3 percent in Italy, and barely 3 percent in the United Kingdom and the United States.[1] Of even greater significance is the degree to which the USSR has relied upon growth in its capital stock as a source of growth of GNP. Approximately 45 percent of the combined contribu-

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[1] Laurits Christensen, Diane Cummings, and Dale Jorgenson, "An International Comparison of Growth in Productivity, 1947–1973," to be published in proceedings of Conference on New Developments in Productivity of National Bureau of Economic Research.

tions of factor inputs and productivity to growth is explained by capital stock. By contrast the share of capital is only 27 percent in Japan, 18 percent in the principal economies of Northwestern Europe, and 25 percent in the United States.[2] This heavy reliance on physical capital for its growth meant that the USSR relied the least of any of the major economies upon advances in productivity—only 30 percent, compared with roughly double that proportion for the principal market economies.

There may well be a causal relationship between the unusually heavy Soviet reliance on capital investment and its poor comparative productivity [3] performance. The link between the two measures is the capital/employment ratio. If the rates of growth of capital stock and of employment [4] of the seven major industrial economies are compared for the years under review, the rate of increase of capital inputs relative to those of employment are high for the Soviet Union compared to those for Northwestern Europe and the United States, though lower than for Japan. At the same time the rates of increase in capital productivity (rate of increase in national income—rate of increase in capital input) is strongly negative for the USSR, somewhat less so for Japan and with no meaningful change for Northwestern Europe or the United States. In Japan's case the negative trend is more than balanced by a rapid rise in labor productivity, (Table 1), giving that country a much superior total productivity growth record. As compared with Northwestern Europe and the United States, it would appear that the Soviet Union was experiencing diminishing returns to capital investment because of the disproportionate growth of this factor relative to that of employment. As compared with Japan, which had an even higher capital-employment ratio, the USSR exhibited a singularly inferior total productivity performance. With approximately the same rates of increase in employment and capital stock as Japan, the entire difference in their GNP growth rates, 5.4 and 10.1 percent respectively, is explained by productivity performance.[5]

TABLE 1.—RATES OF INCREASE IN PRODUCTIVITY OF CAPITAL AND EMPLOYMENT AND THE CAPITAL-EMPLOYMENT RATIO
[ANNUAL AVERAGE RATES]

	Employment productivity [1]	Capital productivity [2]	Total productivity [3]	Capital-employment ratio [4]
U.S.S.R. (1950–70)	3.5	−2.6	1.6	6.4
Japan (1955–68)	8.0	−2.4	5.5	8.4
Northwestern Europe (1950–62)	3.7	0.3	3.0	3.4
United States (1950–62)	1.9	−0.3	1.4	2.1

[1] Rate of increase in national income + rate of increase in employment.
[2] Rate of increase in national income ÷ by rate of increase in capital input.
[3] Rate of increase in national income ÷ by rate of increase in combined inputs.
[4] Rate of increase in capital input ÷ by rate of increase in employment input.

Source: Stanley Cohn, "The Soviet Path to Economic Growth: A Comparative Analysis," "Review of Income and Wealth," March 1976, Table 7.

[2] Stanley Cohn, "The Soviet Path to Economic Growth: A Comparative Analysis," Review of Income and Wealth, March 1976, Table 5. While the time period for the USSR is 1950–1970, that for the Northwestern European economies and the United States is 1950–62 and for Japan is 1955–68.
[3] Defined as joint factor productivity—rate of growth of GNP divided by rate of growth of combined factors of employment and capital.
[4] Defined to include such qualitative changes in employment as educational attainment and the age-sex composition, as well as numbers of full-time equivalent employees.
[5] Ibid., Table 4.

It would appear that Japan has offset the prospect of diminishing returns to investment, which would be expected to arise from such a high capital-employment ratio, through rapid technological advance. The Soviet Union has not been seen to achieve significant technological gains.

Economists distinguish those advances in technology which are the fruits of improved productive machinery and plant and those which reflect more efficient economic organization. The former are termed "embodied" technology since they involve the embodiment of new technology in the form of capital investment; the latter are termed "disembodied." The focus of this study will be upon "embodied" technology. More specifically, the focus of the discussion will be upon the relationship of Soviet investment policies and technological advance. The embodiment concept asserts that technological advance depends upon the rate of investment. The inability of the Soviet economy to show such progress, given its unusually high investment effort implies serious deficiencies in its investment policies. The remainder of the discussion will examine these policies.

A. Rising Dependence Upon Investment

Heavy as it may have been over the past quarter of a century, the dependence of the Soviet economy on investment for its expansion is a rising one which is slated to continue its upward trend through the remainder of the decade. As noted in Table 2, the demographic and structural constraints on possible increases in employment have been operative since the early sixties. They were recognized in the guidelines for the recently completed Ninth Five Year Plan, but their impact was deferred by drawing marginal workers into employment. In the guidelines for the Tenth Plan (1976–79), the rates of increase in employment will continue to be small, a maximum annual growth rate of one percent. A similar trend has occurred for the capital input, but in lesser degree. In the Ninth Plan a sharp rise in the incremental capital-employment ratio was planned, but in actuality was barely half as high because of the aforementioned higher than planned rises in employment. For the Tenth Plan the regime has accepted the reality of resource constraints with a modest growth in employment, and unprecedently low rates of increase in capital. Even with these modest capital increment goals, the role of investment is much greater, as noted by the high capital-employment ratios. As compared with foreign and Soviet historic experience (Table 1), the emphasis on investment is without historical parallel, other than in Japanese experience. Thus, the necessity for technological progress becomes all the more crucial.

TABLE 2.—TRENDS IN SOVIET FACTOR INPUTS, PRODUCTIVITY, AND GNP

[Annual average rates]

Period	Factor inputs			Capital-employment ratio [4]	Productivity [5]	GNP [6]
	Employment [1]	Capital stock [2]	Combined inputs [3]			
1961–65 (7th plan)	2.5	8.6	4.3	3.4	0.6	5.0
1966–70 (8th plan)	1.9	8.3	3.6	4.4	1.8	5.5
1971–75 (9th plan—plan estimates)	1.0	7.1	2.8	7.1	2.9	5.8
1971–75 (9th plan—actual results)	1.8	7.8	3.6	4.3	.3	3.9
1976–80 (10th plan)	1.0	5.5	2.4	5.5	2.4	4.8

[1] Estimates of Murray Feshbach and Stephen Rapawy in J.E.C., "Soviet Economic Prospects for the Seventies," 1973 and in preliminary estimates for current compendium. Man-hours of employment.

[2] Gross fixed capital stock. Tsentral'noe Statisticheskow Upravlenie, "Narodnoe Khoziaistvo SSSR" for 1969–74, "Izvestiia," Dec. 14, 1975 and Feb. 1, 1976.

[3] Inputs combined by weights of 0.7 for employment and 0.3 for capital, based on labor and nonlabor income shares computed from Central Intelligence Agency, "USSR: Gross National Product Accounts, 1970."

[4] Rate of increase in capital stock plus rate of increase in employment.

[5] Rate of increase in GNP divided by rate of increase in combined factor inputs.

[6] Central Intelligence Agency, the Soviet Economy: "1974 Results and 1975 Prospects," March 1975. Estimates of author based upon 1975 plan fulfillment results and announcements of 10th 5-year plan noted in "Izvestiia" references in footnote 2 of this table.

Given the continuing dependence of the Soviet economy upon capital investment for its expansion, the significance of the efficiency of the investment process becomes all the more critical. Unless the return on investment is substantially raised, the relatively modest Tenth Plan will not be fulfilled. The nearly obsessive concern of the leadership and planners with technology as a key to further progress reflects determination to resolve this challenge. However, the mere acquisition of advanced foreign technology and increased domestic generation of technology will be insufficient unless certain current investment policies are changed.

II. Constraining Features of Soviet Investment Policies

Several explanations might be offered to explain the disappointments of Soviet investment policy: (1) Is the sectoral distribution of investment funds such that sectors with delayed, low yield returns are favored? (2) Is the technological composition of investment such as to emphasize long-lived plant and structures instead of short-lived machinery and equipment? (3) Are replacement and depreciation practices of such a character as to discourage rapid incorporation of proved technology into industrial processes? and (4) What is the effect of delayed completion of investment projects upon the return from investment commitments?

A. Sectoral Distribution of Investment

The return on capital differs markedly among economic sectors because of the varying capital intensities (capital-employment ratios) and differences in the service lives of capital stock. The lower the capital intensity and the shorter the life of the assets, the higher will be the return to investment. The concept of return on capital is often expressed in the form of its reciprocal—the incremental capital-output ratio.[6] Has there been a distinctive sectoral distribution in the Soviet

[6] See table 2 for comparative rates of return on capital.

economy of investment which might explain its low capital productivity? (Table 3.)

TABLE 3.—COMPARATIVE SECTOR DISTRIBUTION OF INVESTMENT

[Percentage of total]

Sector	U.S.S.R.	France	United Kingdom	Italy	Japan	United States
Industry:						
1961–65	36.9	36.4	36.7	31.4	32.0	23.8
1966–73	35.4	32.2	32.4	30.9	27.3	24.8
Agriculture:						
1961–65	15.4	5.3	3.3	9.0	5.2	4.0
1966–73	18.1	5.0	2.9	7.3	5.2	3.8
Transportation and communications:						
1961–65	9.7	8.2	10.5	8.9	5.2	7.2
1966–73	9.7	7.6	12.0	10.0	5.1	8.5
Construction:						
1961–65	2.7	(2)	1.9	(3)	2.1	(2)
1966–73		(2)	1.8	(3)	2.5	(2)
Housing:						
1961–65	18.3	25.8	18.3	30.2	15.1	26.9
1966–73	16.3	26.9	18.3	31.3	18.0	17.9
Other:[4]						
1961–65	17.0	24.3	19.9	12.5	27.2	45.5
1966–73	17.0	28.3	25.3	12.2	32.1	42.0

[1] Includes manufacturing, mining, and public utilities.
[2] Not reported.
[3] Included in industry.
[4] Includes trade, finance, public administration.

SOURCES: Organization for Economic Cooperation and Development," National Accounts, the OECD Countries, 1960–73;" Tsentral'noe Statisticheskoe Upravlenie, "Narodnoe Khoziaistvo SSSR," 1973.

The sectoral distribution of Soviet investment is distinctive in the relatively large share devoted to agriculture and the somewhat smaller share to the housing and largely service-oriented "other" categories. On balance, these differences neutralize one another in terms of the impact on an aggregate capital-output ratio.[7] In other words, the sectoral composition of Soviet investment does not explain the prevalence of an unusually low return on investment. In fact, the net impact would be in the direction of a lower aggregate capital output ratio.

B. Technological Composition of Investment

The technological composition of investment refers to its physical and engineering features, particularly to the combination of plant and structures and of machinery and equipment that are selected to achieve economical output in particular sectors. Since buildings are much longer lived than machinery or equipment, improvements in technology can be more quickly incorporated in the latter type of investment.

[7] Estimates published for the 1950's for sectoral incremental capital-output ratios for six different sectors for the United States, Germany, Italy, and the United Kingdom show the following array of unweighted sector ratios for all four countries combined: manufacturing—2.4, utilities—10.1, transportation—11.6, agriculture—9.1, housing—46.8, and services—3.3. See United Nations, Economic Commission for Europe, *Some factors in Economic Growth in Europe During the 1950's.*

TABLE 4.—TECHNOLOGICAL COMPOSITION OF INVESTMENT

[Proportion of total]

Country	Residences	Nonresidential construction	Machinery equipment	Ratio of col. 2 to col. 3
U.S.S.R.:				
1960–65	19.4	51.1	29.5	173.2
1966–73	17.7	(44.0)51.0	(38.3)31.3	(114.8)162.9
France:				
1960–65	25.8	29.6	44.5	66.5
1966–72	26.8	30.4	42.7	71.2
Germany:				
1960–65	23.6	32.9	44.6	73.8
1966–73	23.6	33.0	44.3	74.5
Italy:				
1960–65	30.2	19.0	40.2	47.3
1966–73	31.3	19.1	38.7	49.4
United Kingdom:				
1960–65	18.2	32.8	39.0	84.1
1966–72	18.3	33.9	37.8	70.9
Japan: 1970–73	20.5	40.8	38.6	105.7
United States:				
1960–65	25.9	37.7	36.4	104.6
1966–73	21.6	37.4	41.0	91.2

Sources: Same as table 3. See text for adjustment of Soviet estimates.

The Soviet estimates in Table 4 are not strictly comparable with those of the market economies because of a definitional difference. Soviet statisticians classify installation expenditures under construction, while in the market economy estimates they are classified under machinery and equipment. Recalculations provided by Soviet economists permit an approximate adjustment of the Soviet estimates, which are shown in parentheses in the table.[8] Even after appropriate adjustments, Soviet investments are the most construction intensive.

If residential investment is excluded, then the Soviet reliance upon construction becomes even more distinctive, as is indicated by the rightmost column in the table. The propensity toward construction is even more dramatic if the comparison is limited to industrial investment, as noted in Table 5.

The unusually high proportion of Soviet investment comprised of non-residential construction and the correspondingly low machinery and equipment proportion does not bode favorably for technological progress or high returns on investment. The principal carrier of new technology into the productive process is machinery and equipment. What explanations might be offered to explain this propensity toward construction intensive investment?

TABLE 5.—TECHNOLOGICAL COMPOSITION OF INDUSTRIAL INVESTMENT

[PROPORTION OF TOTAL]

Country	Construction	Machinery and equipment
U.S.S.R.:		
1960–65	61.4–67.8	32.8–38.6
1966–73	59.0–61.8	39.2–41.0
United States:		
1960–65	25.6	74.4
1966–72	23.4	76.6

SOURCE: L. M. Smyshliaeva "Struktura kapital'nkh volzhenii i ikh fakticheskaia effecktivnost' " 1970 p. 113. V. Krasovskii source reference No. 4 U.S. Bureau of Economic Analysis "Fixed Nonresidential Business Capital in the United States, 1925–73" COM –74–10422 pp. 438–39.

[8] V. Krasovskii, "The Integral Effect and the Time Factor," Voprosy Ekonomiki, September 1975 and Voprosy Ekonomiki, August 1974, p. 86.

In part the high construction share is a consequence of the high rate of investment, which distinguishes the Soviet from the other major industrial economies, other than Japan. Other things being equal, the higher the investment growth rate, the higher the proportion of new, as distinguished from replacement, investment. The construction content would be much higher in the former category. However, Japan, with an even higher investment rate than the USSR, has a higher machinery and equipment component. Another factor is the Soviet propensity to stress new rather than replacement investment, which is the topic of the next section. Again, such a policy would increase the construction component.

Beyond these external influences lies the internal weakness of the Soviet construction sector. As compared with industrial production, Soviet construction is less efficient when compared with its counterpart in the market economies. It is a relatively high cost sector. According to the estimates of Abram Bergson,[9] the buying power of the ruble relative to the dollar in 1955 was about 5 to 1 for producer durables, but only about 8 to 1 for non-residential construction. This difference would mean inefficient use of resources in the construction sector. Furthermore, Soviet economists also depict the particular shortcomings of this sector. One notes that the prices quoted for construction projects invariably underestimate final costs by 50 to 100 percent. Furthermore, this situation is unique to the construction sector.[10] Appropriate adjustment of investment statistics to account for this phenomenon would further raise the construction proportion of the total. Estimates of construction costs in 1970 indicate a worsening of the relative inefficiency of the sector.[11]

The inclusion of installation costs under the construction rubric also has significance for the efficiency of the investment process. Since construction organizations rather than the enterprises which produce equipment have the responsibility for its installation, start-up adjustments, debugging, and supply of spare parts, this vital element in the investment process has been entrusted to organizations which do not possess the technical expertise to handle the task competently. In addition to its inefficient implementation of the installation process, the construction sector also performs miserably in completing projects on schedule.[12]

From the foregoing evidence it may be concluded that one of the factors explaining the low return on Soviet investment are the particular inefficiencies of the construction sector. These difficulties serve to compound the overemphasis on construction, or more properly the underemphasis on machinery and equipment expenditure, which characterizes Soviet investment. In order to understand this propensity we now turn to a discussion of Soviet investment replacement and depreciation policies.

C. Replacement, Depreciation, and Capital Repair Policies

If the return on investment in the Soviet economy is to be increased by a more rapid application of new technologies, whether internally

[9] National Bureau of Economic Research, International Comparisons of Prices and Output, 1972, pages 165 and 168.
[10] V. Krasovskii, "Social Product and Final Effect," Voprosy Ekonomiki, June 1975, p. 107.
[11] Central Intelligence Agency, Ruble-Dollar Ratios for Construction (ER76-10068), February 1976, p. 14.
[12] See section on Lags in Construction Completion and Equipment Installation.

generated or borrowed from abroad, it is not only desirable that the machinery and equipment share of investment be raised, but that obsolescent capital be promptly replaced by new machines which incorporate recent proved technologies. Particularly in a period of manpower stringency the rational course would be to devote more attention to that type of investment which reduces cost, as distinguished from that which expands the scale of output. As will be demonstrated in this discussion, Soviet financial and managerial incentives have been adverse to replacement investment and biased in favor of new (expansive) investment. Perceptive economists and planners have been advocating for the past decade or more that the efficiency of resource allocation would be improved if the ratio of replacement of obsolescent assets to investment in new assets were higher. A statement by Kosygin reflects official concern for this issue: "immense additional possibilities for increasing the value of production . . . can be obtained by improving the use of existing fixed capital in the national economy . . . Before beginning new construction it must be ascertained that the internal reserves of a branch have already been exhausted and that the construction of a new enterprise is a most rational course for further development." [13]

The guidelines of the Ninth Five Year Plan (1971–75) envisaged increased emphasis upon investment at existing sites. Over 61 percent of all investments in productive sectors were to be so directed.[14] However, this proportion was only about a one-half percent increase over the Eighth Five Year Plan proportion. This theme is being pushed more emphatically in the guidelines for the Tenth Five Year Plan (1976–80). For the European regions of the country the vast bulk of investment would consist of re-equipment and modernization of existing facilities, with investment in new plant restricted to Asian regions. In addition, there will be greater sensitivity to equipment obsolescence in investment decisions.[15]

The absence of common conceptual definitions prevents a direct comparison between the proportions devoted to replacement and to new investment in the Soviet and U.S. economies. However, there are less direct indicators which show significant differences in emphasis. In U.S. manufacturing in recent years there has been about an even division between investment in replacement and modernization and in net expansion.[16] The previous mentioned Soviet proportion of 61% of investment at existing sites includes expansion of capacity and capital repairs.[17] The extent to which the inclusion of these two concepts inflates the Soviet proportion relative to that of the United States cannot be precisely determined. However, it must be considerable, as capital repairs comprised nearly 21% of all Soviet industrial investment as recently as 1970.[18] If the expansion content is anywhere as large a proportion, the comparable Soviet replacement and modernization proportion would be barely half as large as that of the United

[13] Planovoe Khoziaistvo, November 1972.
[14] Joint Publications Research Service, "Soviet Five-Year Plan for the Development of the U.S.S.R. National Economy for the Period 1971–1975, Part II", p. 235.
[15] *Izvestiia*, Dec. 14, 1975 and March 2, 1976.
[16] Economics Department, McGraw Hill Publications Company, 27th Annual Survey of Business Plans for New Plants and Equipment, 1974–77. Table II.
[17] The capital repair category does not exist in U.S. investment statistics or in business accounting concepts. It refers to major renovating activities to replace defective parts of a fixed asset. If the purpose is to increase the working power of an asset, the term "reconstruction", not capital repair, is applicable in Soviet accounting.
[18] Iu. Lubimtsev, Tsikl vosproizvodstvo i amortizatsiia osnovnykh fondov, 1973, p. 59.

States. One Soviet economist has estimated the replacement and modernization proportion to be approximately a third.[19] Another Soviet economist demonstrates that a considerable portion of reported replacement investment consists of used assets transferred from one industrial ministry to another. If these transfers are taken into consideration, the share of investment devoted to net replacement falls even lower. In 1973 he estimated that only 8.7 percent of industrial investment was directed toward replacement in this net context.[20] In order to explain the low Soviet replacement propensity, it is necessary to examine depreciation and capital repair policies.

Soviet economics journal articles and policy statements with regard to investment single out low depreciation rates and excessive service lives as obstacles to technological progress. Not only have depreciation rates tended to disregard obsolescence, but actual retirement rates are often only half of these understated depreciation rates.[21] Prolonged service lives are sustained through a high incidence of capital repairs.

TABLE 6.—COMPARATIVE SERVICE LIVES OF INDUSTRIAL ASSETS

[In years]

Sector	United States 1974	U.S.S.R. 1961–66
Electric power	20–18	39
Oil and gas	14–16	18
Ferrous metals	18	29
Non-ferrous metals	14	23
Chemicals	11	28
Machinery	8–12	26
Forest products	10–16	18
Construction materials	14–20	25
Textiles and apparel	9–14	28
Food	12–18	28
Buildings	40–60	80–100

SOURCES: U.S.S.R.—V. P. Krasovskii "Planirovanie i analiz narodnokhoziaistvennoi struktury kapital'nykh vloshenii" 1970 p. 178, I. Mitiaev "Nadezhdy i normy" "Planovoe Khoziaistvo" April 1969 p. 45 United States—Department of the Treasury Internal Revenue Service, "Tax Information on Depreciation" publication 534.

In Table 6 U.S. depreciation rates are based on suggested asset guidelines prepared by federal tax authorities. Those for the Soviet Union are announced charges. The unrealistically long scheduled lives of Soviet assets are obvious in the comparison. However, in actuality, replacement rates average about half of the planned rates.[22] The correlation between depreciation rates and service lives in 1972 was .929 in the United States and only .395 in the U.S.S.R.[23] The combination of these policies leads to such absurdities as average lives of 90 years for ferrous metallurgical assets, 70 years in chemicals, 67 years in machinery, 48 years in light industry, 55 years in the food industry, and 167 years for electric power installations.[24] For computers a service life of 50 years was standard until 1974. It has now been reduced to 10 years.[25]

[19] Ibid.
[20] A. Shneiderov, "Vosproizvodstvennye Proportsii Kapital'nykh Vlozenii," Voprosy Ekonomiki, August 1975, p. 28.
[21] L. M. Gatovskii, Ekonomicheskie problemy nauchnotekhnicheskogo progressa, 1971, p. 68.
[22] L. M. Smyshlaieva, "Improvement in the Structure of Capital Investment," Voprosy Ekonomiki, April 1974, p. 19.
[23] A. Tsygichko, "Kapital'noe Vozmeschie v promyshlennosti v SSSR i SSHA," Voprosy Ekonomiki, October 1972, p. 34.
[24] A. Mitrofanov, "Capital Investment and the Renovation of Fixed Assets," Planovoe Khoziaistvo, July 1967, p. 37.
[25] Vestnik Statistiki, December 1974, pp. 53–54.

Such unrealistically low retirement rates mean that enterprises with aged equipment are high cost producers. In ferrous metallurgy in 1969 labor activity in old plants was a quarter to a third that in new installations. In rolling mills with old technology, costs were half again as high as those incorporating new technology. Repair outlays were twice as high.[26]

The new depreciation rates introduced at the beginning of 1975 will partially rectify this self-defeating policy. However, the new rates will still be far below their U.S. counterparts. Rates are increased by averages of 14 percent in energy industries, 13 percent in ferrous, 12 percent in non-ferrous, 17 percent in chemicals, 20 percent in textile and apparel industries, and 46 percent in pharmaceuticals.[27]

Soviet reluctance to consider new technologies, as exemplified in underdepreciation, is further compounded by a hesitancy in phasing out old technologies when new ones are phased in. This is in contrast to market economy practice in which the high cost old methods are scrapped as soon as possible.[28] Of course, such a policy maximizes production capacity, if at high cost. As will be noted in later discussion, the system of financial incentives is not structured to favor risk bearing.

D. Capital Repairs and Investment Policy

Capital repairs may be defined as major renovating outlays to replace defective or worn parts of existing assets. Their purpose is to restore the assets to full working potential, rather than to increase productive capability. As such, these expenditures draw upon the existing state of the arts; they do not utilize new technology. Capital repairs enable fixed assets to remain operative for what appear in U.S. experience to be unrealistically long lives. In U.S. accounting such a concept does not exist in that repair expenditures are charged to current cost unless they are major repairs. In the latter case they would be considered as net investment.

As suggested earlier, the incidence of capital repairs must be high in order to sustain long service lives. They have become a major claimant on investment resources. By 1970, 20 percent of all investment outlays were for this purpose.[29] In 1971–73 they amounted to 60 percent of all investment for machinery and equipment, exceeding the modernization portion. They absorbed the services of every tenth industrial worker and every third metal-cutting tool.[30] In the mid-sixties some 29 percent of the employees of the machinery sector and an eighth of the sector's output was used for repair purposes.[31]

Soviet practice also reflects the excessive use of capital repairs to postpone retirements. In the middle and late sixties for industry as a whole capital repairs exceeded retirements by 90 percent.[32]

[26] L. Kitiaev, "Nadezhdy i normy," Planovoe Khoziaistvo, April 1969, p. 46.
[27] M. Zavalishchin, A. Masal'skii, "Novye edinlye normy amortazatsionnykh otchislennii," Planovoe Khoziaistvo, November, 1974, p. 65.
[28] Jiri Slama and Heinrich Vogel, "On the Measurement of Technological Levels for the Soviet Economy," Forschungsbericht 1974, Osteuropa Institut, 1975, p. 141.
[29] Iu. Lubimtsev, op. cit., p. 56.
[30] A. Shneiderov, op. cit., p. 34.
[31] K. Vinogradov, "Problems of Rationalizing the Organization of Capital Repair Equipment," Voprosy Ekonomiki, August 1965, p. 13.
[32] A. Tsygichko, op. cit., p. 32.

E. Role of Financial Incentives

The pattern of financial incentives contributes toward the propensities of low retirements rates, high capital repairs, and disinclination toward modernization of existing assets. As noted in Table 6, Soviet service lives are much longer than those in the United States. Actual retirement rates were observed as being much lower than these conservative depreciation rates assumed. Not only have Soviet depreciation rates been too low, but the proportion of the amortization deductions, accompanying these depreciation rates, earmarked for capital repairs has averaged around a half over the past decade.[33] Within the deficient proportion reserved for replacement, only 30 percent was directed toward modernization in 1973, the rest being used for new investment.[34]

The new depreciation rates and service lives norms introduced at the beginning of 1975 are intended to rectify these deficiencies, but they proceed cautiously, as noted earlier. The proportion of the higher amortization deductions directed toward capital repairs has been reduced from around half to 40 percent. For machinery and equipment the reduced proportion is somewhat larger—around 15 percent—while that for buildings and structures has been increased to bring programmed norms into accord with actual experience. Within the amortization share remaining for net investment, the modernization proportion has been raised around 18 percent.[35]

III. Lags in Construction Completion and Equipment Installation

The aforementioned policies of investment choice and investment financial incentives are the principal factors explaining the inconsistency between investment policies and the official imperative for technological progress. These basic deficiencies are compounded in their impacts by chronic delays in meeting construction completion and equipment installation schedules. The Soviet term for this phenomenon is "unfinished construction," referring to construction and installation work beyond the initial stages, but not finished to the point of permitting use of the assets. Included within the concept is equipment in the process of being installed or actually inplace in uncompleted structures.[36]

To the extent that investment resources are immobilized and incapable of yielding capital services, the embodiment of technology into the production process is further delayed. Official estimates for the mid-sixties show that the total elapsed time between project initiation and full scale production averages 7 to 8 years for large enterprises and, for some, as much as a dozen years. Foreign projects of similar nature required only about half as much time.[37] Not only was the process of construction and equipment manufacture and installa-

[33] Tsentral'noe Statisticheskoe Upravlenie, Narodnoe Khoziaistvo v SSSR 1973 Godu, p. 777.
[34] A. Schneiderov, op. cit., p. 31.
[35] M. Zavalishchin and A. Masal'skii, op. cit., pp. 60–62.
[36] B. Savin and I. Sher, "Uncompleted Construction and Ways to Curtail it," Finansy SSSR, March 1959.
[37] V. P. Krasovskii, Planorovanie i analiz narodnokhoziaistvennï struktury kapital'nykh vlozhenii, 1970, p. 49.

tion unduly prolonged, but the break-in time for completed projects was too lengthy, averaging 2 to 4 years.

A pilot study comparing total elapsed time for building of thermal electric generating plants showed the average for the United States was 4¼ years, while the average for the USSR was 11 to 15 years.[38] In addition, there were also cost overruns which averaged some 47 percent.

In industrial investment, the ratio of uncompleted construction to total investment in the USSR is about double that for the United States.[39] The actual completion time in the Soviet Union ranges from 20 to 100 percent above the standard set by Gosstroi. Throughout the recently concluded Ninth Five Year Plan the ratio of uncompleted construction to total state financed investment has averaged around 77 percent, a deterioration over the previous two plans.[40]

The goals of the Ninth Plan explicitly sought to ameliorate this seemingly chronic problem, but to no avail. Actual completion times averaged double planned norms. Even these reduced norms were still excessive in that they exceeded actual foreign construction experience. Similarly the goals for mastering completed projects fell short by some 50 percent.[41] In 1973, the leadership attempted to rectify this problem by sharply reducing new investment starts in order to concentrate on completion of on-going projects. At the same time gross additions to new fixed capital jumped sharply, thereby greatly shrinking the growth of the unfinished construction backlog. However, in 1974, the chronic propensity reasserted itself. Additions to new investment returned to a high 7 percent annual rate from 4.6 percent in 1973 and additions to fixed capital fell sharply. The unfinished construction backlog rose once again.[42]

The Tenth Five Year Plan contains the usual admonitions to reduce construction time. It seeks to implement this aim by lowering the average annual investment growth rate from 7 percent in the Ninth Plan to only 4 percent in the Tenth. This reduction in new starts will in turn lead to lower percentage increments to capital stock (Table 2). This policy combined with the previously stated one of placing greater emphasis on replacement investment will hopefully substantially reduce the chronic large construction backlog. If successful, it would lead to an increased rate of technological innovation at a lower investment cost.

IV. Implications of Investment Policies for Technological Advancement

During the Ninth Plan there was no shift of investment composition toward equipment and away from construction. While official data on the proportion of all capital investment on reconstruction, expansion, and technological reequipment of existing plant relative to total investment showed some modest rise, the level obtained in 1974 was not much ahead of the previous high attained in 1966. It remains to be seen

[38] Ibid., p. 53.
[39] Ibid., p. 53.
[40] V. Il'in, "Uskorenie stroitel'stva-vlozhenila narodnokhozialstvennaia zadacha," Voprosy Ekonomiki, January 1976, p. 2.
[41] V. P. Krasovskii, op. cit., footnote 10 of text.
[42] D. Smelev, "Dynamic Development of the USSR National Economy," Planovoe Khozialstvo. March 1975, p. 32.

if the replacement share increase contemplated in the Tenth Plan can be realized. This intention will be supported by the new depreciation guidelines adopted at the beginning of 1975.

Exogenous factors make accomplishment more difficult, but at the same time, all the more imperative. Continued industrial expansion in Siberia requires large outlays for new productive plant and overhead facilities. The necessity to utilize less rich ore deposits requires construction of more extensive processing facilities. The higher proportion of industrial investment in raw materials, as distinguished from manufacturing sectors, involves a heavier construction component. Finally, the belated decision to invest in projects which would alleviate environmental disruption also implies proportionately higher construction outlays.[43]

If the technical structure of investment is beyond the control of planners, other key features relating to its composition are not. Particularly in the manufacturing sectors the bulk of future increases in production will depend upon replacement of existing assets. This imperative will require further measures to induce planners and managers to refrain from prolonging the lives of obsolescent assets through the traditional resort to large capital repairs and to make them more conscious of the significance of economic obsolescence in their investment choices. The new depreciation guidelines and the intentions announced in the Tenth Plan are steps in the right direction, but are too cautious in degree. Without their forthright implementation and more sweeping changes in direction from traditional investment practices, the high hopes of accomplishment from more rapid adoption of new technology will be frustrated. It will also be necessary to reduce existing prolonged construction and installation performance. Technology offers considerable promise for the Soviet economic future, but must be supplemented by significant changes in investment policies and practices.

[43] Izvestiia, op. cit., footnote 15 of text.

OUTLOOK FOR SOVIET ENERGY

EMILY E. JACK, J. RICHARD LEE, AND HAROLD H. LENT

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I. INTRODUCTION

The U.S.S.R. is the only major industrial nation in the world that is self-sufficient in energy and likely to maintain this position for the

foreseeable future. Furthermore, the U.S.S.R. has become a substantial net exporter of fossil fuels to Communist and non-Communist countries. Oil sales to the West are the Soviet Union's largest single source of hard currency earnings, totaling about $3.2 billion in 1975. Coal exports to the West—about 8 million metric tons in 1975—earned about $385 million in hard currency. The U.S.S.R. is in the early stages of becoming a sizable net exporter of natural gas, although at the present time it imports more gas from Iran and Afghanistan than it exports to Western Europe.

Future growth in energy supply depends, however, on successful development of Siberian resources, as 80 percent of the reserves of primary energy lie east of the Urals. In the hostile environment of the northern part of West Siberia the U.S.S.R. is confronted with difficult petroleum exploration and development problems and has begun to purchase western equipment and technology to upgrade the petroleum industry's technical capability.

II. Summary

Domestic production of energy, which accounts for 98 percent of the U.S.S.R.'s total energy supply, is scheduled to grow at an annual rate of 5.0 percent in 1976–80, slightly below the rate during 1971–75. Crude oil will continue to account for slightly more than two-fifths of total production. The share contributed by natural gas will rise to almost one-fourth by 1980, and coal's share will decline to just over one-fourth. Minor sources of energy, including hydroelectric and nuclear electric power, will account for the remaining few percent. Although a net exporter, imports—mainly of natural gas—accounted for 2 percent of total energy supply in 1975; imports will still be of minor importance in 1980.

Exports of energy probably are expected to grow at about 4.7 percent per year in 1976–80, considerably less than the 7.3 percent rate of 1971–75. The bulk will continue to go to other Communist countries. Although exports of natural gas will rise sharply, exports of crude oil and petroleum products will still account for about two-thirds of total energy exports in 1980. Domestic consumption of energy apparently is projected at about 5.1 percent per year, a slight drop from the 5.2 percent rate of 1971–75. This rate of increase appears to be consistent with the planned overall growth of the Soviet economy in 1976–80.

The U.S.S.R. probably will not be able to meet the ambitious targets set for oil and gas production in 1980 but it is likely that lags also will occur in other sectors of the economy thus preserving the overall balance between energy supply and requirements.

The U.S.S.R. has not as yet released its long-range plan (1976–90) but forecasts made by Soviet energy experts in the early 1970's projected energy requirements through 1990 at a growth rate about equal to the rate now set for 1976–80. These forecasts point to a further slowdown in the growth of crude oil production, continued rapid increases in natural gas production, and a slight acceleration in the rate of growth in coal production. A very rapid buildup in nuclear energy production probably will be planned for the 1980's, but its share in total energy supply will still be small in 1990.

III. Production Through 1980

A. Crude Oil

The plan calls for Soviet crude oil [1] production to reach 620–640 million tons in 1980.[2] This output will require a 4.8 percent to 5.4 percent average annual rate of increase compared with the 6.8 percent attained during 1971–75. Annual production over the 5-year period is to increase by 129–149 million tons, about the same as the 138 million ton increment achieved in 1971–75. In 1975 the U.S.S.R. produced a record 491 million tons [3] of crude oil, 32 million tons more than in 1974. Nevertheless, the original 1975 goal of 505 million tons [4] was underfulfilled by almost 3 percent. (See table 1).

TABLE 1.—U.S.S.R.: PRODUCTION OF MAJOR SOURCES OF PRIMARY ENERGY, 1960, 1965, 1970–75, 1980 PLAN

	Crude oil [1] (million metric tons)	Natural gas (billion cubic meters)	Coal [2] (million metric tons)	Hydroelectric power (billion kilowatt hours)	Nuclear electric power (billion kilowatt hours)
1960	[3] 147.9	[3] 45.3	[3] 509.6	[3] 50.9	Negligible
1965	[3] 242.9	[3] 127.7	[3] 577.7	[3] 81.4	[5] 1.4
1970	[3] 353.0	[3] 197.9	[3] 624.1	[3] 124.4	[6] 3.5
1971	[3] 377.1	[3] 212.4	[3] 640.9	[3] 126.1	[8] 4.0
1972	[3] 400.4	[3] 221.4	[3] 655.2	[3] 122.9	[9] 7.3
1973	[3] 429.0	[3] 236.3	[3] 667.6	[3] 122.3	[10] 11.7
1974	[3] 458.9	[3] 260.6	[3] 684.5	[3] 132.0	[11] 18.0
1975	[4] 491	[4] 289	[4] 701	[5] 140	[5] 20
1975 (original plan)	[6] 505	[6] 320	[6] 695	[6] 165	[6] 25
1980 plan	[7] 620–640	[7] 400–435	[7] 790–810	[12] 197	[12] 80

[1] Including gas condensate.
[2] Raw coal.
[3] U.S.S.R., "Tsentral'noye Statisticheskoye Upravleniye, Nardnoye Khozyaystvo SSSR v 1974 g.," Moscow 1975 p. 215, 220–222.
[4] Pravda, Feb. 1, 1976, p. 1.
[5] Estimate.
[6] U.S.S.R., "Gosudarstvenniy Pyatiletniy Plan Razvitiya Narodnogo Khozyaystva SSSR na 1971–75 gody," Moscow 1972, p. 98.
[7] "Pravda", Mar. 7, 1976, p. 3.
[8] "Elektricheskiye Stantsii," May 1973, p. 11; "Teploenergetika". December 1974, p. 10.
[9] "Teploenergetika", June 1974, p. 10; "Teploenergetika," December 1974, p. 10.
[10] "Elektricheskiye Stantsii", January 1974, p. 2.
[11] Ibid., April 1975, p. 13.
[12] Ibid., June 1976, p. 3.

The Soviet oil production goal for 1980 appears overoptimistic. Output probably will approximate 590–600 million tons, a shortfall of 3 percent to 8 percent. Fulfillment depends on rapid development of West Siberian deposits, and on major improvements in equipment and technology for oil and exploration, development, and transport—none of which appears likely in the time allotted.

West Siberia is to provide all of the production increases planned through 1980. Output is to rise from 148 million tons in 1975 to 300–310 million tons in 1980, yielding half of national oil production.[5] This new Siberian goal is considerably higher than an earlier one of 230–260 million tons quoted by various oil industry officials. Although West Siberia exceeded 1975 production plans by almost 18

[1] Includes gas condensate.
[2] Pravda, 14 December 1975, p. 2.
[3] Izvestiya, 1 February 1976, p. 2; the figure includes 9.3 million tons of condensate (Ekonomika Neftyanoi Promyshlennosti No. 1, January 1976, p. 3.
[4] Gosudarstvennyi Pyatiletnii Plan Razvitia Narodnovo Khozaystvo na 1971–75 gody, Moscow. 1972. p. 102.
[5] Pravda, 14 December 1975, p. 2.

percent, available data on West Siberia oilfields indicates that peak production capacity is about 270–290 million tons.[6] Some of these fields have already peaked, and others will peak before 1980. New fields are being discovered in West Siberia, but no giant fields have been found comparable to Samotlor, which has a production potential of 110–120 million tons. In 1975, the Director of the Main Administration for the Oil and Gas Industries in Tyumen' Oblast disclosed that the new oil deposits being discovered in West Siberia are much smaller than Samotlor. As a result, 7 new deposits must be developed each year compared with only 16 during the whole of the past 10 years.[7] West Siberian production of about 250 million tons in 1980 appears to be a reasonable estimate.

The West Siberian goal for 1980 may have been raised above earlier limits because the region exceeded planned output in 1975 and represented the only major source of substantial increase. Moreover, Soviet planners realize that many of the major oil fields in the Urals-Volga region are being depleted rapidly and that ouput from this major producing area cannot be maintained at present levels during the next five years. V. D. Shashin, Minister of the Petroleum Industry, acknowledged the depletion problem when he stated that new production capacity during 1976–80 will have to average 100 million tons per year, two-thirds of which is to offset depletion.[8] This implies a drilling requirement to offset depletion during 1976–80 equivalent to that of the previous 12 years, indeed a formidable task in light of chronic shortfalls in meeting annual drilling goals.

In recent years the rate of discovery of new oil reserves has lagged behind increases in production. As early as 1972 Shashin pointed out that accelerated development of the oil industry after 1975 would be possible only if new oil basins equivalent to West Siberia could be discovered and exploited.[9] As a result, plans have been made for extensive exploration in East Siberia during 1976–80.[10] Given climate and logistic problems worse than in West Siberia, more complex geological conditions, and the lack of adequate geophysical equipment, it is unlikely that East Siberia will make a worthwhile contribution to Soviet oil supply before the mid-1980's.

Soviet offshore experience thus far has been limited chiefly to the shallow waters of the Caspian and Black Seas where operations are conducted from trestles extending from the shore or "man-made islands". The U.S.S.R. has only 4 mobile offshore platforms (jackups), all in the Caspian Sea; only one is capable of drilling in water depths up to 100 meters. Moving into deeper water in the Caspian and Arctic Seas, or in the Sea of Okhotsk off Sakhalin, will require Western equipment and know-how. Even with help, only small amounts of oil could be produced in these areas before 1980.

B. Natural Gas

Soviet plans call for natural gas production in 1980 to reach 400–435 billion cubic meters.[11] The average annual rate of growth required to

[6] Geologiya Nefti i Gaza, No. 3, March 1973, pp. 22–28; Organizatsiye i Upravleniye Neftyanoi Promyshlennosti. No. 12, 1974. p. 16.
[7] Pravda, 11 June 1975. p. 3.
[8] Neftyanoye Khozaystvo, No. 6, 1975. p. 6; Ekonomicheskaya Gazeta, No. 22, May 1976, p. 4.
[9] Geologiya Nefti i Gaza, January 1974.
[10] Sotsialisticheskaya Industriya, 13 September 1974, p. 2.
[11] Pravda, 14 December 1975.

meet this goal ranges from 6.7 percent to 8.5 percent, about the same as the 7.9 percent rate achieved during 1971–75. Annual production over the five-year period is to increase by 111–146 billion cubic meters, about 20–50 billion more than in 1971–75. Production of 289 billion cubic meters in 1975 was almost 10 percent below the original Five Year Plan target of 320 billion cubic meters and only slightly above the revised annual plan for 1975.

The Soviet gas industry has failed to meet production goals for the past decade largely because of inability to coordinate field development with construction and efficient operation of pipelines and gas treatment plants. In recent years depletion of some large, older fields in the western part of the country has also been a factor in plan underfulfillment. The present plan appears as optimistic as those of the recent past, and production in 1980 is unlikely to exceed 390 billion cubic meters.

Fulfillment of the plan depends heavily on substantial production increases from West Siberia, major improvements in gas production and pipeline technology, and increased supplies of high-performance equipment, none of which appears probable. The bulk of new gasfield development and pipeline construction is to be concentrated in the permafrost regions of northern Tyumen' Oblast in West Siberia. Gas reserves here are more than adequate to provide the 87–117 billion cubic meter production increase scheduled for this region. However, in recent years, output goals have not been met from producing fields where difficult climate and working conditions persist. Commercial gas production at Urengoy, the world's largest gas field, in West Siberia is not scheduled to begin until 1978,[12] but delays are likely in coordination of development and pipeline construction schedules.

The basic problem of past years—failure to meet pipeline construction goals because of shortages of large diameter pipe and ancillary equipment—is likely to continue through the present plan period. Plans for 1976–80 call for construction of 35,000 kilometers of gas pipeline. This is about 2,000 kilometers more than was scheduled for 1971–75, when the goal was underfulfilled by about 1,000 kilometers. Most construction is to be of large-diameter, high-capacity lines operating at 75 atmospheres pressure. A substantial part of the necessary line pipe, valves, turbines, and compressors will have to be imported from the West, either by hard currency purchases, or as part of contracts for delivery of Soviet gas.

C. Coal

The plan target for coal production of 790–810 million tons in 1980 is slightly lower than the 810–820 million tons forecast for that year by the Minister of the Coal Industry.[13] Its achievement will require an average annual rate of growth of 2.4 percent to 2.9 percent during 1976–80. This rate is slightly above the actual 2.3 percent annual rate of growth in 1971–75 and the 2.0 percent per year in 1967–70. About nine-tenths of the 89 to 109 million tons increase in output over the 5-year period is to be obtained in the eastern regions of the country—chiefly from (a) the Karaganda coal basin in Kazakh SSR, where out-

[12] Stroitelnaya Gazeta, 4 February 1976, p. 3.
[13] B. F. Bratchenko, *UgoV*, No. 6, 1971, p. 5.

put is to rise from 92 to 127 million tons, (b) the Kuznets basin in West Siberia (up from 137 to 161 million tons), and (c) the Kansk-Achinsk basin in East Siberia (up from 25 to about 40 million tons).[14] Output from the Donets basin in the Ukraine, where costs are high, is to increase only slightly in 1976–80 (up from 221 to 231–233 million tons).[15]

The eastern regions are to account for all of the 50 million ton increase in surface mining operations, an increase that would bring the share of coal extracted by this less costly method to 34 percent in 1980, compared with 32 percent in 1975.[16]

The coal industry goal probably can be achieved without great difficulty. Soviet geologists have estimated total reserves of coal at 6.8 trillion tons.[17] Although explored reserves are only a small fraction of estimated total reserves, they nevertheless are extremely large in relation to projected output. Explored reserves in categories A+B+C1 were claimed to be 452 billion tons as of January 1970, of which 276 million tons were considered economically exploitable reserves, one-half, or about 140 billion tons were estimated by the Soviets to be recoverable.[18] It has been stated that reserves are fully adequate to support the production goals for 1980 although concern has been expressed about the need to speed up the rate of geological prospecting to satisfy the requirements of the industry after 1980, particularly for coking coals.[19]

Problems may arise, however, with respect to construction of new mines and reconstruction of existing mines. A decree issued by the Central Committee of the Comunist Party in February 1976 noted shortages in mine construction in the Donets basin and called for corrective action by the Ministry of the Coal Industry and other responsible authorities.[20] Similarly, mine construction work was recently reported to be lagging in the Moscow coal basin.[21] Moreover, Minister of the Coal Industry Bratchenko complained, in a speech at the 25th Party Congress in March 1976, that Gosplan had not yet allocated funds for beginning construction of new projects in the Kansk-Achinsk basin.[22] In 1974, the latest year for which overall statistics are available on construction in the industry, the capital investment plan was fulfilled only 92 percent.[23] However, the record during the first three years of the Ninth Five Year Plan (1971–75) was only slightly better (an average of about 95 percent).[24] There have been complaints in the Soviet press about deficiencies in equipment production but the problem does not appear to represent a serious bottleneck.[25]

A substantial amount of equipment for the development of production in the South Yakutsk coal basin is being imported from Japan under a $450 million loan to be repaid by deliveries of coal.[26]

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[14] B. F. Bratchenko, *Ekonomicheskaya Gazeta*, No. 2, January 1976, p. 4.
[15] *Pravda*, 10 February 1976, p. 1.
[16] N. V. Mel'nikov, *Ugol'*, No. 2, 1976, p. 39.
[17] Akademiya Nauk SSR i Ministerstvo Geologii SSSR, Geologiya Ugol'nykh Mestorozhdeniy, Vol. 2, Moscow 1971, p. 3.
[18] Ibid., p. 299.
[19] V. F. Cherepovskiy and I. I. Molchanov, Razvedka i Okhrana Nedr, No. 5, 1976, p. 9.
[20] Pravda, 10 February 1976, p. 1.
[21] Pravda, 28 December 1975, p. 3.
[22] Pravda, 3 March 1976, p. 3.
[23] Ugol', No. 4, 1975, p. 74.
[24] Ugol', No. 4, 1974, p. 73; No. 4, 1973, p. 76; No. 4, 1972, p. 72.
[25] Pravda, 14 September 1973, p. 2; Trud, 26 October 1974, p. 2; Izvestiya, 2 April 1975 p. 3; Sotsialisticheskaye Industriya, 15 June 1976, p. 2.
[26] Japan Economic Journal, 2 July 1974, p. 4.

D. Electric Power

The Tenth Five Year Plan provides for production of 1,340–1,380 billion kwh of electric power in 1980. Only about one-fifth of the planned output will be primary energy provided by nuclear and hydroelectric powerplants, the remainder being secondary energy produced at thermal powerplans that burn fossil fuels. (See table 2.) The planned increase in total power production—29 to 33 percent over 1975—is considerably less than the 40 percent increase in power production achieved in the Ninth Five Year Plan, and is the lowest projected rate of growth since World War II. At the same time, the new five-year plan provides for an increase of 35 percent to 39 percent in total industrial output, with an accelerated rate of mechanization of production processes and a substantial cut in the share of manual labor. These latter goals could only be accomplished by considerably increased electrification of industrial processes. Such increases in industrial electrification, along with a planned increase in the share of total electric power allocated to the rural economy, appear to be incompatible with the reduced rate of growth in production of electric power, and contrary to the historic pattern of a faster growth rate for electric power production than for industrial output.

TABLE 2.—U.S.S.R.: ELECTRIC POWER PRODUCTION

[Billion kilowatt-hours]

	1965	1970	1974	1975	1980 plan
Total production	506.7	740.9	975.8	1,038	1,340–1,380
Of which:					
Hydroelectric	81.4	124.4	132.0	[1] 140	197
Nuclear	1.4	3.5	18.0	[1] 20	80

[1] Preliminary estimate.

The goal for installation of new powerplant capacity during 1976–80 is 67,000–70,000 megawatts (MW), which is almost the same as the goal for the preceding five-year plan, of 67,200 MW. Installation of new capacity fell short in the previous plan, however, reaching only 58,000 MW or 86% of the goal.[27]

Nuclear power and hydroelectric power figure prominently in the plans for construction of new generating capacity, representing 40% of the total planned capacity, versus 22% in the previous five-year period.[28] The Soviet Deputy Minister for Power and Electrification, E. I. Borisov, stated recently that the Soviet Union is the only large industrial country in the world that bases its economic development totally on its own fuel and power resources. But in the future the increase in the power potential must be obtained from nuclear fuel, hydro resources, and low-cost open-pit coal.[29]

The plan provides for installation of 13,000–15,000 MW in nuclear powerplants during 1976–80. All of this new capacity will be in European areas of the Soviet Union, where shortages of fuel from local sources for conventional thermal powerplants have led to an increasingly tight electricity supply. The total capacity at nuclear power-

[27] Energetik, March 1976, p. 1.
[28] Izvestiya, 4 May 1976, p. 2.
[29] Sovetskaya Rossiya, 7 April 1976, p. 2.

plants is to reach 20,000 MW by the end of 1980, which assumes that 15,000 MW of new capacity will be placed in operation. This level will be difficult to achieve, because capacity to produce nuclear powerplant equipment is inadequate. Failure to put the Kursk and Armenian nuclear powerplants into operation in 1975 was blamed directly on the failure of the machine building industry to deliver the necessary components.[30] Nuclear machine building is to develop at an accelerated rate—a large nuclear engineering works is now under construction in the North Caucasus area—but for the next few years the industry undoubtedly will continue to be plagued with shortages of equipment and late deliveries. The plan calls for production of 80 billion kwh of electricity at nuclear powerplants in 1980, or 6 percent of total power production, compared with 2 percent in 1975.

The Soviet Union has tremendous hydroelectric power resources, the economic potential of which is equal to 1,095 billion kwh per year. At present only about 13 percent of this potential is being utilized, to generate about 14 percent of annual power production.[31] Extensive development of the hydro power potential is hindered by its regional distribution. Only 18 percent of the hydro resources are located in European areas of the U.S.S.R., which have the greatest economic development, the highest concentration of population, and consume about 80 percent of the power produced. In the current five-year plan period the Soviets plan to install 14,000 MW of new capacity at hydroelectric powerplants. About one-third will be located in the European part of the country, 48 percent in Siberia and the Soviet Far East, and 19 percent in Central Asia. Hydroelectric powerplants are planned to produce 197 billion kwh of electric power in 1980 and thus maintain their 14 percent share of electric power output.

Large-scale thermal powerplants will be built in the future in eastern regions of the Soviet Union where there are large deposits of coal that can be mined inexpensively by the open pit method. Two such powerplants will be built in the current five-year period, one in North Kazakhstan to use Ekibastuz coal and one in Siberia to use Kansk-Achinsk coal. About half of the new thermal generating capacity during this period, however, will be built in European areas of the country.

Prospects for meeting the 1980 plan for electric power output are tied to attainment of the plan for construction of new powerplant capacity. This in turn will be dependent upon the ability of the machine building industry to increase the production of powerplant equipment. The inadequacy of the planned goal for production of electric power apparently disturbs P. S. Neporozhnyy, Minister of Power and Electrification. In his speech at the 25th Party Congress of the Communist Party of the Soviet Union, he stated that at least 70,000 MW of new power capacities must be commissioned, including at least 15,000 MW of nuclear capacity, to insure the generation of 1,400 billion kwh in 1980. The higher production goal presented by Neporozhnyy represents an increase of 35 percent, instead of the officially planned increase of 29 percent to 33 percent. Neporozhnyy pointed out that in the past few years demand for electricity has begun to exceed the commissioning of new electric power capacity, a situation that is reducing the reliability of the nation's electric power supply.[32]

[30] Pravda, 20 December 1975, p. 8.
[31] Gidrotekhnicheskoye Stroitelstvo, February 1976, p. 29.
[32] Pravda, 4 March 1976, p. 3.

IV. Energy Supply and Requirements in 1980

A. Supply

Domestic production of energy, which currently accounts for about 98 percent of the U.S.S.R.'s total energy supply (production plus imports), is scheduled to increase to about 2 billion tons of standard coal equivalent (SCE) [33] by 1980 (see table 3). This equates to an average annual growth rate of 5.0 percent in 1976–80, which is slightly less than the 5.2 and 5.7 percent growth rates achieved in 1971–75 and 1961–70.

TABLE 3.—U.S.S.R.: SUPPLY OF AND REQUIREMENTS FOR ENERGY, 1960–80

[In million metric tons of standard coal equivalent] [1]

	Actual [2]		Estimated	
	1960	1970	1975	Plan, 1980
Total supply	742	1,289	1,686	2,156
Production of fuel	692	1,223	1,593	2,020
Crude oil and condensate	211	503	[7] 702	[7] 900
Natural gas	54	234	[7] 345	[7] 500
Coal	373	433	[7] 491	[7] 560
Peat, shale, and fuelwood [3]	54	53	[7] 55	[8] 60
Hydroelectric power [4]	6	15	[7] 17	[7] 24
Nuclear electric power [5]	Negl.	1	[7] 7	[7] 26
Other sources [6]	33	36	[8] 36	[8] 36
Imports	11	14	[9] 33	[8] 50
Total requirements	742	1,289	1,686	2,156
Consumption	678	1,119	[10] 1,443	[10] 1,851
Exports	60	167	[9] 238	[11] 300
Additions to stocks	4	3	[8] 5	[8] 5

[1] Standard coal equivalent has a heat value of 7,000 kilocalories per kilogram.
[2] "Narodnoye khozyaystvo SSSR v 1972," Moscow, 1973, p. 70.
[3] Excluding fuelwood gathered by the population which might amount to as much as 30,000,000 tons of standard coal equivalent per year.
[4] Converted at the rate of 123 grams of standard coal equivalent per kilowatt-hour (the heat value of electricity), which corresponds to the procedure in the Soviet statistical yearbook cited above. If hydroelectric power were converted at a rate corresponding to the average amount of fuel required to produce electricity in thermal powerplants, which is the practice in some countries, the figures for hydropower would be approximately tripled.
[5] Nuclear electricity is not shown explicitly in Soviet statistics on fuel-energy balances and does not appear to be included in "other sources" because the total shown for other sources has remained virtually unchanged since 1955. Estimated values have therefore been added for nuclear electricity at a rate of 350 grams of standard coal equivalent per kilowatt-hour through 1975, 325 grams in 1980, and 300 grams in 1990. This conforms to the practice of the Organization for Economic Cooperation and Development, and apparently to the practice of at least some Soviet energy technicians.
[6] Minor sources of primary energy, such as agricultural wastes, together with secondary sources such as coke oven and blast furnace gases.
[7] Calculated from data in Table 1.
[8] Estimated.
[9] Calculated from data in Ministerstno Vneshnei Torgovli SSSR, Vneshnaya Torgovlya SSSR za 1975 god, Moscow.
[10] Residual.
[11] From Table 5.

Oil will continue to account for the largest share of domestic energy output, but the reduced rate of growth in oil production will mean that its share will no longer be rising. (See table 4.) Natural gas, whose potential Soviet planners were slow to appreciate, will continue to gain in importance in the energy production mix, with a concomitant drop in the share accounted for by coal. Nuclear electric power production, while growing rapidly, will constitute only a minor share of total energy production through 1980.

[33] Standard coal equivalent is defined as having a heat value of 7,000 kilocalories per kilogram.

TABLE 4.—U.S.S.R.: DISTRIBUTION OF ENERGY PRODUCTION, BY SOURCE,[1] 1960, 1970, 1975, 1980 PLAN

(In percent)

	1960	1970	1975	1980 plan
Total energy production	100.0	100.0	100.0	100.0
Crude oil and condensate	28.9	39.4	42.5	42.7
Natural gas	7.4	18.4	20.9	23.7
Coal	51.0	34.0	29.7	26.5
Peat, shale, and fuelwood	7.4	4.2	3.3	2.8
Hydroelectric power	.8	1.2	1.0	1.1
Nuclear electric power	Negl	Negl	.4	1.4
Other sources[2]	4.5	2.8	2.2	1.8

[1] Calculated from data in table 3.

[2] Minor sources of primary energy, such as agricultural waste, together with secondary sources such as coke oven and blast furnace gases.

Imports accounted for only 2 percent of total energy supply in 1975 and no doubt are scheduled to be of minor importance in 1980. The USSR imports small quantities of natural gas from Iran and Afghanistan (15 million tons of SCE in 1975) and a small amount of coal from Poland (9 million tons of SCE in 1975). Crude oil procurement from Middle Eastern countries for export on Soviet account primarily to Eastern Europe and other Communist countries grew rapidly from 5 million tons of SCE in 1970 to 19 million tons in 1973. In 1974, however, this total dropped to 6 million tons of SCE, because Soviet sales of oil to non-Communist countries declined and more domestic oil was available for export. In 1975, imports of oil increased slightly to 9 million tons of SCE. (For details of Soviet imports of fossil fuels in 1965, 1970, 1974–75, see tables 1–4 in appendix A.)

B. Requirements

Exports currently account for about 14 percent of total Soviet energy requirements. The U.S.S.R. has been a net exporter of oil in increasing amounts since 1955. Since the mid-1960's net exports almost doubled, rising from slightly more than 62 million tons in 1965 to about 124 million tons in 1975, or an average annual rate of 7.1 percent. In recent years a larger share of Soviet oil exports has gone to other Communist countries, especially Eastern Europe, although oil sales to the West are the U.S.S.R.'s largest single source of hard currency earnings. (See table 1 of appendix A.) Until the last few years almost all natural gas produced in the U.S.S.R. was consumed domestically. Since 1970 increasing volumes have been exported to both Eastern and Western Europe that more than offset imports from Iran and Afghanistan. As domestic output of gas increases and the pipeline network expands, the U.S.S.R. will increase its net exports of gas from the present level of about 7 billion cubic meters per year to 40–45 billion in 1980, and foreign exchange earnings from such sales will rise sharply. (See table 2 of appendix A.)

Soviet exports of coal and coke have averaged about 28–30 million tons during the past few years, with almost one-third of the total delivered to non-Communist countries to earn hard currency. (See tables 3 and 4 of appendix A.)

As shown in table 3, planned exports of energy in 1980 are estimated to be 300 million tons of SCE. This amounts to an annual rate

of growth of 4.7 percent during 1976–80, considerably less than the actual rate of growth of 7.3 percent during 1971–75. The figure of 300 million tons was derived from data on planned deliveries to CEMA countries in 1976–80, together with the assumption that the share of Soviet exports of energy scheduled to go to these countries will, following the historical trend, grow from 56 percent in 1975 to 60 percent in 1980. A breakdown of exports is presented in table 5. Exports to CEMA countries are scheduled to rise by about 6.1 percent per year in 1976–80, compared with 9.5 percent in 1971–75. Exports of natural gas will rise very sharply. Exports of crude oil and petroleum products, while rising moderately will still account for about two-thirds of total exports of energy to CEMA countries in 1980. Deliveries of natural gas to non-Communist countries also are scheduled to rise swiftly. The estimates point to a slight decline in planned deliveries of crude oil and petroleum products to non-Communist countries.

TABLE 5.—U.S.S.R.: EXPORTS OF ENERGY, BY DESTINATION AND TYPE, 1970, 1975, AND 1980

[In million metric tons of standard coal equivalent]

	Actual		Estimated plan, 1980
	1970 [1]	1975 [2]	
ALL COUNTRIES			
Total	167	238	[3] 300
Crude oil and petroleum products	136	186	195
Natural gas	4	23	[5] 73
Coal and coke	27	29	[6] 32
CEMA COUNTRIES [7]			
Total	85	134	[8] 180
Crude oil and petroleum products	67	103	[4] 121
Natural gas	3	14	[5] 40
Coal and coke	15	17	[6] 19
OTHER COMMUNIST COUNTRIES [9]			
Total	7	10	13
Crude oil and petroleum products	5	8	[6] 9
Natural gas	0	0	[5] 2
Coal and coke	2	2	[6] 2
NON-COMMUNIST COUNTRIES			
Total	75	94	[4] 107
Crude oil and petroleum products	64	75	[4] 65
Natural gas	1	9	[5] 31
Coal and coke	10	10	[6] 11

[1] Calculated from data in "Vneshnyaya Torgovlya SSSR za 1970," Moscow, 1971.
[2] Ibid., 1975, Moscow, 1976.
[3] Based on the estimate that exports to CEMA countries are scheduled to account for 60 percent of the total in 1980. The comparable percentages for 1960, 1965, 1970, and 1975 were 41, 43, 51, and 56 percent.
[4] Residual.
[5] Based on long-term contracts.
[6] Estimated.
[7] East Germany, Poland, Czechoslovakia, Hungary, Romania, Bulgaria, Cuba, and Mongolia.
[8] Based on the statement that deliveries of "reference fuel" [SCE] to CEMA countries during 1976–80 would total about 800,000,000 tons (FBIS, Daily Report, Soviet Union, Feb. 10, 1976, p. D–3). The 1975 figure of 134,000,000 tons was projected to 1980 at a rate of growth that made total deliveries for 1976–80 equal to 800,000,000 tons. Deliveries are assumed to exclude exports of electric power, which in 1980 are planned to amount to 22,000,000,000 KWH, or 7,200,000 tons of SCE, about 75 percent of which are to go to CEMA counties in Eastern Europe and 18 percent to Finland. In 1975, exports of electric power amounted to 11,000,000,000 KWH, or 3,700,000 tons of SCE.
[9] North Korea, North Vietnam, Yugoslavia, and Communist China.

Planned consumption of energy in 1980 is estimated (as the difference between planned production and net trade plus additions to stocks) to be 1,851 million tons of SCE (see table 3). This would represent a 5.1 percent rate of growth in 1976–80, a slight drop from

the 5.2 percent rate achieved in 1971–75. Such a planned level of consumption in 1980 would be generally consistent with a planned GNP (according to Western calculations) of about 595 billion rubles (1970 prices) in 1980. The implied energy/GNP ratio of 3.11 kilograms of SCE per ruble is compatible with ratios that ranged from 2.94 to 3.39 in 1955–75 with no clearly discernable trend (see Appendix B). The estimated planned rate of growth in consumption does, however, appear to be rather high when compared with the planned rates of growth in electric power production in 1976–80. Electric power, production, as indicated above, is scheduled to grow at a rate of only 5.2 percent to 5.9 percent in 1976–80, compared with 7.0 percent in 1971–75. A possible explanation is that more emphasis is to be placed on direct use of fuels. This could represent an energy conservation measure as two-thirds of the heat value of the fuel is lost when conversion is made to electricity. Use of oil and gas as chemical raw materials will also be increasing rapidly.

Powerplants can be built to use almost any type of fuel, and the Soviets have shown evidence since 1974 of an intention to reverse or halt the trend of increased use of oil and gas in thermal powerplants, which presently account for roughly 30 percent of total energy consumption in the U.S.S.R.[34] This is in part a reaction to the quintupling of world prices for crude oil since September 1973. Other factors undoubtedly are the increased cost in the U.S.S.R. of extracting and transporting natural gas and uncertainty about long-run supplies of both oil and gas.

At the 25th Party Congress in February-March 1976, Party Chairman Brezhnev deplored the use of fuel oil in powerplants, indicating it would make better sense to (a) convert it into more valuable types of fuel, or (b) use it as a petrochemical raw material, or (c) export it.[35] Premier Kosygin told the Congress that in 1976–80 a group of large powerplants in the Urals and Volga areas would be converted from fuel oil to coal and that the "foundations are being laid for the further growth of our power capacity from water power, atomic fuel, and cheap coals."[36] The Minister of the Gas Industry added that a long-range plan must be devised to eliminate wasteful burning of natural gas as a boiler fuel.[37] Subsequent to the Congress, he noted that although the cost of producing and transporting gas had risen sharply in the last 10 years so that it was no longer a cheap fuel, huge quantities were still being used in powerplants and boilers.[38] Late in 1975 the Minister of the Oil Industry suggested an increase in domestic oil prices to reduce consumption.[39]

Early in 1974 a leading energy expert in the U.S.S.R., L.A. Melent'yev, indicated that doubts about the future growth of oil and gas reserves had caused a lowering of long-range forecasts of oil and gas production. He recommended that more of the large thermal power-

[34] During 1961–70 a majority of the powerplants in the European part of the U.S.S.R., the Transcaucasus, the Urals, Central Asia and in part of Kazakhstan, were reported to have been switched to a duel fuel supply system of either fuel oil and gas, or coal and gas. During 1971–75, powerplants to be put in operation in the European part of the USSR were to be based, for the most part, on oil and gas as the "most economic" types of fuel for these regions. (*Energetika SSSR v 1971–75 godakh*, Moscow, 1972, p. 171–174).
[35] Pravda, 25 February 1976, p. 6.
[36] Pravda, 2 March 1976, p. 5.
[37] Pravda, 2 March 1976, p. 2.
[38] FBIS, Soviet Union, 22 March 1976, p. S–1.
[39] Pravda, 18 December 1975, p. 1.

plants planned for the European part of the U.S.S.R. and the Urals be designed to burn coal.[40] He subsequently stated that in the future there would be "relatively limited possibilities for obtaining natural gas and particularly residual fuel oil" for thermal powerplants and boilers.[41]

Despite these statements, the amount of oil and gas used in powerplants apparently is scheduled to rise in 1976–80. However, the rate of growth in the use of these fuels for electric power production is to be slowed considerably, and growth in the use of solid fuels is to be accelerated. (See table 6.)

TABLE 6.—U.S.S.R.: CONSUMPTION OF FUEL IN THERMAL POWERPLANTS OF THE MINISTRY OF POWER AND ELECTRIFICATION [1]

	1965		1975		1980 plan	
	Percent [2]	Million tons SCE	Percent [2]	Million tons SCE	Percent [2]	Million tons SCE
Total	100.0	[3] 210	100.0	[3] 3.93	100.0	[3] 478
Solid fuels	66.4	140	48.4	190	[4] 48–50.1	229–239
Fuel oil	11.5	24	29.5	116	28.2	135
Natural gas	22.1	46	22.1	87	[4] 23–21.7	110–104

[1] These powerplants produced 93.5 percent of the total electric power generated in the U.S.S.R. in 1975 (Elektricheskiye Stantsii, January 1976, p. 2.)
[2] Ibid., June 1976, p. 5.
[3] Estimated. Includes fuel requirements for the production of heat.
[4] Percentages do not add to 100.

C. Prospects

As indicated previously, the plan for coal probably can be met without great difficulty, but it seems unlikely that the U.S.S.R. will be able to attain the ambitious targets set for oil and natural gas. The shortfall probably will amount to 2 to 5 percent of planned total output of energy.

If the Soviet economy were to grow at the planned rate, the lag in oil and gas production might cause some inconvenience and necessitate some belt tightening on domestic consumption or adjustments in foreign trade in energy.

The most logical step would be to reduce the rate of increase in oil and gas consumption. Additional substitution of coal for oil and gas by large industrial users, such as thermal power plants, probably would be the first move, offset by reduced deliveries of coal to lower priority consumers if coal output could not be correspondingly increased. If the average annual rate of increase in oil consumption can be held to about 5 percent through 1980, instead of the 7 percent–7.5 percent of recent years, oil supplies should be adequate to meet domestic needs, increase deliveries to Eastern Europe, and maintain sales to the West near present levels.

If the expected shortfall in oil production is not offset by a smaller rate of growth in oil consumption, the Soviets must either cut exports to Eastern and/or Western Europe or increase imports of OPEC oil. The U.S.S.R. is heavily committed to providing the bulk of Eastern Europe's oil supply and the need for hard currency militates against

[40] L. A. Melent'yev, Izvestiya Akademii SSSR, Energetika i Transport, May–June 1974, p. 15.
[41] L. A. Melent'yev, Teploenergetika, No. 11, November 1974, pp. 7–8.

large reductions in sales to the West. Because large direct purchases would be limited by hard currency shortages, the Soviets probably would seek to get OPEC oil by barter, perhaps for military equipment. With respect to natural gas the Soviets probably would seek to avoid a reduction in exports, especially to Western Europe, as they cannot afford loss of foreign exchange earnings. Some additional gas could be imported from Iran and Afghanistan to supplement indigenous output and to maintain exports. It is more likely, however, that lags will occur in other sectors of the Soviet economy as well, thus preserving the overall balance between energy supply and requirements. In any case, the shortfall in total energy output probably will not be significantly different from the estimated 3 percent shortfall that occurred in the 1971–75 plan period without serious damage to the economy. Estimates for oil and gas supply and demand are shown in tables 7 and 8.

TABLE 7.—U.S.S.R.: ESTIMATED OIL SUPPLY AND DEMAND

[Million metric tons]

	1965	1970	1974	1975	1980
Supply:					
Production	242.9	353.0	458.9	490.7	[1] 590
Imports	1.9	4.6	5.4	7.6	15
Total	244.8	357.6	464.3	498.3	605
Demand:					
Domestic consumption	180.4	261.8	348.1	368.0	[2] 470
Available for export	64.4	95.8	116.2	130.3	135
To Eastern Europe	22.4	40.3	58.7	63.3	75
To other Communist countries	6.5	10.2	13.0	14.4	15
To the West	35.5	45.3	44.5	52.6	45
To hard currency countries	11.5	32.0	30.8	38.6	35

[1] Plan calls for output of 620–640,000,000 tons.
[2] Assumes an average annual increase of 5 percent during 1976–80.

Note: Sources for trade information (1965, 1970, 1974, 1975): "Vneshnaya Torgovlya SSSR za 1965, 1970, 1975 god," Ministerstvo Vneshnei Torgovli SSSR, Moskva.

TABLE 8.—U.S.S.R.: ESTIMATED NATURAL GAS SUPPLY AND DEMAND

[Billion cubic meters]

	1965	1970	1974	1975	1980
Supply:					
Production	127.7	197.9	260.6	289.3	[1] 390
Imports [2]	0	3.6	11.9	12.4	15
Total	127.7	201.5	272.5	301.7	405
Demand:					
Domestic consumption	127.3	198.2	258.5	282.4	346
Exports	.4	3.3	14.0	19.3	59
To Eastern Europe	.4	2.3	8.5	11.3	33
To Western Europe	0	1.0	5.5	8.0	26
Net trade	.4	−.3	2.1	6.9	44

[1] Plan calls for output of 400–435,000,000,000 m³.
[2] From Iran and Afghanistan.

Note.—Sources for trade information (1965, 1970, 1974, 1975): "Vneshnaya Torgovlya SSSR za 1965, 1970, 1975 god," Ministerstvo Vneshnei Torgovli SSSR, Moskva.

V. Energy Requirements and Supply in 1990

The 15 year plan (1976–90) has not been released as yet. Some indication of its contents is available from fragmentary information

published in the Soviet press on long-range forecasts made by Soviet energy technicians in the early 1970's as contributions to the formulation of this plan.

A. Requirements

Total energy requirements for 1990, as shown in table 9, have been forecast at 3.5 billion tons of SCE, which amounts to a growth rate of 5.0 percent per year during 1976–90—about the same rate as is estimated to have been projected in the Tenth Five-Year Plan (1976–80). This figure, together with data presented by Soviet delegates at the World Energy Conference (WEC) in 1974, indicate growth rates of 4.9 percent for consumption and 5.6 percent for exports. Again, these are close to the rates implied by the estimates for 1980 given in table 3. However, the annual growth rate implied by the WEC data for energy inputs to electric power production was 7.2 percent, compared with a projected rate of only about 4.1 percent to 4.8 percent in the 1976–80 plan. As indicated in the previous section, the Soviets may now be planning to place greater emphasis on direct use of fuel as an energy conservation measure.

TABLE 9.—U.S.S.R.: REQUIREMENTS FOR AND SUPPLY OF ENERGY, 1975, 1980, 1990

[In millions of metric tons of standard coal equivalent] [1]

	Estimated, 1975 [2]	Plan, 1980 [2]	Forecast, 1990 [3]
Total requirements	1,686	2,156	3,500
Consumption	1,443	1,851	2,950
Exports	238	300	540
Additions to stocks	5	5	10
Total supply	1,686	2,156	3,500
Production of fuel	1,593	2,020	3,140
Crude oil and condensate	702	900	1,100
Natural gas	345	500	1,100
Coal	491	560	870
Peat, shale, and fuelwood	55	60	70
Hydroelectric power	17	24	35
Nuclear electric power	7	26	175
Other sources [4]	36	36	50
Imports	33	50	100

[1] Standard coal equivalent has a heat value of 7,000 kilocalories per kilogram.
[2] Data from table 3.
[3] CIA research aid, "Soviet Long-Range Energy Forecasts," A(ER) 75 71, September 1975. This publication may be purchased from the Photoduplication Service, Library of Congress, Washington, D.C. 20540.
[4] Minor sources of primary energy, such as agricultural waste, together with secondary sources such as coke oven and blast furnace gases.

B. Supply

The figures for 1990 shown in Table 9 point to a further slowdown in the growth of production of crude oil after 1980, a continued rapid growth in natural gas production, and some acceleration in the rate of growth of coal production. The data also indicate very rapid growth in nuclear energy production in the 1980's although its share in total energy supply will still be small by 1990. The energy production mix as of 1990 would then compare, as shown in Table 10, with the situation in 1975 and in the 1980 plan.

A recent statement by Minister of the Coal Industry Bratchenko suggests, however, that the target for coal production in 1990 may be substantially lower than the figure given in Table 9 of 870 million tons of SCE, or 1.3 billion tons of coal in its natural state. In late 1975, Bratchenko stated that output of coal would "possibly reach" 1 billion tons in 1990.[42] In addition, the goal for nuclear electric power undoubtedly is unrealistic. If 1 billion tons is now the coal target for 1990, and the goal for nuclear power has been lowered, the targets for one or more of the other energy sources—most likely natural gas—will turn out to be higher than indicated in Table 9, and/or the projected target for total energy requirements (consumption plus exports) has been lowered. In any case, it seems likely that the planned rate of growth of energy requirements in the 1980's probably will turn out to be moderately lower than the rate apparently planned for 1976–80.

TABLE 10.—U.S.S.R.: DISTRIBUTION OF ENERGY PRODUCTION, BY SOURCE, 1975, 1980, 1990[1]

[In percent]

	1975	1980 plan	1990 forecast
Total energy production	100.0	100.0	100.0
Crude oil and condensate	42.5	42.7	32.4
Natural gas	20.9	23.7	32.4
Solid fuels	33.0	29.1	27.6
Hydroelectric power	1.0	1.1	1.0
Nuclear electric power	.4	1.7	5.1
Other sources[2]	2.2	1.7	1.5

[1] Calculated from data in table 9.
[2] Minor sources of primary energy, such as agricultural waste, together with secondary sources such as coke oven and blast furnace gases.

APPENDIX A

TABLE 1.—U.S.S.R.: OIL TRADE

[In millions of metric tons]

	1965	1970	1974	1975
EXPORTS				
Total	64.4	95.8	116.2	130.3
To Communist countries	28.9	50.4	71.7	77.7
Eastern Europe	22.4	40.3	58.7	63.3
Cuba	4.7	6.0	7.6	8.1
Yugoslavia	1.0	2.7	3.8	4.4
Other	.8	1.4	1.6	1.9
To non-communist countries	35.5	45.4	44.5	52.6
Western Europe	22.7	38.0	37.7	44.0
Finland	4.5	7.8	9.2	8.8
France	1.6	2.5	1.5	3.4
Italy	7.3	10.2	6.8	6.9
Sweden	2.8	4.8	3.0	3.4
West Germany[1]	3.1	6.3	6.9	7.6
Other	3.4	6.4	10.3	13.9
Near and Middle East	2.3	3.0	1.4	2.4
Egypt	.8	1.6	.2	.2
Greece	1.2	.9	1.0	1.9
Other	.3	.5	.2	.3

See footnote at end of table.

[42] New Times, No. 44, October 1975, p. 5.

TABLE 1.—U.S.S.R.: OIL TRADE—Continued

[In millions of metric tons]

	1965	1970	1974	1975
To non-communist countries—continued				
Africa	1.1	1.3	1.2	1.0
Ghana	.6	.5	.3	.1
Morocco	.4	.7	.6	.6
Other	.1	.1	.3	.3
Asia	6.1	3.1	2.6	2.9
India	1.4	.3	1.0	1.2
Japan	3.9	2.7	1.2	1.3
Other	.8	.1	.4	.2
Latin America	3.3	0	1.2	1.5
Argentina	.9	0	0	0
Brazil	2.4	0	1.2	1.5
North America	0	0	.4	.8
Canada	0	0	.2	.2
United States	0	0	.2	.6
Exports to hard currency countries	23.5	32.0	30.9	38.6
Hard currency earnings (billion)	$0.23	$0.41	$2.56	$3.2
IMPORTS				
Total	1.9	4.6	5.4	7.6
Iraq	0	0	3.9	5.3
Algeria	0	0	0	1.0
Egypt	0	2.0	.2	.2
Romania	1.6	.5	.5	.5
Other	.3	2.1	.8	.6

[1] Includes West Berlin,

Source: Ministerstvo Vneshnei Torgovli SSSR, "Vneshnyaya Torgovlya SSSR za 1965, 1970, 1974, 1975 god," Moscow.

TABLE 2.—U.S.S.R.: NATURAL GAS TRADE

[In billions of cubic meters]

	1965	1970	1974	1975
EXPORTS				
Total	0.4	3.3	14.0	19.3
To Eastern Europe	.4	2.3	8.5	11.3
Bulgaria	0	0	.3	1.2
Czechoslovakia	0	1.3	3.2	3.7
East Germany	0	0	2.9	3.3
Hungary	0	0	0	.6
Poland	.4	1.0	2.1	2.5
To Western Europe	0	1.0	5.5	8.0
Austria	0	1.0	2.1	1.9
Finland	0	0	.4	.7
Italy	0	0	.8	2.3
West Germany	0	0	2.2	3.1
IMPORTS				
Total	0	3.6	11.9	12.4
Afghanistan	0	2.6	2.8	2.8
Iran	0	1.0	9.1	9.6
Net hard currency earnings (millions)	0	$7.0	−$89.0	$52.5

Source: Ministerstvo Vneshnei Torgovli SSSR, "Vneshnyaya Torgovlya SSSR za 1965, 1970, 1974, 1975 god," Moscow.

TABLE 3.—U.S.S.R.: COAL TRADE

[In millions of metric tons]

	1965	1970	1974	1975
EXPORTS				
Total	22.4	24.5	26.2	26.1
To Communist countries	14.8	14.7	16.4	16.5
Eastern Europe	13.6	13.0	14.8	14.8
Other [1]	1.2	1.7	1.6	1.7
To non-Communist countries	7.6	9.8	9.8	9.6
Western Europe	5.5	4.6	5.9	5.5
Austria	.8	.8	.8	.8
Belgium	.3	.3	.4	.2
Denmark	.5	.5	.3	.4
Finland	.7	.5	.5	.5
France	1.6	1.5	1.6	1.7
Italy	1.0	2.0	1.6	1.2
Sweden	.4	0	.5	.6
West Germany	.1	[2]	.2	.1
Other	.1	0	0	0
Japan	1.2	2.9	3.2	3.3
Other [3]	.9	.1	.7	.8
Exports to hard currency countries	6.1	8.0	8.7	8.4
Hard currency earnings (millions)	$74	$92	$238	$385
IMPORTS				
Total	6.8	7.1	9.7	9.8
Poland	6.5	7.1	9.7	9.8

[1] Yugoslavia, North Korea, Cuba, Mongolia.
[2] Negligible.
[3] Egypt, Greece, Algeria.

Source: Ministerstvo Vneshnei Torgovli SSSR, "Vneshnyaya Torgovlya SSSR za 1965, 1970, 1974, 1975 god," Moscow.

TABLE 4.—U.S.S.R.: COKE TRADE

[In millions of metric tons]

	1965	1970	1974	1975
EXPORTS				
Total	3.8	4.2	4.6	4.2
To Communist countries	2.7	3.1	3.5	3.4
Eastern Europe	2.7	3.0	3.2	3.2
Other [1]	[2]	.1	.3	.2
To non-Communist countries	1.1	1.1	1.1	.8
Western Europe	1.0	.9	.9	.7
Austria	.1	.1	.1	.1
Finland	.5	.6	.6	.6
Sweden	.1	.1	.2	[2]
Other	.3	.1	[2]	0
Algeria	0	[2]	.1	.1
Other	.1	.2	.1	.1
Exports to hard currency countries	.5	.3	.4	.2
Hard currency earnings (millions)	$8	$9	$13	$16
IMPORTS				
Total	.7	.7	.7	.9
Poland	.7	.7	.7	.9

[1] Yugoslavia, Mongolia, North Korea, Cuba.
[2] Negligible.

Sources: Ministerstvo Vneshnei Torgovli SSSR, "Vneshnyaya Torgovlya SSSR za 1965, 1970, 1974, 1975 god," Moscow.

Appendix B

U.S.S.R. ENERGY CONSUMPTION, GROSS NATIONAL PRODUCT, AND THE ENERGY/GNP RATIO

	Energy consumption (million metric tons of standard coal equivalent [1] [2]	Gross national product (billion 1970 rubles [3])	Energy/GNP ratio (kilograms per rubles)
1950	331	117	2.83
1955	497	163	3.05
1956	528	177	2.98
1957	578	188	3.07
1958	615	202	3.04
1959	649	212	3.06
1960	678	221	3.07
1961	708	236	3.00
1962	[4] 757	246	3.08
1963	[4] 834	246	3.39
1964	[4] 868	268	3.24
1965	898	286	3.14
1966	952	304	3.13
1967	999	321	3.11
1968	1,045	340	3.07
1969	1,099	352	3.12
1970	1,119	381	2.94
1971	1,180	397	2.97
1972	1,251	404	3.10
1973	1,314	435	3.02
1974	1,372	453	3.03
1975	1,443	464	3.11

[1] Coal with a heat value of 7,000 kilocal /kg.
[2] Data for 1950, 1960 and 1962–74 from the statistical yearbook "Narodnoye khozyoystvo SSSR v 1974 g.", Moscow, 1975 and from earlier issues of this yearbook. Data for 1956–59 and 1961 calculated from production data in the 1961 issue of this yearbook and from foreign trade data in "Vneshnyaya Torgovlya SSSR za 1955–59, 1961 god," Moscow. Figure for 1975 estimated.
[3] Estimated in established prices by CIA, OER.
[4] Adjusted upward from published data, which did not include hydroelectric power for 1962 and 1963 and which did not include energy from certain other sources for all 3 years.

SOVIET DEPENDENCE ON SIBERIAN RESOURCE DEVELOPMENT*

ALAN B. SMITH

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I. INTRODUCTION

Development of Siberia has been designated one of the U.S.S.R.'s chief long-term economic tasks. The "Directives for Development of the U.S.S.R. National Economy in 1976–1980" adopted in March at the 25th Congress of the Communist Party of the Soviet Union call for: Further build-up of the economic potential of the eastern regions and the raising of their role in all-union industrial output; accelerated development of the fuel industry and of energy-intensive production facilities for ferrous and non-ferrous metallurgy and for the chemical and petrochemical industries; comprehensive development of the economy, increase in the extraction of rare, and precious metals, and of

*I gratefully acknowledge the invaluable contributions, advice, and assistance of Emily E. Jack (electric power), J. Richard Lee (oil and gas), Harold H. Lent (coal and energy), Hyman S. Gelman (chemicals), William K. Severin (minerals and metals), and Diane Collins (secretarial). Any factual errors, analytical shortcomings, or imperfections in presentation are, of course, my own.

diamonds, and in the output of products of the timber, pulp and paper, and furniture industries.[1]

Commenting on these directives, the Chairman of the State Planning Committee's (Gosplan) Council for the Study of Productive Forces, Nikolay Nekrasov, pointed out that the entire increase in extraction of oil and natural gas scheduled for the Five-Year Plan period, and more than 90 percent of the increase in extraction of coal, will be obtained east of the Urals. He also singled out as the three most important tasks in developing the region: (1) Accelerated buildup of the energy potential, (2) development of the mineral raw-material base, and (3) creation of major industrial complexes.[2]

Siberia has long been known to be rich in natural resources, but its overall economic development has been slow under both the Czarist and Soviet regimes. (Some industries have, of course, been exceptions to this general rule.) Present programs for developing the eastern regions give rise to such questions as: "Why the Soviet interest in accelerated development now?" "What are the prospects for success?" and "What will be the consequences of such development?" This paper examines Siberian resource development from the point of view of motivation, progress, plans, problems, and implications for domestic economic development and for foreign trade.

II. Summary and Conclusions

The U.S.S.R. is accelerating development of Siberian resources out of economic necessity. Continued growth of the Soviet and East European economies will depend to an increasing degree on Siberian resources.

About 80 percent of the energy used in the Soviet Union is consumed in the European part of the country, but 80 percent of the reserves of primary energy lie east of the Urals.

The U.S.S.R. supplies the bulk of the increasing quantities of energy required by the East European Communist countries mainly from reserves in the western part of the country.

Reserves of energy in the western U.S.S.R. are being depleted and are becoming more expensive to exploit.

Growth in oil production from the extensive reserves of Western Siberia may slow down in 5 or 6 years, and additional reserves will have to be found farther east and offshore.

The U.S.S.R. needs to import western technology and equipment, metals and metal products, and at times grain. It habitually incurs a deficit in its trade with hard currency countries. In 1975 that deficit exceeded $6 billion.

Exports of Siberian oil and gas, timber, gold, diamonds, platinum group metals, and perhaps eventually other minerals and metals can finance needed imports from the West.

Development of chemical complexes and other types of industry based on Siberian electric power and raw materials can reduce dependence on certain types of imports.

Development of Siberian resources will be greatly facilitated if the U.S.S.R. has access to Western technology and equipment either

[1] Pravda, Mar. 7, 1976, p. 7.
[2] Pravda, Apr. 20, 1976, p. 2.

through joint-ventures, commodity pay-back arrangements, or conventional commercial deals. This is especially true in the case of exploration and development of offshore oil and gas reserves, and in certain branches of the chemical industry. Development of Siberian resources is inevitable, however, and can and will be carried out entirely with the Soviet Union's own resources if need be. In this case, development will be somewhat slower and more expensive.

Products of West Siberia, and of East Siberia north and west of Lake Baykal, in so far as they are not required locally, will be shipped for the most part to the western part of the U.S.S.R. and to Europe. Some may even eventually be exported to the U.S. east coast. Production east of Lake Baykal will support development of the Soviet Far East and exports, primarily to Japan and other Asiatic countries, but perhaps also in some small part to the U.S. west coast.

III. Geography and Climate—A Deterrent to Overpopulation

Siberia, somewhat loosely defined, includes more than half of the Soviet Union. (For geographic features and development centers see "Siberian Centers" map, p. 498.) It stretches from the Urals (the dividing line between Europe and Asia) eastward to the Sea of Okhotsk and the Sea of Japan, and north from the Kazakh Republic, Mongolia, and China to the Arctic Ocean. It is officially divided into three economic regions, West Siberia, East Siberia, and the Far East. West Siberia extends from the Urals to the Yenisey River; East Siberia from the Yenisey to the Pacific watershed—a line that meanders from about the peak of the bend of the Amur River north of China, along the western boundary of Yakutskaya ASSR north of Lake Baykal to the Laptev Sea, near the eastern end of the Tymyr Peninsula. The Soviet Far East, nearly as large as West and East Siberia combined, encompasses the remaining territory to the eastern seas. These three economic regions sprawl over an area 63 percent larger than that of the 48 States of the continental United States, but have a population equal to only 13 percent of that of the continental United States.[3]

The slow pace of past development is not surprising in view of the vast distances, forbidding terrain, and harsh climate. Some areas east of the Urals are suitable for agricultural activities, such as wheat and cattle raising. Approximately 12 percent of the grain harvested in the Soviet Union during 1970–74 came from Siberia and the Far East, 8 percent from West Siberia alone.[4]

Other areas are heavily forested. About three-fourths of the timber resources of the U.S.S.R. are located in Siberia and the Far East.[5] Conditions in much of the area east of the Urals, however, are uninviting. A large part of West Siberia is swamp, taiga, and lakes that provide breeding grounds for clouds of giant Siberian mosquitoes. In the north, the permafrost zone—with its watery soil that freezes and thaws,

[3] Narodnoye Khozyaystvo S.S.S.R. v 1974, Moscow, 1975, p. 9. Statistical Abstract of the United States, 1975. Washington, D.C., 1975, pp. 5, 32.

[4] *Narodnoye Khozyaystvo S.S.S.R. v. 1974,* Moscow, 1975. p. 355; *Narodnoye Khozyaystro R.S.F.S.R. v. 1974,* Moscow. 1975, p. 256. This paper does not discuss Siberian agriculture in any detail. At present Siberia is a grain surplus area, shipping much of its harvest to the Western parts of the country. However, the growth in population that is accompanying Siberian development brings with it increased demand for food and the 10th Five Year Plan calls for continued work on draining and irrigating land, establishment of state farms and livestock-raising complexes, and rapid development of the agricultural sector in Siberia.

[5] *Narodnoye Khozyaystvo S.S.S.R. v 1974,* Moscow, 1975, p. 253.

buckles and heaves, according to the temperature—makes construction of all types (buildings, roads, airfields, and pipelines) extremely difficult. The terrain in East Siberia and parts of the Far East is even worse. The permafrost in the Yakutsk basin reportedly is the world's thickest, up to 1,500 meters (about 4,900 feet). Temperatures east of the Urals vary from −80° to 90° Fahrenheit, and in some areas winter winds gust up to 90 miles per hour.

For many years special incentives have been extended to workers settling in Siberia, including higher wages, longer vacations, increased pension rights, and privileges in education and housing. These inducements, however, have not been sufficient to prevent a high rate of turnover in labor. Many workers spend a few months, or years, in Siberia and then return to the western part of the country. Failure to attract and hold a sufficiently skilled labor force has been the biggest single deterrent to development.

IV. Past Development

Although uneven progress, in developing the area has been steady in recent years. Table 1 illustrates how the Siberian share in national industrial output and in production by important branches of industry has changed over the years. The eastern regions share in total industrial production rose from 8 percent in 1940 to a little over 10 percent in 1974. The average annual rate of growth in Siberian industrial production during 1960–74 was 8.8 percent, slightly higher than the national average of 8.2 percent. Siberia's substantial share in national output of coal and timber has grown only slightly over the years. The share of electric power in 1960 was more than double what it was in 1940, but has grown more slowly since. Production of crude oil and natural gas in the eastern regions has begun to assume greater importance in recent years. Early development of the steel and chemical industries was not followed up in Siberia for a number of years during which expansion took place in other areas. The downward trend in Siberia's share in these industries, however, is in process of being checked by a number of projects already underway.

TABLE 1.—SIBERIAN SHARE IN SOVIET INDUSTRIAL PRODUCTION AND OUTPUT OF SELECTED BRANCHES OF INDUSTRY [1]

[In percent]

	1940	1960	1970	1975 [2]	1980 estimate [3]
Total industry	8.0	9.5	9.9	[4] 10.2	NA
Electric power	6.5	15.0	17.9	19.0	20
Crude oil	1.6	1.1	9.6	30.0	48–50
Natural gas	Negligible	.7	5.6	13.0	30–40
Coal	23.5	28.0	31.9	34.0	38
Steel	10.4	8.4	8.1	10.0	12
Chemical fibers	Negligible	15.8	13.0	11.0	15
Timber	22.9	25.7	32.8	35.0	35–40

[1] West Siberia, East Siberia, and the Far East.
[2] Preliminary, extrapolated from 1973, national totals for 1974 and 1975, and fragmentary information on Siberian output.
[3] Based on plans and projects already underway.
[4] 1974, the last year for which data on Siberian industrial output are yet available.

Sources: "Narodnoye Khozyaystvo SSSR v 1974," passim. "SSSR v Tsifrakh v 1975 Godu," passim. "Narodnoye. Khozyaystvo RSFSR v 1965 g.", pp. 49, 82; Ibid., 1969, pp. 44–45, 65; Ibid., 1970, p. 49; Ibid., 1973, pp. 70–76, 95; Ibid 1974, pp. 93, 111. "Pravda", Mar. 7, 1976, "Proceedings of the 25th CPSU Congress" cited in Foreign Broadcast Information Service, "Daily Report, Soviet Union," Mar. 12, 1976. Douglas Whitehouse, "Soviet Regional Development in 1960–69: Trends and Implications," pp. 34–35. (Unclassified report published by the CIA Office of Economic Research, April 1972.)

TABLE 2.—CAPITAL INVESTMENT

	U.S.S.R.	Eastern regions [1]	
	Billion rubles		
	(2)	(3)	Percent of U.S.S.R. total
1946–50	48.1	4.6	9.6
1951–55	91.1	10.2	11.2
1956–60	170.5	19.5	11.4
1961–65	247.6	29.9	12.1
1966–70	353.8	53.8	15.2
1971	88.0	13.8	15.7
1972	94.3	14.9	15.8
1973	98.7	15.7	15.9
1974	105.7	17.0	16.1

[1] West Siberia, East Siberia, and the Far East.
[2] "Narodnoye Khozyaystvo SSSR, 1974," Moscow, 1975, p. 520.
[3] "Narodnoye Khozyaystvo RSFSR v 1969," Moscow, 1970, p. 295; Ibid., 1974, p. 361.

Capital investment in Siberia has been relatively small, considering the size of the area, but has increased more rapidly than investment in the country as a whole, as can be seen in table 2. During 1966–70 Siberian investment was 80 percent greater than during the previous five-year period, and the region's average annual share in national investment had increased to 15 percent compared with 12 percent in 1961–65. The share continued to increase gradually during 1971–75, although not as rapidly as publicity about planned development might have led one to expect. Sixteen percent was not reached until 1974.

V. Economic Necessity, the Motivation for Acceleration

Why the heightened interest in Siberian development now? Some observers suggest that political and military considerations and a desire to occupy the eastern regions more fully—perhaps stemming from the state of Soviet-Chinese relations—have given impetus to programs for Siberian development. Certainly it is true that some strategic advantages will accrue from development of improved transport and communication facilities in the area, and from the growth of industrial and population centers. If nothing else, workers—many of them with military reserve obligations—would be more readily available to strengthen the forces along the Amur and the Ussuri rivers, should need arise. Nevertheless, there is strong evidence that the most fundamental reason for accelerated development of the eastern regions is economic necessity. A point has been reached where continued economic growth of the U.S.S.R., and of its allies in Eastern Europe [5a] will depend increasingly on Siberian resources.

At present, about 80 percent of the energy consumed in the Soviet Union is used in the more heavily populated and industrialized European part of the country,[6] although more than 80 percent of the fuel and power resources are located east of the Urals.[7] The hydroelectric

[5a] Throughout this study "Eastern Europe" refers to Bulgaria, Czechoslovakia, East Germany, Hungary, Poland, and Romania.
[6] N. V. Melnikov (ed.), Energeticheskiye Resursy SSSR, Toplivno-Energeticheskiye Resursy, Moscow, 1968, p. 45. N. V. Melnikov, et. al., Fuel and Energy Resources and Distribution of Productive Forces of the USSR, papers presented at the 9th World Energy Conference, Detroit, September 1974, Vol. 1, No. 1.2–23, p. 2. A. Probst, Voprosy Ekonomiki, June 1971, translated in U.S. Joint Publications Research Service (JPRS), No. 53747, Aug. 3, 1971, p. 37.
[7] P. S. Neporozhny, et. al., Fuel and Power Economy of the Soviet Union at the Current Stage and the Problems in Its Development, papers presented at the 9th World Energy Conference, Detroit, September 1974, Vol. 1, p. 5. Georgi Tarasov, "Siberia: New Frontiers", Soviet Life, January 1974, p. 19.

and power potential of rivers in European Russia has been almost fully developed. Extraction of coal in the older producing regions is becoming more difficult and expensive as work must be conducted at greater depths. Rates of increase in production of oil and gas from most producing fields West of the Urals are slowing down as reserves are depleted. The percentage of water contained in total fluid pumped from oil fields in the Urals-Volga region has been increasing rapidly, and production costs have risen with the need for employing secondary recovery methods and for drilling to greater depths in search of new reserves. P. S. Neporozhny, Minister of Power and Electrification, stated in a paper presented at the World Energy Conference in Detroit in September 1974, that four-fifths of the increase in Soviet production of energy from primary sources through 1990 will come from Siberia.[8]

Economic considerations also are the principal causes of increased interest in developing Siberia's non-fuel minerals. The degree of urgency varies, however, among the many types of mineral resources found in the area. Growing demand—both domestic and foreign—for non-ferrous and precious metals, and for some non-metallic minerals, has led to increased interest in accelerating Siberian output of these products. Development of Siberian industrial and transport facilities is bringing with it an increasing regional demand for steel. Thus far, development of the steel industry has been given lower priority in Siberia than in other parts of the country, but there is growing awareness of the need for more rapid exploitation of Siberia's iron ore deposits and for construction of steel making facilities.

Turning to these new sources of energy and material supply in the east will require heavy capital investment. Soviet sources have commented that although in many cases the conditions for actually working the deposits and the quality of the minerals are better than in the European part of the U.S.S.R.,[8a] the conduct of prospecting and geological survey activities, construction of mining enterprises in the taiga, and building of roads, housing, cultural, and service facilities will be very costly. Equipment, materials, and consumer goods must be hauled thousands of kilometers to the new towns. The cost of transportation and communications will add considerably to the cost of products at the point of consumption.[11] How much will, of course vary from product to product and depend on the locations of production and consumption. For example, transport of Tyumen gas and Kuznetsk coal to Moscow increases their cost by 132 percent and 115 percent respectively, but they are still cheaper than local fuel. According to M. Pervukhin, member of the U.S.S.R. State Planning Committee and head of its Department of Territorial Planning and Siting of Productive Forces, "outlays on the extraction of Tyumen gas are 6.6 rubles per ton of standard fuel, but when the gas is transported to Sverdlovsk the figures rise to 13.1 rubles. If it goes to Moscow outlays are 15.3

[8] Neporozhny, op. cit., p. 17.

[8a] The cost of mining Kansk-Achinsk coal is claimed to be the lowest in the U.S.S.R.,[9] and the cost of producing oil in Western Siberia reportedly is lower than the average cost for the Soviet Union as a whole.[10] This latter claim is made frequently in Soviet literature, but probably is true only in a fairly narrow sense, i.e. the actual production cost. It is doubtful that the cost of West Siberian oil could be lower than the national average if the cost of exploration and of pipelines and other necessary infrastructure were included.

[9] A. Probst. "Paths of Development of the Fuel Industry of the U.S.S.R.", Voprosy Ekonomiki. No. 6, 1971, pp. 51–63. Translated in JPRS, No. 53747, Aug. 3, 1971, p. 43.

[10] Soviet News, Mar. 11, 1975, p. 95.

[11] Yu. Kakovets, "Price Changes on Mineral Raw Materials", Voprosy Ekonomiki, No. 6, 1975, pp. 3–13. Translated in JPRS, No. 65673, Sept. 15, 1975, pp. 23–37.

rubles. The shipping of Kuznetsk Basin coal increases outlays per ton of standard fuel from 8.6 rubles at the place of extraction to 14.1 rubles in Sverdlovsk and 18.5 rubles in Moscow." [12] (Standard fuel is defined as having a heat value of 7,000 kilocalories per kilogram, about equal to that of good-quality bituminous coal.)

Construction costs also vary widely in Siberia. Those in the southern part of West Siberia are similar to costs in the Western U.S.S.R., whereas those in Magadan and Sakhalin are 2 to 3 times as much. Throughout much of the more central area targeted for development in the next few years they range from 30 percent higher to more than double those in the western part of the country.[13] Nevertheless, the Soviets optimistically predict that "in spite of the higher costs of local construction and greater expenditure for providing labor resources, the calculated unit costs in Siberia will be lower in the future than in the European regions of the country for: procurement of wood—by 39–40 percent, for production of paper by 50–70 percent, production of energy consuming products of the ferrous and nonferrous metallurgy and chemicals industries—by 2–4 times, extraction of oil and gas—by 2 to 4 times, production of hydroelectric power—by 3 to 3.5 times, extraction of coal—by 6 to 8 times, etc." [14] It is such expectations, combined with the growing needs of the Soviet and Eastern European economies, and with the desire to export in order to earn hard currency, that make the Soviets feel justified in making the large investments of capital, equipment, materials, and labor necessary for Siberian development.

VI. Hydroelectric Power, a Pioneer in Siberian Development

Soviet planners regard the electric power potential of Siberia not only as a key to opening up the vast riches of that part of the country, but also as an eventual source of cheap electricity for power-short areas of the European U.S.S.R. The rivers of Siberia and the Far East have an enormous hydroelectric power potential, nearly two-thirds of the economically exploitable hydroelectric power potential of the country.[15] Moreover, Siberia has about 40 percent of the surface water resources of the U.S.S.R.,[16] an asset important for many aspects of development other than electric power. The Angara-Yenisey region of East Siberia alone contains one-fourth of the U.S.S.R.'s total hydroelectric resources, and can be economically developed to produce almost 300 billion kilowatt hours of cheap electricity annually. Development of this potential has been under way for some time. The plant at Bratsk on the Angara River, with a capacity of 4,100 megawatts (MW), was when completed in 1966 the world's largest hydroelectric powerplant. It has since been surpassed by the giant 6,000 MW Krasnoyarsk plant on the Yenisey, the world's largest at present, and more recently by the 5,255 MW Churchill Falls plant completed in Canada in 1974. The installed capacity of hydroelectric powerplants in the

[12] M. Pervukhin, "The Importance of Being a Siberian", Literaturnaya Gazeta No. 7, Feb. 18, 1976, p. 11.
[13] CIA, ER–76–10068, "Ruble-Dollar Ratios for Construction", February 1976, pp. 23–26. (Unclassified report available through: Document Expediting Project, Exchange and Gifts Division, Library of Congress, Washington, D.C., 20540.)
[14] V. A. Shelest, Regional'nie Energo-ekonomicheskiye Problemie SSSR, Moscow, 1975, p. 205.
[15] Gidrotekhnicheskaya Stroitelstvo, February 1976, p. 29.
[16] L. I. Gramoteeva, Tekhniko-ekonomicheskie Problemy Razmeshchenila Vazhneishikh Otrasiei Khimicheskoi Promyshlennosti, Moscow, 1970, p. 127.

Angara-Yenisey region, now 12,880 MW, is expected to reach nearly 20,000 MW by 1985 and possibly 60,000 MW by the end of the century.[17] Location of the present capacity is shown in the following tabulation:

Plant name	Present capacity (megawatts)	Initial operation	Completion
Irkutsk	660	1956	1958
Bratsk	4,100	1961	1966
Krasnoyarsk	6,000	1966	1971
Khantayka	440	1970	1972
Ust-Ilimsk	1,680	1974	1978–80

The plant at Ust–Ilimsk is to be expanded to 4,320 MW before 1980, and construction began early in 1976 on a 4,000 MW hydroelectric plant at Boguchany on the Angara, using equipment and manpower becoming available from the Ust–Ilimsk project. Plans for a number of other plants in the Angara–Yenisey region have already been announced.

Development of hydroelectric capacity in West Siberia and in the Far East is on a much smaller scale. At present there is only one hydroelectric plant operating in West Siberia, a 424 MW station at Novosibirsk. Construction is scheduled to begin soon, however, on a 700 MW plant at Krapivino, on the Tom River, 50 miles southeast of Kemerovo.[18] In the Far East, the 400 MW Vilyuy hydroelectric power station, the first large hydro plant to be built in the permafrost zone, is supplying power to the Mirniy diamond mines and to other mining enterprises. Its capacity is to be increased to 648 MW by the end of 1980. A hydroelectric powerplant being built on the Zeya River, in Amur Oblast, went into operation at the end of 1975, and is to reach its full capacity of 1,290 MW in 1977. The 10th Five-Year Plan also provides for construction of a 2,000 MW hydroelectric plant on the Bureya River, a tributary of the Amur. The Zeya and Bureya plants will provide power for a planned pulp and cardboard combine and other industry of the Far East, as well as for the eastern sector of the Baykal–Amur Mainline Railway (BAM).[19] A 900 MW hydroelectric plant scheduled for completion in 1980 on the Kolyma River, in Magadan Oblast, will be an important supplier of the gold mining industry of the region.[20]

Low-cost electric power brings with it other development. Large, modern aluminum plants have been built at Bratsk, Irkutsk, and Krasnoyarsk to take advantage of the power made available by the hydroelectric plants at those locations. Bratsk, which began as a construction camp for workers building the powerplant, has become a modern city with a population of a quarter of a million people.[21] By 1990, a city of 150,000 is expected to develop around the plant at Ust

[17] Gidrotekhnicheskoye Stroitesl'stvo, January 1971, pp. 1–5. Gidro-elektrostantsii Sibiri v Yedinoi Energosisteme SSSR, Moscow, 1975, pp. 9–13.
[18] Stroitelnaya Gazeta, Jan. 21, 1976, p. 3.
[19] BBC, Summary of World Broadcasts, U.S.S.R. Economic Report, June 6, 1975, p. A–8. N. Baybakov, "Great Plans, Great Deeds", Znamya No. 9, September 1974, pp. 3–11, cited in JPRS 63393, Nov. 8, 1974, p. 48.
[20] Vodnyy Transport, June 7, 1972, p. 2. BBC, Summary of World Broadcasts, U.S.S.R., Economic Report, July 19, 1974, p. 8.
[21] Sovetskaya Rossiya, Sept. 1, 1975, p. 2.

Ilimsk, which will supply cheap power [21a] to a pulp and paper complex and to an ore-dressing complex. The present population is 40,000, of which only about 14,000 are construction workers.[23] In the vicinity of the 6,400 MW hydroelectric plant now under construction at Sayan Sushensk, an industrial complex is planned with some 120 enterprises, including an aluminum plant with an ultimate annual capacity of 500,000 tons of primary aluminum, a railway car plant, iron foundries, nonferrous metals enterprises, and electrotechnical, light, and food industries.[24] The new city developing at this site is expected eventually to have a population of 200,000.[25]

VII. Thermal Power and Coal

Development of electric power in the eastern regions is not limited to hydroelectric. About 63 percent of the Soviet Union's "explored" reserves of coal are found in Siberia and the Far East.[26] ("Explored" reserves—razvedanniyye zapasy—are somewhat more comprehensive than "mapped and explored" reserves in U.S. terminology.)

Plans call for construction in Siberia of a large complex of thermal powerplants to be fueled by cheap coal from the vast Kansk-Achinsk deposits that extend for several hundred miles along both sides of the Trans-Siberian Railroad, east and west of the Yenisey River at Kransnoyarsk. This basin has not yet been extensively explored, but it is estimated to contain 1.2 trillion tons of coal. At present, output from the Kansk-Achinsk Basin totals only about 25 million tons annually and makes negligible contribution to the Soviet energy supply. By 1990, however, the basin is tentatively scheduled to be producing 350 million tons annually,[27] about one-third of projected output of coal in that year and approximately 5 percent of the U.S.S.R.'s projected supply of energy in all forms.

Despite the low cost of mining Kansk-Achinsk coal, it is not economically feasible to ship this coal in its raw form to the energy-consuming centers in the European U.S.S.R. because of its relatively low heating value and poor physical characteristics. It is to be consumed locally in electric power stations, processed into semi-coke for long-distance transport by rail, or perhaps eventually delivered to the Western U.S.S.R. by pipeline in the form of a slurry. The first stage of the power complex based on Kansk-Achinsk coal will have six to eight thermal powerplants, each with a capacity of 6,400 MW. Design and specification work for the first of these plants was completed in mid-1975 and construction is expected to start this year at Berezovka, which could mean initial operation by 1980.[28]

[21a] The Soviets claim that the Bratsk hydroelectric powerplant produces the world's cheapest electric power—4.6 kopeks per 100 kilowatt hours (about one-half mill per kwh at the official exchange rate) and that the Ust Ilimsk station will produce electric power even cheaper—3.4 kopeks per 100 kwh—when put into full operation.[22]

[22] Foreign Broadcast Information Service (FBIS), Daily Report, Soviet Union, Jan. 3, 1975, p. S–2, citing a Tass report from Irkutsk.

[23] Die Wirtschaft, Oct. 1, 1975, p. 16.

[24] Ekonomicheskaya Gazeta, No. 6, February 1972, p. 24.

[25] Neues Deutschland, Dec. 3, 1975, p. 7.

[26] N. V. Melnikov, Energeticheskiye Resursy SSSR, Toplivno-energeticheskiye Resursy, Moscow, 1968, p. 64.

[27] FBIS, Daily Report, Soviet Union, May 14, 1974, p. S–2.

[28] Pravda, Apr. 26, 1975, p. 2.

VIII. Transmission and Transport

A. High Voltage Transmission

Part of the electricity generated in Siberia will be used in the area, and the rest will be transmitted to the European part of the country through a very high-voltage direct current transmission line, that is to be built after 1980, once the technology for such transmission is perfected. The U.S.S.R. now has only one experimental direct current high-voltage line, an 800 kv line stretching 473 kilometers (294 miles) from the Volgograd hydro powerplant to the Donbas area of the Ukraine.[29]

The United States similarly has one 800 kv direct current line that extends 850 miles from the Dalles on the Columbia River to Los Angeles and that went into operation in 1970. Another DC line is planned from the coal fields of North Dakota to Minnesota.

The U.S.S.R. plans, during the current Five-Year Plan period, to start construction on a 1,500 kv direct current line from North Kazakhstan to Tambov, about 400 kilometers southeast of Moscow.[30] Completion is scheduled for about 1982. At present there is a 500 kv high-voltage transmission line from Surgut, via Tyumen to Reft in the Urals power system. Surgut, thus far, is connected with the Siberian power system by only a 220 kv line to the large substation at Anzhersk. This line would not be capable of carrying much power from the Kansk-Achinsk region, so before power from this area can be transmitted to the Western part of the country additional transmission facilities will have to be developed.

B. The BAM

Transportation, as well as energy, is essential for development of Siberia's potential. One of the great construction projects that will proceed during the Tenth Five Year Plan period, and that will play a considerable role in the development of Siberian resources, is the Baykal-Amur Mainline Railway, known as the BAM. It will stretch approximately 3,200 kilometers (nearly 2,000 miles) from Ust-Kut on the Lena River, northwest of Lake Baykal, to Komsomol'sk on the Amur, where it will connect with a line to Vladivostok, via Khabarovsk. The length of this railway is roughly 2½ times that of the Alaska pipeline being built under somewhat comparable conditions as to climate and terrain. It will cross seven mountain ranges, a number of large rivers, and traverse 500 kilometers (more than 300 miles) of permafrost.[31]

Among other things it will greatly facilitate development of the region between the Trans-Siberian Railway and its own route, as well as resources to the north of that route. Among these resources are the large Udokan copper deposits, which reportedly have the potential to yield 400,000 tons of refined copper per year for over 50 years. (Such annual production would be equal to about 30 percent of current total Soviet annual output.) The BAM also will make possible exploitation

[29] Izvestiya, May 7, 1965, p. 6.
[30] Kazakhstanskaya Pravda, Dec. 9, 1973, p. 4.
[31] N. K. Baybakov, "Great Plans, Great Deeds", translated from Znamya, September 1974, pp. 3–11, in US Joint Publications Research Service, No. 63393, Nov. 8, 1974, pp. 39–48. P. Runich, "BAM i Razvitiya Ekonomiki Dalnego Vostoka", Planovoye Khozyaystvo, May 1975, pp. 28–37.

of asbestos in the Buryatskaya ASSR, timber, pulp, and paper resources of the Far East, iron ore from the Aldan region, and coal from the Southern Yakutsk Basin—some of it for export to Japan—as well as movement of West Siberian oil to supply the Far East and to export to Japan.

IX. Oil and Gas—Important as Energy and as Raw Materials

A. Reserves

The hope for future increases in Soviet production of oil and gas, at least for the next few years, lies mainly in the development of Siberian resources. Central Asia, the only other important source of increased output in the next 5 years, has regional development problems of its own. Its contribution to increased oil output will be slight, and although it will contribute about 20 percent of the increase in annual production of natural gas by 1980, its share in the national total will decline.

The Soviets have enjoyed considerable success in expanding Siberia's known reserves. The region's "explored" reserves of natural gas are more than 36 times the level of 1965, and constitute approximately two-thirds of all explored reserves of gas in the U.S.S.R.[32] (see table 3). Most of these reserves are located in northern Tyumen Oblast, near the Ob Gulf. (For location of reserves see "Siberian Resources" map, p. 499.) The Urengoy field, the largest known in the world, has reserves estimated at 4–6 trillion cubic meters, about one-fifth to one-fourth of total Soviet explored reserves of gas. Development drilling of this field began in 1975, and commercial production is expected by 1978. The U.S.S.R. has sought foreign financing to develop facilities that would permit export of part of the output from this field to Western Europe or perhaps as liquefied natural gas (LNG) to the U.S. east coast.

Unlike natural gas reserves, the U.S.S.R. does not publish statistics on oil reserves, and Soviet sources discuss them only in very general terms. However, the West Siberian oil reserves unquestionably are very large. Development is being pushed at a rapid pace, but less than one-third of the discovered oil fields are being produced thus far. The bulk of West Siberian output now comes from the giant Samotlor field, which has reserves estimated at more than 2 billion tons, about one and one-half times those of the Alaska North Slope.

TABLE 3.—U.S.S.R.: EXPLORED RESERVES OF NATURAL GAS[1]

[Billion cubic meters]

Region	1965	1970	1974
West Siberia	315	7,116	14,100
East Siberia	91	439	700
European U.S.S.R.	1,771	2,583	4,400
Central Asia and Kazakhstan	1,043	1,962	3,300
Total, U.S.S.R.	3,220	12,100	22,500
Siberia as a percent of total	12.6	62.4	65.8

[1] Approximately equivalent to proved and probable reserves by U.S. definition.

Source: "Planovoye khozaystvo No. 2", February 1975, p. 21.

[32] IU. Bokserman, "Puti Povysheniya Effektivnosti Transporta Topliva", Planovoye Khozyaystvo, No. 2, February 1975, p. 21.

B. Production and Plans

Production of oil and gas in West Siberia has risen sharply since 1964 when commericial production began (see table 4). The original goals for West Siberian production in 1975 were 125 million tons of oil and 44 billion cubic meters of natural gas.[33]

Output of oil in 1975 reached nearly 150 million tons, surpassing the original target by 25 million tons and accounting for about 30 percent of total Soviet crude oil production. Development of the gas fields, and laying of gas pipelines, however, have lagged behind schedule and gas recovery in 1975 was only about 38 billion cubic meters, 14 percent below the original target. As a result of shortfalls in gas output in other parts of the country, however, West Siberian natural gas still accounted for 13 percent of national production in 1975—approximately the share originally foreseen in the Five Year Plan.

TABLE 4.—PRODUCTION OF OIL AND GAS IN WEST SIBERIA

Year	Crude oil[1]		Natural gas	
	Million metric tons[2]	Percent of Soviet output[3]	Billion cubic meters[4]	Percent of Soviet output[5]
1965	0.9	0.4	Negligible	Negligible
1970	31.4	8.9	9.2	4.6
1971	44.8	11.9	9.2	4.3
1972	62.7	15.7	11.4	5.2
1973	87.7	20.4	16.4	6.9
1974	118.4	25.8	24.7	9.5
1975[6]	150	30	38	13
1976 plan[7]	180	35	46	15
1980 plan[8]	300–310	47–50	125–155	29–39

[1] Includes output of gas liquids.
[2] "Neftyanoye Khozyaystvo, No. 5," May 1975. "Ekonomicheskaya Gazeta, No. 19," May 1975.
[3] Based on national totals in "Narodnoye Khozyaystvo SSSR v 1974 g.," Moscow, 1975, p. 220; "Pravda," Feb. 1, 1976, p. 1, and Mar. 7, 1976, p. 3; and "Izvestiya", Dec. 3, 1975, p. 2.
[4] "Ekonomicheskaya Gazeta, No. 8," February 1973. "Gazovaya Promyshlennost No. 1," January 1974; No. 2, February 1974; No. 1, January 1975. A. D. Brents, V. Ya. Gandkin, and G.S. Urinson, "Ekonomika Gazodobyvayushchei Promyshlennosti," Moscow, 1975, p. 28.
[5] Based on national totals from "Narodnoye Khozyaystvo SSSR v 1974 g.," Moscow, 1975, p. 221, and "Pravda," Feb. 1, 1976, p. 1, and Mar. 7, 1976, p. 3; and "Izvestiya," Dec. 3, 1975, p. 2.
[6] "Ekonomicheskaya Gazeta, No. 14," April 1976, p. 1, Ibid., No. 22, May 1976, p. 4.
[7] "Izvestiya," Dec. 3, 1975, p. 3.
[8] "Pravda," Mar. 7, 1976, pp. 3, 7.

Plans for 1980 adopted at the 25th CPSU Congress in March 1976 call for West Siberian production of oil to reach 300–310 million tons, nearly half of the planned national output of 620–640 million tons.[34] This goal for Siberia is considerably higher than one of 230–260 million tons contained in preliminary plans adopted by the CPSU Central Committee and the Council of Ministers in December 1969.[35] The target may have been raised because of the encouraging overfulfillment of the plan for 1975, or because older producing deposits in other parts of the country are being depleted rapidly. However, the rates of development in individual Siberian fields and problems mentioned in articles appearing in Soviet sources make it appear doubtful that the new target can be achieved.[36] A 1980 output somewhere in the range of the earlier preliminary plan appears more probable.

[33] N. K. Baybakov, Gosudarstvennyi Piatiletnii Plan Razvitiya Narodnogo Khozyaystva SSR na 1971–1975 Godi. Moscow, 1972, pp. 103, 107.
[34] Pravda, Mar. 7, 1976, pp. 3, 7.
[35] Planovoye Khozyaystvo, No. 10, 1974, pp. 43–62.
[36] Geologiya Nefti i Gaza, March 1973, pp. 23–28. Organizatsiya i Upravleniya Neftyanoi Promyshlennosti, December 1974, p. 16.

Planned Siberian output of natural gas in 1980 is 125–155 billion cubic meters,[37] roughly one-third of the national goal of 400–435 billion cubic meters. Siberian reserves are undoubtedly more than adequate to support the planned increase. However, given the Soviet Union's past record of consistent failure to achieve natural gas production goals, Siberia's difficult terrain and harsh climate, and the probable continuing shortages of large-diameter pipe and ancillary pipeline equipment, a 1980 output near the lower end of the targeted range appears more likely than one near the upper limit.

C. Lagging Additions to Reserves and the Need for Western Equipment

Production of oil is increasing faster than discovery of new reserves. As early as 1972 Shashin pointed out that after 1975 accelerated development of the oil industry would be possible only if whole oil provinces significantly larger than Western Siberia can be developed.[38] Soviet officials recognize that the increase in petroleum production is now achieved mainly in Western Siberia, and are concerned that the flow of Tyumen oil may slow down in 5 or 6 years, whereas the need for liquid fuel will rise constantly. Creation of a new base for oil and gas production is one of Moscow's major tasks and plans have been made for extensive exploration in East Siberia during the 1976–80.[39]

Given the climate, and logistic problems worse than in West Siberia, more complex geological conditions, and the lack of adequate geophysical equipment, it is unlikely that East Siberia will make any great contribution to the national supply of oil before the mid-1980's. Whether Soviet oil production continues to grow in the late 1970's and 1980's probably will depend, to a large degree, on how rapidly reserves are depleted in the Urals-Volga and older producing regions where production already is being maintained only by such measures as extensive water flooding, use of imported submersible pumps, and exploration and development of smaller, deeper, and economically less attractive deposits.

To the east, exploration is under way in the Vilyuy Basin of the Yakutskaya A.S.S.R., where proved and probable reserves of 700 billion cubic meters of gas have been reported thus far, but oil has not been found in commercial quantities. In March 1976 the U.S.S.R. signed agreements securing $25 million each from Japan and from a consortium of U.S. firms to continue exploration in this area over the next 2–3 years. A possible further arrangement has been discussed whereby—should reserves warrant—facilities might be developed for the export of 10 billion cubic meters per year of LNG from East Siberia to both Japan and the U.S. west coast.

Soviet officials have also, for some time, been holding sporadic discussions with Japanese and U.S. companies concerning possible participation in exploration offshore from Sakhalin, where potential reserves have been estimated at nearly 3 billion tons in water depths up to 330 feet. Substantial reserves also are believed to be located offshore in the Kara, Laptev, East Siberian and Chukchi Seas (the latter two being possible continuations of the Alaska North Slope deposits), but ex-

[37] Pravda, Mar. 7, 1976, p. 7.
[38] Geologiya Nefti i Gaza, January 1974, p. 1.
[39] Sotsialisticheskaya Industriya, Sept. 13, 1974, p. 2.

ploration and development of these reserves probably is some years off, and will be very difficult when undertaken. Soviet experience with offshore oil, thus far, has been limited chiefly to the relatively shallow waters of the Caspian and Black Seas where operations are conducted from trestles or "man-made islands". If the U.S.S.R., is to move into the greater depths and more difficult conditions offshore from Sakhalin and in the Arctic seas, access to Western experience, technology, and equipment will be essential.

Even the search for and exploration of onshore reserves would be greatly facilitated by Western technology and equipment. The U.S.S.R. does not have adequate supplies of sophisticated geophysical tools, such as modern seismic equipment and computerized field units, used routinely in the West. Without such equipment, Soviet capability to locate deep structures is limited. Poor quality drill bits, underpowered mud pumps, and shortages of good quality pipe for drilling and casing (to say nothing of large-diameter linepipe) are factors contributing to inefficient operations in the field. The standard Soviet turbodrill is an excellent tool for the relatively shallow hard rock structures previously encountered in the Urals-Volga region, but is much less efficient at the depths from which most new additions to reserves must now come and for which Western rotary drills are more suited. The U.S.S.R. has purchased a few western rotary drills, but is concentrating mainly on improvement of the turbodrill.

X. Long Range Energy Plans, Exports, and the Hard Currency Trade Deficit

Tentative forecasts for the period up to 1990 advanced by Soviet energy experts indicate that the U.S.S.R. hopes to satisfy almost all of its own energy needs while providing a growing surplus for export.[40] Siberia will figure prominently in this program. Achievement of these objectives will be very difficult, given the serious problems that will be encountered in locating and exploiting reserves in inhospitable regions and the need for technological improvement. However, the exports—particularly of oil—are extremely important to the U.S.S.R. as a means of financing imports of badly needed machinery and equipment, metals and metal products, and of course—at times—grain. In 1975, Soviet imports of Western machinery and equipment alone were valued at $4.6 billion, imports of finished steel (including pipes and tubes) at $2.5 billion, and imports of grain at $2.3 billion.[41]

In 1975, the Soviet Union exported 130 million tons of crude oil and petroleum products, divided roughly 60 percent to other Communist countries and 40 percent to non-Communist countries (see table 5). Soviet oil provided about three-fourths of the supply of the East European Communist countries, 90 percent if Romania, which is self-sufficient in oil, is excluded. For many years the export of oil to non-Communist countries has been the U.S.S.R.'s largest single source of hard currency foreign exchange. In 1975 it exported nearly 39 million tons to the hard currency countries (mostly to Western Europe)

[40] N. V. Melnikov, Toplivno-energeticheskiye Resursy S.S.S.R., Moscow, 1971, p. 7. M. A. Styrikovich, in Kazakhstanskaya Pravda, June 10, 1973, p. 4, translated in U.S. Joint Publications Research Service, No. 59533, July 17, 1973, p. 11. L. A. Melentyev, Izvestiya Akademii Nauk, S.S.S.R., Energetiki i Transport, May–June 1974, p. 16. P. S. Neporozhny, op. cit., Vol. 1, No. 1.2–4, p. 11.

[41] Vneshnyaya Torgovlya S.S.S.R. v 1975 God, Moscow, 1976.

to earn nearly $3.2 billion. In 1974 Soviet exports to hard currency countries were only 31 million tons, 4 million less than in 1973, but as a result of price increases in the world market Soviet hard currency earnings from oil in 1974 ($2.6 billion) were more than double what they were in 1973.[42]

TABLE 5.—SOVIET EXPORTS OF OIL IN 1975

	Million tons	Percent
Total	130	100
To:		
Other Communist countries	78	60
Eastern Europe	(63)	(48)
Non-Communist countries	52	40
Hard-currency countries	(39)	(30)

Source: "Vneshnyaya Torgovlya SSSR v 1975 God," Moscow, 1976.

However, as a result of increased imports (including large purchases of grain) and little growth in exports, because of the recession in the West, the Soviet hard currency trade deficit skyrocketed in 1975, reaching more than $6 billion. The hard currency trade deficit was about $1.7 billion in 1973 and $910 million in 1974, the decrease in 1974 having been attributable largely to the rapid rise in world market prices for a number of raw materials, including oil, exported by the Soviet Union. Without the earnings from oil exports the situation would have been much worse.

Natural gas also is of growing importance to the Soviet Union as an export commodity. In 1975 the U.S.S.R. exported about 19 billion cubic meters—11 billion cubic meters to Eastern Europe, where it constituted about 15 percent of East European supplies, and 8 billion cubic meters to Western Europe earning nearly $210 million in hard currency.[43] By 1980 the U.S.S.R. will be exporting 30–33 billion cubic meters to Eastern Europe—providing about one-third of Eastern Europe's gas supply—and at least 25 billion cubic meters to Western Europe. This latter figure is in accord with arrangements already concluded—most of them involving the exchange of gas for large-diameter linepipe and other equipment. Exports to Western Europe could be even greater as additional deals are still being discussed.

To maintain its position as a net exporter of energy during the next 15 years, the U.S.S.R. apparently will undertake a number of measures. The rate of increase in oil consumption probably will slow considerably and the share of oil in the total energy balance will diminish (see table 6). The share of natural gas, which is more readily available, will increase. The decline that has been taking place since 1960 in coal's share in total fuel production is to come to a halt in the next few years. Coal will be used to an increasing degree in some applications such as in large thermal powerplants, thereby conserving oil and gas for higher priority use as industrial raw materials and for export to earn foreign exchange.

At present the oil and gas being exported comes, for the most part, from the older fields in the western part of the country—the Urals-Volga oil fields and the Ukrainian and Central Asian gas fields. However, supplies must come from the eastern regions if exports are to be maintained as the older fields are depleted. Pipelines are already under construction that will transport Siberian oil and gas to Europe. Moreover, as indicated above, ventures for exporting lique-

[42] Vneshnyaya Torgovlya S.S.S.R. za 1974 God, Moscow, 1975; Ibid., v 1975 God, Moscow, 1976, passim.
[43] Ibid.

fied natural gas, and perhaps oil, from Siberia and the Far East to Japan and the United States have been discussed—thus far without any agreement on financing and prices.

TABLE 6.—U.S.S.R.: PERCENTAGE DISTRIBUTION OF ENERGY PRODUCTION, BY TYPE

	Actual 1974[1]	Estimated 1975[2]	Plan 1980[3]	Forecast 1990[4]
Total	100	100	100	100
Oil	42	43	43	32
Natural gas	20	21	24	32
Coal and other solid fuels	35	33	29	28
Hydroelectric power	1	1	1	1
Nuclear electric power	Negligible	Negligible	1	5
Other sources	2	2	2	2

[1] "Narodnoye Khozyaystvo SSSR v 1974 g.," Moscow, 1975, pp. 83, 219.
[2] Based on production data for crude oil, natural gas, and coal cited in "Pravda," Feb. 1, 1976, p. 1. Shares of other energy sources were based on estimates.
[3] Based on plan data for crude oil, natural gas, and coal cited in "Pravda," Mar. 7, 1976, p. 3. Shares of other energy sources were based on estimates.
[4] Based on: N. V. Melnikov, "Toplivno-energeticheskiye Resursy SSSR," Moscow, 1971, p. 7; M. A. Styrikovich in "Kazakhstanskaya Pravda," June 10, 1973, p. 4 (translated by U.S. Joint Publications Research Service, JPRS 59533, July 17, 1973, p. 11.); L. A. Melentyev, Izvestiya Akademii Nauk SSSR, Energetika i Transport, May–June 1974, p. 16.

XI. Other Hard Currency Earners

In addition to exportable oil and gas, Siberia and the Far East provide the U.S.S.R. with other means of dealing with its chronic hard currency trade deficits. Annual Soviet earnings of hard currency from the export of wood and wood products to non-Communist countries were in the vicinity of $1 billion in 1974, and $700 million in 1975. In 1975 the total value of Soviet exports of wood and wood products declined by about 9 percent and larger shares went to Eastern Europe and to the developing nations.[44] Development of the East Siberian timber industry will make possible increase in export of forest products—perhaps by as much as 15 percent per year for the next decade. Part of this development is the result of agreements with Japan, whereby Japan provided credits for road construction, forestry and wood chip processing equipment, and development of port facilities, and is being repaid, at least in part, in saw logs, wood chips, pulpwood, and other wood products.

Gold is produced in quantity in the Northeast Region—Magadanskaya Oblast and the Yakutskaya A.S.S.R.—in the Lena region of Irkutsk Oblast, and the Transbaykal. (Most future expansion in gold output, however, probably will come from areas outside of Siberia—for example from the large Muruntau deposits in Uzbek S.S.R.) The U.S.S.R. regards information on reserves of gold ore and gold production—like oil reserves—as a state secret and little is published on the subject. However, according to the annual report of the Bank of International Settlements, Communist countries sold 150 metric tons of gold on Western markets in 1974.[45] At an average London market price of $158.80 per troy ounce, these sales would have earned about $766 million. Presumably the U.S.S.R accounted for most of the sales. Soviet sales in 1975 (including 50 tons rumored to have been sold directly to buyers in the Middle East) may have totaled about 200 tons. Such sales could have earned about $1 billion.

Exports to hard currency markets of diamonds (produced in Yakutskaya A.S.S.R.) were valued at about $500 million in 1974, and sales of platinum group metals (mostly produced around Norilsk, in East

[44] Vneshnyaya Torgovlya S.S.S.R. v 1975. Moscow, 1976.
[45] Bank for International Settlements, Forty-fifth Annual Report, April 1, 1974–March 31, 1975, Basle, 9 June 1975, p. 104.

Siberia) were about $350 million in that year. Also in the Norilsk area, a major expansion of the copper and nickel industry is taking place. Development of new mines has been under way for about a decade, and a contract has been signed with Finland for delivery of equipment for smelting copper and nickel concentrates. The Norilsk mining and metallurgical combine already accounts for 10 percent of Soviet copper production and more than half of the U.S.S.R.'s production of nickel and platinum group metals. The availability of nickel for export is likely to increase as the Norilsk projects are completed in the late 1970's and early 1980's. By the mid-1980's production of nickel at Norilsk may exceed 300,000 tons annually—about 20 percent more than the current output of Canada, the world's largest producer. Additional development of copper and nickel deposits is also projected for the area north of Lake Baykal and the BAM. The U.S.S.R., already a net exporter of about 200,000 tons of copper annually,[46] probably will be able to export a large share of its increased output from Norilsk and Udokan.

XII. Longer Run Potential Sources of Foreign Exchange

In the longer run, export of other Siberian minerals and metals may also become a source of foreign exchange. The eastern regions also have considerable iron ore, which thus far is being exploited only on a relatively small scale. At present, Siberia and the Far East account for only about 10 percent of Soviet steel output. However, production of the West Siberian Metallurgical Plant near Novo Kuznetsk, estimated at about 6 million tons of crude steel in 1975, is to be doubled by the early 1980's. Extensive iron ore development is planned at Rudnogorsk and the Angara Pit in East Siberia, and in the Aldan iron ore field of Southern Yakutia. New iron and steel plants are to be constructed in Eastern Siberia and the Far East. Firm locations have not been announced, but Tayshet—at the junction of the BAM and the Trans-Siberian Railway—and Svobodnyy—farther east on the Trans-Sib, have been mentioned frequently as likely locations.[47] The latter plant could use iron ore from local deposits as well as iron ore and coal from the Chul'man area and electricity from the Zeya hydroelectric powerplant. An alternative suggestion has been to locate a plant closer to the Chul'man and Aldan deposits.[48]

Initially the objective will be to satisfy growing requirements for structural and other types of steel needed for development of the eastern regions. Throughout the 10th Five-Year Plan Siberian steel output will remain inadequate to meet the growing needs of the area, although some specialized steel products may be exported in spite of the over-all regional deficit. In the longer run, exportable surpluses—at first of ore, but perhaps later of steel—probably will be generated as major deposits are developed. This would appear even more likely if Japanese or other foreign participation is obtained.

Despite inadequate raw material supplies that force dependence on imported bauxite and alumina, the USSR plans to build, during the 1980's, at least two additional Siberian aluminum plants each—like the one at Sayan Sushensk—with capacity to produce 500,000 tons of primary aluminum annually.[49] Such capacity would increase the

[46] Vneshnyaya Torgovlya S.S.S.R. v 1975 God. Moscow, 1976. pp. 27, 41.
[47] Izvestiya, July 7, 1970, p. 3. Planovoye Khozyaystvo, No. 11, 1973, pp. 59–63.
[48] Sotsialisticheskaya Industriya. Aug. 14, 1974, p. 2.
[49] American Metal Market, Dec. 10, 1974, p. 13.

USSR's already well-developed capability to export aluminum. Exports have been about 600,000 tons per year in recent years, mostly to other Communist countries and to developing countries.[50]

Production of other minerals and metals also figures prominently in Soviet plans for development of the eastern regions. In some cases—such as antimony, fluorspar, tungsten, molybdenum, and tin—the motivation is primarily need to satisfy domestic demand. (Soviet production of tin is almost completely dependent on resources in the eastern areas. (In other cases—asbestos, mercury, lead, and zinc—the pressure to expand production stems not only from domestic requirements, but also from desire to export. Substantially increased Siberian output of these products, however, is unlikely before the 1980's.

XIII. Chemical Complexes and Integrated Resource Development To Hold Down Deficit

Siberian resources are also being developed to reduce Soviet dependence on imports of certain chemical products. Building chemical complexes in Siberia is logical. The chemical industry requires large amounts of electric power and water—both in plentiful supply in the eastern regions—and a relatively small labor force, a desirable characteristic given Siberia's shortage of manpower. Oil, gas, salt, and to a lesser degree coal deposits, as well as timber of the eastern regions afford abundant raw material feedstocks.

Siberia's share in the national output of chemical fibers—Soviet imports of which were valued at more than $130 million in 1975 [51]—is expected to increase over the next decade. A large installation under construction at Barnaul, which includes a 50,000 ton per year nylon fiber and yarn plant, originally was scheduled for operation in late 1975,[52] but commissioning has now been deferred until sometime during the 10th Five-Year Plan Period.[53] A 120,000 ton per year rayon plant has been under construction at Zaozernyy since 1972.[54]

Capacity for production of plastics also is being increased in Siberia. Table 7 relates capacities at proposed Siberian petrochemical combines to total Soviet output of selected plastic materials in 1974. Imports from the West of three of these products—polyethylene, polyvinyl chloride, and polystyrene—were valued at more than $150 million in 1974 and about $100 million in 1975, accounting for approximately 40 percent of total Soviet imports of plastics and related materials from the West in those years.[55]

TABLE 7.—SELECTED SIBERIAN PLASTIC PRODUCTION FACILITIES

Location	Probable completion date	Product	Planned capacity of 1st stage: Thousand tons per year	Planned capacity of 1st stage: As percent of 1974 U.S.S.R. production
Tomsk [1]	1979–81	Polyethylene	350	102
		Polypropylene	100	1,000–1,500
Omsk [2]	1978	Polystyrene	100	85
Zima [3]	1978–79	Polyvinyl chloride	250	84

[1] "Sovetskaya rossiya," Mar. 11, 1975. "Pravada," Mar. 24, 1975. "Plasticheskiye massy, No. 6," June 1975, p. 20: "Stroietelnaya Gazeta," July 4, 1975.
[2] "Journal of Commerce," Aug. 15, 1974.
[3] "Stroitelnaya gazeta," July 21, 1968, p. 2. "Petrochemical News," July 24, 1972. "Chemcal Marketing Reporter," Mar. 24, 1975. "European Chemical News," July 19, 1975.

[50] Vneshnyaya Torgovlya S.S.S.R. v 1975 God, Moscow, 1976, p. 27.
[51] Vneshnyaya Torgovlya S.S.S.R. v 1975 God, Moscow, 1976, p. 44.
[52] European Chemical News, Jan. 19, 1973.
[53] Stroitelnaya Gazeta, May 30, 1976.
[54] Stroitelnaya Gazeta, Sept. 26, 1971.
[55] Vneshnyaya Torgovlya SSSR v 1975 God, Moscow, 1976, passim.

At Tomsk, construction began in 1974 on facilities that are to provide 2 percent more polyethylene and 10 to 15 times the amount of polypropylene produced in the entire USSR in 1974.[56] Oil from the Tomsk and Tyumen areas will be used as raw material feedstock. Substantial output is not expected, however, before 1979–81. Facilities planned for completion at Omsk in 1978 are to have capacity for producing 100,000 tons of polystyrene annually, which is equal to 85 percent of total Soviet output of this material in 1974.[57] At Zima, on the Trans-Siberian Railway west of Lake Baykal, a plant is under construction that by 1978–79 is expected to have capacity for production of 250,000 tons of polyvinyl chloride, equal to nearly 84 percent of the USSR's 1974 output of PVC.

In addition to being a major producer of polyvinyl chloride plastics, the plant at Zima will process local deposits of apatite into phosphate fertilizers,[58] badly needed in the Soviet Union where over 50 percent of the agricultural land is deficient in phosphorous. Farther to the east, at Komsomolsk on the Amur, a large chemical complex has also been proposed that would be based on large apatite deposits of the Aldan region, local phosphorites, and on Yakutsk natural gas and coal.[59]

An interesting example of savings through integrated development of Siberian resources is under way at Tobolsk, where construction began in 1974 on a large petrochemical combine that will produce synthetic rubber, plastics, refined petroleum products, and mineral fertilizer.[60] Electricity will be supplied by a large thermal electric plant operating at Surgut. This plant, which now has an installed capacity of 1,000 MW and will reach 2,400 MW when completed, is the first powerplant in the USSR fueled entirely with associated gas, the natural gas produced in conjunction with oil.[61] Oil and associated gas from the fields of the Middle Ob will be used as raw materials at Tobolsk. In many fields the associated gas is being flared, i.e. burned off. In 1974 about 6 billion cubic meters, or approximately one-fourth of actual Siberian gas output, was wasted in this manner.[62] Use of the gas represents a considerable potential for saving energy now being wasted, but depends on developing facilities for collecting and processing the gas. Unfortunately, thus far, investment in such facilities has been inadequate and equipment for them is in short supply.

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[56] Sovetskaya Rossiya, Mar. 12, 1974. Pravda, Mar. 24, 1975. Plasticheskiye Massy, No. 6. June 1975, p. 20. Stroitelnaya Gazeta, July 4, 1975.
[57] Journal of Commerce, Aug. 15, 1974.
[58] Stroitelnaya Gazeta, July 21, 1968, p. 2. Petrochemical News, July 24, 1972. Chemical Marketing Reporter, Mar. 24, 1975. European Chemical News, July 19, 1975.
[59] Ekonomicheskaya Gazeta, No. 5, 1975, p. 13.
[60] Izvestiya, Aug. 13, 1975. Planovoye Khozyaystvo, No. 7, July 1974. "Tobolsk: Rebirth of a City", Soviet Life, January 1974, p. 41.
[61] Sotsialisticheskaya Industriya, Nov. 5, 1974, p. 1. Izvestiya, Aug. 17, 1975, p. 3. Izvestiya, Sept. 5, 1975, p. 3.
[62] Sotsialisticheskaya Industriya, Apr. 6, 1975.

Siberian Centers
500 Miles
0
500 Kilometers
ARCTIC OCEAN
CHUKCHI SEA
EAST SIBERIAN SEA
BERING SEA
BARENTS SEA
KARA SEA
LAPTEV SEA
TAYMYR PENINSULA
Arctic Circle
Leningrad
MOSCOW
Tambov
Volgograd
CASPIAN SEA
URAL MTS.
Noril'sk
Khantayka
Urengoy
WEST SIBERIA
EAST SIBERIA
Yakutskaya ASSR
FAR EAST
Magadan
Magadan
Yakutsk
Reft
Surgut
Tobolsk
Tyumen
Tyumen
Samotlor
Vilyuy
Mirnyy
Aldan
Chul'man
SEA OF OKHOTSK
SAKHALIN
Omsk
Tomsk
Novosibirsk
Anzhero Sudzhensk
Kemerovo
Barnaul
Novokuznetsk
Zaozernyy
Berezovka
Boguchany
Angara
Krasnoyarsk
Taishet
Sayan
Shusensk
Ust-Ilimsk
Rudnogorsk
Ust-Kut
Bratsk
Zima
Irkutsk
Irkutsk
BAM
Buryat-skaya
LAKE BAYKAL
TRANS SIBERIAN Railroad
Amur-skaya Railroad
Svobodnyy
Komsomol'sk
Khabarovsk
Amur
Ussuri
Vladivostok
SEA OF JAPAN
KAZAKH S.S.R.
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UZBEK S.S.R.
Muruntau
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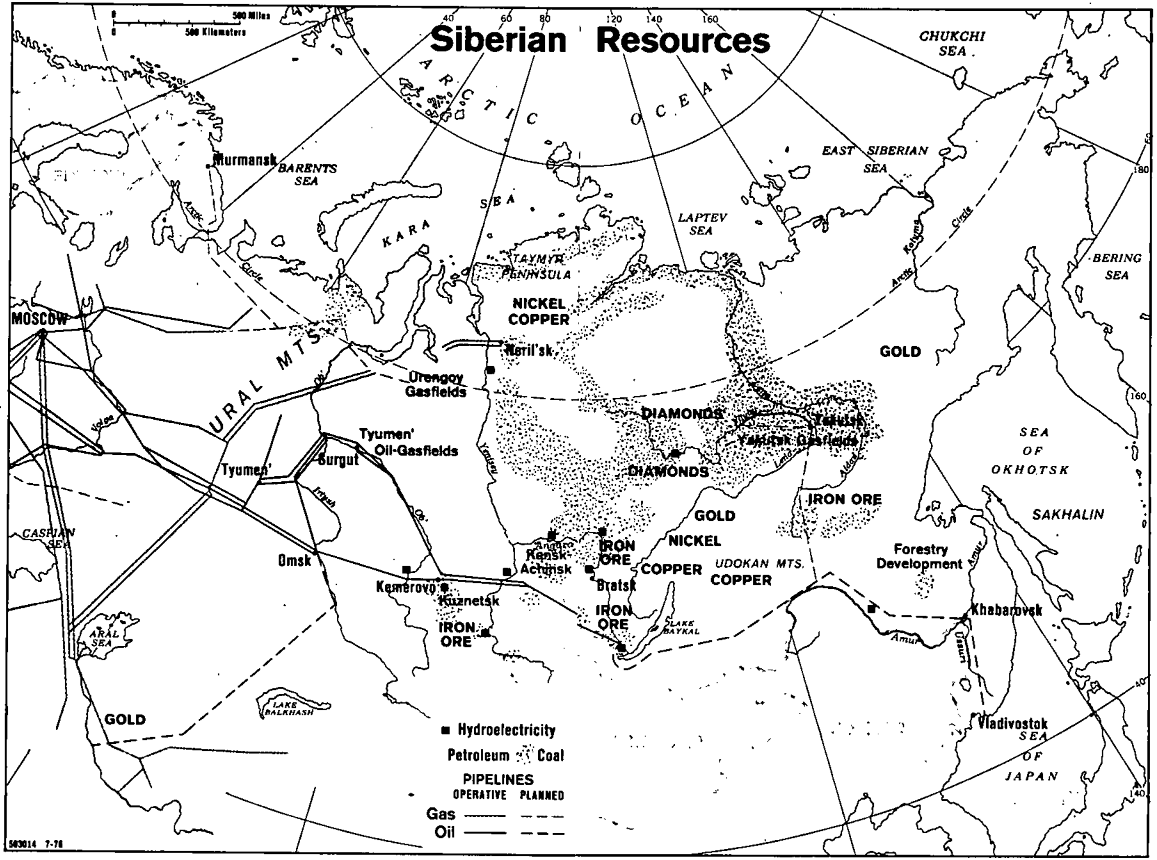
Siberian Resources
500 Miles
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ARCTIC OCEAN
CHUKCHI SEA
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LAPTEV SEA
KARA SEA
BARENTS SEA
BERING SEA
SEA OF OKHOTSK
SAKHALIN
SEA OF JAPAN
CASPIAN SEA
ARAL SEA
LAKE BALKHASH
LAKE BAYKAL
Murmansk
MOSCOW
URAL MTS
TAYMYR PENINSULA
NICKEL COPPER
Noril'sk
Urengoy Gasfields
Tyumen' Oil-Gasfields
Tyumen'
Surgut
Omsk
Kemerovo
Kuznetsk
IRON ORE
Kansk-Achinsk
IRON ORE
Bratsk
IRON ORE
DIAMONDS
DIAMONDS
Yakutsk
Yakutsk Gasfields
IRON ORE
GOLD
NICKEL
COPPER
UDOKAN MTS.
COPPER
GOLD
Forestry Development
Khabarovsk
Vladivostok
GOLD
Ob'
Yenisey
Irtysh
Angara
Lena
Aldan
Amur
Ussuri
Kolyma
Volga
Arctic Circle
■ Hydroelectricity
Petroleum Coal
PIPELINES
OPERATIVE PLANNED
Gas
Oil
503014 7-76

A COMPARISON OF FOSSIL FUEL USE IN THE U.S. AND U.S.S.R.

DANIEL R. KAZMER [1]

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I. KEY FINDINGS

1. The fuel requirements of the U.S. and the U.S.S.R. differ substantially.[2] These differences stem from differences in fuel productivity that affect each economy as a whole and from differences in the level of national output and its mix.

2. The output mix of the U.S. economy stresses satisfaction of consumer wants while the Soviet Union strives for economic growth through heavy investment. This difference is reflected in the ultimate uses for fossil fuels. For example, 32 percent of U.S. fuel requirements in 1967 were used directly or indirectly to supply refined oil products to final demand. The corresponding figure for the U.S.S.R. was only 7 percent. The chief fuel-use for final demand in the Soviet Union in 1966 was construction, which consumed, either directly or indirectly, 18 percent of Soviet fuel. Construction in the U.S. accounted for only 9 percent of American fuel needs in 1967. To perform the same amount of construction, the U.S.S.R. requires between one-quarter and one-half more fuel input than the U.S.

3. Between 1950 and 1972, the productivity of fuels in the U.S. increased at an average annual rate of 0.6 percent with high rates of growth in the early fifties and an absolute decline in the late sixties.

[1] The author is greatly indebted to Ray Converse, who did the research on ruble-dollar ratios for construction and drafted the material presented in Section IV.E. and Appendix B.

[2] Unless otherwise specified, the term fuel refers to fossil fuel.

In the Soviet Union over the same period, fuel productivity increased at an average annual rate of 1.3 percent.

4. If past patterns of sectoral growth rates and increases in fuel productivity were to persist, Soviet aggregate fuel requirements would grow at an average annual rate of 5.2 percent between 1973 and 1990, with emphasis on oil and gas.[3]

II. Introduction

Recent events, particularly the Arab oil embargo of late 1973 and the related increases in international oil prices, have enhanced the importance of fossil fuel balances in world affairs. The U.S.S.R. enjoys an enviable position in this regard. It is well endowed with deposits of all fossil fuels and has recently surpassed the United States as a producer of crude oil. The United States, on the other hand, faces the problem of growing dependence on foreign sources for crude oil and natural gas. However, supply is only one side of the picture. Use of fuel resources by the Soviet Union to gain influence abroad may be limited by growing Soviet domestic requirements for fossil fuels. Likewise, the future vulnerability of the U.S. to interruption of fuel imports depends, among other things, on the growth of U.S. fuel requirements. The growth of fuel requirements in both countries, in turn, is a function of growth in the various fuel-using sectors of the two economies and of changes in fuel productivity.

The purpose of this paper is threefold:

To identify the chief fuel-intensive (as measured by fuel input per unit of output) and fuel-using (as measured by total fuel input) sectors in both economies, taking into account both direct and indirect fuel use;

To compare and contrast past changes in total fuel requirements and fuel productivity in the U.S. and the U.S.S.R. over time;

To project the growth of fuel requirements in the Soviet economy based on (a) past patterns of economic growth, and (b) past trends in fuel use, including trends in fuel productivity and in the substitution of one fuel for another.

III. The Role of Fossil Fuels in the U.S. and Soviet Economies

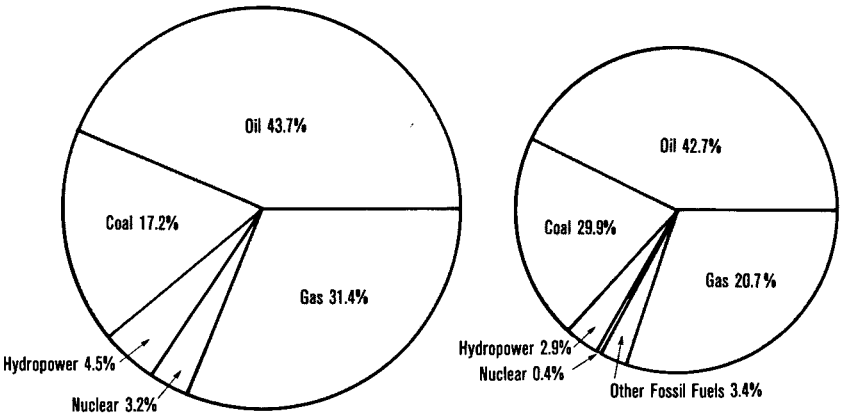
In both the U.S. and U.S.S.R. the relatively small contributions of fossil fuel production to GNP and industrial output belie their importance to the health of the two economies. In the U.S. fossil fuel extraction and refining account for only 2 percent of GNP and 6 percent of industrial production. In the U.S.S.R. in turn, fossil fuels contribute little more—3 percent of GNP and 8 percent of industrial output. In both countries, fossil fuel production accounts for less than 5 percent of industrial employment.

Nevertheless, fossil fuels provide the major source of energy for both the United States and Soviet economies. In 1975, more than 90 percent of the energy requirements in both countries were satisfied by

[3] This projection assumes that each sector of the Soviet economy will grow at its 1968–72 average annual rate and fuel productivity will increase at rates prevailing in 1950–72 with later years more heavily weighted. This is not a prediction—only a projection of what is expected if past patterns of economic growth and fuel productvity continue. Soviet projections of their own fuel requirements are discussed in Emily Jack, J. Richard Lee, and Harold Lent, "Outlook for Soviet Energy," elsewhere in this volume.

burning fossil fuel (see figure 1). In both economies oil plays the major role, accounting for over 40 percent of United States and Soviet energy sources in 1975. While the U.S.S.R. meets its oil requirements from domestic production and exports large quantities to Eastern Europe, the United States—which consumes about 80 percent more energy than the Soviet Union—imports more than one-third of its oil requirements.

U.S. and U.S.S.R.: Energy Sources, 1975 Figure 1



The major difference in the structure of energy sources in the United States and U.S.S.R. occurs in the contribution of coal and natural gas. In the United States, natural gas supplies nearly one-third of total energy while coal makes up somewhat less than one-fifth.

In the U.S.S.R. in contrast, coal contributes nearly one-third of total energy sources while natural gas accounts for only one-fifth.

Both hydroelectric and nuclear energy make up relatively small shares of total energy sources in both countries. In the U.S., however, the share of nuclear power in total energy is more than six times its share in the U.S.S.R. Despite the abundance of water resources in the U.S.S.R., hydroelectric energy contributes a considerably smaller portion of energy supplies than in the United States.

As shown in the following tabulation, the shares of the various energy sources in the U.S. have changed little since 1960. Oil and natural gas were the dominant fuels in 1960 and remain so today. In the U.S.S.R., however, the shares of oil and natural gas have risen sharply since 1960, reflecting primarily the substitution of these fuels for coal.

TABLE 1.—UNITED STATES-U.S.S.R.: CHANGES IN STRUCTURE OF ENERGY SOURCES[1]

[In percent]

	United States		U.S.S.R.	
	1960	1975	1960	1975
Nuclear	3.7	3.2		0.4
Hydroelectric		4.5	1.0	2.9
Fossil fuels	96.3	92.3	99.0	96.7
Coal	22.8	17.2	50.3	29.9
Oil	41.8	43.7	28.4	42.7
Gas	31.7	31.4	7.3	20.7
Other[2]			13.0	3.4

[1] Energy in this paper is measured in British thermal units (B.t.u.). 1 Btu is the quantity of heat required to raise the temperature of 1 pound of water 1 degree Fahrenheit at or near its point of maximum density.
[2] Peat, shale, and firewood.

IV. The Structure of Fuel Requirements in the U.S. and U.S.S.R.

A. Factors Affecting Fuel Requirements

The factors that determine an economy's fuel requirements fall into two categories: (a) technological factors, and (b) demand factors. Technological factors influence the quantity and mix of fuels required to produce a given output at a given time. These factors include the availability of land, labor, and capital; the time and place of production; the value put on labor time and effort; and the vintage and nature of the capital stock.

Both the Soviet and U.S. economies are well-endowed with land, labor, and capital. Several important differences between the two economies affect the quantity of fuel required to produce a given output. Two differences stem from geography: (a) The production centers of the Soviet Union are generally farther north than their U.S. counterparts and require more fuel for heat; (b) the Soviet Union is much larger in area, and the greater distances between raw material sources, manufacturing centers, and markets increase the amount of fuel used in producing and shipping the average unit of output. Another difference between the two countries is the degree to which they economize on worker time and effort. The United States is an acknowledged world leader in this area. The greater substitution of mechanical and electrical energy for labor in the United States tends to increase the fuel-output ratio in the United States.

Final demand for goods and services determines the quantity and mix of outputs that an economy produces. In the United States, final demand is determined by such factors as population size and age, income distribution, climate, and the tastes of individuals and households. In the Soviet Union, in contrast, the preferences of the political leadership and the planning authorities are the chief factors determining the output mix of the economy. The U.S. economy puts primary emphasis on the satisfaction of consumer wants while the Soviet economy stresses production of machinery and equipment to promote economic growth. Thus, the investment component of Soviet GNP was 29 percent in 1974: whereas the investment component of U.S. GNP was 15 percent in 1974.

The cumulative historical effects of technological factors are summarized in the direct plus indirect fuel intensity coefficients derived

from the 1966 Soviet and 1967 U.S. input-output tables in producers' prices.[4]

For example, the coal intensity coefficient for the Soviet automobile industry is 85.003. This means that 85.003 million Btu's of fuel in the form of coal were required to produce one thousand rubles worth of automobiles in the Soviet Union in 1966. Furthermore, the fuel intensity coefficients include both direct and indirect fuel requirements. Thus, the 85.003 million Btu's include not only the coal used in the auto assembly process but also the coal used to make the steel going into the autos. Omitted from this figure, however, is the coal used directly and indirectly to produce the fixed capital and support the labor used in the auto industry and its suporting sectors.[5]

B. Limitations on Comparability

Several factors limit the extent to which comparisons of fuel requirements in the U.S. and U.S.S.R. are possible. First are the differences between the input-output tables themselves. Data collection procedures in the compilation of the two tables may result in some similar transactions entering the two tables differently or even being included in one and excluded from the other. The tables also slice up the economic activity in their respective countries into different cuts. For example, the Soviet table has a separate sector for each of five fossil fuels, while the U.S. table lumps crude oil and natural gas into one sector and does not treat peat and oil shale separately. These differences limit the possibilities for sector-by-sector comparisons.

Comparisons are also limited by the general lack of accurate sectoral ruble-dollar ratios. Even if one knows the amounts of fuel required to assemble a dollar's worth of, say, autos in the United States and a ruble's worth in the U.S.S.R., one must still determine the dollar value of a ruble's worth of autos to compare the fuel intensities of automobile production in the two countries. Foreign exchange rates are inappropriate for this purpose since they are, in the Soviet case, arbitrarily set by the government and bear no necessary relation to the relative market values of the two currencies. Even the ruble-dollar exchange rates in unregulated markets (such as a black market) are inappropriate since these rates are determined by the values of the unique set of goods traded in that market. These goods normally do not bear a reasonably close relation to the products of the sector under consideration. Correct comparisons of the fuel intensities of a sector appearing in both the U.S. and Soviet tables require that the sectors be similarly defined and that a ruble-dollar ratio be carefully computed for that sector. In this paper, a ratio has been computed for the construction sector and permits a detailed comparative analysis of fuel use and intensity of construction in the U.S. and U.S.S.R. The other sectors are compared only by examining their relative positions according to fuel use and intensity within each economy, i.e., not between

[4] Derivation of the fuel-intensity coefficients is described in appendix A.

[5] In all input-output tables both new fixed investment and goods and services supplied to the households of workers are considered deliveries to final demand rather than inputs into the sectors that directly use the new fixed capital and employ the labor. The reason for this limitation is that the input-output table is basically a detailed record of the flow of goods and services from each sector to the other sectors over a single year. But the inputs used in the production of fixed capital and support and training of workers may have been transferred between sector years before the year for which the input-output table is constructed; they are not, therefore, included in the input-output table.

the economies. This kind of comparison may be made without computation of ruble-dollar ratios.

Turning to the dynamics of fossil fuel use in the two economies, computation of comparable economy-wide absolute measures of fuel productivity would also require sectoral ruble-dollar ratios. Accordingly, the fuel productivity indexes derived for this paper are only relative measures. For example, the fuel productivity index for the United States in 1972 was 99.98 (1967=100) and for the U.S.S.R.—106.25 (1966=100). These figures do not indicate that fuel productivity in the U.S.S.R. was higher than U.S. fuel productivity in 1972, but only that Soviet productivity increased at a higher rate between 1966 and 1972 whereas U.S. productivity hardly changed at all over approximately the same period.

C. The Chief Fuel-Intensive Sectors [6]

In both the U.S. and Soviet economies, the most fuel-intensive sectors include fuel extraction, oil refining, and power. After fuel and power, the most fuel intensive sectors in each economy include metal products, chemicals, plastics, paint, paper, and some inputs into construction (see figure 2). The general similarity between the two countries in the rankings of sectors by total fuel intensity also applies to the rankings by individual fuels (see appendix C, tables C3–C6).

[6] Fuel intensity is direct plus indirect fuel input per unit of output of the product of the designated sector. For example, coal intensity includes (a) the product of the coal sector itself, (b) coal burned in the coal sector, and (c) coal burned in other sectors to supply the coal sector with inputs of goods and services (except direct labor and capital) used in coal production.

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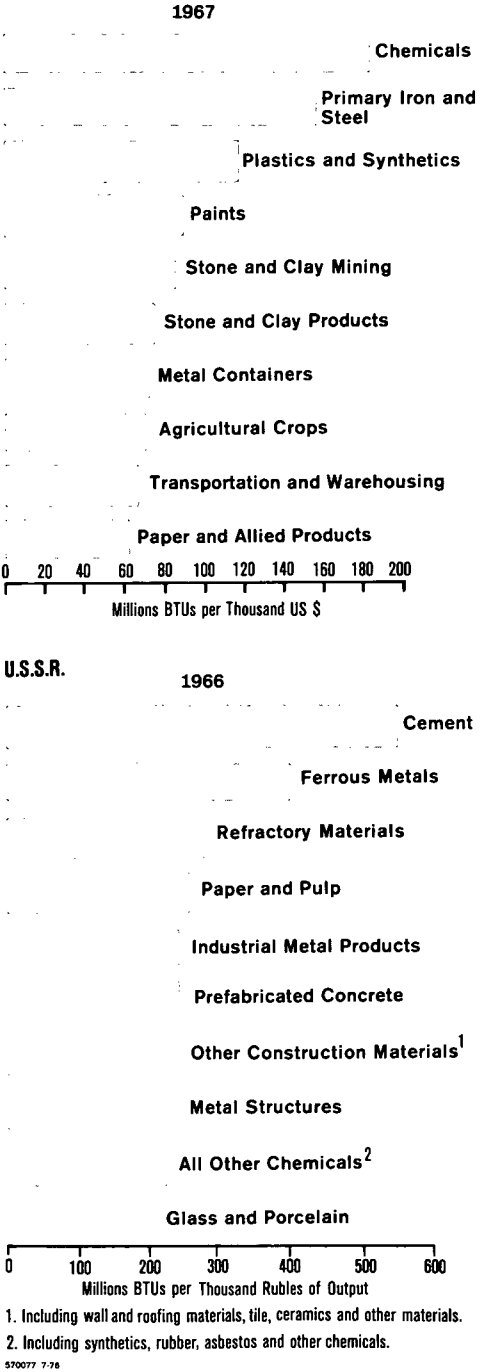
U.S. and U.S.S.R.: 10 Fuel-Intensive Sectors Figure 2



1. Including wall and roofing materials, tile, ceramics and other materials.
2. Including synthetics, rubber, asbestos and other chemicals.

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For example, the most coal-intensive sectors in both countries are coal mining and coking, iron and steel, construction materials, such as cement and structural metal products, and some other metal products.

The most oil-and-gas-intensive sectors in both countries include oil and natural gas extraction, petroleum refining, electric power, plastics and chemicals, and transportation.

The most striking difference in oil and gas intensity between the two countries is in the production of agricultural crops. In the U.S., crop production ranks seventh out of 80 sectors; in the Soviet Union, sixty-second out of 71 sectors. There are three reasons for this difference: (a) The degree of mechanization of agriculture is much higher in the U.S.; (b) American farmers have made heavier use of fertilizers and pesticides derived from petroleum and gas; and (c) Drying of grain crops is practiced more extensively in the United States and is an important use of natural gas in agriculture.

D. The Chief Fuel-Using Sectors

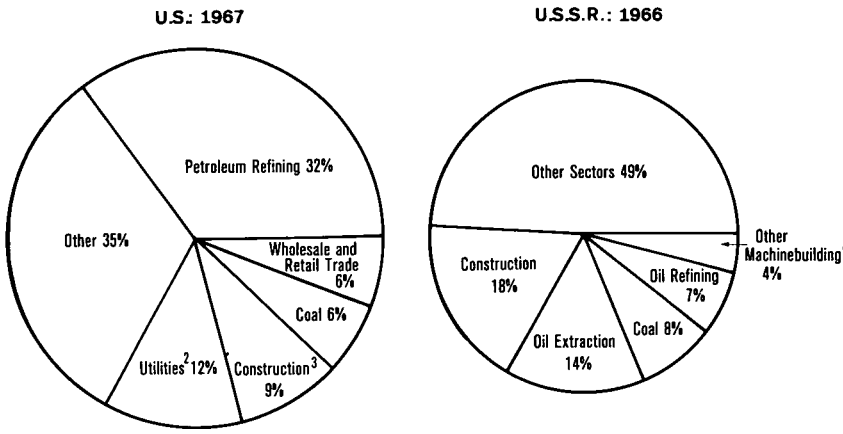
Fuel use is measured as the quantity of fuel required, both directly and indirectly, to produce the output of a given sector for final demand. Thus, its magnitude is affected not only by the technology and organization of production, but also by the proportion of each sector's output that is produced for final demand. Final demand includes public consumption, private consumption, gross fixed investment, net exports, and net additions to inventories.[7]

The different ranking of fuel-using sectors in the United States and the Soviet economies is a reflection of differences in output mix rather than differences in production technologies.

In 1967, 32 percent of U.S. consumption of fuels went directly or indirectly to the provision of refined oil products for final demand—largely to quench the thirst of the private automobile (see figure 3). In the Soviet Union, in 1966, refined oil products ranked fourth and accounted for a comparatively paltry 7 percent of Soviet fuel needs.

[7] Final demand rather than gross value of output, is used for two reasons. First, since the fuel intensity coefficients include both direct and indirect fuel inputs, multiplying them by gross value of output and summing would double-count fuel used by sectors that supply inputs to other sectors. Second, fuel use defined using final demand is more interesting for policy purposes. The traditionally recognized fuel-using sectors include iron and steel, petrochemicals, metalworking, plastics, and several others. These sectors, however, mostly produce inputs to other sectors: thus, policies to save fuel based on changing the shares of these sectors in total output will have repercussions for other sectors throughout the entire economy. Fuel use defined using final demand, on the other hand, includes only fuel used directly and indirectly to produce goods and services that are not inputs into other sectors; it thus reflects more accurately the energy bill for each product that the economy consumes, and the shares of each product in total final demand can be affected by policy with minimum disturbance to the production of other goods. However, fuel used in the production of other goods may still be affected if there are fuel savings or dissavings associated with the scale of production. Also, the quantities of investment goods delivered to final demand will obviously affect production in following periods.

U.S. and U.S.S.R.: Shares of Top Five Fuel-Using Sectors[1] Figure 3



1. Direct plus indirect use for final demand.
2. Including private electric, gas, water, and sanitary services. Government-owned utilities are in other sectors in the U.S. input-output table.
3. Including new construction plus maintenance and repair construction.
4. Including radiotechnical machinery, electronic products, medical implements, and other equipment.

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The second most important fuel user in the U.S. is private utilities which supply electric, gas, water, and sanitary services and which accounted for 12 percent of U.S. fuel requirements in 1967. By contrast, the supply of electric and thermal power to final users in the Soviet Union accounted for only 3 percent of Soviet needs and ranked seventh in fuel requirements for final demand.

Wholesale and retail trade also bulks large in U.S. fuel requirements. This reflects the fuel cost of supplying Americans with many large, brightly lighted, well-heated and air-conditioned stores in widely scattered shopping centers. The counterpart Soviet sector—trade and distribution—ranked fifteenth in Soviet fuel use and was allocated only 2 percent of Soviet direct plus indirect fuel consumption.

In the U.S.S.R., construction is the largest fuel using sector; in 1966, the sector used 18 percent of the Soviet Union's fuel either directly or indirectly. This is indicative of the large role played by planners' preferences and the emphasis on investment and growth in the Soviet Union. Construction activity is also an important fuel using sector in the U.S., (9%), with much of the emphasis on private housing construction.[8]

E. United States and Soviet Fuel Use in Construction: A Case Study

This section compares the fuel intensity of the U.S. and Soviet construction industry. First, the comparison is performed in terms of

[8] Part of the explanation for the apparent predominance of construction in both countries lies in its treatment in the input-output tables. In both the U.S. and Soviet tables, all new construction is considered input to final demand, and construction is not broken down by type in the table as are other big fuel users such as heavy industry. Even so, the importance of construction as a determinant of Soviet (and to a lesser degree, United States) fuel requirements is established. The U.S. percentage includes both new construction and maintenance and repair construction.

dollars, rubles, and an average measure. Second, sources of the divergence in fuel intensities are explored in terms of differences in both input structures and relative fuel intensities of these inputs.

As mentioned earlier, unless reliable ruble-dollar ratios are available for a specific type of economic activity, comparisons of relative United States and Soviet fuel intensities are confined to merely arraying the ordinal rankings of various sectors, e.g., the oil refining industry is the sixth most fuel intensive sector in the U.S.S.R. and the third in the United States. A recently published study computed 1970 ruble-dollar ratios based on a sample of 277 construction projects representing at least 8 types of construction.[9] This information permits a comparison of U.S. and Soviet construction costs, and thereby relative fuel intensities, measured in comparable prices.[10]

The fuel intensities derived in the previous pages were expressed in terms of the amount of fuel expended to produce a given value of output in each country. Ruble-dollar ratios permit the determination of fuel intensities as measured in the other nation's price system. The results of these comparisons are shown below.

FUEL INTENSITY IN CONSTRUCTION

	U.S.S.R.	United States	Ratio U.S.S.R. to United States
Million Btu's per:			
1,000 dollars	75.54	59.31	1.27
1,000 rubles	116.75	79.50	1.47
Geometric mean			1.37

The general result is that the U.S.S.R. uses more fuel than the United States for the same quantity of construction regardless of the price system used for the comparison. On average, the U.S.S.R. requires approximately 37 percent more fuel than the United States for similar construction.

There are two fundamental sources that explain the disparity between the fuel intensity of the United States and Soviet construction sectors. First, the input structure for the two sectors may differ, e.g., the United States uses a different portion of ferrous metals in construction than does the U.S.S.R.

Second, the input sectors for construction have different fuel intensities in each country, e.g., ferrous metals sent to construction in the United States are less fuel intensive than the mix of ferrous metals delivered to the Soviet construction sector. We shall now turn our attention to these two sources of divergence.

Several clues emerge from table 2 to explain the apparent difference in the total fuel intensities between the United States and Soviet construction sectors. In this table appear the shares of various major inputs delivered to the construction sector measured as a percentage of both the total value of output and of total intermediate inputs (gross value of output exclusive of depreciation, wages, indirect business taxes, and other net income).

[9] CIA/OER Publication ER 76-10068, "Ruble-Dollar Ratios for Construction," February 1976.

[10] See Appendix B for a discussion of the procedure used in the ruble-dollar comparisons.

TABLE 2.—UNITED STATES-U.S.S.R.: MAJOR INPUTS OF CONSTRUCTION SECTORS

	Percentage of total output		Percentage of total intermediate inputs	
	United States	U.S.S.R.	United States	U.S.S.R.
Petroleum products	1.96	.61	3.51	1.19
Ferrous metals	1.70	3.27	3.04	6.38
Nonferrous metals	2.29	.26	4.10	.51
Wood and pulp products	5.64	5.79	10.09	11.29
Chemicals	2.16	1.34	3.87	2.61
Construction materials [1]	6.99	17.06	12.51	33.27
Machinery and metal working	15.23	7.92	27.26	15.44
Transportation and communications	2.86	8.14	5.12	15.87
Trade and distribution	7.96	.73	14.25	1.42
Employee compensation	55.87	36.48		

[1] Construction materials include glass, cement, brick, and other stone and clay products.

The major difference in input structures between the two countries concerns the role of labor. Even with the higher labor intensity of Soviet construction, U.S. unit labor costs are so high that the wage bill in the United States represents a substantially larger proportion of costs. Second, in the United States, higher shares of inputs come from the petroleum products, nonferrous metals, chemicals, machinery, and trade and distribution industries. In the U.S.S.R., however, larger shares of inputs come from ferrous metals, wood and paper products, construction materials, and transportation and communications branches.

There are several plausible explanations for the different fuel intensities. First, the U.S.S.R. does not use nonferrous metals on construction to the same extent as occurs in the United States. Instead, the Soviets use several more fuel-intensive inputs, i.e., ferrous metals, construction materials, and wood products. The Soviet nonferrous metals industry is not nearly as developed as in the United States. Moreover, Soviet construction regulations prohibit the use of nonferrous metals except in extraordinary cases. Second, the Soviet construction industry attempts to substitute construction materials, in particular cement and concrete, for other construction inputs wherever feasible. Construction materials tend to be fuel-intensive because most of them pass through a kiln at some time during the production process. Third, Soviet construction has a higher transportation component than U.S. construction, partly because of the greater distances involved in the U.S.S.R. and partly because of the prevalence of wasteful crosshauling. Fourth, in the U.S. market economy, trade and distribution costs form an important element; trade and distribution is a relatively low-intensity fuel user.

These international differences in the fuel intensity of construction can be explained not only by the different input profiles between countries, but also by the different fuel intensities of these inputs when comparing identical branches in the two countries. These sources of variation may be explored by computing branch fuel intensities of the various inputs and then indexing these intensities with the overall fuel intensity of the construction sector serving as a base. The branch coefficients are obtained by using a weighted average of direct plus indirect fuel intensity of each component sector, where the weights depend on deliveries of each sector to the construction industry.

Branch indexes greater than unity indicate that the given input tends to push up the fuel intensity of construction while an index less than unity implies the opposite. By comparing a given branch's index in the U.S.S.R. and the U.S. one may ascertain whether the branch is comparatively more fuel-intensive in one country than the other.

The results appear in table 3. In three of the branches the comparison index registers lower for the U.S.S.R. than the U.S.—petroleum products, transportation and communications, and trade and distribution. The high fuel intensity of petroleum products used in U.S. construction reflects the importance of asphalt and bituminous paving; these materials have always been employed much less frequently in the U.S.S.R.

TABLE 3.—UNITED STATES-U.S.S.R.: FUEL INTENSITY OF MAJOR CONSTRUCTION INPUTS

Sector	United States	Million Btu per $1,000 [1]	Sector intensity divided by construction intensity
11–12	Construction	59.310	1.0000
8, 31	Petroleum products	1449.996	24.4477
37	Ferrous metals	171.808	2.8968
38	Nonferrous metals	44.757	.7546
20–25	Wood, paper, and paperboard	46.594	.7857
27–30, 32	Chemicals	91.266	1.5388
35–36	Construction materials	88.402	1.4905
39–63	Machinery and metalworking	58.797	.9914
65–67	Transportation and communications	71.678	1.2085
69	Trade and distribution	28.236	.4761

	U.S.S.R.	Million SFU per 1,000 rubles [2]	Sector intensity divided by construction intensity
65	Construction	4.203	1.0000
9–10	Petroleum products	70.374	16.7438
2	Ferrous metals	14.189	3.3759
4	Nonferrous metals	6.549	1.5582
44–49	Wood, paper, and paperboard	4.188	.9964
42–43	Chemicals	7.964	1.8948
50–53	Construction materials	8.904	2.1185
15–41	Machinery and metalworking	5.924	1.4095
69	Transportation and communications	4.796	1.1411
70	Trade and distribution	1.607	.3823

[1] Energy in this paper is measured in British Thermal Units (Btu) 1 Btu. is the quantity of heat required to raise the temperature of 1 pound of water 1° F. at or near its point of maximum density.
[2] 1 ton of standard fuel units equals to 27,778,100 Btu's.

The Soviet ferrous metals industry is relatively more fuel-intensive than its U.S. counterpart. This is due, in part, to the greater importance of the basic-oxygen process in the U.S.; the Soviets predominantly employ the more energy-intensive open-hearth process. Nonferrous metals are considerably less fuel intensive than aggregate construction in the United States and considerably more fuel intensive than aggregate construction in the U.S.S.R. Construction materials are more fuel-intensive than construction in both countries, but the difference is more pronounced in the U.S.S.R. This is partly because the U.S. cement industry uses the dry process more extensively than the U.S.S.R., which relies mainly on the energy-expensive

wet process. Another difference in the fuel intensity of inputs to construction occurs in machinery. Machinery has an average influence on fuel-intensity in U.S. construction, an above-average influence in Soviet construction. The apparent explanation is the higher fuel intensity of the Soviet ferrous metals branch, which supplies major inputs to machinery.

In summary, the U.S.S.R. construction industry requires more than a third more fuel than the U.S. for similar quantities of work. The two countries use different construction techniques. They have different input profiles in construction, and the different inputs vary widely in fuel intensities.

V. Trends in Fuel Requirements and Productivity in the U.S. and U.S.S.R.

A. Past Changes in Fuel Requirements

Figure 4 illustrates the growth in fossil fuel requirements (here defined as domestic production plus imports) in the U.S. and U.S.S.R. between 1950 and 1972. U.S. requirements are considerably higher, of course, since U.S. gross national product is higher. Fuel requirements in both countries grew at a fairly steady pace except for coal. The erratic course of U.S. coal requirements reflects both the effects of the business cycle on important coal-using sectors—heavy industry and construction—and substitution of other fuels for coal.

U.S. and U.S.S.R.: Fossil Fuel Requirements

Figure 4

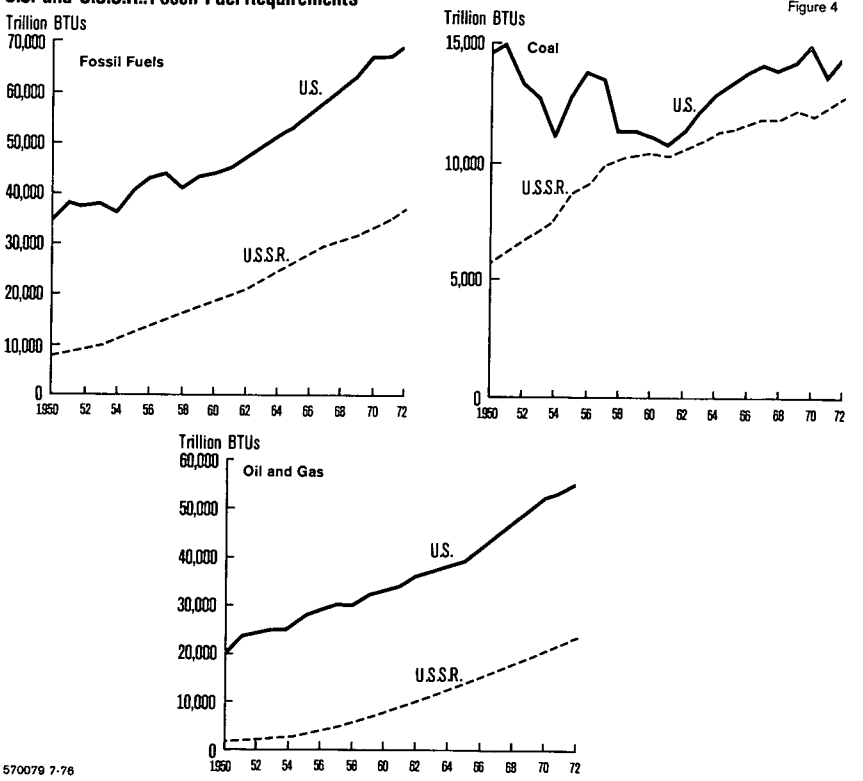

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Table 4 highlights two important facts: Soviet fuel requirements grew faster than U.S. requirements in 1951–72 and total fuel requirements in the U.S.S.R. grew faster than GNP, while in the U.S., fuel requirements grew more slowly than GNP.

TABLE 4.—UNITED STATES-U.S.S.R.: AVERAGE ANNUAL RATES OF GROWTH OF FOSSIL FUEL REQUIREMENTS AND GNP, 1951–72

[In percent]

	United States	U.S.S.R.
GNP	3.6	5.4
Fossil fuels	3.2	7.3
Coal	0	3.7
Oil and gas	4.7	12.6

These differences can be explained by several factors. First, because of war damage and general backwardness, the Soviet economy in 1950 probably was using more labor (and draft animal power) and thus less fuel to produce a given output than the more advanced and undamaged U.S. economy. Second, the rapid growth of the Soviet economy in 1951–72 involved both increased mechanization and greater expansion of the fuel-intensive sectors such as fuels, electric and thermal power, cement, and ferrous metals.

B. Past Changes in Productivity

"Productivity"—quantity of output per unit input—has been commonly applied to the major factors of land, labor, and capital and their combined total. In this paper, two indexes of fuel productivity—output per unit of fuel input—are presented. Each has specific strengths and weaknesses.

The first productivity index is derived by computing indexes of GNP/fuel requirement ratios for each economy for the years 1950–72. This measure of fuel productivity has two important characteristics: changes in both direct and indirect fuel inputs per unit output are reflected in changes in the GNP/fuel requirement ratio; and differing sectoral growth rates—which are not related to actual fuel productivity—are also reflected in changes in the GNP/fuel requirement ratio. For example, if an economy conserves fuel indirectly by producing autos with less steel in them, the GNP/fuel requirement ratio will rise since the economy is producing the same number of autos but with less fuel. However, this measure of fuel productivity is also biased by varying sector growth rates.

For example, if fuel intensive sectors such as heavy industry grow most rapidly, the GNP/fuel requirement ratio will fall even though the fuel requirement per unit output within each sector has not changed. This biases the index based on the GNP/fuel requirement ratio. In the United States, on the other hand, the more rapid growth of the service sectors (characterized by low fuel intensity) biases the U.S. GNP/fuel requirement ratio upward in later years and leads to an overestimation of the increase in fuel productivity.

The second fuel productivity index derived for this paper is a Paasche index of direct physical fuel input per unit value of output weighted by the gross values of output for the various sectors in each country's input-output table.

This index has the form:

$$\text{Productivity} = \frac{\sum_i (D_i)_0 (GVO_i)_1}{\sum_i (D_i)_1 (GVO_i)_1}$$

where D_i is the direct fuel input per unit output for the *ith* sector and GVO is the gross value of output for the *ith* sector. The "zero" subscript indicates base year while the "1" subscript indicates the year to be indexed. This index also has noteworthy characteristics. First, it disaggregates the economy into many sectors (71 for the U.S.S.R. and 80 for the U.S.); thus, the effect of differing sectoral growth rates is largely removed from the index. Second, the indexes compare sector fuel productivity in the current year with productivity in the reference year (1966 for the U.S.S.R. and 1967 for the U.S.), each year having been weighted by its respective sector proportions.[11] Third, the productivity indexes are computed from direct sectoral fuel input coefficients weighted by the gross values of output of the sectors. Thus, factors that indirectly affect fuel requirements will not be reflected in these productivity indexes.

Both the indexes based on GNP/fuel requirement ratios and the fuel productivity indexes computed using the input-output tables are presented in Figures 5 and 6 because each type of index has theoretically desirable properties where the other type of index is weak or subject to error. It should also be noted that the index for each country is a relative index of fuel productivity, not an absolute one.[12]

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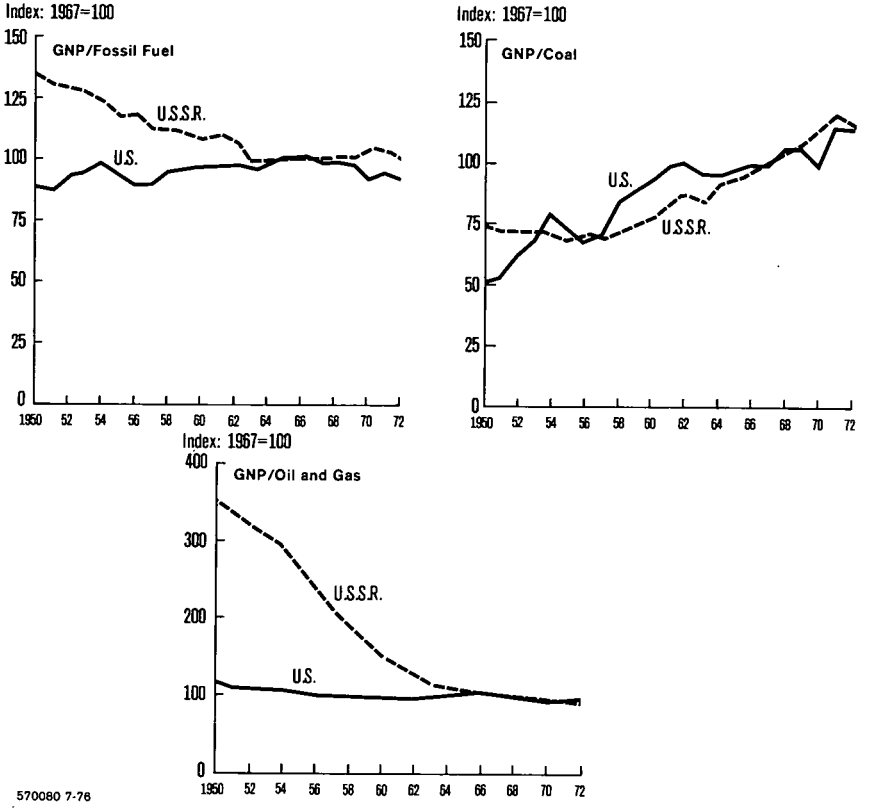
[11] Because of the current year weights, the indexes may be used to compare each current year with the reference year, but the current year indexes, strictly speaking, should not be compared with each other.

[12] If the fuel productivity index for the U.S.S.R. in 1970 is higher than that for the United States in 1970, then fuel productivity in the U.S.S.R. has grown faster between 1967 and 1970 than did fuel productivity in the United States; however, one cannot infer from this that Soviet fuel productivity is higher or lower than U.S. fuel productivity in either 1967 or 1970.

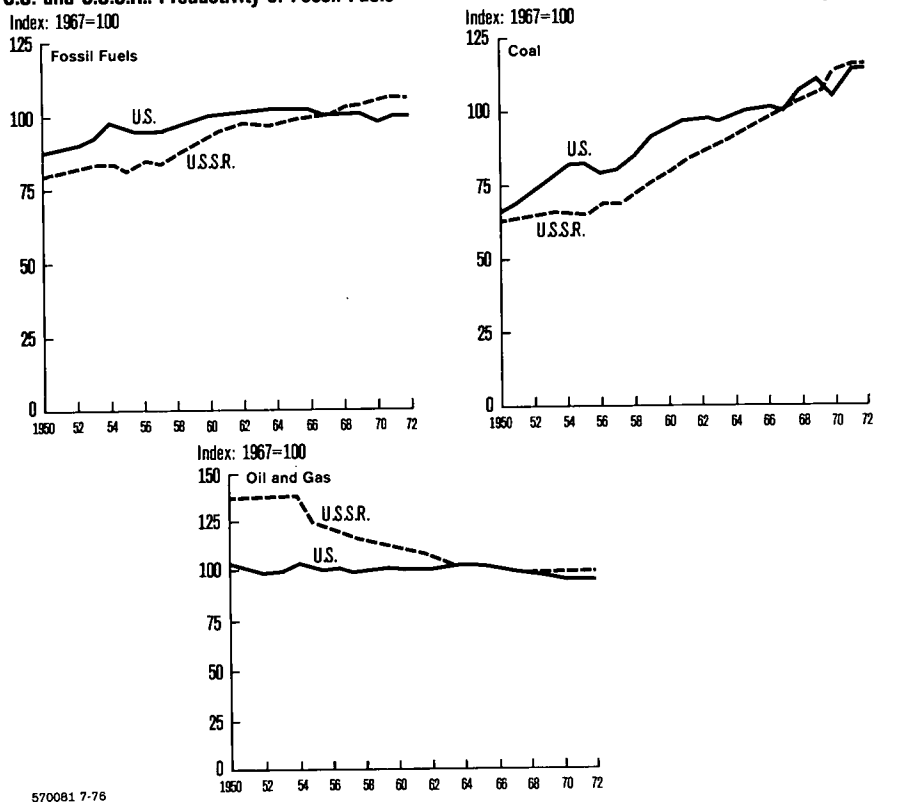
U.S. and U.S.S.R.: GNP/Fossil Fuel Requirement Ratios

Figure 5



U.S. and U.S.S.R.: Productivity of Fossil Fuels

Figure 6



Figures 5 and 6 indicate that in both countries the productivity of coal increased between 1950 and 1972, with the course of coal productivity in the U.S. more subject to temporary reverses.[13]

During 1951–72, coal productivity in the U.S.S.R. increased at about 2.1 percent to 2.8 percent annually; the equivalent figures for the United States are 2.5 percent to 3.7 percent.[14] The high growth periods for U.S. coal productivity were the early fifties and seventies; for Soviet coal productivity, the late fifties and much of the sixties. In the U.S. case, there were periods of actual decline in coal use (see

[13] The U.S.S.R. curve is smoother in figure 6 than in figure 5, suggesting that much of the variation of the Soviet GNP/coal ratio was due to shifts in input-output sectoral growth rates rather than actual changes in productivity. This does not hold true for the United States, however, since both measures of U.S. coal productivity show erratic growth.

[14] The GNP/coal ratio shows the growth of U.S. coal productivity to be much greater than that of the Soviet Union (3.7 percent to 2.1 percent). However, this does not take into account the fact that the more coal intensive sectors in the Soviet economy were also the high growth sectors, while in the U.S. services—which are less coal-intensive—underwent a greater expansion. The coal productivity indexes derived using the input-output tables show the growth of Soviet coal productivity somewhat greater than that of the US (2.8 percent versus 2.5 percent per year), but these figures are not completely reliable since the indexes are Paasche, i.e., with current year weights.

figure 4), so the high rate of productivity growth largely reflects substitution of other fuels for coal. Coal production and use in the U.S.S.R. did not decline in the late fifties and sixties, but the higher growth of coal productivity during these periods is associated with a declining share of coal in total fuel use. The share of coal in total fossil fuel production in 1956 was 67 percent; by 1970 it was down to 36 percent.

Figures 5 and 6 illustrate the combined changes in oil and gas productivity during the period 1951–72. Overall, U.S. oil and gas productivity declined slightly—at an average annual rate of approximately −0.3 percent to −0.8 percent. Oil and gas productivity in the U.S.S.R. registered a much more precipitous decline: −1.5 percent per year with the Paasche-type index and −6 percent per year if measured by the index based on the GNP/oil and gas requirement ratio.

The overall decline in oil-and-gas productivity in both countries was due to (1) a trend toward substitution of oil and gas for coal since these fuels are cleaner and easier to transport, and (2) the rapid growth of sectors such as petrochemicals that use oil and gas as a raw material rather than only to generate heat and power. The overall declines registered in the oil and gas productivity indexes should not be taken as an indicator of a decline in the efficiency with which oil and gas are used in either the U.S. or the U.S.S.R.

Figures 5 and 6 give roughly similar pictures of the course of U.S. total fossil fuel productivity between 1950 and 1972. The productivity index based on the GNP/fuel ratio increased at an average annual rate of 0.2 percent, while the productivity index derived using the input-output table grew at 0.6 percent per year. Both indexes register the highest growth in fuel productivity in the early fifties, the late sixties being a period of overall decline in fuel productivity.

The graphs of Soviet fossil-fuel productivity in Figures 5 and 6 are another matter. They are almost "mirror images" of each other, with the index derived from the Soviet input-output table increasing at an average annual rate of 1.3 percent and the index based on GNP/fuel ratios declining at an average annual rate of −1.3 percent. This is because in the Soviet economy the most fuel-intensive sectors grew most rapidly; thus, the productivity index derived from GNP/fossil fuel ratios underestimates the true change in fossil fuel productivity over time.

C. Simulating Fuel Requirements

The fuel coefficients derived for this paper may be used to project fuel requirements both for individual sectors and for the economy as a whole.[15] Fuel requirements for the U.S.S.R. were projected over the period 1973–1990 assuming that the average annual sectoral growth rates for gross output for the period 1968–72 would prevail to 1990. This assumption was made because (a) these growth rates are reasonable—having prevailed in the Soviet economy for five years; and (b)

[15] For example, the Soviet coal intensity coefficient (which measures both direct and indirect coal inputs) for automobiles is 85.003 million Btu's per thousand 1966 rubles worth of autos. The economy-wide requirement for coal associated with supplying an extra million rubles worth of autos to final demand is 85.003 billion Btus, given no change in the productivity of coal and no change in the delivery of other products to final demand. If, however, one can also estimate the coal productivity index in the auto industry and its supporting industries at, say 110, then the coal requirements associated with a million rubles worth of autos is 85.003÷1.10=77.275 billion Btus of coal.

they span parts of two five-year plans and are less likely to be biased by a single plan.

Multiplication of the direct fuel input coefficients by the projected sector outputs and summing the products yields an estimate of total Soviet fuel requirements unadjusted for changes in fuel productivity.[16] The total fuel productivity index for 1950–72 was projected to 1990 using a moving average formula weighted in favor of the more recent years. Division of the unadjusted fuel requirements by the projected productivity index yields total fuel requirements adjusted for productivity. These fuel requirements for each year then had to be distributed among the various fuels. For this purpose, elasticities of the individual fuels with respect to their sum for 1950–72 were projected to 1990 by a moving average with the recent years more heavily weighted.[17] These elasticities were then used to distribute increases in total fuel requirements among the various fuels. These techniques guarantee continuity with the past and provide a reasonable projection of fuel requirements, assuming no massive changes in consumption patterns, no great technical breakthroughs, and no massive shifts to non-fossil fuel energy sources.[18]

Table 5 provides an indication of the assumptions made in this scenario for the Soviet economy.

TABLE 5.—*U.S.S.R.: Average annual growth rates for selected sectors in the Soviet economy scenario, 1973–1990*

Sector:	*Growth rates 1968–72*
Final demand for fuels:	
Coal	2.1
Oil	5.3
Gas	7.1
Five fastest growing sectors:	
Instruments	15.9
Motor vehicles	13.4
Logging and paper machinery and equipment	12.4
Meat products	11.9
Metal structures	11.0
Five slowest growing sectors:	
Wood chemistry products	−3.7
Sugar	−2.1
Peat	−1.1
Crops	−0.1
Refractory materials	0.1
Gross national product	4.9

Figure 7 depicts the projections of Soviet and U.S. requirements for coal, crude oil and natural gas, and all fossil fuels taken together for the years 1973–1990. The average annual rates of growth associated with figure 7 are given in table 6.

TABLE 6.—*U.S.S.R.: Average annual rates of growth of projected fuel requirements, 1973–1990*

[Assuming 1968–72 sectoral growth rates]

Fuel:	
Coal	1.2
Crude oil and natural gas	6.7
All fossil fuels	5.2

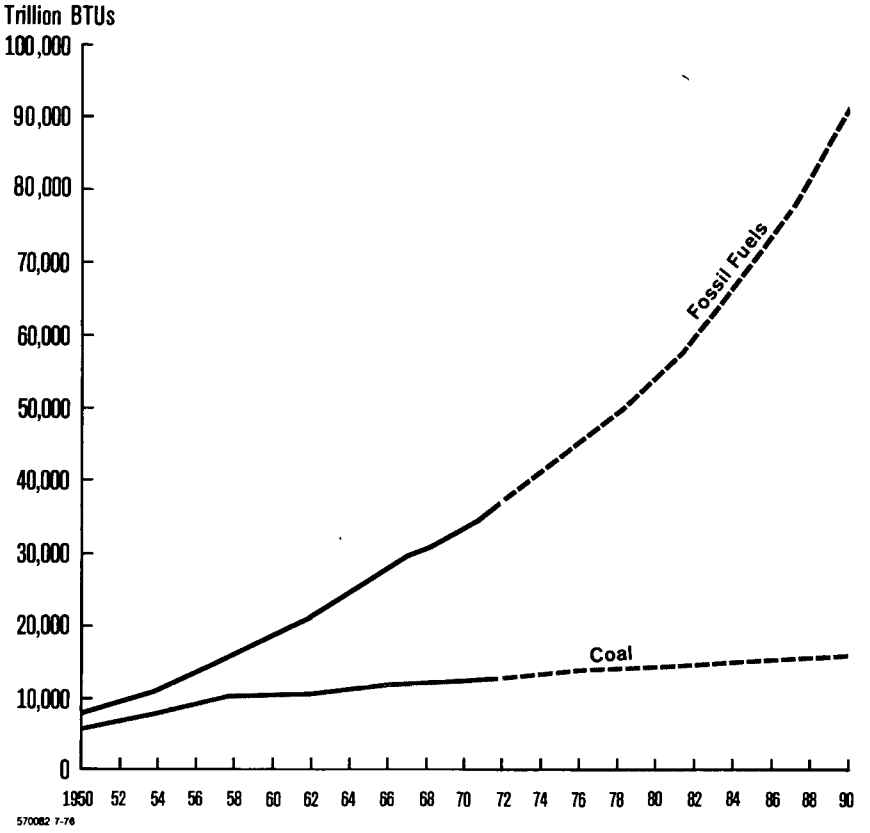
[16] This methodology is presented in detail in appendix A.

[17] Elasticity here is the percentage change in the requirement of one fuel which accompanies a one percent change in the requirement of all fossil fuels. For example, if total fossil fuel requirements increase one percent and oil requirements increase two percent, the elasticity of oil with respect to all fossil fuels is two.

[18] Final demand for each fuel in each scenario is assumed to be a constant share of the total output of the corresponding fuel-producing sector.. This is equivalent to an assumption that the final demand for each fuel grows at the same rate as the value of gross output of the fuel-producing sector.

U.S.S.R.: Projections of Fossil Fuel Requirements (Assuming 1968-72 Sector Growth Rates for 1973-90)

Figure 7



The share of oil and gas in Soviet fuel requirements in 1972 was 63 percent; by 1990 the scenario projects that it will be 81 percent. This large change in fuel shares occurs because the elasticity of the requirement for each fuel with respect to the sum of all fossil fuels was assumed to be a moving weighted average of past elasticities.

Three types of factors affect these elasticities: technical progress, the rates of growth of the various sectors, and policies of substitution among fuels. First, there is no reason to expect technical progress to occur in such a way that the requirements for all fuels are affected proportionally. Second, the differing rates of growth of the sectors change the weights given to fuel coefficients in determining total fuel requirements. A given sector may be increasing its fuel input per unit output, but if its share of total output is declining, that sector may be adding little to total fuel requirements. Finally, deliberate policy may change the share of total fuel requirements given to each fuel. In recent years the Soviets have been implementing a policy of increasing the share of natural gas in total fuel use at the expense of other fuels, primarily coal. The projections of the elasticity of natural gas with respect to the sum of the fossil fuels reflect this policy since they are based on past elasticities.

The upshot is that the projections for the sum of all fossil fuels are more reliable than the projections for any single fuel. Nevertheless, the method used in this paper to allocate increases in total fossil fuel requirements among the fuels has two advantages. First, all three of the factors mentioned above as affecting the elasticity of each fuel with respect to the sum of the five fuels play some role in the allocation. Second, the projected shares of each fuel in the growth of total fuel requirements are based on patterns present in the economy for over twenty years, with greater weight assigned to variations in more recent years.

The projections of Soviet fuel requirements derived for this paper may be put into perspective by comparison with other projections. Although Soviet literature on future fuel demand and supply is scattered, complex, and occasionally contradictory, statements by several Soviet experts have been reduced to consistent numerical estimates of future Soviet energy balances in a recent CIA paper.[19] These figures are compared with those developed in the scenario shown in Table 7.

The figures in Table 7 point up several interesting features of Soviet forecasts. First, differences between the results from the scenario and the Soviet forecast for all fossil fuels are surprisingly small. The scenario figure of 91,440 trillion Btus for 1990 is only 2.4 percent larger than the 89,307 trillion Btus forecast by the Soviets themselves. The Soviet forecast implies an average annual growth in total fuel requirements of 4.8 percent for the period 1974–1990; the rate implied by the scenario is 5.2 percent. The implication is that the Soviet scenario is based on (a) a growth rate for 1975–90 less than the average rate for 1968–72, and/or (b) increases in fuel productivity exceeding past average increases.

TABLE 7.—U.S.S.R.: FOSSIL FUEL SUPPLIES AND REQUIREMENTS PROJECTED TO 1990

[In trillions of Btu's][1]

Fuel and year	Soviet estimates		Scenario projecting 1968–72 sectoral growth rates to 1990
	Production[2]	Requirements[3]	
Coal:			
1973	13,028	NA	13,022
1974	13,306	NA	13,186
1975	13,611	NA	13,347
1980	15,556	NA	14,150
1990	24,167	NA	15,967
Crude oil and natural gas:			
1973	24,889	25,861	24,886
1974	26,917	NA	26,538
1975	28,889	NA	28,301
1980	37,778	NA	39,033
1990	61,112	63,334	74,287
All fossil fuels:[4]			
1973	38,778	40,000	38,764
1974	41,056	NA	40,593
1975	43,334	NA	42,531
1980	54,306	NA	54,145
1990	86,529	89,307	91,440

[1] All requirements include exports and additions to inventories.
[2] CIA publication A(ER) 75–71, "Soviet Long Range Energy Forecasts," September 1975, table 2, p. 7.
[3] Ibid., table 5, p. 19.
[4] Includes peat and oil shale, Firewood was assumed to remain stable at 694 trillion Btu's, its 1973 figure and subtracted from the figure for solid fuels. Hydroelectric and nuclear power supplied 528 trillion Btu's in 1973 and are projected to supply 5,833 trillion Btu's by 1990.

[19] CIA Publication A (ER) 75–71, "Soviet Long Range Energy Forecasts," September 1975. A summary of findings is presented in "Outlook for Soviet Energy" by Emily Jack, J. Richard Lee, and Harold Lent elsewhere in this volume.

The scenario estimates generally match or are slightly less than the Soviet estimate of fuel requirements or production through 1975. After 1975 the scenario estimates exceed the Soviet estimates of fuel requirements of production except for coal in both 1980 and 1990 and all fossil fuels in 1980. The scenario estimates of coal requirements fall farther and farther behind the Soviet estimates over time, especially after 1980. The reason lies in differing assumptions about the future elasticity of the requirement for each fuel with respect to the sum of the fossil fuels. The scenario assumes that the large share of oil and gas in past fuel requirement increases will continue into the future. The Soviet estimates assume the share of coal in the total fuel supply will not decline further after 1980.[20] Thus, the scenario of this paper provides a picture of what Soviet fuel requirements would be if the policy of substitution of oil and gas for coal is continued after 1980.[21]

Appendix A

A Mathematical Presentation of the Methodolgy

The methodology used in this paper is based on input-output analysis. Fuel coefficients were derived from both the 1966 Soviet and 1967 U.S. input-output tables in producers' prices. Twelve fuel coefficients—two each for coal, crude oil, natural gas, peat, oil shale, and the sum of these five fossil fuels—were derived for each of the 71 sectors in the 1966 Soviet table. Two coefficients were derived for each fuel—a direct fuel input coefficient and a direct plus indirect fuel intensity coefficient. Similar coefficients were derived from the 1967 U.S. table for six fuel groups: domestic coal, imported coal, domestic crude oil and natural gas, imported crude oil and natural gas, imported oil products, and the sum of these five fuel groups. These six groups were then consolidated into coal, oil and gas, and all fossil fuels. The coefficients are in millions of Btus of fuel input per thousand rubles of output in the Soviet case and per thousand dollars of output in the U.S. case.

The first step in deriving the direct fuel input coefficients is the determination of direct fuel deliveries in physical units to each sector of the economy and to final demand.[1]

In both the Soviet and U.S. input-output tables, the fossil fuels have sectors in the input-output tables, so the calculation is already largely completed. Given the assumption that the deliveries of fuels in physical units are proportional to deliveries in value units, as defined in the tables, the elements in the fuel rows of the direct flow input-output table may be converted to physical units simply by dividing them by the price of the fuel. This price is the ratio of gross value of output of the fuel sector to the gross output of the fuel in physical units. To obtain the direct fuel input coefficients, the fuel deliveries in physical units are divided by the gross values of output of the corresponding fuel receiving sectors.

[20] CIA Publication A (ER) 75–71, "Soviet Long Range Energy Forecasts," September 1975, page 6.

[21] A similar projection for total U.S. fuel requirements was made assuming that 1964–73 sectoral growth rates would prevail 1974–90. The projections were remarkably close to U.S. Department of Interior projections of total gross energy inputs into the U.S. The Department of Interior projections are summarized in U.S. Bureau of the Census, "Statistical Abstract of the United States; 1975" (96th ed.), Washington, D.C., 1975, p. 531, table no. 881.

[1] The basic advantage to deriving fuel coefficients in physical unit fuel inputs per unit value of outputs is that coefficients for different fuels within the same sector may be added together to obtain cumulative fuel-input coefficients without concern about the effects of government controls or other factors which might cause the relative values of the fuels to differ from their relative usefulness as sources of energy.

The direct fuel input coefficient for final demand equals the reciprocal of the price.[2]

The direct plus indirect fuel intensity coefficients also may be derived easily. Each fuel row in the $(I-A)^{-1}$ matrix is simply divided by the price of the fuel. The procedure may be checked by multiplying each direct plus indirect fuel intensity coefficient by the final demand for the corresponding fuel receiving sector and summing the products. The sum should equal total fuel production or import as the case may be. In the U.S. table, fuel imports are treated as though they were delivered to the fuel sectors and then distributed to the fuel-receiving sectors in the same relative proportions as domestic fuel. In the Soviet table, there is no import sector and Soviet imports are simply subtracted from deliveries to final demand, so fuel imports do not have to be treated in the derivation of the fuel input coefficients.

The total fuel requirement for the economy as a whole, given any gross value of output or final demand vectors for any year may be estimated according to either of the following formulas.

$$(1) \qquad TFR=\frac{\sum_{i=1}^{n+1}(D_i GVO_i)}{PROD}$$

$$(2) \qquad TFR=\frac{\sum_{i=1}^{n} DPI_i \cdot FD_i}{PROD}$$

where,

TFR=total fuel requirement of the economy;

D_i=direct fuel input coefficients for sector i;

GVO_i=gross value of output of sector i;

$PROD$=an index of fossil fuel productivity with $PROD$ in the year of the input-output table equal to 1;

n=the number of sectors in the input-output table with the $n+1$ sector being final demand for the fuel for which the requirement is being computed;

DPI_i=direct plus indirect fuel intensity coefficient for sector i;

FD_i=output of sector i delivered to final demand.

As the above equations indicate, the total fuel requirement must be adjusted for changes in fuel productivity. Most efforts to employ input-output tables for this purpose have centered on techniques to estimate changes over time in individual coefficients or groups of coefficients in the input-output table. The rationale behind such procedures is that the fixed coefficients in the tables are a weakness of the input-output approach which should be remedied by estimation techniques. In this study, the fixed coefficients are viewed as a strength of the input-output table since they provide a base on which productivity indexes may be calculated.

Let $PROD_x$ be productivity index of type x. Only four of the eight possible indexes which can be generated using an input-output table make economic sense.[3]

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[2] Let D =the direct full input coefficient,
P =the price of the fuel,
FD =the fuel delivered to final demand in value terms,
GVO_{FD}=the gross value of output of the fuel-receiving sector, final demand.

Then $D = \frac{FD}{P} + GVO_{FD} = \frac{FG}{P} \times \frac{1}{GVO_{FD}}$

But the value of the fuel delivered to final demand is the "gross value of output" of final demand: $FD=GVO_{FD}$.

Then $D=\frac{1}{P}$.

[3] Weighting the D_i by the FD_i would leave direct indexed fuel inputs into sectors with no or lower deliveries to final demand out of the calculation of the index. Weighting the DPI_i by the GVO_i would double-count indexed fuel inputs under the same circumstances.

Laspeyres indexes

(a) $$PROD_a = \frac{\sum_i (D_i)_0 (GVO_i)_0}{\sum_i (D_i)_1 (GVO_i)_0}$$

(b) $$PROD_b = \frac{\sum_i (DPI_i)_0 (FD_i)_0}{\sum_i (DPI_i)_1 (FD_i)_0}$$

Paasche indexes

(c) $$PROD_c = \frac{\sum_i (D_i)_0 (GVO_i)_1}{\sum_i (D_i)_1 (GVO_i)_1}$$

(d) $$PROD_d = \frac{\sum_i (DPI_i)_0 (FD_i)_1}{\sum_i (DPI_i)_1 (FD_i)_1}$$

Indexes (a), (b), and (d) require more information for their computation than is usually available. Index (a) requires data on direct fuel deliveries to each sector in both the base and given years. Index (b) in effect requires the complete input-output tables for each given year and the final demand vector for the base year. Index (d) requires data on deliveries to final demand by each sector for the given year as well as the input-output table for the base year. Index (c), however, requires only the GVO vector for each given year, the total fuel requirement for each given year (the denominator of the ratio), and direct fuel deliveries to all sectors in the base year. Index (c) is the productivity index computed for this paper.

Productivity indexes of this type were computed for each year 1950–72 for the U.S.S.R. and 1950–73 for the United States according to equation (1) given above. Total fuel requiremnts were equal to fuel production for the Soviet input-output table and production plus imports for the U.S. table since in the Soviet table imports are subtracted from final demand while they have a separate row in the U.S. table. The gross value of output vector for each year was obtained by moving each element of the GVO vector in the input-output table by a time series gross value of output index. Of the 71 sector GVO's in the 1966 Soviet input-output table, 52 were adjusted using SPIOER (Soviet Production Indexes of the Office of Economic Research); 12 were adjusted by indexes computed from data in various issues of Narodnoye Khozyaystvo S.S.S.R.; 5 were adjusted with CIA GNP data; and 2 by SAIOER (Soviet Agricultural Indexes of the Office of Economic Research). Of the 80 vector GVO's in the 1967 U.S. table, 52 were adjusted by Federal Reserve Board industrial production indexes; 16 by Bureau of Economic Analysis GNP data; 6 with data from various issues of Minerals Yearbook, published by the Bureau of Mines, Department of Interior; 4 with data from the Department of Agriculture; and 2 with information from Statistical Abstract of the United States for various years.

For the U.S.S.R., the productivity indexes for the sum of all fossil fuels were projected to 1990 by computing a moving weighted average annual growth rate.

$$PROD_n = \left[\frac{PROD_{n-1}}{1+2+3+\ldots k}\right]\left[k\left(\frac{PROD_{n-1}}{PROD_{n-2}}\right)+(k-1)\left(\frac{PROD_{n-2}}{PROD_{n-3}}\right)+\ldots 1\,\frac{PROD_{n-k}}{PROD_{n-k-1}}\right]$$

where n is the year for which fuel productivity is being projected and $k+1$ is the number of years for which productivity indexes have been previously computed or projected. This formula was chosen because it takes into account the productivity trend as far back as 1950 (the earliest year for which productivity indexes were computed), yet weights the productivity formula heavily in favor of the most recent years. Other assumptions about changes in fuel productivity may be embodied in projected productivity indexes.

Projected total fuel requirements, derived from each scenario as defined in the text and unadjusted for changes in fuel productivity, were divided by the projected productivity indexes to yield final estimates for total fossil fuel requirements for each year up to 1990. Only after this step may requirements for each individual fuel be estimated. Estimating the projected requirements for each fuel individually and then summing these requirements to obtain the total would result in distortions of the projected total fuel requirements due to substitution between fuels. For example, let us assume an economy with only two fuels. The requirement for fuel A in year t is 100 and it grows by 10 in year $(t+1)$; the requirement for fuel B is also 100 in year t but it declines by 10 in year $(t+1)$. The total fuel requirement remains unchanged at 200 from year t to year $(t+1)$.

All that happens is that A is substituted for B. Now extrapolate the growth rates to year $t+2$. Fuel A should grow by 10 percent to 121 in year $t+2$. This means that the total fuel requirement in year $t+2$ is 202—an increase of 1 percent. But projection of the total fuel requirement directly would extrapolate the zero growth rate for total fuel and the requirement would be 100 in year $t+2$. Furthermore, the distortion due to inter-fuel substitution will become worse over time.

Once the total fuel requirement has been projected, the projected increase must be allocated among the individual fuels. First, elasticities for each fuel with respect to their sum for the non-projected years were computed according to the formula:

$$ELAS_{n,\,n+1}=\frac{\dfrac{F_{n+1}-F_n}{F_n}}{\dfrac{S_{n+1}-S_n}{S_n}}$$

where, $ELAS_{n,\,n+1}$ = the elasticity of the requirement for a particular fuel with respect to the requirement for the sum of the five fuels;
F = the requirement for a particular fuel, F;
S = the requirement for the sum of the five fuels;
n = the year n.

These elasticities were extrapolated through 1990 using a moving, weighted average formula.

$$ELAS_{n,\,n+1}=\frac{k(ELAS_{n-1,\,n})+(k-1)(ELAS_{n-2,\,n-1})+\ \ldots\ +1(ELAS_{n-k,\,n-k+1})}{1+2+3+\ \ldots\ +k}$$

where k is the number of elasticities which can be computed without projection. The elasticity measures then were combined with the projected increases in the sum of the five fuels to estimate the increase in each of the five fuels separately for each projected year up to 1990.

The productivity indexes for each of the individual fuels for the projected years were directly calculated by dividing the unadjusted fuel requirement based on the input-output table for year n by the quantity of the fuel estimated to be required in year n. These productivity indexes for the individual fuels played no role in the estimation of future fuel requirements.

The chief constraint on the use of this procedure to estimate the increase in the requirement for any product is that it should simultaneously be applied to any other products which may serve as substitutes for the product under study. Otherwise, substitutions between products may introduce extraneous elements into the projections.

Let $\Delta F=F_{n+1}-F_n$, i.e., the increase in a particular fuel given the increase in the sum of the five fuels.

Then,

$$\Delta F=(ELAS_{n,\,n+1})\frac{S_{n+1}-S_n}{S_n}F_n$$

and

$$F_{n+1}=F_n+\frac{\Delta F}{\sum_{i=1}^{m}\Delta F}(S_{n+1}-S_n)$$

where m is the number of individual fuels or fuel groups under study. This formula constrains the estimated increases in the requirements for the individual fuels ($\triangle$F's) to sum to the independently estimated increase in the overall fuel requirement, $(S_{n+1} - S_n)$.

Appendix B

Ruble-Dollar Ratios for Construction: Procedures and Problems

A comparison of any two economies must come to grips with the problem of valuing two different assortments of output in a common set of prices. The international currency exchange rate cannot be used for the U.S. and U.S.S.R. because (a) the exchange rate is set arbitrarily, (b) foreign trade is a tightly controlled monopoly in the U.S.S.R., and (c) the exchange rate reflects imperfectly only the prices of goods and services that are traded internationally and therefore is not representative of construction activity in the two countries.

The comparisons of U.S. and Soviet fossil fuel use in construction rely on a quite different procedure. The recently published CIA/OER study, Ruble-Dollar Ratios for Construction, *op. cit.*, permits a comparison of U.S. and Soviet construction costs, and thereby relative fuel intensities, measured in comparable prices.[1]

Three different aggregate ruble-dollar ratios for construction were computed in the above cited study: U.S. weighted—0.746; Soviet weighted—0.647; and the geometric mean—0.695.[2] Each country's weights were designed to make the construction samples represent a microcosm of construction in that country The Soviet weighted ratio permits the valuation of Soviet construction in dollars, and the U.S. weighted ratio similarly permits the valuation of U.S. construction in rubles.

Even with the existence of the price ratios, two incompatabilities must be resolved before the comparison of fuel use becames feasible. First, there are differences between the U.S. and Soviet input-output tables concerning construction and how they relate to the ruble-dollar ratios already computed. The Soviet table treats construction as one sector, but the U.S. table distinguishes between new construction and maintenance and repair construction. This problem was resolved by combining the two U.S. sectors into one. Fortunately, this combination procedure is not too critical because the total fuel intensity of new construction versus repair construction differs by less than 5 percent, although the mix of fuel inputs does differ.

TABLE B-1.—UNITED STATES: INPUT MIX FOR NEW CONSTRUCTION AND REPAIR

Sector[1]	Percentage of total value of—		Percentage of total intermediate inputs of—	
	New construction	Repair	New construction	Repair
Petroleum products (sector 8, 31)	1.75	2.67	2.91	6.45
Ferrous metals (5, 37)	1.82	1.27	3.03	3.07
Nonferrous metals (6, 38)	2.70	0.89	4.49	2.15
Wood and paper products (20–25)	6.71	1.96	11.16	4.74
Chemicals (27–30, 32)	1.54	4.25	2.56	10.29
Construction materials (35–36)	7.95	3.37	13.22	8.15
Machinery and metalworking (39–63)	16.34	11.45	27.18	27.69
Transportation and communications (65–7)	3.04	2.24	5.06	5.42
Trade and distribution (69)	8.14	7.37	13.54	17.82
Employee compensation	31.41	50.29		

[1] Numbers in parenthesis are sectors numbers in the 80-sector U.S. input-output table.

[1] CIA, "Ruble-Dollar Ratios for Construction," ER 76–10068, February 1976. Ruble-dollar ratios are computed by determining the relative Soviet and U.S. costs of building identical projects in each country. Two criteria must be satisfied to insure proper computation of these relative price ratios. First, project samples must be structured so they are typical of construction in each country; this is accomplished by developing United States and Soviet value weights. Second, the United States and Soviet projects for which the costs are juxtaposed should be comparable in terms of function, size, structure, social amenities, quality, and honefully aesthetics.

[2] The geometric mean is the square root of the product of the U.S.- and Soviet-weighted ratios. The geometric mean is a type of average and is the generally accepted measure for the crude ruble-dollar ratio when it must be reduced to a single number.

The U.S. distribution of total fuel input, direct plus indirect, is 30 percent coal and 70 percent oil and gas for new construction in contrast to 19 percent and 81 percent respectively for maintenance and repair construction. Analysis of the direct inputs into these two construction sectors, as shown above yields some clues concerning the nature of this variation in fuel mix. First, petroleum products represent a larger share of intermediate inputs for repair than new construction. This is partly because repair construction is more labor-intensive and, as a result, petroleum products are a larger proportion of total intermediate inputs. New construction has a substantially larger share of its inputs coming from the construction materials and nonferrous metals sectors, which tend to receive a larger proportion of their total fuel inputs from coal sources. On the other hand, the chemical sector tends to produce many oil-based products, e.g., paints, which represent a larger share of the cost of repair work than new construction.

At least one possible hazard arises from treating new construction and repair as one type of activity; the study "Ruble-Dollar Ratios for Construction" derived ratios solely for new construction and ignored repair work. Thus, aggregating the two sectors implies the ruble-dollar ratios for both types of work are identical, an assumption to be viewed skeptically. Intuitively, we believe, that ruble-dollar ratios for repair would be higher than for new construction, i.e., the U.S.S.R. is relatively more efficient in new construction than repair construction vis-à-vis the United States. Repair work is similar to finishing work in that it is labor intensive and operations frequently are carried out on a relatively small scale. Soviet performance in this respect is notoriously bad and the press is rife with complaints concerning inefficiency and delays of both types of work. Also, repair work is generally not standardized to the same degree as new construction, especially non-industrial structures. The study mentioned earlier concluded that the Soviets perform standardized construction more efficiently than customized construction, even relative to U.S. performance. To the extent that the repair ratio's value exceeds that of new construction, the results in this section will be slightly biased and show the Soviets in a more favorable light. Fortunately, the share of repair in total construction is not large—somewhat less than a quarter in both countries.

The second impediment to the comparison is that the Soviets and U.S. input-output tables are based on the years 1966 and 1967 respectively, but the ruble-dollar ratios are computed for 1970 prices in each country. Thus, it was necessary to convert the ruble-dollar ratios to 1966 rubles and 1967 dollars by using price indexes. The U.S. side of the equation was obtained directly by using the Department of Commerce Composite Cost Index which reflects an increase of 21 percent in construction costs over the period 1966–70. In the Soviet case, acceptable construction price indexes are not released and most of the available data are published in "estimate costs."[3] Thus 1970 prices were deflated to 1966 prices using two published values for construction and installation work: the 1966 amount as valued in the revised 1955 prices and the 1966 amount as valued in the 1969 prices used in the computation of the original ruble-dollar ratios. The ratio between these two values—1.2351—is taken as the coefficient to convert the ratios to 1966 rubles. The new ruble-dollar ratios after converting to 1966 rubles and 1967 dollars are:

U.S.-weighted	0.733
Soviet-weighted	0.636
Geometric mean	0.683

Appendix C. Tables

The Chief Fuel Intensive Sectors

Fuel intensity is measured as the quantity of fuel required both directly and indirectly, to produce a given value of output. Tables C1–C6 list the top twenty most fuel-intensive sectors in each economy for the sum of all fossil fuels, coal, and oil and gas.

[3] Estimate costs in the Soviet context are defined as the cost if a project were implemented strictly in accordance with standards of physical resources per unit of construction and prices. Some evidence suggests that the costs published as estimate costs are quite close to actual costs.

TABLE C–1.—UNITED STATES: FOSSIL FUEL COEFFICIENTS OF 20 MOST FUEL-INTENSIVE SECTORS, 1967

[Millions of Btu's per thousand dollars of output]

Rank	Sector	Fuel intensity
1	Coal mining	5,175.3
2	Crude petroleum and natural gas	2,826.7
3	Petroleum refining and related industries	1,450.0
4	Private utilities [1]	426.6
5	Chemicals and selected chemical products [2]	202.7
6	Primary iron and steel manufacturing [3]	171.8
7	Plastics and synthetic materials	130.4
8	State and local government enterprises [4]	120.1
9	Paints and allied products	98.8
10	Stone and clay mining and quarrying	94.5
11	Stone and clay products	90.1
12	Metal containers	83.6
13	Agricultural crops	81.2
14	Transportation and warehousing	79.2
15	Federal Government enterprises [4]	75.9
16	Paper and allied products, except containers	74.3
17	Heating, plumbing, and structural metal products	67.3
18	Stampings, screw machine products, and bolts	63.6
19	Maintenance and repair construction	62.0
20	Broad and narrow fabrics, yarn, and thread mills	60.7

[1] Includes electric, gas, water, and sanitary services.
[2] Includes fertilizers.
[3] Includes coke products.
[4] Includes public utilities and transportation.

TABLE C–2.—U.S.S.R.: FOSSIL FUEL COEFFICIENTS OF 20 MOST FUEL-INTENSIVE SECTORS, 1966

[Millions of Btu's per thousand rubles of output]

Rank	Sector	Fuel intensity
1	Gas	15,651.3
2	Oil extraction	8,816.2
3	Coal	3,198.0
4	Peat	2,209.7
5	Oil shales	2,071.6
6	Oil refining	1,941.1
7	Coke products	1,712.5
8	Electric and thermal power	985.5
9	Cement	539.1
10	Ferrous metals	394.1
11	Refractory materials	272.3
12	Paper and pulp	253.1
13	Industrial metal products	238.8
14	Prefabricated concrete	238.3
15	Other construction materials [1]	233.5
16	Metal structures	232.6
17	All other chemicals [2]	221.2
18	Glass and porcelain	203.9
19	Other machinebuilding [3]	203.5
20	Sanitary engineering products	192.1

[1] Includes wall materials, tile, asbestos-cement, slate, roofing materials, construction ceramics, and some other materials.
[2] Includes basic chemistry products, aniline dye products, synthetic resins and plastics, synthetic fibers, synthetic rubber, organic synthetics, paints and lacquers, rubber and asbestos products, pharmaceuticals, and other chemicals.
[3] Includes radio-technical machinery and engineering, electronic products, medical implements, and other equipment.

TABLE C-3.—UNITED STATES: COAL COEFFICIENTS OF 20 MOST COAL-INTENSIVE SECTORS, 1967

[Millions of Btu's per thousand dollars of output]

Rank	Sector	Coal intensity
1	Coal mining	5,139.1
2	Private utilities [1]	163.8
3	Primary iron and steel manufacturing [2]	141.6
4	State and local government enterprises [3]	59.9
5	Metal containers	58.9
6	Federal Government enterprises [3]	52.3
7	Stone and clay products	44.1
8	Heating, plumbing, and structural metal products	43.5
9	Stampings, screw machine products, and bolts	42.7
10	Plastics and synthetic materials	36.7
11	Paper and allied products, except containers	35.8
12	Other fabricated metal products [4]	34.7
13	Construction, mining and oil field machinery	34.5
14	Chemicals and selected chemical products	33.4
15	Farm machinery and equipment	32.8
16	Other transportation equipment [5]	28.9
17	Engines and turbines	28.8
18	Materials handling machinery and equipment	27.9
19	Motor vehicles and equipment	27.3
20	Stone and clay mining and quarrying	26.9

[1] Includes electric, gas, water, and sanitary services.
[2] Includes coke products.
[3] Includes public utilities and transportation.
[4] Includes cutlery, pipes, valves, safes, and hardware not elsewhere classified.
[5] Includes shipbuilding and repairing, railroads, motorcycles, and bicycles.

TABLE C-4.—U.S.S.R.: COAL COEFFICIENTS OF 20 MOST COAL-INTENSIVE SECTORS, 1966

[Millions of Btu's per thousand rubles of output]

Rank	Sector	Coal intensity
1	Coal	3,159.2
2	Coke products	1,631.3
3	Electric and thermal power	585.4
4	Ferrous metals	268.2
5	Cement	186.2
6	Paper and pulp	176.0
7	Metal structures	148.0
8	Industrial metal products	145.5
9	Other construction materials [1]	130.0
10	Sanitary engineering products	120.8
11	Prefabricated concrete	118.4
12	Wood chemistry products	117.9
13	Ferrous ores	117.8
14	Refractory materials	117.4
15	Other chemicals [2]	113.9
16	Nonferrous metals	113.0
17	Cable products	108.5
18	Oil shales	97.9
19	Agricultural machinery and equipment	91.0
20	Bearings	87.5

[1] Includes wall materials and tile, asbestos-cement and slate, roofing materials, construction ceramics, and some other materials.
[2] Includes basic chemistry products, aniline dye products, synthetic resins and plastics, synthetic fibers, synthetic rubber, organic synthetic products, paints and lacquers, rubber and asbestos products, pharmaceuticals, and other chemicals.

TABLE C-5.—UNITED STATES: OIL-AND-GAS COEFFICIENTS OF 20 MOST OIL-AND-GAS-INTENSIVE SECTORS 1967

[Millions of Btu's per thousand dollars of output]

Rank	Sector	Oil and gas intensity
1	Crude petroleum and natural gas	2,820.3
2	Petroleum refining and related industries	1,439.3
3	Private utilities [1]	262.8
4	Chemicals and selected chemical products [2]	169.4
5	Plastics and synthetic materials	93.7
6	Paints and allied products	80.1
7	Other agricultural products—Crops	73.9
8	Transportation and warehousing	71.9
9	Stone and clay mining and quarrying	67.6
10	State and local government enterprises [3]	60.2
11	Maintenance and repair construction	52.1
12	Business travel, entertainment and gifts	47.4
13	Livestock and livestock products	46.7
14	Stone and clay products	46.0
15	New construction	43.8
16	Broad and narrow fabrics, yarn and thread mills	41.9
17	Forestry and fishery products	39.8
18	Drugs, cleaning and toilet preparations	39.5
19	Miscellaneous textile goods and floor coverings [4]	38.9
20	Paper and allied products, except containers	38.5

[1] Includes electric, gas, water, and sanitary services.
[2] Includes fertilizers.
[3] Includes public utilities and transportation.
[4] Lace goods, paddings and upholstery fillings, tire cord and fabric.

TABLE C-6.—U.S.S.R.: OIL-AND-GAS COEFFICIENTS OF 20 MOST OIL-AND-GAS-INTENSIVE SECTORS, 1966

[Millions of Btu's per thousand rubles of output]

Rank	Sector	Oil-and-gas intensity
1	Gas	15,566.6
2	Oil extraction	8,773.0
3	Oil refining	1,874.7
4	Cement	339.9
5	Electric and thermal power	334.7
6	Refractory materials	151.2
7	Glass and porcelain	135.1
8	Ferrous metals	121.3
9	Prefabricated concrete	111.6
10	All other chemicals [1]	100.5
11	Mineral chemistry	97.5
12	Other construction materials [2]	92.5
13	Industrial metal products	89.1
14	Fish products	84.5
15	Transportation and communications	82.2
16	Metal structures	80.6
17	Coke products	76.0
18	Wood chemistry	68.4
19	Automobiles	68.1
20	Industry not elsewhere classified [3]	67.2

[1] Includes basic chemistry products, aniline dye products, synthetic resins and plastics, synthetic fibers, synthetic rubber, organic synthetic products, paints and lacquers, rubber and asbestos products, pharmaceuticals, and other chemicals.
[2] Includes wall materials and tile, asbestos-cement and slate, roofing materials, construction ceramics, and other construction materials.
[3] Includes extraction and primary processing of certain industrial materials, plastic parts, printing and bookbinding, musical instruments, toys, office supplies, commercial laundry and drycleaning and other industries.

The Chief Fuel-Using Sectors

Fuel use is measured as the quantity of fuel required, both directly and indirectly, to produce the output of a given sector for final demand. Thus, its magnitude is affected not only by the technology and organization of production, but also by how much of each sector's product is produced for final demand. Final demand includes public consumption, private consumption, gross fixed investment, net exports, and net additions to inventories.

TABLE C-7.—UNITED STATES: TOP 20 FOSSIL-FUEL-USING SECTORS, 1967, DIRECT PLUS INDIRECT USE FOR FINAL DEMAND

Rank and sector	Trillions of Btu's	Percent of total
1. Petroleum refining and related industries	18,678.7	31.9
2. Private utilities [1]	6,805.5	11.6
3. New construction	4,723.0	8.1
4. Wholesale and retail trade	3,411.3	5.8
5. Coal mining	3,197.3	5.5
6. Food and kindred products	3,037.7	5.2
7. Real estate and rental	2,111.3	3.6
8. Transportation and warehousing	1,640.3	2.8
9. Medical, educational services, and nonprofit organizations	1,408.0	2.4
10. Motor vehicles and equipment	1,359.7	2.3
11. Crude petroleum and natural gas	957.7	1.6
12. Chemicals and selected chemical products [2]	889.0	1.5
13. Hotels, personal, and repair services except auto	642.2	1.1
14. Apparel	584.5	1.0
15. Other agricultural products—crops	556.0	1.0
16. Aircraft and parts	474.1	.8
17. Finance and insurance	465.7	.8
18. Drugs, cleaning, and toilet preparations	450.0	.8
19. Maintenance and repair constructions	353.0	.6
20. Ordinance and accessories	339.7	.6
All sectors	58,474.0	100.0
Percent of total fossil fuel use accounted for by these 20 sectors		89.0

[1] Includes electric, gas, water, and sanitary services.
[2] Includes inorganic and organic chemicals and fertilizers.

TABLE C-8.—U.S.S.R.: TOP 20 FOSSIL-FUEL-USING SECTORS, 1966, DIRECT PLUS INDIRECT USE FOR FINAL DEMAND

Rank and sector	Trillions of Btu's	Percent of total
1. Construction	5,056.9	18.2
2. Oil extraction	3,958.8	14.2
3. Coal	2,215.5	8.0
4. Oil refining	1,907.0	6.9
5. Other machine building [1]	1,246.7	4.5
6. Industry, not elsewhere classified [2]	1,066.3	3.8
7. Electric and thermal power	945.2	3.4
8. Repair of machinery and equipment	749.4	2.7
9. Transportation and communications	644.8	2.3
10. Animal husbandry	574.3	2.1
11. Bread, bakery products, and confections	572.0	2.1
12. Meat products	550.5	2.0
13. Crops	548.5	2.0
14. Other food [3]	538.8	1.9
15. Trade and distribution	537.6	1.9
16. Gas	515.2	1.9
17. Other chemicals [4]	498.1	1.8
18. Food industry machinery and equipment	465.7	1.7
19. Dairy products	369.0	1.3
20. Textiles	352.6	1.3
All sectors	27,811.4	100.0
Percent of total fossil fuel use accounted for by these 20 sectors		84.0

[1] Includes radiotechnical machinery, electronic products, medical implements, and some other equipment.
[2] Includes extraction and primary processing of certain industrial materials, plastic parts, printing and bookbinding, musical instruments, toys, office supplies, commercial laundry and drycleaning, and other industries.
[3] Includes vegetable oils, fruit and vegetable products, tobacco products, cosmetics, and some other foods.
[4] Includes basic chemistry products, aniline dye products, synthetic resins and plastics, synthetic fibers, synthetic rubber, organic synthetics, paints and lacquers, rubber and asbestos products, pharmaceuticals, and other chemicals.

TABLE C–9.—UNITED STATES: TOP 20 COAL-USING SECTORS, 1967, DIRECT PLUS INDIRECT USE FOR FINAL DEMAND

Rank and sector	Trillions of Btu's	Percent of total
1. Coal mining	3,174.9	22.3
2. Private utilities [1]	2,613.5	18.4
3. New construction	1,227.6	8.6
4. Motor vehicles and equipment	774.2	5.4
5. Food and kindred products	732.8	5.2
6. Wholesale and retail trade	671.2	4.7
7. Medical, educational services and nonprofit organizations	400.3	2.8
8. Real estate and rental	376.9	2.7
9. Primary iron and steel manufacturing	217.2	1.5
10. Other transportation equipment [2]	187.6	1.3
11. Aircraft and parts	178.6	1.3
12. Apparel	176.2	1.2
13. Transportation and warehousing	151.2	1.1
14. Ordnance and accessories	148.9	1.0
15. Chemicals and selected chemical products [3]	146.3	1.0
16. Construction, mining, and oil field machinery	142.9	1.0
17. Petroleum refining and related industries	137.9	1.0
18. Hotels, personal and repair services except auto	136.9	1.0
19. Finance and insurance	135.4	1.0
20. Farm machinery and equipment	127.1	.9
All sectors	14,221.0	100.0
Percent of total coal use accounted for by these 20 sectors		83.4

[1] Includes electric, gas, water, and sanitary services.
[2] Includes ship and boat building, locomotives, railroad and streetcars, motorcycles, trailer coaches and other equipment and parts.
[3] Includes inorganic and organic chemicals and fertilizers.

TABLE C–10.—U.S.S.R.: TOP 20 COAL-USING SECTORS, 1966, DIRECT PLUS INDIRECT USE FOR FINAL DEMAND

Rank and sector	Trillions of Btu's	Percent of total
1. Construction	2,452.0	21.0
2. Coal	2,188.6	18.8
3. Other machine-building [1]	664.6	5.7
4. Electric and thermal power	561.4	4.8
5. Industry, not elsewhere classified [2]	556.0	4.8
6. Repair of machinery and equipment	430.3	3.7
7. All other chemicals [3]	256.4	2.2
8. Bread, bakery products, and confections	255.7	2.2
9. Transportation machinery and equipment	250.8	2.1
10. Transportation and communications	237.9	2.0
11. Trade and distribution	237.4	2.0
12. Other food [4]	230.6	2.0
13. Meat products	230.5	2.0
14. Animal husbandry	221.1	1.9
15. Ferrous metals	196.6	1.7
16. Dairy products	178.0	1.5
17. Automobiles	175.8	1.5
18. Agricultural machinery and equipment	168.4	1.4
19. Electrotechnical machinery and equipment	162.6	1.4
20. Textiles	160.5	1.4
All sectors	11,669.6	100.0
Percent of total coal use accounted for by these 20 sectors		84.1

[1] Includes radio-technical machinery, electronic products, medical implements, and some other equipment.
[2] Includes extraction and primary processing of certain industrial materials, plastic parts, printing and bookbinding, muscial instruments, toys, office supplies, commercial laundry and drycleaning, and other industries.
[3] Includes basic chemistry products, aniline dye products, synthetic resins and plastics, synthetic fibers, synthetic rubber, organic synthetic products, paints and lacquers, rubber and asbestos products, pharmaceuticals, and other chemicals.
[4] Includes vegetable oils, fruit and vegetable products, tobacco products, cosmetics, and some other foods.

TABLE C-11.—UNITED STATES: TOP 20 OIL-AND-GAS-USING SECTORS, 1967, DIRECT PLUS INDIRECT USE FOR FINAL DEMAND

Rank and sector	Trillions of Btu's	Percent of total
1. Petroleum refining and related industries	18,540.8	41.9
2. Private utilities[1]	4,191.9	9.5
3. New construction	3,495.3	7.9
4. Wholesale and retail trade	2,740.2	6.2
5. Food and kindred products	2,304.9	5.2
6. Real estate and rental	1,734.3	3.9
7. Transportation and warehousing	1,489.0	3.4
8. Medical, educational services, and nonprofit organizations	1,008.2	2.3
9. Crude petroleum and natural gas	955.5	2.2
10. Chemicals and selected chemical products	742.6	1.7
11. Motor vehicles and equipment	585.6	1.3
12. Other agriculture products—crops	506.3	1.1
13. Hotels, personal and repair services except auto	505.3	1.1
14. Apparel	408.3	.9
15. Drugs, cleaning and toilet preparations	342.4	.8
16. Aircraft and parts	295.6	.7
17. Automobile repair and services	243.5	.6
18. Radio, television, and communication equipment	199.1	.4
19. Ordnance and accessories	190.8	.4
20. Business services	142.6	.3
All sectors	44,253.0	100.0
Percent of total oil-and-gas-use accounted for by these 20 sectors		91.8

[1] Includes electric, gas, water, and sanitary services.

TABLE C-12.—U.S.S.R.: TOP 20 OIL-AND-GAS-USING SECTORS, 1966, DIRECT PLUS INDIRECT USE FOR FINAL DEMAND

Rank and sector	Trillions of Btu's	Percent of total
1. Oil extraction	3,939.4	25.8
2. Construction	2,440.6	16.0
3. Oil refining	1,841.8	12.1
4. Other machine-building[1]	540.2	3.5
5. Gas	512.4	3.4
6. Industry not elsewhere classified[2]	470.6	3.1
7. Transportation and communications	397.8	2.6
8. Crops	355.7	2.3
9. Electric and thermal power	321.0	2.1
10. Animal husbandry	318.6	2.1
11. Repair of machinery and equipment	299.1	2.0
12. Meat products	290.7	1.9
13. Bread, bakery products, and confections	285.0	1.9
14. Trade and distribution	280.4	1.8
15. Other food[3]	278.7	1.8
16. All other chemicals[4]	226.3	1.5
17. Fish products	207.5	1.4
18. Transportation machinery and equipment	200.8	1.3
19. Dairy products	171.7	1.1
20. Textiles	171.5	1.1
All sectors	15,255.7	100.0
Percent of total oil-and-gas-use accounted for by these 20 sectors		88.8

[1] Includes radio-technical machinery, electronic products, medical implements, and some other equipment.
[2] Includes extraction and primary processing of certain industrial materials, plastic parts, printing and bookbinding, musical instruments, toys, office supplies, commercial laundry and drycleaning, and other industries.
[3] Includes vegetable oils, fruit and vegetable products, tobacco products, cosmetics, and other foods.
[4] Includes basic chemistry products, aniline dye products, synthetics, resins and plastics, synthetic fibers, synthetic rubber, organic synthetics, paints and lacquers, rubber and asbestos products, pharmaceuticals, and other chemicals.

TABLE C–13.—UNITED STATES-U.S.S.R.: FOSSIL FUEL REQUIREMENTS, 1950–72

[In trillions of Btu's]

Year	Total fuel		Coal		Gas and oil	
	United States	U.S.S.R.	United States	U.S.S.R.	United States	U.S.S.R.
1950	34,809	7,870	14,657	5,714	20,152	1,708
1951	38,073	8,558	15,074	6,164	22,999	1,897
1952	37,362	9,161	13,270	6,581	24,092	2,106
1953	37,845	9,845	12,774	7,008	25,071	2,339
19..4	36,216	10,847	11,006	7,647	25,210	2,619
1955	40,470	12,431	12,754	8,633	27,716	3,128
1956	43,147	13,389	13,866	9,031	29,281	3,750
1957	43,785	15,047	13,543	9,770	30,242	4,550
1958	41,312	16,209	11,300	10,058	30,012	5,439
1959	43,311	17,372	11,329	10,278	31,982	6,328
1960	44,062	18,447	11,147	10,364	32,915	7,383
1961	45,067	19,531	10,755	10,281	34,312	8,564
1962	47,065	20,820	11,217	10,547	35,848	9,753
1963	49,267	22,678	12,181	10,789	37,086	11,106
1964	51,057	24,428	12,862	11,203	38,195	12,411
1965	52,802	25,920	13,400	11,458	39,402	13,783
1966	55,837	27,811	13,841	11,670	41,996	15,256
1967	58,474	29,384	14,221	11,906	44,253	16,647
1968	60,881	30,498	13,961	11,908	46,920	17,870
1969	63,505	31,928	14,226	12,211	49,279	19,031
1970	67,409	33,200	15,249	12,020	52,160	20,445
1971	67,106	34,953	13,610	12,339	53,496	21,886
1972	69,800	36,892	14,501	12,772	55,299	23,256

TABLE C–14.—UNITED STATES-U.S.S.R.: INDEXES BASED ON GNP/FOSSIL FUEL REQUIREMENT RATIOS, 1950–72

[1967=100]

Year	Total Fuel		Coal		Oil and Gas	
	United States	U.S.S.R.	United States	U.S.S.R.	United States	U.S.S.R.
1950	89.0	134.5	51.3	73.6	116.2	351.5
1951	87.8	130.9	53.9	72.1	110.1	334.9
1952	93.0	129.6	63.6	71.8	108.8	319.8
1953	95.4	127.6	68.7	71.4	108.8	305.0
1954	98.3	124.0	78.7	69.9	106.6	291.4
1955	94.2	118.8	72.4	68.0	103.5	267.9
1956	90.1	119.4	68.0	70.3	100.0	241.8
1957	90.7	112.8	70.9	69.0	98.7	211.4
1958	95.4	112.5	84.8	72.0	99.1	190.1
1959	96.5	110.9	89.7	74.5	98.7	172.8
1960	97.1	109.5	93.2	77.4	98.2	155.0
1961	97.7	110.9	99.0	73.0	96.5	143.3
1962	98.8	107.9	100.4	86.8	97.8	130.6
1963	97.1	99.3	96.2	84.7	98.2	114.9
1964	99.4	100.3	95.9	90.3	100.4	112.1
1965	101.7	101.0	97.5	92.8	103.7	107.6
1966	102.3	100.3	100.0	96.9	102.6	103.7
1967	100.0	100.0	100.0	100.0	100.0	100.0
1968	100.6	102.0	106.2	103.9	98.2	98.9
1969	98.8	100.7	106.9	107.3	96.0	95.9
1970	93.0	104.9	99.4	113.2	90.4	96.5
1971	95.9	104.0	114.8	120.1	96.0	94.2
1972	93.6	101.0	114.0	115.8	97.8	90.7

TABLE C–15.—UNITED STATES-U.S.S.R.: PRODUCTIVITY OF FOSSIL FUELS, 1950–72

[1967=100]

Year	Total fuel		Coal		Gas and oil	
	United States	U.S.S.R.	United States	U.S.S.R.	United States	U.S.S.R.
1950	87.4	79.8	66.0	63.2	103.0	136.7
1951	88.3	80.5	68.2	64.0	101.5	136.9
1952	90.1	82.0	72.8	64.8	99.5	137.2
1953	92.8	83.8	77.9	65.9	100.5	138.6
1954	97.3	84.2	82.0	66.2	104.0	138.8
1955	95.9	80.9	82.4	65.6	102.1	124.7
1956	95.0	84.2	78.9	68.8	102.6	121.7
1957	94.3	83.6	80.3	68.8	100.6	116.8
1958	96.9	87.3	85.0	72.5	101.4	115.7
1959	98.2	89.6	90.6	75.5	101.0	113.9
1960	99.8	92.6	94.2	79.3	101.7	112.1
1961	100.4	95.0	97.3	83.4	101.3	109.4
1962	100.9	96.6	97.7	85.8	101.9	107.4
1963	101.4	96.3	96.6	88.6	103.0	104.5
1964	102.5	97.0	99.1	91.0	103.6	102.9
1965	102.8	98.9	100.7	94.8	103.5	101.9
1966	101.4	99.1	101.2	97.3	101.4	100.8
1967	100.0	100.0	100.0	100.0	100.0	100.0
1968	100.7	102.1	106.3	104.4	99.1	100.0
1969	101.1	102.7	110.5	106.4	98.3	99.6
1970	98.0	104.9	104.3	113.4	96.2	99.2
1971	99.8	105.7	114.2	115.7	96.2	99.3
1972	100.0	105.3	113.9	116.1	96.3	98.9

TABLE C–16.—U.S.S.R.: PROJECTIONS OF FOSSIL FUEL REQUIREMENTS, 1973–90[1]

[In trillions of Btu's]

Year	All fuels	Coal	Oil and gas
1973	38,764	13,022	24,886
1974	40,593	13,186	26,538
1975	42,531	13,347	28,301
1976	44,587	13,506	30,182
1977	46,767	13,666	32,189
1978	49,079	13,825	34,325
1979	51,532	13,986	36,601
1980	54,145	14,150	39,033
1981	56,926	14,317	41,629
1982	59,891	14,489	44,403
1983	63,046	14,665	47,363
1984	66,395	14,844	50,519
1985	69,972	15,027	53,882
1986	73,761	15,211	57,464
1987	77,783	15,397	61,277
1988	82,059	15,585	65,341
1989	86,606	15,775	69,672
1990	91,440	15,967	74,287

[1] Assumes 1968–72 average annual growth rates for U.S.S.R. sectors.

SOVIET CHEMICAL INDUSTRY: A MODERN GROWTH SECTOR

FRANCIS W. RUSHING *

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I. INTRODUCTION

In 1958 the Soviet Union announced the initiation of its Seven Year Plan. Included in this plan was a program for the modernization of the economy. A large portion of this program was devoted to expanding and updating the chemical industry which was to experience a rapid rate of growth in both investment and production. The Soviet leadership hoped through this program to transform the raw material base of industry, bring chemistry to agriculture, and raise the general level of living for the population.

It is the contention of this author that the chemical industry provides a good case study of how plans are formulated and goals are

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implemented in the Soviet economic system. In this chapter we shall discuss the broad objectives of the chemicalization program; how effectively the planners accumulate and allocate the economic resources; what difficulties have arisen, and to what factors the successes and shortcomings can be attributed.

The major divisions of the chemical industry are coke-chemicals, basic chemicals, aniline dyes, synthetic fibers, paints and varnishes, chemical-pharmaceuticals, mineral fertilizers, pesticides and herbicides, petro-chemicals and rubber-asbestos. These headings may be subdivided into a variety of categories. For example, sulfuric acid, caustic soda, calcium soda are considered basic chemicals. The scope of the industry also extends to synthetic detergents, soaps, and cleaning preparations. The Soviets include wood pulp chemistry and hydrolysis of wood cellulose in their definition of chemical production. Data refer to all the chemical industries unless otherwise noted. Unfortunately the Russians do not always make explicit what the chemical industry includes; investment data is sometimes ambiguous.

II. Chemicalization

Following the abandonment of the Sixth Five Year Plan, the Soviet economy operated by utilizing annual and quarterly plans. Khrushchev announced to the Russian people in 1958 the goals which the party had for the next long term plan. One of the most important of his announcements came on May 1, 1958 at a Plenary Session of the Party Central Committee:

Comrades: The Presidium of the Party Central Committee has decided to submit to the plenary session of the Central Committee for discussion measures for accelerating the development of the chemical industry and particularly the production of synthetic materials and finished goods for satisfying public requirements and the needs of the national economy.[1]

In the Seven Year Plan artificial and synthetic fibers, plastics and other synthetic materials were to receive increased emphasis in the industrial sector. Behind these goals was the desire to increase the Soviet standard of living and the need to update the Soviet economy by greater use of synthetics in the consumers and producers goods sectors. The Russians believed that increased chemical production would make possible the substitution of synthetic materials for ferrous and nonferrous metals. With the savings derived from lower production costs the leadership hoped to expand industrial production at a greater speed.[2]

Khrushchev was critical of the status and level of the Russian chemical industry in 1958. He admitted that the Soviet chemical industry lagged significantly behind other advanced countries. Particularly appalling to the Soviet Premier was the level of synthetic rubber production relative to the West. During the 1930's the Soviets had initiated research in the development and production of synthetic rubber but, as Khrushchev said, ". . . the directors of our chemical industry were very late in realizing the need to shift the synthetic rubber industry from food raw materials to economically more advantageous non-food materials."[3]

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[1] Khrushchev's Report on Expanding Chemical Industry," Current Digest of the Soviet Press, Vol. X, No. 19, p. 12 (June 18, 1958).
[2] Ibid.
[3] Ibid.

Khrushchev believed the Soviet chemical industry lagged because of incorrect technical policies, the failure of planning agencies to allocate sufficient capital funds for the development of new chemical branches, the waste of funds allocated to chemical development, the technically inferior (as compared with the West) chemical equipment, and the failure of the research organs to develop synthetic materials and disseminate their technical processes.

Khrushchev explained why the Central Committee stressed the importance of the production of synthetic materials:

> Because, comrades, rapid development of the production of these materials will enable us to create enormous additional raw material resources for increasing the output of consumer goods, and by using this raw material in combination with agricultural raw material, to fully meet the people's need for textiles, clothing and footwear in the next few years. The importance of synthetic materials lies also in the fact that at the present stage of the development of production forces they are a major factor in further technical progress and in considerably increasing the productivity of social labor in all branches of the national economy.[4]

Synthetic fibers were to increase the quantity of fiber available for consumption, and the prices of synthetic fibers were to be less than natural fibers.

Khrushchev's emphasis on the oil and gas industries as a source of raw material for the chemical plants was of notable importance. It was estimated that the use of natural gas rather than coke as a raw material in a nitrogen fertilizer plant with an annual capacity of 700,000 tons would result in a saving in construction of 4,000,000 rubles.[5] Other savings to the economy could be realized by better utilization of by-products and the development of new uses of by-products from oil, gas, coke production, and lumber and woodworking.

The Soviet Party Chairman admitted a serious lag in chemical science in some important fields (especially artificial and synthetic fibers and plastics). Khrushchev explained this as being due to shortcomings in the organization of research and experimental work which reduces the effectiveness with which allocated funds and the efforts of scientists are expended.[6] The chemicalization program called for a marked increase in the quantity of research, better coordination of research projects, more and better research facilities, and a shorter time required to work out and master new techniques of producing and processing synthetic materials.

Khrushchev's chemicalization program became embodied in the Seven Year Plan (1959–1965). The broad goals of the program are outlined in Table 1. In 1963 the goals for chemicals were revised downward, except for chemical equipment. These revisions represented an attempt by the Soviet leadership to make the goals of the plan more realistic in view of the state of world tension, the domestic agricultural crisis, and the economic difficulties which grew out of the chemicalization program itself. Table 1 specifies the goals for chemicals which Khrushchev's successors approved in subsequent plans.

These planned targets are used by the Soviets and others to judge the performance of the chemical industry. Economists, however, are

[4] Ibid., p. 18.
[5] Ibid.
[6] Ibid., p. 22.

also interested in how effectively the Soviets mobilize their resources and how efficiently these resources are applied in an attempt to reach their economic objectives. The main purpose of this chapter is to shed some light on these questions.

Table 2 presents the official output data for 1958–1974. Table 3 shows indexes for the major branches in the chemical industry. The expansion in output for the industry was about a seven-fold increase. The variability of the ratio of growth among the branches ranged from over two and one-half times to over eight times.

TABLE 1.—OUTPUT TARGETS OF THE 7-YR PLAN (1959–65), THE REVISED 7-YR PLAN (1964–65), AND THE 5-YR PLANS (1966–80)

Chemicals	7-yr plan (1959–65)	Revised 7-yr plan (1964–75)	8th 5-yr plan (1966–70)	9th 5-yr plan (1971–75)	10th 5-yr plan (1976–80)
Value of output (billion rubles)	12.7	10.5	24–26	36.3	[1] 60–65
Mineral fertilizer (million tons)	35.0	35.0	70–80	90	143
Plant chemicals (thousand tons)	125.9	NA	450	424	NA
Plastics and resins (thousand tons)	1,648	950	3,500–4,000	3,533	[1] 90–100
Synthetic fibers (thousand tons)	631–664	444	1,350	1,065	1,450–1,500
Automobile tires (units)	28.8	26.4	44	51.2	[1] 35–40

[1] Percent.

Sources: Francis W. Rushing, "An Analysis of the Chemical Industry in the Soviet Union During the Seven Year Plan, 1959–1965," p. 93 (unpublished dissertation). Geoffrey Henry, "The Soviet Chemical Industry," p. 41 (New York: Barnes and Noble Inc., 1971). N. K. Baybakov, "Gosudarstvennyy pyatiletniy plan razviti'ya narodnogo khozyaystva SSSR na 1971–1975 gody," Moscow, 1972. "Pravda," Dec. 15, 1975.

TABLE 2.—PRODUCTION OF MAJOR TYPES OF CHEMICAL OUTPUT, 1958–74

[Units in thousands of metric tons except when indicated]

	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974
Synthetic resin and plastic masses	258	293	312	404	473	589	720	805	971	1,113	1,291	1,453	1,673	1,864	2,042	2,320	2,493
Mineral fertilizer total millions of tons of which:	12.4	12.9	13.9	15.3	17.3	19.9	25.6	31.3	35.9	40.0	43.5	45.9	55.4	61.4	66.1	72.3	80.4
Nitrious (in conversion to sulfate ammonia) (million tons)	4.1	4.4	4.9	5.7	6.9	8.6	10.2	13.2	15.5	18.3	20.4	22.0	26.4	29.5	31.9	35.3	38.3
Phosphorous (in conversion to 18.7 percent P_2O_5) (million tons)	4.7	4.7	4.9	5.0	5.2	5.9	7.5	8.6	9.5	10.0	10.3	11.1	13.4	14.8	15.7	17.3	20.9
Potassium (in conversion to 41.6 percent K_2O) (million tons)	2.4	2.5	2.6	2.8	3.2	3.4	4.6	5.7	6.3	6.9	7.5	7.8	9.8	11.6	13.1	14.2	15.8
Phosphorous meal (in conversion to 19 percent P_2O_5) (million tons)	1.2	1.3	1.5	1.8	1.9	2.0	3.2	3.8	4.4	4.8	5.2	5.1	5.7	5.4	5.3	5.4	5.4
Chemical means of plant protection and pest control	26.6	30.7	35.8	42.4	57.7	61.3	85.3	103.2	114.6	123.1	135.8	157.0	163.8	154.8	173.3	200.5	231.6
Sulfuric acid in monohydric	4,803	5,082	5,398	5,718	6,132	6,885	7,647	8,518	9,367	9,737	10,159	10,665	12,857	12,779	13,685	14,855	16,663
Calcium soda, 95 percent	1,692	1,728	1,887	2,115	2,332	2,545	2,740	2,871	2,963	3,169	3,293	3,462	3,668	3,820	4,052	4,149	4,484
Caustic soda, 92 percent	709	757	765	897	961	1,049	1,153	1,303	1,393	1,524	1,658	1,813	1,938	2,028	2,064	(2,020)	(2,174)
Automobile tires, million units	14.4	15.5	17.2	19.0	20.8	22.6	24.4	26.4	27.7	29.6	31.8	32.6	34.6	36.2	38.8	42.3	47.1
Synthetic detergents	7.9	10.3	22.9	26.6	50.1	55.1	100.5	144.0	189.0	248.0	346.0	417.0	470.0	496.0	533.0	610.0	656.0
Artificial and synthetic fiber	166.0	179.5	211.2	250.4	277.3	308.4	361.1	407.3	458.0	511.0	554.0	584.0	623.0	676.4	746.1	830.0	887.0
Total of which:																	
Artificial fiber	153.3	165.5	196.2	226.8	243.4	265.8	304.3	329.8	362.0	395.0	424.0	441.0	456.4	473.3	507.5	543.0	569.0
From this:																	
Artificial silk	41.8	43.3	47.4	49.7	54.5	63.2	75.5	78.6	82.0	87.0	89.0	91.0	93.1	98.2	105.4	110.0	111.0
Artificial silk for cord	37.9	44.6	53.7	55.2	58.4	68.2	76.7	86.0	99.0	104.0	117.0	127.0	129.0	132.3	140.0	149.0	156.0
Artificial staple fiber	73.6	77.6	95.1	121.9	130.5	134.4	152.0	165.2	181.0	203.0	218.0	223.0	234.3	243.0	262.0	284.0	302.0
Synthetic fiber	12.7	14.0	15.0	23.6	33.9	42.6	56.9	77.5	96.0	116.0	130.0	143.0	166.6	203.0	239.0	287.0	318.0
From this:																	
Synthetic silk	6.2	7.0	6.6	8.7	11.3	12.4	15.9	20.3	22.0	28.0	31.0	36.4	39.5	42.0	47.9	52.0	54.0
Synthetic silk for cord	(2.0)	2.0	2.1	3.7	5.7	7.6	12.0	(17.4)	47.4	57.5	63.0	67.0	75.6	90.3	109.3	124.0	141.0
Synthetic silk for industrial articles	(0.9)	0.8	2.1	2.9	5.6	7.7	11.3	(16.5)									
Synthetic staple fiber	3.6	4.2	4.2	8.3	11.3	14.9	17.7	23.3	26.3	31.0	36.0	39.1	51.5	70.8	81.4	111.0	123.0

NOTE.—Parentheses indicate estimates.

Sources: "Chemical Industry of U.S.S.R." Vestnik statistiki no. 1, 1964, p. 92 and Vestnik statistiki no. 3, 1965, p. 92. "Narodnoye khozyaystvo S.S.S.R. V 1965 godu," Moscow, 1966, pp. 186–192. Nar. Khoz. 1968, pp. 247–253, Nar. khoz. 1969, pp. 210–216. Nar. khoz. 1970, pp. 196–203.

TABLE 3.—INDEXES OF GROSS OUTPUT OF MAJOR BRANCHES OF THE CHEMICAL INDUSTRY

	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974
Chemical industry includiug:	100	111	125	141	162	188	216	245	290	335	[1] 380	424	474	528	580	648	718
Basic chemicals	100	109	124	142	169	201	239	281	308	355	[2] 399	451	551	615	688	767	854
Chemical-pharmaceutical	100	118	137	159	189	223	256	283	307	348	395	452	515	583	649	725	795
Rubber-asbestos	100	112	124	136	151	166	185	201	210	231	[1] 248	267	364	412	462	516	570
Synthetic resin and plastic masses	100	114	129	157	184	229	280	318	376	432	500	563	648	722	791	899	966
Mineral fertilizer	100	104	112	123	139	161	206	252	290	323	351	370	447	495	533	583	648
Chemical means of plant protection and pest control	100	115	135	139	192	231	321	388	431	463	511	590	616	582	652	754	871
Artificial and synthetic fiber	100	108	127	151	165	186	218	245	276	308	344	352	375	407	449	500	534
Sulfuric acid in monohydric	100	106	112	119	128	143	159	177	195	203	212	222	252	266	285	309	347
Calcium soda, 95 percent	100	102	112	125	138	150	162	170	175	187	195	205	217	226	239	245	265
Caustic soda, 92 percent	100	107	108	127	135	148	163	184	196	215	234	356	273	286	291	306	335
Automobile tires	100	108	120	132	145	157	169	183	192	206	221	226	240	251	269	294	327
Synthetic detergents	100	130	289	335	634	[3] 697	1,272	1,823	2,392	3,139	4,380	5,278	5,949	6,278	6,747	7,722	8,303

[1] "Narodnoye khozyaystvo SSSR v 1968 godu," p. 247 (Moscow: 1969), adjusted for shift in base year.
"Narodnoye khozyaystvo," p. 210 (1969) adjusted for shift in base year.
[2] "Vestnik statistiki" No. 1 (1964) gives the value as 853

Source: "Chemical Industry of U.S.S.R." "Vestnik statistiki," No. 1, p. 91 (1964), "Vestnik statistiki," No. 3, p. 89, (1965), "Narodnoye khozyaystvo SSSR v 1965 godu," p. 186 (Moscow, 1966); "Narodnoye khozyaystvo SSSR v 1974 godu," p. 230 (Moscow, 1975).

The planned output goals of the Seven Year Plan and the Eighth Five Year Plan were not achieved. The revised Seven Year Plan had most of the revised sector goals fulfilled from 82 to 100 percent. This is a significantly better record than the one recorded in 1970, the end of the Eighth Five Year Plan. That plan was fulfilled by only 79 percent mineral fertilizer; 48 percent in plastics and resins; 46 percent in synthetic fibers; and 78.6 percent in automobile tires. The Ninth Five Year Plan established goals which were only marginally higher than the projected totals for the Eighth Five-Year Plan. The performance against these constrained goals approached 100 percent achievement levels except for plastics and resins which was only 80 percent. The Tenth Plan appears to reflect the optimism which planners acquired from the achievements of the Ninth Year Plan.

The remainder of this paper will explore the success and failures of the Soviets to design and implement a program of rapid expansion and modernization of this key industry for the period 1958–1975.

III. Capital

Perhaps the best evidence to characterize the dramatic increase in the role of chemistry in the economy is the amount and rate at which the planners allocated investment funds to this industry. Table 4 shows the fixed capital stock estimates for the years 1950–1974. The data show a steady increase in fixed capital stock over the decade of the 1950's, but the growth accelerated in the first half of the 1960's. The rapid growth reflects an increase in gross fixed investment which Table 5 demonstrates. The per annum rate of growth of gross fixed investment from 1959–1964 was 28 percent. The annual average declined about 2.4 percent per annum during 1965, 1966 and 1967. It increased again from 1968–1974 at an annual rate of 9.8 percent.

This tremendous injection of capital by the Soviets was deemed necessary in order to rapidly build new production facilities, expand existing plants, and to finance capital imports. The proportion of capital expenditures spent on enlargement and reconstruction averaged about 50 percent during 1958–1970 with the percentage approximating 55 percent for 1971–1974.[7] New inplace capacity costs 40 to 50 percent less when produced by reconstruction than through new capital construction.

Both new construction and reconstruction of existing plants required large quantities of new chemical equipment to achieve the planned goals. Table 6 shows the ruble value of chemicals equipment produced domestically and imported. The data shows the extent of reliance of chemical output expansion on imported equipment. This reflects both the inadequacies of domestic production for the plans and the desire by the Soviet to upgrade their chemical technology.

[7] Geoffrey Henry, "The Soviet Chemical Industry," p. 73 (New York: Barnes and Noble, Inc., 1971).

TABLE 4.—CHEMICAL FIXED CAPITAL STOCK ESTIMATES, JAN. 1 OF EACH YEAR

[Billions of rubles]

	Stock	Index
1950	1.3	43
1951	1.4	46
1952	1.5	50
1953	1.7	56
1954	N.A	
1955	2.1	70
1956	2.3	76
1957	N.A	
1958	3.0	100
1959	3.8	126
1960	3.9	130
1961	4.6	153
1962	5.2	173
1963	7.2	240
1964	9.1	303
1965	10.7	356
1966	12.5	416
1967	13.7	456
1968	15.7	523
1969	16.3	543
1970	18.1	603
1971	20.7	690
1972	22.8	760
1973	27.6	920
1974	30.6	1020
1975	32.3	1077

Source: Stanley Cohn, "Economic Performance and the Military Burden in the Soviet Union" (Joint Economic Committee, U.S. Congress) p. 188. "Nar Khoz." 1968, pp. 50, 214–215; 1969, pp. 46, 174–175; 1970, pp 61, 166–167; 1971, pp. 60, 152–153; 1972, pp. 60, 188–189; 1973, pp. 57, 236–237; 1974, pp. 55, 198–199.

TABLE 5.—CHEMICAL GROSS FIXED INVESTMENT

[Current prices in millions of rubles]

Year	Current prices	New series	Index
1955	278		61
1956	300		66
1957	296		65
1958	455		100
1959	695		153
1960	890		196
1961	1,063		234
1962	1,164		256
1963	1,466		322
1964	1,948		428
1965		2,171	477
1966		2,091	460
1967		2,047	450
1968		2,155	474
1969		2,369	521
1970		2,415	531
1971		2,483	546
1972		2,759	606
1973		3,121	686
1974		3,490	767

Sources: "Nar. Khoz.", 1961, p. 545; 1962, p. 439; 1963, p. 455; 1964, p. 516; 1965, p. 534; 1970, p. 484; 1974, p. 526.

TABLE 6.—CHEMICAL EQUIPMENT DOMESTICALLY PRODUCED AND IMPORTED

[Millions of rubles]

	Domestic production	Net imports	Total
1958	112	44.0	156.0
1959	173	101.4	274.4
1960	226	163.1	389.1
1961	243	169.9	412.9
1962	266	138.4	404.4
1963	289	192.8	481.8
1964	344	176.1	520.1
1965	386	182.6	568.6
1966	414	203.3	617.3
1967	425	257.5	682.5
1968	443	271.6	714.6
1969	460	222.4	682.4
1970	464	164.8	628.8
1971	528	183.8	711.8
1972	570	313.7	883.7
1973	630[1]	373.2	1,003.2
1974	706[1]	404.3	1,110.3

[1] Estimated to make compatible with series for 1958–72.

Sources: "Nar. Khoz." for relevant years. "Vneshnyaya Torgovlya SSSR" for relevant years.

How effective were the Soviets in planning their chemical investment programs? One series of data which should be investigated is the change in the capital-output ratio over the 1955–1917 period. This ratio is useful because it incorporated capital with other important variables such as the effects of labor productivity through the influence of the quantity and quality of capital on the worker's output.

A. Capital-Output Ratio's in the Chemical Industry [8]

One technique which can be used to estimate the direction of change in the chemical industry's capital-output ratio is to construct indices for output and capital and then to lag the output indices. The indices are official Soviet statistics except in those cases in which it was necessary for the author to interpolate or extrapolate.

There are several caveats which should be noted with respect to the data. Output is measured in constant 1955 prices, and is biased upward because of a significant number of new chemical products which were introduced since 1955. Another problem is that the Soviets revised their industrial classification system in 1965. Some of the changes in the output index after 1966 simply reflect this classification revision.

Table 7 indicates that output per unit of capital inputs has been declining in the Soviet chemical industry. The average capital-output ratio goes up between 1958–1965 but does so unevenly. The ratio declines from 1965 to 1970 then begins to drift upward again. If we lag the output data, the patterns are similar but the peak and trough years vary.

[8] This section is based on an article by this author entitled "Growth, Capital-Output Ratios, and the Soviet Chemical Industry" in Economica Internazionale, Vol. XXV, N. 4, pp. 731–743, November 1972.

TABLE 7.—INDICES OF AVERAGE CAPITAL-OUTPUT RATIO FOR SOVIET CHEMICAL INDUSTRY, 1955–74

Year	Capital stock index (K)	Output index (O)	K/O	K/O 1 yr lag	K/O 2-yr lag
1955	70.0	69.5	100.7		
1956	76.7	78.8	97.3	88.8	
1957	90.0	88.6	101.6	86.6	79.0
1958	100.0	100.0	100.0	90.0	76.7
1959	126.7	111.0	114.1	90.1	81.1
1960	130.0	125.0	104.0	101.4	80.0
1961	153.3	141.0	108.7	92.2	89.9
1962	173.3	162.0	107.0	94.6	80.2
1963	240.0	188.0	127.7	92.2	81.5
1964	303.3	216.0	140.4	111.1	80.2
1965	356.7	245.0	145.6	123.8	98.0
1966	416.7	290.0	143.7	123.0	104.6
1967	456.7	325.0	140.5	128.2	109.8
1968	523.3	380.0	137.7	120.2	109.7
1969	543.3	424.0	128.1	123.4	107.7
1970	603.3	474.0	127.3	114.6	110.4
1971	690.0	528.0	130.6	114.3	102.9
1972	760.0	580.0	131.0	119.0	104.0
1973	920.0	648.0	142.0	117.3	106.5
1974	1,020.0	718.0	142.1	128.1	105.8

Sources: Tables 3, 4, and 9.

The Soviet press has reported data which tends to verify the findings of this table. For example, L. Kostandov in Ekonomicheskaya gazeta, December 1965, reported that in 1960 1.1 rubles of gross output was derived per ruble of fixed assets in the chemical industry while in 1965 the value was only 0.93 rubles.[9] Soviet and Western scholars, although differing on the specific measures, agree that the Soviet capital-output ratio is rising for the economy, for industry, and for chemicals.

B. Factors Causing a Rising Capital-Output Ratio in the Chemical Industry

The Soviet chemical construction program has been plagued with numerous problems at each stage of construction. These problems which are reported in the literature seem to be the rule rather than the exception. Their principal effect has been to lengthen the construction time and to raise costs beyond the planners' original estimates and allocations.

One of the problems with which the construction trust must deal is obtaining a clear design for the plant and equipment. The regional design bureaus produce poor initial designs and have to alter them frequently. In the case of the Balokavo Artificial Fiber Combine, for example, it was discovered that the nitriloacrylic acid facility had its design changed and refined 72 times. In the design of this combine the Giprokhim Design Institute "forgot" to include a heating system for a shop and adopted an inadequate ventilation system for the acid station.[10]

The problem of poor design for plants can be attributed partially to the lack of specialization of design organizations. These organizations must spread their efforts over many types of projects, and many different organizations play a role in a single plan. The result is that

[9] L. Kostandov, "Gains and Setbacks in the Expansion of the Chemical Industry." Ekonomicheskaya gazeta, No. 48, pp. 11–12 (December 1965).

[10] N. Komarov, "Financing of Chemical Industry Construction Projects," Finansy SSSR, No. 2, pp. 8–11 (1964).

the responsibility for the plan becomes lost in the maze of bureaucracy.[11]

The construction of chemical projects has to contend with the problem of quantity, quality, and timing of the supply of equipment and materials. This situation exists in other industries, but it is particularly acute in chemical construction because the Soviet chemical machine-building industry itself is undergoing expansion and technological upgrading.

It has not been uncommon for a chemical enterprise to have designated as its supplier of equipment a chemical machine-building plant which has not been completed. Existing chemical machine-building facilities are not utilized to capacity and the plans for production, as for construction of new capacity, go unfulfilled.

Chemical equipment has been in short supply, and the equipment which has been available has not always been allocated to provide maximum production. The Soviet chemical enterprises, like other industrial enterprises, attempt to maximize their productive capacity and minimize their planned output. Enterprises order equipment for which they have no need and sometimes for which, either due to improper design or lag in construction, they have no place to install. In January, 1964, there were 1,874,000 rubles worth of unutilized equipment in the chemical and pharmaceutical plants, 268,000 rubles worth of which was not usable at all. Almost the same amount of unutilized equipment was imported.[12]

The estimated expenses of many construction projects rose during the plans for 1959–1974. In many instances, planned capital investment proved insufficient to complete the construction of a plant or combine, and projects scheduled for completion fell into the category of "carry over" projects. In 1964, alone, while there were no changes in composition or capacities of production lines, estimated expense of 46 construction projects rose by 663,500,000 rubles or 24.4 percent of the total estimated cost. In some instances, this rise was substantially higher, as for example, 35 percent at the Svetlogorst Artificial Fiber Plant, 90 percent at Rozdol Sulfur Combine, 40 percent at the Apatite Combine, and the 57.6 percent at the Moscow Coke and Gas Plant.[13]

Poor plant designs and lack of planning and coordination of equipment and material supplies for construction have resulted in extending the construction period as well as raising cost of construction. Construction of chemical plants lags 2 to 5 years behind planned completion dates. Thus investment funds are committed, and yet there are unreasonable delays in the initiation of production or in achieving full production. This is reflected in the capital-output data by a sluggish denominator. According to a survey on the construction of 29 new, large-scale chemical and machine-building enterprises, the planned construction time exceeded the norms by up to 50 percent in 13 projects, for 50 to 75 percent in 6 projects, and by more than 75 percent in 10 projects. There was not a single project which did not exceed the standard construction period for the enterprise of that type.[14]

[11] L. A. Kostandov, "The Fourth Year of the Ninth Five-Year Plan," Khimicheskaya promyshlennost', No. 6, pp. 3–6 (1974).

[12] "Expenditures for Unnecessary New Equipment Criticized," Moskovskaii pravda, p. 2 (Apr. 7, 1964).

[13] "To Be Completed, Not Carried Over," Current Digest of Soviet Press, Vol. XVII, No. 2, p. 34 (Feb. 3, 1965).

[14] Ia. Kvasha and V. Krasovskii, "Capital Construction and Accumulation," Problems of Economics, Vol. 8, No. 7, p. 17 (November 1965).

The necessity for the frequent revision of estimates has broad ramifications in a planned system. For instance, the sum of the "shortcomings" (difference between the normal and correct estimate of cost of construction projects) is an amount in excess of the planned volume of capital investment. In an economy which depends on material balances for consistency of plan it is not possible to appropriately cope with the planning task if the stated estimates of construction deviate substantially for the real cost of construction.[15]

The rising capital-output ratio also reflects the increase in the prices of machinery. New equipment enters into the cost accounting at prices higher relative to the prices of existing equipment. The effect of this is upward pressure on the chemical capital-output ratio since a large variety of new chemical equipment was introduced into production in the post-1958 period. The upward bias may be neutralized or completely offset by the relatively higher prices for new chemical final products. Unfortunately we cannot estimate the net effect.

The increased number of chemical plants which were constructed in the Eastern regions (Siberia and Central Asia) has affected the capital-output ratio. These projects, although only about 15 percent of the total chemicals construction program, requires larger investment outlays because of higher wages, cost variation due to climatic conditions, and greater non-productive or social overhead capital cost. Construction cost for industrial enterprises are about 15–20 percent higher in the Eastern region according to the RSFSR State Planning Committee estimates.[16]

It is possible to relate the rising costs of construction, the lengthening period of construction, and the delayed initiation of production to the scale of plant. One study integrates these variables to show that as the scale of plant rises, after a point, a rise in the capital-output ratio results. This rise may be temporary if the economies of scale are realized after the plant is put into operation. The more sophisticated the technology and organization of production, the longer the period required for training of labor. The Soviet planners have not devised effective methods of determining a long term optimum scale of plant. It might be stated that an enterprise in which the indices of output per worker falls over time and the capital-output ratio rises that the optimum size has been exceeded.[17]

There is some evidence that Soviet planners have hastily incorporated new technology into chemical plants under construction before the processes have been sufficiently tested and refined for elimination of problems. This has slowed construction of plants and lengthened the time necessary for full utilization of the production processes. A related problem has been the determining of the appropriate mix of new, standard, and obsolete equipment. The difficulty of designing the optimum equipment mix for an existing and/or proposed plant results from a deficiency of analytical tools. What economic criteria

[15] Ia B. Kvasha, "Capital Intensity," Problems of Economics, Vol. 9, No. 9, p. 72 (January 1967).
[16] T. Khachaturov, "Raising Investment Efficiency, and the Scientific Grounds for its Determinations," Problems of Economics, Vol. IX, No. 7, p. 6 (November 1966).
[17] L. Berri and I. Shilin, "Economic Efficiency of the Concentration of Production in Industry," Problems of Economics, Vol. 8, No. 10, pp. 41, 46 (February 1966).

should be used? What time frame should be employed? What output levels should be projected? Optimalization requires more than intuitive methods. The recoupment period analysis seems to be only a rule of thumb approach.

One feature of the changing economic condition in the Soviet Union which might produce a permanent rising trend in the capital-output ratio is that of a labor-shortage. The Soviet Union has approached, or perhaps even passed, the point at which it can rely on surplus agricultural labor and rising participation rate to assist in expanding industrial production. When these sources are exhausted the growth of output is dependent on increased productivity or increased hours per man per year. Under such conditions the widening of the capital structure gives way to a deepening. This deepening requires an increase in the amount of capital per worker. Table 8 shows that the capital-labor ratio rose throughout the period under investigation. Even though this will generally increase the capital-output ratio, this tendency can be offset by more effective use of the capital by labor. It seems appropriate to note that technical innovation may be capital-saving as well as labor-saving. Kendrick and Sato showed the capital-output ratio decreased in the U.S. economy from 4.58 in 1919 to 2.62 in 1960.[18] Automation and mechanization have been capital-saving as well as labor-saving, but much more has been made of the labor-saving aspect because it has been relatively greater than capital-saving.

Faced with lengthening periods of getting new capital into production, the Soviets elected to slow its rate of capital formation in the late sixties and shift to a greater reliance on updating and reconstruction of older facilities. Their expectation, partially met, was to reduce the cost of expanding and raising the technical level of production.

TABLE 8.—CAPITAL-LABOR RATIOS IN THE SOVIET CHEMICAL INDUSTRY, 1955–74

Year	K/L rubles of capital per wage worker	Index
1955	4,600	77
1956	4,900	82
1957	5,400	90
1958	6,000	100
1959	7,200	120
1960	6,800	113
1961	7,400	123
1962	7,400	123
1963	9,000	150
1964	10,500	175
1965	11,400	190
1966	12,500	208
1967	11,900	198
1968	13,300	222
1969	13,400	223
1970	14,300	238
1971	16,376	273
1972	17,221	287
1973	20,324	339
1974	22,014	367

Sources: Tables 4 and 9.

In general, the rise in the capital-output ratio was most influenced by the failure of planners and managers to employ capital to the extent

[18] John W. Kendrick and Ryuzo Sato. "Factor Prices, Productivity, and Economic Growth," American Economic Review, Vol. 53, p. 999 (December 1963).

of its potential. More specific influences on the capital-output ratio were the increase in costs associated with investing in the eastern regions, use of relatively high price "new" equipment, changes in the product and process mix, and a deepening of the capital structure within the industry.

IV. Labor

Employment in the chemical industry is recorded in Table 9 for 1955–1974. This series of data only covers wage-workers employed during this period. Total employment was published for 1963 when the Soviets revealed there were 986,000 industrial-production personnel in the industry. The table notes both the wageworkers for the old definition of the chemical industry and the new definition for 1965 and 1966. Data for 1967–1974 presumably correspond to the new definition. The index for the series is also included on Table 9. Data for wageworkers in the chemical industry are used to represent the trend in total labor inputs. The bias this sample would have would be to understate labor inputs after 1958 and slightly overstate them prior to that year. In other words, wageworkers increased as a percentage of total chemical labor prior to 1958 and began decreasing after that, although not rapidly. The decline of the percent of wageworkers was a function of a need for more managerial and technical labor to direct and operate the more sophisticated capital.

The number of wage workers rose by 896,000 from 1958 to 1974, or roughly two and three-fourth times. Besides the rapid increase in numbers, the percentage of engineers and technicians in the total chemical labor force increased from 14 to 18.6 percent from 1955 to 1965.[19] Scattered evidence indicates it exceeded 20 percent in 1974. Other evidence of the improving quality of chemical manpower would be the number of chemical technology graduates from secondary and higher educational institutions. Table 10 provides these data.

TABLE 9.—WAGE WORKERS IN THE SOVIET CHEMICAL INDUSTRY, 1955-74

Year	Wage workers annual average in thousands		Index	
	Current	New series	Old	New
1955	452		91	
1956	469		95	
1957	478		97	
1958	494		100	
1959	521		105	
1960	584		118	
1961	621		125	
1962	705		143	
1963	800		162	
1964	870		176	
1965	935	1,017	201	206
1966	991	1,085		220
1967		1,148		232
1968		1,178		238
1969		1,218		247
1970		1,264		256
1971		1,302		264
1972		1,324		268
1973		1,358		275
1974		1,390		281

Sources: "Trud v SSSR," 1968, pp. 86–89. "Nar. Khoz.," v 1967, p. 207; v. 1969, p. 167; v 1970, p. 158. James Noren, "Soviet Industry Trends in Output, Inputs, and Productivity," New Directions in the Soviet Economy, (U.S. Congress, Joint Economic Committee) p. 309. Murray Feshbach and Stephen Rapawy, "Labor Constraints in the 5-Year Plan," Soviet Economic Prospects for the Seventies (Joint Economic Committee, U.S. Congress, 1973) p. 511. "Nar. Khoz.," v 1972, p. 181 ;v 1974, p. 189.

[19] Henry, op. cit., p. 134.

TABLE 10.—GRADUATION OF SPECIALISTS IN CHEMICAL FROM U.S.S.R. HIGHER EDUCATION INSTITUTIONS, 1958–74

[In thousands]

Year	Higher educational institutions	Secondary specialized education institution	Total
1958	5.6	10.6	16.2
1959	5.4	9.1	14.5
1960	5.7	7.0	12.7
1961	5.6	6.9	12.5
1962	6.0	7.6	13.6
1963	6.8	11.6	18.4
1964	7.5	12.0	19.5
1965	10.1	13.4	23.5
1966	10.4	14.7	25.1
1967	12.6	17.4	30.0
1968	12.2	19.9	32.1
1969	13.7	27.2	40.9
1970	16.1	23.3	39.4
1971	18.3	23.8	41.6
1972	18.5	20.8	42.3
1973	17.3	20.2	37.5
1974	16.5	19.1	35.6

SOURCES

Francis W. Rushing, "An Analysis of the Chemical Industry in the Soviet Union During the 7-Year Plan, 1969–65," (Unpublished dissertation) p. 211 and 213.
"Nar. Khoz.," 1968, pp. 689, 690.
"Nar. Khoz.," 1969, pp. 685–686.
"Nar. Khoz.," 1970, pp. 646–647.
"Nar. Khoz.," 1922–72, pp. 442–443.
"Nar. Khoz.," 1972, pp. 646–647.
"Nar. Khoz.," 1974, pp. 646–647.

The data for secondary and higher educational institutions show differences in changes over time, most particularly between 1958 and 1961. Graduates from higher educational institutions were reasonably constant while secondary institute graduates declined. These trends are reflected in the total of the two. The reason for the decline in the total supply of chemical engineering specialists between 1958 and 1961 was due to the educational reforms which were implemented. The reforms emphasized actual job training and work at the enterprise so that the formal programs were extended. This effect was short-lived since the total number of chemical technology specialists increased almost so that the formal programs were extended. This effect was short-lived since the total number of chemical technology specialists increased almost three times during 1962–1970. However, the total declines after 1972 which is puzzling in view of the continued high priority afforded the chemical industry.

Table 11 presents an index of output per wageworker for the chemical industry for 1955–1974. These data show a two and one-half increase in output per wageworker between 1958 and 1974—not a particularly good achievement in view of the increase in chemical production. There are several factors which might explain this occurrence. The chemicalization planners failed to train new chemical workers in advance of the opening of the plant facilities. Training after production is begun results in delays in achieving planned output levels. Plant managers feel that the industry's administrators have failed to utilize properly plant schools to increase the quality of their employees. They complain that plants which do have such schools are so widely dispersed that many chemical workers do not have access to

them. Enterprises have requested an expansion of such programs, but higher officials have been unable or unwilling to expand these programs to any great extent.

The shortage of manpower, and especially skilled manpower, is acute in less populated and less attractive regions outside the major centers in western Russia. For example, one plant manager in the North Caucasus region complained that the number of trainees from the Nevinnomyssk Chemico-Mechanical Tekhnikum was insufficient, but there is a lack of facilities to expand their numbers. The solution which one director desires is for his enterprise to establish its own technical school. Such a school could also supply cadres for other firms in the Caucasus regions.[20]

TABLE 11.—INDEX OF OUTPUT PER WORKER FOR CHEMICAL INDUSTRY, 1955–74

Year	Output
1955	72.85
1956	82.77
1957	92.48
1958	100.00
1959	105.11
1960	113.53
1961	119.69
1962	121.08
1963	123.85
1964	130.83
1965	138.11
1966	154.26
1967	153.81
1968	170.02
1969	183.07
1970	185.15
1971	200.00
1972	216.41
1973	235.64
1974	255.52

Sources: Tables 3 and 9.

The Russians have had a fascination for practicality in education and have frequently taught the application of known techniques rather than training students to research and produce new techniques. Personnel trained in such a manner may be among the technologically unemployed within a few years or they may assert an influence to protect their jobs and status by slowing down the rate of technological change which could then slow the advance of USSR's chemical industry. The Russians have shown, through their comments in numerous publications, that they are aware of this possibility, but find it difficult to overcome the inertia which exists in training engineers.

The era of a rapidly expanding labor force through the induction of farm workers is drawing to an end for several reasons. First, since the crisis in agriculture has grown to such proportions, all labor resources employed in this sector will probably be retained while larger quantities of machinery and fertilizer are added. Secondly, the transferring of collective farms to state farms appears to have been arrested, if only temporarily. The reconstruction of the agricultural sector in the past had released workers since fewer were needed on state farms than on collectives. Thirdly, even if these agricultural workers were

[20] Joint Publications Research Service, No. 23,300, p. 25 (Utilizing Chemical Equipment More Completely at Nevinnimyssk," Trud, p. 2, Nov. 23, 1963).

released they would, in most cases, have to undergo extensive training before they could comprehend and contend with the new chemical technologies.

The cream of the engineers and specialists who are available to the chemical enterprises are usually attracted by research jobs which are generally divorced from production activity. Such a condition at the production level increases the probability of underutilization of equipment. Those engineers remaining at the production level are less likely to be aware of possible innovations. More and better trained technicians would probably compensate for the cost of their education by the increase in chemical output.

The high mobility of the skilled labor force can be attributed to their relative scarcity. The desire by workers to avoid the less pleasant aspects of working in eastern regions is also high on the list of causes of labor turnover. One report states that in one month (July) 544 persons, or approximately 37 percent, left a chemical trust in Kazakhstan. Their primary reason was lack of support facilities.[21] At the Sumgait chemical complex during the first ten months of 1963, 890 new employees were hired, while over the same period 700 received discharges.[22] The result was a net gain of 190 workers. Such a turnover affects the gross production and labor productivity of the enterprise.

Another contributing factor to high rates of turnover is the practice of "robbing." Such a practice occurs when construction of an enterprise is nearing an end, and the plant manager is seeking a production crew. The new manager reasons that the best crew to fulfill his production goals consist of persons currently employed by other chemical enterprises. Thus, he or his representative scouts other plants and makes offers for employment. New plants which can offer the best working conditions and the highest pay are the most successful. The enterprises which lose workers are thrown into the scramble to replace them or they hope for government assigned personnel to fill the vacancies.

A salary-bonus system replaced the piecework system in the chemical industry during the first half of the 1960's because the old system was no longer appropriate for the more technologically advanced industry. The chemical industry continued, however, to lose workers to such industries as the construction and machine-building because of pay differentials within the Soviet economy. The new salary-bonus system had its drawbacks in implementation rather than by design. Bonuses were established for qualitative indexes (savings of raw materials, increase in output of acceptable products, etc.) as well as the more predominant quantitative fulfillment and overfulfillment of plan.[23] In practice many enterprises paid bonuses mainly for quantitative achievement while they inadequately rewarded the qualitative improvements. This condition existed partially because it was easier to measure quantitative achievements than qualitative and past experience proved to most plant officials quantity goals were closely watched by their supervisors. Sometimes bonuses were paid even when one or

[21] Joint Publications Research Service, No. 21,900, p. 14 ("Developing Chemical Industry in Kazakhstan," M. Savel and A. Viser, Kazakhstanskaya Pravda, p. Nov. 19, 1963).
[22] Joint Publication Research Service, No. 21,900, p. 14 ("Developing Chemical Industry of Sumgait," V. Muradian, Bakinskiy raboeniy, p. 2, Nov. 20, 1963).
[23] Joint Publication Research Service, No. 23,300, p. 84, February 1964 ("Material Incentives in the Chemical Industry," I. Pushkov and L. Kunolskiy, Ekonomicheskaya gazeta, No. 47, Nov. 23, 1963).

more of the contingent indexes were not fulfilled, while in other cases bonuses were not justified at all. This misuse of the bonus reduces its ability to stimulate workers for higher productivity, but instead becomes a conveyor for increases in wages.

The utilization of capital in place is a prerequisite to high output per employee. The chemical enterprise, like many other Russian production units, has underutilized its equipment for a variety of reasons. One of the most typical reasons for underutilized capital in place is the shortage of raw and intermediate material inputs.[24]

The chemicalization program was designed to expand the production of chemical raw materials and final products. The size of the program undoubtedly caused problems of coordination. Soviet planners discovered that lags in the construction program or the expansion of production at any level causes feedbacks which reduce efficiency of operations. The most detrimental case is for supplier plants to lag behind the completion of plants utilizing their output. Capital lying unutilized in a plant causes great anxiety among Soviet economists, managers, and planners.

Materials of poor quality supplied to producers can cause disruption of only slightly less proportion than no supply at all. Inputs with impurities or not of the required specification are a larger waste than if the products had not been produced. Higher levels of specification accuracy is a requirement for the sophisticated production of the chemical industry. Quality production must be required at all levels and in all industries. The Soviet incentive system failed to insure this.

The maximum utilization of equipment requires the minimum number of repairs and the shortest possible repair time. The shortage of chemical machine building capacity has resulted in a shortage not only of new equipment but also of spare parts. Equipment which was taken out of production for repairs was idle for several weeks while spare parts were obtained. If spare parts were not available from chemical machine building plants then parts had to be built by the enterprises in need of them.[25] This state of affairs has a double negative effect. First, construction of spare parts requires a longer delay in returning the equipment to the production line. Secondly, enterprises have to remove men from the assembly line to put them in the repair shop.[26]

The solution to any one of these problems associated with utilization of productive capacity and manpower cannot be sought in isolation. The interdependency of the industrialized Soviet economy necessitates changes in many areas to facilitate an improvement in any one area of crisis.

V. Factor Productivity

The effectiveness of the Soviets in expanding output can only be judged after considering the combined factor inputs and output. Table 12 shows the index of combined factor productivity. The index is calculated using the Cobb-Douglas production function with a factor co-

[24] Ye. G. Ostroumova, "Improving Capacity Utilization—One of the Fundamental Factors in Raising the Effectiveness of Chemical Production," Khimicheskoya promyshlennost', No. 10, pp. 791–794 (1975).

[25] Joint Publication Research Service, No. 24,407, p. 19, June 1964, ("Poor Raw Materials, Machines, and Equipment Cut Chemical Fiber Output," Ekonomicheskava gazeta, No. 11, p. 15 (Mar. 14, 1964)).

[26] Joint Publication Research Service, No. 24,407, p. 15, June 1964 ("Expansion Problems of Rustavi Fertilizer Plant," A. Bergarershvili, Zarya vestaka, p. 2 (Feb. 18, 1964)).

efficient of 0.46 for labor and 0.54 for capital (See appendix 1 for methodology).

The index shows little improvement in combined factor productivity between 1958–1962. The index actually declines after then until 1965, when it moves gradually upward until 1968, before making appreciable gains in 1969–1974. The explanation for such a pattern is that the initial rapid growth in the chemical industry resulted from the application of capital labor inputs rather than through productivity increases.

During the 1958–1965 period the evidence indicates the principle causes for the decline in capital productivity was the underutilized or unfinished capital capacity. The Soviet planners took steps in 1965 to reduce the value of unfinished chemical construction and increased their efforts to expand output by reconstructing older plants as compared to new construction. The labor force and investment funds were concentrated on projects which were nearest to completion. The number of projects scheduled for construction was reduced. These decisions were supposed to lower the number of incomplete construction projects by about 30 percent. The capital-output ratio was also improved by the reduction in investment funds going into chemicals. The effect of these changes is indicated in the rise in the index of factor productivity during 1969–1974.

TABLE 12.—*Index of combined factor productivity for the chemical industry, 1958–1974*

1958	100.0
1959	95.5
1960	100.5
1961	101.0
1962	102.1
1963	93.9
1964	91.5
1965	88.4
1966	93.4
1967	97.2
1968	104.3
1969	112.2
1970	116.5
1971	119.0
1972	123.3
1973	122.8
1974	127.4

Sources: Tables 3, 4, and 9.

The labor applied to chemical production during the early years of chemicalization was generally not educated or trained in the chemical processes. It took time to build a reservoir of personnel who had the capabilities to enhance productivitv. New capital in inexperienced hands was slow to reach capacity. The lack of trained personnel resulted from the failure of the planners to anticipate and provide the necessary prerequisites for a rapid expansion of this industry. Labor bottlenecks appeared which took time to correct. In general, however, labor productivity probably helped offset the decline in capital productivity during most of the sixties.

In an earlier study by this author [27] an attempt was made to identify

[27] Francis W. Rushing and Carlisle Moody, Jr., Technological Change in the Soviet Chemical Industry, Stanford Research Institute SSC–TN–2625–8 (February 1975).

the principal contributing factors to the growth in the chemical industry between 1955 and 1970. Over that period real value added grew at the very high average rate of 11.87 percent per year, while capital stock increased over 15 percentage points annually and man hours slightly over 5 percentage points. According to this analysis the weighted growth of capital stock accounted for approximately 70 percent of the observed average annual growth rate of output and labor accounted for about 20 percent. Total factor input, therefore, accounted for approximately 90 percent of the observed average growth of output. The remaining 10 percent can be attributed, in part, to technical progress. When the labor input is converted to man-years the unexplained residual falls to about 7 percent.

In the United States during 1950–1964 about 20 percent of the growth in real output was attributable to technical progress as compared to the U.S.S.R.'s 6–10 percent for 1955–1970. The comparative annual rates of growth of factor productivity for these selected periods was 1.03 for the United States and 0.72 for the U.S.S.R.

VI. Chemicalization and Planning: Some Concluding Observations

The chemicalization program in the Soviet Union has succeeded in rapidly increasing the output of the chemical industry. This success can be attributed to the application of large amounts of new capital and labor to this sector. Chemicalization appears to be an application of the basic Soviet economic model to a particular industry. However one unique aspect of the program is a reliance on foreign capital and technology. Even though foreign capital has been actively imported for the economy in general on a large scale in recent years, the chemical industry's expansion has relied on foreign capital from its inception in 1958.

Khrushchev announced the program with the promise that (a) it would increase consumer related chemical products and (b) it would serve as the key to the modernization of all of Soviet industry. An examination of the production data and the planned targets would lead one to conclude that consumer related chemical products have experienced greater underfulfillment than goods related to heavy industry. This would parallel what one witnesses in the economy as a whole where there is generally less stress on consumer goods than on heavy industry. Whether chemicalization can serve as a model for modernization of the rest of the economy is a more difficult question to analyze.

The chemicalization program has increased the quantity and quality of chemical products in the Soviet economy. The expansion of output has been rapid but not particularly efficient. The highest rates of growth parallel the period of most rapid application of resources and lowest productivity—1958–1965. An attempt to cut back on investment to stimulate efficiency only resulted in a decline in the rate of growth of output. Capital appears to have been the least efficiently applied resource throughout the chemicalization program. Labor's contribution to output, although undoubtedly not maximized, was considerable particularly when it is noted that the work week was reduced from 46.4 hours in 1955 to 40.7 hours in 1971.

Chemicalization more than any other single program since the death of Stalin has revealed the inadequacies of traditional Soviet planning and decisionmaking in an environment of rapid change in a high technology industry. The chemicalization program, involved chain linked construction projects and required detailed planning and effective management. The priority status of chemicalization meant that each new construction project, every new production line, every new product, and new chemical research and development caused the planners' task to become greater and more complex, requiring more precision. For each new chemical plant, planners had to provide suppliers of its inputs and consumers for its output. Each new product placed in production meant a reconstitution of the distribution of the old supply channels. Development of a new industry causes a redirecting of investment. Since the bureaucracy itself was a part of the economic structure which was being altered, there was inertia to overcome, and, consequently, new and better controls had to be established.

The failure of the early large chemical investment program to enable fulfillment of planned production levels was to some extent the result of the confused state of the chemical construction program. The plant designs were poor; the engineers and workers were inexperienced or improperly motivated; the program was poorly coordinated by the bureaucracy; chemical equipment was in short supply; and the technology was outdated. The chemical construction program was too large to be efficiently carried out. Projects were begun which were completed only after extended delays. Although a large part of the blame for the rising capital-output ratio rested with the inefficiency in capital construction, other contributing factors were the change in the product mix which resulted in greater capital intensity, and the decline, at least temporarily, in the returns from this new capital because of the unfamiliarity of labor with the technology and the production processes. The rise in the capital-output ratio may be permanently reversed as labor adapts to the new technology. At present, however, the most significant influence on the trend of the capital-output ratio has been a broader adoption of the "critical path" techniques in construction and a narrowing of the construction program to a manageable size in order to reduce the number of unfinished construction projects.

Factor productivity analysis identifies similar reasons for the problems the Soviets have found in the chemicalization program. The causes for the decline in composite factor productivity in the 1960s are many. The most significant are the difficulties ascribed to growing pains—such as the learning process and the inability of the Soviet planning and industrial organizations to effectively absorb the rapid application of new labor and capital, particularly the latter. The improvement in factor productivity in the first half of the seventies reflects improved human capital in the industry and the positive influence on productivity resulting from the slowed pace of investment in the late 1960s. There is still potential for greater labor productivity through the reduction of the 20 percent of chemical labor currently utilized in repairs and maintenance. This will probably have to await the application of better and thus more reliable equipment from the chemical equipment industry or from abroad. Greater capital productivity will rely on the effectiveness of the Soviet chemical

R. & D. programs to generate new production processes and products, on the capabilities of the economy to continue to import foreign technology, and on the ability of the Russians to use their capital resources effectively.

The Soviet leadership has placed great emphasis upon scientific research and development as a dynamic factor in the socialist economy since 1958. The leadership, however, has continuously criticized the managers and scientific workers because of their failure to meet the performance specifications. There were about 40 primary chemical research institutes by the end of 1965, almost double the number which existed at the beginning of the plan. Basic research made some remarkable accomplishments, but applied research and development were hamstrung by poor organization, improper incentives, and ineffective administration. The progress in automation was and remains spotty in the Soviet chemical industry. A number of pilot plants was established but the technology of automation was not widely disseminated. Automation was limited to primary production processes almost to the total exclusion of auxiliary jobs, which in the Soviet chemical industry includes a large percentage of the total workers as noted above. Mechanization of chemical production facilities is more extensive than automation, but the pace of mechanization of this industry depends upon an acceleration in the production of chemical equipment.

Foreign technology has been an integral part of the Soviet chemicalization program. Entire chemical plants were being imported by 1960 and the foreign chemical equipment has been a principle component of the modernization plans for the industry. Western engineers and managers have provided training for Soviet workers. Reliance on the West for equipment and technical know-how was a function of the Soviet desire for rapid updating of the chemical industry and a realization of their own limitation to generate technical progress—a realization that was expanded economywide by 1970. Since then the Soviets have carefully allocated their hard currency. Any significant reduction of chemical equipment imports could have important effects on the growth and efficiency of the chemical industry. The most modern components of the chemical industry operate with imported equipment and rely on foreign supplies for replacements and parts. Since foreign equipment is an important source of technical progress, a reduction of imports have far-reaching effects on the industry in the future.

Chemicalization was both a victim and a partial cause of the problems in Soviet economic planning. This ambitious program has been thwarted on many fronts by the complacency and the inefficiency which creep into bureaucratic economic management. On the other hand, chemicalization was of sufficiently large magnitude that it placed the heaviest pressure on the weakest elements of the Soviet planned economy: namely the poor allocation of skilled manpower and technically advanced equipment, the poor organization of production management, and the lack of proper economic incentives at all echelons.

Production associations were introduced into the chemical industry during the Ninth Five Year Plan in hopes of resolving the planning problems. They were designed to raise the effectiveness of production and lower the cost of administration. Seventy-two production associ-

ations and ten scientific-production associations were established. At the same time the number of independent enterprises was reduced by 27 percent.[28] Yet the complaints of ineffective plannning persist. It is not yet possible to make a quantitative assessment of the impact of the associations on chemical production and productivity, yet the signs indicate that associations by themselves will not provide the solution to the planning and management problems described above.

The future success of chemicalization will rely upon the ability of the Soviets to increase efficiency. The seemingly endless capital and labor resources are pressing against their limits. Thus, to maintain high growth rates requires an expansion of output with few additional inputs. A more deliberate pace of development will probably permit a greater balance between efficiency and rates of growth and will give the planners time to analyze and deal with the economic problems. The long term effect may be a growth rate below historical levels, but one which would be sustainable.

The rate of growth of the chemical industry in the latter years of the 1970s will reflect the fruits of the learning process and the completion of long delayed construction projects. New technologies which offer expanded production and increases in output per worker are currently lying dormant. Basic research with its promise of new products and applications await an effective organizational vehicle to transmit them to the production line. Equipment shortages and idle plant capacity should be diminished as the production of Soviet chemical equipment is expanded and foreign technologies are adopted and improved. Yet, even though the future of the Soviet chemical industry holds great promise, the fulfillment of this promise depends to an appreciable extent upon a solution to the problems of Soviet planning—a solution not easily achieved.

Appendix I

The index formula used to aggregate inputs was derived from the Cobb-Doublas production function in its geometric form

$$P_t = cL_t^a K_t^b$$

where P_t=predicted output in year t resulting solely from increase in inputs L_t and K_t. Labor coefficient a and capital coefficient b sum to one, and C is the multiplicative constant.

If it is assumed that the inputs labor and capital are paid according to the value of their marginal product in the base year, then it can be shown that the values for a and b are equal to their proportionate share of value added in the base year.

The ratio of predicted output would be

$$P_t/P_o = L_t^a K_t^b / L_o^a K_o^b = (L_t/L_o)^a (K_t/K_o)^b$$

and the factor productivity index would be calculated by

$$I_t = (P_t/P_o)/(L_t/L_o)^a (K_t/K_o)^b$$

The coefficients for capital (K) and labor (L) represent the average for the period 1958–1970. The derived coefficients are a=0.46 and b=0.54.

The index in the text uses a 1958 base year to make it compatible with other indices in the chapter.

[28] L. A. Kostandov, "Progress in the Chemical Industry," Ekonomicheskaya gazeta, No. 4, p. 5 (January 1976).

POSTWAR DEVELOPMENTS IN THE SOVIET CEMENT INDUSTRY

ALAN ABOUCHAR*

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I. INTRODUCTION

Soviet cement production will exert a major influence on future economic growth and economic welfare, as a major input into capital investment, affecting thereby the growth of all industries, and as a component of final consumption, chiefly housing, but also other components of urban settlement. In this study I evaluate the efficiency of the cement industry in terms of certain critical and relatively unambiguous aspects of the industry's operation since World War II. In an earlier study of the prewar period I showed that the industry

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was inefficient in gross and unexpected ways, while performing very satisfactorily in one important respect—short-term transportation utilization.[1] Accordingly, the primary objective of this study is to investigate the extent to which the prewar problems have been remedied in the postwar period.

To start the analysis, Section II provides a short survey of the industry and its postwar growth. The following three sections present the evidence on the important efficiency-related aspects of industry performance (location and transport utilization, production technology including labor productivity, and standards). Section VI contains a brief comment on the reforms in light of the preceding investigation. Finally, Section VII explores the recent trends in cement utilization and their implications for future construction potential.

II. The Industry and Its Postwar Growth

1. Growth and Product Mix

Between 1940 and 1975 cement production has grown at nine percent a year, one of the highest growth rates in Soviet heavy industry, exceeding steel (6.2 percent), petroleum (8.1 percent), and electric power (9.2 percent), but lagging a little behind the growth of the chemical industry, expressed in rubles (11.2 percent). In terms of annual tonnage, its 1973 output of 95 million tons exceeded pig iron production (95.9 million tons) by nearly 10 percent, although it fell 22 million tons short of steel output. (131.5 million tons).[2]

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[1] The Soviet approach to product standardization and performance indicators was the major short-run inefficiency. The analysis showed that there would have been a small saving in production costs and a large saving in transport costs with a standards policy like that in the United States and most other modern industries which would have promoted the production of higher-quality cements. Instead, the industry was geared to a success indicator expressed in tons which encouraged the production of lower-strength cements. Had the specifications of grade 400 been set as the minimum acceptable standards for portland cement in the 1930's, an overexpenditure of 28 percent would have been avoided in transport cost and a 6 percent overexpenditure in production cost as well. Instead, only 25 percent of cement production (and that only late in the decade) met the requirements of grade 400 or higher, although there was no technological obstacle to production of cement of this quality. Since this problem was so significant for this industry it would seem to be of even greater consequence in other industries where standardization of the product mix and performance measurement are more difficult.

The second important short-run conclusion concerns the efficiency of the distribution of the cement which actually was produced. During the first three five-year plans, which spanned the years from 1928 until the Second World War, when the economy was experimenting with new forms and methods and was adapting to the realities and difficulties involved in instituting socialism, the distribution patterns of the industry were remarkably efficient. This was deduced by comparisons between the actual transport utilization and the utilization required by the optimal linear programme solution in 1936 which exposed an overexpenditure on transport of no more than 7 percent. The conclusion about rational distribution was further supported by evidence for 1935 and also by examining the water route use pattern. This contrasts with the protests of numerous critics of the industry's distribution and transport practices of the time.

The long-run aspects of the industry's operation were much less satisfactory. During the first three plans the regional imbalances between production and consumption worsened, as is shown most graphically in the increase in the average length of haul of cement. The most notable deficiency in planning of new capacity appeared in the failure to build more in the eastern regions. The analysis of 1936 and 1940 showed that a 70 percent saving in transport would have resulted from a better planned distribution of new capacity providing more production in the east, and total delivered cost would have been 33 percent lower.

Most of the unjustified decisions regarding new cement capacity during this period reflect a common failing—they emphasized production costs to the neglect of total delivered costs. This was promoted by the nature of the industry's success indicators: since total output was the indicator of greatest consequence the industry naturally had an incentive to produce as much as possible with the funds at its disposal. This policy would naturally lead to production in the west where production costs were lower. For details see Alan Abouchar, "Soviet Planning and Spatial Efficiency, The Prewar Cement Industry," Indiana University Press, Bloomington, Ind., 1971.

[2] Calculated from Narodnoe khoziaistvo S.S.S.R., 1970, pages 179, 184, 190, 196, and 230.

Annual output of hydraulic cements[3] by major type is shown in Table 1. Unfortunately, nowhere is a consistent table published showing the breakdown by type over the entire period, and we have had to dovetail series from several sources and rely on scattered information on product mix to produce this table. Especially notable is the absence of any consistent and careful breakdowns since 1962, the year the cement handbook (*Spravochnik po proizvodstvu tsementa*) was published, and the data that appears in the press since then is very scanty and contains errors (see note to Table 1).

2. The Technological Framework

Notwithstanding the materials intensiveness of cement production—1.5 ton of calcium carbonate, 0.4 ton of clay, and 0.3 ton of coal (when used as the basic fuel) per ton of portland cement—rational cement industry location tends to be market-oriented for two reasons: (1) input materials are widely found, and (2) scale economies in production are small relatively to transport costs. Market orientation has been further stimulated by the development of gas technology, since gas can usually be delivered at costs which are competitive with coal even in the mining regions.

Cement technology in the postwar period has developed in the direction of larger kilns and automation of the more readily mechanizable operations. These and other technological developments are not important enough to exert a strong pull on location, however, since the lower production costs of the greater plant scale and concentration that they imply cannot offset the higher transport costs which concentration entails.

The industry continues to be vertically and horizontally unintegrated. While slag wastes from steel production and a limited number of other complementarities exist,[4] nearly all hydraulic cement is still produced by cement plants. Some imagination has been shown in raw materials diversification, as in the Leningrad region, traditionally short of fuel and calcium carbonates, where gas-shale has been made to substitute simultaneously for fuel and some of the clay and lime raw materials, as well as in joint production of e.g. iron alloys and aluminous cement at a cement-metallurgical plant in the 1950's,[5] but this is still extremely insignificant. This is quite understandable in view of the ubiquity of conventional raw materials, and the wide-

[3] Soviet hydraulic cements (cements which harden and resist prolonged action of fresh or salt water) are divided into three classes: 1) portland cement, ground from clinker, produced by roasting calcium carbonate and silicious materials in a kiln, and then grinding; 2) portland pozzolan, produced by grinding portland clinker together with 20–50 percent (of final weight) pozzolanic (volcanic) materials, not cementitious themselves, but capable of reacting with lime to form a hydraulic binder; and 3) portland-slag cement, formed by grinding portland clinker with blast furnace slag (20–85 percent of final weight), which contains silica and lime, and reacts with the portland to form a permanent binder. The portland specification itself permits the introduction of additives (up to 15 percent by final product weight). There are also various special purpose cements (oil-well, white and colored portland cements, aluminous cement, etc.).

For fuller description of products and technology, see Abouchar, op. cit. Ch. II. The designations and compositions have been essentially unchanged since the mid-30's, the most recent standards simply modifying testing procedures and grade strengths (see section V below).

[4] N. V. Grokhotov and V. A. Kropotov, "Ispol'zovanie otkhodov drugikh otroslei promyshlennosti," Tsement, 1963, No. 5, pp. 3–5.

[5] Z. I. Loginov, Tsementnaia promyshlennosti S.S.S.R., Moscow, Gosplanizdat, 1959, pp. 216–217.

spread availability of slag and pozzolan constituents which have come to be very extensively used since the mid-30's.

Likewise, there has been virtually no move towards integration with final production processes. Precast concrete components and, to a lesser extent, asbestos cement products, offer the most obvious possibilities for vertical integration, although concrete component integration is not likely to foster any great economies, while failure to develop integration based on asbestos cement products may simply reflect the greater advantages of other building materials and inconsequential use of cement for this purpose (perhaps 300–500 thousand tons in the late 60's).[6]

We have, then, an industry with relatively simple output mix and production technology which can be analyzed much more easily than, say, machinery, consumers durables, clothing, or construction.

III. Transport and Location

The average length of haul of cement is shown in Table 2. After the very long hauls of the 30's, which exceeded the pre-World War I haul by as much as 300 percent, the average haul has fallen to levels a little higher than those of the Tsarist period. Since cement consumption continues to be very dispersed nationally,[7] and since the high prewar average haul was due, not to irrational shipping operations but, rather, to an unsatisfactory location pattern, it is to a radical regional realignment that we must look as the source of the postwar reduction in transport input. This realignment can be seen in Tables 3–5.

The essence of the regional realignment was a move towards self-sufficiency. This tendency in Eastern Siberia and the Far East was especially marked and had especially favorable results on transport costs, since theirs was the most transport-intensive cement consumption. Thus, between 1940 and 1970, the relative deficit (as measured by the ratio between annual regional production and consumption) fell from 100 percent to 5 percent and from 52 percent to 18 percent in these two regions respectively. Since the average hauls to these regions from the traditional supply areas (Ukraine, the lower Volga, or southwest Russia) ranged from 6,000 kilometers (Eastern Siberia) to 10.000 kilometers (Far East),[8] this increased self-sufficiency was bound to have a remarkably salubrious effect on the national average length of haul. Against this reduction—of 50–70 percent—we must compare the production cost increase implicit in the shift. Since (1) in the prewar period total national cement transport costs were approximately equal to production costs; (2) eastern production costs are roughly twice as high as costs in the west; and (3) the eastern regions account for about one-seventh of total consumption, the net reduction in average total delivered cost implied by the postwar, as compared with the prewar, location pattern to service the postwar consumption pattern is around 20–25 percent.

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[6] Asbestos-cement shingle production in the late 1960's was around 5 billion per year (Nar. khov. 1970, p. 234) implying a cement input of 300–500,000 tons.

[7] The Far East and Eastern Siberia—the main contributors to the high average haul—accounted for around 7–8 percent of consumption during the 1930's and the same share in the 1950's. (see Abouchar, op. cit., p. 46, and Loginov, op. cit., p. 135).

[8] Abouchar, op. cit., p. 93.

IV. Production Technology

1. Scale

The size of the kiln and number of kiln lines are the main sources of scale economies. Estimates of cost reduction in moving from the largest prewar kiln (108 meters) to kilns up to 185 meters in length are not available, but scattered data on reduction of e.g. fuel or labor inputs testify to the advantages of larger kilns. Kiln size distribution for 1964 is shown in Table 6.

If too little is known about the kiln scale economies, the plant size cost function is probably more difficult to evaluate. Loginov [9] has argued that plant size economies are appreciable—capital costs falling by 70 percent between 60,000 ton and 90,000 ton capacity, with average total production cost declining by about two-thirds, and a reduction of over 40 percent in many cases of from when annual capacity rises from 450,000 to 900,000 tons. In a severe criticism of these results, Belov has argued that these estimates were based on empirical observations relating to widely different equipment age and regional cost structures, and that in fact the technological scale economies are much smaller, their measurement being very sensitive to shipping distances for fuels and additives. Belov estimated a unit cost reduction of about 11 percent as plant size doubles to 900,000 tons a year.[10]

Plant scale has increased continually and substantially since the war. For example, while the prewar industry had two-thirds of its output in plants smaller than 200,000 tons, less than one percent of 1968 capacity was in such small plants. Moreover, as the comparison between 1958 and 1968 in Table 7 shows, the trend towards larger scale has persisted even in the last fifteen years. This is not intended as criticism of the prewar industry—far from it, indeed, since in the prewar industry few regions had a market for more than 200,000 tons a year, so that small scale was proper. In fact, the smaller scale of the prewar industry represented a rationalist victory over the gigantomania of some Soviet planners who held sway during the First Five-Year Plan. But the large scale of the postwar industry was accompanied by the sharp declines in average haul, noted earlier, and, indeed, even the trend towards concentration in 1958–68 was accompanied by a reduction of around ten percent in average haul. Could a further economically significant reduction have been achieved during this decade by a reduced emphasis on large scale? This is a tempting hypothesis, given the 135-percent rise in annual output (table 1). But if we make the reasonable assumption that most of this growth was consumed in proportion to the 1958 regional consumption pattern, we must conclude that there were no major new markets that would have consumed a large share of the production increase. In this case, it is unlikely that the transport cost reductions in the by-then traditional market areas would have justified the higher cost of smaller plants. If a conservative estimate of the long-run cost function, such as Belov's, is accepted, retention of the smaller scale pattern of

[9] Z. I. Loginov, "Ob optimal'noi moshchnosti tsementnykh zavodov," Tsement, 1955, No. 4, pp. 3–4.
[10] G. G. Belov, "K voprosu ob optimal'noi moshchnosti tsementnykh zavodov," Tsement, 1955, No 6, p. 21.

the mid-fifties would have raised average real production costs by around 15 percent. Assuming that real transport costs at the time were 50 percent as high as production costs, a 30 percent decline in transport would have been required just to offset the higher costs of the smaller scale production. In other words, the average haul in 1968 would have had to be around 320-kilometers just to break even if smaller production scale had been chosen.

2. Fuel

Since the war, gas has come to play the main role in the cement industry's fuel balance, accounting for nearly 50 percent of the caloric capacity of the industry's fuel consumption in 1962, coal (39.3 percent), oil (11.1 percent), and other fuels (2.1 percent) comprising the rest.[11] Gas utilization has continued to grow, its total consumption nearly tripling between 1960 and 1966 [12] while cement output grew by two-thirds, suggesting that most of the new capacity was by fired gas.

Gas utilization in the cement industry is undoubtedly extremely rational. First, as Campbell shows, even though gas transmission costs (operating costs and capital costs, including 10 percent interest) are higher than all other forms of energy except low-grade coal and electric power, the delivered costs of gas in all major regions are much lower than those of other fuels thanks to its very low production costs, about 16 percent of the cost of oil and 4 percent of that of coal extraction.[13]

In the second place, capital and operating cost of cement plants are also lower when gas is used, since storage and coal-grinding are avoided with their attendant investment, electric power, and labor requirements.[14] Life of kiln linings is extended, with kiln shutdown frequency falling sharply; the Novorossiissk "Proletarii" plant reported increases of up to 100 percent in lining life and an average increase of 45 percent.[15] This was exceptional, undoubtedly, and while data are not available on a systematic basis, gas use is an important factor in raising national average kiln operating rates from 75 percent in 1950 to 87 percent in 1969.[16] This was taking place even under the introduction of new long kilns which, as we have seen, generally had a difficult break-in period. Gas also permits more even heat control and more uniform clinker and gives a better product.

The only drawback of gas is the greater flue-dust loss which accompanies it. No quantitative information has been published on this, however, and it can be overcome by adjusting the heat exchange devices.[17]

The low production and transportation cost of gas together with reduced costs when working with gas, make it very attractive, and its increasing use reflects a rational technological policy.

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[11] "Spravochnik po proizvodstvu tsementa," Gosstroiizdat, 1963, p. 843.
[12] Robert W. Campbell, "The Economics of Soviet Oil and Gas," Baltimore, Johns Hopkins Univ. Press, 1967, p. 214.
[13] *Ibid.*, pp. 209, 211.
[14] L. V. Gudkov, B. B. Kuznetsov, V. V. Mikhailov, and G. E. Nezhintsev, "Razmeshchenie tsementnykh zavodov guchetom vida teknologicheskogo topliva," Tsement, 1969, No. 10, pp. 3–4.
[15] N. Zakharova, "Opyt raboty tsementnykh zavodov na gazoobraznom toplive," Tsement, 1959, No. 6, p. 7.
[16] Narovdnoe khoziaistvo S.S.S.R., 1969, p. 242.
[17] Zakharova, op. cit., p. 6.

Perhaps the clearest testimony to the dominance of gas is the change in the treatment of fuel between the 1959 and 1963 editions of Lure'e's standard treatise on portland cement; the 1954 edition shows some hypothetical cost relationships for a standard operating regime consisting of limestone, clay and coal while the standard regime for the calculations in the 1963 edition consists of limestone, clay, and gas.[18]

3. Electric Power

Most cement plant operations use electricity—input grinding, kiln rotation, clinker grinding, and even some dust recovery. In general, the larger the plant, the greater the power input, although the lower will be the unit power input, owing to scale economies in kiln power demands. On the other hand, higher power input, all other things equal, will yield a better product through finer grinding and more even kiln rotation. Finally, mechanization of some processes, such as intraplant materials transport, will also lead to higher power input per ton, this time in substitution for labor. Therefore, increased power consumption per ton of output indicates greater efficiency—it can generally be presumed to save labor and improve quality. Power consumption did increase by eight percent per ton between 1950 and 1962.[19] Per man hour of employment, the rise was much more dramatic, increasing nearly seven-fold between 1950 and 1968.[20]

4. Labor

Labor productivity rose markedly, as shown in Table 8. The more than nine-fold increase since 1928 reflects many factors. First, the product mix has altered in the direction of blends, the 1968 mix including 64 percent portland.[21] But a 60-percent portland mix already characterized output in the mid-30's (see Table 1) and productivity has increased about 6–8 times since then. It is also startling that output per man doubled between 1958 and 1968 even while portland was increasing in importance from 45 percent to 64 percent. As suggested in the note to Table 1, however, this increase may be exaggerated. On the other hand, even if the portland share was unchanged, the average grade over the period was rising regularly by 50 percent between 1940 and 1967, and by twelve percent between 1960 and 1967.[22]

The sources of this growth are undoubtedly the technological factors we have already seen—longer kilns, expansion of gas use, and increased provision of electric power. The larger plant size is surely itself a factor, but it is difficult to separate out the effect of size from the effect of other aspects of technological change. In 1962, according to the cement production handbook, output per man in million-ton plants was twice as high as that in 200–350-thousand ton plants,[23] but the

[18] Iu. S. Lur'e, Portlandtsement Leningrad, Gosstroiizdat, 1959 (pp. 344–345), and 1964 (pp. 390–392).
[19] Spravochnik, p. 843.
[20] Spravochnik, p. 837.
[21] A. N. Liusov, "Ekonomika tsementoi promyshlennosti," Tsement, 1970, No. 4, p. 9.
[22] P. P. Budnikov and B. V. Volkovskii, "The Most Universal and Widespread Building Material," Tsement, 1967, No. 5, p. 15.
[23] Spravochnik, p. 843.

larger plants were also newer and reflected the most recent technological advances.

V. Standards

Everything so far considered testifies to a rational industry in the post-war period. Progress in technology has been seen in kiln size, fuel mix, use of electric power, and plant scale. The journals in this period contain abundant evidence of experimentation—on the plant sites and not just in central laboratories—with other improvements: more efficient heat transfer apparatus and chimney design modification to reduce stack loss, two-end kiln feeding, and so on. To be sure, in the absence of hard data one could argue that these improvements were not unqualifiedly efficient, that for example, cement is so cheap that it does not pay to install dust loss reduction apparatus, or that power is mispriced and really represented an inefficient use of resources, but the burden of proof would be on any one advancing this thesis. On the other hand, one unqualified source of inefficiency in the postwar period, as in the 1930's, is the approach to cement standards.

Portland cement standardization methodology in most advanced industrial countries allows for much less strength variability. For example, although U.S. portland cement standards permit five types of portland cement, most variations relate to mineralogical tolerances for use in special conditions or for early hardening.[24] General purpose (types I and II) account for 94 percent of total production in 1968.[25] This makes it much easier to control output (indeed, as Machlup has argued, this uniformity was a result of the oligopolistic market structure).[26]

According to information presented in "Cement Standards of the World," a recent publication of the European Cement Association, uniformity rather than diversity appears to be the rule in most nations. In general, the approach of countries such as U.K., Japan, Germany, or Brazil is to have one basic or ordinary type, supplemented by special purpose types (early-hardening, low-heat, sulfate-resistant).[27] Nothing is seen that resembles the Soviet practice of permitting five or six grades of ordinary portland, to be decided by test, in addition to specially marked early-hardening cement, and those with special mineralogical properties. The Russian practice is to grade as it comes out of the kilns. The grade distribution is shown in Table 9.

There are four advantages in a uniform standards systems, with a reasonably high strength requirement: (1) lower production costs; (2) lower transport and attendant costs; (3) greater reliability; and (4) easier plant performance measurement and control.

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[24] "ASTM Standards on Cement," Sept. 1958, p. 3. American Society for Testing Materials, Phila., 1958.

[25] "Minerals Yearbook," Vol. I–II, 1968, p. 259, U.S. Bureau of Mines, Department of the Interior, Washington.

The Bureau reports Types I and II together. Both are for general use. But the latter is especially suited to use under moderate sulfate action or where low heat of hydration is required. It has different mineralogical specifications imposed. Types III, IV, and V are for high early strength, low heat of hydration, and high sulfate resistance. There are in addition various types of air-entraining cements. All of these, small amounts of portland-slag and portland pozzolan, and other special purpose mixes accounted for six percent of production in 1968.

[26] Fritz Machlup, "The Basing-Point System," Phila., The Blakiston Co., 1949, p. 80.

[27] "Cement Standards of the World," Paris Cembureau (The European Cement Association), 1968, passim.

1. Lower Production Costs

The most complete analysis of the relationship between quality and production cost was given by A. Evdokimenko of the Moscow sovnarkhoz in 1965.[28] His calculations show that the production cost of grade 700 is about 16 percent higher than grade 400, although its concrete making potential is nearly 50 percent greater! Its cost is 5 percent higher than grade 500, while its concrete potential is 17 percent greater.

Thus, in the first place, imposition of higher strength requirements would have reduced concrete-making costs on this account considerably.

2. Transport and Related Costs

If grade 700 has 50 percent greater concrete making potential, only two-thirds ton would have to be shipped for every ton of grade 400 that it replaced. For the prewar period, the transport overexpenditure on this count was estimated to be 28 percent of total transport cost (see note 1). The relative transport overexpenditure was probably of the same order in the postwar period. Excess production cost was around 6 percent, and probably about the same in the post-war period. The total relative inefficiency in the industry today is less, however, perhaps around the percent, since transport costs bulk smaller today.

In addition, however, related savings would have arisen through better shipping practices. For the prewar period, it was estimated that dust less may have resulted in a cost of 10 percent when cement was shipped in bulk,[29] which was the case for about two-thirds of total shipments. Losses in the postwar period have been variously estimated at 2 percent, three percent on four important rail lines including the Volga and Ukraine networks,[30] and as high as 8–10 million tons from all causes in distribution in 1968.[31]

The last estimate amounts to ten percent of that year's production, and, if true, is astounding. The estimate is accompanied by an attempt to relate the losses to different kinds of rolling stock. The internal consistency of the various loss information in the article, together with the apparent care in analyzing transport-related costs (cleaning of wagons, loading and unloading, etc.), seem to support the 8–10 million ton estimate.

3. Reliability

What has so far been said argues for raising product quality—not necessarily for product uniformity. We would maintain, however, that if the wisdom of holding to the multi-grade system of cement standards had been reviewed, a single high grade would have been adopted which would then have been justified construction of specialized rolling stock. (Bags were not really the answer since they require extensive and costly handling.) But the very fact of uniformity would itself have had a positive influence on the industry.

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[28] A. Evdokimenko, "'Sebestoimost', tsena, 'effektivnost'", Ekonomicheskaia gazeta, 2/3/1965, pp. 5–6.
[29] Abouchar, op. cit., p. 39.
[30] Z. I. Loginov, "Razmeshchenie proizvodstva i perevozki tsementa," Moscow, Promstroiizdat, 1957, Ch. IV.
[31] M. G. Kobrin and A. N. Liusov, "Puti snizheniia izderzhek na tsement v sfere obrashcheniia," Tsement, 1969, No. 10, p. 1.

Now, the problem of reliability in construction is never explicitly analyzed in the cement industry journals, but certainty regarding grade must have been a serious problem for builders. In the first place, builders frequently had to deal blindly with cement since it was often shipped in advance of the 28-day test specifications, which followed when available. As one author put it in 1954: "Usually, by the time the user gets the test documents, the cement has already been used, so that he is unable to get full value from it." [32] In 1964, it was argued that this practice be terminated,[33] and the situation by 1968 had not improved. According to a check by Gossnab in that year "cement is used in construction in far from optimal ways." [34] Indeed research to develop procedures for accelerated testing and early prediction of 28-day test strengths is a recurring theme in Tsement.

Finally, the multiplicity of grades wrought chaos in some of the warehousing installations. With a possible total of 30 or 40 grade-types to store,[35] there must have been a great deal of confusion. For example, "trust No. 4 of Glavvolgoviatskstroi (in Dzerzhinsk) receives ten different kinds and grades from six suppliers, while even the largest concrete-making plant has only four cement storage silos, as a rule. In these circumstances, different grades of cement will inevitably get mixed up, and cement is bound to be used as though it were all the lower grade, resulting in substantial losses of this building material." [36] It goes without saying, of course, that any attempt to raise exports would require better grading procedures. One plant (Novorossiissk), for example, seeking export markets advertises its product as all being equal to British standard, which shows an awareness of the advantages of a single grade system.[37]

4. Measurement and Control

Grade multiplicity makes it extremely difficult to control and measure performance. For example, how should the performance of the two plants, whose output is shown in Table 10, be compared. How should performance be calculated? How should it be related to production cost. Evdokimenko in the previously cited 1964 article proposed conversion coefficients expressed in terms of concrete-making capacity, but the idea, though seconded by some others, has never caught on. In any event such coefficients neglect the very important dimension of transport input, i.e. that 1½ tons of grade 400, which are nominally equal to one ton of grade 700 in terms of concrete making potential, would require fifty percent more transport to do the same job!

The easiest solution to the control and performance evaluation problem is to impose a single-grade standards policy. Considering the manifest superiority—especially for a planned economy—of this approach, it is little short of incredible that the issue has been so little

[32] V. I. Pomiluiko, "Novoe v pasportizatsii tsementa," Tsement, 1954, No. 2, p. 24.
[33] "Uluchshat' kachestvo tsementa", Tsement, 1964, No. 4, p. 1.
[34] I. V. Kravchenko, Z. B. Entin, and N. I. Oleinikova, "O sovershenstvovanii deistvuiushchikh standartov na tsementy," Tsement, 1969, No. 11, p. 5.
[35] There were 35 in 1963, and new grades were being added or dropped. New standards, applying primarily to testing procedures, were introduced in 1966. "Uluchshat' . . ." loc. cit.
[36] Kravchenko, et al., loc. cit.
[37] Tsement, 1966, No. 4. Advertisement on back cover.

discussed. Many of the difficulties inherent in the present system have, of course, been recognized, as is evident from the foregoing allusions.

Development of conversion coefficients based on concrete-making capacity has been proposed by a number of other writers as well.[38] One of these writers (Vezlomtsev) on another occasion proposed a more Marxist approach, recommending a production cost rather than use value criterion.[39] The system, which had been developed by the Scientific Research Institute for Cement (NIITsement), and was ready for use, commensurated all grades in terms of their labor content, labor being the best indicator of prime cost. The trouble with use-value coefficients, according to Vezlomtsev, was that there were scale economies: unit and materials, fuel, power, and labor costs all fall with rising strength (calculated either by standard 28-day tests or concrete-making capacity) and so these indicators fail to be an accurate index of how much the output costs to produce. This is true, of course, they do not. But the institution of the NII Tsement system of indicators would give no incentive to higher quality—indeed, it might serve as a disincentive. The plant would be guided by the relationship between labor ratio and the total cost ratio of different grades or types, and there is no way to tell whether this relationship would stimulate higher quality. For example, suppose that the following patterns held for portland 400 and portland 600 (per ton):

	Labor input	Total production cost (rubles)	Concrete-making capacity (grade 400=100)
400	3	30	100
600	3.2	35	131
Ratio	1.067	1.16	1.31

It is easy to verify that in this case the result would be perverse. Thus, the national economic advantage of producing the higher grade is the improved concrete-making strength divided by the increased production cost, or $(1.31/1.16)-1=12.9$ percent. The higher grade is, therefore, more efficient. Commensurating output in terms of labor cost, however, would mean that if the plant produced the higher grade, it would have to spend 9.4 percent more per unit of its success indicator. I.e. it would spend 16 percent more and raise its success indicator by 6.7 percent, and so it would produce the lower grade.

That negligence of grade uniformity has continued so long is the more difficult to understand since Soviet technicians have long been familiar with international testing procedures and product specifications, as is attested by numerous comparative tests and specifications presented in Tsement in the last two decades. Perhaps part of the problem is that these publications place too much stress on the diversity rather than the uniformity of some foreign products. For example, in 1959, and again in 1965,[40] tables are presented which

[38] E.g. Loginov, Tsem. prom., p. 245. Slightly different coefficients, based on the same principle, are proposed by S. I. Il'in and V. I. Vezlomtsev, "Planirovat' proizvodztvo i potreblenie tsementa g uchetom ego kachestvo," Tsement, 1963, No. 5, p. 6.

[39] V. I. Vezlomtsev, "Sovershenstvovat' metody analiza effektivnosti proizvodstva." Tsement, 1966, No. 3, pp. 8–9.

[40] "Standarty razlichnykh stran na portlandtsement." Tsement, 1959, No. 5, pp. 23–24; B. V. Volkonskii and N. P. Shteiert, "Rol' standartov v povyshenii kachestva tsementa," Tsement, 1965, No. 3, pp. 1–3.

show the five types of U.S. portland cement, giving them equal prominence and suggesting, thereby, that they are all approximately equal in the industry's output. The fact is never mentioned that 94 percent of total output (in 1968) is Type I and II (ordinary general purpose and ordinary low heat portlands, with the same strength characteristics but differing slightly in minerological composition), and that the others are produced in small quantities (about six percent in all) for special purposes, as indicated by their name, e.g. rapid-hardening, sulfate-resistant, etc.

VI. The Reforms in the Cement Industry

The Kosygin reforms began in 1965 with the transition of three plants to the new form operation, and several more in 1966. By 1968, the entire industry was working on the new basis.[41] The essence of the reforms in this industry, as in others, was the inception of a system of only four control indicators: sales, with product mix; the wage fund; profit; and rate of profit. The inception of the reforms at the Voskresensk plant—one of the first—was accompanied by the usual recitation of the advantages of the new system, although it is not clear that desirable effects will necessarily follow. For example, sales is supposed to "expand substantially the economic independence of the enterprise, which will not now find it profitable to maintain excess stocks," [42] which seems a naive way to project the impact of the new indicator. It is hard to imagine that the plant ever thought of itself as producing primarily for stock. If stocks were accumulating because of poor quality or wrong assortment, the combination of seller's market and prescription of output mix would combine to obviate an automatic realization of the presumed advantages of the new operating procedures.

It is impossible at this time to devise a criterion to evaluate the success of the reforms. Workers at the Voskresensk plant in subsequent years published a number of articles pointing to the success of the new procedures, e.g., the 19 percent wage rise during 1965–1968 against a productivity increase of 22 percent.[43] The Voskresensk experience is esteemed not only by the plant officials themselves, but in other circles as well. But since (1) some other plants on the reforms (Briansk and Korkinsk) were actually doing worse since they went on the reform in 1966 than before; (2) others were doing, apparently, better, but not as well as Voskresensk; [44] and, finally, (3) the average change in labor productivity in the industry as a whole between 1965 and 1968, was 23 percent (see Table 8), it is difficult to share the observer's enthusiasm for the reforms.

While the foregoing comparison does not prove or disprove that the reform was a success in the cement industry, it may well be irrelevant. The reform was introduced, after all, not with the view to achieving any specific objective in this industry, but, rather, simply as part of the overall industry-wide transformation. As long as

[41] A. N. Liusov and T. I. Golidze, "Novaia sistema planirovaniia i ekonomicheskogo stimulirovaniia vstupaet v deistvie," Tsement, 1966, No. 2, p. 3.
[42] "Zadachi tsementnoi promyshlennosti," Tsement, 1968, No. 1, pp. 1–2.
[43] I. F. Babryka, "Chto nam daet khozialstvennaia reforma," Tsement, 1969, No. 7, p. 1.
[44] A. N. Liusov and A. D. Evdokimenko, "Ekonomicheskaia reforma v deistvii," Tsement, 1967, No. 6, p. 1.

the reforms did not worsen cement industry performance—and they probably did not—evaluation of the reforms need show no special concern for this industry.

On the other hand, as this presentation has shown, the industry throughout the postwar period was showing itself alert to new ideas and to possibilities for more efficient operations, with the single exception of rationalizing cement standards, a decision which would lie beyond the scope of plant manager responsibility in any event. Design of product standards, rather, is the responsibility of higher levels, the transformation of the behavior of which was not the objective of the reforms, which were, rather, directed to the plant manager level. It is interesting to speculate whether similar patterns may exist in other industries which might have obviated the need for the kind of reforms actually executed if they had been squarely faced. But this is another story.

VII. Trends in Cement Use

The major development in cement use during the postwar period has been the trend towards prefabricated concrete components in the construction industry, the trend being especially marked since 1960. An appreciation of the importance of this relationship may best be gained by comparing the share of cement gross value of output going into the concrete component industry to the share going directly into construction—49 percent vs. 32 percent—in 1966 [45] and noting the continuing high growth of the production of concrete components between 1960 and 1973, rising from 30.2 million to 102.9 million m^3. (Nar. khoz., 1973, p. 301).

One of the fastest growing of all the structural components group is wall panels, which showed a nearly sixteen-fold growth during this period and reached 15.8 million m^3 in 1973. Wall panels, of course, are particularly significant for urban housing, and other components are also significant for the provision of urban amenities—concrete pipe, power poles, and reinforced concrete girders, especially.

This new technology has conditioned an improvement in the overall housing mix. First of all, the total urban housing stock has risen from 958 million m^3 to 1,661 million m^3 between 1960 and 1972, or 73 percent of the total, while total urban population has risen much more slowly—45 percent (Nar. khoz., 1972, pp. 543, 32). The number of gasified apartments has increased at a far greater rate, rising from 3.3 million apartments in 1960 to 30.3 in 1972, (Nar. khoz. 1972, p. 547) and to 37.8 million in 1974 (Ekon. gaz., 1975, No. 31, p. 1). While total annual provision of new housing has been fairly stable at 100–110 million m^2 since 1960, there has been a heavy shift towards urban housing whose annual provision has increased by 24 percent since 1960 and which now accounts for 70 percent of the annual total.

Probably symptomatic of the improved quality of housing is the increase in average expenditure per square meter of housing. This

[45] Calculated from Steven Rosefielde, The Transformation of the 1966 Soviet Input-Output Table from Producers to Adjusted Factor Cost Values. General Electric-Tempo, Santa Barbara, California, 1975, pages 122, 126, 130, 190, 194, 198. These calculations are insensitive to the rate of interest used for capital charges, there being no change when 0.06 or 0.18 is used.

has risen from 56.9 rubles in 1960 to 137.2 rubles in 1972, or 4.2 percent annually. (Nar. khoz., 1972, p. 539). While the overall behavior of prices has not been adequately studied over this period, the average wage, at least, has risen by 3.8 percent a year between 1950 and 1970, according to Katsenelinboigen.[46] That the average construction expenditure has risen at a rate 10 percent faster in spite of the enhancement to labour productivity implied by the move to prefinished components, and in spite of the partical substitution of concrete components for steel, may be partly explained undoubtedly by the higher quality of the finished product, with better internal facilities (plumbing, electricity, heating, etc.), although it is possible that the economies on the construction site have not yet been fully exploited (it is also possible that the behaviour of the minimum wage is not an adequate index of inflation). With the continuing high rate of development of cement production and the construction trends noted here, however, the outlook for improved housing for Soviet consumers is good.

TABLE 1.—ANNUAL HYDRAULIC CEMENT OUTPUT, BY MAJOR TYPES, 1913–70, SELECTED YEARS

[In thousands of tons]

Year	Total	Portland	Portland—pozzolan	Portland—slag	Others	Portland as percent of total
1913	1,777					
1928	1,850					
1936	5,916	4.4	0.6	0.9		74.1
1937	5,454					
1940	5,675	3.6	.3	1.2	0.5	64.0
1950	10,194	5.2	1.2	3.3	.5	50.2
1955	22,484	10.0	3.0	7.8	1.6	44.6
1958	36,698	16.4	6.1	13.4	.8	44.7
1960						
1961	49,997	23.4	7.7	18.7	.2	46.8
1962	56,300	29.6	7.5	19.1	.1	52.6
1964 [a]	64,934	45.4	2.9	14.9	1.6	70.0
1966 [a]	80,013					
1968	87,512	55.6	6.0	24.2	1.7	63.5
1969	89,740					
1970	95,248					
1971	100,331					
1972	104,299					
1973	109,521					
1974	115,100					
1975 (plan)	122,000					

[a] The 1964 and 1966 portland shares seem high and mistakes may well have been made in reporting. The 1964 shares are from Moroz (source No. 6) who also gives 1958 shares which correspond with Loginov's (source N. 4). Liusov's data (source No. 7) is unconfirmed anywhere else, and elsewhere he has been observed to give figures one-third higher than official statistics published in "Spravochnik." (See A. N. Liusov, "O spetsializatsii tsementnykh zavodov", Tsement, 1963, No. 6, p. 4).

SOURCES

1. 1913. TsSU, "Promyshlennost' S.S.S.R.," 1964, p. 318.
2. 1938–55 and 1964–70, total production from, TsSU, "Narodnoe khoziaistvo S.S.S.R.," 1970, p. 230.
3. 1958–62, total production, and shares from "Spravochnik," pp. 837–838.
4. 1936–55, relative shares from Loginov, "Tsementnaia promyshlennost' S.S.S.R.," Moscow, Gosplanizdat, 1960, p. 106.
5. G. Brodskii, "Geografiia potrebleniia tsementa v S.S.S.R.," Tsement, 1938, No. 6, p. 11.
6. I. K. Moroz, "Povyshenie kachestva tsementa—glavnaia zadacha," Tsement, 1965, No. 1, p. 2.
7. 1968 product volumes from A. N. Liusov, "Ekonomika tsementnoi promyshlennosti," Tsement, 1970, No. 4, p. 9. This portland cement output may be seriously overstated. See note above.
8. 1971–73 from TsSU, "Narodnoe khoziaistvo S.S.S.R.," 1973, p. 300.
9. 1971–75 from Ekonomicheskaia gazeta, July 1975, p. 1.

[46] Aaron Katsenelinboigen, "A Hesitant Inflation," in Alan Abouchar, ed., "The Socialist Price Mechanism," Duke University Press, in press.

TABLE 2.—AVERAGE LENGTH OF HAUL OF CEMENT, 1912–68, SELECTED YEARS

Year	Average length of haul
1912	450
1927/28	750
1933	1,800
1935 (2d half)	807
1939	1,325
1950	680
1951	710
1955	554
1968	477

Sources: 1912–50 and 1955 from various sources cited in A. Abouchar, "Soviet Planning and Spatial Efficiency," Indiana University Press, 1971, p. 44; 1951 and 1968 and from A. N. Liusov, "Ekonomika tsementnoi promyshlennosti," "Tsement," 1970, No. 4, p. 9.

TABLE 3.—REGIONAL DISTRIBUTION OF HYDRAULIC CEMENT PRODUCTION, 1936–58, SELECTED YEARS

Region	1936		1940		1951		1958	
	Thousands of tons	Percent of annual total	Thousands of tons	Percent of annual total	Thousands of tons	Percent of annual total	Thousands of tons	Percent of annual total
North		0		0	2.4	0.2	7.4	0.2
Northwest	165	2.8	95	1.7	311	2.6	1,199	3.6
Centre, West, and Central Black Earth	1,071	18.2	1,144	20.2	2,707	22.3	6,564	19.7
Volga	706	11.9	524	9.2	993	8.2	2,547	7.6
North Caucasus	1,246	21.0	962	17.0	1,228	10.2	2,399	7.2
Urals	406	6.8	345	6.1	1,272	10.5	5,049	15.3
Western Siberia	283	4.8	263	4.6	618	5.1	1,921	5.8
Eastern Siberia		0		0	315	2.6	1,367	4.1
Far East	149	2.5	234	4.1	486	4.0	865	2.6
Central Asia—Kazakh SSR	153	2.6	267	4.7	425	3.5	1,504	4.5
Transcaucasia	330	5.6	326	5.7	611	5.1	2,149	6.5
Ukraine	1,287	21.8	1,218	21.5	2,361	19.7	6,290	18.9
Western Republics *	120	2.0	297	5.2	719	6.0	1,379	4.2
Total	5,916		5,675		12,070		33,307	

* For 1936, includes only Belorussia, for later years, includes Baltic republics as well.

Source: 1936, G. Brodskii, "Geografiia potreblenii tsementa v SSSR," "Tsement," 1938, No. 3, p. 11. Other years from Loginov, "Tsem. Prom.," p. 134.

TABLE 4.—REGIONAL DISTRIBUTION OF HYDRAULIC CEMENT CONSUMPTION, 1936–58, SELECTED YEARS

Region	1936		1940		1951		1958	
	Thousands of tons	Percent of annual total	Thousands of tons	Percent of annual total	Thousands of tons	Percent of annual total	Thousands of tons	Percent of annual total
North	20	0.3	91	1.7	140	1.0	485	1.4
Northwest	456	7.9	551	10.2	745	5.5	1,570	4.5
Centre, West and Central Black Earth	1,953	33.8	1,085	20.1	2,536	18.7	7,144	20.3
Volga	260	4.5	319	5.9	832	6.2	2,595	7.4
North Caucasus	440	7.6	523	9.7	1,135	8.4	1,697	4.8
Urals	367	6.3	427	7.9	1,539	11.4	3,938	11.2
Western Siberia	118	2.0	182	3.4	742	5.5	2,118	6.0
Eastern Siberia	127	2.2	72	1.3	476	3.5	1,432	4.1
Far East	309	5.3	458	8.5	537	4.0	1,051	3.0
Central Asia—Kazahk SSR	218	3.8	267	4.9	955	7.0	3,379	9.6
Transcaucasia	418	7.2	421	7.8	993	7.3	1,629	4.6
Ukraine	965	16.7	750	13.9	2,361	17.4	6,479	18.4
Western republics [1]	129	2.2	255	4.7	562	4.1	1,643	4.7
Total	5,780		5,401		13,553		35,160	

Note; For 1936, includes only Belorussia. For later years includes Baltic republics as well.

Source: Same as table 3. 1936 partially estimates (see Abcuchar, "Soviet Planning and Spatial Efficiency," p. 45).

TABLE 5.—RELATIVE REGIONAL SELF-SUFFICIENCY IN CEMENT PRODUCTION (ANNUAL PRODUCTION/ANNUAL CONSUMPTION) X100 1936–58, SELECTED YEARS

Region	1936	1940	1951	1958
North	0	0	17	15
Northwest	36	17	42	76
Centre, West and Central Black Earth	55	105	107	92
Volga	272	164	119	98
Northern Caucasus	283	184	108	141
Urals	111	81	83	128
Western Siberia	240	144	83	91
Eastern Siberia	0	0	66	95
Far East	48	51	90	82
Central Asia—Kazakh S.S.R.	70	100	44	44
Transcaucasia	79	77	62	132
Ukraine	133	162	100	97
Western republics	93	116	128	84

Note: For 1936, includes Byelorussia only. For later years, includes Baltic Republics as well.

Source: Calculated from tables 3 and 4.

TABLE 6.—KILN SIZE AND RELATIVE CAPACITY, 1964

Length of kiln (meters)	Percent of total clinker capacity
185	1.5
170	16.8
150	31.8
135	3.3
127–9	9.8
118	4.6
All others	32.2
Total	100.0

Source: L. Iu. Astanskii and A. N. Liusov, "Polnoe osvoenie moshchnosteiosnova uvelicheniia proizvodstva, tsementa," "Tsement," 1965, No. 4, p. 1.

TABLE 7.—INDUSTRY PLANT SIZE DISTRIBUTION, 1958 AND 1968

Size of plant (thousands of tons annual capacity)	Share of total accounted for by this size plant	
	1958 production	1968 capacity
Less than 200	26.0	0.8
201 to 500	23.4	3.8
501 to 1,000	14.3	29.7
1,001 to 1,500	20.8	22.6
1,501 to 2,000	9.1	18.4
Greater than 2,000	6.5	24.7
Total	100.0	100.0
In plants larger than 1,000,000 tons	36.4	65.7

Sources: 1958, "Spravochnik," p. 837, 1968, from absolute data in A. N. Luisov, "Ekonomika tsementnoi promyshlennosti," Tsement, 1979, No. 4, p. 9,

TABLE 8.—ANNUAL OUTPUT OF HYDRAULIC CEMENT PER MAN, 1928–68, SELECTED YEARS

Year	Tons	1950=100
1928	104	36
1934	138	48
1940	222	77
1950	288	100
1955	535	186
1957	576	200
1958	650	226
1959	681	236
1960	765	266
1961	824	286
1962	877	305
1963	902	313
1964	974	338
1965	1,035	360
1966	1,138	392
1967	1,232	428
1968	1,274	443

Sources: 1938–55; Loginov, Tsem. prom,, p. 111. 1957–68; M. M. Smekhov, "Proizvoditel'nost' truda—eto samoe glav-noe,' Tsement, 1970, No. 4, p. 3,

TABLE 9.—GRADE MIX OF HYDRAULIC CEMENTS 1962 AND 1965, PERCENT OF TOTAL

Grade	1962				1973		
	Portland	Portland-pozzolan	Portland-slag	Total	Total	Portland	Total
200							1.1
400	1.7	3.1	29.3	11.1	2.0	3.8	21.2
500	22.4	48.4	53.6	35.8	29.1	71.1	60.9
300	63.1	47.7	17.1	44.6	56.1	24.6	16.5
600 and higher	12.7	.8		6.7	11.2	.4	.3
Total	100.0	100.0	100.0	98.2	94.8	100.0	100.0

Source: 1962, Spravochnik, pp. 836-839. Overall total does not sum to 100 for unknown reason. 1965 I. K. Moroz, "Povyshenie kachestva tsementa—glavniaia zadacha," Tsement, 1965, No. 1. Total does not sum to 100 for unknown reason. 1965 data not available for individual types. 1973, Narodnoe khoziaistvo S.S.S.R. 1973, p. 300.

TABLE 10.—HYPOTHETICAL PRODUCT MIX OF TWO PLANTS

Grade	Yearly production by—			
	Plant A		Plant B	
	Tons	Percent of total	Tons	Percent of total
300	50	14.3	60	17.1
400	110	31.4	90	25.7
500	80	22.8	70	20.0
600	60	17.1	70	20.0
700	50	14.3	60	17.1
Total	350	100.0	350	100.0

SOVIET AGRICULTURE: RECENT PERFORMANCE AND FUTURE PLANS

DAVID W. CAREY

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I. INTRODUCTION

After over fifty years of Communist rule, the U.S.S.R. is entering its Tenth Five-Year Plan with reported demonstrations over food shortages.[1] Paradoxically, during the last decade, agricultural output

[1] Le Figaro, May 18, 1976.

increased substantially. Yet Brezhnev's program to provide consumers with more meat pushed demand for grain far beyond domestically produced supply.

Under Brezhnev, the U.S.S.R.'s farm sector has received consistently generous support in expanding the resource base. Although rapid growth in investment and in the flow of industrially produced materials such as fertilizer, lubricants, and electric power has helped boost the general level of agricultural production, it has not stabilized farm output. After a series of progressively better harvests in the late 1960s, farm output, especially when measured simply by the size of the grain crop, fluctuated substantially during the past five years. For example, two years after the record 222.5 million ton grain harvest in 1973, the Soviets suffered their worst crop in a decade—140 million tons.[2]

Two harvest shortfalls during the Ninth Five-Year Plan period (1971–75) wrecked planned goals, slowed economic development, contributed to record hard currency deficits, and jeopardized the gains made by the consumer. The backbone of the regime's consumer program has been a scheduled improvement in diets, symbolized by a rapid expansion of meat output. To attain meat goals quickly, livestock herds were expanded rapidly without first ensuring adequate supplies of feed grains. Had the U.S.S.R. been favored with an extended period of excellent weather this gamble would probably have paid off. However, the combination of the livestock program's nearly insatiable demand for grain, the leadership's commitment to the consumer, and bad weather forced the Soviets to purchase massive amounts of grain from the West. Grain imports in 1972 were sufficient to avert substantial herd reductions, but even larger grain purchases in 1975 were inadequate to prevent large-scale slaughtering of livestock. The Ninth Five-Year Plan thus ended on a discordant note, one which will be heard for at least the coming year.

Despite these setbacks there apparently has been no basic change in agricultural policy or the policy to improve the lot of the consumer. After a sharp downturn in 1976, meat production is to increase rapidly during the next four years. Average grain output in 1976–80 is to jump by one-fifth over the average for the previous five years. In addition, the Tenth Five-Year Plan continues the effort to improve the quality of farmland and to increase the use of fertilizer, key factors in raising crop yields. The rate of growth of total investment will be slowed, however. Agriculture's share of total investment will be maintained, but yearly flows of machinery and other investment goods will grow markedly slower than in the past. This slowdown probably does not stem from a policy shift. Instead, it most likely reflects the economy-wide program to increase productivity and product quality in lieu of large new inputs. Planned productivity increases notwithstanding, output plans for key commodities have not been

[2] Official Soviet data for grain production are used in this report. Data include production of wheat, rye, barley, corn, oats, millet, buckwheat, rice, and pulses. Figures reported are in "bunker weight" which includes excess moisture, unripe and damaged kernels, weed seeds, and other extraneous materials and has not been adjusted to reflect post-harvest losses incurred in handling and storage.

relaxed and are perhaps overly ambitious. Planners are apparently hoping anew for an extended period of better-than-average weather.

This paper briefly reviews the constraints under which agriculture labors, discusses the agricultural achievements during the past five years—focusing on agriculture's performance in 1975 and its impact on the rest of the economy—and examines the Tenth Five-Year Plan goals released thus far.[3]

II. Background

The Soviet farm sector has made considerable progress in the face of serious environmental contraints, constraints that include highly variable weather conditions. Agricultural production generally is sufficient to provide consumers with enough to eat in terms of daily calories, even though their diet is heavily weighted with starches and deficient in meat, vegetables, and fruit. Environmental factors notwithstanding, however, the agricultural sector—given the resources invested and the products obtained—suffers from low productivity and ineffective management.

The environmental constraints on agriculture are formidable. Three-fourths of the U.S.S.R.'s own area is climatically comparable to the Prairie Provinces of Canada and the Northern Great Plains area in the United States. As in these analogous areas, the Soviet Union's agricultural land is relatively deficient in heat, moisture, and nutrients. Almost one-third of the U.S.S.R. is too cold for agriculture, and an additional two-fifths is so cold that only hardy, early-maturing crops can be grown. Only in the southern U.S.S.R. is the available warmth sufficient to permit a wide range of crops. Moisture deficiency is also a major problem. Drought-resistant plant varieties are being developed and dry-farming techniques improved, but irrigation remains the most effective solution. Irrigation, however, is costly in both capital and labor, and in some regions soil deterioration makes the benefits of irrigation difficult to sustain. The Soviet Union has some comparatively good soils, but natural soil fertility supplies only a part of plant nutrient requirements. Proper pairing of soil and crop, correct crop rotation, and large quantities of organic and mineral fertilizers and of trace elements are necessary.

As a result of these and other factors, the farmland of the U.S.S.R. is less productive than that of the United States. Even with a larger area under crops in the Soviet Union, production is less than in the United States (see table 1). Soviet agricultural output was about 70 percent of the U.S. level in 1960. Since that time the value of Soviet output has increased by about 45 percent and by the early 1970s stood at about four-fifths of U.S. production.[4] However, Soviet farm output

[3] The author wishes to thank Constance B. Krueger for assistance with input data and for research on prices used to calculate the value of net agricultural production and Jonetha Lynard for help in preparing several of the tables used in this paper.

[4] For a more comprehensive comparison of agricultural production in the two countries, see F. Douglas Whitehouse and Joseph F. Havelka, "Comparison of Farm Output in the US and USSR", U.S. Congress, Joint Economic Committee, "Soviet Economic Prospects for the Seventies," U.S. Government Printing Office, Washington, D.C., 1973.

TABLE 1.—U.S.S.R. AND UNITED STATES: AGRICULTURAL PROFILE, 1974

	U.S.S.R.	United States	U.S.S.R. as a percent of United States
Agriculture's share of gross national product (percent)[1]	17.6	2.6	NA
Agriculture's share of the labor force (percent)	26.3	3.7	NA
New fixed investment in agriculture per worker as a percent of new fixed investment per worker in industry (percent)	.5	3.2	NA
Area sown (million hectares)	216.5	[2] 137.4	157.6
Fertilizer application (million metric tons of nutrients)	15.0	[3] 17.5	85.7
Stock of agricultural machinery (thousands):			
Tractors	2,267	4,376	51.8
Trucks	1,336	2,906	45.9
Combines	673	698	96.4
Agricultural output:			
Food grain:[4]			
Area (million hectares)	70.0	20.5	341.5
Production (million metric tons)	[5] 89.9	43.5	206.7
Yield (centners per hectare)	12.8	21.3	60.1
Feed grain:[6]			
Area (million hectares)	46.6	35.1	132.8
Production (million metric tons)	[5] 72.6	133.9	54.2
Yield (centners per hectare)	15.6	38.1	40.9
Potatoes (million metric tons)	81.0	48.6	166.7
Meat (million metric tons)[7]	14.6	17.2	84.9
Milk (million metric tons)	91.8	[8] 52.3	175.5

[1] Share of GNP at factor cost originating in agriculture in 1970 prices for the U.S.S.R. and in 1972 prices for the United States.
[2] Based on 1969 land census.
[3] 1973.
[4] Wheat, rye, and rice.
[5] Official Soviet production data minus an estimated 3 percent handling loss and an estimated 8 percent waste resulting from excess moisture and extraneous matter. See footnote 2 on p. 576.
[6] Corn, oats, and barley.
[7] Carcass weight equivalent. U.S. data exclude edible byproducts (horsemeat, rabbit, poultry game, edible offal, and lard).
[8] Whole milk.

Source: Data are in large part found in "Survey of Current Business" and "Agricultural Statistics: 1975" for the United States, "Narodnoye khozyaystvo S.S.S.R. v 1974 godu" for the U.S.S.R. Methodology for computing GNP data for the U.S.S.R. is discussed in "U.S.S.R.: Gross National Product Accounts, 1970," Central Intelligence Agency, A(ER) 75-76, November 1975.

is still dominated by breadgrains and potatoes—the U.S.S.R. normally produces about twice as much wheat as the United States but less than one-tenth as much corn—while output of higher quality foods, particularly meat and fruit, lags far behind that of the United States and is not sufficient to satisfy the growing demands of the Soviet consumer.

Institutional problems compound the effects of environmental constraints. Agriculture has been structured with emphasis on control rather than efficiency. Moreover, in terms of management and labor, agriculture historically has been a residual claimant. As a consequence, productivity is low. The U.S.S.R. maintains more than one-fourth of its labor force in agriculture, a farm labor force eight times the size of the agricultural work force in the United States. Incentives, in the form of both monetary rewards and improved living conditions, have not been sufficient to keep the younger, better-trained workers in the countryside. More importantly, the institutional setting has blunted the effectiveness of the massive resources invested in agriculture during the last decade.

III. Plan and Performance, 1971–75

The Ninth Five-Year Plan period was a mixture of success and failure: a period difficult to characterize because of the extreme year to year fluctuation in agricultural output. Years of record and near-

record output were interspersed with harvest failures. On balance, though, it must have been a disappointing five years for the leadership. Investment goals were consistently met, but output targets were almost as consistently missed. Moreover, agriculture's problems disrupted overall economic growth, and large expenditures of hard currency were required to buy grain in order to keep the livestock program from total collapse.

A. Agricultural Production

Farm output oscillated during the past five years. For the period as a whole, net production fell at an annual average rate of 0.6 percent, with crop production down 2.2 percent yearly and output of livestock products up 0.7 percent (see table 2).[5]

These figures mask agriculture's performance, however, reflecting the good base year 1970 and the disastrous terminal year 1975. In 1971, output held at the 1970 level but dropped 6½ percent in 1972, the result of a severe winter and a summer drought centered in the Volga valley. An expansion in sown area and good weather led to record production in 1973, an increase of almost 15 percent with crop output up 30 percent for the year. The following year, a late summer drought in eastern Kazakhstan, among other problems, cut crop production 12 percent, but livestock products grew 8½ percent, keeping the total value of farm output close to the 1973 record. Finally, in 1975, a prolonged drought that affected most of the Soviet Union's cropland cut the size of the harvest another 11 percent. A shortage of feed led to distress slaughtering of livestock, mainly hogs and poultry. Livestock products were down 6 percent and net agricultural production fell 8½ percent.

[5] Net agricultural production is the estimated value of agricultural output for sales and home consumption, using 1970 prices, minus farm products used for seed and livestock feed and including changes in inventories of livestock. For additional tabular material and a short discussion of the methodology used to measure net agricultural production, see the Appendix.

TABLE 2.—U.S.S.R.: PLANNED AND ACTUAL PRODUCTION OF MAJOR CROPS AND ANIMAL PRODUCTS, SELECTED YEARS

	Average annual							Average annual		
	1966–70 plan	1966–70 actual	1971	1972	1973	1974	1975	1971–75 plan	1971–75 actual	1976–80 plan
Rate of growth (percent):										
Total value of farm output [1]	[2] 5.3	4.5	0.1	−6.5	14.9	−1.3	−8.4	[2] 4.4	−0.6	[2] 5.5
Crops [3]	NA	5.5	−1.2	−10.7	29.6	−11.8	−11.3	NA	−2.2	NA
Animal products [4]	NA	3.7	1.2	−3.2	4.0	8.5	−6.3	NA	.7	NA
Production of major farm commodities (million metric tons):										
Grain	167.0	167.6	181.2	168.2	222.5	195.7	140.0	195.0	181.5	215–220.0
Potatoes	100.0	94.8	92.7	78.3	108.2	81.0	88.5	106.0	89.7	[5] 102.0
Sugar beets	80.0	81.1	72.2	76.4	87.0	77.9	66.2	[5] 87.0	75.9	95–98.0
Sunflower seeds	NA	6.4	5.7	5.0	7.4	6.8	5.0	[5] 6.8	6.0	[5] 7.6
Vegetables	NA	19.5	20.8	19.9	25.9	24.8	22.3	24.7	22.8	[5] 28.1
Cotton	5.6–6.0	6.1	7.1	7.3	7.7	8.4	7.9	6.8	7.7	[5] 8.5
Meat	11.0	11.6	13.3	13.6	13.5	14.6	15.2	14.3	14.0	15–15.6
Milk	78.0	80.6	83.2	83.2	88.3	91.8	90.8	92.3	87.4	94–96.0
Wool (thousand tons)	NA	398.0	429.0	420.0	433.0	462.0	463.0	464.0	441.0	[5] 473.0
Eggs (billion)	34.0	35.8	45.1	47.9	51.2	55.5	57.7	46.7	51.5	58–61.0

[1] Agricultural output for sales and home consumption minus farm products used for seed and livestock feed. Price weights for 1970 have been used in aggregating the physical output of crops and animal products (including changes in inventories of livestock).

[2] Plan for growth of gross volume of agricultural output.

[3] Value of food and technical crops less seed but including the portion fed to livestock.

[4] Value of output of meat, milk, eggs, wool, and other livestock products less livestock feed and adjusted for changes in herd inventories.

[5] Calculated using the implied average annual rate of growth derived from production data in the base year and planned output in terminal years.

[6] Gusev, N. "Glavnaya vadacha sel'skogo khozyaystva v desyatoy pyatiletke," "Ekonomika sel'skogo khozyaystva," No. 8, 1976, pp. 14-26.

Source: Production statistics for 1966–74 from "Narodnoye khozyaystvo S.S.S.R. v . . . . godu," selected years. Data for 1975 are from preliminary press reports. Plan data for 1966–70 are from "Pravda," Apr. 6, 1966, p. 4, for 1971–75 from "Gosudarstvennyy pyatiletniy plan razvitiya narodnogo khozyaystva S.S.S.R. na 1971–75 gody," pp. 167, 169–70, and for 1976–80 from "Pravda" Mar. 7, 1976, pp. 2–8.

Soviet officials tend to blame the weather for agricultural shortfalls, while timely organization and good management are given credit for successful crops. Paradoxically, however, weather during 1970–74 was generally good and relatively stable. Average cumulative precipitation for October through July during this time was higher than any five-year period since 1960 (see table 3). Periods of good weather and economic planning periods do not always coincide, unfortunately. Average annual precipitation for 1971–75 was about the same as for 1966–70. Table 3 also shows that no single weather variable explains yield. The temporal and spatial distribution of rain is difficult to measure, and short-lived weather phenomena, such as the hot, dry winds known as sukhovey, often do not appear in weather statistics but can have a marked effect on crop yield. For example, cumulative precipitation in 1973 was 11 percent less than in 1970, but yield was 13 percent greater. Precipitation was higher in 1974 than in 1973, but a late season sukhovey, which could not be detected on monthly weather summaries, cut yields. Nevertheless, precipitation is a rough measure of yields. In 1975, rainfall was similar to 1962 and 1965, as was yield.

TABLE 3.—U.S.S.R.: INDEXES OF PRECIPITATION, OCTOBER THROUGH JULY, AND GRAIN YIELD, 1961–75
[1966–70, annual average=100]

Year	Index of total precipitation, October–July[1]	Index of grain yield[2]
1961	83	78
1962	75	79
1963	67	60
1964	102	83
1965	82	69
Annual average, 1961–65	82	74
1966	100	100
1967	91	88
1968	96	102
1969	94	96
1970	119	114
Annual average, 1966–70	100	100
1971	106	112
1972	95	102
1973	106	128
1974	110	112
1975	78	79
Annual average, 1971–75	99	107
Annual average, 1970–74	107	114

[1] Precipitation in millimeters—available through the World Meteorological Organization reporting system—weighted by the distribution of the area sown to grain in 1973.
[2] Index of yields of all grain in centers per hectare from "Narodnoye khozyaystvo S.S.S.R. v.... gody," selected years.

Production of grain, the U.S.S.R.'s most important crop, fluctuated widely during 1971–75. Plans for an average harvest of 195 million tons were unrealized. The actual average crop was 181.5 million tons, with the plan for individual years met only once—by the record crop in 1973. The variance in the size of the grain crop, as measured by the deviation from a long-term trend line, far exceeded the variance in production during the Seventh and Eighth Five-Year Plan periods.

More important than the unfulfilled plans and the variations in production, the U.S.S.R. was twice caught between a poor harvest and the livestock program's growing demand for feed. Following the bad 1972 harvest, purchases of 23 million tons of grain from the West, worth approximately $1.5 billion, were enough to forestall distress slaughtering and tide the program over (see table 4). The more serious shortfall in 1975, however, resulted in purchases of 24 million tons

during fiscal year 1976, which cost about $3.6 billion.[6] These imports, even with a number of conservation measures, were not enough to support livestock inventories.

TABLE 4.—U.S.S.R.: EXPORTS AND IMPORTS OF GRAIN[1]
[In thousands of metric tons]

	Exports	Imports[2]	Net imports
Fiscal year:[3]			
1970	7,687	2,178	−5,509
1971	8,296	3,509	−4,787
1972	7,252	7,841	589
1973	5,331	22,900	17,659
1974	6,987	10,960	3,973
1975	4,134	5,582	1,448
1976[4]	0	25,528	25,528

[1] Includes grain equivalent of flour, converted using a 72 percent extraction rate, and groats.
[2] Including purchases on Soviet account for shipment to East European countries and other client states.
[3] Data are for fiscal years ending June 30 of the stated year. Data for fiscal years 1970–71 are an average of 2 calendar years.
[4] Estimates.
Source: "Vneshnyaya torgovlya S.S.S.R. za . . . gody," selected years and press accounts of grain trade.

Plans for other crops were also generally unfulfilled (see table 5). Cotton, which is primarily grown on irrigated land, was the notable exception. Production of cotton reached a new high each year until 1975, when output fell slightly but remained above plan. Only in the record year 1973 did production of other crops exceed planned levels.

TABLE 5.—U.S.S.R.: PLANNED AND ACTUAL OUTPUT DURING THE NINTH FIVE-YEAR PLAN PERIOD
[Million metric tons]

	Annual average 1971–75[1]	1971[2]	1972[2]	1973[3]	1974[4]	1975[5]
Grain:						
Plan	195.0	189.5	192.2	197.4	205.6	215.7
Actual	181.5	181.2	168.2	*222.5	195.7	140.0
Potatoes:						
Plan	106.0	99.8	102.8	105.0	107.9	109.8
Actual	89.7	92.7	78.3	*108.2	81.0	88.5
Sugar beets:						
Plan	87.0	81.5	84.2	87.4	91.3	94.0
Actual	75.9	72.2	76.4	87.0	77.9	66.2
Vegetables:						
Plan	24.7	22.3	23.4	24.5	26.1	27.4
Actual	22.8	20.8	19.9	*25.9	24.8	22.3
Cotton:						
Plan	6.8	6.3	6.5	6.8	7.3	7.7
Actual	*7.7	*7.1	*7.3	*7.7	*8.4	*7.9
Sunflower seeds:						
Plan	6.8	6.4	6.6	6.8	7.1	7.4
Actual	6.0	5.7	5.0	*7.4	6.8	5.0
Meat:						
Plan	14.3	12.9	13.6	12.9	14.4	15.3
Actual	14.0	*13.3	*13.6	*13.5	*14.6	15.2
Milk:						
Plan	92.3	85.6	89.0	86.2	90.8	94.8
Actual	87.4	83.2	83.2	*88.3	*91.8	90.8
Eggs:						
Plan (billion)	46.7	42.6	44.6	47.5	53.5	55.8
Actual (billion)	*51.5	*45.1	*47.9	*51.2	*55.5	*57.7
Wool:						
Plan (TMT)	464	433	448	434	460	472
Actual (TMT)	441	429	420	433	*462	463

[1] Original ninth five-year plan given or derived from data in "Gosudarstvennyy pyatiletniy plan razvitiya narodnogo khozyaystvo S.S.S.R. na 1971–75 gody," pp. 167 and 169–70.
[2] Output plans for 1971 and 1972 are derived from actual 1970 production and planned average output for 1971–75. For sugar beets, cotton and sunflower seed, planned output for 1975 was available.
[3] Gusev, N., "Sel'skoye khozyaystvo v reshayushchem gody pyatiletki", "Ekonomika sel'skogo khozyaystva," No. 2, 1973, p. 8.
[4] Gusev, N., "Sel'skoye khozyaystvo v opredelyayushchem gody pyatiletki"; "Ekonomika sel'skogo khozyaystva," No. 2, 1974, p. 3.
[5] Gusev, N., "Plan zavershayushchego goda pyatiletki", "Ekonomika sel'skogo khozyaystva", No. 2, 1975, p. 5.
*Indicates plan fulfillment.
Sources: Production statistics from "Narodnoye khozyaystvo S.S.S.R. v . . . . gody," selected years. Other sources given above.

[6] For delivery during fiscal year 1976. Another 2.7 million tons were bought for delivery between June and October 1976, while further purchases were made for delivery after October.

The record for the livestock sector is somewhat better, in large part due to the massive grain imports. The value of livestock inventories grew at an average annual rate of 1.2 percent during 1971–75. Cattle inventories in the socialized sector grew steadily while in both private and socialized sectors the number of hogs—heavy grain consumers—dropped in 1972 and 1975 as feed supplies became scarce. Meat production goals, which were reduced following the harvest problems in 1972, were met every year except 1975, when the target was missed by only 100,000 tons. Had premature marketing of lighter-than-normal animals not been necessary during the fall of 1975, this goal would also undoubtedly have been made. Egg production exceeded planned levels throughout the period, while milk and wool targets were reached in 1973–74 and 1974, respectively.

B. The 1975 Crop Shortfall and Its Effects

The 1975 crop failure was the worst during the Brezhnev period, jeopardizing the much touted program to improve consumers' diets. Production of all major crops suffered from the severe drought. The 140 million ton grain crop was roughly 50 million tons below the average for 1971–74 and the worst in the postwar period when measured as a deviation from the long-term trend. Output of other major crops such as sugar beets and sunflower seeds—an important source of vegetable oil—was also below 1974 levels. Further, the drought dried up pastures and reduced supplies of forage crops, compounding the shortage of feedgrains.

Grain production was less than two-thirds of needs, hitting the livestock sector the hardest. The regime did everything it could to maintain herds, using such stopgap measures as shipping animals from drought to non-drought areas and feeding reeds, leaves, and other low-grade feed stuffs to starving livestock. In addition, normal grain exports were apparently cancelled. Finally, the U.S.S.R. contracted for about 27 million tons of foreign grain for delivery by October 1976. In this connection, the Soviets for the first time commited themselves to a long-term grain import agreement with the United States for the purchase of 6 to 8 million tons per year for the five years beginning October, 1976.[1]

Despite these measures feed supplies were inadequate. As a result, state and collective farms began distress slaughtering of hogs and poultry by late summer. Private farmers, who provide about one-third of the country's meat and own over two-fifths of the hogs and cattle and about half of the poultry, followed suit. Consequently, inventories of hogs and poultry dropped 20 percent and 15 percent respectively during 1975. Sheep and cattle were relatively unaffected (see table 6). Despite the sharp decrease in the number of animals during the fourth quarter of 1975, meat output did not increase noticeably. Part of the reduction in livestock numbers reflected decisions to reduce farrowing and hatching rates, while the prematurely killed animals were underweight.

[1] Under the terms of the agreement exceptions can be made. The U.S. may sell less than 6 million tons if it declares a shortage. It may sell more than 8 million tons if the U.S.S.R.'s need is exceptional and U.S. supplies permit.

TABLE 6.—U.S.S.R.: LIVESTOCK INVENTORIES

	Annual average, 1966–70	1971	1972	1973	1974	1975
Index of total livestock inventories (1970=100)[1]	94.7	103.6	103.4	106.4	109.5	105.9
Number of livestock (million head, end of year):						
All sectors of the economy:						
Cattle	96.9	102.4	104.0	106.3	109.1	111.0
Hogs	56.3	71.4	66.6	70.0	72.3	57.8
Sheep and goats	142.1	145.3	144.7	148.5	151.2	146.9
Poultry	566.9	686.5	700.0	747.7	792.4	[2]674.0
Socialized sector:						
Cattle	69.9	77.5	79.3	81.7	84.6	87.6
Hogs	41.6	55.6	53.3	56.4	58.6	45.6
Sheep and goats	108.9	112.6	112.4	116.4	119.2	117.7
Private sector:						
Cattle	27.0	24.9	24.7	24.6	24.5	23.4
Hogs	14.7	15.8	13.3	13.6	13.7	12.2
Sheep and goats	33.2	32.7	32.3	32.1	32.0	29.2

[1] Index of end-of-year inventories for cattle, hogs, sheep, goats, and poultry weighted by relative liveweight prices in 1970.
[2] Estimate.

Sources: "Narodnoye khozyaystvo S.S.S.R. v . . . godu," selected years and "S.S.S.R. v tsifrakh v 1975 godu."

In general, the consumer was unaffected during 1975 by agriculture's problems. An inventory of processed foods, coupled with the usual lag between a crop shortfall and a downturn in livestock production, kept enough food in the marketing pipeline. For the year as a whole, per capita food consumption increased 1½ percent and meat consumption was up 1 percent, reaching a record level. Meat prices rose in the free markets, but this was due not to shortages but rather to higher incomes and greater demand.[8]

Because agriculture accounts for roughly one-fifth of Soviet gross national product, growth in GNP slumped to about 2½ percent in 1975, down from 4 percent in 1974 and an average annual rate of 4½ percent in 1971–73. Other sectors of the economy were not visibly affected by agriculture's problems in 1975. Industrial output in particular equaled the average annual rate achieved for the 1971–74 period. The rate of growth in the other principal sectors either maintained the same pace (services and transportation) or fell moderately (construction). The delivery of $2.8 billion worth of grain, however, combined with a rapid rise in most categories of imports and very little export growth to push the Soviet hard-currency deficit in 1975 to about $6.3 billion.

The main impact of the 1975 crop failure is being felt this year. The consumer has been hardest hit, but growth of industrial production and GNP also is being slowed, and the Soviets continue to carry a large hard-currency trade deficit. Moreover, the U.S.S.R.'s agricultural situation remains precarious with carry-over stocks of grain depleted, livestock herds reduced, remaining livestock underfed, and output goals dependent on above-average weather.

Probably the most serious problem in 1976 is the expected drop in meat consumption. At the beginning of the year, domestic and imported feed supplies were not sufficient to support already reduced livestock inventories. Distress slaughtering continued during the

[8] In addition to the state-run retail network, some food products are sold in collective farm markets where farmers sell excess produce from their private plots and where prices fluctuate according to supply and demand.

spring, but because animals continued to be slaughtered at lighter-than-normal weights meat production dropped off. Meat production in government-operated packing plants during January through July was off 21 percent from a year earlier. Meat shortages were widely reported in the Western press.[9] As feed supplies improve during the summer and fall—assuming normal weather and a reasonable crop outlook—efforts to rebuild the average weight of animals in order to support breeding and get the livestock program back on track may keep meat production at depressed levels.

Per capita meat consumption in 1976 may drop as much as one-quarter. This would return the consumer to the level of the late 1960s. Although per capita consumption of meat has increased 21 percent since 1970, and 48 percent since 1960, the average Soviet citizen still eats only two-fifths as much meat as his U.S. counterpart and three-fourths as much as the average Pole or Hungarian.

In addition, an expected downturn in egg and milk production from 1975 levels, albeit less severe, will further erode the quality of the Soviet diet. This decrease in availability of livestock products will temporarily reverse the steady decline in the share of starchy staples in the average Soviet diet. Bread and potatoes currently account for about one-half of the calories consumed.

Agriculture is expected to slow GNP growth again in 1976. Even if favorable weather provides a substantial expansion in crop production, the roughly 8½ percent rebound in farm output for 1976 projected in the Five-Year Plan appears optimistic. Despite the improvement in feed supplies that such weather would bring, production of meat will drop in 1976 and cannot expand substantially until livestock herds are built up again. This takes time—a year or so for pigs, but several years for cattle.

C. Agricultural Inputs

The farm sector's problems in 1971–75 were not the result of a reduced commitment to agriculture. Resource flows to agriculture grew steadily and were not cut back after bumper harvests. Ambitious plans for agricultural investment and for the delivery of machinery and materials to the farms were, with only minor exceptions, met.

New fixed investment during the last five years grew at an average annual rate of over 9½ percent, faster than the rate achieved in 1966–70 and planned for 1971–75. Moreover, investment in agriculture grew almost two-thirds faster than investment in the remaining sectors of the economy. As a result, agriculture's share of investment for the five-year period as a whole amounted to about 26 percent.[10]

In addition to direct investment, farms benefit from investment in other branches of the economy. When agriculture is defined in its broadest terms to include additions to production capacities in

[9] For example, see "A Meatless Day Begun in Moscow," New York Times, May 16, 1976, page 6, "Soviet Fish Days," The Washington Post, May 16, 1976, page A17, and "Soviets Quietly Cut Meat Content in Sausages," Ibid., June 8, 1976, page A11.

[10] Includes productive investment, such as the purchase of agricultural machinery, as well as investment for non-productive purposes such as housing. Alone, productive investment in agriculture amounts to about 20 percent of the economy's total investment. In the United States, productive investment in agriculture is less than 5 percent of total investment.

branches supporting agricultural development, "agricultural investment" grew at an annual average rate of 10½ percent during the Ninth Five-Year Plan period and amounted to slightly more than 34 percent of the economy's investment funds.[11]

Support of agriculture from industry also generally met planned levels. Deliveries of trucks and agricultural machinery grew steadily, meeting or slightly exceeding the plan (see table 7). The number of tractors and combines sent to the farms narrowly missed planned goals, but shipment of newer, greater horsepower machines upgraded existing parks. Efforts to improve cropland also continued. Deliveries of fertilizer averaged a little more than 61 million tons per year and reached 75.4 million tons in 1975, 400,000 tons above plan (see table 8). Lime, needed to neutralize acid soil and to maximize the beneficial effects of fertilizer, was applied to an average of 6 million hectares a year, 1½ million hectares above the yearly average for 1966–70. The gross addition of irrigated land far exceeded plans while the area drained was somewhat short of the target.

TABLE 7.—U.S.S.R.: DELIVERIES OF MACHINERY AND EQUIPMENT TO AGRICULTURE, PLANNED AND ACTUAL

	Annual average							Annual average		
	1966–70 plan	1966–70 actual	1971	1972	1973	1974	1975	1971–75 plan	1971–75 actual	1976–80 plan
Deliveries to agriculture of:										
Tractors:										
Thousand units	358	293	313	313	323	348	370	340	333	380
Rate of growth[1]	[2]13.7	5.2	1.3	−0.1	3.3	7.7	6.4	[2]3.2	3.7	[2]0.9
Trucks:										
Thousand units	220	143	169	188	225	251	269	220	220	270
Rate of growth[1]	[2]29.7	10.7	8.2	10.7	19.9	11.6	7.4	[2]11.6	11.5	[2]0.1
Agricultural machinery:										
Billion rubles	2.2	1.8	2.5	2.7	3.1	3.5	3.8	3.1	3.1	4.6
Rate of growth[1]	[2]11.3	7.2	16.0	11.4	13.1	11.9	8.9	[2]12.9	12.2	[2]6.6
Of which, combines:										
Thousand units	110	94	99	93	82	83	92	109	90	108
Rate of growth	[2]11.1	4.1	2.0	−6.3	−12.2	2.3	10.3	[2]3.8	−1.1	[2]5.3

[1] Rates of growth computed from unrounded data.
[2] Constant rates of growth derived from actual deliveries in the base year and planned total deliveries for the succeeding five-year period.

Sources: "Narodnoye khozyaystvo S.S.S.R. v.... gody," selected years, "S.S.S.R. v tsifrakh v 1975 gody," and yearly plan fulfillment reports.

[11] Since the beginning of the Ninth Five-Year Plan, annual plans and plan fulfillment reports have presented a concept of gross fixed investment in agriculture that includes: (1) investment for such items as construction and equipping of livestock shelters, irrigation and drainage construction, electrification, expenditures for tractors, transport means, agricultural machinery and equipment; (2) investment for construction of housing, schools, clubs, hospitals; and also (3) expenditures for construction of repair enterprises, for agricultural scientific-research institutions, for development of various construction enterprises, and other expenditures entering into the complex of expenditures for the development of agriculture.

A second and larger concept of gross fixed investment in agriculture has also emerged, that is, gross fixed investment in agriculture and branches supporting its development. This concept includes gross fixed investment as defined above and also: (1) Gross fixed investment in additions to production capacities in branches supporting agricultural development (for the most part industrial branches) and (2) gross fixed investment in housing construction in rural areas financed with funds of collective farm members and wage and salary workers. While some data regarding these expenditures are available for the 1976 Plan, no data are available for the 1976–80 Plan as a whole.

TABLE 8.—U.S.S.R.: EFFORTS TO IMPROVE CROPLAND, PLANNED AND ACTUAL[1]

	Annual average							Annual average		
	1966–70 plan	1966–70 actual	1971	1972	1973	1974	1975	1971–75 plan	1971–75 actual	1976–80 plan
Mineral fertilizer, deliveries to agriculture:[2]										
Million tons, standard units	41.4	37.0	50.5	54.8	60.0	65.9	75.4	60.6	61.3	93.4
Percent increase	15.2	11.0	10.7	8.4	9.5	9.8	14.5	10.4	10.6	9.7
Area limed:										
Million hectares	6.0	4.5	5.2	5.5	[4] 5.9	[4] 6.4	[4] 7.0	6.4	6.0	8.0–10.0
Percent increase	[3] 25.5	11.7	3.3	6.4	8.3	8.3	8.3	[3] 8.4	7.0	[3] 4.5-12.1
Gross addition of irrigated land:										
Thousand hectares	550.0	360.0	515.0	784.0	960.0	1,090.0	1,250.0	800.0	920.0	980.0
Percent increase	[3] 11.3	—.4	33.4	52.2	22.4	13.5	14.7	[3] 25.5	26.0	[3] —8.0
Gross addition of drained land:										
Thousand hectares	1,250.0	782.0	834.0	837.0	905.0	815.0	1,017.0	1,000.0	882.0	940.0
Percent increase	[3] 19.6	2.9	2.3	.4	8.1	—9.9	24.8	[3] 6.9	4.5	[3] —2.6

[1] Rates of growth calculated from unrounded data.
[2] Includes feed additives.
[3] Constant rates of growth derived from actual performance in the base year and planned total performance for the succeeding five-year period.
[4] Estimated.

Source: "Narodnoye khozyaystvo S.S.S.R. v . . . . gody," selected years, "S.S.S.R. v tsifrakh v 1975 gody," and yearly plan fulfillment reports.

Although total deliveries of machinery and gross addition of irrigated and drained land are impressive and reflect agriculture's high priority for investment funds, they can be somewhat misleading. Retirement rates are high, and stocks, whether tractor parks or area under irrigation, grow more slowly. For example, although approximately 1.7 million tractors and 449,000 combines were delivered to agriculture during 1971–75, parks grew by only 423,000 and 67,000, respectively. Retirement rates of improved land are even higher, averaging roughly one-quarter of gross additions.

IV. The Tenth Five-Year Plan

The Tenth Five-Year Plan has already been tarnished by the 1975 crop disaster. In contrast to the last five-year plan, which followed a series of relatively successful years, the present plan is beginning with shattered momentum in the agricultural sector, depleted reserves, a population unhappy about food shortages, and an economy that is vulnerable to further setbacks. Basic agricultural policy has not been changed, however. Indeed, few options are available to the leadership.

Output plans for the Tenth Five-Year Plan are generally consistent with or above long-term trends. The targets for livestock products have been cut back in response to last year's harvest disaster but remain tied to an ambitious herd rebuilding program. On the other hand, the planned growth in the flow of resources to agriculture, although in keeping with the investment program for the rest of the economy, has been sharply reduced from the last Five-Year Plan. Deliveries of fertilizer will continue to grow at an average annual rate of roughly 10 percent, but little expansion in land melioration efforts is planned, and deliveries of equipment will grow only slightly. Major increases in productivity must therefore be realized and weather conditions must be above-average if the agricultural targets are to be met.

A. Output

The gross value of output of agricultural production is to increase at an average annual rate of about 5½ percent in 1976–80. This rate exceeds the growth planned for 1966–70 and 1971–75. At first glance this increase appears only moderately ambitious, based as it is on the bad showing in 1975. Success, however, will depend largely on the size of the grain crop.

Grain production during 1976–80 is to average 215 to 220 million tons yearly (see table 9). Grain production in 1976 is planned at 205–210 million tons.[12] If the 1976 plan is met, production in 1977–80 would have to appear somewhat as follows, assuming a constant average annual rate of growth, if the 1976–80 plan is to be fulfilled.

[12] Planned grain production in 1976 was given as "14 percent higher than average annual production in the Ninth Five-Year Plan", 181.5 million tons.

TABLE 9.—U.S.S.R.: AVERAGE ANNUAL OUTPUT OF MAJOR CROPS AND ANIMAL PRODUCTS, 1966–70 PLAN AND ACTUAL, 1971–75 PLAN AND ACTUAL, AND 1976–80 PLAN

[In million metric tons]

	Average annual, 1966–70			Average annual, 1971–75			Average annual, 1976–80	
	Plan	Increase in plan over actual average for preceeding five years (percent)	Actual	Plan	Increase in plan over actual average for preceeding five years (percent)	Actual	Plan	Increase in plan over actual average for preceeding five years (percent)
Grain	167.0	28.2	167.6	195.0	16.4	181.5	[1] 217.5	19.8
Potatoes	100.0	22.6	94.8	106.0	11.8	89.7	102.0	13.7
Sugar beets	80.0	35.1	81.1	[2] 87.0	7.3	75.9	[1] 96.5	27.1
Cotton	[3] 5.8	16.2	6.1	[4] 6.8	10.7	7.7	[3] 8.5	10.4
Meat	11.0	18.3	11.6	14.3	23.3	14.0	[1] 15.3	9.3
Milk	78.0	20.6	80.6	92.3	14.5	87.4	[1] 95.0	8.7
Eggs (billion)	34.0	18.5	35.8	46.7	30.4	51.5	[1] 59.5	15.5

[1] Midpoint of planned range of average annual production of 215,000,000 to 220,000,000 tons for grain, 95,000,000 to 98,000,000 tons for sugar beets, 15,000,000 to 15,600,000 tons for meat, 94,000,000 to 96,000,000 tons for milk and 58,000,000,000 to 61,000,000,000 eggs.

[2] Calculated using the implied average annual rate of growth derived from production data in the base year and planned output in the terminal year.

[3] Midpoint of planned range of average annual production of 5,600,000 to 6,000,000 tons.

[4] Rounded from planned average annual production of 6,750,000 tons.

Sources: Production statistics for 1966–74 are from "Narodnoye khozyaystvo S.S.S.R. v . . . . godu," selected years Data for 1975 are from "S.S.S.R. v tsifrakh v 1975 godu." Plan data for 1966–70 are from "Pravda," Apr. 6, 1966, p. 4, for 1971–75 from "Gosudarstvennyy pyatiletniy plan razvitiya narodnogo khozyaystva S.S.S.R. na 1971–75 gody," p. 167, 169–70, and for 1976–80 from "Pravda," Mar. 7, 1976, pp. 2–8.

Grain production

	Million metric tons
1976	207
1977	212
1978	217
1979	223
1980	228
Average, 1977–80	220

The overall grain production plan coincides perfectly with the 1950–74 trend line but appears optimistic. When the 1975 harvest is included in the trend calculation, average grain production for 1976–80 drops to 205 million tons. Such a projection, of course, assumes normal weather, but the frequency of weather-related crop shortfalls in the past—notably 1963, 1965, 1972, and 1975—suggest that one or perhaps two of the next five years will be unfavorable, making fulfillment of the grain production plan unlikely.

More intensive fertilizer applications are to account for the bulk of this increased grain production—about 55 percent. In addition, there is to be some restructuring and expansion of the grain area. Higher-yielding grains such as winter wheat, winter rye, spring barley, and corn are to be emphasized. The area under pulses is also to expand. Land reclamation and the use of fertilizer on pastures and other fodder crops is to increase yields of these crops to the extent that some of this pastureland can be switched to grain. Double cropping on irrigated land and the expanded use of irrigated land for grain are also to boost production. In addition, improvement of the soil will support the program. By Soviet account about 12 million tons of grain are foregone each year due to inadequate liming. Moreover, the availability of higher-quality machinery is to improve the timeliness

of sowing and harvesting operations, allowing the harvest of another 6 million tons of grain yearly.[18]

Data on plans for other crops are scanty. Production of cotton is to reach 9 million tons by 1980, a plan that will undoubtedly be overfulfilled. Output of sugar beets is to average 95 to 98 million tons for the five years, consistent with projections based on a long-term trend. Plans for other crops—including potatoes, an important food and feed crop—have not yet been released.

Output targets for livestock products were apparently reduced in the wake of the distress livestock slaughtering stemming from last year's poor crop. Average production of meat (15–15.6 million tons), milk (94–96 million tons), and eggs (58–61 billion eggs) are only slightly above the levels achieved in 1975. Even so, the reduced plans are ambitious. For example, the 1975 setback in the livestock program probably will limit meat production in 1976 to about 12 million tons. Fulfillment of the plan would then require a staggering 12 percent average annual increase in meat output during the remainder of the Five-Year Plan period. If grain production falters, the Soviets will be forced to rely on continuing substantial imports of grain to meet the plan for livestock products.

B. Investment Goals

Agriculture will maintain its priority among resource claimants during the next five years. As shown below, about one-fourth of new fixed investment in 1976–80 will go to agriculture, as it did during the past two plan periods.

Agriculture's share of new fixed investment

	Percent
1961–65	19.6
1966–70	23.2
1971–75, plan	25.7
1971–75	26.2
1976–80, plan	26.9

Yearly growth in the amount of funds channeled to agriculture will be cut substantially, however. Investment is to grow at an average annual rate of only 3½ percent, a sharp reduction from the 9½ percent recorded during 1971–75. The slowdown seems to be largely a reflection of a general tightening of investment funds throughout the economy rather than a reaction to either the good or bad harvest of the past five years. Investment in sectors other than agriculture is scheduled to grow at a yearly rate of about 4 percent.

On the whole, plans for the commitment of resources to agriculture during 1976–80 are somewhat puzzling. Deliveries of mineral fertilizer will continue to grow at high average annual rates and the area limed will increase yearly. Average annual gross additions to irrigated and drained cropland, however, will be somewhat below the 1975 level. Growth in deliveries of tractors, trucks, and agricultural machinery will slow appreciably. These plans are consistent with the overall design for the economy, that is an increase in productivity

[18] Stepanov, A. I., "Grain Economy Must Be Developed Thoroughly," Zernovoye khozyaystvo. No. 3, 1976, pp. 18–19, and Ibid., pp. 2–3.

is to be the prime source of growth. Considering the planned increases in output, however, the investment strategy would seem to stress efficiency and productivity gains not warranted by agriculture's record.

Fertilizer deliveries are the only inputs scheduled to continue to increase at past rates. Deliveries to agriculture are to grow at an average annual rate of 9.7 percent, compared with the 10.6 percent yearly rate achieved in 1971–75. By 1980, 120 million tons of fertilizer, including five million tons of feed additives, will be sent to the farms, three-fifths more than the amount delivered last year. Increased application of fertilizer is to account for over one-half of the planned rise in grain production. Until recently, fertilizer application schedules have favored technical crops and potatoes. Applications to grain are increasing, however. In 1975 the amount of fertilizer applied to grain was ten times the level in 1960. Applications to grain are to increase another 75 percent by 1980 and are to be directed to those areas with adequate moisture—such as the Non-Black Soil Zone—where response rates are the greatest.

Much of the fertilizer earmarked for agriculture in 1976–80 will not be available until late in the period. The capacity to produce the 120 million tons for 1980 delivery won't be available until 1978 or 1979. Given the deliveries planned for 1976 and 1980, as well as the total amount scheduled for delivery in 1976–80, it appears that deliveries will grow by about 4 or 5 percent yearly through 1978 and then shoot upward in 1979 and 1980. If this schedule holds, almost half of the fertilizer delivered to agriculture in 1976–80 will be received during the last two years. The effect on grain yields will therefore not be steady. Moreover, planned applications to grain will be difficult to meet unless losses in transportation and storage—currently some 10 to 15 percent—are reduced.

Efforts to improve the quality of cropland will also be continued. The area limed is to average 8 to 10 million hectares yearly, against the 6 million hectares averaged during 1971–75. Application of lime will be a key ingredient in the program to raise productivity in areas such as the Non-Black Soil Zone of European Russia. The average yearly gross addition to irrigated and drained land during 1976–80 will be smaller than the area added in 1975. If current retirement rates are maintained, however, the area of improved land will grow by about 7 million hectares in 1976–80, equal to the net addition in 1971–75. The stock of improved land would increase even more if the area retired each year could be reduced. These improvements are noteworthy. While much of this improved land is used for technical crops such as cotton, a growing share is devoted to grain. Average grain yields in 1972–74 were two-thirds greater on irrigated and drained land than on non-improved land. Moreover, year to year variation in yields on improved land is less.

Scheduled shipments of tractors, trucks, and agricultural machinery, will also grow at sharply reduced rates. Deliveries of tractors are scheduled to grow about one percent yearly, while the average yearly number of trucks received will approximate the 1975 level. Agricultural machinery delivered will increase about 6½ percent yearly, but this is only one-half the rate for 1971–75. Delivery of

combines, a major component of agricultural machinery, is to grow at an average annual rate of about 5½ percent, following below-plan performance in 1971–75.

The slowdown in the delivery of equipment, especially tractors, in part reflects the fact that the industry is approaching its output capacity. In order to increase substantially the deliveries of agricultural machinery a complex changeover to a second shift or addition of new production capacity would be required. Given lags in construction and commissioning of new capacity—as well as the competition from similar projects such as the Kama truck plant and the Baikal-Amur mainline railroad for funds to buy capital equipment—building would have had to start years ago in order to bring this capacity on line during 1976–80. No program was started.

As in the case of other inputs, the slowdown in machinery deliveries may well be offset by other factors. The retirement rate for tractors dropped sharply in 1975. Lower retirement rates would allow faster-than-normal expansion of parks despite the slower growth in deliveries. Also the trend to larger tractors with greater horsepower and the recent introduction of new combine models will allow parks to be qualitatively improved. Improvement in the mix of associated farm equipment would further increase the productive capacity of existing parks, but the failure to produce complementary agricultural machinery for higher horsepower tractors has been one of the constant complaints of the last decade.

The regime may decide to make some short-run adjustments in its investment strategy. Some republic leaders have questioned the planned pattern of investment for farms, specifically the wisdom of continuing to build large-scale livestock complexes without first ensuring an adequate feed base. In addition, some middle-level planners, who in 1975 wrote bullish articles about farm achievements during the past decade, now stress agriculture's need for help from other sectors. The adjustments that could be made during the next five years, however, are few. Currently planned investment is largely designed to save labor. A transfer of resources, for example from construction of automated livestock feeders to production of traditional agricultural machinery, would emphasize increased output, but as discussed earlier, the agricultural machinery industry is facing capacity limitations. The alternatives may therefore be reduced to stimulation of the private sector and taking pains that the planned gains from improvements in the Non-Black Soil Zone are realized.

C. The Private Sector

By encouraging agriculture's private sector, the regime could boost the availability of selected food products without directly investing in their production. About one-quarter of total agricultural output, including one-fifth of the crops—mostly potatoes, fruits, and vegetables—as well as one-third of the livestock products, comes from private producers. Such high-quality products are in especially short supply this year.

Although the state does not invest directly in the private sector, private activity does have some cost. Private agricultural production

is almost exclusively made up of small holdings of land, up to one-half hectare, frequently combined with one or two head of livestock and a small flock of poultry. Private farmers also have access to additional areas for pasturing of livestock, and resources—including labor, young livestock, feed, and other materials—are siphoned, legally or illegally, from the farms to the private plots.

The long-run policy toward this sector has been constrictive, but restrictions have been temporarily relaxed after bad harvests. In the past, output in the private sector has been easily spurred by supplying more livestock and feed to individuals, reducing taxes, lowering barriers to the use of public lands, and allowing some urban residents to own livestock. The current leadership is familiar with this process; when farm production stagnated in 1965, the Brezhnev regime immediately turned to the private sector. Private livestock holdings rose 13½ percent in that year, and by 1966, total acreage and livestock holdings in the private sector were up 7½ percent and 15 percent, respectively, from 1964 levels, while output increased 7 percent.

The regime is already encouraging agriculture's private sector to produce more. Although there was little reference to private agriculture in the speeches given at the Twenty-Fifth Party Congress in February, 1976, the draft directions of the five-year plan noted that farms are "to render rural dwellers necessary assistance in conducting private subsidiary activities."[14] At least one advocate has gone further and discussed the need to both coordinate production in the private and public sectors and to introduce modern equipment and technology into the private plots.[15]

D. The Non-Black Soil Zone Program[16]

Increased attention is being devoted to development of the Non-Black Soil Zone of the Russian republic. This attention may be well founded. Success in developing this area will further efforts not only to raise production but also to stabilize farm output. To this end the U.S.S.R. plans to invest heavily in land melioration, delivery of fertilizer, farm equipment, and construction of the rural infrastructure during the next five years (see table 10).

TheNon-Black Soil Zone is already an important producer of agricultural products and was targeted for some attention in Brezhnev's programs of 1965 and 1970. This zone includes large tracts of boggy, uneven, and stony land with soils low in natural fertility. Moderate amounts of money were spent, mainly for draining, clearing, leveling, liming, and fertilizing. Although there is a relatively short growing season, the zone has the highest annual average rainfall of any large agricultural area in the European U.S.S.R.

Although some resources were earmarked for this area in the past, the zone will receive an increased share of all types of inputs in 1976–80. Gross fixed investment is to total 35 billion rubles with another 8

[14] *Pravda*, March 7, 1976, page 6.

[15] Shmelev, G. I., "The Private Subsidiary Farm as a Sphere of Public Interest Under Socialism," *Izvestiya akademii nauk SSSR: seriya ekonomicheskaya*, Number 6, 1975, pp. 85–94, and *Izvestiya*, January 24, 1976, page 2.

[16] The Non-Black Soil Zone of the Russian Republic includes 29 oblasts, an area of about 52 million hectares. In 1975 this zone produced 13 percent of the U.S.S.R.'s grain, 35 percent of its potatoes, 19 percent of its vegetables, 16 percent of its meat, and 21 percent of its milk.

billion rubles used to develop other branches that are closely connected with agriculture. Fertilizer deliveries during the period will be double the amount used in 1971–75, a total of 120 million tons. Delivery of all types of equipment will grow faster in this area than in the rest of the country. About 1.8 million hectares of drained land will be put into operation. As a result, grain production is scheduled to increase from 18.8 million tons in 1975 to 31 million tons in 1980. Other crops are to respond likewise and production of livestock products—including large-scale livestock complexes—is to increase.

TABLE 10.—U.S.S.R.: RESOURCES INVESTED IN THE NON-BLACK SOIL ZONE (NBSZ) OF THE RSFSR

	1971–75		1976–80 plan	
	U.S.S.R.	NBSZ	U.S.S.R.	NBSZ
Total gross fixed investment in agriculture:				
Billion rubles	131.5	19.5	171.7	35.0
Percent share	100.0	14.8	100.0	20.4
Deliveries of:				
Tractors:				
Thousand units	1,667	287	1,900	380
Percent share	100.0	17.2	100.0	20.0
Trucks:				
Thousand units	1,102	190	1,350	230
Percent share	100.0	17.2	100.0	17.0
Grain combines:				
Thousand units	449	73	538	94
Percent share	100.0	16.2	100.0	17.5
Fertilizer:				
Million tons	307	63	467	120
Percent share	100.0	20.5	100.0	25.7

E. Outlook

How well the U.S.S.R.'s economy performs during the course of the Tenth Five-Year Plan depends in large part on the pattern and severity of weather-induced fluctuations in crop production, particularly grain. If average weather prevails over the next five years, most of the agricultural goals are in reach. Should the Soviets suffer another harvest disaster, its effect would depend on timing.

If weather conditions are beneficial during the 1976 growing season, the Soviets could harvest more grain than their minimum domestic requirements, estimated at roughly 175 million tons.[17] Under these conditions, the U.S.S.R. could increase the weight of animals being marketed, begin the slow process of rebuilding livestock herds, and start to replenish carry-over grain stocks. If the harvest merely met minimum needs, expansion of herds would be postponed or depend on imported grain.

Another grain shortfall—say 150 million tons—in 1976, however, would be a major calamity and could foredoom the goals of the five-year plan. A failure at this time would force further large reductions

[17] Under normal conditions, grain requirements for food, industrial raw materials, seed, exports, and livestock feed would amount to some 200 million tons yearly. Because livestock feed accounts for roughly one-half of this requirement, the sharp reduction in herd size following the 1975 crop disaster has lowered the minimum grain requirement.

in livestock numbers and additional massive imports of grain from hard-currency areas, worsening the large trade deficit anticipated in 1976. In turn, this might force the U.S.S.R. to make substantial cutbacks in non-agricultural imports. The Soviet consumer would face another reduction in meat supplies, more than erasing the gains made under Brezhnev.

On the other hand, good crops in 1976 and 1977 might well be enough to generate sufficient momentum to survive a shortfall late in the plan period.

Appendix

Measuring Net Agricultural Production

The measure of agricultural production used in this paper is an approximation of the value of farm output available for sale and home consumption. It is based on the physical output of 41 crops and animal products weighted by average prices received by all producers (collective and state farms, other state agricultural enterprises, and individual producers) in 1970 for output sold through state procurement channels and the collective farm market and commission trade.[1] This value of agricultural output is then adjusted for changes in inventories of four classes of livestock and deductions are made to account for the intra-agricultural uses of farm products such as feed and seed; that is, deductions are made for the amounts of grain, potatoes, and milk fed to livestock, for the quantity of eggs used for hatching, and for the amounts of grain and potatoes used as seed.

An index of the value of net agricultural output from 1960 through 1975 is given in Appendix Table 1 and broken into indexes for crop and livestock production in Appendix Table 2. Output of commodities included in the calculation, minus seed but including the portion fed to livestock, is shown in Appendix Table 3, and the value of net agricultural production, as defined above, is derived in Appendix Table 4.

The physical commodities and livestock inventory series are for the most part official production statistics. Data for grain and sunflower seed production have been discounted to reflect waste and losses in handling. Procurement data are used for sugar beets and some minor crops. Estimates of output of individual types of vegetables are derived by using the relative shares of each type of vegetable in government purchases. Additional adjustments are made to some minor crops to compensate for the lack of data.

Estimates of the amount of grain and potatoes used as livestock feed are based on the availability of these crops after deductions for other uses (industrial use, seed, food, net exports, and change in stocks). In estimating the appropriate deduction from the gross value of livestock for the value of grain fed, it is assumed that one-third of the product used as feed from a given crop is fed during the calendar year in which it was produced and that two-thirds are fed during the following calendar year. Estimates of milk fed to livestock are based on official sources. The amount of grain used as seed is estimated from official data on area sown to each grain and on seeding rate norms by grain by oblast for the RSFSR, Belorussia, and Moldavia. The quantity of seed for each year is that quantity required to plant the crop of the following year.

For a more comprehensive explanation of the methodology used in constructing this measure of net agricultural production see Douglas B. Diamond, "Trends in Output, Inputs, and Factor Productivity in Soviet Agriculture," U.S. Congress, Joint Economic Committee, "New Directions in the Soviet Economy, Part II–B," U.S. Government Printing Office, Washington, D.C., 1966, and Douglas B. Diamond and Constance B. Krueger, "Recent Developments in Output and Productivity in Soviet Agriculture," U.S. Congress, Joint Economic Committee, "Soviet Economic Prospects for the Seventies," U.S. Government Printing Office, Washington, D.C., 1973.

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[1] Prices were derived by Constance B. Krueger in an unpublished memorandum.

APPENDIX TABLE 1.—U.S.S.R.: INDEX OF THE VALUE OF NET AGRICULTURAL PRODUCTION, 1960–75

Year	Index (1970=100)	Annual rate of growth (percent)
1960	68.9	−0.5
1961	75.3	9.2
1962	73.2	−2.8
1963	62.9	−14.1
1964	75.7	20.4
1965	80.4	6.2
1966	86.4	7.5
1967	85.7	−.8
1968	90.3	5.4
1969	88.1	−2.4
1970	100.0	13.6
1971	100.1	.1
1972	93.6	−6.5
1973	107.6	14.9
1974	106.2	−1.3
1975	97.2	−8.4

APPENDIX TABLE 2.—U.S.S.R.: INDEXES OF AGRICULTURAL PRODUCTION, 1960–75
[1970=100]

Year	Net agricultural production	Crops [1]	Livestock [2]
1960	69	66	72
1961	75	72	78
1962	73	67	78
1963	63	62	63
1964	76	82	71
1965	80	76	84
1966	86	88	85
1967	86	89	83
1968	90	95	86
1969	88	87	89
1970	100	100	100
1971	100	99	101
1972	94	88	98
1973	108	114	102
1974	106	101	111
1975	97	89	104

[1] Value of food and technical crops less seed but including the portion fed to livestock.
[2] Value of output of meat, milk, eggs, wool, and other livestock products less livestock feed and adjusted for changes in herd inventories.

APPENDIX TABLE 3.—U.S.S.R.: PRODUCTION OF COMMODITIES USED IN NET AGRICULTURAL OUTPUT, 1960–75

[Thousand metric tons]

Component	1970 prices (rubles per ton)	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
Wheat	103	34,611.5	42,349.6	40,794.0	28,076.6	43,956.4	33,986.0	66,945.8	49,136.8	59,572.5	47,693.5	65,659.4	66,801.2	55,373.5	70,660.5	53,783.2	38,957.9
Rye	116	7,998.3	10,322.5	9,539.0	6,154.6	6,752.6	9,553.3	7,492.2	7,695.6	8,235.1	5,787.3	7,916.7	8,267.8	5,370.8	6,742.3	9,763.6	5,270.8
Buckwheat	306	331.7	536.6	448.1	243.9	425.0	605.3	580.4	797.1	1,001.4	879.2	680.1	779.1	476.8	831.5	616.5	234.8
Rice	306	115.8	182.7	187.3	297.9	323.6	429.5	522.9	670.9	771.3	793.6	943.3	1,074.3	1,216.7	1,237.6	1,411.6	1,481.6
Corn for grain	138	6,354.1	13,511.4	10,807.5	8,426.0	10,028.7	5,851.8	6,114.2	6,794.7	6,285.0	8,677.7	6,863.2	6,324.1	7,145.2	9,412.8	9,007.8	5,204.8
Oats	82	6,322.9	5,149.3	3,041.9	2,254.0	3,214.5	3,784.0	6,092.4	7,816.7	7,465.0	8,439.2	9,555.0	10,008.2	9,000.0	11,002.2	9,838.4	7,465.6
Barley	81	9,388.0	8,452.3	11,914.0	12,717.8	18,169.8	12,766.7	18,865.6	16,464.9	19,064.4	21,135.4	26,350.0	23,910.4	23,897.2	36,156.2	37,029.0	21,962.8
Millet	81	2,279.9	2,302.4	2,033.4	1,451.8	2,643.2	1,723.7	2,439.1	2,540.8	2,025.9	2,490.5	1,605.6	1,597.2	1,616.7	3,288.3	2,234.5	806.4
Pulses	113	1,241.3	2,378.8	4,232.9	4,381.9	6,317.9	3,970.5	4,388.1	4,147.9	4,578.8	4,989.6	4,952.0	4,485.6	4,335.7	5,054.4	5,557.8	2,858.3
Other grain	61	191.1	214.4	30.7	110.7	110.2	133.8	52.7	59.5	176.6	57.1	126.8	177.9	134.0	179.6	321.8	171.0
Total, grain	103	68,834.6	85,400.0	83,028.8	64,115.3	91,942.0	72,804.7	113,493.5	96,125.1	109,176.0	100,943.0	124,652.1	123,425.8	108,566.7	144,565.3	129,564.2	84,414.0
Potatoes	114	67,000.4	67,400.0	53,147.0	55,684.0	77,492.0	72,313.2	71,908.2	79,635.1	86,412.1	76,389.0	81,461.4	77,656.4	63,330.4	92,967.7	65,831.5	73,414.9
Beets	108	878.0	711.0	688.0	697.0	895.0	917.0	1,018.0	1,006.0	1,046.0	1,125.0	1,188.0	1,167.0	1,117.0	1,451.9	1,389.0	1,260.0
Cabbage	95	6,613.0	6,137.0	6,140.0	5,879.0	7,125.0	6,504.0	6,054.0	7,577.0	6,369.0	6,298.0	7,488.0	7,356.0	7,037.0	9,147.0	8,733.0	7,920.0
Carrots	153	878.0	872.0	863.0	682.0	1,129.0	987.0	964.0	1,047.0	1,103.0	1,331.0	1,294.0	1,271.0	1,214.0	1,576.4	1,513.0	1,372.0
Cucumbers	212	1,956.0	1,631.0	1,487.0	1,515.0	2,219.0	1,410.0	1,750.0	2,053.0	1,787.0	1,725.0	2,291.0	2,250.0	2,154.0	2,800.1	2,680.0	2,430.0
Onions	430	1,376.0	1,421.0	1,471.0	1,000.0	1,246.0	1,639.0	1,661.0	1,417.0	1,559.0	1,575.0	2,015.0	1,980.0	1,892.0	2,457.9	2,357.0	2,138.0
Tomatoes	168	4,044.0	4,587.0	4,429.0	4,294.0	5,587.0	5,129.0	5,143.0	6,078.0	5,893.0	5,436.0	5,558.0	5,462.0	5,231.0	6,800.7	6,500.0	5,895.0
Other vegetables	99	829.0	792.0	911.0	984.0	1,266.0	1,041.0	1,267.0	1,356.0	1,254.0	1,255.0	1,378.0	1,354.0	1,296.0	1,693.0	1,639.0	1,241.0
Total, vegetables	163	16,574.0	16,151.0	15,989.0	15,051.0	19,467.0	17,627.0	17,857.0	20,534.0	19,011.0	18,745.0	21,212.0	20,840.0	19,941.0	25,927.0	24,811.0	22,256.0
Fruits, berries, nuts	282	4,942.0	5,050.0	5,978.0	6,411.0	6,866.0	8,100.0	7,805.0	8,966.0	10,621.0	9,467.0	11,690.0	12,307.0	9,570.0	13,351.0	12,441.0	13,700.0
Sugarbeets	26	52,198.0	47,742.0	43,946.0	41,455.0	76,124.0	67,500.0	69,715.0	81,579.0	84,168.0	65,283.0	71,385.0	64,329.0	68,043.0	77,799.0	67,471.0	61,900.0
Cotton	555	4,289.0	4,518.0	4,304.0	5,210.0	5,285.0	5,662.0	5,981.0	5,970.0	5,945.0	5,708.0	6,890.0	7,101.0	7,296.0	7,664.0	8,409.0	7,864.0
Tobacco	2,086	112.0	103.0	100.0	102.0	122.0	184.0	169.0	178.0	215.0	215.0	228.0	230.0	275.0	275.0	293.0	260.0
Makhorka	582	72.0	70.0	33.0	30.0	28.0	43.0	43.0	38.0	32.0	46.0	39.0	24.0	17.0	30.0	20.0	30.0
Sunflower seeds	187	3,649.6	4,372.8	4,411.4	3,942.2	5,573.4	5,013.1	5,658.0	6,079.4	6,150.2	5,849.4	5,652.5	5,210.0	4,644.2	6,794.2	6,241.3	4,572.4

APPENDIX TABLE 3.—U.S.S.R. PRODUCTION OF COMMODITIES USED IN NET AGRICULTURAL OUTPUT, 1960–75

[Thousand metric tons]

Component	1970 prices (rubles per ton)	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
Soybeans	260	220.0	425.0	510.0	413.0	338.0	429.0	638.0	553.0	532.0	353.0	629.0	618.0	606.0	424.0	360.0	700.0
Flax seed	245	65.0	80.0	90.0	90.0	90.0	85.0	100.0	100.0	100.0	90.0	65.0	64.0	62.0	101.0	63.0	90.0
Mustard seed	250	20.0	31.0	80.0	77.0	102.0	80.0	100.0	80.0	75.0	70.0	50.0	49.0	48.0	131.0	122.0	70.0
Castor beans	800	15.0	45.0	55.0	55.0	45.0	20.0	45.0	90.0	106.0	60.0	79.0	78.0	76.0	89.0	76.0	80.0
Other oil crops	375	20.0	9.0	5.0	5.0	5.0	6.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	22.0	15.0	7.0
Total oil crops	203	3,989.6	4,962.8	5,151.4	4,582.2	6,153.4	5,633.1	6,548.0	6,909.4	6,970.2	6,429.4	6,482.5	6,026.0	5,443.2	7,561.2	6,877.3	5,519.4
Fiber flax	2,344	425.0	399.0	432.0	380.0	346.0	480.0	461.0	485.0	402.0	487.0	456.0	486.0	456.0	443.0	409.0	478.0
Tea	940	163.7	161.6	178.9	195.6	193.7	197.0	238.2	234.4	229.0	244.6	272.7	280.0	291.0	305.0	314.0	315.0
Beef and veal	2,454	3,252.0	2,864.0	3,277.0	3,741.0	3,571.0	3,917.0	4,377.0	5,081.0	5,513.0	5,569.0	5,393.0	5,490.0	5,715.0	5,873.0	6,384.0	6,500.0
Pork	2,252	3,276.0	3,704.0	4,011.0	4,267.0	2,813.0	4,143.0	4,465.0	4,456.0	4,079.0	4,094.0	4,543.0	5,290.0	5,413.0	5,081.0	5,515.0	5,900.0
Mutton and kid	1,824	1,019.0	1,006.0	1,062.0	1,119.0	1,052.0	1,013.0	933.0	1,028.0	1,029.0	969.0	1,002.0	997.0	901.0	954.0	974.0	1,000.0
Poultry	2,368	766.0	813.0	822.0	802.0	606.0	696.0	745.0	764.0	817.0	866.0	1,071.0	1,197.0	1,203.0	1,295.0	1,420.0	1,500.0
Other meat	3,601	369.0	313.0	290.0	266.0	245.0	187.0	184.0	186.0	210.0	272.0	269.0	298.0	401.0	324.0	327.0	300.0
Total, meat	2,351	8,682.0	8,700.0	9,462.0	10,195.0	8,287.0	9,956.0	10,704.0	11,515.0	11,648.0	11,770.0	12,278.0	13,272.0	13,633.0	13,527.0	14,620.0	15,200.0
Milk	196	61,718.0	62,565.0	63,931.0	61,248.0	63,262.0	72,563.0	75,992.0	79,920.0	82,295.0	81,540.0	83,016.0	83,183.0	83,181.0	88,300.0	91,760.0	90,800.0
Eggs (million)	100	27,464.0	29,309.0	30,089.0	28,523.0	26,694.0	29,068.0	31,672.0	33,921.0	35,679.0	37,190.0	40,740.0	45,100.0	47,910.0	51,154.0	55,509.0	57,700.0
Wool	4,650	356.8	366.3	371.4	372.7	340.7	356.9	370.9	394.5	415.1	389.7	418.9	428.8	420.1	433.3	461.6	463.0
Honey	1,600	210.6	248.0	205.0	219.0	214.0	291.5	228.3	211.1	204.1	178.6	210.0	210.0	210.0	221.0	199.0	210.0
Silk cocoons	5,100	29.7	28.9	30.6	33.9	33.3	34.8	34.7	36.9	36.1	35.7	33.7	36.7	37.0	40.0	39.0	43.0
Changes in number of livestock (thousand head):																	
Cattle	442	1,547.0	6,297.0	4,911.0	−1,540.0	1,723.0	6,265.0	3,675.0	56.0	−1,432.0	−573.0	4,063.0	3,209.0	1,572.0	2,260.0	2,856.0	1,878.0
Hogs	173	5,231.0	8,028.0	3,262.0	−29,106.0	11,985.0	6,733.0	−1,548.0	−7,161.0	−1,820.0	7,008.0	11,428.0	3,951.0	−4,841.0	3,439.0	2,240.0	−14,472.0
Sheep and goats	37	−3,660.0	4,194.0	1,912.0	−6,850.0	−8,886.0	4,642.0	5,726.0	2,999.0	2,100.0	−10,338.0	7,618.0	1,912.0	−643.0	3,844.0	2,698.0	−4,332.0

APPENDIX TABLE 4.—U.S.S.R.: VALUE OF NET AGRICULTURAL OUTPUT, 1960–75

[Million rubles (1970 price weights)]

Component	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
Food grains	4,629.7	5,779.5	5,502.7	3,771.6	5,539.9	4,925.4	8,102.1	6,403.0	7,633.7	6,095.6	8,178.0	8,406.7	6,844.7	8,693.3	7,292.8	5,149.3
Feed grains	2,492.4	3,439.8	3,350.8	2,997.3	4,054.1	2,748.4	3,568.1	3,590.5	3,716.0	4,370.5	4,562.3	4,277.2	4,288.8	5,978.3	5,877.8	3,508.2
Total, grain	7,122.1	9,219.4	8,853.5	6,768.9	9,594.0	7,673.8	11,670.2	9,993.5	11,349.6	10,466.2	12,740.4	12,684.0	11,133.5	14,671.5	13,170.7	8,657.5
Potatoes	7,638.0	7,683.6	6,058.8	6,348.0	8,834.1	8,243.7	8,197.5	9,078.4	9,851.0	8,708.3	9,286.6	8,852.8	7,219.7	10,598.3	7,504.8	8,369.3
Vegetables	2,625.2	2,599.0	2,571.7	2,308.1	3,016.4	2,836.3	2,907.3	3,188.5	3,050.2	3,003.9	3,460.0	3,399.4	3,252.2	4,227.6	4,047.1	3,646.1
Oil crops	780.1	994.9	1,045.5	931.7	1,215.5	1,108.1	1,312.1	1,399.7	1,419.1	1,275.8	1,314.8	1,227.9	1,116.6	1,517.7	1,373.1	1,143.2
Fruits, berries, nuts	1,393.6	1,424.1	1,685.8	1,807.9	1,936.2	2,284.2	2,201.0	2,528.4	2,995.1	2,669.7	3,296.6	3,470.6	2,698.7	3,765.0	3,508.4	3,863.4
Sugarbeets	1,357.1	1,241.3	1,142.6	1,077.8	1,979.2	1,755.0	1,812.6	2,121.1	2,188.4	1,697.4	1,856.0	1,672.6	1,769.1	2,022.8	1,754.2	1,609.4
Cotton	2,380.4	2,507.5	2,388.7	2,891.5	2,933.2	3,142.4	3,319.5	3,313.3	3,299.5	3,167.9	3,823.9	3,941.1	4,049.3	4,253.5	4,667.0	4,364.5
Tobacco	233.6	214.9	208.6	212.8	254.5	383.8	352.5	371.3	448.5	448.5	475.6	479.8	573.6	573.6	611.2	542.4
Makhorka	41.9	40.7	19.2	17.5	16.3	25.0	25.0	22.1	18.6	26.8	22.7	14.0	9.9	17.5	11.6	17.5
Fiber flax	996.2	935.3	1,012.6	890.7	811.0	1,125.1	1,080.6	1,136.8	942.3	1,141.5	1,068.9	1,139.2	1,068.9	1,038.4	958.7	1,120.4
Tea	153.9	151.9	168.2	183.9	182.1	185.2	223.9	220.3	215.3	229.9	256.3	263.2	273.5	286.7	295.2	296.1
Total, crops	24,722.2	27,012.6	25,155.1	23,438.8	30,772.5	28,762.7	33,102.2	33,373.6	35,765.4	32,835.9	37,601.8	37,144.4	33,165.1	42,972.6	37,901.9	33,629.8
Meat	20,359.3	20,256.9	22,002.4	23,687.8	19,334.2	23,111.6	24,924.9	26,857.7	27,282.6	27,683.6	28,797.7	31,111.7	32,150.8	31,828.1	34,402.8	35,694.1
Milk	12,096.7	12,262.7	12,530.5	12,004.6	12,399.4	14,222.3	14,894.4	15,664.3	16,129.8	15,981.8	16,271.1	16,303.9	16,303.5	17,306.8	17,985.0	17,796.8
Eggs	2,746.4	2,930.9	3,008.9	2,852.3	2,669.4	2,906.8	3,167.2	3,392.1	3,567.9	3,719.0	4,074.0	4,510.0	4,791.0	5,115.4	5,550.9	5,770.0
Wool	1,659.1	1,703.3	1,727.0	1,733.1	1,584.3	1,659.6	1,724.7	1,834.4	1,930.2	1,812.1	1,947.9	1,993.9	1,953.5	2,014.8	2,146.4	2,152.9
Honey	337.0	396.8	328.0	350.4	342.4	466.4	365.3	337.8	326.6	285.8	336.0	336.0	336.0	353.6	318.4	336.0
Silk cocoons	151.5	147.4	156.1	172.9	169.8	177.5	177.0	188.2	184.1	182.1	171.9	187.2	188.7	204.0	198.9	219.3
Livestock change	1,453.3	4,327.3	2,805.7	−5,969.5	2,506.2	4,105.7	1,568.4	−1,103.1	−870.1	576.6	4,054.8	2,172.6	−166.5	1,736.1	1,749.7	−1,833.9
Gross livestock products	38,803.3	42,025.3	42,558.6	34,831.5	39,005.6	46,649.9	46,821.8	47,171.4	48,551.1	50,241.0	55,653.3	56,615.3	55,557.0	58,558.9	62,352.1	60,135.3
Net livestock products	32,425.3	35,400.6	35,497.1	28,672.9	31,981.2	37,864.8	38,491.8	37,632.5	39,050.8	40,162.0	45,298.6	45,861.8	44,412.1	46,188.4	50,119.3	46,971.3
Total, net farm output	57,147.5	62,413.2	60,652.2	52,111.7	62,753.7	66,627.5	71,594.0	71,006.0	74,828.3	72,997.9	82,900.4	83,006.2	77,577.2	89,161.0	88,021.2	80,601.1

THE SOVIET TRACTOR INDUSTRY: PROGRESS AND PROBLEMS

EARL M. RUBENKING

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I. INTRODUCTION

The Soviet tractor industry is an industry in transition. Since 1970, the theme has been tractor modernization. The old historic (since World War II) emphasis upon growth in output with insufficient regard for the needs of agricultural and industrial users has been suspended, if only temporarily, to permit greater emphasis on quality and performance. Still, old habits die hard and goals for technical improvements are proving more difficult to achieve than monotonic increases in output.

The purpose of this study is to put the new trend into context. The paper discusses production, technology, and uses of Soviet tractors, and the technical goals and achievements of the modernization program. It provides a detailed comparison of Soviet and U.S. tractors in terms of output, parks, horsepower, and use; assesses the general

quality and maintainability of Soviet and U.S. tractors; and evaluates the importance of Western technology and foreign trade to the Soviet tractor industry.[1]

II. Production

The U.S.S.R. is the world's largest producer of tractors. In 1975, the U.S.S.R. produced about 550 thousand tractors, more than double that of the United States (see table 1). However, the average Soviet tractor is less powerful than its U.S. counterpart. Thus, measured in total horsepower[2] (estimated), Soviet output exceeded that of the U.S. by only about 60 percent. Soviet tractor output in 1975 was about 13

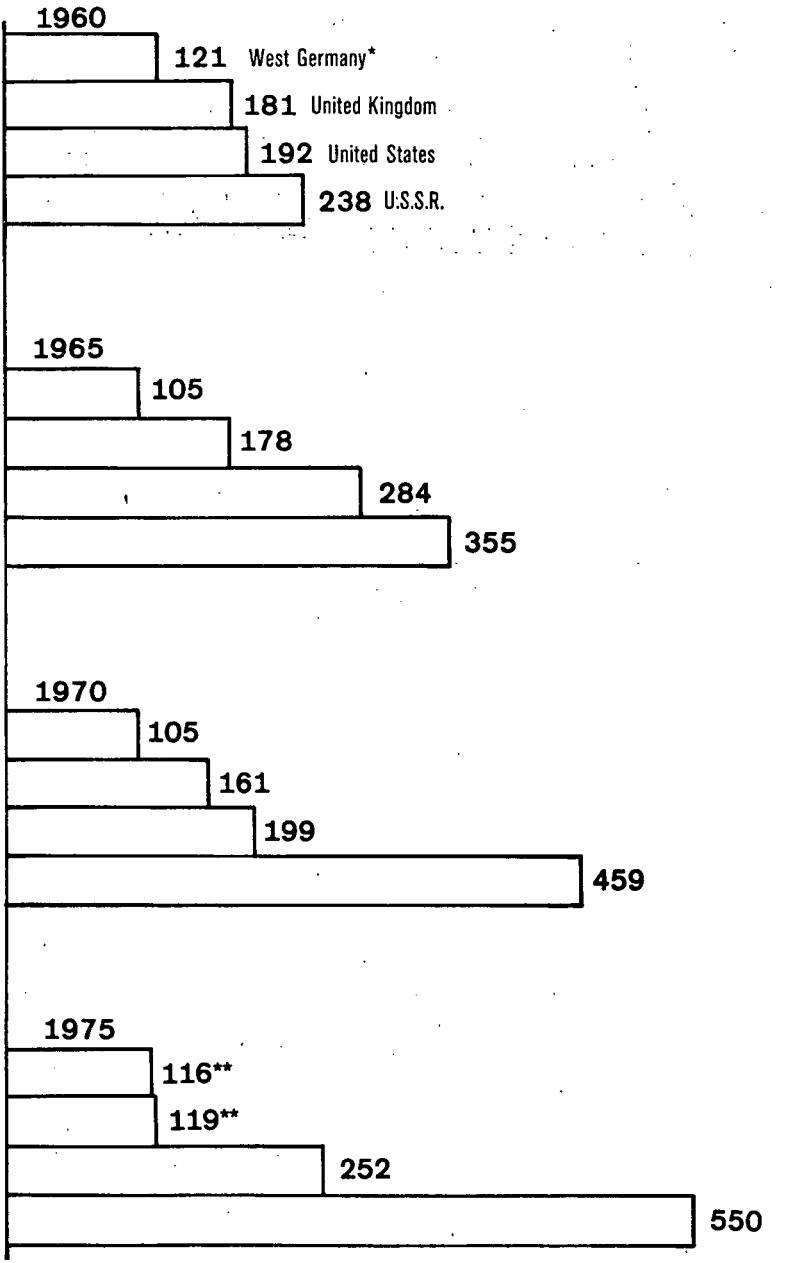
[1] The sources used in this paper are principally drawn from Soviet journals, newspapers, and monographs. Specific sources are available from the author on request.

[2] Unless otherwise indicated, horsepower in this paper refers to engine horsepower at the rated revolutions per minute of the engine.

percent larger than the combined output of the United States, United Kingdom, and West Germany, three of the leading producers in the non-Communist world (see figure 1).

Major World Producers of Tractors Figure 1

(Thousand Units)



*Data for West Germany exclude tracklaying tractors.
**Data are for 1974; data for 1975 are not available.

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Soviet tractors are highly standardized, and unlike those in the United States, are seldom built to the user's custom specifications. Production is characterized by long runs of a relatively few models produced in mass volume in a relatively few huge plants. Nine major plants account for more than four-fifths of all tractors produced annually in the U.S.S.R.[3]

By standardizing models, and keeping models in production long after designs of new and improved models had become available, the Soviets have been able to achieve high and steady growth in output. During 1951–65, for example, output climbed steadily at an average annual rate of about 8 percent.

However, as production grew, tractor quality, design, and technology were neglected, making major adjustments sooner or later inevitable if other goals, such as improvement in the average life of the tractor park, were not to be sacrificed. During 1966–70, the Soviets tried to have it both ways—sustain the previous high growth rate while upgrading tractor quality—but failed; the growth rate fell off from 8.3 percent in 1961–65 to 5.3 percent in 1966–70 and output fell short of plan by about 25 percent.

In the 1971–75 plan period the Soviets lowered their production sights and launched a major effort to upgrade the quality and technical capabilities of tractors. Planned output for 1975 was set at 575,000 units, implying an annual growth rate of only 4.6 percent, the lowest of any post war plan period. This slowing in the rate of growth was intended to facilitate a retooling and reequipping program for the production of several new and improved tractor models. Apparently, new models were to make up one-third to one-half of total tractor output. However, none of the goals of this program were fully achieved: actual output fell short of plan by about 25,000 units or about 5 percent; and new models accounted for only about one-sixth of production. Major new models that were introduced into production by 1975 are listed in table 2. Models currently in production are shown in table 3.

Newer tractor models have greater horsepower ratings than older models and improved performance characteristics generally, but they also cost more. Moreover, new prices are high relative to claimed tractor productivity. For example, the current price of the new 150-horsepower T–150 tracklaying tractor is 135 percent greater than that of the T–74 model it is replacing, but its productivity in power consuming operations is only 40 percent to 80 percent higher.

III. Composition of Output: An Unsettled Controversy

For many years the USSR favored the production and use of tracklaying, rather than wheeled, tractors. Although tracklaying types are more expensive to produce and operate and lack the speed and mobility of wheeled types, they have better traction in most soils, compact the soil less, consume less fuel per hectare, and are more easily adapted to non-agricultural (e.g., construction) applications. During the late 1950s and early 1960s, however, influenced by expansion in

[3] In the ascending order of size (by unit output) with the share of total output given in parentheses, these are: Chelyabinsk (5 percent), Vladimir (5 percent), Pavlodar (5 percent), Rubtsovsk (7 percent), Lipetsk (10 percent), Dnepropetrovsk (10 percent), Kharkhov (12 percent), Volgograd (14 percent), Minsk (16 percent).

sown acreage of row crops in the USSR (which favors the use of wheels rather than tracks) and a personal directive by Premier Khrushchev to copy US practice (in which wheeled tractors predominate), the production of wheeled tractors was given a spectacular boost. Output of wheeled tractors increased from 21 percent of tractor output in 1953 to a peak of 57 percent in 1964.

Khrushchev's decision to push output of wheeled tractors generated an intense, and sometimes bitter, controversy over product mix that continues to be reflected in the ebb and flow of relative output shares. During 1964–72, the share of tracklaying types creeped steadily upward to a post-1964 high of 48 percent in 1972. The economic justification for the shift away from the wheeled version was a gradual decline in acreage of row crops, and the promise of powerful new engines for tracklaying types capable of offsetting the speed advantages of wheeled tractors. Since 1972, however, the share of tracklaying tractors has again declined, as the output of heavy-duty wheeled types, especially the T–150K and K–700 series, has rapidly accelerated. Apparently, the Soviets are now persuaded that wheeled tractors are superior to tracklaying types in many agricultural applications. For example, wheeled tractors are especially useful in Soviet agriculture for trailer-transport of farm products and other materials. In the United States, trucks are normally used for this purpose.

Currently, the U.S.S.R. produces about 20 percent more wheeled than tracklaying tractors (291,600 wheeled and 239,500 tracklaying in 1974). Larger and heavier tractors, 90 horsepower and greater, primarily are of tracklaying design; smaller and lighter tractors, less than 50 horsepower, are wheeled. In the intermediate horsepower ranges (50 to 89 horsepower) wheeled tractors outweigh tracklaying by a margin of 2 : 1. In the United States, 85 percent to 90 percent of all tractors produced annually are wheeled and include a more even representation of light, medium, and heavy types.

Tractor output is heavily biased toward light and medium-powered types of less than 90 horsepower. Only about one-third of production in 1974 consisted of large, heavy-duty types and about two-thirds of these were relatively low powered (no more than 108 horsepower). Very powerful tractors (200 horsepower and up) are produced in relatively small quantities (about 20,000 in 1974) and nearly all are wheeled tractors for use, primarily, in agriculture; high-powered tractors for industrial applications are in extremely short supply.

To plug the gap in heavy-duty tractors, the Soviets are building a large new plant at Cheboksary for the production of special-purpose industrial-type tractors in 330 hp and 500 hp models. Although originally planned for construction during 1966–70, ground was not broken until 1972. By the end of 1975, the Soviets had managed to assemble a couple of tractors in one major building already completed. However, most of the components for these two tractors apparently came from the Chelyabinsk Tractor Plant where designs were developed and prototypes made. The first stage of production at Cheboksary—several thousand units per year—is still a long way off and may not be achieved before 1980 at the earliest. Clearly, it will be many years beyond 1980 before this plant will be able to meet growing Soviet needs for heavy tracklaying tractors for construction.

IV. Key Subsectors

A. Tractor Engines

Production of diesel engines for tractors,[4] paradoxically, has helped both to advance and to retard progress in the tractor industry. On the one hand, increasing specialization of engine production for more than a decade has freed production capacity at tractor plants, helping to sustain secular growth in tractor output. Whereas in 1960, tractor plants were, themselves, the major producers and suppliers of tractor engines, by 1974, seven major specialized producers provided roughly 70 percent of the engines used for new tractor production.[5] Only three tractor plants—Bryansk, Chelyabinsk, and Vladimir—continue to produce engines for their own tractors, for road and construction machinery, and for other industrial uses. The Vladimir plant, which produces far more engines than tractors, supplies engines to producers of wheeled tractors.

On the other hand, lags in the development of planned "families" of improved tractor engines have delayed introduction of new tractor models, in some cases for ten years or more. For example, the first prototypes of the MTZ–80 (which is to replace the MTZ–50) were tested in 1963, but production didn't begin until the latter half of 1974. The first prototypes of the T–130 (which is to replace the T–100M) were tested as far back as 1960, but the tractor still was not in full scale production by the end of 1975. Reasons for lags in engine development are not clear; almost certainly they include: bureaucratic resistance to change, difficulties in getting engine plants retooled, and lack of a close working relationship between developers and producers.

Production of diesel engines in the USSR is characterized by an inadequate level of specialization and standardization in the production of major engine components and parts. There are complaints that components and parts are still produced in a relatively large number of enterprises with wide variations in output levels (and costs). For example, in the early 1970s, crankshafts for tractor engines were produced by ten plants with annual levels of output ranging from about 80,000 to 180,000 units; pistons were produced in ten plants with outputs ranging from 300,000 units to 3 million units. The quality of workmanship and the quality of metal inputs in component parts very often have varied from producer to producer.

Standardization of engines often means only standardization of bore and stroke. Such standardization promotes the use of similar piston sizes but not wide interchangeability of parts. For example, the Soviet press reports that 75 horsepower engines produced by three different plants have the same number of cylinders, and the same cylinder diameters, but otherwise different engine designs. Thus, many other parts and accessories are not interchangeable. One factor retarding progress in standardization has been poor coordination among the seven ministries manufacturing diesels for all purposes, and among the plants within the same ministry.

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[4] All tractor engines produced since 1957 have been diesel and virtually all tractors now in use are diesel powered.

[5] These specialized plants are located in Barnaul, Khar'kov (two plants), Minsk, Rybinsk, Yaroslavl, and Volgograd.

B. Spare Parts and Repair

Soviet production of spare parts for tractors, relative to that of the United States, is huge, as may be seen from the following example: in 1974, the U.S.S.R. produced spare parts valued at 1.02 billion rubles, representing about two-thirds of the value of output of new tractors.[6] In the United States, production of spare parts amounted to a little over one-fourth of the value of new tractor output. On balance, the ratio of spare parts to output ought to be somewhat higher in the USSR, than in the US, because of the greater use of tracklaying tractors in agriculture.[7] Even taking this factor into account, however, under comparable US standards spare parts production in the USSR probably would not exceed 35 percent to 40 percent of the value of output of new tractors.

In effect, Soviet spare parts production in 1974 was roughly equivalent to 350,000 new tractors, whereas US spare parts production, for the same year, was the equivalent of about 64,000 tractors.[8] This comparison is especially striking in view of the fact that the US park of tractors in agriculture is about 2 million units larger than the Soviet park, and the average age of the US park is about double that of the USSR.

Despite the exceptionally large volume of spare parts production, Soviet output still is not able to meet domestic needs. To take one example: in 1970, output amounted to about 800 million rubles, but this was only 73 percent of 1.1 billion rubles worth of new parts that Soviet officials estimated were needed for that year. Moreover, nearly 20 percent of the parts classified as "especially important" were produced in below-plan quantities. An official of the U.S.S.R. Ministry of Tractor and Agricultural Machine Building expressed the dilemma of spare parts production in a Pravda article (22 March 1972) as follows:

> The more spare parts we turn out, the greater the need for them becomes. Expenditures of metal on spare parts now come to a good one-half of the metal earmarked for the manufacture of new machines. But we are still told that there aren't enough spare parts.

To offset persistent shortfalls in new parts production, repair enterprises have accelerated the reconditioning of worn parts. In 1970, reconditioned tractor parts were valved at 170 million rubles, or 21 percent of the value of new parts production. Reconditioned parts are said to be 40 percent to 60 percent cheaper than new parts, and service life is said to be good.

The exceptionally large need for spare parts, which uniquely dramatizes the technological lag of the Soviet tractor industry, stems from both engineering and managerial deficiencies. Engineering deficiencies include: mediocre construction quality, mediocre quality of many parts and uneven durability of a significant share of production. Managerial deficiencies include: overproduction of easily made parts and under-production of the more complex ones; faulty dis-

[6] Estimated at 1.6 billion rubles.

[7] More spare parts are required to maintain tracklaying tractors than wheeled. For example, in the United States the value of spare parts shipped for tracklaying tractors amounted to about 50 percent of the value of complete units in the period 1970–74, compared with about 20 percent for wheeled tractors.

[8] Based on the estimated unit value of the tractors produced in each country in 1974.

tribution which results in receipts of unwanted parts; poor field maintenance; the tendency of farms and tractor repair organizations to overstock parts to be on the safe side; and, finally, over-repair or the tendency to replace unworn parts along with those that are worn. The tendency to replace unworn parts apparently has increased in recent years with the development of a large number of assembly-line type facilities for major overhaul work. Since every tractor that enters one of these shops is totally disassembled, technicians are tempted to replace internal parts that normally are hard to get to just to be on the safe side.

V. Technology

Historically, Soviet tractors have lagged behind those of the United States in design, durability and power; hence, they have been less versatile and reliable. Although some new models of Soviet tractors have greatly narrowed the gap in one or more of these aspects during the past five years, it remains generally true that U.S. tractors, on the average, can do more work, perform more efficiently, and last longer than their Soviet counterparts.

A. Design

Soviet tractor design has tended to follow, sometimes with a substantial timelag, changes in Western technology. Native innovations have been few. Most of the complex features of Western tractor technology such as automatic transmission, power steering, and turbocharging are incorporated into certain of the current Soviet models, but they are found on a much smaller share of total output than is the case in the United States. One additional feature that has been copied and very widely applied is the four-wheel drive; the U.S.S.R. produces more tractors with this feature than the United States or any other Western country. Recently, the Soviets have modified four-wheel drive to provide for automatic engagement at a predetermined level of slippage. Automatic engagement is in use on some type of motor vehicles in the United States but has not yet been applied to tractors, apparently to keep down the price.

For many years the Soviets have not copied U.S. models outright, although a number of new Soviet wheeled tractors bear a close resemblance to U.S. counterparts. Some tracklaying models still in production, such as the DT–54A and the T–100M, are only slightly modified versions of models developed in the United States more than 25 years ago.

The quasidependence of the Soviet tractor industry on the United States for design technology has its historical roots in the extensive assistance that U.S. firms provided in the early 1930s in designing and equipping the first Soviet tractor plants in Chelyabinsk, Khar'kov, and Volgograd (then Stalingrad). However, a major shift away from reliance on U.S. design technology appears imminent; industrial tractors to be built at the new Cheboksary plant have an innovative Soviet design of cab at the front of the tractor, and bear no resemblance to U.S. tracklaying models.

B. Durability

Soviet tractors, though rugged, tend to break down more frequently than their U.S. counterpart. For example, the average period of use before first major overhaul is about 4,500 hours compared with 6,000 hours in the United States.[9] Soviet tractors are not built to the precise tolerances of U.S. equipment, generally do not incorporate high strength metal alloys to the same degree, are not serviced with comparable high-quality lubricants and oils, and are not assembled with the same degree of craftsmanship that characterizes U.S. practice. In past years, thousands of newly built tractors have been rejected by agricultural equipment procurement representatives[10] before leaving plant shipping areas and have had to be set right by the producers; thousands more have become quickly inoperative shortly after delivery.

C. Power

Soviet tractors, on the average, are less powerful than U.S. tractors (see table 4). In 1975, tractors produced in the U.S.S.R. averaged about 76 horsepower, compared with about 103 horsepower in the United States. The disparity was even greater for tracklaying tractors—about 87 horsepower in the U.S.S.R. compared with about 145 horsepower in the United States.[11]

In general, Soviet tractors are underpowered relative to weight. However, weight to power ratios are vastly improved over those common in the 1950s, and the newest tractors have weight to power ratios that are as good as many U.S. models. The average wheeled tractor produced in the U.S.S.R. in 1974 (weighted by output) weighed an estimated 56 kilograms per horsepower, compared with an estimated 46 kilograms per horsepower for U.S. wheeled tractors.[12] For more powerful tractors used in construction, weight to power ratios tend to be higher in both countries. For example, the most powerful tracklaying tractor currently in production in the U.S.S.R. (the 300-horsepower DET–250M) weighs about 98 kilograms per horsepower, based on service weight, compared with about 93 kilograms per horsepower for the most powerful U.S. model (524 horsepower). In some construction applications, high weight is advantageous.

Soviet tractors weigh relatively more than U.S. tractors, and, by comparison, are underpowered, mainly because more metal is used in the fabrication of engines, components, and parts than is the case in the United States.[13] More metal is used to compensate for its relatively

[9] Planned average operating norms for Soviet tractors used in agriculture before first major overhaul are: tractor tansmissions—6,000 hours; engines and undercarriages of wheeled tracetors—5,000 hours; undercarriages of tracklaying tractors—4,000 hours. These averages apply only if prescribed operating and maintenance producers are strictly followed.

[10] Officials of Soyuzsel'khoztekhnika (All-Union Agricultural Equipment Association), an organization that acts as intermediary between the producer and agriculture for tractors and agricultural machinery, as well as for fuel, mineral fertilizers, and other items. Soyuzsel'khoztekhnika also controls the major repair facilities not owned by collective and state farms.

[11] Data on tracklaying tractors are for 1974.

[12] These data are not entirely comparable. Because weight-to-horsepower ratios for tractors produced in the United States in 1974 are not available, the above figure is based on power take-off (PTO) data for a sample of 80 diesel wheeled tractors tested at the University of Nebraska test center during 1971–75. PTO horsepower in the tests was estimated to be 95 percent of engine horsepower. Since Soviet data are given in terms of engine horsepower, PTO in the United States was divided by 0.95 to get engine horsepower.

[13] For example, the new Soviet MTZ–80 tractor tested at Nebraska weighs more in relation to its power than a similar U.S. model tested earlier with the same maximum PTO and drawbar horsepower. The MTZ–80 weighed (without ballast) 47.5 kilograms per maximum PTO horsepower compared with 40.9 kilograms for the U.S. model.

poorer quality; metal used in Soviet tractors lacks the high strength characteristics of U.S. alloys. Soviet tractors also tend to be underpowered because engines are adjusted to run at lower speeds to reduce wear and extend operating life. Although newer Soviet tractors are being operated at 2,000 to 2,200 rpm, typical of many U.S. tractors of the late 1960s, engine rpm's of 2,400 to 2,800 now are quite common in the United States.

Soviet tractors also lose more horsepower than do U.S. tractors between the engine and the drawbar where the power counts; that is, relatively more of the power of the average Soviet tractor goes into moving the tractor itself. The average U.S. tractor is able to translate a greater share of engine horsepower into usable power at the drawbar, because it has less weight relative to engine horsepower, and better gear ratios. However, the margin of U.S. superiority in this respect seems to be diminishing. Only a few years ago, the drawbar horsepower of the average Soviet diesel wheeled tractor was about 70 percent of engine horsepower compared with nearly 90 percent for U.S. models. Current Soviet models, according to tests apparently carried out on a Soviet track in much the same way as tests at the University of Nebraska test center, are claimed to have approximately the same drawbar horsepower in relation to engine horsepower as similar U.S. tractors.

VI. Uses

A. Agriculture

Agriculture absorbs by far the greater share of production of tractors in the U.S.S.R. as in the United States, and currently accounts for about 2.4 million tractors, or about two-thirds of the total tractor park, compared with about 4.2 million in U.S. agriculture, or about three-fourths of the total.[14] However, because tractor attrition rates are high, the number of tractors in use in agriculture in the U.S.S.R. falls far short of what is optimally desired. Also, shortages of spare parts frequently keep tractors out of service for extended periods, further reducing the number available for use. As an illustration of the seriousness of this problem, in the late 1960s, 30 percent to 40 percent of the entire tractor park was in a standdown condition from time to time awaiting parts.

According to a recent Soviet estimate, about 3.2 million tractors are needed in the U.S.S.R. for optimal farm exploitation. That quantity of tractors in use would have been reached by about 1971 if the rate of tractor retirements from the park had been kept at about 4 percent to 5 percent during the past two decades, a rate that has characterized U.S. practice for many years.

In fact, more than 12 percent of the existing park of tractors in Soviet agriculture has been retired annually during the past decade, a sharp rise over the 9 percent average of the 1961–65 period (see table 5). In recent years the number of tractors retired has been equal to about 78 percent of the number of new tractors being delivered to agriculture, resulting in only relatively small additions to the existing

[14] The harvested acreage of the U.S.S.R. in 1974 was about 216,500 hectares, or about 67 percent more than that of the United States, while the estimated value of Soviet net farm output in the early 1970s was only about four-fifths that of the US. In 1974, there were about 96 hectares of harvested acreage per tractor in the USSR compared with about 30 hectares in the United States.

stock. For example, during 1970–75, about 2 million new tractors were delivered, and about 1.5 million units were retired, resulting in a relatively modest increase in the total park of tractors over a six-year period of about 450,000 units. By comparison, in the United States, the annual retirement of tractors since the mid-1960s has been considerably in excess of the number of new tractors delivered, in some years by as much as 75 percent to 80 percent. Such retirements have been possible because the U.S. park has long been near the saturation point, and new tractors have been purchased primarily for replacement. Also, the sharp increase in the use of higher horsepower tractors has permitted fewer tractors to do the same or an even greater amount of work. The U.S. park reached the current Soviet level in 1945.

The relatively high rate of retirement of Soviet tractors is a reflection of deficiencies in machine quality and durability, and, perhaps, to a lesser extent, to poor maintenance and high usage rates. In addition, the fact that output norms are set the same for both old and new tractors within a power class encourages collective and state farm managers to replace older and less productive tractors as soon as they can justify retirement to higher authorities. Since there is no used-tractor market in the U.S.S.R., tractors that are retired, in effect, are scrapped.

The number of tractors in use in agriculture in the U.S.S.R. will not reach optimum levels even by 1980 if the 12 percent retirement rate of the past decade continues, as seems likely. During 1976–80, 1.9 million new tractors are scheduled for delivery to agriculture, and an estimated 1.4 million units will be retired, a net increase in the park of about 500,000 tractors. By the end of 1980, Soviet agriculture is scheduled to have a park of 2.87 million tractors, or about 330,000 short of the optimum. Rising allocations of tractors to non-agricultural consumers, especially construction and roadbuilding, has prevented Soviet planners from allocating a larger share of production to agriculture. Agriculture is to get about 66 percent of new output during 1976–80, the same share as in 1971–75.

Tractors in use in Soviet agriculture, particularly the higher powered new models, are often grossly underutilized because of low inventories of complementary farm machinery. For example, thousands of the new K–700/700A and T–150K heavy-duty wheeled tractors in agriculture cannot be fully utilized because of a serious shortage of farm trailers, plows, harrows, and other machinery. Soviet experts estimate that purchases of new agricultural machinery other than tractors should amount to about 2.5 rubles per ruble expended on new tractors. That desired ratio, which is met by only a few leading farms, compares with an actual coefficient in 1970 of about 1.4 rubles throughout agriculture. Although this coefficient probably rose during the 1971–75 Plan period, the imbalance between the number of tractors in use and available agricultural machinery [15] probably will persist for some time.

By upgrading the quality and durability of tractors, modifying tractor and engine designs to increase engine horsepower and overall pulling power, and increasing the volume of spare parts, Soviet planners hope to reduce attrition rates (increasing indirectly the park of tractors) and improve the utilization and efficiency of tractors in use.

[15] The value of output of agricultural machinery increased by 79 percent in 1975 over 1970 (compared with a 20 percent increase in unit output of tractors).

B. Industry

The U.S.S.R. has made slow progress in satisfying the highly specialized needs of industrial users. Although about 28 percent of all tractors produced annually in the U.S.S.R.[16] are allocated to industrial consumers, most are tractors that have been designed primarily for use in agriculture.[17] In 1974, the U.S.S.R. produced only about 20,000 tractors specially designed for industrial applications, and 19,000 of these were logging tractors. Special-purpose tractors and tractors modified for use under differing climatic and geographic conditions are urgently needed. For example, one of the basic bulldozers in use in construction and roadbuilding is a general-purpose tracklaying tractor designed for agriculture with a blade mounted on the front. Only about one-fourth of the tractors in industrial use are said to be adapted especially for conditions under which they are operated. Tractors in use in northern climates frequently are not built for sustained operations under conditions of extreme cold,[18] and tractors with inadequately ventilated cabs that are used in permafrost regions are sent to desert regions in the south as well.

Beginning in 1974 or 1975, air-conditioning was installed for the first time on some tractors going to hotter climates.

VII. Export

The U.S.S.R. exports a relatively small share of tractor output—about 6 percent to 7 percent for the past 15 years—because of a large domestic need. Nevertheless, the U.S.S.R. has become one of the world's largest exporters of tractors. In 1974, exports totaled about 40,300 units, about 88 percent that of the United States,[19] and about one-third that of the United Kingdom,[20] the world leader. About three-fourths of all Soviet tractor exports go to Communist countries, primarily Eastern Europe and Cuba (see table 6). These countries have been dependent on the U.S.S.R. for tracklaying models, since only Bulgaria, Poland, and Romania produce tracklaying types and, until recently, only in models of up to about 65 horsepower. However, Poland now produces more powerful tracklaying tractors in the 140 to 285 horsepower range through an agreement with a U.S. company, and Romania is producing models of domestic design of 150 and 180 horsepower. Thus, historic East European dependence on Soviet models is diminishing.

For many years the U.S.S.R. shipped to non-Communist countries roughly a fourth of all the tractors that were exported. During 1963–72, an overwhelming proportion of these—about 80 percent—were shipped to the developing nations; in turn, about one-half of these went to India alone. During this period, relatively few tractors went to industrialized countries—2,000 or less annually—and most of these to France. In 1973 and 1974, however, sales to industrialized countries were more than double and in 1975 triple the 1972 level, owing to sud-

[16] An average for 1970–74.

[17] In 1970, of the tractors allocated in the non-agricultural sector, construction and roadbuilding received an estimated 70 percent, forestry 15 percent, and mining and miscellaneous 15 percent.

[18] Insufficient use is made of special low-alloy metals, special rubber, and special lubricants designed for cold climates.

[19] Exports from the United States averaged about 37,000 units annually in the decade 1965–74, with a peak of 72,000 units in 1953.

[20] Data for the United Kingdom are for 1973. Exports for the period 1970–73 fell within a very narrow range around the annual average of 116,400 units.

den large purchases by the U.K., Canada, and the U.S. Soviet officials are hoping for future sales in the United States alone of 5,000 to 8,000 units annually.

To attract Western buyers, the U.S.S.R. has made some minor modifications in tractor design in an effort to meet the special requirements of foreign customers and has set up some modern servicing facilities and spare parts depots in the West.[21] Export tractors are beginning to match up fairly well with the performance standards of United States and other Western-built tractors. More importantly, the U.S.S.R. has priced tractors below competitive Western models. For example, according to industry sources, Soviet four-wheel drive tractors are being offered in the United Kingdom at about two-thirds of the price of United Kingdom-manufactured models; tractors are being offered in the United States at roughly four-fifths the price of comparable U.S. models.[22] To carry out sales in Canadian and U.S. markets, the U.S.S.R. has formed a Canadian-Soviet joint-stock company.

These Soviet initiatives have helped to overcome the traditional reluctance of farmers in the West, and especially in the United States, to purchase Soviet tractors. Moreover, they came at a time when a heavy domestic demand in the United States was delaying deliveries for certain U.S. models and were aided also by a changed political climate which seems to have lessened the stigma of purchasing Soviet products. Although some U.S. customers seem actually to prefer Soviet tractors because of their greater simplicity and lack of frills, it is still too early to judge whether Soviet tractors will prove to be sufficiently sturdy, reliable, and efficient to gain widespread acceptance in the United States.

VIII. Import

The U.S.S.R. has shown little interest in large purchases of Western-made tractors for use on Soviet farms (buying only small quantities for testing purposes) but has shown a growing interest in procuring large, high-powered, specialized models for industrial applications. The U.S.S.R. has already purchased between four and five thousand large (up to 524 horsepower) tracklaying tractors from the United States and Japan. Those in the upper horsepower range are used in laying gas pipelines and ripping ground in mining operations in the permafrost regions. Included in the purchases from Japan are tracklaying models for use in forest-clearing and mining projects in the Soviet Far East.

IX. Goals for the Seventies

A. 1971–75

During 1971–75, the Soviets planned for major improvements across-the-board—in engines, components, tractor design, and spare parts. Major technical goals included increased engine rpm's, improved fuel consumption, wider applications of turbocharging, increased average horsepower, and better weight to horsepower ratios. Though reason-

[21] The largest are located in France, Canada, and the United States (New Orleans and Milwaukee).

[22] Selling prices of Soviet tractors in the United States bear no relation to the dollar prices obtained by converting domestic Soviet ruble prices at the official exchange rate. For example, the converted price of the MTZ–50 (one of five models being offered in the United States) would be about $3,200 (2,400 rubles×$1.33); or about one-third the price of a comparable U.S. tractor.

able, and technically feasible, these goals were realized only partially, or not at all.

The Soviets had planned to increase the engine speed of the average Soviet tractor by 20 to 40 percent by raising average rpm's from 1600–1800 rpm's in 1970 to 1900–2500 rpm's in 1975. In fact, nearly all tractor engines in production in 1975 had the same rpm rating as in 1970. Planned speeds were achieved in only three of the new models: the T–150 tracklaying (2,000 rpm), the T–150K wheeled (2,100 rpm), and the MTZ–80 wheeled (2,200 rpm).

Fuel consumption on some Soviet tractors is as good or better than on some U.S. tractors, but the plan to have typical consumption rates of about 170 to 180 grams per horsepower hour by 1975 was not realized. Indeed, only four tractors in production in 1975 had consumption rates within this range (the MTZ–80 and K–700/700A wheeled and the T–100M and T–130 tracked); consumption of 185 to 195 grams per horsepower hour seemed to be typical.

Currently, engines of the heavy-duty K–700/700A wheeled and the new T–130 tracklaying tractors are turbocharged for increased power. The Soviets had planned to add turbocharging to three or four more engines for tractors in mass production, but this does not appear to have happened.

The power of the average Soviet tractor (weighted by output) was to have increased to 93 horsepower by 1975, that is, by 45 percent above the average for 1970. The actual average in 1975 was only 76 horsepower or 18 percent higher than 1970.

A significant reduction in weight-to-horsepower ratios was planned—down to 35 to 50 kilograms per horsepower for wheeled tractors (similar to the U.S. ratio), and to 40 to 70 kilograms per horsepower for tracklaying tractors (somewhat better than the U.S. ratio).[23] The Soviets made substantial progress toward these goals. All four of the major new models of wheeled tractors that were in mass production by the end of 1975 (the MTZ–80, YuMZ–6, T–150K, and K–701) had weight-to-horsepower ratios within the planned range, based on designed weight. The new T–150 tracklaying tractor also has a low weight-to-horsepower ratio of 44 kilograms based on designed weight, but it had not gone into mass production by the end of 1976. All other major models of Soviet tracklaying tractors weigh considerably in excess of 70 kilograms per horsepower, with the exception of the mass-produced T–4A and DT–75M (which average about 70 kilograms per horsepower).

Finally, an unprecedented feature of the Ninth Five-Year Plan was an objective to satisfy completely all requirements for spare parts by 1975. This was to be accomplished, in part, through increased consolidation of enterprises producing spare parts. Consolidation was expected also to reduce wide differences in production costs through increased economies of scale in production programs. For the five years as a whole, the Soviets had planned to increase output of parts and components for tractors and farm machinery in specialized enterprises by 2.5 billion rubles; by 1975, output of spares was scheduled to amount to one-fourth of the gross value of output of tractors and

[23] It is not clear whether these Soviet weight-to-horsepower ratios have been calculated on the basis of the designed weight of the tractor or the service weight (fueled and ready to go), but probably it is the former. The difference can be significant. For example, the average weight per horsepower of all Soviet wheeled tractors produced in 1974, weighted by estimated output, was 51 kilograms based on designed weight and 56 kilograms based on service weight. For tracklaying tractors, the figures were 81 and 86 kilograms, respectively.

agricultural machinery combined. The Soviet press has since been silent about these goals or their implementation. However, there is evidence that the spare parts supply problem persists, and that the existing patterns of spare parts distribution and consumption that contribute so importantly to the problem have remained fundamentally unchanged.

B. 1976–80

In the current Five-Year Plan period, the Soviets will try again to reach many of the same technical objectives that they failed to reach during 1971–75. If, as seems likely, most of the 1980 technical goals are met, the Soviets will have taken a major step toward upgrading their tractors to world standards. However, they probably will not achieve comparability with the United States. The thrust in the U.S. tractor industry for improvements in tractor performance seems to be even more intense than in the U.S.S.R.

One area that may prove difficult is raising average tractor horsepower to 93 horsepower by 1980 as planned. To a large extent, that goal will depend upon successful full-scale production of new tractor models at Chelyabinsk and Pavlodar. Additional capacity is under construction at Chelyabinsk but is moving slowly. Pavlodar plans to put into production the 300-horsepower K–701 wheeled tractor but has had experience producing only a single 90-horsepower tracklaying model.

X. General Conclusions

In general, Soviet tractors in 1975 were better made and more powerful than those produced in 1970, although, on the average, not as well-made or as powerful as those produced in the United States; the average Soviet tractor still cannot be said to be the technological equivalent of the average U.S. counterpart. During the past five years, the technology gap with the United States has been narrowed sufficiently in Soviet export models to make them acceptable to at least some U.S. farmers, but acceptability in the U.S. market is not a sure indicator of technical equivalence as long as the Soviet price is substantially lower than the U.S. counterpart. Moreover, export models are manufactured with special care and cannot be said to be characteristic of Soviet production, generally.

The Soviet drive to raise average tractor horsepower is well directed and should help to improve productivity in agriculture, and perhaps also to reduce agricultural manpower requirements. Even so, new, higher horsepower models are likely to be underutilized for many years because of shortages of complementary farm machinery. In addition, shortages of spare parts will continue to keep many tractors out of service for extended periods.

A critical shortage of special-purpose heavy-duty industrial-type tractors, including pipelayers and tractors for construction work as bulldozers, is likely to persist throughout the remainder of the 1970s. This shortage, coupled with an anticipated growth in demand generated by projects such as the Baikal-Amur Railroad (BAM), make it likely that the U.S.S.R. will continue purchase of large tractors in the United States and other Western countries. The U.S.S.R. may also acquire U.S. production technology under a recently signed scientific and technical cooperation agreement with a large U.S. company.

TABLE 1.—UNITED STATES AND U.S.S.R.: PRODUCTION OF TRACTORS, BY MAJOR TYPE

	Thousand units						Percent of total			
	Total [1]		Wheeled		Tracklaying		Wheeled		Tracklaying	
	United States [2]	U.S.S.R.	United States	U.S.S.R.	United States	U.S.S.R.	United States	U.S.S.R.	United States	U.S.SR.
1950	[3] 542.4	108.8	498.8	23.8	[3] 43.7	85.1	91.9	21.8	8.1	78.2
1955	[3] 377.1	163.4	330.1	62.9	[3] 47.0	100.5	87.5	38.5	12.5	61.5
1960	192.1	238.5	152.2	116.5	39.9	122.0	79.2	48.8	20.8	51.2
1961	199.5	263.6	171.4	127.0	28.1	136.6	85.9	48.2	14.1	51.8
1962	216.2	287.0	188.1	149.3	28.1	137.7	87.0	52.0	13.0	48.0
1963	235.5	325.3	203.4	176.1	32.0	149.2	86.4	54.1	13.6	45.9
1964	253.3	329.0	213.2	186.3	40.1	142.7	84.2	56.6	15.8	43.4
1965	284.4	[4] 354.5	244.0	197.5	40.4	157.0	85.8	55.7	14.2	44.3
1966	311.0	382.5	270.7	209.8	40.3	172.7	87.0	54.8	13.0	45.2
1967	270.1	405.1	242.2	220.0	27.9	185.1	89.7	54.3	10.3	45.7
1968	245.5	423.4	213.2	229.4	32.3	194.0	86.9	54.2	13.1	45.8
1969	227.9	441.7	195.7	233.9	32.2	207.8	85.9	53.0	14.1	47.0
1970	199.0	[5] 458.5	171.6	240.8	27.4	217.7	86.2	52.5	13.8	47.5
1971	194.1	472.0	167.5	246.5	26.6	225.5	86.3	52.2	13.7	47.8
1972	229.2	477.8	197.2	248.3	32.0	229.5	86.0	52.0	14.0	48.0
1973	247.4	499.6	211.5	269.5	35.9	230.1	85.5	53.9	14.5	46.1
1974	243.5	531.1	209.4	291.6	34.1	239.5	86.0	54.9	14.0	45.1
1975	[6] 251.5	[7] 550.4	[6] 226.0	NA	[6] 25.6	NA	89.8	NA	10.2	NA

[1] Because of rounding, components may not add to the totals shown.
[2] Peak production in the United States was 617,100 units in 1951, of which 567,400 (92 percent) were wheeled.
[3] Excluding tracklaying tractors produced as shovel loaders.
[4] The plan called for 450,000 units.
[5] The plan called for 600,000 to 625,000 units.
[6] Shipments.
[7] The plan called for 575,000 units.

TABLE 2.—U.S.S.R.: MAJOR NEW TRACTOR MODELS INTRODUCED DURING 1971–75

New models	Horsepower rating	Models being replaced	Horsepower rating	Percentage increase in horsepower of new models
Wheeled:				
YuMZ–6M/6L	60/65	MTZ–5MS/LS	48	25/35
MTZ–80/82	75/80	MTZ–50/52	50/55	50/45
T–50/50A	50	T–40/40A	40	25
K–701	300	K–700/700A	215	40
T–150K	165			
Tracklaying:				
T–150	150	T–74	75	100
T–130	140/160	T–100M	108	30/50

TABLE 3.—U.S.S.R.: UNIT PRODUCTION OF TRACTORS, BY MODEL, 1974[1]

[In thousands of units]

Model	Horsepower	Total	Light—Less than 50 hp	Medium—50 to 89 hp	Heavy—90 hp and above	Producing plant
All models		531.1	73.7	282.1	175.3	
Tracklaying		239.5	.9	98.4	140.2	
DET–250M	300	.5			.5	Chelyabinsk Tractor Plant.
T–180, T–180G	175	.4			.4	Bryansk Motor Vehicle Plant.
D–804M	175	.1			.1	Do.
T–150	150	.5			.5	Khar'kov Tractor Plant.
T–130	140/160	Negl			Negl	Chelyabinsk Tractor Plant.
T–4A	110	22.1			22.1	Altay Tractor Plant (Rubtsovsk).
TT–4	110	5.0			5.0	Do.
T–100M, T–100MB	108	27.5			27.5	Chelyabinsk Tractor Plant.
DT–75M	90	84.1			84.1	Volgograd Tractor Plant; Pavlodar Tractor Plant.
DT–75, DT–75A	75	8.0		8.0		Volgograd Tractor Plant.
DT–75B	75	10.0		10.0		Do.
T–74	75	47.7		47.7		Khar'kov Tractor Plant.
TDT–75	75	2.0		2.0		Altay Tractor Plant (Rubtsovsk).
TDT–55, LKhT–55	62	7.0		7.0		Onega Tractor Plant (Petrozavodsk).
T–54V, T–54L, T–54S.	55	8.6		8.6		Kishinev Tractor Plant.
DT–54A	54	10.0		10.0		Altay Tractor Plant (Rubtsovsk).
TDT–40M	50	5.1		5.1		Onega Tractor Plant (Petrozavodsk).
T–38M	48	.9	.9			Lipetsk Tractor Plant.
Wheeled		291.6	72.8	183.7	35.1	
K–700, K–700A	215	19.6			19.6	Plant Imeni Kirov (Leningrad).
T–150K	165	15.5			15.5	Khar'kov Tractor Plant.
MTZ–80/82	80	1.0		1.0		Minsk Tractor Plant.
YuMZ–6M/6L	60	53.0		53.0		Southern Machine Building Plant (Dnepropetrovsk).
MTZ–50M/50L	55	61.6		61.6		Minsk Tractor Plant.
MTZ–52M/52L	55	19.0		19.0		Minsk Tractor Plant.
MTZ–50Kh	55	2.5		2.5		Do.
T–28Kh4	50	21.6		21.6		Tashkent Tractor Plant.
T–40/40M	50	8.2		8.2		Lipetsk Tractor Plant.
	40	8.2	8.2			Do.
T–40A/40AM/40AN	50	16.8		16.8		Do.
	40	16.8	16.8			Do.
T–25A	25	28.0	28.0			Vladimir Tractor Plant.
T–16M	20	19.8	19.8			Khar'kov Tractor Assembly Plant.

[1] For the most part, output data for basic models also include output for modifications of the basic model.

TABLE 4.—UNITED STATES AND U.S.S.R.: ESTIMATED AVERAGE HORSEPOWER OF TRACTORS PRODUCED

	1965		1970		1974		1975	
	United States	U.S.S.R.	United States	U.S.S.R.	United States	U.S.S.R.	United States	U.S.S.R.
Average horsepower per tractor:								
Total	70	59	78	64	93	75	103	76
Wheeled	63	47	70	50	86	65	95	NA
Tracklaying	116	75	131	79	145	87	166	NA
Average horsepower of Soviet tractors as a percent of United States:								
Total	100	84	100	82	100	81	100	74
Wheeled	100	75	100	71	100	76	100	NA
Tracklaying	100	65	100	61	100	60	100	NA
Index of average horsepower (1965=100):								
Total	100	100	111	108	133	127	147	129
Wheeled	100	100	111	106	137	138	151	NA
Tracklaying	100	100	113	105	125	116	143	NA

TABLE 5.—UNITED STATES AND U.S.S.R.: DELIVERIES, INVENTORY, AND RETIREMENTS OF TRACTORS IN AGRICULTURE

Year	Deliveries				Inventory[2]		Retirements					
	1,000 units		Percent of production		1,000 units		1,000 units		Percent of inventory		Percent of deliveries	
	United States[1]	U.S.S.R.	United States	U.S.S.R.	United States	U.S.S.R.	United States	U.S.S.R.	United States	U.S.S.R.	United States	U.S.S.R.
1955	269.6	123.3	71.5	75.5	4,480	840.0	134.6	78.3	3.1	9.8	49.9	63.5
1960	118.5	157.0	61.7	65.8	4,743	1,122.3	63.5	88.7	1.4	8.4	53.6	56.5
1961	133.5	185.3	66.9	70.3	4,763	1,212.0	113.5	95.6	2.4	8.5	85.0	51.6
1962	148.4	206.0	68.6	71.8	4,778	1,328.9	133.4	89.1	2.8	7.4	89.9	43.3
1963	150.4	239.3	63.9	73.6	4,786	1,442.0	142.4	126.2	3.0	9.5	94.7	52.7
1964	144.2	222.5	56.9	67.6	4,787	1,539.0	143.2	125.5	3.0	8.7	99.3	56.4
1965	177.2	239.5	62.3	67.6	4,783	1,613.2	181.2	165.3	3.8	10.7	102.3	69.0
1966	197.2	276.0	63.4	72.2	4,786	1,660.4	194.2	228.8	4.1	14.2	98.5	82.9
1967	180.3	287.4	66.8	70.9	4,766	1,738.8	200.3	209.0	4.2	12.6	111.1	72.7
1968	151.9	290.3	61.9	68.6	4,712	1,821.3	205.9	207.8	4.3	12.0	135.5	71.6
1969	131.5	304.3	57.7	68.9	4,619	1,908.2	224.5	217.4	4.8	11.9	170.7	71.4
1970	121.1	309.3	60.9	67.5	4,562	1,977.5	178.1	240.0	3.9	12.6	147.1	77.6
1971	118.0	313.2	60.8	66.4	4,469	2,045.7	211.0	245.0	4.6	12.4	178.8	78.2
1972	138.8	312.8	60.6	65.5	4,387	2,111.9	220.8	246.6	4.9	12.1	159.1	78.8
1973	176.8	323.0	71.5	64.7	4,376	2,188.5	187.8	246.4	4.3	11.7	106.2	76.3
1974	145.3	348.0	59.7	65.5	4,263	2,266.5	258.3	270.0	5.9	12.3	177.8	77.6
1975[3]	140.0	370.0	55.7	67.2	4,190	2,362.3	213.0	274.2	5.0	12.1	152.1	74.1

[1] Shipments for farm use. For 1966–74, data are based on retail sales of agricultural wheeled tractors (excluding imports) and do not include deliveries of agricultural tracklaying tractors. About 1,600 of the latter went to agriculture in 1965 and probably smaller quantities in subsequent years.

[2] As of December 31.

[3] U.S. data estimated. U.S.S.R. delivery data given; other U.S.S.R. data estimated.

TABLE 6.—U.S.S.R.: EXPORT OF TRACTORS

[In units]

Year	Total	Communist countries				Non-Communist countries			
		Total	Eastern Europe [1]	Cuba	Other	Total	Industrial	Less developed	Undesignated
1960	18,887	15,824	12,149	601	3,074	3,063	522	2,539	2
1961	16,136	12,757	10,141	1,468	1,148	3,379	350	3,006	23
1962	12,351	10,569	8,296	1,025	1,248	1,782	66	1,716	0
1963	23,109	18,105	13,787	2,996	1,322	5,004	331	4,655	18
1964	21,010	15,831	11,807	3,168	856	5,179	156	5,005	18
1965	21,867	16,817	9,814	5,475	1,528	5,050	569	4,442	39
1966	21,435	16,504	11,161	2,770	2,573	4,931	1,058	3,809	64
1967	23,378	16,838	10,370	4,444	2,024	6,540	1,854	4,611	75
1968	27,275	19,709	13,077	4,619	2,013	7,566	1,920	5,613	33
1969	30,709	19,050	12,925	4,862	1,263	11,659	2,234	9,372	53
1970	28,269	21,163	15,225	4,171	1,767	7,106	1,534	5,518	54
1971	27,520	21,026	14,784	3,893	2,349	6,494	1,408	5,047	39
1972	27,750	20,891	14,981	3,454	2,456	6,859	1,923	4,872	64
1973	33,820	25,095	17,507	4,002	3,586	8,725	4,100	4,570	55
1974	40,274	31,782	23,590	3,686	4,506	8,492	5,128	3,364	0
1975	38,719	27,916	20,194	4,494	3,228	10,803	6,377	4,091	335

[1] Excluding Yugoslavia, which imported 17,796 Soviet tractors during 1960–75.

SOVIET CONSUMPTION AND INCOME POLICIES IN PERSPECTIVE

GERTRUDE E. SCHROEDER AND BARBARA S. SEVERIN

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Meeting in the Kremlin in early 1976 for the 25th Party Congress, the leadership of the Soviet Communist Party could look back with both pride and frustration on the fruits of its policies affecting the welfare of the population over the preceding quarter century. The period (1950–1975) was one of relative peace and quiet, witnessing none of the upheavals of the preceding 25 years—the advent of central planning, the collectivization of agriculture, the political purges, World War II with its catastrophic loss of life, property and production in the economy. Even with restored output by 1950, the population had benefited little from the advent of socialism. Per capita consumption was not much above the level of 1928 or 1913, and the goods and services provided were primitive and inferior in mix and quality, even for a semi-developed country. The subsequent quarter century has brought great progress, particularly in quantitative terms. By 1975, the level of living of the Soviet people was more than double that of 1950 and had gained significantly relative to industrialized countries of the West. Qualitative gains were much less spectacular. Rapid quantitative progress has revealed, as well as helped to produce, serious consumer-related problems, which seem to defy solution within a system of centrally-planned socialism.

This paper will consider: (1) the record of progress during 1950–1975, as measured by revised indexes of real per capita consumption of goods and services; (2) the concomitant changes in money incomes from work and in state welfare programs; (3) the problems arising from these consumption and income policies and the current difficulties in managing the consumer sector of the economy; (4) the inherent systemic dilemma and the policy options facing the political leadership.

I. Consumption—The Record

The consumption indexes on which the following discussion is based are revisions of indexes given in the JEC volume, Soviet Economic Prospects for the Seventies, published in 1973. The principal changes are: (1) use of 1970 base-year weights instead of 1968 weight; (2) substitution of several quantity series for deflated retail sales; and conversely, (3) replacement of a small, unrepresentative, quantity sample of consumer durables with a broader series representing deflated retail sales of all consumer durables and other miscellaneous household goods. The net effect of these and lesser changes is to reduce the growth of total consumption by 0.4 percentage points per year during 1951–71; the greatest impact was on consumer durables, where growth was reduced by 2.5 percentage points annually. The consumption index is a base-year weighted index of a number of individual series for goods and services. The sample underlying the index is approximately 95 percent complete. Thus, quantity changes are represented quite completely, and quality change is accounted for in those cases where reliable data are available.

A. Overall

During the period 1951–75—the Fifth through the Ninth Five-Year Plans—per capita consumption of all goods and services increased about 2.6 times, an average annual rate of 4 percent. The relevant data

are presented in summary form in Table 1. Progress was uninterrupted but quite uneven, with the greatest gains being made during the 1950's. After relatively low rates of growth during the early 1960's, per capita consumption accelerated in the late 1960's, only to be followed by another slowdown during the early 1970's. Poor agricultural performance was the main cause for the slowdown in consumption in both 1961–65 and 1971–75. The slowdown affected all categories of consumption except household services. In contrast to the pre-war years, consumption of goods and household services rose more rapidly than communal consumption (state-provided education and health). Despite such rapid progress, per capita consumption in the U.S.S.R. is still only about one-third of that in the U.S. and well behind that of Western Europe. The disparities are even greater when allowance is made for the inferior quality and limited assortment of Soviet goods and services.

Evidently, the Soviet leadership is contemplating relatively slow gains in per capita consumption over the next few years. The quantitative goals set in the Tenth Five-Year Plan (1976–80) imply growth at about the same rate as in 1971–75. In view of the tautness of this plan, poor harvests would jeopardize even this modest improvement in levels of living.

TABLE 1.—GROWTH OF PER CAPITA CONSUMPTION IN THE U.S.S.R., 1950–75

	Indexes (1950=100)					
	1950	1955	1960	1965	1970	1975
Total consumption	100.0	129.3	159.2	180.5	226.8	264.9
Household	100.0	130.3	161.8	182.4	231.5	270.8
Goods	100.0	131.4	163.8	181.4	229.4	266.1
Food	100.0	125.6	144.3	159.1	189.4	210.0
Soft goods	100.0	142.6	212.8	232.7	320.5	367.0
Durables and miscellaneous	100.0	223.3	382.7	473.7	751.9	1,196.2
Services	100.0	121.9	148.6	188.5	245.7	303.2
Communal	100.0	124.0	142.7	169.9	198.0	228.7
Education	100.0	115.6	125.2	160.9	188.2	222.4
Health	100.0	139.5	174.4	185.9	215.1	239.4
	Average annual rates of growth					
	1951–75	1951–55	1956–60	1961–65	1966–70	1971–75
Total consumption	4.0	5.3	4.2	2.5	4.7	3.2
Household	4.1	5.4	4.4	2.4	4.9	3.2
Goods	4.0	5.6	4.5	2.1	4.8	3.0
Food	3.0	4.7	2.8	2.0	3.5	2.1
Soft goods	5.3	7.4	8.3	1.8	6.6	2.7
Durables and miscellaneous	10.4	17.4	11.4	4.4	9.7	9.7
Services	4.5	4.0	4.0	4.9	5.4	4.3
Communal	3.4	4.4	2.8	3.6	3.1	2.9
Education	3.2	2.9	1.6	5.1	3.2	3.4
Health	3.6	6.9	4.6	1.3	3.0	2.2

Source: App. A, table 1.

B. Food

Although it is the slowest-growing category, per capita food consumption has more than doubled in real terms during the past quarter century. Year-to-year gains have varied widely, depending on the size of the harvest. In addition to quantitative gains, the quality of the diet has improved markedly in a direction typical of developing countries—more meat, milk and vegetables and less bread and potatoes. As shown by the data in Table 2, the average person ate over twice as much meat in 1975 as he did in 1950, when consumption of meat was even below what it was in 1913. Per capita consumption of fish and vegetable oil also doubled, while that of eggs, sugar and fruit more than tripled. In contrast, per capita consumption of potatoes was half what it was in 1950, and consumption of grain products has declined. Even so, the average Soviet citizen still gets about half his daily calories from bread and potatoes and eats less than half as much meat as do his counterparts in the U.S. and Western Europe. Moreover, in 1975, consumption of bread and potatoes still exceeded the "rational consumption norms" established by Soviet statisticians for long-range planning purposes by over one-fifth, and consumption of meat, milk and eggs was below these norms by over one-quarter.[1] Only for sugar and vegetable oil were the norms exceeded.

Influenced, perhaps, by the crop failure in 1975, Soviet planners have scheduled a growth in food consumption in 1976–80 at the low rates realized during 1961–65 and 1971–75. As a consequence of shortages of feed and distress slaughtering of animals, per capita consumption of meat will probably decline in 1976, perhaps by as much as one-quarter. However, the plan emphasizes continued improvement in the quality of the diet over the 5-year period as a whole. Barring another series of crop disasters, the Soviet Union should be able to meet or even exceed the modest planned goals for food consumption, with the exception of meat.

TABLE 2.—PER CAPITA CONSUMPTION OF MAJOR FOODS, 1950, 1960, 1970, AND 1975 [1]

[Kilograms per year]

	1950	1960	1970	1975
Meat and meat products, including fat	26.0	40.0	48.0	58.0
Milk and milk products	172.0	240.0	307.0	315.0
Eggs (units)	60.0	118.0	158.0	215.0
Fish and fish products	7.0	9.9	15.4	16.8
Sugar	11.6	28.0	38.8	40.8
Vegetable oil	2.7	5.3	6.8	7.9
Potatoes	241.0	143.0	130.0	120.0
Vegetables and legumes	51.0	70.0	83.0	87.0
Fruits and berries	11.0	22.0	35.0	37.0
Grain products	172.0	164.0	149.0	142.0

[1] Although the U.S.S.R. Central Statistical Administration states that it calculates per capita consumption of food products from an overall production-consumption balance, doubt exists as to the reliability of levels of consumption in the individual series (see Appendix A, p. 642). At the same time, the trends depicted are consistent with independently constructed balances.

Sources: Narodnoye khozyaystvo SSSR, 1922–72, p. 372. SSSR v tsifrakh v 1975 godu, p. 202.

[1] The norms cited in this paper are given in Philip Weitzman, "Soviet Long-term Consumption Planning: Distribution According to Rational Need," Soviet Studies, Vol. XXVI, No. 3, July 1974, pp. 305–322.

C. Soft Goods

Per capita consumption of soft goods expanded about four-fold during the past 25 years. Gains were nearly twice as great during the 1950's as during subsequent years. This group includes clothing, shoes, haberdashery, fabrics and a wide variety of other soft goods, ranging from soap to publications. Factory-made clothing has been rapidly displacing home-sewn garments, resulting in a slowing growth in consumption of fabrics and rapid growth in outlays on ready-made garments. The average person now buys three pairs of shoes per year, compared with only one pair in 1950, and the U.S.S.R. has now met the "rational norm" established for consumption of this item. The quality, style and variety of soft goods have also improved markedly, even though they still appear shoddy and drab by Western standards. Imports of these goods in recent years have added quality to the wardrobe of consumers affluent enough to pay the high prices fixed for them or having the credentials to purchase them at low prices in special stores not accessible to the general populace.

The goals established for the textile and clothing industries in the Tenth Five-Year Plan imply a planned growth in per capita consumption of soft goods at the relatively low rate achieved during 1971–75. The plan emphasizes that a concerted effort is to be made to upgrade the level of quality, style and fashion in clothing and shoes.

D. Durables and Miscellaneous Goods

In 1950, a consumer durable goods industry was almost non-existent in the U.S.S.R., and sales of durables and miscellaneous common household items represented only about 5 percent of total retail sales of non-food goods. A quarter century later the U.S.S.R. had developed sizeable capacities to produce ordinary durables such as sewing machines, washing machines, refrigerators, furniture, radios and TV's, and had established belatedly a moderate-sized passenger car industry. Sales of such durables in 1975 comprised about one-fifth of total sales of non-food goods. Overall, per capita consumption of durables and miscellaneous goods increased twelvefold during 1951–75, an average annual growth of 10.4 percent. Although most Soviet consumer durables are of poor quality and obsolete design by modern standards, ordinary durables, nonetheless, are becoming a feature of most Soviet households. Indeed, some families now own two or more of some durables.[2] Automobiles are a striking exception, since only about 4 of every 100 families owned one in 1974 [3]—the consequence of the government's long delay in deciding to produce cars for sale to the population in large quantities. Table 3 provides data showing the change in household stocks of major consumer durables over the past 15 years; data for 1950 are not available, but stocks must have been insignificant.

By far the largest gains in consumption of durables took place during the 1950's, when explosive growth occurred in production of washing machines, refrigerators, vacuum cleaners and television sets from very low levels. Subsequently, growth in sales of such conventional durables slowed greatly, but after 1970 the number of automobiles sold at retail rose over eight-fold—from 123,000 to 924,000; their sales probably approached 4 billion rubles in 1975. The Tenth Five-Year

[2] Sovetskaya torgovlya, No. 5, 1976, p. 16.
[3] P. A. Lokshin, Spros, proizvodstvo, torgovlya, Moscow, 1975, p. 211.

Plan provides for output of major consumer durables (other than cars) and miscellaneous household goods to increase at about the same rate as was achieved in 1971–75. Judging from this evidence and the leveling off of the production of automobiles, it appears that per capita consumption of consumer durables will expand somewhat less rapidly in 1976–80 than in 1971–75. At the same time, the plan calls for continued upgrading of the quality and servicing for durables, shifts in mix toward more modern designs (e.g., self-defrosting refrigerators) and introduction of new products, such as air conditioners and video tape recorders.

TABLE 3.—HOUSEHOLD STOCKS OF CONSUMER DURABLES, 1960, 1970, AND 1975[1]

[Units per 100 families]

	1960	1970	1975
Watches and clocks	286	346	457
Radios and phonographs	46	72	78
Television sets	8	51	74
Cameras	18	27	27
Bicycles, motor bikes and mopeds	39	50	54
Motorcycles and motorollers	4	7	8
Vacuum cleaners	3	12	19
Sewing machines	35	56	61
Refrigerators	4	32	62
Washing machines	4	52	65

[1] During the 1960's, data on stocks of durables appeared to reflect simply the sum of production divided by population. This no longer is the case; retirement rates seem to be incorporated, to some extent at least, as the following tabulation shows:

	Stocks of selected durables in 1975, units per 1,000 persons			
	Television sets	Refrigerators	Washing machines	Vacuum cleaners
1. Officially reported	216	179	188	55
2. Sum of production 1948–75 divided by Midyear population	300	209	201	92

Note: We suspect, however, that the retirement rates may not be adequate; thus, true household inventories may be smaller than reported.

Source: Narodnoye khozyaystvo SSSR, 1922–72 ,p. 373. SSSR v tsifrakh v 1975 godu,p. 204.[1]

E. Housing and Personal Services

Per capita consumption of services tripled during 1951–75, and in contrast to all other major categories grew more rapidly in the 1960's and 1970's than in the 1950's. This group consists of housing, utilities, personal transportation and communication, repair and personal care, and a variety of recreational and cultural services paid for by the population. Personal transport and communication services grew most rapidly over the period, expanding over fivefold. In contrast, the total housing stock rose by only 75 percent, reflecting an increase in per capita living space in urban areas from 4.7 square meters in 1950 to 8.1 square meters in 1975 and somewhat larger gains in rural areas. The majority of urban families now have their own apartments, a great gain over earlier years, when most urban families shared kitchen and bath facilities with several neighbors. All housing now has electricity, and the use of gas is growing rapidly. Despite these visible gains, Soviet housing remains crowded, drab and monotonous and represents an area of great consumer frustration and relative neglect.[4]

[4] By the end of 1975, according to the Ninth Five-Year Plan, approximately three-quarters of all urban families were supposed to live in separate apartments, compared with 40 percent in 1940. Voprosy ekonomiki, No. 5, 1972, p. 24. Evidently, this goal was not met. That housing is a major sore point for consumers is indicated by a recent survey showing that 56.9 percent of those questioned were dissatisfied with their housing conditions, Ekonomicheskiye nauki, No. 5, 1974, p. 27.

Among the remaining services, repair and personal care services increased scarcely at all on a per capita basis until about 1963–64, when the government launched a major program to expand state-run service facilities of all kinds. Nonetheless, expenditures on such state services were a mere 26 rubles per capita in 1975. By all accounts, their poor quality continues to remain the basis for a flourishing private sector.

According to the Directives for the Tenth Five-Year Plan, a continued rapid rate of expansion of the entire services sector is planned, although evidently at much lower rates than in the preceding decades. If urban housing goals are met—something never accomplished in the past—per capita living space will still not have reached the minimum norm for health and decency established by the Soviet government in 1928. A slowdown in the growth of state-provided repair and personal care service facilities also is in prospect, although their quality is supposed to improve.

F. Communal Services

Government outlays on education and health services more than tripled over the past quarter-century, representing a growth in real per capita expenditures of 3.4 percent annually. Such expenditures now account for about 7 percent of gross national product, a large share for a country at the Soviet level of development. The two sectors have expanded at similar rates, and both have experienced reduced growth rates since 1965, a result consistent with slowing population growth. In education, this substantial effort has resulted in an increase in the median number of years of schooling of persons aged 16 years and older from 5.0 years in 1950 to an estimated 7.7 years in 1975.[5] The goal of a universal, ten-year (high school) education is close to being realized. The large-scale investment in higher education is evidenced by the fact that 84 out of every 1,000 persons working in 1975 had completed college, and an additional 667 had some college or secondary specialized education; in 1959, the corresponding figures were 33 and 400.[6]

In health, the Soviet effort is reflected in reductions in general and infant mortality rates to levels that compare favorably with those of Western industrialized countries. According to Soviet statistics, the number of doctors per 10,000 population rose from 14.6 in 1950 to 32.6 in 1975, and the number of hospital beds per 10,000 population rose from 56 to 118 during the same period.[7] By all accounts, the quality of health care varies greatly among regions and is far better in cities than in rural areas and for elite groups than for the general population. Although the quality of both personnel and facilities may be poor by Western standards, the U.S.S.R. has developed a generally adequate public health system available to everyone without direct charge. The costs of such an extensive system have been kept low mainly by fixing low wages for health service personnel.

The Directives for the Tenth Five-Year Plan outline the planned achievements in education and health during 1976–80. Educational ad-

[5] Ann S. Goodman and Murray Feshbach, "Estimates and Projections of Educational Attainment in the U.S.S.R.," U.S. Bureau of the Census, International Population Reports Series P 91, No. 16, December 1967, p. 17.

[6] Narodnoye khozyaystvo SSSR v 1974 godu, p. 42.

[7] Narodnoye khozyaystvo SSSR, 1922–1972, p. 378. SSSR p tsifrakh v 1975 godu, p. 207.

vance apparently is planned to proceed about at rates of the recent past, with much emphasis to be placed on vocational training and upgrading of skills. In health, the quality of service is to be improved, and the number of hospital beds is to increase by about 10 percent, compared with about 25 percent during 1971–75.

II. Personal Incomes

Along with rapid growth in quantities of goods and services consumed, the past quarter century has brought remarkable changes in the growth and structure of personal incomes. First of all, money incomes have increased steadily and rapidly. Table 4 and appendix B present the available data on disposable money incomes. In considering these data, it should be noted that they understate total current money incomes by several percent,[3] because of the absence of data on such incomes as prisoners' wages, various kinds of money payments not included in the regular wage fund, receipts from sale of property and from private nonagricultural activities, and others. Per capita reported money incomes quadrupled during 1950–1975, rising somewhat more rapidly than per capita retail trade and household services (3.7 times). Incomes grew more rapidly during the 1960's (6.5 percent annually) than during the 1950's (5.2 percent annually). A cutback in growth to 4.9 percent annually was registered in 1971–75.

TABLE 4.—GROWTH OF MONEY INCOMES AND OUTLAYS PER CAPITA, 1950–75

[In rubles]

	Disposable money incomes [1]	Money outlays on goods and services [2]	Money outlays on goods and services and savings
1950	220.5	226.2	227.7
1955	282.8	287.5	290.2
1960	366.1	406.3	410.2
1965	492.9	499.1	512.2
1970	685.1	696.3	730.0
1975	871.6	842.1	889.6
Average annual rates of growth:			
1951–55	5.1	4.9	4.9
1956–60	5.3	7.1	7.1
1961–65	6.1	4.2	4.4
1966–70	6.8	7.0	7.3
1971–75	4.9	3.9	4.0

[1] Taken from app. B, tables 1–3.
[2] Soviet-reported retail trade (less estimated sales to institutions) and outlays on household services included in the index for services described in app. A. It is assumed, as Soviet sources claim, that price changes for services were negligible. The population's outlays on education and health are not included, because they cannot be estimated accurately over time. They are small, in any case. Only expenditures in legal markets are included.
[3] Retail sales to the population plus the increment in the population's deposits in savings banks as reported in Soviet statistical handbooks.

To the extent that one can judge from the incomplete data, both for incomes and for outlays, shown in Table 4, the Soviets have had an uneven record of performance in their efforts to match the growth of money incomes with equivalent growth in the supply of goods and services. The most successful periods seem to be 1951–55 and 1966–70. The record for 1956–60 and 1961–65 is greatly affected by events in 1960, when an unusually large increase in retail trade occurred, prob-

[3] Abraham S. Becker, Soviet National Income 1958–1964, RAND R–464–PR, August 1969, p. 76. Central Intelligence Agency, U.S.S.R.: Gross National Product Accounts, 1970, A (ER) 75/76, November 1975, p. 25.

ably because people feared that the currency devaluation announced for 1961 would be confiscatory. Evidently, there was dishoarding of cash in that year. For the decade 1956–65, reported money incomes and purchases of goods and services grew at about the same rate. Rising incomes, along with failure to match their growth with desired goods and services and severely limited access to consumer credit, has resulted in growth of per capita deposits in savings banks from a mere 10.3 rubles in 1950 to 357.4 rubles in 1975. Additional savings have taken the form of purchases of private and cooperative housing and purchases of state bonds, but these are small compared with savings deposits, at least since 1955, when compulsory purchase of state bonds was discontinued.

The rise in money incomes has been spread quite unevenly among major groups of the population. Nonagricultural workers experienced a growth in average annual money earnings of 3.1 percent annually. Average wages increased nearly twice as fast during the 1960's as during the 1950's. In the latter period the growth in earnings reflected mainly rising productivity and a higher level of skill and education of the labor force. Also, in this period the workweek was reduced by one-sixth, a major wage reform was carried out in the industrial sector, and the minimum wage was raised substantially. In the 1960's, the minimum wage was again raised—from 20–30 rubles per month to 40 rubles and then to 60 rubles per month. The wage reform along with large increases in wage levels was extended to the long-neglected service sectors. During the latter half of the decade, average wages were raised significantly as a result of increased bonuses paid from profit-based incentive funds established by the general economic reform launched by Kosygin in late 1965. The acceleration in the growth of money earnings, along with an even greater increase in the level of savings deposits, led to a policy of severely restricting the expenditure of incentive funds in 1971–75. Another round of wage reforms was launched and reportedly completed in the so-called "productive" sectors; it involved an increase in the minimum wage to 70 rubles per month, establishment of new wage scales and tightening of work norms, and increases in regional and other such pay differentials. Substantial wage increases were also made for major groups of workers in education and health.

Throughout the entire period, money wages of agricultural workers increased over three times as fast as wages of nonagricultural workers. In part, this spectacular growth reflects the monetization of the collective farm sector. In 1953, only about 40 percent of total wages paid to collective farmers by the farms was paid in cash; the rest was paid in kind. By 1973, nearly all wages were paid in money.[9] As a result of this change, the large rise in agricultural procurement prices, and a deliberate policy of gradually raising collective farm wage rates to the level of state farms, money wages of collective farmers increased at an average annual rate of 13.6 percent during 1951–75. At the same time, wages in state agriculture were raised more rapidly (4.9 percent annually) than wages of all other state employees (3.1 percent annually). The growth of average money wages for both groups combined was more rapid during the 1950's than during the 1960's, with a pronounced

[9] P. A. Lokshin, op. cit., p. 9.

slowdown occurring in 1971–75. The data for the several groups of workers in the labor force are shown in Table 5.

TABLE 5.—AVERAGE ANNUAL MONEY WAGES OF AGRICULTURAL AND NONAGRICULTURAL WORKERS, 1950–75

[In rubles]

	Nonagricultural workers [1]	All agricultural workers [2]	State agricultural workers [3]	Collective farmers [4]
1950	830.1	89.57	459.6	42.8
1955	927.8	208.81	559.2	123.4
1960	1,008.4	330.90	645.6	221.5
1965	1,190.5	614.40	900.0	483.1
1970	1,490.8	961.42	1,212.0	825.9
1975	1,780.7	1,225.79	1,528.8	1,027.8
Average annual rates of growth:				
1951–55	2.2	18.5	4.0	23.6
1956–60	1.7	9.7	2.9	12.4
1961–65	3.4	13.2	6.8	16.9
1966–70	4.6	9.4	6.1	11.3
1971–75	3.6	5.0	4.7	4.5

[1] Total wage bill for all state employees less the wage bill for state agriculture. Employment and average wages are reported in the annual statistical handbooks.
[2] Average annual wages of workers in state and collective farm agriculture weighted by their respective employment.
[3] Average wages are reported in the annual statistical handbooks and for 1975 in SSSR v tsifrakh v 1975 godu,p. 180.
[4] Average wages are calculated by dividing total wage payments to collective farm members given in app.B, table 2, by average annual employment estimated by Murray Feshbach and Stephen Rapawy, "Labor Constraints in the Five-Year Plan," in Joint Economic Committee, Soviet Economic Prospects for the Seventies, Washington, 1973, pp. 520–521.

The increase in *total* agricultural incomes, however, was much less rapid than indicated by changes in wages alone. Agricultural families obtain a substantial share of their total real incomes from consumption-in-kind and from sale of products from their own private farming activity (private plots). These sources are a larger share of the total incomes of collective farmers than of state farm workers. When net household incomes from sale of farm products are added to farm wages and the farm labor force adjusted to include employment in private agricultural activities, the growth of average money incomes during 1951–75 is reduced to 8.1 percent annually, over twice as fast as average money incomes of nonfarm workers.

With respect to consumption-in-kind, the evidence points unmistakeably to a steady decline in its share in total farm household incomes. One Soviet source reports that in-kind incomes (including in-kind payments from collective farms) comprised 15 percent of the total personal consumption fund in 1950, 12 percent in 1960, and about 8 percent in 1973.[10] From this information, coupled with available data on farm and non-farm money incomes, it can be estimated that average farm incomes were 41 percent of non-farm incomes in 1950, 64 percent in 1960, and 86 percent in 1973. These are surely maximum ratios, since they attribute all consumption-in-kind and money earnings from the sale of farm products to farm households, whereas urban households obtain small incomes from these sources also. Another calculation based mainly on family budget data in Soviet statistical handbooks produced an estimate that average annual farm incomes were 57.4 percent of non-farm incomes in 1960 and 74 percent in 1970.[11] Whatever the "true" figures may be, the term "revolution" is certainly appro-

[10] Ibid.
[11] Gertrude E. Schroeder, "Consumer Goods Availability and Repressed Inflation in the Soviet Union," in NATO, Directorate of Economic Affairs, Economic Aspects of Life in the U.S.S.R., Brussels, 1976, p. 45. For a recent study of farm inomes see Karl-Eugen Wadekin, "Income Distribution in Soviet Agriculture," Soviet Studies, Vol. XXVII, No. 1, January 1975, pp. 3–26.

priate to describe the large rise in farm incomes over the past 25 years, both absolutely and relative to non-farm incomes.[12]

According to the Directives for the Tenth Five-Year Plan, the growth of money incomes is to continue, but at slower rates than during the Ninth Five-Year Plan. Wages of the state labor force (agricultural and nonagricultural) are scheduled to rise 16–18 percent, and wages of collective farmers are to rise by 25–27 percent. Thus, the trend toward narrowing of income differentials between farm and non-farm workers will continue. The minimum wage of 70 rubles per month, along with related changes in wage and salary rates, is to be completed in the service sectors, and a new round of increases in the minimum wage is to be started.

Another major development affecting the level of personal incomes is the rapid rise in transfer payments, which increased over 6 times during the past 25 years. These payments consist mainly of state pensions, various kinds of welfare benefits and stipends for students. In 1950, pension and welfare payments amounted to a mere 19 rubles per capita; in 1975 they amounted to 123 rubles. Their growth has been far more rapid than the growth in wages, reflecting not only gradual aging of the population and increasing wages (to which pensions are tied), but also large increases in minimum pensions and liberalization of other welfare programs. In the mid-1950's, a major reform raised pensions and disability benefits, liberalized eligibility requirements, and set minimum pensions of 20–30 rubles per month. During the 1960's, a formal system of pensions for collective farmers was established, patterned after the system for state employees and partially financed by the state budget. During 1971–75, pensions and benefits for various categories of workers were further increased, eligibility rules for collective farmer pensions were liberalized, and (in 1974) a system of family allowances for low income families was introduced. In 1972, stipends for students were increased by 25 percent. The Tenth Five-Year Plan provides for further improvement in pension and welfare programs, including increases in minimum pensions, for both state workers and collective farmers. Apparently, no major program changes are planned, however, since the funds to be allocated to such programs and to education and health are scheduled to rise much less in 1976–80 (28–30 percent) than in 1971–75 (41 percent).

Up to now, the discussion has concerned money incomes alone. Consideration of real incomes requires a price index that measures changes in the cost of living with reasonable accuracy. The index used in previous JEC studies to express per capita disposable money income in real terms is a combination of the official Soviet index of state retail prices and an index of prices on collective farm markets derived from official data. These indexes have been severely criticized by both Soviet and Western economists, because they do not really measure changes in prices of goods actually sold.[13] The official retail price index, by virtue of the method of construction, is an index of prices on state price lists, rather than an index of prices actually paid. The index is

[12] For a careful analysis of farmer incomes in the period 1953–1967, see: David W. Bronson and Constance B. Krueger, "The Revolution in Soviet Farm Household Incomes 1953–1967," in James R. Millar (ed.), The Soviet Rural Community, Urbana, University of Illinois Press, 1971, pp. 214–258.

[13] For a critique of official Soviet price indexes, see Morris Bornstein, "Soviet Price Statistics," in Vladimir G. Treml and John P. Hardt, (eds.), Soviet Economic Statistics, Durham, N.C., Duke University Press, 1972, pp. 355–376.

widely believed to understate real price changes, especially in recent years. Lack of data precludes independent construction of a substitute price index from sample price and quantity data.

To provide an alternative to the official index and to give some idea of what actual price changes might have been, an "alternative" index was calculated; it is the price index that is implicit in a comparison of indexes of goods sold in the retail trade network in constant and in current prices. More specifically, an index of consumption of purchased goods in constant prices was derived from the index of consumption of goods shown in Appendix A, Table 1, by deducting consumption in kind in constant prices from the index for food and then combining the resulting index for food with the indexes of soft goods and durables. The index in current prices is derived from total retail and collective farm market sales regularly reported in Soviet statistical handbooks. The implicit price index resulting from comparison of these two indexes is shown for benchmark years in Table 6. A more complete explanation of the methodology is given in Appendix B. The two indexes behave rather differently; whereas the official index is nearly flat after 1955, the "alternative" index rises steadily but at a slow average annual rate of 1.3 percent.

TABLE 6.—GROWTH OF REAL PER CAPITA DISPOSABLE INCOME USING ALTERNATIVE CONSUMER PRICE INDEX, 1950–75

	Per capita personal disposable money income (rubles)	Price Indexes		Real per capita disposable money income (rubles)	
		Official	"Alternative"		
		(A)	(B)	(A)	(B)
1950	220.49	100.0	100.0	220.49	220.49
1955	282.77	74.7	83.4	378.54	339.05
1960	366.08	75.1	87.2	487.46	419.82
1965	492.90	75.8	93.4	650.26	527.73
1970	685.13	75.4	99.6	908.66	687.88
1975	871.56	75.8	108.0	1,149.82	807.00
Average annual rates of growth:					
1951–55	5.1			11.4	9.0
1956–60	5.3			5.2	4.3
1961–65	6.1			6.0	4.7
1966–70	6.8			7.0	5.4
1971–75	4.9			4.8	3.2
1951–75	5.7			6.8	5.3

The alternative price index has shortcomings in that: (1) its coverage, although very close, is not identical with the coverage of officially reported retail sales; (2) it is derived from a sample index, even though coverage is nearly complete; (3) it includes several component indexes which are themselves based on retail sales deflated by the official price indexes. Nonetheless, the "alternative" index is believed to be a more accurate measure of real price changes of goods actually purchased than is the official index. If anything, it understates the increase in prices. Its movement accords with the mass of anecdotal evidence that points to a downward bias in the official retail price index. Neither index, of course, takes account of the price increases that result from such phenomena as disappearance from the market of low-priced types of a given product and their replacement with higher-priced goods without a commensurate increase in quality.[14]

[14] For an emigree's discussion of the many ways in which hidden price increases have occurred in the U.S.S.R., see: A. I. Katsenellenboigen, "Disguised Inflation in the Soviet Union," in NATO, Economic Directorate, Economic Aspects of Life in the U.S.S.R., Brussels, 1976, pp. 101–109.

As shown in Table 6, real per capita disposable money incomes grow quite a bit more slowly, when the "alternative" consumer price index is used as a deflator than they do when the official retail price index is used. During the entire period 1951–1975, the former shows a less than fourfold growth, compared with a more than fivefold growth shown by the latter index. The former increases more slowly than the latter in all periods, with the differences being greater in more recent years. The index of real per capita incomes using the "alternative" deflator is also more consistent with the independently-constructed index of real per capita household consumption shown in Table 1. The former still increases more rapidly for various reasons, the principal ones being the rapid monetization of the agricultural sector that occurred during the first two decades, and the rapid growth of per capita savings deposits. The consumption index, of course, takes account of the fact that consumption-in-kind, while still a sizeable share of peasant incomes, scarcely increased.

III. Some Consequences of Soviet Consumption and Income Policies

Since the early 1950's, Soviet policies in the area of consumption and personal incomes have reflected a large-scale effort to redress in part the gross imbalance in the economy which was Stalin's legacy. At the same time, the leadership strove to do so with a bare minimum of change in Stalinist arrangements for production and distribution of goods and services. Rapid growth in quantities of basic goods and services, along with essentially unchanged institutional arrangements over the past quarter century, has produced a number of serious problems in the consumer sector. The problems may be grouped in two categories: (1) those relating to provision of the mix and quality of goods and services that people want, when and where they are wanted, and (2) those relating to the presence of a large overhang of liquid assets in the hands of the population. The two groups of problems are related, as are the constraints on their solution imposed by current dogma and institutions.

A. Problems of Quality and Mix

By about 1960, the needs of the population for basic goods had essentially been met. People had enough to eat, and the quality of the diet had steadily improved; they also had minimum stocks of clothing and shoes and a few common durables. With basic physical needs satisfied and with rising incomes, the general seller's market long characteristic of the Soviet consumer sector came to an abrupt end. People began to buy selectively; they rejected goods of obsolete design and shoddy quality.

The problem of unsaleable goods appeared first in the area of soft goods. For example, between the end of 1960 and the end of 1965, retail inventories of cloth expressed in days of turnover rose from 138 to 237; and the corresponding figures were 108 and 130 for clothing and underwear, and 71 and 109 for knitwear.[15] The build-up in stocks did not occur for durables, except in the notable case of sewing machines, for which stocks rose from 45 days to 227 days. By dint of price

[15] *Narodnoye khozyaystvo SSSR v 1970 godu*, pp. 593–594.

cuts, exports and reallocation of stocks during 1965–70, the Soviets managed to reduce these inventories substantially. Since 1970, the problem has again become evident, now affecting selectively both soft goods and durables. Thus, between 1970 and 1974, stocks of knitwear rose from 104 to 138 in days of turnover; wool cloth from 92 to 149, leather and synthetic shoes from 79 to 144; metal dishware from 137 to 195; electrical appliances from 103 to 141.[16] Judging from complaints voiced in the press in 1975–76, the problem of above-norm inventory accumulations continues to persist. The current situation, unlike that in the early 1960's, does not involve an overall buildup of inventories relative to sales, but rather a selective build-up in stocks of particular goods.

In recent years, the Soviets have attempted to cope with inventory pileups of slow-moving goods by conducting nationwide sales at greatly reduced prices and covering the resulting losses for retail stores with budget subsidies. There is much lament in the press over the high cost of these sales and their only partial success. According to a special survey, slow-moving and unpopular goods whose prices had to be cut by 50 percent or more in order to sell amounted to 3.8 billion rubles as of March 1, 1972, and 4.2 billion rubles as of April 1, 1975, or about 13 percent of total retail stocks of non-food goods.[17] In 1975, prices were cut on unfashionable and shopworn goods by 59 percent; even with such steep price cuts, a "significant" share was not sold.[18] During 1971–74, the budget allocated 2.4 billion rubles to compensate retail stores for losses on such sales,[19] and in 1975 "over a billion rubles" were allocated for this purpose.[20]

At the root of this persistent problem is the chronic inability of enterprises producing consumer goods to turn out products with the quality, design and mix that consumers wish to purchase. Over the past decade, the Soviet press has provided a mountain of evidence of the poor quality of consumer goods. The following is a sample of recent evidence: in 1974, over one-fifth of the cotton fabrics, knitwear and leather footwear and over one-quarter of synthetic fabrics inspected by trade inspectorates was rejected or downgraded;[21] in the first half of 1975, the percentage of light industry products rejected by trade inspectors was essentially unchanged from previous rates;[22] 23–25 percent of all refrigerators inspected by national inspection agencies in 1973–74 were defective, and in the first quarter of 1975 the share was 40 percent;[23] in 1973, the State Trade Inspectorate scrapped 19 percent of the washing machines, 27 percent in 1974, and 14 percent in the first quarter of 1975;[24] unpopular models of vacuum cleaners are "inundating" the stores (in the fall of 1975);[25] work clothes frequently shrink 12–15 percent after the first washing;[26] in 1973, wholesale trade organizations rejected 13 percent of all clothing and knitwear and 8 percent of all shoes;[27] in 1975, customers and

[16] *Narodnoye khozyaystvo SSSR v 1974 godu,* pp. 644–645.
[17] Voprosy ekonomiki, No. 2. 1976. p. 37.
[18] Finansy SSSR, No. 4, 1976, p. 13.
[19] Finansy SSSR, No. 8, 1974, p. 12.
[20] Sovetskaya torgovlya, May 2, 1975.
[21] Voprosy ekonomiki, No. 2. 1976. p. 37.
[22] Finansy SSSR, No. 3. 1976. p. 26.
[23] Kommercheskiy vestnik, No. 20, October 1975, p. 19.
[24] Ibid, p. 20.
[25] Ibid.
[26] Pravda, February 21, 1975.
[27] Planovoye khozyaystvo, No. 7, 1975, p. 124.

stores rejected nearly 500,000 refrigerators, about 9 percent of total output.[28]

Some of this evidence relates not only to physical quality per se, but also to obsolete design and fashion. Soviet industry adapts with great delay and difficulty to changes in technology and in consumer taste. In 1973, for example, two-thirds of the washing machines were of the obsolete hand-wringer type.[29] Most refrigerators are still small-size, and in 1975 less than 10 percent of the TV sets produced were color sets. Pants suits and platform shoes came to the U.S.S.R. several years after they were common elsewhere.

Another problem related to product mix concerns imbalances in the availability of complementary goods. Recent examples cited in the press include: a plethora of cameras and acute shortages of film; tape-recorders but no tape; lenses but no eyeglass frames; flashlights, transistor radios, electric shavers but no batteries. The chronic shortage of spare parts for almost everything is legendary—"Motorists literally have to search for years to find batteries, switches and similar parts for cars." [30] A shortage of rubber washers in Moscow results in waste of millions of gallons of water every year.[31] Tableware rarely is available in sets, and in 1975, for example, the plans of one ministry (the Ministry of Defense) provided for manufacture of 11.2 million stainless steel spoons and only 1.8 million knives and forks.[32] An acute shortage of some random household items, such as meat grinders or bread boxes, frequently creates a hue and cry in the press, which ultimately results in large surpluses. Shortages of a product in particular geographic areas and surpluses in another are common, even though supply and demand may be balanced overall.

Press reporting on these indicators of pervasive imbalances in consumer goods markets in 1975 did not differ essentially from what it was 10–15 years earlier. The reasons for the chronic problems are the same. First, there is the "second class" status and secondary priority of the industrial sectors making consumer goods and of the distribution and service network catering to consumers. This situation prevails, notwithstanding Party Secretary Brezhnev's excoriation of those who treat consumer goods as a "second-class" sector.[33] The true status of the sector is reflected in practice in the relatively inferior quality of materials and manpower allocated to the sector and the relatively low wages and generally inferior social status of trade and service jobs.

Second, incentives throughout the supplier-producer-transport-distribution chain are geared mainly to fulfilling plans for output or other activity measured in rubles or physical units or both. The change in labels introduced by recent economic reforms (from gross value of output to sales) and the addition of success indicators, such as profits and labor productivity, have not altered the fact that in actual practice the real priority attaches to fulfilling plans for output, with emphasis on physical measures. Moreover, when value indicators (cost, output, profits) are indeed used to measure and reward performance, they continue to be based on arbitrary prices set by

[28] Pravda, March 28, 1976.
[29] P. A. Lokshin, op. cit., p. 204.
[30] Voprosy ekonomiki, No. 3, 1976, p. 60.
[31] Sovetskaya Rossiya, February 26, 1975.
[32] Voprosy ekonomiki, No. 3, 1976, p. 57.
[33] Pravda, February 25, 1976.

administrative bodies in ever greater detail. As a consequence, some goods are "profitable" to produce and others "unprofitable", regardless of demand (e.g., spoons, but not knives and forks; sofas and armchairs, but not kitchen chairs). Some products are "profitable" for retail stores to sell (e.g., alcoholic beverages) and others bring losses because of low trade markups (e.g., fish, vegetables, canned fruit, eggs, jam, laundry soap and windowglass).[34] Continuous tinkering with prices and success indicators during 1965–1975 has left the basic problems largely untouched. Although one or another abberration may have been removed, others have been created.

Third, although management of food processing and soft goods production is concentrated in the Ministries of Food and Light Industries, production of durables and miscellaneous household items is scattered among dozens of ministries. This sector has simply been allowed to grow like Topsy, much of it as side-line operations in enterprises in heavy industry. In 1975, 50 ministries and organizations were in charge of the production of such goods, whose share in output of heavy industry rose from 10 percent in 1970 to 12.4 percent in 1975.[35] This period also witnessed a high-priority campaign to enlist all heavy industry plants in producing consumer goods of one kind or another, particularly those of the "odds and ends" variety.[36] The result of this haphazard, campaign-style approach to development of production capacity for household goods has been faulty planning and forecasting of demand, poor quality and mix of output, a "poor relative" attitude toward such output, failure to develop repair and service facilities parallel with output of major durables, and a low level of specialization. In 1971, for example, 9 ministries produced 35 models of washing machines in 35 plants, only 11 of which were specialized.[37]

Fourth, connections among the several links in the chain from materials supplier to producer to distributor to seller of consumer goods are administrative or bureaucratic rather than economic in nature. The U.S.S.R. has not found a method for ensuring that each link in the chain is rewarded or punished economically, depending on whether retail customers buy or do not buy a given product. A chemical plant making dyes, for example, cares only to fulfill its own plan as measured by the relevant rubles or tons; it is not affected economically by the fact that the printed cloth in which its dyes are used fades, or the colors run after the first washing by a Moscow housewife. For the most part, the worst that will happen is for the plant to be roundly scolded in *Pravda*. Connections in the producer-consumer chain are administrative at each stage because of the absence of alternative suppliers, producers, distributors, and even products. Although ultimately some feedback may occur, the mechanism is slow and cumbersome. The system of economic contracts, "direct ties," fines and penalties for contract violation has proved ineffective, and the multiple tinkerings with these arrangements over the past decade have improved matters only marginally.

[34] P. A. Lokshin, op. cit., p. 228.
[35] Voprosy ekonomiki, No. 3, 1976, p. 51.
[36] For a description of the nature of this campaign and its accomplishments, along with the confusion and waste that it created, see: Gertrude E. Schroeder, "Consumer Problems and Prospects," Problems of Communism, March-April 1973, pp. 10–24; and Gertrude E. Schroeder, "Consumer Goods Availability and Repressed Inflation in the U.S.S.R.," loc. cit., p. 39. See also Voprosy ekonomiki, No. 3, 1976, pp. 51–62.
[37] P. A. Lokshin, op. cit., p. 190.

B. Money Incomes, Goods Availability and Accumulation of Liquid Assets

Much attention and argument among Western analysts has centered on the question of the interpretation of these facts: (1) per capita savings deposits have been rising over the past two decades at an average rate of about 15 percent annually, more than twice as fast as both per capita disposable money incomes and per capita outlays on goods and services; (2) by 1975, per capita savings deposits had reached 357 rubles, over two-fifths as large as per capita disposable income; (3) total savings deposits amounted to 91 billion rubles in 1975, equal to 43 percent of total retail trade turnover in that year and amounting to over 5 months' earnings for the average state wage and salary worker. These and similar data and calculations have been used, in particular, to suggest the presence of a sizable and perhaps growing amount of repressed inflation in the U.S.S.R. In other words, the rapid buildup in liquid asset holdings in the form of savings deposits is taken to mean that people are being "forced" to save, because the government has failed to provide the goods and services that people wish to purchase at their income level.

These facts and interpretations of them involve several issues. First of all, the true rise in consumer prices cannot be measured. While there are published data on price changes in official markets (state retail trade network and collective farm markets), these data have long been suspect. As indicated in II above, the implicit price index calculated by juxtaposing independent measures of real consumption and Soviet retail sales in current prices shows an average annual price increase of 1.3 percent over the past 20 years. The official Soviet indexes show almost no increase. Comparison of the two indexes suggests that a slow rate of price increases in official markets has been hidden by a faulty price index.

Second, by all accounts extensive "unofficial" or "parallel" markets coexist with official markets. There is no way to measure either the size of these markets or price changes in them. In fact, systematic analysis of these markets and integration with analysis of official markets has yet to be done. Much anecdotal evidence, including statements by recent emigrees, indicates that both the level of prices and the rate of increase of prices in unofficial markets have been much higher than in official markets.[38] The unofficial markets not only absorb spillover purchasing power from official markets, but also generate incomes; since neither incomes nor expenditures can be measured, one can only say that the phenomena may or may not reflect repressed inflation on the macro level. However, their presence certainly reflects the failure of official channels to satisfy consumer wants in numerous individual markets for goods and services.

Third, there is the question of whether the state has been able to achieve reasonable balance between aggregate money incomes and aggregate money expenditures, allowing for a planned growth of savings at "normal" rates that one would expect to accompany gradually rising per capita incomes, monetization of the economy, and

[38] See, for example: Dimitri K. Simes, "The Soviet Parallel Market" in NATO, Economic Directorate, Economic Aspects of Life in the U.S.S.R., Brussels, 1976, pp. 91–100; and A. I. Katsenellenbolgen, "Disguised Inflation in the Soviet Union," in Ibid., pp. 101–109.

development of modern savings institutions. The data shown in Table 4, though admittedly far from definitive, suggest that fairly good balance has indeed been achieved on the whole, better in some periods than in others. The pattern seems to be one of ebb and flow; excess growth of incomes in one period relative to growth in goods tends to be met with corrective actions, either to increase the supplies in official markets and/or to slow down the growth of incomes.

Fourth, questions arise about how to interpret the notable buildup of savings deposits. Why do people save in the Soviet Union? Is the savings rate abnormally high compared with other countries? Do the accumulations indicate a rising marginal propensity to save, i.e., are people saving a rising share of rising incomes? Since 1955, savings deposits have been almost the only significant outlet for savings in the U.S.S.R.; state loans and private housing are negligible by comparison. Savings deposits yield current income of 2–3 percent and hence are to be preferred to hoards, unless the populace fears confiscation. Most important of all, probably, is the fact that for all practical purposes, consumer credit is not available for most goods, especially those of good quality and in high demand. Even when credit is available, required down payments are high, roughly 25 percent. Would-be purchasers of most big-ticket items, such as furniture, appliances, and cars, must pay cash. Credit sales amounted to only about 5 percent of all retail sales of non-food goods in 1974. Purchasers of cooperative housing must make down payments of 40 percent of the cost (about 2,500 rubles).[39] Since the early 1960's, at least, saving to buy appliances and furniture has been stimulated by steady growth in construction of new apartments, by rapid expansion in quantities of home appliances available, by the slow shift in their mix toward models of more modern design, and by perennial government publicity promising more and better appliances in the future. Savings behavior in the decade 1965–75 surely was also affected by the government's decisions to greatly expand production of passenger cars and to allocate a larger share of annual output for sale to the population. Between 1970 and 1975, the number of cars sold to the people rose about eight-fold. A Zhiguli (Fiat) cost about 7,500 rubles in 1975 and had to be paid for in cash. Finally, a substantial amount of liquid assets surely is highly desirable to hold "just in case," in view of the chronic uncertainties as to just when some desired article may appear in the stores or when one's position on a waiting list may reach the top.

Although comparisons are tricky, because there are no data on currency holdings in the U.S.S.R.. the savings rate does not appear to be abnormally high in the U.S.S.R. Average and marginal propensities to save have been calculated for the period 1955–75, using the data on per capita disposable money incomes given in Appendix B, Table 1. Deposits in savings accounts are taken to represent total saving, and the "alternative" price index is used to express both incomes and savings in real terms. For the period as a whole the marginal propensity to save is shown to be 6.7 percent.[40] The average propensity rises slowly

[39] Willard S. Smith, "Housing in the Soviet Union—Big Plans, Little Action," in Joint Economic Committee, Soviet Economic Prospects for the Seventies, Washington, 1973, p. 412.

[40] A similar result was obtained by another investigator, using data on real per capita incomes for 1955–71 published in previous JEC volumes and savings data defined to account for bond purchases and net borrowing as well as savings deposits. See Joyce Pickersgill, "Soviet Household Saving Behavior," Review of Economics and Statistics, Vol. LVIII, No. 2, May 1976, pp. 139–147.

from .08 percent in 1955 to 4.1 percent in 1975. There is no statistically significant tendency for the marginal propensities to rise during the period.

If, as suggested by such calculations as these, saving by Soviet households out of current income is not high by comparison with other countries, what accounts for the evident concern of Soviet planners over the rapid buildup of total deposits, some 70 percent of which are demand deposits.[41] Soviet economists seem to be uneasy over the growing amount of what they call "postponed demand." Probably, they believe that planning is made more difficult because of uncertainty about how much the populace may save voluntarily and what the people may choose to do with the large absolute sums available for discretionary use. After all, 91 billion rubles is larger than total retail sales of nonfood goods in 1974 and represents a potentially destabilizing element. Total deposits in 1975 exceeded the Ninth Five-Year Plan target by some 11 billion rubles. Some of the savings might fuel the so-called "second economy", or unofficial markets not subject to planners' control. Also, the Soviet government may feel uneasy about the growing accumulations of private wealth and the fact that possession of sizable cash assets makes the average worker more independent of state control. And, too, the Soviets may view the accumulation of large amounts of savings simultaneously with accumulations of inventories of unsalable goods as indicating pervasive planning failures. Finally, they may fear that work incentives will be adversely affected by the pent-up demand, if desired goods are not forthcoming with reasonable speed. In a word, they may believe that the people's savings are indeed "forced" savings, at least in part.

IV. Policy Options

Over the past quarter century, the Soviet economic system and the policies of its leadership have produced an impressive rate of growth in total national product and in per capita consumption. The success in raising levels of living quantitatively, however, has been accompanied by snail's pace progress in improving the population's lot in a qualitative sense. In fact, the policy of giving people more of almost everything has itself contributed to the urgency of faster qualitative gains. As it enters the third quarter century, the Soviet economy faces the strong likelihood of much slower economic growth in the future and a slowing of growth in consumption as well. Continued slowdown in the latter is implicit already in the goals established in the Tenth Five-Year Plan, which also reasserts the traditional priorities of significantly more rapid growth of producer goods than of consumer goods.

Given these prospects for quantitative gains and the current set of problems in the consumer sector, what situations may confront the Soviet leadership and what seem to be its policy options, their costs, and probable benefits? The Soviet people over the years have come to expect visible, albeit modest, progress in meeting their wants. Such has been their experience since World War II, even though grandiose plans may have been met only in part, and scheduled welfare measures may have been delayed.

[41] Yu. M. Belugin, "Ekonomika sberegatel'nogo dela," Moscow, 1975, p. 53.

As long as the economy can provide a little more food, clothing, durables, and services each year, consumer expectations likely will be met insofar as quantitative gains are concerned. The Soviet people also are accustomed to difficulties in acquiring goods and services, chronic deficiencies of quality and mix, sporadic shortages and queues. Along with this, they probably expect a little progress in improving the quality and mix of products. Prospects are for more of the same. Despite the label of the "plan of efficiency and quality" attached to the Tenth Five-Year Plan, no big gains in these areas seem likely. Repeated tinkering with administrative arrangements in the past aimed at removing these blights from the consumer scene has produced few positive results.[42] As of this writing, the outlook is for more "improvements" in planning and administrative arrangements along past lines, as well as for continued frustration at the persistence of the problems they were designed to solve. Thus, evidence of pervasive dis-equilibria in a host of individual markets is likely to remain a familiar part of the Soviet scene, along with a flourishing "second economy" to provide some corrections.

Should the leadership opt to seek a substantial increase in consumption and a major improvement in its qualitative aspects, it would find itself faced with dilemmas and conflicts of priorities and shackled by ideology. The fundamental conflict is between consumption and growth. A speedup in the rate of construction of housing, an infrastructure to service the automobiles provided, and more retail trade and service facilities would be a boon to consumers, but the substantial resources needed to overcome past neglect in these areas would divert labor and investment resources from growth-oriented ends. Industrial facilities for producing consumer goods are relatively technologically backward, and much capacity represents merely side-line production. Large gains, both quantitative and qualitative, could be had by building specialized plants, especially for consumer durables and the numerous items of ordinary household use. Such a program, however, would claim investment resources; imports of specialized modern plants from the West would take resources of hard currency that otherwise could be used to purchase modern plants to produce steel, for example. As an alternative, finished consumer goods could be imported on a larger scale and sold to consumers with the stiff price markups now in effect.[43] While such a move would increase consumer satisfaction and absorb some of the rubles that otherwise might go into savings deposits, the requisite hard currency would have to be taken from competing uses. Except for the last, policies involving major reallocation of resources to consumption would not have quick payoffs, and any attempt to implement them quickly might create serious disruptions in the short-run, thus exacerbating the conflict between growth and consumption.

[42] There is much evidence on this point. For example, a recent opinion survey of light industry managers of enterprises and department stores showed that considerably fewer than half of them thought that the change from value of ouput to sales as a success indicator had produced positive results in terms of quality improvement and satisfying consumer demand. Department store managers were much more negative than enterprise managers. Ekonomika i organizatsiya promyshlennogo proizvodstva, No. 5, 1975, pp. 107–121.

[43] In 1973, the price markup on various items of cloth, clothing, knitwear and shoes ranged from 2.7 times to 11.1 and averaged 5.5. The markup on furniture was 2.2 in 1974 and for consumer durables and related items it was 6.1. These ratios were calculated from data on imports of these items in retail prices cited in P. A. Lokshin, op. cit., pp. 157, 171, 191, 193; and in foreign trade prices in *Vneshnaya torgovlya SSSR za 1973 god*, p. 48–49 and *Vneshnaya torgovlya SSSR 1974 god*, p. 52.

Another source of conflict is inherent in the necessity to maintain work incentives, if economic progress is to continue. Along with steady increases in real consumption, the population has come to expect a steady, even if slow, rise in money incomes. In fact, despite much emphasis on "moral incentives" and socialist competition during the Tenth Five-Year Plan, the government is basically relying on material incentives to elicit work effort. Thus, money incomes are scheduled to grow, albeit slowly, during 1976–80, more or less in line with planned growth in goods and services. If past behavior prevails, the worrisome accumulation of liquid assets in the hands of the population will also continue. These accumulations have the potential for serious disruptive effects, should some crisis of confidence occur. The government's options for dealing with this situation are not very good. One easy method already being used to capture some of these rubles is to encourage the purchase of insurance. During 1971–75, net insurance premiums tripled and in 1975 amounted to 2 billion rubles.

Taxes could be raised and bond purchases made compulsory, but the government as of now has committed itself to reducing taxes and redeeming past bond issues. A change in this policy would carry great risks of alienating the populace, to the detriment of work incentives and perhaps also to social and political stability. For similar reasons, confiscation of savings accounts directly or via a currency revaluation would not be a likely remedy.

An option that would both absorb large amounts of liquid asset holdings and increase quantitatively measured output would be to permit more private activity of various kinds. By easing restrictions on investment in cooperative and private housing, the government could induce the population to take over more of the cost of building housing and to pay the full maintenance cost as well. Surely, both parties would be made economically better off thereby. Similarly, easing restrictions on private activity in providing services of all kinds would accomplish similar ends, and would also help to convert grey or black markets into legal ones. Restraints on private activities in agriculture could be eased, a policy that has invariably yielded quick response in output gains in the past. But official ideology militates against encouraging private activities. State-provided housing is viewed as the wave of the Socialist future, and private housing is viewed as a relic of the past. Private activities are considered an anachronism in a centrally planned economy where the means of production are supposed to be state property.

Another measure that would benefit both consumers and the State would be to raise retail prices for selected goods and services, so as to clear individual markets and eliminate subsidies. With present prices, for example, there is excess demand for many foods and for housing, along with large State subsidies to maintain these prices. There, again, however, oft-repeated dogma stands in the way of raising prices. Low rents and stable retail prices are touted as among the virtues of a centrally planned socialist economy. Indeed, the Soviet people have come to expect low and unchanging prices for a variety of basic goods and services. Aside from ideology, the leadership must take this expectation into account. Khrushchev's sudden hike in the prices of milk and meat in 1962 resulted in civil unrest.

Painful though the choices may be in respect to policies designed to raise output of consumer goods and to better manage money in-

comes, they are probably much less so than those that attend any serious effort to provide major qualitative improvements in the consumer sector. Poor quality, mix and design of consumer goods, random shortages and surplusses of individual goods, queues, black and other colored markets—all have characterized the consumer sector from the outset of central planning. They are rooted in the nature of the system itself and in the set of priorities persistently maintained. Even if the secondary priority status of the consumer sector were changed, these qualitative difficulties would remain. Repeated attempts over the past decade at piecemeal reform in the economy's working arrangements—prices, norms, managerial incentives, rules governing financial and contractual matters, allocation of supplies and equipment—have not altered their essential nature in any respect, nor has more extensive use of computers and mathematical models.

To remove the chronic malfunctions in the consumer sector, changes would need to be made that would alter the very system itself. Since the problems in the consumer sector are largely micro-problems, not macro ones, a shift to the use of market arrangements in at least some parts of the economy should provide a solution in the long-run. Such a sweeping change would surely create major disruptions in the short-run, however, and would entail enormous political risks. The Party's control over policy and resources would be greatly weakened by the introduction of "market socialism", as would its grip on the lives of the population. Bureaucratic resistance to any major reforms, especially ones entailing transfer of major functions, such as price-fixing and allocation of supplies, to markets would be unrelenting. Serious and perhaps destabilizing conflicts within the Party leadership surely would result. Attempts to solve consumer and efficiency problems merely by a shake-up in the administrative apparatus, rather than by introducing markets, would likely do much more harm than good, as did Khrushchev's innovations in the 1960's.

Each of the policy options discussed above is riddled with potential conflict within the political leadership, whether Brezhnev and company or their successors. None of the choices promises large gains in per capita consumption without an accompanying cost in investment and growth. An economic reform that ultimately might alleviate the qualitative problems could not be implemented without short-run costs and long-run problems of its own. Given these considerations, it is not surprising that Soviet leaders up to now have come down on the side of prudence. Treading along a familiar path may have its costs in continued frustration of the population's desires, but such a course carries minimal risk of social and political upheaval. No one can say what future leaders may opt to do. One can be fairly sure, however, that they will face the same difficult choices as does the present leadership. Meanwhile, painful decisions can be postponed by a concerted effort to obtain the largest possible infusion of technological aid and consumer goods from the West on the best terms available.

Appendix A

Estimate of an Index of Consumption for the U.S.S.R.

The following tables present the index of consumption for the U.S.S.R. in its revised and updated form. The revised index differs somewhat from that published in JEC, "Soviet Economic Prospects for the Seventies," June 1973, p. 396, because:

1. the base weights and prices have been shifted from 1968 to 1970;
2. several new line items have been added; and
3. the techniques used to estimate several line items have been changed or refined.

Table 1 presents the indexes of total consumption and per capita consumption, by major category. Table 2 presents the component indexes in detail. Table 3 outlines the basic type of data used to derive each line item series and gives the weights used to aggregate them. The estimates for 1975 are preliminary and may change substantially as new statistical material appears. The following paragraphs provide a general description of the indexes and the underlying data, along with a detailed explanation of the revisions.[1]

Limitations of the Consumption Index

Construction of an index of consumption must proceed within the limits of Soviet data. The index therefore cannot be viewed as a precise measure of changes in consumption between two consecutive years. Nevertheless, it is believed to be a reasonably accurate indicator of Soviet real personal consumption over time. The basic data are fairly reliable, double counting has been reduced to a minimum, and both the sample and the weights are adequate. At the same time, some of the improvement in quality of goods and services that has occurred over time can be incorporated satisfactorily.

Basic Data

Slightly over half the line items presented in the index (see Appendix Table 3) are based directly on official Soviet production series expressed in physical units or value terms.[2] About one-fourth (the services sector) is based on estimated expenditures, another 15 percent is based on retail sales and the remaining few line items are based on Soviet reports of quantities consumed. To eliminate double counting of products at different stages of production, the portion undergoing further processing has been netted out of the quantity available for human consumption. Series based on the value of production or retail sales in constant prices are official Soviet series, which are used in the index because no alternative data are available. Considerable reservation attaches to the reliability of Soviet pricing practices and price indexes.[3] Finally, the Central Statistical Administration states that food consumption in kilograms is calculated from an overall production-consumption balance and does not rely solely on either budget survey or production data.[4]

The unit prices used to aggregate the production-based series are less satisfactory. Unit prices are either retail prices (used if the product moves through the retail channel only) or combination prices reflecting all marketing channels. In both cases, the retail price (or part of price) is based on Moscow observations or on official price handbooks that may or may not reflect real retail prices, but are believed to be the best available. Prices for products consumed in-kind and purchased in collective farm markets are taken from CIA A (ER) 75-76, U.S.S.R.: Gross National Product Accounts, 1970, November 1975, p. 32 ff. (hereafter GNP 1970). Although the average prices may not be exact, the relative levels—for example, between meat and fruit—are reasonably accurate.

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[1] Detailed source notes are available from the authors on request. A full methodological description and documentation of the index is to be presented in a forthcoming CIA publication.

[2] Production series are adjusted for foreign trade and inventory changes insofar as possible.

[3] See, for example, Rush V. Greenslade; "Industrial Production Statistics in the U.S.S.R." in Vladimir G. Treml and John P. Hardt (eds.), "Soviet Economic Statistics." Durham, N.C., Duke University Press, 1972, pp. 155–194; and Morris Bornstein, Soviet Price Statistics," in ibid., pp. 355–396.

[4] See, for example, Vestnik statistiki, No. 2, 1971, p. 60–63. At the same time, this article points out, calculation for some products—the more pure ones such as sugar and potatoes—is more accurate than for those products with numerous subproducts such as meat. Balances worked out, by us, for three of the four food series in the index that are based on per capita consumption data indicate that the quantities are at least reasonable and consistent with production and utilization data. The fourth series, flour and groats (grain and grain products in Russian), is not. We believe it is understated, primarily because the budget survey is not representative of the entire population, excluding low income groups who tend to eat more grain products than middle and upper income groups. Furthermore, this balance calculation is particularly complicated because the grain and grain products group contains 60 different kinds of grain products, all of which are converted to flour equivalents with standard factors (ibid., p. 62).

Sample

The sample, which comprises over 95 percent of consumption, includes as complete a basket of goods and services in as much detail as possible from regularly published data. It encompasses total food and durable goods consumption, total consumption of health and education services, over 90 percent of soft goods consumption, and nearly all of the major household services. The items not represented, such as matches, kerosene, and some of the lesser services, are relatively unimportant. Their absence probably does not bias the index seriously.

Weights

The expenditure weights used to aggregate the component indexes—food, soft goods, and so forth—are from GNP 1970, p. 8. About 55 percent of the price or purchase weights used to aggregate the line items within the components are based directly on published data in the base year. The remainder are based on adjusted production valued at prices of the base year or on estimated total expenditures.

General Notes on Sources

Production, per capita consumption, and retail sales data, as well as the price indexes to deflate retail sales data, are from the annual Soviet statistical abstract—*Narodnoye khozyaystvo v . . . godu.* Also from the abstract are data on inventory change (wholesale and retail) used to adjust production data. Foreign trade data, also used to adjust production data, are from the annual foreign trade statistical abstract—"Vneshnyaya torgovlya za . . . god. Sovetskaya torgovlya," Moscow, 1964, and various issues of the monthly statistical journal, Vestnik statistiki, added useful information on the distribution of some products within a given line item category.

In order to eliminate double counting of products at different stages of production, the portion further processed is netted out of the quantity available for human consumption. For example, flour and sugar used in confectionery are subtracted from total flour and sugar consumed, adjustment is made for canned foods, and so on. Adjustments are based on sources such as L. V. Opatskiy, "Razmeshcheniye pishchevoy promyshlennosti SSSR," Moscow, 1958, V. P. Zotov, ed., "Pishchevaya promyshlennost' SSSR," Moscow, 1967, and N. V. Vinogradov, ed., "Ekonomika pishchevoy promyshlennosti SSSR," Moscow, 1968.

Two types of prices are applied to the production data to value those line item series that are production based—retail and combination. Retail prices are used for those products which move primarily or entirely through the state store network; combination prices are used for those products which move through collective farm market and in-kind channels as well as retail. Retail prices are based on price observations in Moscow during 1969–71. Retail prices for fruits and vegetables are seasonally adjusted. Combination prices are based on retail prices (observed in Moscow during 1969–71), average collective farm market prices and estimated in-kind prices (from GNP 1970, p. 27) and estimated prices paid by the military. These prices are weighted by their respective shares of the total consumed.

The component weights and estimates of expenditures on services in 1970 are from GNP 1970, p. 8. Annual expenditures on services are estimated with the aid of indexes to move the base weights. In some cases, such as housing where the index indicator is housing stock, the result is probably a reasonably accurate reflection of true expenditures. In other cases, however, such as recreation, art and culture where the indicator is movie admissions, the result is less satisfactory. The bulk of the data used to derive the services indexes—budget, employment, wage, investment, construction, transportation, communication, and so on—are from the annual statistical abstract. Various textbooks and trade journals were additional sources of useful information, particularly in the utilities sector.

Impact of Changes in Weights and Methodology

The revised index uses base year weights for 1970 instead of 1968. The new weights are taken from a comprehensive and consistent set of national accounts in 1970 (GNP 1970, p. 8). The weights for major components of the consumption index, therefore, are much more reliable than those previously used. With respect to individual line items within major components, prices for 1970 were obtained directly, thus obviating the need to update the original 1955 prices with official

price indexes. Changes in the base weights per se had a negligible impact on the index for total consumption. Rounded to one decimal place, the average annual rate of growth during 1951–75 is the same (5.4 percent) with both sets of weights. Aside from base year weights, a number of revisions were made in respect to components and individual line items, with the objective of improving the accuracy of the index. The net effect of all these changes was to slow the growth of the index for total consumption during 1951–71 by 0.4 percentage point per year.

Revisions were made for particular components and line items as follows:

FOOD

(1) The fish index is based on per capita consumption instead of deflated retail sales.

(2) The confectionery index is based on production adjusted for quality change instead of deflated retail sales.

(3) The canned goods base weight is retail sales instead of production.

(4) The alcohol and soft drinks index is based on production adjusted for net trade instead of deflated retail sales.

(5) Tobacco has been transferred to the food component from soft goods.

The net effect of these changes has been to slow growth in total food consump- percentage point per year during 1951–71.

SOFT GOODS

The index has been expanded and now includes 13 line items, comprising 93 percent of the base weight. The new items are household soap and synthetic detergents, toilet soap and perfumes, school supplies, and publications. The net effect of these changes is to speed growth of total soft goods consumption by 0.5 percentage points per year during 1951–1971.

DURABLES AND OTHER MISCELLANEOUS GOODS

The durables goods index has been completely revised. Originally an index based on a small sample of durable goods measured in physical units, it is now a broadly based series, including not only durable goods but miscellaneous other goods as well. Items such as toys, sporting goods, jewelry, and medical supplies are now included. Indeed, the series covers all items in the weight. The index represents retail sales of these products calculated in constant prices. Since data in current prices are regularly published in official statistical abstracts, the procedure for calculating the index amounts to deriving the price index for them that is implicit in the official price index for non-food goods and the indexes for given sub-categories. More specifically, the component series for durables was calculated as follows:

(1) Total retail sales of non-food goods are published in Soviet statistical abstracts in current prices for each year; a constant price series can be calculated using the official retail price index.

(2) Retail sales of 17 groups of soft goods (accounting for 70 percent of all sales of non-food goods) are also given in current prices for each year; constant prices series can be calculated for each group, using official price indexes.

(3) Summation of the values for the 17 groups in current and constant prices in each year results in series for total sales of these soft goods in the two sets of prices.

(4) Subtracting the current and the constant price series for soft goods sales from the respective current and constant price series for total retail sales of non-food goods results in two residual series representing sales of all nonfood goods other than the 17 groups of soft goods. The residual group is arbitrarily labelled "durables and other miscellaneous goods". The series so obtained in constant prices is the new component index.

The index has shortcomings, in that it relies on dubious official price indexes and a less than complete understanding of how these indexes are calculated. Moreover, the component index does not exactly match the base year weight in respect to coverage. Nevertheless, the new index is much more reliable and representative than the old index, which overstated growth significantly. That sample (all that could be obtained with available data) was made up almost entirely of products which had experienced phenomenal growth from a close-to-zero base in 1950. The new index grows by roughly 2½ percentage points per year less during 1951–71.

SERVICES

(1) A new line item—trade union and Communist Party dues—has been added.
(2) Base weights for utilities, recreation, transportation, and communications have been expanded in coverage.
(3) Allowance for privately supplied services has been made in the line item for repair and personal care.
(4) Several of the indexes used to move the base year weights have been broadened in coverage. For example, the communications index formerly relied on officially-reported revenues of the communications industry; it now is based on the summation of expenditures on the various types of communications (see Table 3).
(5) Manhours worked, rather than average annual employment, is now used to move the wage component of the base year weight for health and education. Revision of the materials purchases component of the indexes for health and education could not be completed in time for this monograph.

The net effect of all these changes has been to slow growth of personal services by 2½ percentage points per year during 1951–71, and to slow growth of health and education services by 2 percentage points per year.

TABLE 1.—U.S.S.R.: INDEXES OF CONSUMPTION BY COMPONENT, 1950, 1955–75

[Indexes 1970=100]

	1950	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
AGGREGATE																						
Total consumption	32.7	46.1	48.9	53.4	56.1	59.3	61.9	63.6	66.5	68.1	70.7	75.7	80.4	85.3	89.6	95.2	100	104.8	107.5	113.3	117.8	122.5
Household	32.1	45.5	48.3	53.1	55.9	59.1	61.7	63.3	66.2	67.5	69.9	74.9	76.9	84.6	89.2	95.0	100	105.0	107.6	113.6	117.9	122.6
Food	39.2	53.6	56.0	60.2	62.6	65.9	67.2	68.6	71.7	73.0	74.8	79.9	83.5	88.9	92.3	96.4	100	104.1	103.8	110.4	113.4	116.3
Soft goods	23.1	35.9	40.1	46.2	50.9	53.9	58.6	60.4	62.5	62.8	64.6	69.0	74.8	78.2	84.0	93.7	100	104.5	107.7	111.2	115.2	120.1
Durable and miscellaneous goods	9.9	24.0	26.4	32.4	35.7	39.3	44.9	45.9	48.5	48.3	53.2	59.9	67.3	73.6	82.3	89.5	100	113.7	130.6	141.4	153.1	166.9
Services	30.2	40.1	42.2	46.8	47.9	51.0	53.4	56.1	59.8	63.2	67.7	72.9	78.3	84.2	89.6	94.5	100	105.1	110.5	116.0	122.6	129.4
Communal	37.5	50.7	53.9	55.8	57.4	60.6	63.7	65.8	68.3	72.6	77.0	81.6	86.6	89.8	92.2	95.4	100	103.4	107.2	111.2	116.8	121.2
Education	39.4	49.6	51.2	53.0	54.0	56.4	58.7	61.5	66.5	71.2	76.0	81.3	86.3	90.2	93.2	97.8	100	104.3	108.8	113.2	119.5	123.9
Health	34.5	52.4	58.1	60.2	62.7	67.2	71.6	72.6	71.1	74.9	78.5	82.2	87.1	89.1	90.5	94.1	100	102.1	104.8	108.0	112.5	116.8
PER CAPITA																						
Total consumption	44.3	57.0	59.5	63.8	65.9	68.4	70.2	70.8	72.8	73.5	75.3	79.6	83.6	87.7	91.3	96.1	100	103.8	105.5	110.2	113.4	116.8
Household	43.2	56.3	58.7	63.4	65.7	68.2	69.9	70.5	72.5	72.8	74.4	78.8	82.7	87.1	90.9	95.9	100	104.0	105.5	110.4	113.6	117.0
Food	52.8	66.3	68.1	72.0	73.5	76.0	76.2	76.3	78.5	78.8	79.6	84.0	86.8	91.5	94.0	97.3	100	103.1	101.8	107.4	109.2	110.9
Soft goods	31.2	44.5	48.7	55.2	59.8	62.2	66.4	67.2	68.5	67.8	68.8	72.6	77.7	80.5	85.6	94.6	100	103.5	105.7	108.1	110.9	114.5
Durable and miscellaneous goods	13.3	29.7	32.1	38.7	42.0	45.4	50.9	51.1	53.1	52.1	56.7	63.0	69.9	75.8	83.9	90.3	100	112.6	128.2	137.5	147.4	159.1
Services	40.8	49.6	51.4	55.9	56.3	58.9	60.5	62.5	65.5	68.2	72.0	76.7	81.4	86.7	91.3	95.3	100	104.1	108.4	112.8	118.0	123.4
Communal	50.5	62.6	65.5	66.7	67.4	69.9	72.1	73.2	74.8	78.3	81.9	85.8	90.1	92.4	94.0	97.3	100	102.5	105.2	108.1	112.5	115.5
Education	53.1	61.4	62.3	63.3	63.4	65.0	66.5	68.5	72.8	76.8	80.9	85.5	89.7	92.8	95.0	98.7	100	103.4	106.8	110.1	115.1	118.2
Health	46.5	64.8	70.7	71.9	73.6	77.5	81.1	80.8	77.9	80.8	83.6	86.4	90.5	91.7	92.2	95.0	100	101.2	102.8	105.1	108.4	111.5

TABLE 2.—U.S.S.R.: INDEXES OF CONSUMPTION BY LINE ITEM,—1950, 1955-75

[Indexes 1970=100]

	1950	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
Food:																						
Animal products:																						
Fish	33.7	49.3	50.7	52.2	54.2	55.2	56.7	57.5	59.8	65.8	74.4	77.8	80.6	83.3	91.1	101.7	100	97.0	100.0	107.6	111.2	114.4
Meat	39.6	54.1	56.0	60.6	63.7	74.9	72.3	72.2	75.3	78.7	72.5	80.6	86.4	92.1	95.7	96.2	100	107.5	111.0	113.7	117.2	125.9
Slaughter fat	37.1	52.2	55.0	64.9	65.8	74.6	69.8	73.5	80.4	86.8	64.8	85.6	92.6	96.8	94.0	94.0	100	111.5	114.1	110.8	119.6	125.8
Milk	47.9	55.7	63.0	70.4	76.9	79.5	79.5	77.2	76.8	74.0	74.8	80.7	87.1	93.5	96.8	99.0	100	97.9	94.4	95.7	102.9	102.4
Butter	34.1	47.0	53.5	57.7	64.4	66.2	68.9	70.6	70.4	71.6	75.7	79.7	78.8	82.2	90.4	98.6	100	97.1	98.5	121.2	113.4	113.3
Cheese	15.2	27.6	30.8	32.4	35.4	36.8	40.6	42.7	47.5	48.3	57.5	64.9	73.6	76.2	81.6	90.1	100	96.8	101.0	112.1	118.2	120.9
Eggs	28.9	45.8	48.4	55.1	56.9	63.0	67.9	72.3	74.4	71.0	66.5	72.2	78.8	84.4	88.6	92.0	100	110.5	118.6	126.4	137.6	141.8
Processed foods:																						
Sugar	19.2	45.3	47.3	49.7	51.9	55.0	64.6	68.3	71.4	76.3	77.5	84.8	90.0	94.4	96.2	96.8	100	103.5	101.8	108.1	108.9	110.2
Vegetable oil	22.8	56.0	64.7	64.8	61.5	64.6	69.2	74.2	77.4	81.4	96.6	93.3	88.0	89.6	94.4	97.6	100	100.3	102.5	109.4	110.4	115.9
Magarine	25.6	53.0	55.9	58.2	54.8	58.1	61.7	63.9	67.4	75.2	83.2	82.4	78.6	81.1	86.4	94.6	100	106.3	114.5	123.5	127.7	130.2
Confectionery	31.3	44.6	50.9	51.0	54.5	57.7	56.0	58.3	63.1	65.9	74.5	75.7	75.0	80.7	86.9	95.0	100	100.3	103.2	110.2	115.1	113.3
Canned goods	14.5	29.8	32.9	36.7	39.5	42.7	46.0	52.2	63.3	58.9	68.1	68.5	74.2	86.6	89.7	93.3	100	106.3	115.5	125.3	132.1	134.9
Macaroni	28.9	69.8	63.7	71.6	77.0	73.8	80.8	80.7	87.8	63.0	94.5	91.3	90.8	93.6	91.5	100.0	100	105.9	118.6	110.9	110.7	115.1
Basic foods:																						
Potatoes	137.5	92.0	93.6	95.9	98.3	100.1	97.1	98.8	99.7	100.6	101.2	103.9	105.1	100.9	98.9	99.9	100	101.7	94.9	98.1	96.6	96.8
Vegetables	50.4	74.9	75.5	77.6	77.5	76.2	84.8	80.6	77.4	72.7	95.4	86.5	86.9	98.5	89.8	88.0	100	96.4	88.4	120.6	101.4	93.4
Fruits and berries	36.7	44.4	37.2	59.9	64.4	58.1	56.4	53.7	62.4	66.8	66.5	86.5	72.5	84.7	83.8	69.4	100	105.6	59.0	136.6	106.3	108.6
Flour and groats	75.0	94.6	94.5	93.9	92.2	92.7	93.2	93.6	94.5	90.3	92.8	93.5	94.6	94.8	97.2	98.5	100	101.3	99.8	99.5	100.0	101.2
Alcohol, soft drinks, tobacco:																						
Alcohol, soft drinks	20.1	36.8	38.7	43.4	45.5	45.5	48.0	51.2	56.9	60.6	64.3	69.3	74.8	81.9	88.4	100.3	100	107.4	108.1	108.8	118.9	123.1
Tobacco	29.3	43.2	45.6	47.5	49.3	51.2	53.7	55.2	56.2	59.1	63.4	68.7	72.6	79.1	86.2	94.5	100	106.3	112.3	118.6	123.8	129.4
Total	39.2	53.6	56.0	60.2	62.6	65.9	67.2	68.6	71.7	73.0	74.8	79.9	83.5	88.9	92.3	96.4	100	104.1	103.8	110.4	113.4	116.3

TABLE 2.—U.S.S.R.: INDEXES OF CONSUMPTION BY LINE ITEM,—1950, 1955–75—Continued

[Indexes 1970=100]

	1950	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
Soft goods:																						
Cotton fabric	91.7	134.9	119.8	123.2	117.5	125.0	126.2	113.0	108.0	103.4	101.3	99.8	105.0	109.4	108.9	107.7	100	96.8	92.2	96.3	88.0	88.0
Wool fabric	55.4	49.9	66.1	84.0	91.6	92.5	109.3	101.5	92.5	84.1	83.2	96.4	94.7	95.4	100.7	101.6	100	103.3	116.4	127.1	139.8	152.0
Silk and rayon fabric	19.7	56.3	69.0	86.0	88.6	85.1	87.8	84.3	89.7	89.2	85.0	96.1	99.1	101.9	97.1	93.5	100	98.3	114.5	122.9	130.1	139.0
Linen fabric	32.2	30.7	41.6	54.4	60.5	61.7	66.9	67.5	68.1	68.4	69.3	69.6	82.7	88.2	97.0	100.9	100	105.8	110.6	110.3	109.4	111.9
Sewn goods	15.0	22.7	30.2	37.8	45.3	49.6	53.9	57.5	59.8	58.6	57.1	57.1	62.7	62.7	70.6	90.6	100	106.2	107.5	109.4	112.5	118.8
Hosiery	35.3	57.7	60.0	63.1	66.3	69.2	72.0	74.8	77.2	83.9	92.4	100.8	107.9	111.0	109.6	104.3	100	97.8	99.9	105.4	109.8	115.3
Leather shoes	29.0	37.8	41.4	46.1	51.8	55.6	59.6	63.4	66.8	66.6	69.2	74.1	79.4	84.4	89.9	93.7	100	100.0	99.1	100.2	105.1	107.2
Knitwear	15.1	32.0	32.2	34.4	36.7	36.8	43.2	44.9	47.7	50.9	58.7	67.5	75.0	81.5	87.8	94.5	100	104.4	105.9	110.6	113.0	114.5
Haberdashery	11.9	22.7	25.5	31.5	35.1	38.3	43.5	47.1	51.7	52.9	55.0	61.2	67.4	72.7	80.7	89.9	100	111.2	121.8	126.0	132.4	139.0
Household soap	23.1	36.6	40.3	42.3	45.2	45.6	50.1	52.6	54.0	60.3	61.8	69.6	75.9	85.9	93.5	96.3	100	109.0	119.8	118.7	123.8	131.3
Toilet soap	25.3	44.5	45.9	53.0	57.6	61.4	63.3	65.8	68.7	69.9	72.2	75.1	79.3	85.0	88.6	94.5	100	108.8	115.5	121.9	129.3	135.8
School supplies	13.5	24.7	27.6	30.3	32.7	35.3	38.5	40.0	41.6	43.6	49.5	54.3	60.2	66.1	75.9	87.7	100	111.0	122.5	127.4	137.9	147.0
Publications	19.3	28.4	32.0	35.4	39.1	43.6	46.2	48.4	50.8	54.5	57.7	65.7	73.0	80.0	84.4	94.5	100	106.0	112.5	118.7	125.0	131.3
Total	23.1	35.9	40.1	46.2	50.9	53.9	58.6	60.4	62.5	62.8	64.6	69.0	74.8	78.2	84.0	93.7	100	104.5	107.7	111.2	115.2	120.1
Durables and other miscellaneous goods	9.9	24.0	26.4	32.4	35.7	39.3	44.9	45.9	48.5	48.3	53.2	59.9	67.3	73.6	82.3	89.5	100	113.7	130.6	141.4	153.1	166.9
Personal services:																						
Trade union and Party membership dues	36.9	45.9	48.6	51.5	54.4	57.5	60.9	64.7	68.6	72.3	76.3	80.6	86.2	91.2	94.3	97.2	100	102.3	104.7	106.8	108.9	111.2
Housing	47.3	55.6	57.2	59.7	62.9	66.7	70.6	74.1	77.4	80.5	83.3	86.0	88.8	91.7	94.5	97.3	100	102.8	105.5	108.2	111.4	114.4
Utilities	22.2	28.3	30.4	32.7	35.3	38.0	41.0	47.0	53.0	59.1	65.3	71.6	77.1	82.5	87.8	93.8	100	105.7	111.4	117.6	126.0	137.1
Transportation	16.0	27.7	29.2	39.2	36.1	39.1	42.8	46.6	52.3	56.8	60.8	66.0	73.1	80.1	87.8	93.8	100	106.6	114.0	120.3	129.2	138.0
Communication	22.4	33.0	35.6	38.4	40.6	43.2	46.4	49.2	52.2	55.3	59.2	65.4	72.3	79.7	85.5	92.9	100	107.2	115.1	123.4	132.4	141.8
Repair and personal care	42.2	44.6	45.8	47.0	48.1	52.1	49.6	45.9	45.9	47.9	53.1	61.2	69.1	76.7	82.2	90.0	100	107.7	116.0	125.4	135.2	145.6
Recreation, art and physical culture	32.8	53.3	57.8	61.4	66.0	68.4	71.0	75.6	78.1	79.3	83.9	87.6	88.3	93.5	97.4	98.2	100	101.8	102.9	104.9	106.3	106.7
Communal services:																						
Education	39.4	49.6	51.2	53.0	54.0	56.4	58.7	61.5	66.5	71.2	76.0	81.3	86.3	90.2	93.2	97.8	100	104.3	108.8	113.2	119.5	123.9
Health	34.5	52.4	58.1	60.2	62.7	67.2	71.6	72.6	71.1	74.9	78.5	82.2	87.1	89.1	90.5	94.1	100	102.1	104.8	108.0	112.5	116.8

TABLE 3.—U.S.S.R.: STRUCTURE OF THE INDEX OF CONSUMPTION

Product	1970 weight	Type of data used to derive— 1970 base weight	Series
Total	100.0		
Food	49.0		
Animal products:			
Fish	.1	Retail sales	Per capita consumption adjusted to total consumption by multiplying by midyear population.
Meat	8.6	Same as series	Production adjusted for trade and inventory change priced at the 1970 average weighted price.
Slaughter fat	1.7	do	Tonnage is percent of meat production, priced at the 1970 retail price.
Milk	4.3	do	Production[1] reduced by quantity of milk fed and of milk used for further processing (butter, cheese, canning) priced at the 1970 average weighted price.
Butter	1.8	do	Production adjusted for trade and inventory change, priced at the modal observed 1970 retail price.
Cheese	.6	do	Production[1] priced at the modal observed 1970 retail price.
Eggs	1.8	do	Production[1] reduced by quantity required for hatch, priced at the 1970 average weighted price.
Processed foods:			
Sugar	3.4	do	Per capita consumption adjusted to total consumption by multiplying by midyear population, then reduced by the quantity of sugar required for confectionery, priced at the 1970 retail price.
Vegetable oil	.4	Retail sales	Annual retail sales deflated by the official price index for vegetable oil.[2]
Margarine	.6	Same as series	Production adjusted for inventory change,[3] priced at the modal observed 1970 price.
Confectionery	2.6	do	Production adjusted for quality change.[4 5]
Canned goods	1.2	Retail sales	Production by type adjusted for trade and inventory change, priced at the respective modal observed 1970 prices.
Macaroni	.3	do	Retail sales deflated by the official price index for macaroni.
Basic foods:			
Potatoes	1.7	Same as series	Per capita consumption adjusted to total consumption by multiplying by midyear population priced at the 1970 average weighted price.
Vegetables	2.2	do	Production reduced by a waste factor and by those quantities further processed, priced at the 1970 average weighted price.
Fruit, berries and grapes	1.2	do	Production reduced by a waste factor and by those quantities further processed, priced at the 1970 average weighted price.
Flour and grain products	4.7	(6)	Per capita consumption adjusted to total consumption by multiplying by midyear population reduced by quantities used to produce macaroni and adjusted for quality change.[5]
Beverages and tobacco:			
Alcoholic and soft drinks	10.6	Estimated retail sales.[7]	Production of alcoholic and soft drinks adjusted for trade,[8] weighted by 1970 observed retail prices.
Tobacco	1.2	Retail sales	Retail sales deflated by the official price index for tobacco.
Soft goods	20.8		
Cotton fabric	.9	do	Retail sales deflated by the official price index for cotton fabric.
Wool fabric	.6	do	Retail sales deflated by the official price index for wool fabric.
Silk fabric[9]	.7	do	Retail sales deflated by the official price index for silk fabric.
Linen fabric	.2	do	Retail sales deflated by a derived price index for linen fabric.[10]
Sewn goods	7.1	do	Production.[1]
Hosiery	.8	do	Do.
Leather shoes	3.2	do	Production adjusted for trade and inventory change.
Knitwear	3.3	do	Production of under and outer knitwear weighted by their respective observed model 1970 prices.
Haberdashery	1.7	do	Retail sales deflated by the official price index for haberdashery.
Household soaps[11]	.3	do	Retail sales deflated by a derived price index for household soaps.[9]
Toilet soap[12]	.6	do	Retail sales deflated by a derived price index for toilet soap.[9]
School supplies	.5	do	Retail sales deflated by a derived price index for school supplies.[9]
Publications	.9	do	Retail sales.[13]

See footnotes at end of table.

TABLE 3.—U.S.S.R.: STRUCTURE OF THE INDEX OF CONSUMPTION—Continued

Product	1970 weight	Type of data used to derive— 1970 base weight	Series
Durables and other miscellaneous goods,	6.4	(14).....	(14).
Services [15].....	11.9		
Trade union and Party membership dues	1.0	Expenditures [16]...	Trade union and Party membership.
Housing.....	1.6	....do.....	Housing stock.
Utilities.....	1.6	....do.....	Estimated use of heating, gas and electricity.
Transportation.....	3.3	....do.....	Estimated expenditures on all forms of transportation.[17]
Communication.....	.5	....do.....	Estimated expenditures on all forms of communication.[18]
Repair and personal care.....	2.1	....do.....	Officially reported purchases of services from the state sector[19] and of estimated purchases from the private sector.
Recreation, art and physical culture.....	1.8	....do.....	Employment at hotels, movie admissions and number of persons at rest homes.
Communal services.....	11.9		
Education.....	7.3	....do.....	
Wages.....	4.5	.....	Man-hours worked.
Materials.....	2.8	.....	Budget expenditures less investment and wages deflated by an estimated index.
Health.....	4.6	Expenditures [16]	
Wages.....	2.6	.....	Man-hours worked.
Materials.....	2.0	.....	Budget expenditures less investment and wages. deflated by an estimated index.

[1] Cannot be adjusted for trade or inventory change because the necessary data are not published.
[2] Officially reported per capita consumption data could not be used because they include industrially used vegetable oil.
[3] Product does not enter U.S.S.R. foreign trade.
[4] The assortment problem precludes adjustments for trade or inventory change.
[5] Quality adjustment is based on changes in production assortment.
[6] Sum of (1) retail sales of bread and bread products, flour, and groats; (2) estimated military consumption of these products; (3) collective farm market sales of grain; and (4) estimated in-kind grain consumption.
[7] Assumed to be 90 percent of category, "other" food goods, the share during those years prior to 1963 when data on sales of "alcoholic and nonalcoholic beverages" were published.
[8] Cannot be adjusted for inventory change because the necessary data are not published.
[9] Includes synthetic fabrics.
[10] Price index derived from data on sales in constant and in current prices.
[11] Includes synthetic soaps.
[12] Includes perfumerie.
[13] Data on assortment and prices of published material, available for 1965, 1970–73, indicate the average weighted price has not changed significantly.
[14] See text of Appendix A, p. 644, for brief explanation of the technique used to derive the base weight and series for this component.
[15] The series for each service is an index based on one or more types of data. When more than one type of data is used, either in index form or absolute, the segments are weighted together with their respective 1970 expenditures.
[16] CIA, A (ER) 75-76 U.S.S.R.: Gross National Products Accounts, 1970, Washington, D.C., November 1975, p. 8.
[17] For example, number of subway rides at the 1970 price, number of streetcar rides, passenger—kilometers on planes, trains, ships, and so on.
[18] For example, postal, urban and rural telpehone, telegraph, and so on.
[19] Excluding housing repair.

Appendix B

Estimate of Personal Disposable Money Income in the U.S.S.R.

The following tables update the estimates of personal money income in the U.S.S.R. that appeared in JEC 1973, p. 393. The format has been changed and the data have been disaggregated. Table 1 summarizes money incomes and deductions from incomes and derives real per capita disposable money income. Table 2 presents money income by source, and Table 3 sets out deductions from money income by type. Detailed sources and methodology accompany each table. The estimates for 1975 are preliminary and can be expected to change when more information becomes available.

Some of the earlier estimates have been revised on the basis of new data or changed methodology. The main revisions pertain to military pay and insurance indemnities and premiums. Several new items have been added, namely, trade union and Communist Party membership dues, interest on savings accounts, and lottery winnings. As a result of these changes, the new estimates for per-

sonal disposable money income for 1950–72 are smaller in most years by about 2 percent, compared with estimates previously published.

While the new estimates present a more comprehensive picture of personal disposable money income, coverage is not complete. The total of missing income is believed to be small, amounting to roughly 7 percent in 1970 (see GNP 1970, p. 3). Much of the missing income is thought to be derived from privately supplied services, a category that cannot be reliably estimated. In addition, income from the smaller lotteries—DOSAAF (the Voluntary Society for Assisting the Army, Air Force and Navy), Sportloto and so on—is not included because of lack of data for years prior to 1971. Revenue from these lotteries amounted to 264 million rubles in 1975, about the same as that from the "money-goods" lottery (Finansy SSSR, no. 4, 1976, p. 25). Also missing are receipts from the sale of personal property, incomes from travel expense accounts, and miscellaneous money payments by enterprises not included in the wage fund.

On the deductions side, outlays for miscellaneous dues (paid to professional organizations, DOSAAF, sporting clubs and the like) and those for compulsory insurance premiums are not included because of lack of data. Neither item is large. Miscellaneous dues are estimated to have amounted to 300 million rubles in 1970 (GNP 1970, p. 41), about 15 percent of total dues paid. Premiums for compulsory insurance paid by individuals have declined from 60 percent of total premiums paid for all forms of insurance in 1960 to 12 percent in 1974, when compulsory payments were about 500 million rubles (Finansy SSSR, no. 6, 1975, p. 59.)

In Table 1, per capita disposable money incomes are expressed in real terms with the use of two consumer price indexes: (1) an "official" index that combines the Soviet official index of state retail prices with an index of collective farm market prices based on officially published data; the two components are weighted with their respective shares in total retail and collective farm market sales in 1970; and (2) an "alternative" index of prices for consumer goods that is implict in a comparison of an index of purchased goods in current prices with a similar index in constant prices. The current price index is based on the values of total retail and collective farm market sales in current prices regularly published in Soviet statistical handbooks. The index in constant prices is derived from the goods components of the index of total consumption given in Appendix A, Table 1. Specifically, an index of goods purchased in retail trade and collective farm markets is obtained by subtracting the value of consumption in-kind in each year from the total value of goods consumed, both values expressed in 1970 prices. The derivation of the index of consumption of goods is explained in Appendix A. Estimates of consumption in-kind in 1970 prices were made by Constance B. Krueger for benchmark years (1950, 1955, 1960, 1966, 1970 and 1974), following the methodology described in GNP 1970, pp. 26–38. Values for other years were derived by interpolation on the basis of the trend in the share of consumption in-kind in total consumption of food.

The nature and respective merits of the two price indexes are discussed in the text. The shortcomings of the Soviet official retail price indexes are well known. With respect to the "alternative" index, it is in no sense an independently calculated index based on observed prices. Rather, it is an implicit price index, and its accuracy depends on the accuracy of the measures of consumption in constant prices presented in this paper. Since the "alternative" price index is derived from largely independent sets of data, year-to-year changes are not necessarily accurate. The trend seems reasonable, however, and accords well with other evidence concerning changes in prices actually paid by consumers during the period investigated.

TABLE 1.—U.S.S.R.: PERSONAL DISPOSABLE MONEY INCOME, 1950, 1955, 1960, 1965–75

	1950	1955	1960	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
1. Total personal money income (billion rubles)	46.64	64.26	85.14	123.43	134.42	144.77	160.05	170.20	182.98	194.53	206.70	219.37	234.94	247.89
2. Deductions from personal money income (billion rubles)	6.93	8.78	6.69	9.62	10.60	11.59	13.34	15.04	16.63	17.84	19.46	21.39	23.42	25.99
3. Personal disposable money income (billion rubles)	39.71	55.48	78.45	113.81	123.82	133.18	146.71	155.16	166.35	176.69	187.24	197.98	211.52	221.90
4. Per capita personal disposable money income (rubles)	220.49	282.77	366.08	492.90	530.28	564.32	615.65	644.89	685.13	720.89	756.52	792.87	839.03	871.56
5. Real per capita disposable money income (rubles) deflated by:														
(a) Soviet official price index	166.28	285.34	367.55	490.45	531.88	566.02	617.50	645.54	685.13	720.89	755.76	791.29	837.36	868.09
(b) "Alternative" implicit price index	219.61	337.84	418.86	526.04	560.55	584.79	625.04	653.38	685.13	715.17	721.87	763.84	795.29	804.02

SOURCES AND METHODOLOGY

1. Total personal money income: a. All years—Table 2.
2. Deductions from personal money income: a. All years—Table 3.
3. Personal disposable money income: a. All years—line 1, less line 2.
4. Per capita personal disposable money income: a. All years—line 3 divided by midyear population obtained from U.S. Department of Commerce, Bureau of Economic Analysis, Foreign Demographic Analysis Division.
5. Real per capita disposable money income: a. Soviet official price index: 1. 1950, 1955, 1960, 1965–74—line 4, deflated by an index of prices paid by consumers for goods. The deflator is a weighted index based on the official retail price index from "N.Kh. 1974," p. 653, and a collective farm market price index derived from "N.Kh. 1974," p. 626. The weights are the respective shares of total sales in 1970 from "N.Kh. 1974," p. 625; 2. 1975—estimated.
b. "Alternative" implicit price index: 1. All years—line 4, deflated by the "alternative" implicit price index (see App. B, and text).

TABLE 2.—U.S.S.R.: PERSONAL MONEY INCOME, 1950, 1955, 1960, 1965–75

[Billion rubles]

	1950	1955	1960	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
1. Total personal money income	46.64	64.26	85.14	123.43	134.42	144.77	160.05	170.20	182.98	194.53	206.70	219.37	234.94	247.89
2. Gross earnings of wage and salary workers	32.00	44.51	59.97	89.05	95.83	103.40	115.09	123.31	132.05	140.02	148.74	157.83	168.98	179.30
3. Wage payments to collective farm members	1.18	3.06	4.94	9.13	10.96	12.66	13.40	13.66	14.04	14.38	14.82	15.77	16.24	16.24
4. Net incomes of households from sale of farm products	4.18	4.11	5.39	6.39	7.15	6.84	7.35	6.90	8.26	8.97	9.39	9.59	9.70	9.50
5. Profits distributed to cooperative members		.01	.02	.02	.02	.02	.02	.02	.03	.03	.04	.04	.03	.03
6. Military pay and money allowances	4.65	5.75	3.38	3.17	3.19	3.26	3.26	3.33	3.32	3.45	3.45	3.50	3.60	3.76
7. Transfer payments	3.99	5.36	10.39	15.01	16.55	17.71	19.93	21.80	24.04	26.28	28.70	30.90	33.47	35.88
8. Pensions and welfare payments	3.49	4.57	9.68	13.85	15.18	16.22	18.27	19.92	21.96	23.89	25.94	27.49	29.17	31.30
9. Pensions	2.40	3.20	7.20	10.60	11.80	12.60	14.00	15.00	16.20	18.00	19.80	20.80	22.10	24.30
10. Welfare payments	1.09	1.37	2.48	3.25	3.38	3.62	4.27	4.92	5.76	5.89	6.14	6.70	7.07	7.00
11. Temporary disability benefits	.54	.64	1.33	1.96	2.02	2.28	2.81	3.34	3.73	3.69	3.86	4.27	4.44	NA
12. Maternity benefits	.18	.24	.51	.62	.65	.66	.72	.79	.87	.94	.99	1.04	1.19	NA
13. Grants to large families and unwed mothers	.37	.49	.50	.46	.46	.45	.45	.44	.44	.43	.42	.41	.40	NA
14. Other grants			.14	.21	.25	.23	.29	.35	.72	.83	.87	.98	1.04	NA
15. Stipends to students	.46	.74	.60	.90	1.00	1.10	1.18	1.30	1.30	1.40	1.50	1.90	2.10	2.14
16. Insurance indemnities	.04	.05	.11	.26	.37	.39	.48	.58	.78	.99	1.26	1.51	2.20	2.44
17. Loan service	.51	1.43	.70	.10	.10	.20	.20	.20	.10	.10	.08	.11	1.10	1.10
18. Net borrowing	.07	−.09	.06	.09	.02	−.04	−.06	−.04	−.03	−.03	−.01	−.03	−.04	−.04
19. Interest on savings	.06	.12	.23	.38	.46	.55	.65	.78	.93	1.10	1.25	1.42	1.62	1.87
20. Lottery winnings			.06	.09	.14	.17	.21	.24	.24	.23	.24	.24	.24	.25

Personal Money Income

Sources and Methodology

1. *Total money income*

a. All years—Sum of lines 2 through 7 and 17 through 20.

2. *Gross earnings of wage and salary workers*

a. 1950, 1955—Narodnoye khozyaystvo SSSR v 1974 godu. Moscow, 1975, p. 549, 562 (hereafter, *N. Kh*, and the appropriate year). Includes gross earnings of cooperative artisans of .88 billion rubles in 1950 and 1.17 billion rubles in 1955 respectively. Cooperative artisans earned a wage equal to two-thirds that of industrial wage and salary workers according to U.S. Bureau of the Census, "Producers' Cooperatives in the Soviet Union," by Frederick A. Leedy, International Population Reports Series, P 95, no. 51, Washington, D.C., p. 14. The average annual number of artisans is reported in N. Kh. 1964, p. 545. The average annual industrial earnings are from Trud v SSSR, Moscow, 1968, p. 140. Producers' cooperatives were converted into state enterprises in 1960 and members were then classified as state workers.

b. 1960, 1965–74—N. Kh. 1974, p. 549, 562. Gross earnings are the product of the average annual number of wage and salary workers and the average monthly earnings, adjusted to an annual basis. In 1968, the U.S.S.R. Central Statistical Administration (hereafter CSA) changed the reporting of average wages to include bonuses from non-wage fund sources. Estimates in this table have been adjusted accordingly.

c. 1975—Sel'skaya zhizn, February 1, 1976, p. 1.

3. *Wage payments to collective farm members*

a. 1950, 1955, 1960—David W. Bronson and Constance B. Krueger, "The Revolution in Soviet Farm Household Income, 1953–1967," in James R. Millar (ed.), The Soviet Rural Community, University of Illinois Press, Urbana, 1971, p. 250.

b. 1965–75—Derived for each year as the product of (1) official statistical handbook data regarding total wage payments (money plus in-kind) made by collective farms to collective farm members for their work in socialized activity of the farms and (2) the share constituting money payments only. Data for total wage payments (money plus in-kind) are available for 1965–70 in Sel'skoye khozyaystvo SSSR, Moscow, 1971, p. 479; for 1971–74 in N. Kh. 1974, p. 422; for 1975, in SSSR vtsifrakh v 1975 godu (hereafter *Tsifrakh*), p. 135. Money payments accounted for 79.4 percent of total payments (money plus in-kind) in 1965 (V. N. Zhurikov and V. I. Solomakhin, compilers, Spravochnik po oplate truda v kolkhozakh, Moscow, 1973, p. 10); 85.6 percent in 1966; 92.4 percent in 1967; 93.7 percent in 1968; 96.9 percent in 1969 (S. V. Rogachev, Ekonomicheskiye zakony i razvitiye sel'skogo khozyaystva, Moscow, 1973, p. 217); and 93.6 percent in 1970 (Zhurikov and Solomakhin, op. cit.). Money payments are estimated to amount to 94 percent in 1971, in line with the 1970 share, and to 95 percent in 1972 through 1975.

4. *Net income of households from sales of farm products*

Net income of households from sales of farm products is derived as the difference between (1) total money income of households from sales of farm products—sales to state procurement and state and cooperative trade organizations, sales in collective farm ex-village markets and commission trade, and sales of livestock to collective farms—and (2) money outlays—purchases from outside the sector of materials and services used in production of these agricultural products and indirect taxes. Included in indirect taxes are fees charged collective farm market traders and taxes levied on livestock holdings of households.

a. All years—Unpublished estimates of Constance B. Krueger, Central Intelligence Agency.

5. *Profits distributed to cooperative members*

Consumers' cooperatives constitute a separate trade network, paralleling that of the state stores but designed primarily to service rural areas with stores and restaurants. A cooperative is usually composed of residents of a single village. Nominally, the cooperatives system is controlled by its members, but the government actually exercises strict control over profits, prices, and earnings. A small share of profits is distributed to members. During 1962–65, 68.4 million rubles were distributed to cooperative members according to A. P. Ilyushin (ed.), 50 let sovetskoy potrebitel'skoy kooperatsii, Moscow, 1967, p. 142. Total coopera-

tive profits for those years were 3,389 million rubles. (N. Kh. 1963, p. 637 and N. Kh. 1964, p. 747.) Dividing distributions by profits, results in a distribution rate of 2.02 percent. This rate is applied to reported profits for each year.

a. 1950, 1960, 1965–67—N. Kh. 1967, p. 857.
b. 1955—N. Kh. 1960, p. 843.
c. 1970–74—N. Kh. 1974, p. 739.
d. 1975—Assumed equal to 1974.

6. *Military pay and monetary allowances*

The U.S.S.R. publishes no data on aggregate military pay. An estimate of total pay for 1970 was recently published by CIA. This is used as a base weight and is moved from 1950 to the current year by an index based on military manpower, including paramilitary personnel such as border guards and security forces.

a. 1970—GNP 1970, p. 3.
b. All other years—Index based on military manpower estimates from the annual publication of the International Institute for Strategic Studies, "The Military Balance," London.

7. *Transfer payments*

a. All years—Sum of lines 8, 15 and 16.

8. *Pensions and welfare payments*

The Soviet Union has established an extensive program of social services covering a wide range of contingencies. The state social security program—which includes benefits for sickness, maternity, and large families, and pensions for old age and disability—covers workers in state enterprises as well as military personnel. Since 1965, a similar but more limited program has existed for collective farmers. Pensions and welfare payments are derived as the difference between total outlays for social security and social insurance, including pensions, and the sum of outlays for health resorts and sanitoria, outlays for kindergartens and pioneer camps, and miscellaneous outlays.

a. 1950, 1968–69—N. Kh. 1969, p. 771, 774. In 1950, the sum of reported welfare payments (lines 11 through 14) exceeds total welfare payments derived by subtracting reported pension payments from reported total pension and welfare payments by 120 million rubles. Therefore total welfare payments and, consequently, pension and welfare payments have been adjusted upward by that amount.
b. 1955—N. Kh. 1958, p. 905–906, adjusted, assuming relationship between expenditures in 1950 as reported in N. Kh. 1958, p. 905–906, and N. Kh. 1969, p. 771, 774, applied in 1955. Welfare payments and, consequently, pension and welfare payments are adjusted upward by 150 million rubles, as in 1950 above.
c. 1960, 1966–67—N. Kh. 1968, p. 776, 779.
d. 1965, 1970–74—N. Kh. 1974, p. 758, 760.
e. Finansy SSSR, no. 1, 1976, p. 14.

9. *Pensions*

State workers and collective farmers are given pensions for permanent disability, survivor, old-age, and long service.

a. 1950, 1968–69—N. Kh. 1969, p. 758.
b. 1955—Estimated to be 72 percent of pensions and welfare payments, based on the relationships existing in 1950 and 1960.
c. 1960, 1966–67—N. Kh. 1968, p. 776.
d. 1965, 1970–74—N. Kh. 1974, p. 758
e. 1975—Finansy SSSR, no. 1, 1976, p. 14.

10. *Welfare payments*

a. Total pension and welfare payments (line 8) less pensions (line 9).

11. *Temporary disability benefits*

Sickness and injury benefits are payable from the day of the disablement until recovery or until a medical commission certifies that the patient is incurable and should receive a pension for permanent disability. Since 1957, all state workers have been eligible to receive 100 percent of their earnings for temporary disability resulting from work-connected injury or from any one of 22 designated occupation illnesses.

a. 1950, 1965, 1970–74—N. Kh. 1974, p. 760.
b. 1955—N. Kh. 1958, p. 906.
c. 1960, 1968–69—N. Kh. 1969, p. 774.
d. 1966–67—N. Kh. 1967, p. 779.

12. *Maternity benefits*

Paid maternity leave was lengthened from 77 to 112 days in 1956. Payments are based on earnings and length of employment, ranging from 66⅔ percent if employed for less than one year to full compensation if employed for three years or more.

a. All years—Sources to line 11, above.

13. *Grants to large families and unwed mothers*

a. 1950, 1955, 1960—Gosudarstvennyy byudzhet SSSR i byudzhety soyuznykh respublik, (hereafter Gos. byud. 1966), Moscow, 1966, p. 25.

b. 1965–69—Gosudarstvennyy byudzhet SSSR i byudzhety soyuznykh respublik 1966–1970 gg. (hereafter Gos. byud. 1972), Moscow, 1972, p. 25.

c. 1970–74—N. Kh. 1974, p. 759.

14. *Other grants*

Includes payments for retraining state workers and burial payments for state workers and their families. Total welfare payments (line 10) less temporary disability benefits (line 11), maternity benefits (line 12), and grants to large families and unwed mothers (line 13).

15. *Stipends to students*

a. 1950, 1955—Raskhody na sotsial'no-kul'turnye meropriyatiya po gosudarstvennomu byudzhetu SSSR, Moscow, 1958, p. 46.

b. 1960, 1969—N. Kh. 1970, p. 537.

c. 1965, 1970–74—N. Kh. 1974, p. 578.

d. 1966–68—Estimates based on numbers of students in higher education (N. Kh. 1968, p. 682, and N. Kh. 1969, p. 675) and average stipend paid in 1965 and 1969.

e. 1975—Estimate based on increase in numbers of students in higher education (Tsifrakh 1975, p. 219).

16. *Insurance indemnities*

Sum of compensation received for personal property and life and accident insurance claims.

a. 1950, 1955—N. Laptev (ed.), Finansy i sotsialisticheskoye stroitel'stvo, Moscow, 1957, p. 355–56.

b. 1960—A. G. Zverev, Natsional'nyy dokhod i finansy SSSR, Moscow, 1961, p. 258.

c. 1965–66—G. P. Kosyachenko, et al, 50 let sovetskikh finansov, Moscow, 1967, p. 347–48.

d. 1967–68—A. G. Zverev, Natsional'nyy dokhod i finansy SSSR, Moscow, 1970, p. 282.

e. 1969—Ekonomicheskaya gazeta, no. 41, 1971, p. 6.

f. 1970—Finansy SSSR, no. 1, 1971, p. 10.

g. 1971–72—Based on Ekonomicheskaya gazeta, no. 41, 1971, p. 6, and Finansy SSSR, no. 4, 1973, p. 8.

h. 1973—Finansy SSSR, no. 4, 1974, p. 14.

i. 1974—Finansy SSSR, no. 6, 1975, p. 59.

j. 1975—Finansy SSSR, no. 5, 1976, p. 17.

17. *Loan service*

a. 1950, 1955—N. Kh. 1958, p. 900.

b. 1960, 1965–68—N. Kh. 1968, p. 774.

c. 1969–70—N. Kh. 1970, p. 730.

d. 1971—N. Kh. 1922–72, p. 482.

Since 1971, budget reporting has carried no item on loan service. Estimates for 1972 forward are based on the following:

e. 1972–73—Den'gi i kredit, no, 1, 1974, p. 4. In 1972 and 1973, 2.6 billion rubles and 3.6 billion rubles of 3 percent lottery bonds were sold respectively.

f. 1974–75—Den'gi i kredit, no. 11, 1974, p. 90. The government resumed redemption of the subscription loans in December 1974. In 1974 and in 1975, 1 billion rubles were to be paid to the population. Total loan service for each year includes an estimated 0.1 billion rubles of payment for 3 percent lottery loans. Finansy SSSR, no. 4, 1976, p. 24, confirms that in 1974–75, 2 billion rubles of loans were paid off.

18. *Net borrowing*

The difference between long-term loans to the population outstanding at the end of the given year and loans outstanding at the end of the previous year.

a. 1950, 1955—Vestnik statistiki, no. 2, 1960, p. 89–92.
b. 1960—N. Kh. 1962, p. 639.
c. 1966–68—N. Kh. 1968, p. 779.
d. 1969—N. Kh. 1969, p. 774.
e. 1970— N. Kh. 1970, p. 735.
f. 1971–74—N. Kh. 1974, p. 761.

19. *Interest on savings*

State savings banks offer the following major types of accounts for individuals:

1. demand (vklady do vostrebovaniya) paying 2 percent yearly interest;
2. time (srochnyye vklady) paying 3 percent yearly when held for more than 6 months;
3. lottery deposit (vyigryshnyye vklady) paying an average of 3 percent yearly in winnings. (A. P. Sakharov and V. K. Chirkov, Operatsii sberegatel'nykh kass, Moscow, 1973, p. 21–23.)

For all years, except 1950, interest payments are assumed to be 2.2 percent of average annual reported deposits, based on Vestnik statistiki, no. 1, 1967, p. 22, which stated that interest on savings amounted to 383 million rubles in 1965—2.2 percent of average annual deposits in that year. Long-term deposits make up the bulk of savings accounts, amounting to 73.1 percent in 1971 according to Den'gi i kredit, no. 8, 1971, p. 68. The same article stated that no significant changes occurred in the distribution of deposits by category during 1965–70. In 1975, the proportions remained about the same; approximately 70 percent of savings deposits were in long-term accounts, according to Finansy SSSR, no. 4, 1976, p. 23.

For 1950, however, interest payments are assumed to equal 3 percent of total deposits because, according to Vestnik statistiki, no. 1, 1967, p. 22, interest payments were lowered from 3–5 percent to 2–3 percent in 1955.

a. 1950, 1968–69—N. Kh. 1969, p. 585.
b. 1955—N. Kh. 1960, p. 854.
c. 1960, 1966–67—N. Kh. 1967, p. 699.
d. 1965, 1970–74—N. Kh. 1974, p. 607.
e. 1975—Sel'skaya zhizn', February 1, 1976, p. 2.

20. *Lottery winnings*

A cash-or-commodity lottery was begun in 1957 with winnings set at 50 percent of total lottery revenues (G. Yeremeyeve, et al, Osnovy sberegatel'nogo dela, Moscow, 1965, p. 50). In 1966, winnings were increased to 60 percent of revenues (Den'gi i kredit, no. 4, 1966, p. 9) and by 1968, 95 percent of lottery revenues were paid out (Den'gi i kredit, no. 8, 1970, p. 69). Since 1968, it is assumed that money winnings were 95 percent of reported lottery revenues. Winnings from other lotteries are not included.

a. 1960—Gos. byud. 1966, p. 11.
b. 1965–70—Gos. byud. 1972, p. 12.
c. 1971–75—Finansy SSSR, no. 4, 1976, p. 24.

TABLE 3.—U.S.S.R.: DEDUCTIONS FROM PERSONAL MONEY INCOME, 1950, 1955, 1960, 1965–75

[Billion rubles]

	1950	1955	1960	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
1. Total deductions	6.93	8.78	6.69	9.62	10.60	11.59	13.34	15.04	16.63	17.84	19.46	21.39	23.42	25.99
2. Direct taxes	3.58	4.83	5.60	7.70	8.44	9.32	10.50	11.60	12.74	13.70	14.80	15.80	17.10	18.40
3. Personal income tax	2.04	3.55	4.64	6.77	7.50	8.36	9.50	10.54	11.61	12.47	13.47	14.38	15.56	16.74
4. Agricultural tax	.80	.44	.40	.36	.35	.35	.34	.33	.33	.33	.33	.33	.33	.33
5. Bachelor and small family tax	.74	.84	.56	.57	.59	.62	.66	.73	.80	.90	1.00	1.09	1.21	1.33
6. Local taxes	.28	.29	.14	.17	.19	.19	.20	.19	.18	.18	.18	.18	.18	.18
7. State fees	.03	.04	.04	.05	.06	.06	.07	.07	.07	.07	.07	.07	.07	.07
8. Building tax and land rent	.13	.17	.07	.09	.09	.10	.10	.10	.11	.11	.11	.11	.11	.11
9. One-time collections at collective farm markets	.04	.02	.02	.02	.02	.02	.02	.02						
10. Collections on transportation and livestock in cities	.08	.06	.01	.01	.02	.01	.01							
11. State loans	2.70	3.14	.06	.18	.22	.13	.28	.36	.47	.20	.20	.20	.20	.56
12. Trade union dues	.24	.36	.55	.86	.96	1.08	1.20	1.28	1.38	1.45	1.54	1.63	1.75	1.85
13. Party membership dues	.10	.12	.17	.28	.30	.31	.36	.39	.42	.44	.46	.48	.51	.54
14. Insurance premiums	.03	.04	.17	.43	.49	.56	.80	1.22	1.44	1.87	2.28	3.10	3.68	4.46

Deductions from Personal Income

Sources and Methodology

1. *Total deductions*

a. All years—Sum of lines 2, 6, 11, 12, 13, 14.

2. *Direct taxes*

a. 1950, 1955, 1960—Gos. byud., 1966, p. 11.
b. 1965–1970—Gos. byud., 1972, p. 12.
c. 1970–1974—N. Kh. 1974, p. 756.
d. 1975—Tsifrakh, p. 43.

3. *Personal income tax*

a. 1950, 1955, 1960, 1965–70—Sources a. and b. of 2. above.
b. 1971–75—Assumed 91 percent of direct taxes (line 2. above), average rate for 1966–70.

4. *Agriculture tax*

a. 1950, 1955, 1960, 1965–70—Sources a. and b. of 2. above.
b. 1971–75—Assumed constant at 1970 level.

5. *Bachelor and small family tax*

a. 1950, 1955, 1960, 1965–70—Sources a. and b. of 2. above.
b. 1971–75—Line 2 less lines 3 and 4.

6. *Local taxes*

It is assumed that half of local taxes paid for state fees, building taxes and land rents, and one-time collections at collective farm markets are paid by individuals. In addition local taxes include an "admission tax" paid solely by institutions (US Bureau of the Census, The Soviet Financial System: Structure Operation, and Statistics, Washington, 1968, p. 127–28).

a. 1950, 1955, 1960—Gos. byud., 1966, p. 70, reduced by value of "admissions tax" from Gos. byud., 1966, p. 70, and half the value of taxes paid on the three categories listed below.

b. 1965–70—Gos. byud., 1972, p. 76, reduced by value of "admission tax" from Mestnyye byudzhety SSSR, Moscow, 1970, p. 11. "Admission taxes" assumed to grow by 3% during 1969–70, the rough average annual rate during 1960–68.

c. 1971–75—Assumed constant at 1970 level.

7. *State fees*

It is assumed that one-half of state fees are paid by individuals.

a. 1950, 1955, 1960—Gos. byud., 1966, p. 70.
b. 1965–1970—Gos. byud., 1972, p. 77.
c. 1971–1975—Assumed constant at 1970 level.

8. *Building tax and land rent*

It is assumed that one-half of building taxes and land rents are paid by individuals.

a. 1950, 1955, 1960, 1965–70—Sources a. and b. of 2. above.
b. 1971–75—Assumed constant at 1970 level.

9. *One-time collections at collective farm markets*

a. 1950, 1955, 1960, 1965–69—Sources a. and b. of 2. above.
b. 1970—Value too small to be reported (source b. of 2. above).
c. 1971–75—Assumed continued too small to be reported.

10. *Collections on transportation and on livestock holdings in cities*

a. Line 6 less lines 7, 8, and 9.

11. *State loans*

a. 1950, 1955, 1960—Gos. byud., 1966, p. 11. Includes compulsory bond purchases of 2.6 billion rubles in 1950 and 3.0 billion rubles in 1955.
b. 1965–70—Gos. byud., 1972, p. 12.
c. 1971–74—N. Kh. 1974, p. 757.
d. 1975—Finansy SSSR, no. 4, 1976, p. 24.

12. *Trade union dues*

Trade union dues are the product of estimated trade union membership and 1 percent of the average annual wage. The rate is found in Spravochnik prof-

soyuznogo rabotnika, 1972, Moscow, 1972, p. 463. The average annual wage is derived by adjusting the average monthly wage, found in N. Kh. 1974, p. 562, and Tsifrakh, p. 179, to an annual basis. Data on trade union membership are scattered, but available for several years. Membership is established for 1949, 1954, 1959, and 1963 in Emily C. Brown, Soviet Trade Unions and Labor Relations, Harvard, 1966, p. 48. Membership for 1967 and 1971 is given in Sovetskiye profsoyuzy, no. 5, 1972, p. 6. Membership for the remaining years is estimated on the basis of percentage of state labor force belonging to the trade unions or by percentage increases in the state labor force. State labor force data are found in N. Kh. 1974, p. 549 and Tsifrakh, p. 173.

13. *Party membership dues*

Party membership dues are the product of average annual party membership and 2 percent of the average annual wage. The rate is from GNP 1970, p. 40. The average annual wage is derived by adjusting the average monthly wage, found in N. Kh. 1974, p. 562, and Sel'skaya zhizn', February 1, 1976, p. 2, to an annual basis. Party membership is from Partiinaya zhizn', no. 14, July 1973, p. 10, Kommunist, no. 5, March, 1975, p. 11, and Sel'skaya zhizn', February 25, 1976, p. 6.

14. *Insurance premiums*

a. 1950, 1955—Estimate based on relationship of total value of annual voluntary property insurance and life insurance in 1950, 1955, and 1960, from N. Laptev, (ed.) Finansy i sotsialisticheskoye stroitel'stvo, Moscow, 1957, p. 355–356, and A. G. Zverev, Natsional'nyy dokhod i finansy SSSR, Moscow, 1961, p. 258, to voluntary life insurance payments in 1960 (b. below).

b. 1960, 1965—Finansy, SSSR, no. 4, 1972, p. 3.

c. 1966—Interpolated.

d. 1967, 1972—Finansy SSSR, no. 1, 1973, p. 57.

e. 1968—Finansy SSSR, no. 12, 1968, p. 7.

f. 1969—Estimate based on Finansy, SSSR, no. 4, 1974, p. 16. Premiums paid during the Eighth Five-Year Plan were 4,515.8 mr.

g. 1970, 1974—Finansy SSSR, no. 6, 1975, p. 59.

h. 1971—Interpolated.

i. 1973—Finansy, SSSR, no. 4, 1974, p. 14.

j. 1975—Estimate based on Finansy SSSR, no. 4, 1974, p. 16. Premiums paid during the Ninth Five-Year Plan will be 15,391.2 mr.

RAW MATERIAL PROBLEMS OF THE SOVIET ALUMINUM INDUSTRY

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I. THE SOVIET ALUMINUM INDUSTRY

The Soviet Union, generally presumed to be one of the major potential purveyors of mineral raw materials to the world economy, is poorly endowed with resources for one of its rapidly growing industries—aluminum. Despite an intensive geological prospecting effort over the years, identified exploitable reserves of high-grade bauxite remain limited. The nation's economic planners have sought to overcome the domestic bauxite shortage in two ways: (1) By pioneering the use of nonbauxitic raw materials, such as nepheline and alunite, which are not used elsewhere in the commercial production of alumina, the intermediate product of aluminum processing; (2) by steadily increasing imports of both bauxite and alumina from a wide range of foreign suppliers.

In 1975, out of a national aluminum metal output estimated at 2.4×10^6 tons, only 37 percent was derived from domestic bauxite resources, with 24 percent coming from nonbauxitic materials and 40 percent from imported raw materials. There has been growing evidence in the Soviet press and technical literature that Moscow planners have become disenchanted with the technical problems and the economics of using the nonbauxitic materials, once widely publicized as the potential solution to the Soviet Union's raw material problems in the aluminum industry. No expansion of nonbauxitic projects appears planned and, in fact, an alunite-based alumina plant is in the process of being converted to the use of imported bauxite. The

*The New York Times and Soviet Geography: Review and Translation.

outlook is therefore for growing reliance on imported raw materials for an expanding aluminum industry as the vast hydro-electric potential of south-central Siberia is being realized.

A. Historical Development

From the time its aluminum industry began in 1932, the Soviet Union has become the world's second largest producer of aluminum metal, with an annual output of 2.4 x 10^6 tons. This is about half of United States production and twice the level of the world's third producing nation, Japan (Table 1).

The Soviet industry had its beginnings in northwest European Russia, where a small aluminum plant, with a designed capacity of 11,000 tons went on stream in 1932 at Volkhov near Leningrad, using a low-grade bauxite from a nearby deposit at Boksitogorsk and power from a small local hydro-electric station. The Volkhov plant was followed in 1933 by the opening of a 36,000-ton reduction plant at Zaporozh'ye at the newly completed hydro-electric station in the Ukraine. Alumina was at first derived from bauxite at the two reduction plants and, as requirements expanded, from an additional alumina plant opened in 1938 at the Boksitogorsk mine itself.[1]

The discovery of bauxite resources in the Urals, of higher grade than the Boksitogorsk deposit, led to the growth of the aluminum industry in the Urals starting in the mid-1930's. This eastward trend was accelerated during World War II by the loss of the aluminum capacity in the European part of the country under German occupation. The first combined alumina and aluminum plant in the Urals opened in 1939 at Kamensk. During the war, some equipment could be evacuated from the threatened plants at Zaporozh'ye and Volkhov and was installed in a new aluminum plant built at Stalinsk (now Novokuznetsk), put in operation in 1943 in Siberia's Kuznetsk Basin, and in a second combined alumina (1943) and aluminum plant (1945) in the Urals, at Krasnoturinsk, not far from the North Urals bauxite center of Severoural'sk. As a result of these projects, Soviet aluminum production rose during World War II from 60,000 tons in 1940 to about 85,000 tons in 1945, despite the loss of the plants in the European part of the USSR.

After the war, expansion of aluminum capacity resumed at first in the European part of the country, based both on domestic bauxite and on some bauxite imports that came initially from Hungary and later from Greece. Aside from the reconstruction of the two prewar plants, at Volkhov and Zaporozh'ye, five new aluminum reduction plants were put into operation during the 1950's. Two became part of the northwest cluster of the industry, with the Kandalaksha plant on the Kola Peninsula opened in 1951 and the Nadvoitsy plant in Karelia put in operation in 1954. Two others became part of a southwest cluster in Transcaucasia, with the Yerevan plant in Armenia starting in 1950 and the Sumgait plant near Baku in Azerbaijan in 1955. The fifth and then largest reduction plant (with a capacity of about 200,000 tonnes of metal) went on stream in 1959 at Stalingrad (now Vol-

[1] For a detailed account of the Soviet aluminium industry up to the late 1950's, see Shabad, Theodore. "The Soviet Aluminum Industry." New York, American Metal Market, 1958), 25 pp., and a supplement "Soviet Aluminum Developments in 1959" (New York, American Metal Market, 1960), 22 pp. For developments during the 1960's, see Shabad, Theodore. "Basic Industrial Resources of the U.S.S.R." (New York, Columbia University Press, 1969), pp. 58–63 and elsewhere under individual projects.

gograd), on the site of a new Volga River hydro-electric station. This expansion program, still based largely on domestic bauxite resources, raised primary aluminum production from about 155,000 tons in 1959 to 430,000 in 1955 and about 550,000 in 1960.

In the 1960's began a new phase in the Soviet aluminum industry as the development of the huge hydro-electric potential on the Angara and Yenisey rivers in south-central Siberia attracted large new aluminum reduction capacity. The rapid expansion of the industry generated raw-material demands that could no longer be met from traditional bauxite sources, and stimulated a search for additional domestic bauxite, even of low grade; the use of nonbauxite materials and, beginning in the mid-1960's, a greatly expanded raw-material import program. Three new plants opened production in Siberia during the 1960's, each associated with a major hydro-electric station. They were open at Shelekhov (near Irkutsk) in 1962; at Krasnoyarsk in 1964, and at Bratsk in 1966. A fourth, associated with the Sayan hydro-electric station under construction on the Yenisey at Sayanogorsk is to go on stream in 1978. The only new plant outside Siberia is the Regar plant, which went into operation in April 1975 in the Tadzhik Republic of Central Asia, using power from the Nurek hydro plant.[2]

This pronounced eastward shift of aluminum capacity raised Soviet production to about 1 x 10^6 tons in 1965, with 35 percent coming from Siberia; 1.7 x 10^6 in 1970, with about 50 percent from Siberia; and 2.4 x 10^6 in 1975, with about 65 percent from Siberia. The new five-year plan (1976–80) has set an increase of 20–30 percent in aluminum production, or at least 2.9 x 10^6 tons by 1980. This increase will come from the installation of the final production units at Bratsk and Krasnoyarsk, additional units at Regar and the first unit at the new Sayanogorsk plant.[3]

II. Principal Domestic Resources

A. Bauxite

The Soviet Union now mines bauxite in three areas: Boksitogorsk near Tikhvin, in the Leningrad area; Severoural'sk in the northern Urals, and Arkalyk in the Turgay area of northwest Kazakhstan.

The Boksitogorsk deposit, discovered in 1916, contained relatively small reserves of low-grade bauxite (41–48 percent alumina) with a high silica content (10–20 percent), but it became the first Soviet source of bauxite, with modern mining operations getting under way in the early 1930's. The bauxite was converted into alumina at the Volkhov alumina-aluminum plant (commissioned in 1932) and at a local alumina plant (opened in 1938). Boksitogorsk-based alumina was the principal raw material for the northwest cluster of the Soviet

[2] Pravda (27 April 1975). The first stage, with four potlines, may have produced about 50,000 tons of aluminum in 1975. The five-year plan 1976–80 calls for a production growth of 560% (Pravda, 6 January 1976), with the addition of one potline planned for 1977, three for 1978 and three more for the 1979–80 period (Ekonomicheskaya Gazeta, 1976. No. 4).

[3] The Soviet Union does not publish official production statistics for the aluminum industry. Western estimates vary widely, with a series published by the U.S. Bureau of Mines for primary metal output running at about 70% of the production level in a series published by the Central Intelligence Agency. The Bureau of Mines figure for 1970 was 1.1 x 10^6 tonnes ("Minerals Yearbook 1972." Vol. III: Area reports: International. Washington, 1974), p. 817. The C.I.A. figure for 1970 was 1.7 x 10^6 tonnes ("Handbook of Economic Statistics 1975." op. cit.). The present author has found the CIA figures to conform more closely to the scattered indications found in the Soviet technical literature and the Soviet press.

aluminum industry until the early 1960's, when nephelite (a byproduct of the Kola apatite operation) became the principal resource base for the northwestern plants. By that time, the most accessible and highest grade bauxite had been depleted at Boksitogorsk, the local alumina plant was converted in 1960–65 to the production of abrasive-grade alumina for grinding and polishing materials.[4] Since that time, the Boksitogorsk bauxite mine has in effect ceased to be a significant element in the Soviet aluminum industry.

The northern Urals bauxite mines at Severoural'sk, known as the Krasnaya Shapochka (Red Ridinghood) deposit, yield a high-grade ore of 55 percent alumina and about 4 percent silica that represents the Soviet Union's principal source of domestic bauxite. The deposit was discovered in 1931, and mining operations began in 1934, when Urals bauxite began to move to the Zaporozh'ye alumina-aluminum plant, replacing the lower-grade Boksitogorsk ore at that Ukrainian plant. During World War II the Severoural'sk mining district became the Soviet Union's main bauxite producer, forming the basis of two Urals alumina-aluminum plants, one at nearby Krasnoturinsk (alumina commissioned in 1943 and aluminum in 1945), the other at Kamensk, in the middle Urals, where a combined alumina-aluminum plant opened in 1939. In the postwar period, the Urals supplied alumina to the expanding aluminum industry in the European part of the USSR and, after 1960, increasingly to the new large metal-reduction plants in Siberia.

Development of the Urals reserves has been hampered by an unfavorable mining geology. Unlike the surface deposits of Boksitogorsk, most of the Urals reserves are underground in karst limestone and have been plagued by severe flooding problems. Early mining operations were in small open pits and sloping shafts. As mining proceeded in the 1950's to greater depths below the watertable, the flooding problem became so severe that surface streams had to be diverted or their channels had to be lined with impervious materials. This river-control program made it possible to tap deeper horizons and to start some large open pits in areas previously subjected to flooding.

Beginning in the 1960's, several vertical shaft mines were driven to depths of 500 meters or more, and there are plans to penetrate to 1,600 meters.[5] The first large open-pit mine began operations in late 1971.[6] Bauxite production in the Severoural'sk district increased from close to 500,000 tons in 1945 to 2 x 10^6 tons in 1965 and 3 x 10^6 tons in 1975, thus accounting for about 75 percent of Soviet bauxite.[7]

The Arkalvk bauxite deposit in northwest Kazakhstan, containing a high-silica bauxite (45–46 percent alumina, 12 percent silica), was discovered in 1946, and an open-pit operation began production in 1964, designed for an ultimate capacity of 3 x 10^6 tons. The bauxite from Arkalyk is hauled 640 miles by rail to an alumina plant at Pav-

[4] "Severo-Zapadnyy ekonomicheskiy rayon"/The Northwest Economic Region/(Moscow, Nauka, 1967). p. 83; Darinskiy, A. V., "Leningradskaya Oblast" (Leningrad, Lenizdat, 1975). p. 346.

[5] Gornyy zhurnal (October 1974).

[6] Izvestiya (14 January 1972).

[7] Severoural'sk output was close to 500,000 tons in 1945 (Shabad, Soviet Aluminum Developments in 1959, op. cit., p. 2). Subsequent increases were reeported by Soviet sources as follows: 170 percent in 1945–55 and 50 percent in 1955–65 (Gornyy zhurnal, December 1967); 22 percent in 1965–70 and about 25 percent in 1970–75 (Gornyy zhurnal, October 1974), yielding about 3 x 10^6 tons in 1975.

lodar with a capacity of over 500,000 tons that was put on stream also in 1964. Pavlodar alumina is shipped to Siberia aluminum plants. It has developed in recent years that the reserves of the best bauxite in the Arkalyk area are limited (about 20 years if used at full capacity), and this has required the exploration of inferior bauxite deposits nearby for a mix with the higher Arkalyk grades. The Lower Ashut deposit, with poorer ore, opened in 1974, and the Upper Ashut deposit in 1975. The Ayat deposit, about 250 miles northwest of Arkalyk, has been producing such inferior bauxite since 1971.[8] As a result of the deterioration of the raw-material base of the Pavlodar alumina plant, the plant's process design has been disrupted. Because of high-silica content of the bauxite, the plant had been designed for the combination process in which the standard Bayer process yields a red mud from which additional alumina is then extracted by the lime-soda sinter process. The inferior bauxite yielded more red mud than originally designed, upsetting the capacity ratio of the Bayer and sinter sections.[9] The deterioration of the raw-material input was evident from the fact that bauxite mining in the Arkalyk district increased by more than 50 percent from 1970 to 1975 while alumina output at Pavlodar rose by only 23 percent.[10] Soviet authors have noted that the Pavlodar alumina plant is the only installation in the world that is processing such low-grade aluminous raw material in large volumes, pointing out that the material would be regarded abroad as lateritic clay rather than bauxite. This author estimates that by 1975 the Pavlodar alumina plant produced over 500,000 tons a year, using about 2.3 x 10^6 tons of the low-grade Kazakhstan bauxite.

Outside of the two major bauxite mining districts—the northern Urals and northwest Kazakhstan—bauxite development has been under way in the North Onega deposit, on the Onega River near Plesetsk in northern European Russia. The deposit, with a low-grade bauxite containing 53 percent Al_3O_3 and as much as 18.5 percent SiO_2, was discovered in 1949, and development of a surface mine began in 1967. The bauxite lies under a water-saturated overburden, and the area of the prospective pit had to be drained before excavation could begin. After seven years of work, a 60-meter deep pit was completed and the first bauxite was extracted in 1974.[11] However there has been no further word about the development of the mine, and it has not been included in the published outline of the new five-year plan 1976–80. More significantly, perhaps, the Soviet Union has not announced the formal creation of an urban center on the site of the mine. Design calculations in the 1960's concluded that North Onega bauxite would be mined more cheaply than the Arkalyk bauxite of Kazakhstan. North Onega bauxite was envisaged as a raw-material source for the Boksitogorsk alumina plant (replacing the depleted local deposit) and for the Zaporozh'ye alumina-aluminum plant in the Ukraine. Ultimately a local alumina plant near the North Onega deposit had been projected.[12] However there has been no recent report on progress, and the outlook for the mining project remains in doubt.

[8] The start of operations in the Ayat deposit was announced in Kazakhstanskaya Pravda (Oct. 5, 1971); Lower Ashut in Sovetskaya Latviya (Jan. 6, 1974) and Upper Ashut in Kazakhstanskaya Pravda (Aug. 16, 1975). The need for a mix of ores is discussed in Narodnoye Khozyaystvo Kazakhstana (November 1970, pp. 51).
[9] Tsvetnyye Metally (August 1975); Kazakhstanskaya Pravda (Nov. 23, 1974).
[10] Kazakhstanskaya Pravda (Nov. 21, 1975).
[11] Izvestiya (June 30, 1974); Sotsialistisheskaya Industriya (July 9, 1974).
[12] Severo-Zapadnyy ekonomicheskiy rayon (op. cit.), p. 80–81.

Future commercial bauxite prospects are focused on the Timan district in Komi Autonomous Republic of northern European Russia and on the Belgorod district of central European Russia. Geological exploration in the Timan district concentrated in recent years on the Vezhayu-Vorykva deposit, 100 miles northwest of the town of Ukhta, where the bauxite, accessible by surface mining, contains 45–48 percent alumina and about 10 percent silica. So far identified reserves have not been adequate for commercial development.[13]

B. Nepheline

The first nonbauxitic source of alumina in the Soviet Union was the nepheline, a complex silicate of sodium, potassium and aluminum, that occurs with apatite, a calcium phosphate, in the Kirovsk district of the Kola Peninsula of northern European Russia. The mining of apatite, the principal Soviet source of phosphatic fertilizer, began in 1931, with the nepheline component discarded as tailings in the process of apatite concentration. The possibility of using nepheline concentrate (29 percent Al_2O_3) from the tailings for the production of alumina was demonstrated experimentally in 1932, and a nepheline concentrator was built at Kirovsk in 1939.[14] However, World War II intervened, and it was only after the war that the nepheline-to-alumina process was introduced commercially, first at the Volkhov alumina-aluminum plant near Leningrad, and then at a larger, new alumina plant at Pikalevo, near the old bauxite center of Boksitogorsk.

The alumina plant at Volkhov, originally based on the use of Boksitogorsk bauxite, was converted to the nepheline process in the late 1940's, and the first shipment of nepheline concentrate from Kirovsk was received in 1949. It took five years for the new technology to be mastered, and it was not completely operational until 1954. The process was judged so successful at the time that it was introduced at the new Pikalevo alumina plant, commissioned in 1959.

Despite the low alumina content in nepheline (29 percent, compared with about 50 percent in high-grade bauxite), the nepheline process was judged to be economical because it yields both cement and alkalis (soda ash and potash) as byproducts. The sintering of 4–4.5 tons of nepheline concentrate with about twice as much limestone yields one tons of alumina, one ton of alkalis and about 7 tons of cement. The large limestone requirements and the large potential cement yield made the nepheline-limestone sinter process particularly economical in areas with large limestone resources and a nearby market for the vast cement output.

The nepheline-based alumina capacity in the northwest region of the European USSR is limited to about 350,000 tons (about 50,000 tons at Volkhov and about 300,000 tons at Pikalevo).[15] The proc-

[13] Sovetskaya Geologiya (December 1975), pp. 114–115.

[14] Kitler, I. N., and Layner, Yu. R. Nefeliny—kompleksnoye syr'ye alyuminiyevoy promyshlennosti/Nephelines—a multicomponent raw material for the aluminum industry/(Moscow, Metallurgisdat, 1962), p. 31.

[15] The alumina output in the Northwest can be estimated both from published soda-ash production (about 260,000 tons in 1970) on the basis of 0.75 ton of soda ash for every ton of nepheline-based alumina and from published data on cement production from nepheline-based alumina plants (about 2.5 x 10^6 tons) on the basis of 7 tons of cement for every ton of alumina.

essing capacity has limited the use of nepheline concentrate to 1.5 x 10^6 tons a year, which represents only about one-sixth of the nepheline potential in the tailings left by the apatite industry. If fully used, the mining operation in the Kola Peninsula would yield one ton of nepheline concentrate for every 1.5 tons of apatite concentrate; in 1975, 15 x 10^6 tons of apatite concentrate were produced at Kirovsk, equivalent to a potential nepheline output of 10 x 10^6 tons.[16]

The apparent cost-effectiveness of the nepheline process in the Northwest, which resulted in part from the fact that the nepheline was a byproduct of a major apatite mining industry, stimulated the use of nepheline as an aluminous raw material elsewhere in the Soviet Union. Development began in the middle 1950's on two sites that appeared the most suitable: the Achinsk district of southern Siberia, which was to be the first of a series of large nepheline-based alumina plants supplying the expanding aluminum industry of Siberia, and the Razdan district of Armenia, which was to become a nepheline-based alumina source for the Transcaucasian cluster of the aluminum industry.

The Achinsk project was originally designed to use nepheline from a nepheline-syenite deposit at Goryachegorsk, 85 miles southwest of Achinsk, and a railway to the site was completed in 1959. However, the discovery of a higher-grade deposit on the Kiya-Shaltyr River at Belogorsk, 35 miles farther to the southwest, disrupted the original plans. It required new engineering designs adapted to the new ore, the building of a new access railway, and the start of construction at the Belogorsk site from scratch. The shift in raw-material base delayed completion of the Achinsk plant. As a makeshift operation, the cement section of the project went on stream in 1965 on the basis of a local limestone deposit, with a capacity of 2 x 10^6 tons of cement. Alumina production did not begin until April 1970, with the 10th and final rotary calcination kiln initalled in late 1971.[17]

It became soon evident that the Achinsk alumina plant, with a designed capacity of 800,000 tons, was not working efficiently or economically. A report in the Soviet Government newspaper Izvestiya in 1974 called the project a failure, saying that after 15 years of construction the plant "did not justify the hopes that had been placed in the use of nepheline in Siberia, and the output, once advertised as the cheapest alumina in the USSR, in fact turned out very expensive." [18] According to other Soviet accounts, only 53.5 percent of the plant's capacity was being used in 1973 and the plant was expected to work profitably only in the fourth quarter of 1975. One reason for the uneconomical operation, aside from any technological problems, was the limitation of the cement market in southern Siberia. Since it was not economical to haul cement over long distances, only about one-half of the byproduct calcium silicate (the so-called belite slurry) was being used for byproduct cement at Achinsk.[19] By 1975, judging

[16] The 1975 apatite output was given in Pravda (Feb. 20, 1976). For the apatite-nepheline ratio see Granik, G. I. Ekonomicheskiye problemy razvitiya i razmeshcheniya proizvoditel'nykh sil Yevropeyskogo Severa SSSR/Economic problems in the development and location of productive forces in the European North of the USSR/(Moscow, Nauka, 1971), p. 118. For the actual use of nepheline concentrate, see Ekonomicheskaya Gazeta (1974, No. 7) and Izvestiya (Dec. 29, 1974).

[17] Stroitel'naya Gazeta (May 14, 1965; Apr. 12, 1970; Jan. 1, 1972).

[18] Izvestiya (Dec. 29, 1974).

[19] Tsvetnyye Metally (January 1975; June 1975; August 1975).

from a soda-ash yield of about 400,000 tons, the Achinsk plant was producing about 550,000 tons of alumina, or about two-thirds of designed capacity.[20]

The Armenia nepheline project was designed in 1958; construction began in 1960, and it is still incomplete.[21] The use of the ore, from the Tezhsar nepheline-syenite deposit near Razdan, had been described by the Armenian designers as yielding not only byproduct cement, but also a wide range of chemicals (sodium and calcium metasilicates, potash, amorphous silica) enhancing the cost-effectiveness of the nepheline-alumina operation. In anticipation of the new industry, Razdan was selected as the site for Armenia's largest power generating complex. It consists of a 300,000-kilowatt heat and power station (completed in 1970) and an 800,000-kilowatt condenser-type power station (completed in 1974), or a combined capacity of 1.1 x 10^6 kilowatts. In the absence of the expected large steam consumption at Razdan, it has now been suggested that the excessive heat capacity of the power complex be used in local greenhouse cultivation.[22] As in the case of Achinsk, the delay in the alumina project induced the planners to proceed at least with cement production, and a cement plant with a capacity of 1.2 x 10^6 tons was commissioned in late 1970 for the growing Armenian market.[23] But the outlook for the alumina section is dim. As of mid-1975, 43 million rubles still remained to be invested in the project, but only one-tenth of that amount was being allocated annually.[24] The Razdan project continues to be listed in five-year plans, but early completion seems unlikely unless the rate of construction is greatly accelerated.

The problems at Achinsk and Razdan appear to have had an impact on further expansion of the use of Kola nepheline.

Under plans announced in the 1960's, the production of nepheline concentrate was to have been expanded in the Kirovsk district in an effort to make use of the waste tailings, and the nepheline was to be transported by cheap water route to cement centers in the Volga valley where the existence of a large market would justify the construction of a large-capacity alumina-cement complex. Two sites were proposed: one at Novoul'yanovsk, a cement town south of Ul'yanovsk; the other at Mikhaylovka, in Volgograd Oblast.[25] At Novoul'yanovsk, which already has a limestone-based cement plant producing 2 x 10^6 tons a year (opened in 1961), the start of an alumina plant project was actually announced in the late 1960's, but no further word has been heard.[26] At Mikhayloka, a small cement plant of 1.1 x 10^6 tons capacity was built in the early 1950's and expanded to 2.7 x 10^6 tons in the 1960's, but the alumina project does not appear to have been implemented.[27]

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[20] The 1975 estimate for Achinsk alumina output is further supported by the announcement in Stroitel'naya Gazeta (Feb. 8, 1976) that alumina production is scheduled to rise by 43 percent in the new five-year plan 1976–80, presumably to reach the designed capacity of 800,000 tons.

[21] Kommunist (Yerevan newspaper; Dec. 28, 1963; July 13, 1966; June 22, 1969; Mar. 16, 1971; Aug. 3, 1975).

[22] Kommunist (Jan. 7, 1970; Aug. 3, 1974; Jan. 4, 1976).

[23] Kommunist (Nov. 5, 1970).

[24] Kommunist (Aug. 3, 1975).

[25] Izvestiya (Apr. 4, 1967); Granik (op. cit.), p. 120.

[26] Tsvetnyye Metally (June 1967; November 1969); Sovetskaya Rossiya (Mar. 21, 1970).

[27] Tsvetnyye Metally (June 1967; November 1969); Problemy razvitiya i razmeshcheniya proizvoditel'nykh sil Povolzh'ya/Problems of Development and Location of Productive Forces in the Volga Region/ (Moscow, Mysl', 1973), p. 156.

Failure to go ahead with an expansion of Kola nepheline use evidently reflected disenchantment among Soviet aluminum planners with regard to the Achinsk project and, by extension, to the entire nepheline avenue to aluminum production. According to advocates of Kola nepheline, the designers of the Achinsk plant ignored the experience of nepheline-based alumina plants at Volkhov and Pikalevo. But the Ministry of Nonferrous Metallurgy interpreted the failure at Achinsk in its own fashion. It explained the high cost of Siberian alumina by saying that it is "far more difficult to process nepheline than it is to process bauxite." [28] The director of the apatite mining complex was quoted as having said in early 1976: "The Ministry of Nonferrous Metallurgy, which is the principal consumer of nepheline, uses it in limited amounts and plans no significant increase in nepheline consumption in the 10th five-year plan (1976–80).[29]

C. Alunite

Aside from nepheline, the only nonbauxitic material that has found commercial use as an alumina source in the Soviet Union is alunite, a potassium aluminum sulfate, found in substantial reserves in the Zaglik deposit near Kirovabad in the Azerbaijan Republic of Transcaucasia. A Soviet engineer, Georgiy V. Labutin, proposed a process decomposing the alunite to alumina, potassium sulfate (a fertilizer) and sulfur oxides (used to produce sulfuric acid). He contended that this process would be even more economical than the nepheline-based alumina process because the alunite byproducts (sulfuric acid and potassium sulfate) were of higher value than the cement and soda ash obtained in the nepheline process.[30] In the alunite process, as designed by Labutin, 6.6–6.7 tons of alunite ore (containing 50% alunite) yield one ton of alumina as well as 1.15–1.3 tons of sulfuric acid and 0.2–0.235 tons of potassium sulfate.[31] Construction of the Kirovabad alumina plant, with an ultimate designed capacity of 400,000 tons of alumina, began in 1955. Construction was not pursued with much energy until 1958, when the pace accelerated and 1962 was set as the target date for the start of the first of four 100,000-ton sections. However, the first alunite ore, hauled from the nearby Zaglik mine (town of Alunitdag) by a 5-mile cableway and then by a 22-mile electric railway, reached the alumina plant only in late 1965, and yielded the first alumina and sulfuric acid early the following year.

The potassium sulfate department did not open until 1968.[32] The breaking-in process proved to be long and difficult. By the end of 1969, the first section of the plant was said to be operating at only 40% capacity, suggesting an alumina output of 40,000 tons, and this was to be doubled in 1970.[33] The first sulfuric acid section, with a designed capacity of 125,000 tons, was not operating properly and was producing only about 15,000 tons of acid, much of it below standard.

[28] Izvestiya (Dec. 29, 1974).
[29] Sovetskaya Rossiya (Jan. 5, 1976).
[30] Labutin, G. V. Alunity (Moscow, Metallurgiya, 1965), p. 9.
[31] Belyayev, A. I. Metallurgiya legkikh metallov/Metallurgy of Light Metals/(Moscow, Metallurgizdat, 1962), p. 148; Sushkov, A. I., and Troitskiy, I. A. Metallurgiya alyuminiya (Moscow, Metallurgiya, 1965), p. 221.
[32] Bakinskiy Rabochiy (Baku newspaper; Nov. 26, 1965; Mar. 3, 1966); Izvestiya (May 5, 1968).
[33] Bakinskiy Rabochiy (Dec. 19, 1969; Jan. 7, 1970).

The potassium sulfate department used what was later described as an outdated technology[34] and yielded about 20,000 tons in 1970. By 1974, the annual production plan for potassium sulfate was announced as 40,000 tons, doubling production of both fertilizer and alumina. The sulfuric acid department, having been reconstructed, finally began full operation in 1973.[35] It yielded about 250,000 tons of acid in 1975, corresponding to about 200,000 tons of alumina and 40,000 tons of potassium sulfate. After nearly a decade of operation, the Kirovabad alumina plant was described as working normally.[36]

Nevertheless the Soviet aluminum planners saw their future in bauxite rather than in alunite. It was announced in late 1974 that further expansion of alumina production at Kirovabad would be based on imported bauxite.[37] The 10th five-year plan for Kirovabad describes "organization of the processing of imported bauxite" as the principal task, and set an alumina goal of 800,000 tons for 1980, of which half would be alunite-based and half would use bauxite.[38] A storage facility for imported Guinean bauxite was completed in February 1976 at Kirovabad. The bauxite-based alumina operation, due to start in 1977, will supply alumina to the Regar aluminum plant.[39]

III. Other Potential Aluminum Sources

Aside from the commercial use of bauxite, nepheline and alunite, the Soviet Union has at various times raised the prospects of employing other aluminum-bearing materials, some of which have been tested and have even reached the pilot-plant stage. However none is now scheduled in published plans for commercial use.

A. Kyanite

This aluminum silicate is present in large deposits in the Keyv (Keiv) upland of the central Kola Peninsula, far from settlement and transportation. More than 20 deposits have been identified in the area, and the Kola branch of the Academy of Sciences of the USSR has recommended the use of kyanite concentrate for direct electrothermal reduction to aluminum-silicon alloys. The Shuurta deposit, in the heart of the peninsula, has been recommended as a priority site for development.[40]

B. Sillimanite

This mineral, of the same type as kyanite, is found in a deposit at Kyakhta in southern Siberia on the Mongolian border, and was envis-

[34] Bakinskiy Rabochiy (Aug. 12, 1975).

[35] Bakinskiy Rabochiy (Dec. 15, 1973). The start of operations at the sulfuric acid department is evident from announced production figures for the Azerbaijan republic, where another acid plant, at Sumgait, was already producing about 130,000 tonnes a year. The republic's output rose from 132,000 tonnes in 1972 to 291,000 in 1973, 337,000 in 1974, and 378,000 in 1975. The increment represents mainly Kirovabad production.

[36] Bakinskiy Rabochiy (Sept. 30, 1975). This source states that alumina and potassium sulfate production doubled from 1970 to 1974 while sulfuric acid output increased by a factor of 14.

[37] Bakinskiy Rabochiy (Dec. 28, 1974).

[38] Bakinskiy Rabochiy (Jan. 30, 1976). The five-year plan calls for a nearly four fold increase in alumina production by 1980 (to 330 percent of the 1975 level), suggesting a goal of about 800,000 tonnes. But the two by-products of the alunite process are scheduled only to double in production—sulfuric acid to increase by 90 percent and potassium sulfate by 120 percent. This suggests a doubling of alunite-based alumina, to the original designed capacity of about 400,000 tonnes, leaving another 400,000 tonnes of alumina to be derived from imported bauxite (representing an annual requirement of about 800,000 tonnes of bauxite by 1980).

[39] Bakinskiy Rabochiy (Feb. 18, 1976).

[40] Granik (op. cit.), pp. 85–86; Tsvetnyye Metally (March 1968), pp. 44–46.

aged in the late 1950's as a raw material for the Irkutsk aluminum plant at Shelekhov. Sillimanite concentrate was obtained from an experimental concentrator in 1959, for use in an electrothermal department that opened at the Irkutsk aluminum plant in late 1960.[41] However the use of Kyakhta sillimanite did not appear to go beyond that pilot stage, and the Irkutsk plant, whose first electrolytic potline went on stream in 1962, has been using long-haul alumina from the Urals, Pavlodar and Achinsk.

C. Kaolin clay

This clay is present in the overburden of the lignite strip mine of Angren, east of Tashkent in Central Asia, and a lime-sinter process was proposed in the 1950's to convert the kaolin into alumina, with cement as a byproduct.[42] A pilot plant testing the process began operating in 1968–69 at Almalyk, 30 miles west of Angren.[43] The pilot phase was completed in 1972, with what were described as positive results justifying the clay-to-alumina conversion on a commercial basis.[44] Advocates of the process have urged implementation, proposing a complex with a capacity of 1 x 10^6 tons of alumina and 6 x 10^6 tons of cement,[45] but such a project has yet to be approved by the Soviet planning authorities. Angren kaolin was originally envisaged as a potential source of alumina for the Regar aluminum plant, which went on stream in 1975, presumably using imported alumina.

IV. Raw-Material Imports

The Soviet Union began importing Hungarian bauxite in the early postwar years. The ore moved by rail over a distance of nearly 2,500 miles to the Urals alumina plants, reaching a peak of 560,000 tons in 1950, or about one-fourth of the Soviet Union's total bauxite supply. Hungary also provided up to about 40,000 tons of alumina for the Ukraine's Zaporozh'ye aluminum plant, where metal production resumed in 1949, but the alumina section was not rebuilt until 1955.[46] Both bauxite and alumina shipments ceased in 1955 as Hungary used increasing amounts of raw materials for a domestic alumina and aluminum industry, supplying most of the surplus to East Germany and Czechoslovakia, where aluminum industries were also developing. Beginning in 1955, Greece replaced Hungary as the Soviet Union's bauxite supplier,[47] with average annual shipments of 450,000 tons in the 1960's rising to an average of 550,000 tons in the 1970's. Most of the Greek bauxite was converted into alumina at Zaporozh'ye for use in the local reduction plant and in the Transcaucasian aluminum plants at Sumgait and Yerevan.

As the expanding aluminum industry made increasing demands on the Soviet raw-material base, the import program was significantly expanded in the 1960's. In addition to Greek bauxite, ore shipments

[41] Sovetskaya Rossiya (Aug. 19, 1959) ; Promyshlenno-Ekonomicheskaya Gazeta (Mar. 16, 1960) ; Izvestiya (Dec. 31, 1960).
[42] Pravda Vostoka (Tashkent newspaper; Mar. 19, 1960; Dec. 24, 1960; Apr. 1, 1965).
[43] Pravda Vostoka (Jan. 7, 1968; Dec. 2, 1969; Jan. 20, 1970).
[44] Proizvoditel'nyye sily Uzbekistana i perspektivy ikh razvitiya/Productive Forces of Uzbekistan and Prospects of Development/(Tashkent, Fan, 1974), pp. 185–186.
[45] Pravda Vostoka (Jan. 14, 1976). Two sites for such an alumina complex have been proposed: Angren itself, or Akhangaran, a town just north of Almalyk where a cement plant with a capacity of 1.5 x 10^6 tons was inaugurated in 1961.
[46] Shabad, The Soviet Aluminum Industry (op. cit.), pp. 9–10.
[47] Shabad, Soviet Aluminum Developments in 1959 (op cit,), pp. 6–7.

began arriving in 1965 from Yugoslavia, which soon surpassed Greece as the principal supplier; in 1968 from Guinea, and in 1971 from Turkey. In 1975, the Soviet Union imported 3.5 x 10^6 tons of bauxite, or the equivalent of 800,000 tons of aluminum, with one-half coming from Guinea (table 2).

Beginning in 1967, as alumina capacity did not keep pace with aluminum capacity increases in Siberia, the Soviet Union also turned increasingly to alumina imports. Under an agreement with Hungary, the Hungarians began in 1967 to ship alumina to the Volgograd aluminum plant (which had first used Urals alumina after its completion in 1959) and took aluminum meal in return under a barter arrangement. By the mid-1970's, the Soviet Union was receiving an average of 330,000 tons of Hungarian alumina, and exporting over 100,000 tons of aluminum metal to Hungary. Another long-term source of alumina for the Soviet Union has been the United States (beginning in 1967), and shipments from Jamaica, Guyana, Turkey and Italy started in 1973. By the mid-1970's the Soviet Union was importing an average of 900,000 tons of alumina, the equivalent of 450,000 tons of aluminum metal (table 3). Combined raw material imports thus represented over 1 x 10^6 tons of aluminum production, or 40 percent of Soviet output. This represented a significant increase in the role of imports over the last decade. In 1965 the Soviet Union derived about 150,000 tons of aluminum from imported materials, or 15 percent of total production.

Table 4, which reconstructs the raw-material balance of the Soviet aluminum industry, shows that the contribution of the domestic bauxite-mining industry—essentially the Urals and the Arkalyk area of northwest Kazakhstan—has been steadily declining, from 70 percent in 1965 to about 50 percent in 1970 and 37 percent in 1975. In the five-year period from 1965 to 1970, the principal increment was provided by a steep surge in imports, which rose from 15 percent of the total raw-material supply to 40 percent. During the five-year period from 1970 to 1975, as the new nephelite-based alumina plant at Achinsky came on stream, nonbauxitic materials provided the principal increment, rising from 12 percent of the total raw-material supply in 1970 to 23 percent in 1975.

V. Outlook for the Future

Recent statements in the Soviet press suggest a general disenchantment with nonbauxitic domestic raw materials, both on technological and economic grounds. Having completed the two principal nonbauxitic projects—Achinsk nepheline and Kirovabad alunite—that had been designed in the late 1950's, the Soviet aluminum planners now appear to be turning increasing to imported raw materials as a source for future expansion of the industry.

In addition to the planned bauxite-based expansion of the Kirovabad alumina plant, a new alumina plant is under construction on the Black Sea coast of the Ukraine. This plant, with an estimated capacity of 1 x 10^6 tons, is situated at Zhovtnevove, a southern suburb of Nikolayev.[48] It will process Guinean bauxite from the 2.5 x 10^6 tons mining operation at Debele (near Kindia) that was developed with Soviet credits, to be repaid in bauxite.[49] Nikolayev alumina is to be hauled

[48] Pravda Ukrainy (Dec. 28, 1973) ; Pravda (Sept. 29, 1975).
[49] Vneshnyaya Torgovlya (June 1975), p. 15.

by railway over a distance of nearly 3,000 miles to the Sayanogorsk aluminum plant, with an estimated capacity of 500,000 tons. The Sayanogorsk plant is scheduled to go into operation in conjunction with the adjacent Sayan hydroelectric station, now scheduled for first power production in 1978.[50]

Soviet planners have also recommended the construction of a second seaboard alumina plant on the Pacific coast. This plant, which would be built in the 1980's, would have a capacity of 1.1 x 10^6 tons of alumina and would be located at a site yet to be determined in the Maritime Territory of the Soviet Far East. It would process imported bauxite, possibly from Australia, and ship its alumina to the aluminum plants of southern Siberia. The long-term Soviet intention is to re-export aluminum metal to countries in the Pacific basin.[51] Such an operation would be greatly facilitated by the construction of the 2,000-mile Baykal-Amur Mainline railway, to be completed in the early 1980's. This new railway, running parallel to, and to the north of, the present Trans-Siberian Railway, is designed mainly to open up new Siberian resource sites for export through Pacific ports. Much of the traffic on the BAM railway would thus be eastbound, making it particularly suitable to haul large volumes of alumina from the coast westward to the Siberian reduction plants. Over the long run, the growing hydroelectric complex of southern Siberia may well become one of the world's leading aluminum reduction centers of the world, importing raw material and re-exporting metal.

TABLE 1.—PRINCIPAL ALUMINUM-PRODUCING COUNTRIES

[In 10^3 tons]

	1965	1970	1974
United States	2,499	3,607	4,448
Soviet Union	1,000	1,700	2,150
Japan	294	733	1,124
Canada	753	962	910
West Germany	234	309	689
Norway	276	522	652
France	340	381	394
China	115	220	320
United Kingdom	36	40	294
Italy	124	146	223
Australia	88	168	208

Source: Central Intelligence Agency. "Handbook of Economic Statistics 1975." Publication A (ER) 75-65, August 1975, p. 95.

TABLE 2.—BAUXITE IMPORTS OF THE SOVIET UNION

[In 10^3 tons]

	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
Greece	449	481	427	430	457	529	615	526	441	635	503	611
Yugoslavia		124	360	647	721	827	814	600	794	690	664	947
Turkey								76	152	148	203	75
Guinea					55	44	119	211	328		253	1,844
Total	449	605	787	1,077	1,233	1,400	1,548	1,413	1,714	1,473	1,623	3,477

Sources: "Vneshnyaya torgovlya SSSR" (Foreign Trade of the USSR), statistical yearbook, Moscow, 1965 through 1976. Note: A substantial portion of the increased imports from Guinea in 1975 was stockpiled pending completion of additional processing capacity at Kirovabad and ultimately at Nikolayev.

[50] Sovetskaya Rossiya (Aug. 18, 1975; Feb. 3, 1976).
[51] Ekonomicheskaya Gazeta (1975, No. 5), p. 13.

TABLE 3.—ALUMINA IMPORTS OF THE SOVIET UNION

[In 10^6 tons]

	1967	1968	1969	1970	1971	1972	1973	1974	1975
Hungary	89	148	169	202	161	244	345	323	405
Greece	22	28	38						
United States	53	194	354	291	447	243	206	85	114
Jamaica					20		79	143	169
Trinidad						160			
France		18	29						
Guinea			5						
Yugoslavia	3								
Guyana							134	82	121
Turkey							62	127	38
Italy							26	51	76
India									47
Others				25	127	51	51	75	59
Total	168	388	596	518	755	698	903	886	1,029

Sources: "Vneshnyaya torgovlya SSSR" (Foreign Trade of the USSR), statistical yearbook, Moscow, 1965 through 1976.

Note: Some columns do not add up because of rounding.

TABLE 4.—RAW MATERIAL BALANCE OF THE SOVIET ALUMINUM INDUSTRY

[In alumina equivalent of 10^6 tons]

	1965	Percent	1970	Percent	1975	Percen
Domestic materials	1.7	85	2.1	62	2.9	60
Bauxite	1.4	70	1.7	50	1.8	37
Nepheline [12]	.3	15	.3	9	.9	19
Alunite			.1	3	.2	4
Imported materials	.3	15	1.3	38	1.9	40
Bauxite	.3	15	.8	23	[1] 1.9	19
Alumina			.5	15	1.0	21
Total alumina equivalent	2.0	100	3.4	100	4.8	100
Total aluminum	1.0		1.7		2.4	

[1] Actual bauxite imports in 1975 were 1.7×10^6 tons in alumina equivalent, of which about one-half is believed to have been stockpiled pending completion of new alumina capacity at Kirovabad and ultimately at Nikolayev.

Source: Author's calculations.

Part III. FOREIGN ECONOMIC ACTIVITIES

U.S.S.R. FOREIGN TRADE: A GREATER ROLE FOR TRADE WITH THE WEST

JACK BROUGHER

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I. Introduction

During 1971–75 U.S.S.R. foreign economic relations entered a "qualitatively new stage," in the words of Foreign Trade Minister Nikolai Patolichev.[1] The most spectacular developments have come in trade with the West, which now accounts for more than 31 percent of Soviet trade. While U.S.S.R. trade with the world during 1971–75 more than doubled, trade with the developed countries of the West increased more than three times. (See Figure 1.) Commerce with individual Western countries such as the United States, Japan and West Germany has reached rather substantial levels.

In the years since the 24th U.S.S.R. Communist Party Congress in 1971 the Soviet leadership has increasingly come to believe that foreign trade can play an important role both in U.S.S.R. economic development and Soviet participation in world affairs. Whereas Party General Secretary Brezhnev in his report to the 1971 Congress referred to foreign trade as a "big reserve" for Soviet economic development,[2] in 1976 he told the 25th Party Congress that the development of Soviet foreign economic relations now ranks among "central economic problems." [3]

The increasing importance of trade is perhaps most visible in the Soviet Far East, where a number of projects in cooperation with the Japanese are speeding development. Massive amounts of equipment are also being imported from the United States, Western Europe, Japan, and Eastern Europe for the Kama Truck Plant, which is to be the world's largest, and for the construction of pipelines and a number of fertilizer plants. As the U.S.S.R. economy finds itself in a stage where growth must be based to an ever greater extent on higher labor productivity and improved application of advances in science and technology, the Soviet Union is increasingly turning to trade, particularly with the West, as one source of the machinery and technology it needs.

Both Brezhnev and Council of Ministers Chairman Kosygin made it clear at the 25th Party Congress that the U.S.S.R. plans to step up its participation in international economic affairs over the long term. As regards trade with the West, Brezhnev asserted that "economic and scientific-technical ties with the capitalist states strengthen and broaden the material basis of the policy of peaceful coexistence." [4] He also emphasized that the Soviet Union could not stand aside from the resolution of important economically-related international matters such as the availability of natural and energy resources, exploitation of the resources of the seas, protection of the environment, and mastery of outer space.

Pleased with the rapid pace of foreign trade expansion since 1972, the Soviet leadership is becoming increasingly concerned with raising the "effectiveness" of U.S.S.R. participation in an international division of labor. The Soviets believe that through effective trade, particularly with the West, the Soviet economy can take advantage of the

[1] N. S. Patolichev—interview, "Glavnaia tsel'—blagosostoianie liudei, Ministr vneshnei torgovli S.S.S.R. N. S. Patolichev otvechaet na voprosy Izvestii," Izvestiia, Feb. 18, 1976.
[2] Materialy XXIV S"ezda KPSS (Moscow, Politicheskaia Literatura, 1974), p. 61.
[3] L. I. Brezhnev, "Otchet tsentral'nogo komiteta KPSS i ocherednye zadachi partii v oblasti vnutrennei i vneshnei politiki, doklad General'nogo sekretaria TsK KPSS tovarishcha L. I. Brezhneva, 24 fevralia 1976 goda," Ekonomicheskaia gazeta, No. 9, February 1976, p. 11.
[4] Ibid., p. 11.

benefits of international industrial specialization and transfer of technology. A number of new departures have accompanied the recent dramatic growth of trade, but much progress remains to be made in perfecting the Soviet foreign trade system, particularly if the rapid pace of growth of trade with the West is to be maintained.

In 1975 the U.S.S.R. sustained a large hard currency trade deficit with the West and is expected to do so again in 1976. If the Soviets are to increase or even maintain their purchases in the West, as they clearly feel it is advantageous to do, they will have to significantly increase sales. Furthermore, the Soviets have become convinced that they will be at a disadvantage until they succeed in exporting substantial amounts of machinery and equipment to these countries, in addition to the raw materials which now make up the bulk of U.S.S.R. exports. But thus far little sucess has been achieved, despite calls to raise the quality and competitiveness of Soviet manufactured goods produced for export. Some success has been achieved in gaining access to Western technolgy by working out new forms of cooperation with foreign firms, especially compensation agreements and scientific-technical cooperation agreements.

Under a compensation agreement the Soviets purchase on credit equipment and services for the construction of industrial facilities in the U.S.S.R. and later pay off the loans through long-term delivery of products, which are often produced at the new facility. The scientific-technical cooperation agreements concluded with foreign firms are intended to bring about exhange of information and cooperation in research that could in some cases lead to cooperation in production. More than twenty-five compensation agreements and over one-hundred and seventy scientific-technical agreements have been signed with Western firms. Much progress, however, remains to be made in increasing their utility for both the Soviets and the Western firms.

Soviet purchases of Western machinery and equipment are traditionally allocated primarily for priority projects and industries. At least one prominent Soviet observer [5] has asserted that if the U.S.S.R. economy is to take more advantage of an international division of labor, foreign purchases should be oriented not so much to satisfying current needs as to raising productivity and quality throughout the economy in the long run. In a related matter, Soviet plans for 1976–80 economic development repeat a call made by Kosygin in 1971 to increase the role and responsibility of industrial ministries in foreign trade. In fact, industrial ministries and their enterprises have begun taking a more active part, particularly in purchasing. However, really effective measures to increase the number of industries significantly involved in importing and exporting and the number of domestic organizations playing a more direct role in foreign trade operations could face strong resistance from several sources. These include ideological purists, who will fear an erosion of centralized control, and the Ministry of Foreign Trade, which now has a predominant role.

This article will survey recent trends in U.S.S.R. foreign trade and examine some of the new developments, particularly as regards trade with the West.

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[5] O. Bogomolov, "Trebovanie zhnizni, vneshneekonomicheskie sviazi: puti razvitiia i sovershenstvovaniia," Izvestiia, Feb. 26, 1974.

II. U.S.S.R. Trade Highlights and Trends, 1971–75

By 1975 U.S.S.R. foreign trade had reached 50.7 billion rubles (about $70.5 billion), more than double the level of 1970. (See table 1.) Rapid growth really began in 1973 and has continued through 1975. (See figure 1.) Imports from Western countries showed the most dramatic expansion and by 1975 made up over one-third of total Soviet imports. The growth of imports from the West outstripped exports to these countries by unprecedented margins, and as a result the U.S.S.R. sustained large hard currency trade deficits in 1975 and first quarter 1976.

The rise in importance of trade with the West has been accompanied by a decline in the share of trade with socialist countries, 56.3 percent of U.S.S.R. trade in 1975, compared to 65.4 in 1971. (See table 2.) This decline reflected not only the increase in the volume of trade with the West but also the fact that prices in Soviet trade with the countries of the Council of Mutual Economic Assistance (CEMA)[6] were largely insulated from the sharp inflation of prices on the world market that helped push up the value of imports and exports in Soviet trade with the West.

A. Hard Currency Trade

Over the three years of rapid growth 1973–75, Soviet imports grew 101 percent, while exports grew 89 percent, and in 1975 the U.S.S.R. incurred a total trade deficit of 2.7 billion rubles. With both socialist and developing countries the Soviet Union showed a positive balance, but with Western countries it registered a trade deficit of 3.6 billion rubles. Commerce with most of the industrialized Western countries and with a number of developing countries is conducted in convertible currencies. In 1975 the Soviets sustained a hard currency trade deficit estimated at $6.3 billion. This follows estimated deficits of $900 million in 1974, $1.7 billion in 1973, and $1.4 billion in 1972. The largest deficit in 1975 came in trade with the United States—$1.6 billion—followed by a $1.5 billion deficit with the Federal Republic of Germany (U.S. and FRG statistics as reported by the IMF).

Following the sharp increases in 1973 and 1974 of world prices for the fuels and materials which make up a large portion of Soviet exports to the West, U.S.S.R. terms of trade in its hard currency commerce improved greatly. It appeared for awhile, therefore, that the Soviet Union would experience a large trade surplus with these countries. However, recession in the West caused a decline in the volume of some major Soviet exports to the West while imports of equipment from the West continued to grow steadily, from roughly $1.3 billion in 1972 to over $5 billion in 1975. At the same time continuing rapid inflation in the West caused the terms of trade to shift in the direction of machinery and equipment. The Soviets are financing their large 1975 deficit through non-trade revenues, reductions in foreign exchange holdings, gold sales, and drawings on Western credits. The 1976 deficit is also expected to be substantial. Whether the Soviet Union can finance this deficit without slowing trade with the West will depend on a number of factors, i.e., the grain harvest in 1976, success in exporting to the West, and availability of credits.

[6] Bulgaria, Hungary, German Democratic Republic, Cuba, Mongolia, Poland, Romania, and Czechoslovakia.

Soviet exports through 1975 continued to be dominated by fuels and industrial materials. (See table 3.) Exports of petroleum and petroleum products assumed even greater significance: 24.6 percent of Soviet exports in 1975, compared to 11.5 percent in 1970. Since 1972 oil export volume increased 21 percent, while revenue grew by 247 percent, as a result of sharp price jumps for oil and oil products in the West in 1973 and 1974. Beginning in 1975, higher prices for Soviet exports to CEMA countries as well contributed to the rise in revenue from sales of oil and oil products.

B. Socialist Trade

For political and economic reasons, the Soviets continue to do by far the largest part of their trade with socialist countries, particularly the members of CEMA. (See table 4.) The value share of trade with socialist countries in total U.S.S.R. trade declined from 1972 to 1974, but rose slightly in 1975 to 56.3 percent. As increases agreed on in 1975 bring CEMA prices up toward world market prices, the CEMA countries' share, and with it the overall socialist portion, of Soviet trade should recover somewhat. In fact, in 1975 the CEMA share alone increased 2.9 percentage points, raising the total Socialist share by 2.2 percent to 56.3 percent, even though Soviet trade with the West continued its fast climb.

At present three-fourths of Soviet exports of machinery, equipment and means of transport go to the socialist countries, and the latter in turn supply over two-thirds of Soviet imports of these items. The socialist countries also take large portions of Soviet exports of many fuels, industrial materials and consumer goods. By far the largest Soviet trading partner is the GDR, which in 1973, 1974 and 1975 supplied 24 percent, 22 percent, and 18 percent, respectively, of U.S.S.R. imports of machinery, equipment and means of transportation.

C. Developing Countries

Trade with the developing countries remains a rather small part of total U.S.S.R. foreign trade. (See table 2.) At the same time the Soviet Union has succeeded in sending a substantial portion of its exports of machinery, equipment and means of transportation to these countries in recent years: 21 percent, 17 percent and 18 percent in 1973, 1974, and 1975, respectively. The developing countries also are an important source of various materials such as tin, cotton fiber, rubber, and foodstuffs, including fruits.

D. Industrial West

As noted above, the last three years have witnessed a tremendous growth in Soviet trade with the West. While not explicitly scheduling such rapid growth, the foreign trade section of the 1971–75 Plan for Soviet economic development had provided that adjustments could be made to significantly enlarge trade with Western countries that showed increased "interest."

In regard to the United States, Kosygin had announced in 1971 that the Soviet Union did "not exclude" development of economic ties

that more fully corresponded to the economic potential of both countries.[7] According to U.S. figures, by 1975 Soviet imports from the United States had grown to $1.8 billion from $162 million in 1971. Soviet exports to the United States in 1975 were $278 million compared to $57 million in 1971. Of course, some of this growth has been due to inflation of prices of Soviet imports from and exports to the Western countries.

With the exception of the United States, Soviet trade with each of its principal Western trading partners has grown fairly evenly. In 1975 the United States ranked behind West Germany, Japan, and Finland. (See table 4.) In 1974 it ranked behind West Germany, Japan, Finland, Italy, France and the United Kingdom, whereas in 1973 it had been second only to West Germany. In 1971–72 it had been behind all the above countries. Trade with the United States has fluctuated sharply as a result of tremendous variation in Soviet purchases of U.S. grain. In 1973 and 1975, for example, agricultural products constituted 77 percent and 61 percent, respectively, of American exports to the U.S.S.R., while in 1974 they made up less than 50 percent.

Over the last several years the Soviet Union has steadily increased its imports of machinery and equipment from each of its major Western trading partners, including the United States. In 1975 machinery and equipment, including transportation facilities, accounted for 53 percent of U.S.S.R. imports from France, 53 percent from the FRG, 40 percent from Italy, and 35 percent from Japan. Soviet imports of machinery, equipment and means of transportation from West Germany have increased by more than five and three-quarters times since 1971. According to U.S. figures Soviet imports of American machinery and transport equipment have grown from $62 million in 1972 to $547 million in 1975.

In various high priority areas the Soviet Union is making a large portion of its purchases in the West. Well over half of its imports of chemicals and equipment for the chemical industry are coming from the West. In 1974 about three-fourths (by volume) of imports of pipe and more than three-fourths of rolled ferrous metals came from the West. In many fields in which production in other CEMA countries is well developed, the Soviet Union continues to make the majority of its purchases in those countries. For example, at least 98 percent of U.S.S.R. imports of railroad rolling stock and auxiliary equipment came from the GDR, Poland, and other socialist countries in 1972–74.

Due to recession in the West the volume of Soviet exports of various important hard currency earning commodities declined in 1974 and 1975. This decline occurred despite Soviet efforts to increase exports, as illustrated by the large rise in exports of oil and oil products in 1975. In several cases, the decline in exports continued a process which began in 1973. Round timber and sawn lumber exports dropped from 26.9 million cubic meters in 1973 to 26.1 in 1974 and 24.7 in 1975. Pig iron declined from 5.2 million metric tons in 1973 to 4.9 in 1974 to 4.7 in 1975. Aluminum and copper exports, which had risen in 1974, dropped in 1975: aluminum from 529 thousand metric tons to 502, and copper from 248 thousand metric tons to 206.

[7] Materially, op. cit., p. 184.

III. Growing Role of Foreign Trade in the U.S.S.R. Economy

As indicated by their pronouncements at the 25th Party Congress, Soviet leaders seem to have committed themselves to an increased role for foreign trade in the U.S.S.R.'s future economic development. Clearly, utilization of foreign equipment and technology can make possible today development of natural resources and industrial production facilities that would otherwise have to wait until later. Purchases abroad may at times also be necessary in order to minimize economic bottlenecks. For example, in 1972–73 and again in 1975–76 the U.S.S.R. chose to make massive, costly purchases of foreign grain, principally from the United States, to compensate for disastrous harvests and continue their ambitious livestock development program. Perhaps more importantly in the long run, however, the Soviets have concluded that their economy has entered an advanced stage where further development depends primarily on raising the quality, not quantity, of inputs into the economy. They have observed the stunning success of many countries, particularly Japan, in utilizing imported technology and in turn advancing it. The U.S.S.R. leadership evidently has concluded that the Soviet economy, too, at its stage of development could significantly benefit from a greatly increased level of participation in international trade.

The Soviets believe that importation of modern equipment and technology, particularly from the West, can be an efficient way of adding both production capacity for domestic needs and capacity for producing goods saleable on world markets. Minister of Foreign Trade Nikolai Patolichev has pointed out, for example, that expenditures on imports of equipment for the Volga Automobile Plant (VAZ), the massive plant built with extensive Fiat participation, have already been covered by earnings from the export of cars (called Lada for export purposes) produced at the plant.[8] Soviet exports of cars have increased from 85 thousand in 1970 to 296 thousand in 1975, mostly to the GDR, Czechoslovakia, Bulgaria, and Hungary. Exports in 1975 constituted about one-fourth of Soviet automobile production.

A. Resource Development

The contribution of trade to the U.S.S.R. economy is perhaps most clearly observable in Siberia and the Soviet Far East, where the Soviet Union is utilizing equipment purchased in the West, much of it on a long-term commodity payback or compensation basis, to accomplish a number of development projects which would otherwise have had to wait a number of years. By far the most important source of equipment for these projects is Japan, with whom cooperation, in the words of the U.S.S.R. Trade Representative in Japan, Victor Spandaryan, "allows the Soviet Union to accelerate the development of natural resources and the building of production capacities in the Far East and Siberia."[9] As Siberian development continues, facilitated by foreign trade, Soviet planners foresee significant expansion of trade between the Eastern part of the U.S.S.R. and the countries of the Pacific

[8] Patolichev, op. cit.
[9] Spandar'ian, "O razvitii sovetsko-iaponskikh ekonomicheskikh otnoshenii," Vneshniaia torgovlia, 4 (April) 1975, p. 16.

Basin. Enlargement of port facilities at Nakhodka and construction of a new port at Vostochny are evidence of Soviet intentions to build trade with the Pacific.

Since 1968 the Soviets and Japanese have signed a series of agreements extending credits to the U.S.S.R. for purchase of Japanese machinery and equipment, often with repayment in goods produced at the new facilities. Under the first agreement in 1968 Soviet purchases of $166 million in equipment and consumer goods were supported by Japanese Eximbank credits. The Soviets used the sale of the consumer goods in the U.S.S.R. to help finance local costs. Japanese firms received shipments of timber products during 1969–74. In 1974 a similar agreement, more than three times as large, was signed. A 1971 agreement supported construction of a wood chip plant, and deals for two pulp and paper plants are under discussion. A 1974 agreement is supporting development of coking coal deposits in Southern Yakutia, and a 1975 agreement provides for joint exploration for oil and gas along a portion of the continental shelf around Sakhalin Island. Purchase of Japanese machinery and equipment for development of Vostochny Port, near Nakhodka, has been supported by a 1970 agreement. The port will be capable of handling containerized cargo, coal, and wood chips, all of which are of interest to Japan.

In March 1976 financing was arranged in Japan and the United States in support of the completion of Soviet exploration and confirmation of reserves in Yakutia for a proposed trilateral Soviet-Japanese-American liquefied natural gas project. Under an agreement signed in November 1974, El Paso Natural Gas and Occidental Petroleum Corporation of the United States and the Siberian Natural Gas Company of Japan assisted in arranging financing and will help procure the necessary equipment and services. Commercial bank financing was obtained in the United States, while a combination of Eximbank and commercial credits was arranged in Japan. Prospects for development of reserves in the near future and shipment of gas to the United States and Japan are uncertain. It had been expected that this undertaking would require utilization of U.S. and Japanese government credit facilities. However, the Soviet Union has not been eligible for further participation in U.S. Government credit programs since passage of the Trade Act of 1974 and the Soviet decision in January 1975 not to comply with several provisions of the Act regarding freer emigration from the U.S.S.R. Even were the U.S.S.R. to become eligible, several provisions of the Export-Import Bank Amendments of 1974 that restrict the amounts of loans in general and for energy-related projects specifically would make significant Eximbank participation in energy projects with the Soviets unlikely.

A number of additional compensation projects for Siberian development are also being considered. Among them are an aluminum smelter at Sayanogorsk in Eastern Siberia, under discussion with French and American firms, and a copper smelter at Udokan, near the new Baikal-Amur Railroad now under construction.

The Soviets have puchased a large amount of equipment in the West for Siberian development projects and are likely to continue doing so. For example, in the last several years they have purchased U.S. heavy equipment for gold-mining north of Magadan, American-Canadian heavy dump trucks for surface coal mining in Southern Yakutia,

American oil and gas equipment for Western Siberia, oil refining and petro-chemical equipment from several Western countries for plants at Tomsk, Omsk and Tobolsk in Western Siberia, and various types of equipment for construction of a new second trans-Siberian railroad, the Baykal-Amur Mainline, from various Western countries, including well over $100 million in U.S. crawler tractors.

IV. Efforts To Improve the Effectiveness of Soviet Foreign Trade [10]

The question of the role and effectiveness of foreign trade in the Soviet economy has been under discussion in the U.S.S.R. for a number of years. Among the proponents of greater Soviet participation in an "international division of labor" Soviet Academician O. T. Bogomolov (Director of the Institute of the Economy of the World Socialist System) two years ago pointed up the need for new approaches to the theory and management of Soviet foreign trade.[11] These proposals appear to aim at nothing less than a major transformation of the concept of foreign trade from a subsidiary source for supplementing domestic production to an active force to improve the functioning of the Soviet economy using the criteria of comparative advantage.

Some of the specific steps Bogomolov proposed are:

1. The improvement of Soviet planning to (a) allow a better evaluation of the "effectiveness" of Soviet foreign trade and (b) to provide a basis for weighing the economic soundness of choices between imports and domestic production of goods.
2. Establishing a basis for relating Soviet domestic production costs to world prices.
3. Active and "profitable" participation in foreign trade by individual ministries and production associations.

There are no present indications that the Soviets are contemplating any sweeping changes in their approach to foreign trade, which, in Bogomolov's words, would require "greater efforts, a definite psychological reorientation and the working out of many theoretical and methological problems." For the time being at least it appears that the Soviets will more likely apply administrative and procedural remedies. Still, there are a number of areas where some new departures in the management and conduct of foreign trade are occurring or appear to be under consideration. Those given official blessing at the Party Congress include: (1) Tightening the coordination of the activities of all organizations involved with foreign trade to insure a balance of political and economic interests; (2) developing closer links between production and trade; (3) diversifying exports to the West; and (4) devising new forms of economic cooperation with Western firms.

A. Closer Coordination of Decisionmaking

At the 25th Party Congress a strong call was issued for greatly improved coordination and management of all decisions and activities affecting U.S.S.R. foreign economic relations. This is probably not

[10] Several points in this section were originally made in a presentation by Hertha W. Heiss before the Annual Meeting of the Washington Chapter of the American Association for the Advancement of Slavic Studies, Apr. 30, 1976.

[11] Bogomolov, op. cit.

unrelated to the dynamic development of Soviet trade with the Industrial West in the last few years, since it is this segment of Soviet foreign commerce that is most subject to both political and economic uncertainties. Brezhnev states: "In foreign economic relations politics and economics, diplomacy and commerce, industrial production and trade are woven together. Consequently, the approach to them and management of them must be integrated, tying into one knot the efforts of all departments, and our political and economic interests. This is precisely how the Party's Central Committee has posed this important question." [12]

This statement seems to foreshadow greater centralization of decisionmaking in the sphere of foreign economic relations. Involved are operations coming under the authority of various agencies: the Ministries of Foreign Affairs, Foreign Trade, Finance, Maritime Fleet, Civil Aviation, various industrial ministries, Gosplan, the State Committee for Science and Technology and others. The "narrow departmental approach" against which Brezhnev inveighed in 1971 apparently still persists.[13] The form the centralization may take has not been indicated and probably has not yet been decided.

At the Council of Ministers level, a Commission for Foreign Economic Questions under the Presidium deals with foreign trade policy. Up to now, however, its duties are believed to have been of an advisory nature. The formation of a body to perform the comprehensive oversight and management of foreign economic relations for which Brezhnev calls would almost certainly erode the primacy of the Ministry of Foreign Trade, at present the dominant organization.

B. Import Policy

Noting that Soviet import policy has emphasized the purchase of equipment for the industrial branches receiving emphasis in the five-year plans, Bogomolov has asserted that "rationalization" of Soviet imports is now a pressing matter. He has in mind the utilization of imports not so much for filling current needs as for raising labor productivity and quality of production throughout the whole economy. In this connection he asserts that work needs to be done on perfecting the planning of foreign trade and the evaluation of its effectiveness. Planning methods should be developed to enable calculation of whether the most beneficial and rapid development will be achieved by building domestic production of a product or increasing Soviet export capacity for the purpose of importing the product. So far it appears that planning calculations of this type have had little role in the actual planning of exports and imports.

The "Basic Directions for the Development of the National Economy of the U.S.S.R. 1976–80" and the speeches of Brezhnev and Kosygin at the Party Congress emphasize only that the role of trade in accelerating scientific-technical progress and resolving the chief national economic tasks should be enhanced. In recent years this has continued to mean the planning of massive imports for certain high priority projects, such as the giant Kama Truck Plant, the Baykal-Amur Railroad, steel plants for the Kursk Magnetic Anomaly, a series of gas pipelines, and a number of fertilizer and other chemical plants.

[12] Brezhnev, op. cit., p. 11.
[13] *Materially*, op. cit., p. 61.

In his summary of 1975 U.S.S.R. foreign trade the head of the Planning-Economic Administration of the Ministry of Foreign Trade, Vasily Klochek, notes that the U.S.S.R. "continued to successfully utilize the advantages of the international division of labor," buying abroad technically advanced equipment and licenses for the accelerated development of various branches of the economy and increasing the pace of technical progress.[14] The ferrous and non-ferrous metallurgy, chemical and petrochemical, gas, pulp and paper, textile and food industries received the largest volumes of imported equipment in 1975.

C. Managing Dependence

Opening up the Soviet economy to the benefits of trade, including the utilization of significant amounts of equipment from abroad in various branches rather than attempting to produce everything domestically, would involve the possibility of developing a degree of dependence on foreign goods. As mentioned previously, Bogomolov seems to presume that there is advantage in relying on foreign goods in various areas, when he cites the need for new methods of evaluating the effectiveness of importing or developing domestic production in a given area. Brezhnev's summary of the advantages of foreign trade at the 25th Party Congress, however, seems rather carefully formulated to avoid any impression of anything approaching Soviet economic dependence on foreign goods: "We, like other nations, strive to utilize the advantages provided by foreign economic ties for the purpose of mobilizing additional possibilities for the successful solution of economic tasks and gaining time, and for increasing the effectiveness of production and accelerating the progress of science and technology."[15]

Soviet sensitivity to assertions in the Western media that the U.S.S.R. cannot get along without aid from the West was reflected in a statement by N. I. Inozemtsev, Deputy Chairman of Gosplan for foreign trade planning, that appeared in Business Week: "Indeed, we can tackle any problem ourselves. They say we are extremely interested in Western technology. There is some interest but it does not mean we are unable to solve the problem by our own efforts. It would just cost more."[16]

D. Closer Links Between Production and Trade

Some limited progress has been made over the last few years in coupling production and trade activities, a measure advocated 10 years ago by Kosygin at the 23rd Party Congress and again by Brezhnev at the 24th Congress as a means of raising foreign trade effectiveness. The 1971 24th Party Congress directives for economic development 1971–75 called for greater initiative and responsibility for industrial ministries and enterprises in the conduct of foreign trade and the 1976–80 Plan repeated the call. A number of ministries have set up special departments, called zagranpostavki, to handle their planning of exports and imports and to supervise the delivery of goods for export. Contacts between industry officials and foreign firms have increased considerably as more and more industrial ministry delegations travel abroad to

[14] V. Klochek, "Vneshniaia torgovlia SSSR na rubezhe desiatoi piatiletki," Vneshniaia torgovlia, 5 (May) 1976, p. 7.
[15] Brezhnev, op. cit., p. 11.
[16] Apr. 7, 1975, p. 49.

observe foreign manufacturing facilities and host visiting businessmen in the U.S.S.R. Where particularly large purchases of machinery and equipment are concerned, officials of the end user ministry often conduct the technical negotiations with foreign firms and then turn negotiations of commercial matters over to the appropriate foreign trade organization.

In 1973 several measures for industrial reorganization were announced that many eventually facilitate more direct participation in foreign trade by industrial ministries and groups of enterprises underneath them. Ministry main production administrations which were in charge of all plants of a certain type are being eliminated and replaced with smaller "industrial" and "production" associations of enterprises. The new associations are to take on some of the responsibilities heretofore carried by the central ministry administrations.

As regards foreign trade, for example, the associations are responsible for reviewing applications by member factories for the purchase of foreign goods and for seeing that goods to be produced for export are delivered for shipment abroad as ordered. Since transition to the new system is still far from complete, it is difficult to judge what effect it will have on participation by production entities in foreign trade. More direct access by plants and groups of plants to imports and direct responsibility in deciding what to produce for export might help raise their interest in trade. But there seems little likelihood that production entities will get direct access to foreign markets in the foreseeable future, for this would seem to involve giving up many of the advantages the Soviets believe they now get through highly centralized planning and conduct of foreign trade.

E. Diversifying Exports

At the Party Congress Brezhnev called for increasing "in earnest" the role of manufactured goods in exports to the West. However, in its trade generally, not only with the West, the Soviet Union remains and is likely to remain for some time primarily an importer of machinery, equipment and foodstuffs and an exporter of fuels and raw and semiprocessed materials. (See table 3). The Soviets have achieved some success in boosting exports of manufactured goods to socialist and developing nations. But fuels and raw materials still dominate Soviet exports, particularly to the West. For example, oil and oil products in 1975 accounted for over one-half of U.S.S.R. exports to West Germany and almost two-fifths of those to France. Round timber made up more than one-third of Soviet exports to Japan. The compensation agreements now underway with Western countries and with the communist countries of Eastern Europe have thus far tended to reinforce the traditional Soviet role as importer of machinery and technology and exporter of fuels and materials. They are providing for increased shipments of machinery and equipment to the Soviet Union and will result in substantial increases in Soviet exports of fuels and materials.

Soviet goods are not filling the demands of the world markets in terms of variety, quality and competitiveness, as Brezhnev and Kosygin recently acknowledged at the Party Congress. The Soviets are hoping that goods produced with high quality imported equipment

will be more readily saleable abroad. Many Ladas produced at the plant built in cooperation with Fiat, for example, are already being exported. But it must be noted that relatively few Soviet-made autos are being sold in Western countries. If the Soviets are successful, as Brezhnev hopes, and are able to arrange compensation deals involving manufacturing plants, this could result in some exports of manufactured goods to the West, with marketing left up to the Western firms taking the goods in payment.

A suggestion by Kosygin illustrates one problem that arises in adapting the centrally planned and administered Soviet economy to the requirements of foreign trade. It could conceivably improve Soviet export production but at the same time eliminate a few of the benefits trade can bring. Kosygin proposed that a number of special enterprises be organized to produce for foreign markets. If this approach were successful in producing goods readily marketable on world markets, it would be of great aid to Soviet trade by helping to produce the revenue necessary to pay for imports of machinery and equipment, particularly from the West. Plants operated under this approach would have the advantage of specializing in the production of a particular line of products and could be expected to achieve a significantly higher quality of production.

Soviet observers have noticed that at present production of goods for export is widely dispersed through the Soviet economy. Soviet machinery destined for export is produced at plants that do not even specialize in the output of the given type of machinery. Output of one type of machine for export is assignd to diverse enterprises.[17] By concentrating production of some exports, Kosygin's proposal, if implemented, could also be expected to raise the effectiveness of several measures now being used to stimulate production of exports. One of these incentive mechanisms rewards an enterprise for producing for export by providing for additions to wholesale prices of goods that are to be sold abroad. Another provides for bonuses for workers as a reward for high quality and timely production of goods for export. Under the third measure an enterprise receives the right to spend for imports part of the currency earned by the export of goods it has produced. Presently, production for export in many enterprises represents too small a proportion of their total output, often no greater than 5–6 percent, for such stimulants to be very effective.[18]

Ultimately, however, Kosygin's suggestion could reduce the overall benefits to be derived from Soviet participation in the international division of labor by tending to isolate the U.S.S.R. economy from the stimulation of export competition, which under Kosygin's suggestion would be limited to the special export production facilities. For believers in the potential effectiveness of foreign trade in accelerating scientific-technical progress throughout the Soviet economy, such as Bogomolov, an increasing ability to export is a "certain indicator" of the maturity of an industry.[19] Deputy Foreign Trade Minister Smelyakov puts it most strongly when he says, "If machinery is not suitable for export, if they don't buy it on the world market, it is not necessary

[17] F. Levshin, "Mashinostroenie i eksport," Ekonomicheskaia gazeta, N° 46, November 1975.
[18] Ibid.
[19] Bogomolov, op. cit.

for us." [20] Ideally, competition in an industry to produce goods saleable on world markets should stimulate advances in quality throughout the industry and as a result benefit domestic as well as foreign consumers.

F. New Trade Forms: Compensation Agreements and Industrial Cooperation

Over the last several years the U.S.S.R. has been trying to work out new forms of commerce with the West that increase its access to financial credits and facilitate close scientific-technical and production cooperation with Western firms. Brezhnev has flagged this as a major task. At the Party Congress he called for the "development of new forms of foreign economic relations that go beyond the limits of usual trade, greatly expand our possibilities, and provide, as a rule, the greatest effect." [21]

It appears that the Soviets will continue to reject any form of foreign ownership in the U.S.S.R., even in connection with some form of industrial cooperation. By "new forms" Brezhnev has in mind compensation agreements, under which in cooperation with foreign firms new industrial facilities are created which belong completely to the Soviet state.

Since 1968 the Sovit Union has signed more than 25 compensation agreements with Western firms in the chemical, forestry, natural gas and other industrial areas. One of the largest is the approximately $20 billion fertilizer exchange deal with Occidental Petroleum of the United States that also includes construction of four ammonia plants, a pipeline, and port facilities in the U.S.S.R., development of U.S. phosphate deposits and construction of tankers to transport the fertilizer. There are also more than ten compensation arrangements with members of CEMA.

In the East-West context compensation agreements represent a device to create additional sources of hard currency earnings, and gain long-term access to Western technological and managerial know-how and to Western marketing channels and techniques. In Soviet practice a compensation arrangement is a set of transactions involving mutual, but not simultaneous, deliveries of goods, usually of equal value and usually over an extended period of time. Credit is usually arranged by the Western partners for U.S.S.R. purchases of equipment, technology and know-how. The credit is then repaid over a long-term period using hard currency earned by Soviet delivery of goods, which often are produced at the newly created facility.

Up to this point compensation arrangements have for the most part created facilities for the production of raw and semi-processed materials, but Brezhnev asserts that it is time to search for methods of cooperating with Western firms by concluding compensation deals in manufacturing industries. Soviet foreign trade officials have been stressing the key role compensation deals are to play in the future. Deputy Foreign Trade Minister Vladimir Sushkov, for example, recently predicted that compensation arrangements may generate as

[20] N. Smeliakov, "Delovye vstrechi," Novyi mir, December 1973, pp. 209, 210.
[21] Brezhnev, op. cit., p. 11.

much as 38% of Soviet-American trade over the 1976–80 period. The Occidental Petroleum-U.S.S.R. fertilizer deal mentioned above will play the biggest role.

In an effort to obtain more access to Western technology the Soviets have also continued efforts to conclude science and technology agreements with Western firms. Over 170 of such agreements are now in existence, of which over 50 are with American firms. These agreements typically call for exchanges of visits and information, as well as joint research and development in particular fields. In many cases the agreements have so far had little practical results. As a step to expedite actual cooperation programs, the Soviets are now encouraging firms to sign protocols with the industrial ministeries concerned outlining some definite steps.

V. Conclusion

The Soviet leadership, convinced that trade can play an important role in U.S.S.R. economic development as well as in foreign affairs, will probably try to maintain a rapid pace of foreign trade growth, particularly with the West. In addition to political imponderables, however, there are economic factors that somewhat cloud the outlook for continued rapid growth of Soviet trade with the West. Large hard currency trade deficits are limiting Soviet ability to buy for cash all but top priority foreign goods. Other uncertainties involve Soviet agricultural performance, Western demand for Soviet exports, the impact of Western inflation on the purchasing power of available Soviet foreign exchange, and the need to strike a balance among Soviet domestic requirements, CEMA needs and the supply of goods to export for hard currency.

Because of these problems it seems unlikely that Soviet East-West trade in the years 1976–80 can equal the extraordinarily high growth rates achieved during 1973–75. These uncertainties about the East-West trade component may account in part for the surprisingly low overall foreign trade target set for the current Five-Year Plan—30 to 35 percent. Although nearly identical to the ninth Five-Year Plan goal, this range is less than half that of the actual growth rate for 1971–75.

At the same time, there is every reason to expect further substantial growth. For example, during the past three years the U.S.S.R. has ordered machinery, equipment, large diameter pipe and construction materials and services from Western Europe and Japan adding to over $13 billion. Major Soviet new projects such as the Orenburg gas pipeline will continue to generate orders for Western equipment. Deliveries of raw and processed materials already contracted for under compensation agreements with Western firms will begin augmenting Soviet hard currency export flows. Over the years 1976–80 Soviet deliveries under compensation agreements should earn $4–5 billion, which in large part will be used to pay for earlier deliveries of Western equipment.

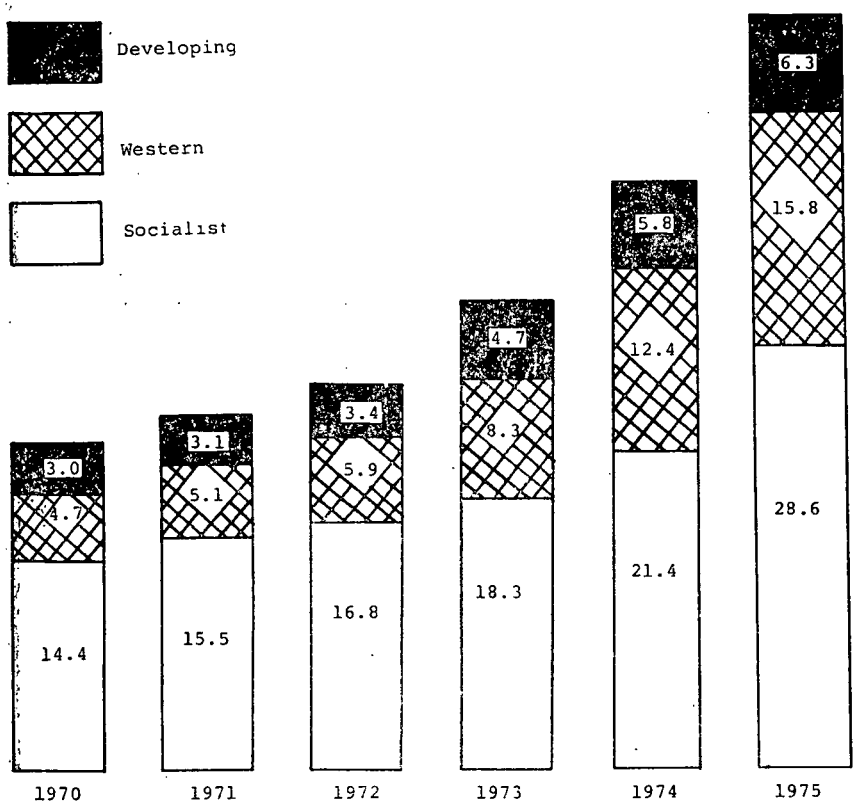
The U.S.S.R.'s major Western European trading partners, Japan and Canada have extended to the Soviet Union over $11 billion in government-backed credits since mid-1974 and half of these are not tied to specific projects. In addition, the Soviets directly and indirectly

have obtained Eurocurrency loans and credits from commercial sources. For example, for the Orenburg Project alone the Soviets have obtained a total of almost $1 billion in Eurodollar loans through the CEMA International Investment Bank.

It would appear, barring a series of poor grain harvests, that these existing contracts and outstanding credit commitments will provide a solid base for substantial Soviet trade with the West during the current five year period.

Figure 1

U.S.S.R. Foreign Trade Turnover 1970-75
(billions of rubles)



Source: Table 1

TABLE 1.—U.S.S.R. FOREIGN TRADE 1970–75

[In billions of rubles]

	1970	1971	1972	1973	1974	1975
Total:						
Exports	11.5	12.4	12.7	15.8	20.7	24.0
Imports	10.6	11.2	13.3	15.5	18.8	26.7
Turnover	22.1	23.7	26.0	31.3	39.6	50.7
Socialist countries:						
Exports	7.5	8.1	8.3	9.1	11.1	14.6
Imports	6.9	7.4	8.5	9.2	10.3	14.0
Turnover	14.4	15.5	16.8	18.3	21.4	28.6
Western countries:[1]						
Exports	2.2	2.5	2.4	3.7	6.3	6.1
Imports	2.5	2.6	3.4	4.6	6.1	9.7
Turnover	4.7	5.1	5.9	8.3	12.4	15.8
Developing countries:						
Exports	1.8	1.8	2.0	2.9	3.4	3.3
Imports	1.1	1.3	1.4	1.7	2.4	3.0
Turnover	3.0	3.1	3.4	4.7	5.8	6.3

[1] "Western" refers to the non-Communist industrially developed countries of the world.

Note: Figures may not add because of rounding.

Source: "Vneshniaia torgovlia SSSR za 1971 god, 1972 god, za 1973 god, za 1974 god, v 1975 g."

TABLE 2.—PROPORTION OF U.S.S.R. FOREIGN TRADE WITH SOCIALIST, WESTERN, AND DEVELOPING COUNTRIES

[In percent]

	1970	1971	1972	1973	1974	1975
Total	100.0	100.0	100.0	100.0	100.0	100.0
Socialist	65.2	65.4	64.5	58.5	54.1	56.3
CEMA	(55.6)	(56.2)	(59.6)	(54.0)	(48.9)	(51.8)
Western	21.3	21.5	22.6	26.6	31.3	31.3
Developing	13.5	13.1	12.9	14.9	14.6	12.4

Source: "Vneshniala torgovlia SSSR za 1971 god, 1973 god, v 1975 g."

TABLE 3.—SOVIET FOREIGN TRADE BY MAJOR COMMODITY GROUPS, 1970–75

[Percent distribution]

Commodity	1970	1971	1972	1973	1974	1975
Exports, total	100.0	100.0	100.0	100.0	100.0	100.0
Machinery and equipment	21.5	21.8	23.6	21.8	19.2	18.7
Fuels and electric energy	15.6	18.0	17.7	19.2	25.4	31.4
Ores, metals, concentrates, etc	19.6	18.7	19.0	17.1	14.7	14.3
Chemicals	3.5	3.4	3.3	3.0	3.6	3.5
Wood and wood products	6.5	6.3	6.1	6.4	6.9	5.7
Textile fibers and fabrics	3.4	3.3	3.8	3.3	3.3	2.9
Foodstuffs	8.4	9.2	5.9	5.6	7.1	4.8
Manufactured consumer goods	2.7	2.9	3.1	3.0	2.9	3.1
Other	18.8	16.4	17.5	20.6	16.9	15.6
Imports, total	100.0	100.0	100.0	100.0	100.0	100.0
Machinery and equipment	35.5	34.0	34.6	34.3	32.4	33.9
Fuels and electric energy	2.0	2.7	3.0	3.4	3.5	4.0
Ores, concentrates, metal etc	9.6	9.8	8.9	9.9	13.6	11.5
Chemicals	5.7	5.4	4.9	4.3	6.3	4.7
Wood and wood products	2.1	2.1	1.8	1.6	1.9	2.2
Textile fibers and fabrics	4.8	4.5	3.3	3.7	4.1	2.4
Foodstuffs	15.8	15.2	18.0	20.2	17.1	23.0
Manufactured consumer goods	18.3	20.1	18.6	15.9	14.6	13.0
Other	6.2	6.2	6.9	6.7	6.5	5.3

Source: "Vneshniaia torgovlia SSSR za 1970 god, za 1971 god, za 1972 god, za 1974 god, v 1975 g."

TABLE 4.—U.S.S.R. TRADE TURNOVER WITH SELECTED COUNTRIES 1970–75

[In millions of rubles]

	1970	1971	1972	1973	1974	1975
Western countries:						
Federal Republic of Germany	569	699	853	1,246	2,272	2,874
Japan	652	734	816	994	1,680	1,922
Finland	531	569	602	777	1,540	1,756
United States	161	184	538	1,161	742	1,600
Italy	472	495	464	614	1,137	1,427
France	413	476	544	722	941	1,297
United Kingdom	641	605	558	715	890	959
Socialist countries:						
Members of CEMA:						
Germain Democratic Republic	3,295	3,443	3,706	3,965	4,315	5,623
Poland	2,350	2,520	2,803	3,000	3,584	4,853
Bulgaria	1,817	2,069	2,345	2,555	2,904	3,991
Czechoslovakia	2,193	2,422	2,626	2,760	3,030	3,911
Hungary	1,480	1,661	1,882	2,064	2,282	3,274
Cuba	1,045	891	822	1,110	1,642	2,589
Romania	919	936	1,053	1,130	1,191	1,526
Mongolia	231	235	287	339	404	480
Others:						
Yugoslavia	520	548	569	671	1,240	1,558
North Korea	329	452	380	357	343	338
North Vietnam	183	161	117	180	236	207
People's Republic of China	42	139	211	201	214	201
Developing countries:						
Egypt	606	644	514	541	728	710
India	365	372	457	589	616	686
Iraq	64	105	152	332	453	596
Iran	231	239	230	277	496	510
Brazil	23	44	73	126	202	396

Note: Average U.S.S.R. ruble-dollar exchange rate was $1.11 per ruble in 1970 and 1971, $1.21 in 1972, $1.35 in 1973 $1.32 in 1974, and 1.39 in 1975.

Source: "Vneshniaia torgovlia za 1971 god, 1972 god, 1973 god, za 1974 god, v. 1975 g."

SOVIET FOREIGN TRADE PLANNING*

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I. INTRODUCTION

An analysis of foreign trade planning in the Soviet Union provides insight into a number of issues of current concern to U.S. policy makers. Some have argued, for example, that detente is essentially a Soviet tactic to extract economic and political concessions from the West, and that one should expect the Soviet Union sooner or later to return to a position of economic autarky and military confrontation.[1] Whether the Soviet opening to the West since 1970 reflects a longer-term trend toward increased interaction with the world economy or only a short-run cycle can best be decided by examining the evidence for fundamental changes in the system of planning which directs the economy. It should also be possible to determine how extensive such changes are, i.e. whether they extend beyond the central administrative core of Gosplan and the Council of Ministers to affect decision making by various branch ministries and enterprises.

A related issue concerns how far and how fast the Soviet Union may go in expanding foreign economic ties with both other CMEA countries and the developed capitalist West. The progress toward CMEA economic integration, in particular the success of current efforts to expand and promote joint planning, mutual multilateral trade, international economic organizations and agreements on cooperation and specialization, depends in large measure on the ability of the Soviet Union to involve its major economic sectors in such endeavors in an effective way. In trade with the West the foreign trade planning system has a dual function of direction and control. The future expansion of commercial ties with western firms, for example, increased flexibility regarding joint economic ventures in the Soviet Union, is related to the effectiveness of the foreign trade planning system: Does the current system provide Soviet leaders desired control over the process of economic interchange with the West, such that the country is not sub-

*The views expressed herein are the sole responsibility of the author, and they should not be considered as reflecting the official position or endorsement of his employer.

[1] For a discussion of these and other views see Daniel Seligman, "Communist Ideology and Soviet Power," Fortune, January 1976, pp. 115–16.

ject to undue exposure to western economic leverage or that the domestic economy and fulfillment of plan targets is not strongly influenced by unexpected foreign economic developments? The adequacy of Soviet foreign trade planning in monitoring and controlling the interdependencies created by the expansion of foreign economic ties may be expected to influence Soviet leaders' decisions about future foreign economic policy.

Lastly, the tools and procedures of foreign trade planning are themselves of interest in many respects, as a reflection: of how adjustments are made to external developments and how foreign trade problems are solved, of how the planning process deals with uncertainty associated with foreign trade, of how world prices affect decisions, of how the transfer of technology is handled, etc.

It is primarily this last group of subjects which is of direct interest to the U.S. business community. As U.S. business involvement in the Soviet Union increases, there is a desire to understand better the process of decision making which attracts business opportunities and ultimately has direct impact on the U.S. company doing business there. Some projects are huge in size with substantial commitments of resources on the side of the American business partner, and hence, substantial risks may be associated with these projects. The availability of more economic information on the Soviet economy should help reduce the risk perceived by prospective U.S. partners and reduce as well the price charged the Soviet buyer.

It should be emphasized that the interest of U.S. business in obtaining more economic information as a basis for expanding long-term business commitments is characteristically different from the situation in Japan and Western Europe. In these countries business typically looks to the existence of bilateral political agreements as the basis for expansion of sales and there is a much closer identification of national goals and private business interests (i.e. export expansion) than in the U.S. Lacking such support from their government and because they tend to define their interests on a global basis, U.S. firms with substantial commitments in the Soviet Union place high priority on economic information.

II. New Approaches to Foreign Trade Planning

The evidence surveyed below points to the conclusion that Soviet foreign trade planning is currently in a significant transition period. The new planning methods being introduced represent a radical departure from past practices and reflect a revolution in Soviet concepts regarding the role of foreign trade in the national economy. By their very nature, changes such as these require time and effort to implement. But, judging by the growing literature on the subject, considerable progress has already been made. It will be possible here only to highlight the major changes taking place and to discuss the views of Soviet specialists in this field; it is hoped to analyze the topic in more detail in a future study.

The Soviet approach to the expansion of commercial ties with the West appears to reflect a policy of selective interdependence with a gradual broadening of interdependencies over time to include addi-

tional economic sectors. The starting point was the Tolyatti automobile plant built with Fiat during the Eighth Five-Year plan 1966–70.

The decision to import automotive technology was broadened in the formulation of the Ninth Five-Year Plan 1971–75 to include truck technology. As the Fiat arrangement had been the centerpiece of the Eighth Five-Year Plan, the Kama River Truck Plan development became the major focus of Western machinery importation in the Ninth Five-Year Plan. The selected areas for special attention were widened from automotive technology to include (1) natural gas, oil, timber, metal extraction, processing, and distribution technology; (2) chemical processes ranging from fertilizer to petrochemicals; (3) computer assisted systems technology; (4) agribusiness technology; (5) tourist facility technology.[2]

The current Tenth Five-Year Plan projects a further expansion of western economic ties with the addition of the aluminum industry to the list of preferred sectors.

Although Soviet policy reflected a gradual and controlled expansion of foreign economic ties, the development of new methods of foreign trade planning have necessarily lagged the expansion of trade. Imports could be increased easily, merely by removing existing restraints to purchases of foreign technology; whereas, the new planning methods require the development of data systems and the dissemination of new analytical procedures throughout the economy. This cannot be done overnight. The pace of institutional change, though, appears to have been influenced by the unexpected disruptions in the world economy during 1973–75: the oil price hikes, record inflation followed by sharp recession in the West, and the Soviet harvest setback in 1975. In his speech to the Twenty-Fifth Party Congress Alexei Kosygin, Chairman of the Council of Ministers, gave emphasis to this:

Measures are to be taken to improve further the planning, management, and organization of the U.S.S.R.'s foreign economic relations. There is to be a heightening of the role and responsibility of the sector ministries and departments in developing foreign economic ties, in increasing the production and extending the range of export goods and in insuring the timely construction and startup of industrial enterprises and other projects being installed on the basis of imported equipment. There is to be an improvement in economic incentives for developing and raising the efficiency of foreign economic relations.[3]

It appears that the further implementation of new and improved methods of foreign trade planning has received high priority in the current Tenth Five Year Plan 1976–80.

The Transition from Old to New

Traditional methods in foreign trade planning during the fifties and early sixties were strongly influenced by two major factors: the relatively small share of foreign trade in the national economy and the predominant share of other CMEA countries in Soviet trade. Because of the secondary importance of foreign trade, it was possible for Gosplan to assign much of the decision making and control to specialized institutions; the Ministery of Foreign Trade (MFT) for import and export activity and foreign trade statistics, the State Bank (Gosbank) for management of the country's foreign exchange re-

[2] John Hardt, "The Role of Western Technology in Soviet Economic Plans," presented at a NATO Colloquium on "East–West Technological Cooperation," March 17–19, 1976, p. 3.
[3] Pravda, Mar. 7, 1976.

serves and the Foreign Trade Bank (Vneshtorgbank) for foreign receipts and payments. The importance of CMEA in Soviet trade and the practice of bilateralism determined to a significant extent the composition of exports and imports.

The traditional foreign trade planning system has usually been described as one of planning with material balances: preliminary export and import targets were derived from the set of aggregative material balances prepared by Gosplan during the annual planning cycle—if the material balance showed a deficit, imports were planned, if a surplus, then exports.[4] It is likely, however, that the actual practice was rather different. Exports, for example, reflected to a large extent other CMEA countries' needs for raw materials to support their industrialization drives. Because of the similarity of growth patterns which emphasized heavy industry these items were in short supply in the Soviet Union itself. Hence, export commitments probably reflected political decisions taken at the highest level. And imports, given the system of bilateralism, reflected what other CMEA countries had available for export. Since the availability of "hard goods" was limited, the Soviet MFT negotiators had little difficulty from year to year in deciding which of these goods to import in additional quantities. It was probably more difficult to decide which of the "soft goods" offered should be imported. But these goods were not centrally allocated in any case, so decisions about distribution were made by the MFT not Gosplan.

The traditional system of planning was, therefore, well adapted to meet the relatively limited demands placed upon it. But with the expansion of foreign economic relations during the late sixties, the need to introduce new approaches to foreign trade planning was evident.

> When foreign economic relations of our country were relatively weakly developed, which found expression in the small number of forms of such relations (mainly foreign trade) and in the small and limited nomenclature of goods imported and exported, the technology of planning based on hand methods of working with plan information fully met the needs of the time. At the current stage, which is characterized by the growing scale of the national economy, a significant increase in the number of forms of geographical orientation and volume of foreign economic relations, there arose the objective necessity to modernize the methods of their planning, which is needed not only for the organization and decisions about future tasks when formulating plans but also for the deeper analysis of problems already currently under examination.[5]

The new system of foreign trade planning being introduced is designed to address the following tasks: (1) The analysis of foreign trade and its impact on general economic productivity in future planning periods; (2) the forecasting of the volume and structure of foreign trade and economic cooperation with foreign countries; (3) the determination of a more rational export and import structure for the Soviet economy; (4) the guaranteeing of the organic integration

[4] See for example Herbert S. Levine, "The Effects of Foreign Trade on Soviet Planning Practices," in "International Trade and Central Planning," edited by Alan Brown and Egon Neuberger (Berkeley: University of California Press, 1968), pp. 262–65; and Andrea Boltho, "Foreign Trade Criteria in Socialist Economies" (Cambridge: Cambridge University Press, 1971), p. 52.

[5] S. Zakharov and V. Sulyagin, "Sistema ASOP-Vneshtorg: tseli, zadachi, struktura," Planovoe Khozyaistva, No. 12, 1974, p. 39.

of current and prospective foreign trade plans and of foreign trade and national economic plans; (5) the improvement of control and the economic incentive system in fulfilling plan targets.[6]

The theoretical foundations of the new foreign trade planning system are by now quite well developed. The major theoretical gaps yet to be filled relate primarily to questions of CMEA specialization and the transfer of foreign technology. The basic direction of change at present is to bring theory and practice together. The modification of abstract theoretical concepts consistent with the real possibilities of calculation in the economy and the improvement of the information base and its accessibility to decision makers are seen as prerequisites for a broader dissemination of new planning methods throughout the economy.[7] While one may speak of a revolution when comparing the new with the old methods of planning, it is premature to talk of reform involving some decentralization as has occurred in Poland and Hungary. The greatest economic gains for the time being will derive from the increased effectiveness of centralized foreign trade decision making.

III. The Foreign Trade Plans

In analyzing the planning process it is easiest to identify the final product, which is a set of interrelated foreign trade plans, and then work backwards to discuss the various procedures for constructing these plans.

There are three major plans: (1) the plan for imports and exports, including related plans for delivery or receipt of goods by the ministries; (2) a plan for deliveries of equipment and materials for projects outside the Soviet Union where Soviet technical participation is involved; (3) a balance of payments plan.[8] All of these plans are constructed for annual, five-year, and fifteen-year planning periods. Some of the longer-term plans, in particular the balance of payments plans, though, are highly aggregative and primarily reflect projected trends. The plans for foreign technical assistance include services performed under foreign aid agreements, services performed under contract and certain other foreign economic activities. These plans are drawn up by the State Committee of the Council of Ministers for Foreign Economic Relations. Because of their special nature these plans will not be discussed further here.

The export and import plans relating to CMEA trade are based on the coordination of CMEA national plans and agreements associated with other aspects of CMEA integration. Plan coordination primarily involves Gosplan and the State Committee on Science and Technology (SCST). The SCST has responsibility to prepare and coordinate the CMEA five-year plan of scientific-technical cooperation. This plan is based on proposals submitted by the branch ministries and beginning in 1976 occupies a special section of the individual CMEA na-

[6] Ibid. p. 39.
[7] O.K. Rybakov, Ekonomicheskaya effektivnost' sotrudnichestva S.S.S.R. s sotsialisticheskimi stranami (Moskow: Mysl'. 1975), p. 4.
[8] The material for this section is taken from Metodicheskie ukazaniya k razrabotke gosudarstvennykh planov razvitiya narodnogo khozyaistva S.S.S.R. (Moscow: Ekonomizdat, 1974), pp. 573–601.

tional plans. Gosplan and SCST jointly oversee the work on the coordination of the aggregate plans and plans within branches of the economy. The branch ministries and certain other institutions work out the details of coordination and explore areas for further specialization and cooperation at their level (see below). After the national plans have been coordinated and a protocol signed by the respective planning organs, the MFT prepares the trade agreements and concludes orders falling within the plans.

Related to plan coordination is joint planning, which includes the working out of a five-year plan of multilateral integration measures and within its context a plan of joint construction, a plan of development of specialization and cooperation of production, and in certain cases joint planning of industrial branches and types of products. In contrast to plan coordination joint planning encompasses specific measures associated with CMEA integration, though obviously there is some overlap. Beginning in 1976 these measures are included in a special section of each country's five-year plan (broken down by year) with a description of the needed material, financial and labor resources.

The practice of joint planning for the 1976–80 five-year plan period was separated into several distinct phases. During the first phase of work the branch ministries analyzed the projects associated with CMEA integration using for guidance limits on the balance of mutual trade deliveries by branch and orientation limits on capital investment set by Gosplan. The results, recommendations and needed resources were then transmitted to Gosplan and SCST for further study. The final phase of preliminary work involved the branch ministries, Gosplan, MFT, the Ministry of Finance and several other bodies. At this time questions were resolved regarding each CMEA country's role (deliveries of goods and their schedule), the fixing of credit terms and prices, and each country's scientific-technical involvement in the various projects. After approval by Gosplan and SCST, the agreements were worked into the draft of the 1976–80 national economic plan.

The overall plan for exports and imports is to an important extent based on the activities associated with CMEA trade and cooperation described above. The plan has three component parts: (1) Export and import by country; (2) the schedule of deliveries of goods for export by ministries, union republics and other organizations; and (3) the distribution of imported goods to the national economy. In the export and import plans by country, the groupings include: socialist countries, of which CMEA; developed capitalist countries; developing countries; and all important trading partners in each grouping are detailed separately. The trade by country is further identified by type of payment (receipt): clearing, convertible currency (cash or credit), and other forms. For each country shown separately the following information is given: total export (import), form of receipt (payment), and the quantity (in some cases value) of goods to be exported (imported). In addition some goods are designated for export for convertible currencies without specification of country of sale. For CMEA countries additional information is provided on deliveries associated with CMEA integration measures. Prices valuing

both exports and imports are on an FOB basis and are derived from contract prices for socialist trade (adjusted to FOB) and estimated future prices of basic goods for trade with non-socialist countries.[9]

The unified balance of payments plan is drawn up by Gosplan together with the Ministry of Finance on the basis of projected balance of payments plans of the MFT and certain other ministries. The plan of the MFT, for example, reflects the payment and receipt for goods included in the import and export plan, i.e. type of currency and terms—cash or credit. The unified balance of payments plan has five divisions: goods, services, non-trade invisibles, credit and property, and foreign aid. Commodity credits and foreign aid commodity grants are not included in the plan but are shown separately. Within each category the following currency groups are detailed: transferable and clearing rubles, national currencies of socialist countries; convertible currencies including clearing with the possibility of conversion of balances; blocked currencies and clearing with limitations on conversion. A characteristic feature of Soviet accounting practice is that financial flows associated with trade are identified as current or credit transactions. This gives an accurate representation of the underlying transactions and is superior to accounting practice which records only actual payments or receipts (as used in Bulgaria, Romania, the G.D.R. and a number of western countries).[10] The fulfillment of the balance of payments plan is monitored by means of a monthly accounting prepared by Vneshtorgbank.

In addition to the unified balance of payments plan, the Ministry of Finance, Gosbank, and Vneshtorgbank prepare an annual capital balance sheet for the country. Included are: (1) claims and liabilities from commercial credit up to one year; (2) claims and liabilities connected with services and non-trade activities; (3) claims and liabilities of the banks; (4) government and long-term credit; and (5) capital investment.[11]

The summary description of the various foreign trade plans above cannot be expected to yield detailed information about the various criteria used to construct plans. It is clear, however, that the branch ministries play a significant role in analyzing prospective projects, posing the need for standardizing methods of analysis at various levels of the planning process. Also the newly developed plans connected with joint CMEA planning (particularly joint projects and specialization) point to the need for integration of these elements into the ministries' plans and the overall national plan.

IV. Efficiency Calculations in Foreign Trade

The theoretical basis of the recommended procedures in Soviet foreign trade planning is a calculation of the domestic cost of foreign exchange—foreign exchange earned in the case of exports and foreign exchange expended in the case of imports. The nature of such criteria has already been described and analyzed in general terms for the So-

[9] Additional information on the detailed components of these plans is given in ibid.
[10] Jan Vit, "Pouzivane metody sestavovani platebni bilance v clenskych statech RVHP," Finance a Uver, No. 9, 1975, pp. 623–24.
[11] Ibid.

viet Union and other CMEA countries.[12] Readers wishing a general introduction to the topic should refer to these sources.

Foreign trade efficiency indices (FTEI) provide a measure of the cost to the national economy of producing a good for export relative to the foreign exchange received abroad, or in the case of imports the foreign exchange expended abroad in purchasing a good relative to what it would have cost to produce the good domestically. Many refinements are necessary to deal with the following specific situations: (1) The divergence of actual prices from national economic costs; (2) the variability of purchasing power from sales of identical exports goods depending on country of destination; (3) importing goods which have no domestically produced counterpart; (4) the export or import on credit terms; and (5) advanced forms of cooperation such as CMEA joint projects and industrial specialization, and compensation agreements with western firms.

The general form of FTEI recommended at present is the following:[13]

Export index

$$X_{ei}=\frac{V_e}{Z_e}\,cx_{i\cdot eq}$$

where X_{ei} represents the "index of export effectiveness" taking into account the purchasing power of foreign exchange receipts earned; V_e foreign exchange receipts; Z_e domestic cost of production from the point of view of the national economy, calculated as

$$Z=S+r_nK$$

where S (sebestoimost) represents the average cost of production, r_n is the relevant normative rate of return (15% on K, capital employed; c is the "coefficient of credit influence" which reflects the ratio of the discounted value of receipts (payments) to their nominal value calculated using a discount factor equal to r_n (15%, though some recommend 8 percent as is used for domestic projects); $X_{i.eq}$ is the "import equivalent" representing the purchasing power of the proceeds from the exported goods, defined as

$$\frac{\sum Z_iP_i}{\sum V_iP_i}$$

(where P represents a product) which gives the total domestic cost of producing the list of goods imported from the country of export sale relative to the actual foreign exchange expenditures for these imports.

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[12] C. H. McMillan, "Some Recent Developments in Soviet Foreign Trade Theory," Canadian Slavonic Papers, Fall 1970, pp. 243–72; Boltho, Foreign Trade Criteria; Edward A. Hewett, "Foreign Trade Prices in the Council for Mutual Economic Assistance" (London: Cambridge University Press, 1974).

[13] S. N. Zakharov, Raschety effektivnosti vneshneekonomicheskikh svyazei (Moscow: Ekonomika, 1975), pp. 47–8. The terms effectiveness and efficiency are used interchangeably throughout this paper.

Import index

$$X_{ic}=\frac{Z_i}{V_i}\frac{1}{c}X_{e\cdot eq}$$

where X_{ic} represents the "index of import effectiveness" taking into account the efficiency of exports to the given country or group of countries; V_i foreign exchange expenditures; Z_i cost of producing the imported goods if produced domestically; $X_{e.eq}$ is the "export equivalent", defined as

$$\frac{\sum V_h P_e}{\sum Z_e P_e}$$

or the total foreign exchange receipts from the list of goods exported to the country in question relative to the national economic cost of producing these exports.

Calculations of this nature in a simplified form (excluding the last two terms) began to be made in Gosplan in 1963. A similar index in which actual prices—ex-factory, wholesale or retail prices, depending on the situation—are substituted for the calculation of national economic cost (privedennye zatraty or effective expenditures) has been used within the MFT for many years, probably since the early fifties.[14] Such indices called "indices of budgetary effectiveness of foreign trade" reflect the impact of foreign trade on the government budget. They are not recommended for analyzing the economic efficiency of foreign trade because of the frequent divergence between actual prices and national economic costs. However, actual prices are often used where calculations of national economic costs are lacking.

The use of FTEI has become widespread during recent years. They are not as yet obligatory for the ministries which prepare import or export proposals, though such a move has been recommended and may be made in the near future.[15] By nature FTEI are rather complex and their calculation poses the need for information some of which is not available at present at the level of Gosplan and within the branch ministries. Hence, current efforts to improve foreign trade planning have focused on the information problem and on standardizing the methodology of calculation.

Official recommendations for calculating FTEI were first published in 1967–69 in a series of model calculations relating to comparisons of the economic effectiveness of capital investment in CMEA countries (1967, issued by the CMEA Secretariat), the economic effectiveness of foreign trade (1968, issued by Gosplan), and the economic effectiveness of capital investment (1969). An additional model calculation for analyzing the economic effectiveness of CMEA specialization and cooperation was approved in 1973.[16] These documents, however, do not cover all practical aspects of making such calculations and a number of additional procedures have been proposed in the professional literature.[17]

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[14] S. N. Zakharov, V. Sulyagin. "Raschety effektivnosti vneshneekonomicheskikh svyazel," Planovoe Khozyaistva, No. 6. 1973, p. 79.
[15] Rybakov, Ekonomicheskaya, p. 236.
[16] Zakharov, Raschety, p. 8.
[17] Ibid.

The FTEI have been criticized because they cannot be used as a guide to optimize foreign trade.[18] While this is true, it is also not very relevant to current Soviet decision making in trade matters. Much of Soviet trade with other socialist countries reflects basic political commitments, e.g. to supply raw materials to CMEA, and the bilateralism inherent in such trading relations limits the scope of application of any economic efficiency criteria. Hence. planners desire guidance primarily in specific areas where some marginal adjustment is possible. And given the present system of planning and foreign trade in the Soviet Union the FTEI seem to be well suited to this purpose. The recent expansion of foreign trade with nonsocialist countries and the growth in types of commercial relations associated with CMEA integration (specialization, joint projects) pose new demands on Soviet foreign trade decision makers. The extent to which planners may be able to meet these new demands for greater efficiency depends in large measure on the success of current efforts to improve the informational inputs into foreign trade planning and subsequent to this the improvement of incentives relating to foreign trade activity at the level of enterprises and ministries. Significantly, these points have received particular emphasis by the leading Soviet specialists on foreign trade.[19]

V. Practical Aspects of Foreign Trade Planning

In this section issues relating to the informational basis of foreign trade planning are surveyed. The purpose is to indicate the nature of the problems encountered and to discuss the solutions being recommended by foreign trade specialists.

Under optimal conditions the full range of data for decision making would include: volume and value of exports and imports (by commodity group and country), the production or consumption of traded goods by separate domestic economic sectors, data on foreign and domestic prices and market conditions (availability), economic costs of production of traded goods (including their capital intensity), relevant transport costs, and the volume and terms of credits granted and received. It is obvious that informational needs cover a wide scope. At the same time such data must provide detail on individual goods. What is usually needed is information on a particular good, such as a given type and model of a machine tool, rather than for machine tools in general. Also the lack of financial integration in the CMEA area requires that data on any given good be viewed relative to trade possibilities in the West (for hard currency) and for each CMEA country individually.

The crux of the data problem is twofold: (1) The creation of data processing systems capable of handling the needed data; and (2) the provision of the needed data which may be fed into such a system. The first problem is being approached by the creation of the "Automated System of Optimal Planning of Foreign Economic Relations" which is one of the sixty-odd subsystems of the general "Automated System

[18] See for example Hewett, Foreign Trade Prices, pp. 141–142, and Boltho, Foreign Trade Criteria, pp. 72–4.

[19] Zakharov, Raschety, p. 10; Zakharov and Sulyagin, "Sistema," pp. 40, 47; Rybakov, Ekonomicheskaya, p. 7, 236–42.

of Planning Calculations." [20] The second problem has many complex aspects. To the extent that the data are already being used in the actual planning process then it is largely a question of making them available where they may be needed. If the data are not currently available, then means must be found to collect the data or to make estimates. This in itself is a major task. And where primary data derive from enterprises, ways must be found to insure the correctness of such submissions, i.e. to prevent enterprises from understating their capabilities or magnifying their requirements.[21]

The following which is based on the commentaries of Soviet specialists surveys selected information problems.

Foreign Exchange Receipts or Expenditures

Data on CMEA and world market prices are generally available. The actual export price on western markets, though, may diverge from the western price level, thus, the use of actual contract prices is recommended. And all relevant transport and packaging costs should be factored into the calculations of foreign trade efficiency. As in the West projections of future world market price trends face well known uncertainties.

Estimation of Domestic Costs

In the case of export goods, the average unit cost of production is generally known, but frequently there is difficulty in estimating a good's capital intensity which is needed for calculation of effective expenditures (defined as average cost of production plus the normative rate of return on capital, see above). As in the West, available capital data reflect an accounting rather than economic concept of capital.[22] Also the ministries and research institutes often do not have the Gosplan calculated values of effective expenditures available to them. Hence, they tend to use actual wholesale prices even though this procedure is not officially recommended.[23]

A partial solution is provided by the use of special coefficients relating wholesale prices to effective expenditures for a list of representative goods.[24] Selected coefficients may be used for similar goods, i.e. goods whose wholesale prices reflect a similar relation to production cost. Because of the lack of coordination of calculations at various levels, one Soviet specialist has recommended that ministries and research institutes use actual prices in efficiency indices, with parallel calculations of indices using such coefficients or effective expenditures at the level of Gosplan.[25]

Even when calculated according to recommended procedures the FTEI may be misleading in certain cases. Soviet specialists recognize that marginal rather than average costs of production may be relevant, particularly where raw materials are concerned.[26] Also the prices of

[20] Zakharov and Sulyagin, "Sistema," p. 40.
[21] For a discussion of data problems in the context of input-output analysis, see A. Tretyakova and I. Birman, "Input-Output Analysis in the U.S.S.R.," Soviet Studies, April 1976, pp. 183–85.
[22] Rybakov, Ekonomicheskaya, p. 82.
[23] Ibid., pp. 60, 70.
[24] Ibid., pp. 67, 71.
[25] Ibid., pp. 64, 71.
[26] Ibid., pp. 85–8.

purchased inputs may have certain defects, e.g. underpricing of raw materials due to the exclusion of rents. The desirability of adjusting the indices to measure foreign trade efficiency on a value added basis is recognized but such indices are exceedingly difficult to constructed in practice.[27]

Indices of import efficiency require the estimation of the domestic cost of production of the imported good. Thus, in addition to the above mentioned problems, there are added difficulties. Some imports have no counterpart in domestic production, or there may be differences in quality, performance, etc. Various procedures for dealing with these problems have been discussed in the literature.[28] A set of coefficients for converting foreign to domestic prices were constructed for various groupings within the category of machinery and equipment. However, for various reasons the use of these coefficients is no longer recommended.[29] Because of the complex and often subjective estimations required, work on import indices is done primarily at the Gosplan level.

Foreign Trade Equivalents and Foreign Exchange Rates

The use of foreign trade equivalents provides an adjustment to foreign exchange receipts (expenditures) to allow for comparisons on a standard basis (see Section IV for definitions). Export and import equivalents are calculated by Gosplan for convertible trading partners as a group and for individual socialist countries. Foreign exchange receipts are usually expressed in valuta rubles with hard currencies converted at the official rates and transferable rubles at parity. The purchasing power of such receipts, however, vary depending on the country of export sale, i.e. whether a good is sold for hard currencies or transferable rubles, and if the latter then the country of sale is important because the transferable rubles are typically employed to pay for goods within the existing bilateral trading relationship. The efficiency of exporting a given good to different countries may be assessed by deflating the receipts with the relevant "import equivalent."

On the import side the use of the "export equivalent" has the effect of deflating outlays in valuta rubles by an index of the efficiency of export to a given country, i.e. the relative domestic cost of earning foreign exchange by exporting to the countries in question.

When applied to total exports (imports) to a given country, the index of foreign trade efficiency has the nature of a composite index reflecting the relevant terms of trade and the gains to trade. The overall export and import indices differ by virtue of the different weights applied.[30]

The foreign trade equivalents are used as foreign exchange rates in specific situations.[31] The conversion of valuta to domestic rubles is performed using the "import equivalent." The opposite conversion of domestic to valuta rubles presumably uses the "export equivalent," although the inverse of the "import equivalent" could also be used.[32]

[27] McMillan, "Recent Developments," pp. 258–60.
[28] Rybakov, Ekonomicheskaya, pp. 91–98.
[29] Ibid., p. 98.
[30] Some weighted average of the two values could be constructed, but no mention of the possibility was found in Soviet sources.
[31] Zakharov, Raschety, pp. 100–01. The conversions are presumably done by Gosplan.
[32] See footnote 30.

It specified sales are made for cash and the goods to be purchased with these proceeds are unknown, the inverse of the export equivalent (instead of the import equivalent) is used. The equivalents have been adopted for a number of other situations where conversions between foreign and domestic values are necessary. It should also be noted that no fixed rate has as yet been set for conversions between domestic and transferable rubles.[33] Most other CMEA countries have fixed internal conversion rates between the TR and the domestic currency.

Credit

The inclusion of credit effects in FTEI calculations is done by means of indices called "coefficients of credit influence." The relevant values may be calculated directly or read from tables which give the data for typical types of credit arrangements, i.e. for a given term, interest rate and repayment schedule.[34] The methodology is similar to that used in the West. There appears, however, to be a difference of opinion regarding the use of the normative discount factor where intertemporal calculations are concerned.[35] Some economists use 8 percent, as is the case for domestic investments, others recommend 15 percent, equal to the normative rate of return on capital in foreign trade.[36]

CMEA Specialization

Various indices have been worked out in order to analyze CMEA specialization proposals. Such indices generally include a measure of the gains to trade, the reduction of unit costs of production due to specialization and balance of trade effects (surplus or deficit). There are still a number of unresolved issues of theory and practical methodology in this field. Unfortunately a more detailed analysis of these issues is not possible in the present study.[37]

Data Systems

The Automated System of Optimal Planning of Foreign Economic Relations mentioned earlier is designed to perform a series of four interrelated functions: (1) the analysis and forecasting of foreign trade variables in future planning periods; (2) the evaluation of plan variants from the standpoint of economic efficiency; (3) the analysis of decisions taken and the preparation of planning documents; (4) the formation of systems of incentives and control of plan fulfillment.[38] A scale model of the system was constructed on the computer of Gosplan's Economics Institute. Current efforts apparently are focused on transferring the system from second to third generation computers and linking it to Gosplan's computer center and the planning models used for national economic planning.[39]

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[33] Rybakov, Ekonomicheskaya, p. 126.
[34] Zakharov, Raschety, pp. 160–68.
[35] The normative discount factor is needed to calculate costs or revenues depending respectively on whether credits are granted or received.
[36] Rybakov, Ekonomicheskaya, p. 108.
[37] For a discussion of these issues see ibid., pp. 180–214, and the sources cited therein.
[38] Zakharov and Sulyagin, "Sistema," p. 41.
[39] Ibid., p. 47.

VI. Conclusions

While the survey in the preceding section tended to focus on the tasks facing planners in improving the system of foreign trade planning, the nature of problems themselves gives ample evidence of the striking evolution in Soviet foreign trade decision making in recent years. When measured against progress in other sectors of the Soviet economic planning apparatus, the changes in foreign trade are impressive. And further changes in this field will likely continue in the forefront in coming years. The documents of the recent 25th Congress of the CPSU gave explicit recognition for the first time of foreign economic relations as a vital and independent branch of the national economy.[40]

The Soviet Union appears to have abandoned its past autarkic orientation in foreign trade in the late sixties. In the relatively short period of time since then it has not been possible to implement the new comprehensive system of foreign trade planning at all levels of the planning process. Yet it is currently possible at the level of central decision making to bring the new economic criteria to bear on major foreign trade decisions. This is a major achievement. Soviet foreign trade specialists do not seek to minimize the difficult tasks facing them currently, in particular the broadening of the system to lower levels of the planning hierarchy, the integration of foreign trade into national economic planning, the collection and processing of data, and the improvement of foreign trade incentives at the enterprise level. The nature of these tasks should stimulate further change away from the traditional autarkic model of decision making.

[40] Interview material.

SOVIET EFFORTS TO INCREASE EXPORTS OF MANUFACTURED PRODUCTS TO THE WEST

PAUL ERICSON

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I. INTRODUCTION

Since 1965, the Soviet Union has attempted to expand significantly its exports of manufactured products to the developed West. This paper analyses the economic rationale behind such a decision and the steps taken by the U.S.S.R. in an attempt to spur export sales. The problems encountered are discussed in detail, with particular attention paid to the basic conflict between the highly planned Soviet productive system and the flexibility and innovation required to compete successfully in Western markets. Actual performance is examined and areas of relative success discussed. The paper concludes with an assessment

of the potential for increased exports during the balance of the decade, with emphasis on those hard decisions which must be made before the U.S.S.R. can significantly upgrade its ability to export manufactured goods.

II. Conclusions

Soviet exports to the developed West consist largely of raw materials and semi-manufactured products; manufactured products [1] constituted less than 5 percent of exports in 1974. Several economic factors argue for a marked increase in the sale of Soviet manufactured goods to the West. These include the increasing cost of developing raw material resources and the need to expand exports to pay for imported Western technology and equipment.

Soviet leaders have been aware of the need to increase manufactured goods exports for some time. This interest has grown markedly in recent years as a result of the decision to increasingly use Western equipment and technology to upgrade the Soviet economy. New programs have been initiated and sales have risen sharply since 1972 in absolute terms. They still, however, represent only a small share of total exports to the West.

Despite Moscow's efforts, the manufactured goods export program remains characterized by poor product appearance and quality; inadequate spare parts, servicing, and technical documentation; a separation of Soviet producers from Western buyers; and inflexible production schedules which limit Soviet ability to quickly respond to Western needs. These and related problems must be sharply reduced if manufactured goods are to occupy an important share of Soviet exports to the West. These problems, however, affect all Soviet economic planning and production, and past attempts at change have been frustrated by the large and conservative politicized bureaucracy which controls Soviet production and sales.

Statements by Brezhnev and Kosygin at the 25th Party Congress in February 1976, suggested the possibility of radical reorganization of foreign economic activity, including establishing firms and/or industries to produce solely for export. The U.S.S.R. has in fact begun to encourage compensation-type agreements for manufactured goods [2] and is in the final stages of drafting joint-venture legislation allowing for Western participation in Soviet production.

If the U.S.S.R. follows up on the recent leadership pronouncements with meaningful change, the large Soviet industrial base could eventually provide the basis for a substantial growth in sales. It would take time, however, for changes to work their way through the system. For the balance of the decade, Soviet manufactured goods should continue to account for less than 10% of exports to the West.

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[1] For the purposes of this study manufactured goods are considered to consist of Soviet products falling under sections seven and eight of the Standard International Trade Classification (SITC 7, 8). They include exports of machinery and equipment; transport equipment; consumer goods such as furniture, footwear, and clothing; and other finished goods. Since the study is concerned with the ability of the U.S.S.R. to manufacture and market highly differentiated finished goods in competitive Western markets, Soviet manufactures falling under SITC 5 and SITC 6 were excluded. For the most part products falling under these two categories are intermediate goods where a higher degree of standardization allows for a greater role of price respective to other competitive factors.

[2] Compensation agreements are characterized by collateral purchase guarantees signed by the Western firm(s) exporting plant and equipment to the U.S.S.R. By this means the U.S.S.R. is certain of an export market for project-associated production and, in turn, its ability to repay the long-term credits extended by the West to cover original Soviet imports of plant and equipment. Until recently this type of agreement has been limited to resource development projects where Western firms have agreed to purchase Soviet raw materials, fuels, or chemicals.

III. Economic Rationale for Expanding Exports of Manufactured Products

Key economic factors which argue for a greater share of manufactured products in Soviet exports to the West include: (1) A need to expand total export earnings to finance growing import requirements, (2) the increasing cost of developing natural resources, and (3) the benefits which accrue to domestic production from a developed export program. Over the long run, import capacity is tied to the growth in export earnings. To the extent that Soviet manufactured goods exports add to rather than supplant exports of raw materials Soviet import capacity from the West will be increased.[3]

The development of new raw material deposits and efforts to increase production from existing sites have proven increasingly costly in recent years. Many of the undeveloped raw material deposits are located in remote areas where climate, terrain, and working conditions are difficult. The USSR not only faces the costs of developing the new deposits per se, but must also bear the costs of developing a supporting infrastructure—rail lines, housing, roads, and power. Also, expensive Western technology and equipment must often be acquired if Moscow is to exploit the new deposits efficiently or increase production from the existing projects. This is particularly true in the case of crude oil.

Soviet production for domestic use will also benefit from an expansion of manufactured goods exports to the West. Sales in Western markets depend on competitive advantages rather than on the production targets which govern Soviet output. To expand exports, Soviet producers will be forced to make their products more competitive by placing increased stress on quality control, spare parts production, and upgrading design and production. Although this would be a classic case of the tail wagging the dog, if such innovations were incorporated into products for the domestic market they would represent a major improvement over current Soviet practices such as shoddy workmanship, poor quality control, and long lags between technological advances and their incorporation into actual production. Expanded exports could also increase the efficiency of domestic investment by allowing for longer production runs. A significant share of the cost of producing an aircraft, for example, results from the initial investment in developing a prototype and equipping a plant to produce the aircraft. Longer production runs made possible by export sales would significantly increase the rate of return on such investments.

IV. Evolution of Policy

The Soviet commitment to increasing manufactured good exports was first evident in directives issued in 1966 by the 23rd Party Congress. The Congress recommended reforms in those areas—poor appearance, advertising, technical documentation, spare parts, and servicing—where the Soviet export program was particularly deficient. Reports from the Congress also indicated the desire to increase contacts between the Soviet Foreign Trade Organizations (FTOs) [4] and

[3] See also Inozemtsev, N. "Socialism and International Economic Cooperation," Pravda, May 16, 1973, pp. 4–5.

[4] The 60 FTOs are the operational elements of the Ministry of Foreign Trade. As such they have total responsibility for all commercial negotiations in their respective areas of specialty, e.g., power equipment, chemical products. By their direct control over all negotiations they often represent a substantial barrier to needed dialogue between potential buyers and sellers.

producing ministries and to encourage initiative within the FTOs to seek additional export sales.[5]

Changes implemented during 1966–70 were organizational in nature and did little to spur sales. In any event, there was apparently insufficient impetus from the leadership to overcome bureaucratic inertia, especially in the Ministry of Foreign Trade. By 1970, Soviet leaders began to recognize the necessity for basic changes within the system. In his report to the 24th Party Congress in 1971, Brezhnev stated the need to improve the management of foreign economic activity and to eliminate a "narrowly departmental approach to this important matter."[6] The Central Committee Report of the Congress stressed the need to combine production and commercial functions in order to be more responsive to Western requirements.[7] [8] If the Soviet leadership was now more aware of the basic obstacles to expanding exports, little was done about it.

High level concern over the need to expand manufactured goods to the West mounted during the early 1970s, particularly as the Soviets realized that an expanded export base was a crucial prerequisite to Brezhnev's commitment to an increased use of Western technology and equipment in Soviet economic development. The U.S.S.R.'s export effort was a major topic addressed at the April 1973 Party Congress plenum.

The decisions reached by the April plenum became evident from Soviet articles and statements during 1973. In a June speech to US businessmen in Washington, D.C., Brezhnev criticized Soviet foreign trade operators for "lack of initiative, timidity, outmoded ideas and for deficiencies in their performance." In an April 1973 paper and address given at the Stanford Research Institute, Dr. Ivan D. Ivanov of the Institute of US Studies discussed the role of foreign trade in the 1975-1990 period. He stated that foreign trade was becoming an important component of growth policy rather than just a means of covering temporary shortages in domestic production. He stressed the Soviet determination to become an important exporter of machinery and equipment regardless of the rapid rise of raw material prices, and spoke of the need to expand export specialization in the most advanced industries, and to orient industrial capacities to export production.[9]

Similar views were expressed by other officials. Nikolai Inozemtsev, a deputy chairman of Gosplan responsible for long-term planning of foreign trade, stated in June 1973 that a top priority campaign had been set to bring manufactured goods up to world quality standards and to update Soviet trading practices and institutions. Inozemtsev spoke of room for improvement in three main areas: a reorganization of the FTOs, the need for closer relations between the FTOs and producing industries, and a need for increased contact between producing industries and Western firms. He explained that the 1973 reforms

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[5] Patolichev, N, "Soviet Foreign Trade in the New Five-Year Plan," Foreign Trade, (English Edition), 1967, pp. 3–7.

[6] Brezhnev, LI, "Report of the C.P.S.U. Central Committee to the 24th CPSU": Novosti Press Agency Publishing House, Moscow, 1971, pp. 101–102.

[7] The directives also emphasized the need to increase the initiative and responsibilities of ministries and enterprises in the development of foreign economic ties.

[8] Kovan, I. "The Leninist Principle of the Soviet States' Economic Relations with Other Countries." Foreign Trade, April 1973, p. 8.

[9] Ivanov, "Foreign Trade Factors in the U.S.S.R.'s Economic Growth and Some Perspectives for the U.S.-Soviet Economic Cooperation."

called for industrial producers to be given greater responsibilities in generating exports and stated that producers would be given control over funds earmarked for the production of high-quality goods for the world markets.[10] [11]

A February 1974 Izvestia article by Oleg Bogomolov, director of the Institute of Economics of the World Socialist System, revealed continued leadership concern. The article stated that specific reforms related to questions of improving the planning of foreign economic relations and of assessing their impact on the domestic economy were under active consideration. The article critized the parochial concept of the MFT, which views foreign trade solely in terms of Moscow's commitments to other socialist states and developing countries and relegates trade with the West to a secondary position. Bogomolov referred to the basic nature of future changes, stating that the process of change in the foreign trade sector will require "much effort" and "a certain psychological reorientation" within the economic bureaucracy.[12]

The concerns raised in the April 1973 plenum culminated in the new directives issued earlier this year at the 25th Party Congress. The Brezhnev and Kosygin speeches and the draft directives for the 1976–1980 plan all demonstrate a commitment to improve exports of manufactured products. Brezhnev spoke of the need to expand the production of goods which are in demand on foreign markets and the need to make these same goods more competitive. He also called for the expansion of compensation agreements to include the production of manufactured products and for the search for new approaches to production cooperation.[13] Kosygin's speech touched on the need for new forms of cooperation and greater involvement of the producing ministries. The speech specifically called for an examination of the possibility of organizing special production facilities to be oriented toward export markets.[14]

V. The Economic Setting in 1965

The Soviet economic system was singularly ill-equipped to make the changes required to manufacture products that could compete in sophisticated Western markets. Designed to service a vast internal market in an autocratic fashion, the Soviet economy was totally isolated from the competitive forces prevailing in the West. The highly structured and politicized system of central planning which governed Soviet economic decisionmaking was to prove particularly resistant to change.

FTOs dealing in manufactured products had little perception of what was required to establish marketing and sales-service organizations capable of supporting export expansion. Neither did they appreciate the importance of such factors as product reliability and appear-

[10] Parks, Michael, "Russia Prepares for Trade Changes," Baltimore Sun, June 29, 1973.
[11] Shabad, Theodore, "Soviet Considers Shift on Trade," New York Times, July 10, 1973, pp. 55, 63.
[12] Bogomolov, O., "A Demand of Life," Izvestia, Feb. 26, 1974, p. 4.
[13] Brezhnev, L., Opening remarks to the 25th CPSU Congress, Feb. 24, 1976 (FBIS–Sov–76–38, Feb. 25, 1976, Vol. III, No. 38, Supplement 10, p. 43).
[14] Kosygin, A. Address before the 25th CPSU (FBIS–Sov–76–46; Vol. III, No. 46, Supplement 23, Mar. 8, 1976.

ance, and spare parts availability which are important elements in the sale of manufactured products in the West. Soviet sales of manufactured goods traditionally had been largely confined to the developing nations—where equipment exports were backed by low-interest credits or outright grants—or to other Communist nations in accordance with plan targets. Equipment exported to the West was often part of a larger deal involving Soviet purchase of Western equipment. Western firms accepting Soviet equipment in this fashion often resold or discarded the equipment.

The FTOs not only had little perception of the problems in expanding exports but had little incentive to do so. The quality of personnel employed by the export organizations was often poor; the brighter graduates of the Soviet Foreign Trade Institute gravitated toward importing FTOs. The concept of businessmen, moreover, had long held an unfavorable connotation in the U.S.S.R.,[15] and prior to 1965, personnel employed by the FTOs were paid substandard wages. FTOs were judged by their ability to dispose of a targeted amount of goods rather than on their ability to expand export markets. Any attempts at expansion were difficult because of inelasticities and the unwillingness of producers to either alter products to Western standards or to provide for export a wider range of types and sizes. Most production was geared to the domestic and East European markets where sales were guaranteed. Promotions and other incentives were based on management's ability to meet or exceed planned targets.

Managers of producing enterprises also tended to avoid change. Innovations were considered risky because they could endanger current plan fulfillment, and they carried little potential for future reward because output targets or quality standards would simply be ratcheted upward if the innovations were successful. Producer avoidance was further encouraged by a bonus system that produced no rewards for underfulfillment but substantial rewards for exceeding plan targets.[16] This risk aversion was most pronounced in areas where technological advances are incorporated into production.

Additional problems faced Soviet producers who attempted to upgrade their production or otherwise alter their output to meet Western standards. Since they had little contact with potential buyers, it was difficult to ascertain what changes were needed. Attempts to alter product design or upgrade quality were also inhibited by the suppliers of component parts. These suppliers, lacking sufficient capacity or incentive to produce the new parts, would neither agree to the application of their products in additional models nor listen to any talk concerning the upgrading of quality or the creation of new models of the items they manufactured.[17] A final problem stems from the material balances approach and full production targeting used in the Soviet Union. While Western firms often attract business as a result of their ability to guarantee deliveries within a short amount of time, Soviet producers are often forced to make delivery commitments contingent upon future production plans leading to long delivery lags.

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[15] . . . "Izvestia" Discovers the Businessman: BI/Eastern Europe Report, Mar. 22, 1974. p. 86.

[16] Gregory, P. and Stuart, R., "Soviet Economic Structure and Performance," Harper & Row, New York, 1974. p. 187.

[17] . . . "A Heavy Machine Tool Ministry Innovates," The Current Digest of Soviet Press, Vol. 26, No. 3, p. 23.

VI. First Period of Change, 1966–72

A. Reorganization Within the Foreign Trade Ministry

During the 1960's the MFT made several bureaucratic changes designed to place increased emphasis on manufactured goods exports (see chart). As late as 1962 there were only two main export administrations, one for raw materials and a second for machinery and equipment. By 1969, the main export administration for machinery and equipment had been split into four main export administrations, one each for the export of industrial equipment, transportation equipment, road-building and agricultural machinery, and manufactured and consumer goods.

The FTOs dealing in manufactured goods were also expanded in an effort to establish a greater parallelism with the producing industries. In July 1966, Mashinoexport, for example, was reorganized into three separate FTOs—Mashinoexport, Tekmashexport, and Energomashexport—each concentrating on specific lines of equipment. Other FTOs were subsequently created in support of Soviet efforts to expand exports of particular product lines. In 1971, for example, Electronorgtechnica (ELORG) was founded to handle the export sales of Soviet computers. The MFT also established two FTOs to support the entire export program: Zapchast'export (in 1965) to handle the export of spare parts and Vneshtorgreklama (in 1964) to undertake the advertising requirements of Soviet export organizations.

Chart

U.S.S.R.: Measures taken to stimulate export sales of manufactured products

Year and program	*Goal*
1965—Raise salaries of workers in the Ministry of Foreign Trade.	To encourage higher quality personnel into foreign trade sector.
1965—Allow for form of accelerated depreciation.	To encourage increased use of new equipment in production.
1965—Formation of a Foreign Trade Organization to handle spare parts.	To centralize, and thus improve, spare parts availability.
1966—Formation of additional Foreign Trade Organizations and Main Export Administrations.	To place increased emphasis on exports of manufactured products.
1967—Formation of Export Councils by Foreign Trade Organizations.	To increase producer-exporter contacts.
1968—Formation of new Soviet-controlled firms in the West.	To give Soviet exports direct access to Western markets and to establish sales/service centers.
1968—Formation of zagranpostavkas by producing ministeries.	To centralize control over export activities.
1968—Increase in bonuses for export production.	To encourage production for export.
1973—Formation of leasing companies.	To take advantage of widely used method for manufactured goods sales.
1973—Application of compensation agreements to manufactured goods industries.	To encourage production for export.
1973—Study of possibility of joint-ventures involving Western participation in Soviet production.	To examine possibility of obtaining Western technology and know-how on a continuing basis.
1973—Use of Western consultants to assist in marketing and product design.	To improve Soviet product appearance and knowledge of Western marketing conditions.

B. Foreign Commercial Operations

The late 1960s saw a rapid expansion in the number of Soviet-controlled commercial outlets established in developed Western countries which dealt with manufactured goods.[18] Soviet FTOs organized 17 such firms during 1968–75, bringing the number of Soviet-controlled establishments to 22. In some cases, the FTOs bought a majority interest in Western firms already dealing in the sale of Soviet products; in other instances new firms were created to handle the sale of Soviet manufactured goods. The FTOs have allowed for minority equity participation by Western firms or businessmen who were also given a major role in the management of the new firms. Stankoimport, Avtoexport, and Mashpriborintorg have each participated in the formation of five firms, and Mashinoexport, Tractorexport, Aviaexport, and Techmashexport have also established outlets in the West.

The new firms gave the FTOs direct control over sales efforts and allowed for badly needed exposure to the marketing techniques and competitive conditions existing in Western markets. Showrooms, spare parts depots, and service facilities were usually established by the new firms and, where required, these firms also sought to organize branch dealerships and repair facilities. Foreign workers designated to service Soviet products were given specialized training, often in Soviet-based facilities.

The FTOs were not fully committed, however, to providing the initial investment and subsequent marketing environment which was required to support the export expansion they desired. Merchandising outlets and service facilities were often limited to one or two locations within a given country and Soviet firms were often unable to obtain the amounts or types of equipment which could most readily be sold. Even the ability of the Soviet-owned firms to operate within their respective Western markets was limited by the rigid control exercised by the parent FTOs over their day to day operations.

C. Spare Parts

The Ministry of Foreign Trade reacted to the problem of insufficient spare parts in a typically bureaucratic fashion. In 1965, a new foreign trade organization, Zapchast'export, was organized to centralize spare parts storage and delivery to foreign customers. By the end of 1970, Zapchast'export accounted for 80 percent of all Soviet spare parts exports. A large central warehouse was established in Moscow and smaller consignment depots were set up in the West. Spare parts inventories were also maintained by most of the Soviet-controlled firms operating in the West.

While this reorganization has led to a greater centralization in the handling of spare parts and has been supported by specialized associations within the production ministries and by special production bonuses, spare part shortages continue to plague Soviet export efforts. Many producers remain unwilling to commit production facilities to spare part production. Moreover, Zapchast'export's spare parts sup-

[18] During the 1965–75 period the U.S.S.R. also rapidly expanded the number of banks in the West, opening commercial banks in West Germany, Switzerland, and the Netherlands. Several firms were also established which deal in raw materials or intermediate goods, and the U.S.S.R. opened a series of firms to service its growing role in international shipping.

plies—and hence the amount of parts which are made available abroad—are determined by the production ministries' estimates of spare parts needs rather than by foreign demand.

The problem of spare parts is compounded by the attitude of some FTO personnel who find it hard to accept the importance potential buyers attach to assured spare parts deliveries and the efforts Western firms make to insure prompt response to buyer requests for needed parts. They often state that Western buyers should bear the responsibility of manufacturing their own spare parts from engineering designs provided by the producer, arguing that this is the manner in which Soviet importers handle their spare parts problems.

D. Export Councils

In response to the 1966 directives, the FTOS began to consult more regularly with industry representatives in the planning and implementation of foreign trade. Industry participation in FTO decisionmaking was formalized in late 1967 with the establishment of permanent Export Councils. The Export Councils consist of high-level representation from the production ministries, exporting enterprises, and the FTOs handling their products. The Councils provide a forum for the discussion of export-related problems and serve as a vehicle for producing enterprises to acquaint the FTOs with the possibility of new export products or of additional production of existing export lines.

Some tangible results have come from the work of various Councils including improved packaging, production according to Western standards, and the introduction of technical documentation and advertising. However, the Councils' ability to effect more basic changes is limited. Designed to serve as consultants, they can only suggest, not require, changes in production or sales techniques.

E. Zagranpostavkas

In the late 1960s, the decision was made to centralize the foreign trade operations of individual production ministries by establishing specialized associations or zagranpostavkas.[19] The zagranpostavkas were given main departmental status and in some cases, the ministries created the office of deputy minister for export to head the newly-formed association. It was hoped that the zagranpostavkas would relieve the FTOs of some areas of responsibilities not strictly connected with commercial negotiations. Staffing of the zagranpostavkas is financed by the FTOs dealing in the products produced by the parent ministry.

Zagranpostavkas are responsible for the punctual fulfillment of export contracts, the observance of quality regulations, after-sales service, and installation work. In practice, they have usually assumed industry-wide responsibilities in maintenance and spare parts supplies for exported equipment. In some cases, the zagranpostavkas have been assigned more substantial roles similar to those normally assigned to the FTOs. The zagranpostavka for the Ministry of Nonferrous Metals is responsible for compensation negotiations with Western firms, while members of the Ministry of Aviation's zagranpostavka

[19] Zagranpostavkas (delivery to foreign countries) are known to have been created by the Ministries of Aircraft Industry, Nonferrous Metallurgy, Machine Tools, and Instrument Making.

have taken leading roles in discussions involving demonstration flights of the Yak–40.

Those ministries which have formed zagranpostavkas view them, in part, as an alternative to the FTOs themselves. Zagranpostavka personnel not only have a vested interest in the parent ministry's operations and capabilities, but have also gained increasing knowledge of world market conditions and potential markets for Soviet exports. Apparently out of concern for losing centralized control over foreign trade, however, in 1975 Soviet officials indicated that the zagranpostavka would continue to serve solely in an advisory capacity to the FTO dealing in the ministry's products.

F. Incentives

The incentives provided for in the directives following the 23rd Party Congress did little to increase producer desire to expand exports of manufactured products. They proved too negligible to compensate producers for the extra efforts required for export production. The bonus system in effect during the 1960s provided producing enterprises with foreign exchange allocations based on export receipts which, in turn, could be used for the purchase of imported machinery and equipment. Managers were also rewarded on the basis of the share of exported goods in total production. Soviet disappointment over the failure of the bonus system led in 1968 to an increase in the hard currency allocation from 3%–5% to 4%–6% of the value of exported items.[20] As Deputy Foreign Trade Minister Smelyakov commented in a 1973 article on Soviet exports to the West, however, the new incentives failed to solve the problem.

> First of all we must provide incentive for the export of machinery and equipment. The decade of the sixties was characterized by the fact that there was practically no such incentive. Unfortunately even until quite recently the export of machinery, equipment, and replacement parts has been considered by some plants as a kind of punishment. . . . Financial, administrative, and other responsibility for export deliveries makes export unpopular in the Soviet Union. It is difficult to recall an instance where plant management submitted a proposal to the MFT calling for additional above-target export delivery. . . .[21]

The bonus was made even less attractive by being tied to Western acceptance of the exported equipment. Moreover, the production ministries were not given discretion over the use of the bonus funds; desired purchases had to be channeled through (and were contingent on) FTO approval.[22] Recent policy statements indicate that, as part of a proposed reorganization of foreign economic activity, industries producing for export will receive hard-currency allocations and considerable independence in making purchases with those funds. Penalty clauses for faulty production will be maintained.[23]

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[20] Leznik, A. D., "Economic Stimulation of Production for Export;" (Translated in JPRS 55,223, Feb. 15, 1972, p. 12).

[21] Smelyakov, N., "Soviet Deputy Foreign Trade Minister Discusses East-West Trade," *Novyy Mir*, December 1973 (Translated in JPRS 61148, Feb. 5, 1974, p. 25.)

[22] Leznik, A.D., pp. 14–15.

[23] See also an article by Yu. Samokhin in Ekonomicheskaya Gazeta, No. 12, March 1975, which explains additional steps taken to increase producer incentive.

VII. Second Drive to Increase Exports, 1973–75

The high-level concern evidenced at the April 1973 party plenum has been reflected in new approaches taken by Soviet planners and exporters attempting to increase the export of manufactured goods. The 1973–75 period saw a markedly increased Soviet interest in Western market conditions and requirements. Soviet producers and FTO officials began to examine more seriously potential markets for their products and the changes in production required to sell in the West. Interest was largely directed at the US market where Moscow felt Soviet goods could be sold in quantity once the U.S.S.R. was granted most favored nation (MFN) status.

Soviet officials touring the United States in 1973 were most interested in recommendations for marketing their products. They sought to determine those changes required in their products, which products would be of greatest interest to U.S. buyers, the proper advertising and retailing techniques, and the best method of distributing and servicing the goods they wished to sell. In many cases they sought U.S. companies to act as distributors for their products or otherwise assist future sale efforts. Although the subsequent failure to achieve MFN status muted Soviet attempts, Moscow's newest approach to the marketing problem was unique and demonstrated growing Soviet awareness of the need to tailor production and merchandising to Western markets.

The Soviets enlisted U.S. marketing and design consultants to assist in their efforts. In November 1973, the U.S.S.R. reached an agreement with the industrial design firm of Raymond Loewy/William Snaith Inc. to design selected Soviet products for the U.S. market.[24] In addition, the U.S. firm was to undertake studies of consumer requirements for Soviet products and to exercise some quality control over any Soviet productions advertised as being designed by Raymond Loewy. The Soviet contract was for 2½ years and covered the design (or redesign) of automobiles, motorcycles, cameras, watches, tractors, and hydrofoils. Concomitantly, other U.S. consultants were hired to undertake other marketing studies on the U.S.S.R.'s behalf.

A. Compensation Agreements

Soviet expansion of compensation agreements in the manufactured goods sector dates back to 1973 when State Committee for Science and Technology (SCST) officials stated that production industries could obtain hard currency credits for equipment purchases if such credits would be covered by subsequent hard currency exports. At the same time, an IMEMO official indicated that a new foreign trade policy was under discussion which would involve the development of profit-oriented industries designated to manufacture goods for export.

Soviet exporters began to solicit Western participation in compensation agreements whereby the USSR would pay for imported Western capital goods with manufactured products. They offered to

[24] Farnsworth, Clyde H., "Loewy Got A "Da' for Many Consumer Designs but 'Nyet' on Vodka," New York Times, Dec. 5, 1973.

set up special production facilities or to otherwise tailor production to Western specifications. Some compensation-type agreements have been concluded. One involves Soviet production of machine tools designed with West German assistance. The West German firm involved will produce the initial prototype and subsequently supply the Soviets with equipment required to set up production in the USSR. The West Germans will take production from these facilities in repayment.[25] In most cases, however, potential Western partners have shied away from such deals because of uncertainty over the quality of Soviet-produced products and over the ability of Soviet producers to meet assigned production targets and to supply spare parts.

B. Joint Ventures

The Soviets realized that a more comprehensive form of cooperation was needed to entice Western firms into taking production as repayment and, more importantly, into sharing technology and production know-how on a continuing basis. In late 1973, the USA Institute began a study of the various forms of ownership and management control commonly employed by Western firms. By querying Western firms directly, the USA Institute hoped to develop a form of cooperation which, while inducing desired Western participation, would result in minimal conflict with traditional Soviet insistence on complete control over domestic production.

In 1975, Institute members stated that the concept of joint-ventures was being considered in light of the Hungarian and Romanian experiences and openly discussed those changes which would have to be made in Soviet law to enable foreign equity investment. By the end of 1975, Soviet planners had decided on the guidelines for such joint-ventures. The USSR would allow Western participation in the management of Soviet firms involved in the joint venture and would grant special exceptions to cover imports and exports connected with the joint venture. While the U.S.S.R. will not consider Western equity ownership of Soviet-based production facilities, Soviet officials indicated that Western investment would be guaranteed by Gosbank and that other provisions, amounting in theory to joint-ownership, might be included. Such guidelines are recognized by the Soviets as being very provisional; the final form of Soviet joint-venture legislation will probably be defined after agreements with Western firms have been reached and experience has been gained in operating joint-ventures with the West.

C. Leasing

Soviet FTO's did not begin leasing operations in their export efforts until 1970 when the Soviet-owned United Machinery Organization began leasing heavy duty construction equipment to British firms. Soviet interest in the potential of leasing resulted in the organization, in 1973, of two jointly owned companies to promote and finance leasing operations in Europe. In October, East-West Trading Company was founded by the Soviet Moscow Narnody Bank and the UK's Morgan Grenfell Bank, and in December the Soviet-owned Banque

[25] . . . "Ecotass," Mar. 11, 1974, p. 11.

Commerciale Pour l'Europe de Nord (BCEN) in Paris joined with France's Credit Lyonnais to form Promolease. The new firms are supervised by the leasing subsidiaries of the Western banks involved. While the leasing operations are intended to assist Soviet imports, they are principally concerned with increasing Soviet exports of manufactured goods to the West.

VIII. Actual Growth in Manufactured Goods Exports, 1965–74

The absolute growth of Soviet exports of manufactured goods (albeit from a small base) has been impressive. Annual sales rose from $48 million in 1965 to over $100 million in 1970 [26] (see Figure 1). Growth has been particularly striking in recent years, rising from $134 million in 1972 to $268 million in 1974 (the last year for which detailed figures are available). The USSR has been unsuccessful, however, in raising the share of manufactured products in total exports to the developed West. In 1965, manufactured good sales accounted for only 3.3 percent of total exports; by 1974 the level had risen slightly to 3.4 percent. For most of the intervening years the annual share ranged from 3.4 percent (in 1969) to a high of 4.6 percent (in 1972 and 1973).

Soviet Exports of Manufactured Goods to the Developed West

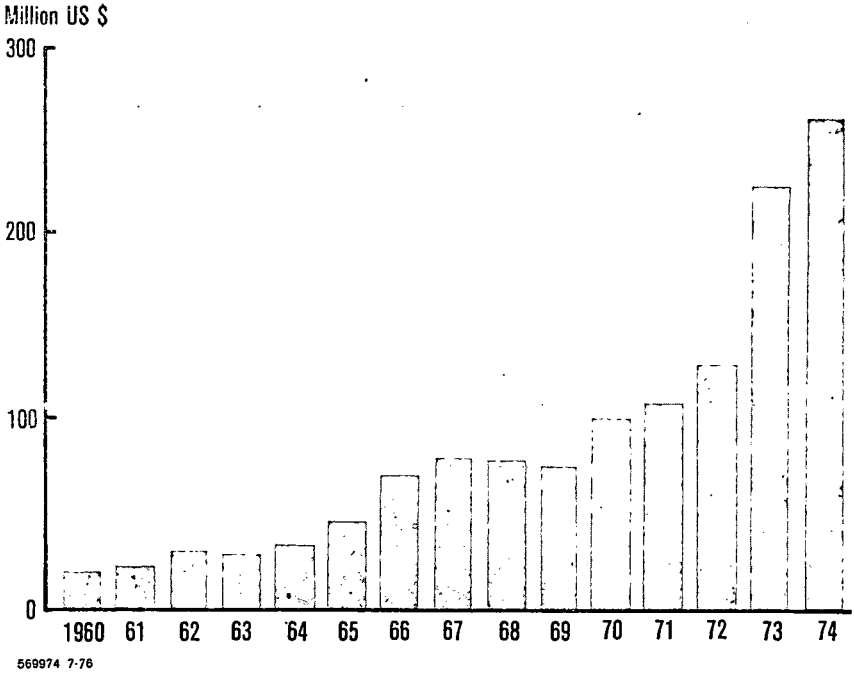

Figure 1

[26] Based on official Soviet foreign trade statistics as presented in "Vneshniaia torgovlia S.S.S.R."

Sales of Soviet manufactured goods in the West have been concentrated in Europe (see table 1). More than one-fourth of such exports in 1974 went to Finland, reflecting, in part, the special trading arrangements between the two countries. The United Kingdom has also been a major recipient of Soviet products, particularly automobiles, cameras, and watches. Soviet manufactured goods exports to West Germany in 1974 were led by ship sales, while export of manufactures to Italy consisted mainly of machine tools and communication equipment. Despite its special interests in expanding trade with the U.S.S.R., France has yet to become the major importer of manufactured products that the Soviets would like it to be. In 1974, Paris accounted for only 10 percent of total Soviet manufactured goods exports to the Developed West; major items included agricultural and transportation equipment.

TABLE 1.—U.S.S.R.: DISTRIBUTION OF MANUFACTURED GOODS EXPORTS BY PURCHASER

[Value in millions of U.S. dollars]

	1965		1970		1972		1973		1974	
	Value	Percent	Value	Percent	Value	Percent	Value	Percent	Value	Percent
Total Developed West	48.0	100.0	104.1	100.0	133.8	100.0	229.3	100.0	267.9	100.0
Belgium	3.8	7.9	3.1	3.0	8.0	6.0	22.2	9.7	14.0	5.2
France	2.5	5.2	9.2	8.8	14.7	11.0	24.4	10.6	27.0	10.1
Finland	17.2	35.8	16.5	15.9	26.3	19.7	57.3	25.0	72.7	27.1
Italy	1.0	2.1	5.5	5.3	7.1	5.3	14.1	6.1	20.1	7.5
Japan	2.7	5.6	6.5	6.2	8.9	6.7	9.0	3.9	11.5	4.3
West Germany	3.8	7.9	32.7	31.4	25.7	19.2	24.1	10.5	28.7	10.7
United Kingdom	10.8	22.5	8.7	8.4	17.4	13.0	26.8	11.7	40.1	15.0
United States	3.3	6.9	2.6	2.5	3.9	2.9	5.2	2.3	7.5	2.8

With the introduction of the Lada (the Soviet Fiat) in Western markets in 1972, automobiles have become the USSR's major manufactured goods export item (see table 2). Sales of power and electrical equipment have risen rapidly in recent years to $36 million in 1974. Ship sales have continued as a major export item, while sales of metal processing equipment—primarily metal-cutting machine tools—have grown steadily. In the consumer goods sector, the USSR has steadily increased camera sales and has been able to increase sharply the sale of watches in the West.

TABLE 2.—U.S.S.R.: DISTRIBUTION OF MANUFACTURED GOODS EXPORTS BY TYPE

[Value in millions of U.S. dollars]

	1965		1970		1972		1973		1974	
	Value	Percent	Value	Percent	Value	Percent	Value	Percent	Value	Percent
Total Developed West	48.0	100.0	104.1	100.0	133.8	100.0	229.3	100.0	267.9	100.0
Metal processing equipment	4.4	9.2	11.7	11.2	16.5	12.3	20.3	8.9	21.7	8.1
Power and electrical equipment	1.0	2.1	3.6	3.5	4.9	3.7	13.9	6.1	35.9	13.4
Mining, metallurgical, petroleum equipment	.3	.6	1.3	1.2	5.6	4.2	8.4	3.7	8.1	3.0
Medical and laboratory equipment	1.7	3.5	5.8	5.6	12.1	9.0	21.8	9.5	12.1	4.6
Tractors and agricultural equipment	.9	1.9	2.2	2.1	3.0	2.2	7.8	3.4	9.2	3.4
Ships and marine equipment	2.6	5.4	30.1	2.3	11.2	8.4	27.1	11.8	18.0	6.7
Automobiles	6.5	13.5	5.4	5.2	20.0	14.9	35.9	15.7	42.5	15.9
Watches	.8	1.7	2.4	2.3	5.3	4.0	7.0	3.1	11.1	4.1
Cameras	.9	1.9	2.2	2.1	3.0	2.2	6.2	2.7	6.5	2.4

IX. Factors Behind Sales Successes

As a rule, Soviet prices of manufactured goods are set below prices of competing goods in the West; in some cases discounts are quite substantial (see table 3). Soviet-produced injection-moulding equipment, for example, is being offered to UK buyers at 40 percent below prices charged by British manufacturers; Soviet machine tool and agricultural equipment prices are routinely set 20 percent to 50 percent below the prices of comparable models produced in the West.

Table 3.—*U.S.S.R.: Sample Soviet Prices for manufactured products, 1974–75*

Product:	*Percentage discount from Western prices for comparable goods*
Transformers	30
Resistors	30
Tractors	20–40
Machine tools	40–50
Turbines and compressors	40–50
Color television sets	25–31

Discount pricing has undoubtedly led to a great number of orders, particularly when Soviet sales have involved compenent parts such as electrical resistors or other manufactured goods where other competitive factors—appearance, technical documentation, and a repair/spare parts network—are of minimal importance. Low prices have also served as sufficient stimulus when, as in hydroelectric generating equipment, Moscow was able to offer a state-of-the-art product and integrate its sales effort into a larger deal involving a Western producer whom buyers could rely upon to rectify any subsequent problems.

The U.S.S.R. also has resorted to collateral purchase requirements in its attempts to expand exports of manufactured products. Soviet importers of Western capital equipment have often insisted that the Western supplier accept Soviet equipment in lieu of cash payment for 5 percent to 10 percent of the contract value. While this effort was traditionally employed only in the context of Soviet equipment purchases, more recently Moscow has predicated some agricultural purchases on counterpurchases of Soviet equipment. In November 1974, for example, the Soviets indicated that purchases of agricultural products from New Zealand were contingent on New Zealand buying Soviet equipment.

In addition to establishing their own firms, many FTOs have sought to initiate marketing and distribution agreements with Western companies. Low prices, deliveries on consignment, and easy payment terms have made such proposals attractive to a number of Western firms. The Soviets, in turn, are able to penetrate established markets by relying on Western companies familiar with retailing in established Western markets. In some cases—machine tools and watches—the arrangements have included a blending of Soviet with Western components and marketing under the Western firms' trademarks. Soviet watch sales are concentrated in France and the UK where such arrangements are in effect.

The Soviets have also been active in establishing networks of dealerships to assist in the sales and servicing of automobiles and tractors sold in the West. Some 150 dealers have been appointed in the United Kingdom to support Satra Corporation's sales of Soviet automobiles, and Soviet automobile sales efforts in Norway, Sweden, and Finland are also backed by a network of local dealerships. Soviet tractor sales in France are supported by over 130 local outlets, and Belarus Equipment of Canada—a Soviet controlled company specializing in tractor sales—is in the process of expanding its dealerships in both Canada and the United States.

Another factor behind Soviet sales successes has been the willingness of some Soviet exporters to tailor their products to Western specifications. Such alterations often call for only minor changes in Soviet production, such as the painting of Soviet resistors to Western standards.[27] The U.S.S.R. has also sought to combine Soviet and Western components to make the product more attractive to Western buyers. Soviet-produced machine tools are often coupled with Western numerical controls and Soviet aircraft with Western avionic equipment. Most recently, the U.S.S.R. signed an agreement with Italy's Worthington Italiana SPA for the joint production of pumps for use in the chemical and hydrochemical sectors.

X. Prospects

We cannot enter the world marketplace straitjacketed by our domestic habits and traditions of planning, manufacture, and transport, basing our actions and decisions solely on the laws of the domestic market. We must be up to the level of the demands of the world market. Attainment of this level will not cause damage to our planned economy, nor to the laws of socialist production, nor particularly to Communist ideology. On the contrary, this principle will teach us much and will make us a stronger competitor with capitalism.[28]—N. Smelyakov, 1973.

Several problems must be resolved before the Soviet Union can expect manufactured goods to become an important share of Soviet exports to the West. Recently instituted changes—accommodation to Western requirements, joint-production, and use of Western marketing expertise—represent a distinct improvement over the superficial and largely organizational measures undertaken during 1966–1972. The new programs, however, leave untouched the more basic problems related to the traditional approach to foreign trade production and sales.

If exports are to be expanded meaningfully, Soviet producers must be made directly accountable, and compensated accordingly, for the success or failure of their sales efforts in the West. To be effective, this change would involve providing the producer with:

Direct access to potential buyers, including participation in Soviet-owned companies in the West and a direct say in marketing efforts associated with the product;

the ability to import Western technology and equipment needed to make his output more competitive;

the authority to have component parts produced in the quantity and quality necessary to meet his export commitments; and

considerable freedom in production, allowing him to be responsive to changes in Western demands.

[27] . . . Soviet Push Sales of Products in West Germany, Der Spiegel, Mar. 30, 1970, pp. 20–24.

[28] Smelyakov N., "Soviet Foreign Trade Minister Discusses East-West Trade," p. 20.

Producing ministries have become increasingly aware of Western needs and competitive conditions in recent years by their increased participation in negotiations with Western firms. As noted earlier, the establishment of zagranpostavkas, in particular, has the potential for greater producer participation in the export process. Compensation agreements currently being advocated for the producing sectors also represent a step in the direction of tasking producers with export responsibilities. Yet, the potential for compensation agreements is limited by Western reluctance to provide state of the art technology and marketing assistance on a continuing basis without some form of management and equity participation.

In addition to allowing producers direct access to buyers and holding them accountable for sales, other key indicators of a Soviet commitment to implement changes needed to significantly improve Moscow's exports of manufactured goods include:

Affirmative action on recent high-level statements calling for the establishment of firms producing solely for Western export markets;

where required, some allowance for Western management and possibly equity participation;

a greater availability of goods for export and a more flexible production schedule allowing for quicker delivery times; and

a greater emphasis on spare parts production and the establishment of additional outlets in the West.

The U.S.S.R. is studying U.S. proposals for joint-venture agreements involving U.S. participating in Soviet production. In a December 1975 address, Deputy Minister of Foreign Trade Sushkov discussed some of the proposals forwarded by U.S. firms which were being considered. One firm, for example, has submitted a proposal to build a plant to produce automobile parts in the U.S.S.R. for resale in the West under the U.S. firm's brand name. The proposal provides for joint management of production, with the Western firm's representatives responsible for quality control and the use of state-of-the-art technology and equipment in production. The U.S. firm would be paid for its capital investment and services out of Soviet production of the finished products [29] The U.S.S.R., however, has yet to formalize the requisite joint-venture legislation which would allow for such an arrangement.

Moscow will find it difficult to arrive at a meaningful program, such as joint-ventures, which will be implemented by the massive and conservative Soviet bureaucracy. Advocates of change, such as N. Smelyakov, appear to be in a distinct minority. Although their influence on policy seems on the rise, their past initiatives have been frustrated by widespread bureaucratic resistance and by the failure of the U.S.S.R. to gain most-favored-nation status from the United States.

In the final analysis, politics rather than economics may prove to be the major barrier to needed change. The Communist party maintains tight control over the Soviet economy, and the political element

[29] Sushkov, V. N., address given on Dec. 8–11, 1975, Symposium on U.S.-Soviet Technological Cooperation.

plays a pervasive role at all levels of economic decisionmaking. This political element has proven very resistant to needed economic change in the past, particularly when such changes threatened to result in a diminution of its control. It is difficult to perceive of an economy responsive both to the needs of a capitalist market and the party. The creation of a special export sector, which like the military economic sector is distinct from the larger domestic economy, may prove to be the only feasible solution to this dilemma.

Over the next several years, continued implementation of recently initiated programs should allow the U.S.S.R. to continue to increase sales of manufactured products in the West. Sales will continue to be centered in those areas—automobiles, tractors, power equipment, machine tools—which have been the mainstay of past efforts. Until more meaningful changes are fully implemented, however, Soviet manufactured goods sales will remain a small percentage of total exports to the West; they should account for less than 10 percent of total exports for at least the balance of the decade.

SOVIET TRADE AND PAYMENTS WITH THE WEST

JOHN FARRELL AND PAUL ERICSON

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I. INTRODUCTION

Foreign trade has been the most rapidly growing sector in the Soviet economy in the last decade. Turnover (exports plus imports) has grown at an average annual rate of almost 16 percent, and amounted to slightly more than $70 billion in 1975.[1] During this period, the Communist countries' share of Soviet trade fell from 66 percent to 56 percent and the less developed countries share rose only fractionally to 13 percent. The principal gainer in trade with Moscow has been the developed West, which represents most of the Soviet hard currency trade.[2]

The U.S.S.R.'s trade with the West has grown rapidly in recent years, characterized by a much greater growth in Soviet imports than exports. Much of the growth in imports has resulted from a growing Soviet commitment to Westen technology and equipment in developing its domestic economy. As part of this program, the U.S.S.R. has sought large amounts of Western capital to assist in the development of raw material resources, such as natural gas, forestry, and chemicals. Also pushing up imports in recent years, was Moscow's need to purchase huge quantities of Western grains following poor harvests in 1972 and 1975.

The U.S.S.R. has been unable to generate sufficient exports to pay for the growing level of imports from the West. Annual hard currency trade deficits for 1966–73 averaged about $550 million and were topped

[1] Unless otherwise specified, Soviet foreign trade data presented in this paper are derived from official Soviet statistics (U.S.S.R. Ministeratvo Vneshnei Torgove. "Vneshniaia Torgovlia S.S.S.R. za 1967 (1975) god").

[2] See appendix A for a complete listing of those countries trading with the U.S.S.R. on a convertible (hard currency) basis.

by a then record trade deficit of $1.7 billion in 1973 (see table 1). Hard currency receipts from long-term credits and invisibles allowed the U.S.S.R. easily to cover such deficits. Unexpected large deficits, such as the one in 1973, have also necessitated the sale of large amounts of gold and/or the need to step up short- and medium-term borrowing from Western commercial banks.

The rapid rise in world market prices for traditional Soviet exports—oil, forestry products, and metals—allowed the U.S.S.R. to limit its deficit in 1974. However, Moscow's hard currency deficit in 1975 soared to $6.3 billion when recession in the West limited Soviet exports at a time when imports were shooting upward. In addition to heavy use of government-backed credits, the U.S.S.R. was forced to borrow over $4 billion from Western commercial banks last year.

TABLE 1.—U.S.S.R.: HARD CURRENCY TRADE DEFICIT

[In millions of U.S. dollars]

	Exports	Imports	Balance
1966	1,517	1,755	−238
1967	1,711	1,616	+95
1968	1,909	2,018	−109
1969	2,125	2,436	−311
1970	2,197	2,711	−514
1971	2,652	2,955	−303
1972	2,815	4,171	−1,356
1973	4,818	6,566	−1,748
1974	7,630	8,541	−912
1975	7,800	14,081	−6,281

II. Trade, 1974–75

Soviet hard currency trade in 1974–75 clearly reflected Western inflation and recession and last year's poor Soviet harvest. The economic downswing in the West had little effect on world trade during the first half of 1974 as inflation was boosted to record levels by soaring prices for oil and other commodities. Fear of shortages and expectations of still higher prices brought continued growth in trade volume. This speculative boom set the stage for the sharp fall in world trade which began in the final quarter of 1974. With economic activity contracting, firms in many industrial countries had built up excessive inventories, and the stock overhang considerably worsened the trade slump in the fourth quarter. This slump continued well into 1975 before Western nations began a slow recovery.

Soviet hard currency exports mirrored world trade in 1974; they rose rapidly in the first three quarters, but fell sharply in November and remained low in December when Western demand (and prices for many Soviet raw materials) declined rapidly. Soviet exports remained depressed in 1975, rising only 2.7 percent in value over 1974. At the same time, most Soviet imports continued to rise, and import volume rose too, especially capital goods and steel.

Western firms, caught with high inventories and declining demand, were eager to meet standing Soviet requests for increased imports—particularly for steel products. As a result, Soviet purchases of steel products climbed dramatically during November and December. Soviet imports continued at a high level in 1975, and for the year rose in value by 66 percent over 1974. The 1975 rise resulted from a record

level of capital goods imports, a continued high level of imports of Western steel products, and increased purchases of grain and other agricultural products.

A. Imports

Soviet imports from the West rose by $2 billion in 1974, in spite of a $900 million decline in grain purchases. Larger volume and higher prices were both important factors in the sharp increase in nongrain imports (see table 2). For example, imports of nontubular steel, machinery and equipment, plastics, rubber, and pipe all rose both in volume and price. For other products, particularly chemicals, higher prices accounted for most of the increase.

Soviet imports in 1974 featured:

A doubling in value of Soviet purchases of steel products from the West to $1.9 billion. Western firms accounted for 70 percent of total Soviet steel imports and the average price was up 41 percent above 1973.

Soviet purchases of machinery and equipment from the West were up by $600 million over the 1973 level to $2.3 billion, largely a result of orders placed in 1972 and 1973 (see table 3). Orders for most 1974 deliveries were placed before the 1973 oil embargo, when prices were relatively stable, thus prices were not a major factor in the increase.

TABLE 2.—U.S.S.R.: CHANGES IN THE PRICE AND QUANTITY OF SOVIET IMPORTS

	Change from 1973 to 1974 (million U.S. dollars)	Percentage change	
		Quantity	Price
Total imports	1,975	NA	NA
Machinery and equipment	594	[1] 22	[1] 10
Crude oil	59	−69	294
Steel	988	50	41
Pipe	226	8	42
Shaped and rolled steels	718	102	43
Plastics and related materials	236	[1] 7	[1] 171
Other chemicals	212	[1] −10	[1] 139
Natural rubber	127	22	62
Textile raw material and semi-manufactures	54	[1] −3	[1] 3
Grain	−900	−76	45
Other foods	−61	NA	NA
Manufactured consumer goods	59	NA	NA
Unspecified imports	233	NA	NA
Other imports	419	NA	NA

[1] Representative sample.

TABLE 3.—U.S.S.R.: KNOWN PLANT AND EQUIPMENT ORDERS FROM THE WEST BY SELECTED COUNTRIES

[In millions of U.S. dollars]

	1971	1972	1973	1974	1975
Total	850	1,585	2,265	4,125	4,508
France	80	370	425	845	866
Italy	65	170	130	310	915
Japan	140	135	205	445	817
United Kingdom	120	75	155	250	148
United States	240	325	480	865	571
West Germany	145	370	645	1,060	698
Other	60	140	225	350	493

Soviet imports of chemical products, particularly plastics, increased rapidly as a result of higher prices.

Grain purchases fell sharply—by 63 percent to $523 million—but Moscow paid an average price 45 percent more than in 1973.

Soviet imports of textile raw materials and related semimanufactures rose by only $54 million; however, they constituted a a major component of Soviet hard currency imports at almost half a billion dollars.

Soviet hard currency imports in 1975 rose by 65 percent in value to $14.1 billion. Increased purchases of grain (up $1.8 billion) and Western equipment (up $2.2 billion) accounted for almost three-quarters of this rise. Steel products rose by about $600 million, despite a decline in imports of nontubular steel. Pipe imports were responsible for the increase. Imports of plastics and rubber declined in volume and in price.

Soviet imports in 1975 were highlighted by:

A near doubling of machinery and equipment purchases, up by $2.2 billion to $4.5 billion. The largest increases came in transportation equipment, metallurgical and petroleum equipment, metal processing equipment, and industrial fixtures.

A growth in grain imports more than four times the 1974 level, reaching $2.4 billion and reflecting both the seriousness of the Soviet crop failure and higher prices for Western grain.

Increased imports of steel products—to $2.5 billion—despite a drop of over $200 million in nontubular steel imports. Shortages of hard currency may have forced Soviet cancellation or deferment of certain steel imports.

Little change in the value of chemical imports despite lower prices and a drop of $90 million in imports of plastics.

Among other imports, sugar increased sharply to $225 million from $17 million and meat imports almost tripled to $355 million. Rubber dropped in value by 19 percent to $208 million. Textile raw materials and related semimanufactures also declined by about $100 million.

B. Exports

Higher world market prices for major Soviet exports, principally oil and wood, led the large rise in Soviet export earnings in 1974 (see table 4). On the average, Soviet export prices almost doubled and

TABLE 4.—U.S.S.R.: CHANGES IN THE PRICE AND QUANTITY OF SELECTED EXPORTS

	Change from 1973 to 1974 (million U.S. dollars)	Percentage change	
		Quantity	Price
Total exports	2,813	[1] −19	[1] 95
Of which:			
Oil and oil products	1,314	−13	136
Coal and coke	120	11	68
Round timber	119	−10	45
Coniferous lumber	139	−30	118
Cotton fiber	134	−10	79
Platinum, platinum group metals[2]	[2] 79	[2] −10	[2] 43
Copper	63	14	22
Aluminum	33	2	61

[1] Based on a weighted price index.
[2] Estimated.

almost the entire change occurred in the first half of 1974. The prices of such commodities as oil, copper, and diamonds fell during the latter part of the year in response to recession-induced decline in demand.

Soviet receipts from the sale of crude oil and petroleum products almost doubled in 1974 to $2,564 million and accounted for almost half of the total rise in Soviet export earnings. Despite the rapid rise in world market prices for oil and record domestic crude oil production, the volume of Soviet crude oil and petroleum products exported to hard currency countries fell by 13 percent to 617,000 barrels per day.

Other Soviet export commodities played a major role in Soviet trade in 1974.

Soviet earnings from the sale of wood and wood products rose by $312 million to $1 billion in 1974 on the strength of substantially higher prices.

Higher world prices also contributed to a 60 percent increase in Soviet cotton export earnings in 1974 to $357 million, despite a 10 percent decline in volume.

Earnings from exports of coal and coke increased 89 percent in 1974 to $255 million with average prices up 68 percent.

Natural gas earnings were only $86 million in 1974 as deliveries to Italy were just beginning and those to West Germany remained small.

Strong world demand, fueled in part by speculation, also led to higher prices for Soviet platinum and platinum group metals in 1974. Despite an estimated 10 percent drop in volume, 1974 earnings rose by an estimated $80 million to $350 million.

Despite a falloff in world demand, Soviet diamond sales picked up during the last 6 months of 1974 and totaled $400 million for the year.

Despite apparent attempts to increase hard currency export earnings to cover rapidly growing import costs, Soviet hard currency exports rose less than 3 percent in 1975 because of the recession in the West.

Earnings from exports of wood and wood products fell more than 30 percent to $699 million because of lower prices and reduced demand. Soviet exports of sawn lumber to the United Kingdom, for example, fell by 7 percent in volume and 35 percent in price. Exports of round timber to Japan, while slightly above 1974's level, dropped in value by 25 percent.

Total exports of cotton were down almost 20 percent to $289 million. Soviet earnings from cotton sales were hurt by lower prices; prices from United Kingdom buyers were down by 22 percent.

Moscow increased significantly exports of oil and oil products to the West, otherwise Soviet hard currency earnings would have fallen absolutely. Export earnings from these commodities rose by 23 percent to $3.2 billion on the strength of a 24 percent increase in export volume.

Gas exports almost tripled at $218 million as volume rose by 44 percent. Exports of coal and coke rose 53 percent, reaching $389 million.

III. Financing the Deficits

Moscow's past ability to achieve a surplus in its basic balance of payments despite continual trade deficits has resulted largely from the willingness of Western governments to finance Soviet equipment purchases with long-term, low-interest credits. The Soviet decision to rely heavily on Western credits has led, however, to a steady rise in the U.S.S.R.'s hard currency indebtedness, which stood at $7.5 billion at the end of 1975. The long-term structure of the debt and the growth of Soviet exports, however, have kept debt service at or below 20 percent (see appendix C).

Soviet trade deficits have also been covered, in part, by earnings from gold sales and by short- and medium-term borrowing from Western commercial banks. These sources play a particularly important role in years when deficits are unusually large and, hence, are not adequately covered by medium- and long-term credits extended by the West to finance Soviet equipment purchases. Massive Soviet grain purchases in 1972–73 led to such financing problems and probably were in great part responsible for the Soviet decision to resume the large-scale sales of gold. In addition, revenues from non-trade sources—tourism, transportation, and arms sales for hard currency—have helped cover hard currency trade deficits.

TABLE 5.—U.S.S.R.: HARD CURRENCY BALANCE OF PAYMENTS

[In millions of U.S. dollars] [1]

	1974	1975
Merchandise exports, f.o.b.[2]	7,600	7,800
Merchandise imports, f.o.b.[2]	−8,500	−14,100
Nonmonetary gold	800	[3] 1,000
Services and transfers, net	300	200
Current account balance	200	−5,200
Medium- and long-term capital, net [4]	800	3,000
Basic balance	1,000	−2,200
Change in Eurocurrency position, net [5]	NA	3,200
Errors and omissions [6]	−1,000	−1,000

[1] Data rounded to nearest $100,000,000.
[2] Derived from Soviet statistics.
[3] Including rumored sale of 50 tons directly to Middle Eastern buyers, which may have earned some $250,000,000.
[4] Includes government-backed export credits and estimated Soviet medium- and long-term commercial borrowing in the United States and Europe.
[5] Position includes some medium-term borrowing.
[6] Changes in short-term capital and hard currency receipts from less developed countries for Soviet credits and arms sales.

IV. The 1974 Deficit

The U.S.S.R. achieved a basic balance of payments surplus of $1 billion in 1974 as credit drawings and gold sales more than compensated for the $912 million deficit in Soviet hard currency trade (see Table 5). The U.S.S.R. drew an estimated $1.7 billion in medium- and long-term credits—most of which were government guaranteed and made available at subsidized interest rates—to finance 1974 imports. An estimated $1.4 billion worth of machinery and equipment imports was financed in this manner, and West Germany, France, and

Japan were the major sources of credit. The remaining $300 million in long-term credits were drawn to finance Soviet imports of large-diameter pipes as part of the several gas-for-pipe compensation agreements signed in recent years. Because Soviet repayments on past drawings rose faster than new drawings, net medium- and long-term credits fell to $800 million. Nonetheless, earnings from exports increased even faster than debt service, and the debt service ratio fell to 15 percent.

Although gold sales were not required to balance Soviet payments in 1974, the U.S.S.R. took advantage of record gold prices in earning an estimated $750 million from the sale of roughly 150 tons of gold. A good portion of these earnings were apparently deposited with Western banks. Soviet assets in United Kingdom banks rose by $500 million in 1974 and by the end of the year total Soviet assets and liabilities with all commercial European and U.S. banks were roughly in balance. The general improvement in the U.S.S.R.'s balance of payments also allowed Moscow to forego the use of CCC credits in purchasing roughly $300 million in U.S. wheat, corn, and rye in 1974.

V. Problems in 1975

In 1975, the U.S.S.R. incurred a basic balance deficit of about $2.2 billion, despite increased use of medium- and long-term credits and a higher volume of gold sales in the West. Medium- and long-term credits drawn to finance equipment and pipe imports covered only a portion of the 1975 hard currency trade deficit of $6.3 billion. Once allowances are made for the repayment of principal and interest on past debt, only $2.2 billion was available, and Moscow was forced to finance the remaining $4.1 billion from other sources.

A. Eurodollar Borrowing

The U.S.S.R. entered 1975 with a net liability of only $74 million vis-a-vis its position with Western commercial banks.[3] (See the chart.) During the year, Moscow borrowed roughly $4.3 billion from Western commercial banks while at the same time reducing its holdings by $371 million. At year's end, total Soviet liabilities stood at $7.6 billion and net-liabilities (subtracting out Soviet assets held by Western banks) at $4.7 billion.[4] Much of this borrowing was done on a direct bank-to-bank basis whereby the U.S.S.R. obtained time deposits and other short- and medium-term credits simultaneously from a great number of banks. Borrowing was heaviest during the first ($1.4 billion) and fourth ($1.7 billion) quarters of the year. The U.S.S.R. also drew heavily on its deposits in Western banks during January-June of 1975, only to rebuild them during the third and fourth quarters.

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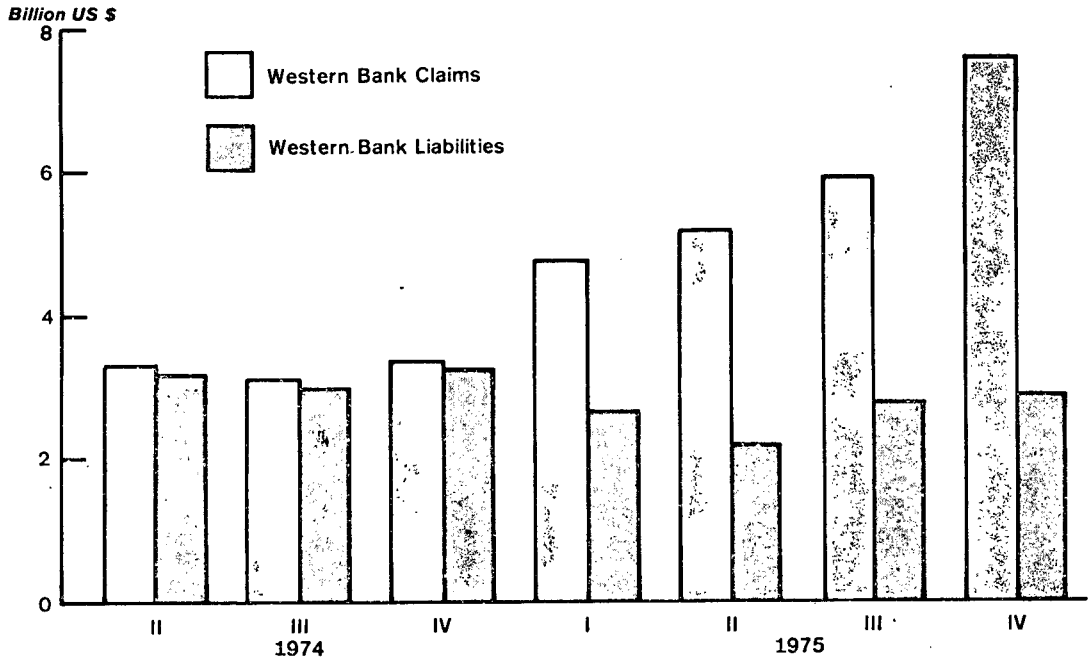
[3] Bank of International Settlements data, which includes reporting from the commercial banks of Belgium-Luxembourg, France, West Germany, Italy, the Netherlands, Sweden, the United Kingdom, Canada, and the United States. The U.S.S.R. was probably a net debtor vis-a-vis Swiss banks, which do not report their positions with the U.S.S.R. to the BIS.

[4] According to U.S. Treasury and Federal Reserve statistics, U.S.-based banks and their major foreign branches held $1 billion in claims against the U.S.S.R. at the end of 1975. Almost 60 percent of these claims were held by the foreign branches.

Western Commercial Banks: Claims and Liabilities vis-a-vis the USSR

Figure 1



1. Banks of Belgium-Luxembourg, France, West Germany, Italy, the Netherlands, Sweden, the United Kingdom, Canada, and the United States since the second quarter of 1974 and offshore branches of US banks, beginning in the fourth quarter of 1975. The USSR is also believed to be a significant net debtor with Swiss banks.

Syndicated medium- and long-term loans accounted for only $800 million of total Soviet Eurodollar borrowing in 1975. In all cases, the U.S.S.R. was able to obtain relatively favorable terms and management fees. Lead Western banks had little trouble in arranging the syndications.

Well over $500 million of Soviet Eurodollar borrowing was probably indirect, resulting from the discounting of private supplier's credits by Western firms with their banks. In such instances, the U.S.S.R. paid for Western equipment with a series of negotiable notes which were guaranteed by the Soviet Bank of Foreign Trade and which carried a fixed interest rate of 6.5 percent to 7.5 percent. In most cases the notes matured over a period of five years or more and were discounted on a nonrecourse basis at 8 percent to 9 percent. The total medium- and long-term component of Soviet 1975 Eurodollar borrowing was thus probably in the range of $1.3 billion to $1.8 billion or more.[5]

B. Gold Sales

The Soviets were constrained in their efforts to sell gold in 1975 by market developments—such as the August 1975 IMF announcement of gold sales—which helped to push the gold price down from $165 per ounce to below $130 per ounce. Nonetheless, heavy Soviet sales allowed Moscow to earn roughly $750 million from its 1975 sales on the Swiss market. In addition, the U.S.S.R. acknowledged direct sales to Middle Eastern buyers, notably Kuwait and Saudi Arabia. Some 50 tons, worth an estimated $250 million, reportedly were sold last summer.

C. Other Sources of Hard Currency Revenue

The U.S.S.R. also benefited from net revenues from its transportation and tourism and from direct lending from OPEC nations. An expanding merchant marine allowed the U.S.S.R. to net an estimated $400 million in revenues last year, and net 1975 earnings on tourism are estimated at $150 million.

VI. Prospects for 1976

A. Trade

The U.S.S.R. ran a hard currency trade deficit of almost $2 billion in the first quarter of 1976 and early indications suggest that Moscow faces a $4 billion to $6 billion deficit for the year as a whole (see table 6). The Soviets were able to keep nongrain imports at the first quarter 1975 level, while recovery in the West enabled the U.S.S.R. to increase export earnings by 31 percent. Western economic recovery is expected to continue to stimulate export earnings for the balance of the year. The size of the deficit will depend upon the level of imports for the year, particularly grain. If all additional grain purchases are delivered in 1976 and nongrain imports grow only slightly, the deficit could be as low as $4 billion. Should the U.S.S.R. fail to hold down nongrain imports to close to last year's level or should new contracts call for substantial increases in grain deliveries this year, the trade deficit could approach, or possibly exceed, $6 billion.

[5] This amount is included in Soviet medium- and long-term indebtedness as discussed above and shown in appendix C.

TABLE 6.—U.S.S.R.: HARD CURRENCY TRADE 1975–76

[In millions of U.S. dollars]

	1st quarter 1975	1st quarter 1976	1975	1976
Soviet imports, f.o.b.	3.6	4.0	14.1	[1] 15–16.5
Of which:				
Grain	[1].6	[1] 1.0	2.4	[1] 2.8–4.0
Soviet exports, f.o.b.	1.5	2.0	7.8	[1] 10.5–11.0
Balance	−2.1	−1.9	−6.3	[1] −4.0–6.0

[1] Estimated.

B. Financing the Deficit

Tight controls over hard currency outlays and a deferment of some orders for equipment will not significantly reduce the projected 1976 deficit. It may, however, allow Moscow to reduce substantially that portion of assets held in Western banks to cover day-to-day financial needs. There is little to suggest a sharper cutback on imports, and Moscow's ability to do so is constrained by contracts previously signed for equipment, steel products, and grains.

The U.S.S.R. is again expected to obtain medium- and long-term credits to cover a major share of the estimated $4.5 billion to $5 billion in machinery and equipment which will be imported from the West this year. As in the past, a major portion of such credits will again be backed by Western governments. Approximately $1 billion in government-backed credits are expected to be advanced in support of Soviet large-diameter pipe imports. The U.S.S.R. also is expected to make heavier use of promissory note financing in 1976, possibly to the detriment of concomitant attempts to obtain pure financial credits on the Eurocurrency market. Total medium- and long-term credits associated with equipment and pipe imports will thus probably reach $3.7 billion. Allowing for principal and interest repayments on past medium- and long-term credit drawings, new drawings will net the U.S.S.R. roughly $1.4 billion which can be applied against the 1976 trade deficit.

As in 1975, other invisibles and earnings from arms sales should net the U.S.S.R. $750 million, leaving roughly $2 billion to $4 billion to be covered by gold sales and additional financial credits from the West. Although the U.S.S.R. remains an excellent credit risk in the eyes of Western bankers, heavy Soviet borrowing in 1975 may have constrained Moscow's ability to borrow as heavily in the Eurocurrency market this year. At a minimum, it appears that the U.S.S.R. will have to pay higher interest rates and management fees for additional borrowing in 1976. The Soviets have traditionally resisted increases in interest rates and may instead opt for heavier gold sales. Press reports, for example, recently included an example whereby the U.S.S.R. used gold to cover a $7 million progress payment due a Swiss exporter.

Appendix A

Hard Currency Trading Partners of the U.S.S.R. in 1975

Developed West

EEC	*Other Europe*	*Non-Europe*
Belgium	Austria	Australia
Denmark	Norway	Canada
France	Sweden	Japan
Ireland	Switzerland	New Zealand
Italy		Union of South Africa
Luxemburg		United States
Netherlands		
United Kingdom		
West Germany		

Less Developed Countries

Europe	*Latin America*	*Asia and Mid-East*
Malta	Argentina	Burma
Portugal	Bolivia	Cyprus
Spain	Brazil	Indonesia
	Chile	Iraq
	Colombia	Israel
	Costa Rica	Jordan
	Dominican Republic	Kuwait
	Ecuador	Lebanon
	El Salvador	Malasia
	Guatemala	Nepal
	Guyana	Philippines
	Jamaica	Saudi Arabia
	Honduras	Singapore
	Mexico	Thailand
	Nicaragua	Yemen Arab Republic
	Panama	Yemen Peoples Republic
	Paraguay	
	Peru	
	Trinidad & Tobago	
	Uruguay	
	Venezuela	

Africa

Burundi	Liberia	Tanzania
Cameroon	Libya	Togo
Central African Republic	Malagasy Republic	Uganda
Congo, Peoples Republic (Brazzaville)	Malawi	Upper Volta
Dahomey	Mauritania	Zaire Republic (Congo, Kinshasa)
Ethiopia	Mauritius	Zambia
Equatorial Guinea	Niger	
Gabon	Nigeria	*Other*
Gambia	Rwanda	Hong Kong
Ivory Coast	Senegal	Macao
Kenya	Sierra Leone	
	Sudan	

Appendix B

U.S.S.R.: COMMODITY COMPOSITION OF HARD CURRENCY TRADE[1]

[In millions of U.S. dollars]

	1974		1975	
	Value	Percent	Value	Percent
Total exports[2]	7,630	100.0	7,800	100.0
Crude oil and petroleum products	2,564	33.6	3,165	40.6
Coal and coke	255	3.3	389	5.0
Natural gas	86	1.1	209	2.7
Ferrous and nonferrous metals	582	7.6	328	4.2
Wood and wood products	1,032	13.5	699	9.0
Lumber	436	5.7	242	3.1
Cotton fiber	357	4.7	289	3.7
Furs and pelts	71	.9	65	.8
Other	1,434	18.8	1,645	21.1
Unspecified[3]	1,247	16.3	1,010	12.9
Total imports[2]	8,541	100.0	14,081	100.0
Machinery and equipment	2,333	27.3	4,553	32.3
Rolled ferrous metals	1,871	21.9	2,497	17.7
Pipe	654	7.7	1,502	10.7
Nonferrous metals	103	1.2	98	.7
Chemicals	727	8.5	728	5.2
Plastics	331	3.9	241	1.7
Rubber	256	3.0	208	1.5
Textile raw materials and related semi-manufactures	507	5.9	384	2.7
Food	1,082	12.7	3,203	22.7
Grain	523	6.1	2,298	16.3
Manufactured consumer goods	261	3.1	428	3.0
Other	785	9.2	1,122	8.0
Unspecified	616	7.2	860	6.1

[1] Source: Official Soviet foreign trade statistics.
[2] Because of rounding, components may not add to totals shown.
[3] Composed mainly of exports of diamonds, platinum, and platinum group metals, and nickel.

Appendix C

U.S.S.R.: ESTIMATED DRAWINGS AND SCHEDULED REPAYMENTS ON MEDIUM- AND LONG-TERM CREDITS

	Million U.S. dollars					
	Drawings[1]	Scheduled payments to principal[2]	Scheduled payments to interest[2]	Amount available to offset trade deficit	Outstanding debt at yearend	Debt service ratio (percent)[3]
1970	715	310	79	326	1,722	18
1971	682	374	103	204	2,029	18
1972	[4] 1,030	451	122	457	2,608	20
1973	[4] 1,690	657	157	875	3,641	17
1974	1,710	890	220	600	4,461	15
1975	4,300	1,272	276	2,752	7,489	20
1976[5]	4,450	1,760	509	2,181	10,179	([6])

[1] Estimates of medium- and long-term drawings are based on deliveries of machinery and equipment to the U.S.S.R. judged to be covered by government-backed credits and Soviet promissory note financing, Commodity Credit Corporation credits granted by the United States in 1972 and 1973, and known medium-term consortium credits drawn in 1975 and estimated consortium credits ($750,000,000) for 1976.
[2] Repayments of principal and interested are made on the basis of average credit lengths and interest rates estimated to have been in effect during the year in question.
[3] Repayments of principal and interest taken as a percentage of Soviet hard currency exports. Inclusion of invisibles receipts would decrease the debt-service ratio only slightly.
[4] Including drawings on 3-year Commodity Credit Corporation credits.
[5] Preliminary estimates.
[6] Not available.

U.S. GOVERNMENTAL AND PRIVATE INDUSTRY COOPERATION WITH THE SOVIET UNION IN THE FIELDS OF SCIENCE AND TECHNOLOGY

LAWRENCE H. THERIOT *

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I. Background

One of the important consequences of the evolution of U.S. relations with the Soviet Union since 1972 has been the increasing exchange of various types of information between the two countries. An important part of this new information flow results from programs for joint cooperation in the fields of science and technology. Such exchanges have special significance in terms of their long term impact on U.S.-U.S.S.R. economic and commercial relations.

From 1958 to 1972, ad hoc intergovernmental exchanges visits of scientists and exchanges of scientific and technological information between the U.S. and the Soviet Union had taken place chiefly under the Cultural Exchanges agreement between the two countries. However, joint cooperation was institutionalized at the Moscow Summit in may 1972, where an agreement on the Basic Principles of Relations between the U.S. and the U.S.S.R. was concluded. Point 8 of the principles states:

> The two sides consider it timely and useful to develop mutual contacts and cooperation in the fields of S&T. Where suitable, the U.S. and the U.S.S.R. will conclude appropriate agreements dealing with concrete cooperation in these fields.

This principle has served as the basis for eleven intergovernmental cooperation agreements in various fields of science and technology.

U.S.-U.S.S.R. Cooperation Agreements

Science and Technology [1]	May 1972.
Environmental Protection [1]	Do.
Medical Science and Public Health	Do.
Space Cooperation	Do.
Agriculture [1]	June 1973.
Transportation [1]	Do.
Studies of the World Ocean [1]	Do.
Atomic Energy [1]	Do.
Energy [1]	June 1974.
Artificial Heart Research and Development	Do.
Housing and Other Construction [1]	Do.

[1] Indicates inclusion of an article (usually No. 4) which encourages contact between appropriate organizations and firms on both sides.

Nine of the eleven accords established a Joint Committee to implement their provisions. These Committees meet, at least annually, to approve cooperation in selected areas, to provide overall guidance and to review accomplishments and failures in cooperative programs. In the interim between annual meetings, their operational responsibilities are assumed by U.S. and Soviet government agency coordinators for the agreements. On the U.S. side, these lead agencies include various cabinet and subcabinet level organizations which are matched with the appropriate Soviet institutions. (See appendix A for details of the organizational structure under each of the eleven agreements.) The agreements also provide for the establishment of Executive Secretaries to coordinate administrative support for and oversee the cooperative programs. About 150 such programs are currently being carried out under the eleven agreements.

Several Western European countries have also signed intergovernmental S. & T. agreements with the U.S.S.R. Moreover, the United States has concluded an intergovernmental S. & T. agreement with

Poland and received proposals for agreements from other Eastern European countries. However, the broad range and substantial level of bilateral U.S.-Soviet cooperative activity in science and technology appears to be unique.

One of the eleven agreements, the Agreement for Cooperation in the Fields of Science and Technology (AST for brevity) established a basic format and organizational structure for the ten subsequent intergovernmental accords. Eight of the eleven agreements contain similar articles (usually number 4) which have proven particularly significant, because they have been interpreted by the Soviets as a juridical basis for joint cooperation directly between Soviet agencies and private U.S. companies. Article 4 of the AST states:

> Both parties will, as appropriate, encourage and facilitate the establishment and development of direct contacts and cooperation between agencies, organizations and firms of both countries, and the conclusion, as appropriate, of implementing agreements for particular cooperative activities engaged in under this agreement.

Fifty-three "cooperation agreements" (hereafter termed CAs) [1] have been concluded between U.S. corporations and the Soviet Union's State Committee for Science and Technology (hereafter SCST), under the terms of Article 4 of the AST. No equivalent agreements between Soviet agencies and private companies have been concluded under any of the seven other intergovernmental agreements which specifically provide for such direct contacts. These cooperation agreements (CAs) between the Soviet Government and U.S. firms are the focal point of this paper.

However, because CAs have been concluded within the framework of government-to-government cooperation, the intergovernmental aspects of U.S.-U.S.S.R. cooperation in S. & T. are described as background in Section II. Both U.S. and Soviet institutional structures for cooperation are considered as well. Section III deals directly with the commercial aspects of S. & T. cooperation and specifically with private firm involvement with the SCST. A survey of Soviet cooperation in S. & T. with other Western countries is presented in Section IV.

II. Intergovernmental Aspects of U.S.-U.S.S.R. Cooperation in S. & T.

A. The Government-to-Government Agreements

A chart of organizations involved in implementing the eleven U.S.-U.S.S.R. intergovernmental cooperation agreements is attached as appendix A. The eight articles of the AST merit some explanation because most of the subsequent governmental agreements, as well as the CAs between U.S. companies and the Soviet State Committee for S. & T., are based on its format. Moreover, specific interpretation of parts of the AST have significance for implementation of the other 10 agreements as well. The text of the AST and an interpretative synopsis is attached as Appendix B.

---

[1] CAs are often incorrectly called "protocols." The Soviets use "protocol" in referring to a record of discussion or a memorandum of understanding between parties. Article 4 of the intergovernmental energy cooperation agreement, for example, calls for "implementing protocols and contracts." Consequently, protocols can be signed by companies and Soviet organizations to implement a variety of specific activities, whether these are under the auspices of a cooperation agreement or not.

B. U.S. Governmental Organization for S. & T. Cooperation

Direct USG participation in S. & T. cooperation with the Soviet Union has greatly expanded since May 1972, as is clear from appendix A. The activities of three of the agencies involved are described briefly below.

NATIONAL SCIENCE FOUNDATION (NSF)

NSF inherited the role of serving as the Executive Agent for the AST on the U.S. side after the White House Office of Science and Technology was abolished. Its director (currently H. G. Stever), is both Science Advisor to the President and U.S. Co-Chairman of the AST Joint Commission. The NSF Science and Technology Policy Office provides staff and administrative support to the Joint Commission and the 12 working groups currently employed in 49 specific research areas. The Office of International Programs lends technical support to the AST Joint Commission as well.

DEPARTMENT OF STATE

The Department of State has major responsibilities in managing and overseeing the overall U.S.-U.S.S.R. S. & T. cooperation effort. The Under Secretary of State heads the Under Secretaries Committee of the National Security Council which has oversight responsibilities for coordination of U.S.-Soviet relations in general and specific responsibility for assessing reciprocity in U.S.-Soviet S. & T. exchange.

Operation and administration of the cooperative programs are under the purview of the Office of Soviet and East European Science Affairs in the Bureau of Oceans and International Environmental and Scientific Affairs. The director of that office serves as Executive Secretary for the AST and is also chairman of the Executive Secretaries Coordinating Group. This group, composed of the 11 Executive Secretaries develops and coordinates policies in such areas as financing, patents, and export licensing where questions may arise in the operation of joint programs.

DEPARTMENT OF COMMERCE

The Assistant Secretary for Science and Technology is a member of the AST Joint Commission. She is also chairperson of the Commerce Technical Advisory Board (CTAB), a group of business and government executives who devote their efforts to specific ad hoc problem areas of interest to the Secretary of Commerce. CTAB is conducting an on-going review of the whole area of East-West technology trade. In conjunction with the Bureau of East-West Trade (BEWT), the advisory board recently sponsored the second of two symposia with private industry on the issues involved in technology trade with the Soviet Union. A later section of this paper draws heavily on the proceedings of the first symposium in asessing the motivations involved in concluding CAs with the U.S.S.R.

Commerce's National Oceanic and Atmospheric Administration is the Executive Agent for the Agreement for Cooperation in Studies of the World Ocean. It also participates in the Working Group on Consequences of Pollution under the Environmental Agreement.

BEWT monitors activities of U.S. firms in concluding CAs with the SCST. Its Trade Development Assistance Division facilitates corporate contacts within the U.S.S.R., provides copies of the AST and the standard CA format, suggests particular contacts within the SCST and generally attempts to assist companies in pursuing this type of business activity.

Under existing laws companies are not required to report the conclusion of any CA to the Commerce Department, though any actual transfer of technology that may occur under CAs is, of course, covered by Export Administration regulations.

C. U.S.S.R. Organization in the Area of S. & T. Cooperation

The Soviet Union has significantly expanded its efforts to acquire foreign technology and equipment in order to increase economic efficiency. A small number of specialized Soviet organizations have major responsibilities for the development and acquisition of foreign technology.

THE STATE COMMITTEE FOR SCIENCE AND TECHNOLOGY

The Soviet State Committee for Science and Technology (SCST) was created in 1965 to replace the State Committee for Coordination of Scientific Research. An institution with no counterpart in the market economies, SCST appears to dominate the R. & D. field generally and in particular the area of policy development and funding international programs involving science and technology. It is one of several state committees which, under the aegis of the U.S.S.R. Council of Ministers, formulates economic policy and controls most Soviet noncommercial activity in the fields of science and technology. SCST Chairman V. A. Kirillin was the Soviet signator of the AST.

In the U.S.S.R. governmental organization, the SCST is at the same authority level as the State Planning Committee (GOSPLAN) and Chairman Kirillin is a Deputy Prime Minister of the U.S.S.R. SCST's prestige and staff have grown considerably in recent years, a trend consistent with Party General Secretary Brezhnev's commitment to up-grade the level of technology employed throughout Soviet industry.

SCST's general functions include: (1) Planning and funding of R. & D. in all industrial areas, (2) formulating the technical development segment of the Five Year Plans, and, (3) deciding whether the source of technology be domestic or foreign.[2] One SCST Deputy Chairman is D. M. Gvishiani (Premier Kosygin's son-in-law) who participates in many U.S. company CA negotiations and has been an important contact for American firms.

An Interdepartmental Council for Problems of Improving Management of the National Economy is also located in SCST. Chaired by Kirillin, this council is indicative of the important role played by the SCST in improving Soviet economic performance. Operating departments are organized by industrial sector, e.g., Power and Electrical Technology, Transportation, etc. Other specialized departments in-

[2] Department of Commerce. "U.S./U.S.S.R. Technology Licensing Prospects 1973." Summary report of U.S. delegation visit to U.S.S.R. for study of Soviet management and licensing practices.

clude the International Economic and Scientific Organization Department and the Institute for Management of the National Economy.

Most important for the Western technology exporter is the Patent and Licensing Department which prepares those segments of the Plan dealing with imported technology. It also issues permits to appropriate foreign trade organizations (FTO) for the purchase and sale of licenses, advises SCST on the economic value of technology transfers in both directions and monitors the domestic use of foreign technology. (See Chart I below.) SCST's Foreign Relations Department has obvious importance for the Western businessman. Geographically organized (Dr. E. A. Aykazyan, who heads the U.S. section, is also Soviet Executive Secretary for the AST), it investigates potential foreign technology sources and negotiates the specific content of any cooperation agreements approved by the SCST. However, once a decision is reached in the SCST to acquire a particular technology from a foreign company, the related activities become commercial in nature and therefore involve the Ministry of Foreign Trade and the appropriate foreign trade organizations. SCST does not participate in foreign commercial transactions.

VNESHTECHNIKA

SCST also supervises the FTO Vneshtechnika, which was established in 1967 to provide research and design consultant services within the Soviet Union and abroad for both Soviet and foreign clients. Its five departments (plant construction, scientific equipment and samples, technical documentation and assistance) enter contracts for construction and testing of equipment, training of specialists, and plant construction. As of July 1973, Vneshtechnika had 2,000 contracts outstanding. Most were for training and appraisal of samples, but about 100, for research and design services, accounted for 80 percent of its annual revenues.

Through 1974 approximately 80 percent of Vneshtechnika's contracts had been with Eastern European enterprises often at concessionary consultant fees. However, since Vneshtechnika is financially independent with working capital sourced internally rather than from the State budget, there may be significant interest in increasing the more profitable contracts [3] with Western companies.

LICENSINTORG

Should technical cooperation involve the purchase or sale of licenses, Licensintorg, a Soviet FTO organized under the Ministry of Foreign Trade, may be involved. Should the SCST authorize purchase of foreign know-how, the relevant industrial ministry will submit a "commission agreement" to Licensintorg, which will then enter the acquisition process and negotiate the contract with the Western source. Licensintorg also promotes U.S.S.R. technology sales and it deals with the U.S. companies primarily through its five agents here.

Any FTO may deal directly with a foreign concern for the purchase of narrowly specified technology, usually in conjunction with

[3] Based on U.S.–U.S.S.R. Technology and Patents, Sales and License Prospects, Licensing Executives Society, Edward White, ed. 1974.

equipment purchases, and many have in fact done so. Nevertheless, Licensintorg can be an important link in the chain of technology trade. Indeed although it enters the licensing process only at the direction of a Ministry, it signs the contract and thus is established as the Soviet legal party in the arrangement.

III. Commercial Aspects of Science and Technology Cooperation Between the U.S. and the U.S.S.R.

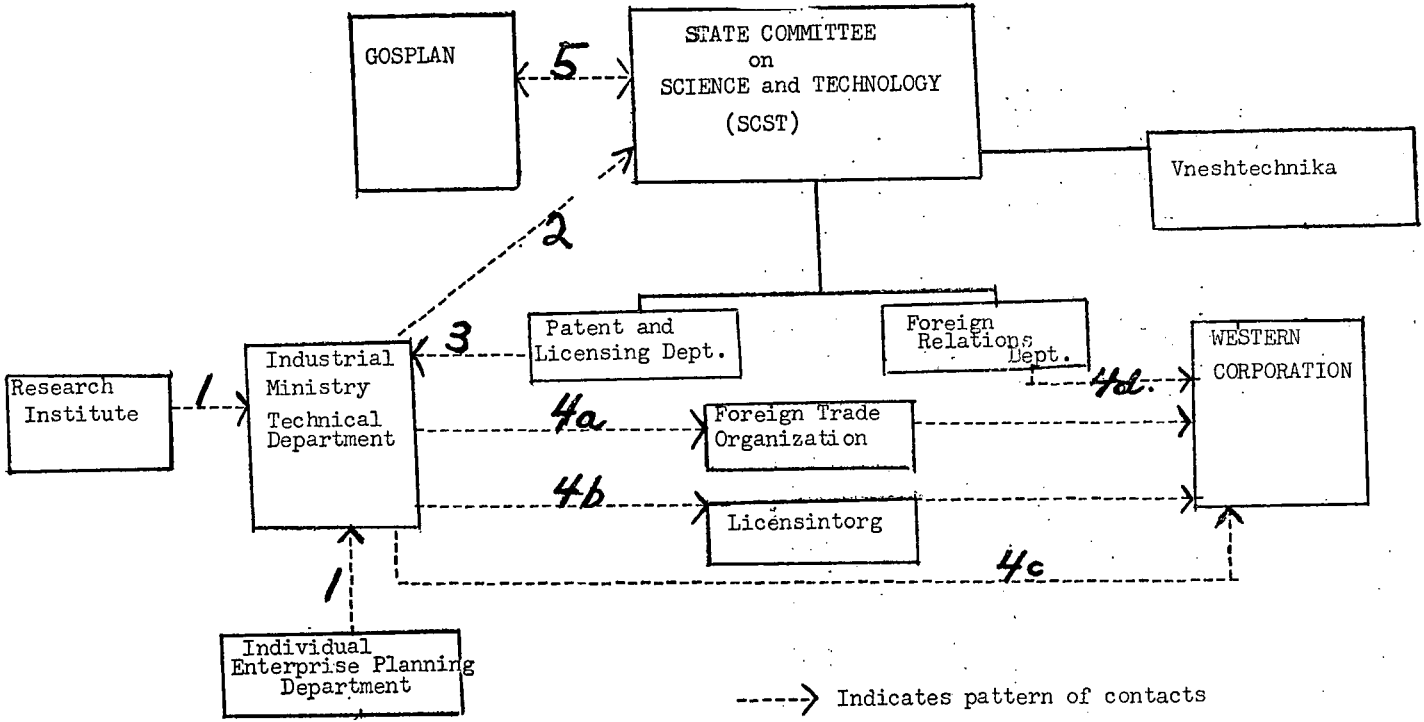
There are various commercial channels through which the U.S.S.R. and American firms can exchange scientific and technical information. These include direct purchases of licenses, construction of prototype turnkey plants and equipment and purchases of plants with technology update agreements. These forms of industrial cooperation transactions are considered elsewhere in this volume (see Smith). Here the scope is limited to joint cooperation between private companies and the State Committee for Science and Technology.

A. Analysis of Soviet Procedures for Acquisition of Technology from Western Firms

Whether or not a CA is actually concluded, there are several Soviet organizations that participate in the procurement of technology from foreign sources. The procedures involved are represented in Chart I. The numbered paragraphs below describe the activity that occurs at the corresponding numbers on the chart.

CHART 1

U.S.S.R. ADMINISTRATIVE UNITS INVOLVED IN ACQUISITION OF WESTERN TECHNOLOGY



When the Soviets initiate a contract the following sequence is likely:

1. An enterprise or research institute submits its plan, containing recommended purchases of required foreign technology, to the technical department of its industrial ministry.

2. The industrial ministry coordinates and evaluates total purchases of foreign technology and submits the plan to the SCST for final approval. The ministry stresses economic justifications for the purchases (e.g., technical bottleneck problems solved, increased capacity to fulfill plan indicators, and domestic R&D funding saved).

3. If the SCST approves the purchase, the Patent and License Department will issue the necessary purchase permit to the Ministry. At this point, the transaction becomes commercial and therefore responsibility is assumed by the appropriate organization in the Ministry of Foreign Trade.

4. Depending on SCST's assessment of the technology involved:

a. If the technology is embodied in a major plant or equipment purchase, the Industrial Ministry may approach the relevant FTO directly to negotiate the contract.

b. The Ministry may issue a "commission agreement" to FTO Licensintorg directing it to take the appropriate steps to secure the technology from a firm, via a license purchase.

c. If it is a specifically defined area of technical know-how, e.g., a particular material handling process, the Industrial Ministry may decide to purchase the technical know-how from the firm via the appropriate FTO. The private firm and the Ministry would then sign a protocol or memorandum of understanding confirming that the sale will be made.

d. Should the Ministry's interest be in joint development of a broader area of technology, e.g., data processing, the SCST Foreign Relations Department will investigate possible sources among leading foreign firms and negotiate any CAs required. CAs considered in this paper were usually arranged in this manner.

When Foreign firms initiate contact the sequence is altered somewhat, according to Dr. E. A. Aykazyan, the Soviet Executive Secretary for the AST. Generally, the interested firm makes the availability of its technology known simultaneously to both the Foreign Relations Department of the SCST, Vneshtechnika, and the appropriate industrial ministry or research institute. The SCST, if interested, refers the company to the relevant industrial ministry for its assessment. It may also obtain an assessment from research institutes and enterprises as appropriate. The firm may be invited to send a high level delegation to the U.S.S.R., with the SCST making local arrangements and contacts.

SCST will suggest a CA be arranged (negotiated by its Foreign Relations Department) only if the relevant ministry positively assesses the proposed cooperative relationship. Industrial Ministry approval is thus a necessary, but often not a sufficient condition, for a successful CA because the SCST is extremely selective in its choice of companies.

Chart II, attached as appendix C, details some of the changes in the Soviet system for procurement of technology following a 1973 industrial reorganization plan that called for the establishment of

production associations in most Soviet industrial sectors. It focuses specifically on the impact of that reorganization on the chemical industry.[4] One of the objects of the plan was to improve the coordination of technical research in order to expedite the introduction of new techniques and products into industrial application. As a result, the importance of industrial research institutes has been enhanced.

B. Cooperation Agreements Between U.S. Companies and the Soviet State Committee for Science and Technology

CAs are usually rather generally framed agreements between U.S. firms and the SCST, providing for cooperative research activities and exchanges of information and specialists in areas of mutual interest. Although the line dividing scientific from technical information is difficult to draw, CAs generally focus on technical information. These agreements are not commercial contracts and in themselves do not provide for any specific exchanges. Thus, CAs might be termed merely "agreements to agree" which usually require conclusion of specific implementing protocols or contracts between the firm and the appropriate Soviet ministry, institute, or enterprise to actuate any cooperative or joint project. Also, any commercial transactions for sales of technology or equipment related to the areas of cooperation are concluded separately, always involve the Ministry of Foreign Trade and appropriate FTO and must comply with Export Administration licensing procedure of the United States Government before any proprietary information can be transferred to the Soviet Union. The State Committee is not involved in commercial contracts.

C. Descriptive Analysis of a Typical Cooperation Agreement Between a U.S. Firm and the U.S.S.R. State Committee for Science and Technology

Appendix D lists the 53 American firms which, at this writing, have concluded CAs with the SCST. The individual agreements tend to be very similar since each is based on a format similar to the AST itself. A CA generally consists of seven articles, each dealing with some aspect of cooperative activities.

Article one specifies the areas of cooperation by enumerating the broad product lines and technical fields for joint activities. Specificity (or lack of it) in terminology may indicate Soviet priorities, i.e., the more detailed the description of the technical areas, the more eager are the Soviets to apply it and the more likely that it will result in commercial opportunities for the firm.

Article two lists the forms of cooperation (e.g., exchanges of specialists, joint seminars, etc.) and is a near exact mirror of Article three of the AST.

Article three commits the parties, usually in standard language, to establish special groups of experts to develop programs and draft working plans. In some instances, the CA details the specific joint project proposals in this article.

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[4] Based on U.S.–U.S.S.R. Technology and Patents, Sales and License Prospects, Licensing Executives Society Edward White, ed. 1974.

Article four provides that legal, financial or commercial aspects that may arise in implementing the CA will be handled through separate contracts or protocols.

Article five provides assurances that the confidentiality of any information developed jointly will be maintained and prohibits the transmittal of such information to any third party without the consent of the second party. This article has limited the utility of any jointly developed know-how for American companies since, in most cases, the CA stipulates that any subsidiary which is less than 50 percent owned by the parent company, is a third party. In actual practice, a Western firm may thus be prohibited from providing technical information to some of its subsidiaries, while on the Soviet side, SCST is able to share expertise with all Soviet enterprises. The SCST has attempted to increase the 50 percent third party criterion during negotiations over new CAs, but the percentage is apparently flexible and at least one American firm has succeeded in reducing it.

Article six covers procedures for financing expenses of the participating specialists. Originally, CAs specified that all local costs were the liability of the host organization and other costs were handled by the sending organization. However, as with the AST, troubles have arisen because of Soviet interest in minimizing expenditure of hard currency. The article was changed in 1975 and now the sending party pays all costs of travel for its delegations. This new provision allows the U.S.S.R. to maximize its net hard currency receipts because U.S. representatives pay much higher hotel rates in the Soviet Union, while American companies generally voluntarily cover the expenses of Soviet visitors.

Article seven specifies the term of the CA, usually five years.

D. Extent of the CA Phenomenon

Appendix D lists the 53 American firms with CAs with the U.S.S.R. as well as, for industrial enterprises, their position in the 1974 Fortune 500 Largest Industrials. The SCST has tended to conclude CAs with mostly large corporations; 40 of the 47 industrial firms with CAs are numbered among the top 300 U.S. industrial companies ranked by sales volume. Perhaps this indicates that the Soviets believe the most current technology can best be obtained from the leading firms in particular industries. However, the larger companies also usually have worldwide marketing system which can provide export prospects for any Soviet enterprises that actually apply to production the technology developed under a CA.

A breakdown of the specific economic sectors cited in 41 of the 53 CAs concluded by U.S. firms is presented in Appendix E.[5] Standard Industrial Classification (SIC) numbers have been assigned to each area of cooperation. In some cases, however. the classification assigned represents only a broad industry category because of the general nature of the areas of cooperation covered under a particular CA.

It should again be noted that the existence of an agreement involving a specific SIC category is only an indication of Soviet interest in

[5] The breakdown is derived from published and other information available on 41 of the agreements. Similar information was not available to the writer on the remaining 12 agreements.

that particular area of U.S. technology and does not necessarily lead to expanded commercial activity in that product line. Any exports of information or product under a CA must be transacted through regular foreign trade channels and usually will involve the appropriate Soviet foreign trade organization and Industrial Ministry, as well as the SCST. On the U.S. side, normal export administration licenses are also required.

The largest number of agreements have been signed in the areas of radio, television and electronic equipment (9), engineering (6), data processing (5), aircraft and parts (5), machine tools (4), food product machinery (4).

E. Participant Motivations

U.S. COMPANIES

What are the motivations of those U.S. firms that have concluded CAs with the U.S.S.R.? The most frequent response is that the CA is seen as an entry vehicle into the large Soviet market, possibly enabling a firm to expand its sales in a broad range of product lines. CAs are also seen as possibly resulting in more end-user contacts and thereby providing a more effective means of assessing the Soviet market. There is, however, a lack of agreement among observers as to the value of a CA as a market entry device. At a 1974 Commerce technology trade symposium, it was noted that "those (businessmen) who signed CAs are usually not those who sign contracts." Indeed, since 1972 little correlation is evident between the existence of CAs and the signing of commercial contracts by American companies. Another observer indicated that only travel has resulted from the CA signings, but that travel often leads to trade with the U.S.S.R. On the other hand, one U.S. executive felt that the SCST was the "appropriate vehicle for big deals."[6]

There are also some practical administrative advantages in CAs since the SCST can serve as official sponsor when a company applies for a business visa. It is illegal to conduct business in the U.S.S.R. on a tourist visa and a business applicant must have the sponsorship of some Soviet agency. Similar sponsorship is required for accreditation to open an office in the U.S.S.R.

A Soviet official in the SCST once assured an American company that after it signed a CA, it would be established as the prime supplier of the item in question, that is, other companies would no longer be in competition in that particular field.[7] If accurate, this appraisal would provide obvious competitive motivation for any company. However, Appendix E indicates that may not be the case. There are approximately 86 technology areas covered in the 41 U.S. company CAs included in that Appendix. In 24 of those areas, at least two CAs have been signed with other American firms. Moreover, CAs have often been concluded with one or more non-U.S. firms in these same technical areas. Of course, the knowledge that a major competitor (domestic or

[6] Proceedings of 1974 Department of Commerce East-West Technological Trade Symposium.

[7] The SCST official could have been referring to a CA under which the technical area was so narrowly specified that the SCST would find another company's technology needlessly redundant. However, few CAs appear to have such a narrow specificity.

international) has or will conclude a CA with the SCST may provide important motivation for a firm to negotiate one as well.

Companies may also perceive that they can obtain commercially useful technology from the Soviet Union, whether through joint development or direct purchases of Soviet licenses. Soviet technical capabilities may be particularly attractive in areas where R&D investment in the West has been minimal because of insufficient commercial interest in the output of that research. Since Soviet research efforts are less limited to areas with direct commercial applicability, the results may be unobtainable elsewhere in the West.

Some further insights into U.S. company goals in signing CAs resulted from a 1973 NSF-Bureau of East-West Trade survey of 230 major U.S. firms. This early assessment of the degree of involvement of U.S. companies with the SCST attempted to determine: (1) If and to what degree, individual firms were operating at a disadvantage vis-a-vis the SCST in obtaining valuable technology; and (2) determining the means which might be employed for correcting any lack of reciprocity. At the time of the survey, however, only seven American companies had CAs, although others were then engaged in discussions with the SCST. Thus the findings are only of limited value as indicators of the current situation.

At the time of the survey, one firm expressed concern that the Soviets were surreptitiously obtaining technology through visits to U.S. plants by SCST personnel. Another viewed CAs as a "preliminary opportunity to assess Soviet technical potential and marketing opportunities." The representative of a multinational company observed that the opportunity lies in a trade off of U.S. technology for Soviet R. & D. results, mostly at the Institute or pilot plant level. The most positive assessment was that of an equipment manufacturer who found technology in his area more advanced than comparable U.S. technology. He observed that "we are gaining information at a far greater rate than we are giving it."

SOVIET MOTIVATIONS

Broad Soviet motives for acquiring foreign technology were clearly defined by GOSPLAN in a 1970 assessment—foreign technology could be expected to advance the application of innovative techniques by two to five years, thereby satisfying product demands more quickly with the highest quality available domestically. This could be accomplished while economizing on domestic R. & D. expenditures and expanding hard currency earnings through exports of finished product. These objectives are certainly still applicable.

The general assessment is that the Soviets are interested only in commercially usable, applied S&T and are little concerned with basic science research. Indeed, the Soviets have great praise for Japan's ability to utilize imports of technology to expand industrial capacity in the 1950s and appear to have committed themselves to emulating the Japanese experience.[8] They have acted in accord with that commitment by concluding CAs with firms in technology areas with direct application to industrial production.

[8] JEC, Soviet Economic Prospects in the Seventies, June 1973, p. 88.

One U.S. business executive reported at the 1974 Commerce symposium, that the Soviets employ the CA as a device for attaining their technology import goals while limiting the impact of foreign contacts on the domestic system. CAs not only provide Soviet industry access to Western technology, but also serve as a "cutoff point for U.S. companies" since the SCST, as the monitoring agent in all these negotiations, is able to limit foreign contact to only select Soviet technicians.

One final note on Soviet motivation comes from an executive who quoted two SCST representatives as challenging his company to provide more concreteness and expand the areas covered in the proposed CA. His impression was that SCST did not favor over-generalized CAs because these generated unrealistic expectations in Soviet industrial ministries. The SCST also prodded this firm to find "some way to get dollars," a clear indication of the hard currency constraint on the ability of the U.S.R. to import technology. Faced with a record deficit in its hard currency trade for 1975, the Soviets can be expected to expand this hard currency search.

F. Assessment of the Resulting Technology Flow

FLOW FROM THE U.S.

Appendix E provides only an indication of the potential for the eastward flow of technology, since the mere existence of a CA in a particular technical area does not necessarily lead to actual contracts involving the transfer of proprietory U.S. technology. Although there have been 53 CAs to date with American companies, relatively little actual activity exists upon which to base empirical investigation. Furthermore, what has occurred is private and not subject to government monitoring, except when U.S. technology or products are exported, in which case export licenses are required. The Department of State, through contacts with most of the American firms that have CAs, has concluded that very little cooperative activity has occurred to date.[9] Most observers in the Commerce Department appear to agree.

FLOW FROM THE SOVIET UNION

Although a potential exists for reciprocity in the flow of technical information, it has yet to be achieved even though in some cases, technology obtained by U.S. firms has been substantial and of high quality. As of June 1975, twenty American firms had licensed Soviet technology. Four of these companies have CAs with the SCST, however, it is not possible to determine whether purchase of these licenses is directly related to the CA.

According to a representative of one firm with a CA, the Westward flow of Soviet technical information is limited, partly because Licensintorg, the Soviet license enterprise, adheres to a very conservative marketing philosophy. The Soviets have been extremely cautious and will not license any technique that is not already employed in actual production in the U.S.S.R. This conservatism limits the availability of the most up-to-date Soviet technology that is most likely to interest American companies.

[9] Congressional testimony, Nov. 18, 1975, by Myron B. Kratzer, Acting Asst. Secretary of State for Oceans and International Environmental and Scientific Affairs.

IV. Soviet Cooperation in S. & T. With Other Western Countries

Western European governments and companies have historically had relatively more extensive trade and technical contacts with the Soviet Union. Therefore, a brief description of their experience can perhaps illuminate some of the prospects and pitfalls involved in East-West technical cooperation. The U.S.S.R. has concluded intergovernmental S. & T. cooperation agreements with a number of Western countries, frequently utilizing a format which is quite similar to the AST. CAs have also been concluded with private companies.

Appendix F lists selected countries and private firms which are known to have CAs with the SCST. SIC numbers are assigned to the technical areas (where known) covered in the cooperation agreements. The largest number of CAs with foreign firms have been in the areas of chemicals (7), machine tools (6), engineering (5), and pharmaceuticals (4).

As has been the case with U.S. companies, the Soviets have selected the leading large firms in Europe and Japan for CA partners. Of the 52 known companies with Agreements, 27 are listed in the 1974 Fortune 300 Largest Non-U.S. Industrial companies.

The most recent assessment of individual country involvement in S. & T. cooperation with the U.S.S.R., conducted in 1974, produced the following information.

France

French President de Gaulle's 1966 trip to Moscow was the occasion for creation of "la Grande Commission" which is similar in organization to the U.S.-Soviet Joint Commission for the AST. Its purview is limited to three specific areas of conomic and scientific cooperation, i.e., a common color television system, space studies and nuclear energy development. "La Petite Commission" was also created to coordinate activities in the scientific, technological and economic fields. It establishes working groups and stimulates industrial contacts for French companies with Soviet agencies. In 1971, a new intergovernmental agreement for a ten year cooperative program was signed covering the 1973–83 period. French experts have expressed interest in Soviet capabilities in the more theoretical (rather than applied) facets of nuclear chemistry, microbiology, physics, microwave electronics, computer studies, oncology, radio astronomy and pharmacology. The French have also participated in cooperation in the area of information management, particularly at the Soviet facilities in Novosibirsk. At least one French company, Moet Hennessy, has concluded a CA with the Soviet SCST.

Italy

The Agreement of Economic and Technical Scientific Cooperation of April 1966 is the Italian-Soviet counterpart of the U.S. AST, however, an updated agreement concentrating on S&T and excluding the economic aspect was concluded in February 1974. The 1966 agreement created a Mixed Commission similar to the U.S.-U.S.S.R. Joint Commission and, significantly, the Soviet chairmanship is held by Vice Minister of Foreign Trade Komarov. The Commission conducted its seventh session in March 1974. The commercial orientation of Soviet

interest in cooperation is indicatd by appointment of a trade official as co-chairman of the mixed commission.

Italian companies have limited involvement with the SCST through membership on working groups of the Mixed Commission. However, at least eight firms, several with partial state ownership, have concluded CAs with the SCST.

Japan

A 1963 cooperative agreement exists between the Soviet East European Trade Society (200 major Japanese firms in a private association) and the SCST, which was designed to facilitate Soviet access to Japanese commercial technology and Japanese access to Soviet basic science expertise. An intergovernmental S&T agreement was signed in October 1973 and the first commission meeting was held in Tokyo, in contrast to the experience of other countries where Moscow is the usual site. Article 4 of the agreement is similar to the enabling article in the U.S. AST. The Ministry of International Trade and Industry (MITI) is the Japanese agency in charge of administering the agreement. In 1974, MITI anticipated a large volume of business in licensing of Japanese computer and electronic technology. Six Japanese companies are known to have concluded CAs with the Soviet SCST, including the major trading houses, Mitsubishi, Mitsui and C. Itoh Company.

Netherlands

There is a Dutch-U.S.S.R. intergovernmental agreement on cooperation in S&T. Three private CAs exist between Dutch companies and the SCST, but it is not known if the three are related to the governmental agreement. One is unique since it involves joint cooperation between SCST, two Dutch firms and one American company for production of specialized climatic paints.

Sweden

Sweden signed an Agreement on Economic Technical and Scientific Cooperation with the U.S.S.R. in 1970. It is similar to the U.S. agreement and is a supplement to an already existing Bilateral Trade Agreement. It provides for cooperation in the field of materials technology (welding, corrosion), transportation (rail) and geological sciences (prospecting, mining). Environmental protection (Baltic Sea) and aviation technology (landing strip maintenance) were added at the 1973 Joint Commission meetings in Stockholm. Private firms contact the SCST directly to market their technology and the Swedish government's involvement in the process has been limited to general interest on the part of the Ministry of Trade. A firm may also obtain technical assistance from the Royal Engineering Science Academy. The SCST functions are limited, in the Swedes' opinion, to approval of the company's products and services and authorization for the appropriate Soviet organization to negotiate directly with the firm. As with the United States, the SCST enters S. & T. cooperation agreements directly with Swedish firms, while commercial or industrial arrangements are handled by Ministry of Foreign Trade and the appropriate FTO.

United Kingdom

A U.K.-U.S.S.R. Agreement for Science and Technology was concluded in January 1968 and an updated version, including economic and industrial cooperation aspects, was signed in April 1974. The 1968 agreement created a Joint Commission and seven working groups for cooperation in the usual technical areas but many of these groups were already operating under the auspices of the Confederation of British Industry and the U.K. Chamber of Commerce. The working groups are staffed with experts from the appropriate U.K. trade associations.

West Germany

FRG's contacts with the Soviet Union are extensive on both a technical and commercial level, reflecting Germany's position as the U.S.S.R.'s leading trade partner in the West. An intergovernmental agreement was negotiated in 1973, however it has never been officially signed and brought into force. Nevertheless, private firms are significantly involved with the SCST. The SCST plays a crucial role since it controls most of the R&D funding in the U.S.S.R. As with the United States, the SCST assumes an active role as initiator of technical contacts with FRG companies and, although a firm may approach an industrial ministry directly, the SCST will inevitably be the final arbiter in any agreement negotiations. The FRG has established a special staff within its Moscow embassy to assist medium sized firms in their dealings with the SCST.

Canada

An Agreement between the Governments of Canada and the U.S.S.R. on Cooperation in the Industrial Application of Science and Technology was concluded in 1971. Since then, the Mixed Commission has held four annual sessions and the intergovernmental agreement has been extended for an additional five years. Joint cooperation has taken place or is scheduled in the areas of thermal power, turbodrills, permafrost oil well drilling, high viscosity oil fields, animal feed, gas wells, compressors. Ad hoc groups have been formed to consider cooperation in biophysical surveying, exploitation of tar sands and air cushion vehicles. At least two Canadian firms have concluded CAs with the SCST.

Australia

In January 1975, the U.S.S.R. and Australia signed an Agreement on Science and Technology Cooperation covering joint activities in the areas of earth sciences, entomology, plant industry, radio astronomy and textiles. The Australian Department of Foreign Affairs and the Soviet SCST and Academy of Sciences are the joint coordinators for the agreement. Cooperative activities have focused on basic science rather than applied technology and there have apparently been no cooperation agreements involving Australian companies and Soviet organizations.

Appendix A

U.S. Organizations Participating in U.S.-U.S.S.R. Science and Technology Cooperation

Agreement on Science and Technology

U.S. Chairman: H. G. Stever—Presidential Science Advisor and Director National Science Foundation.
U.S.S.R. Chairman: V. A. Kirillin—State Committee for Science and Technology (SCST).
U.S. Executive Secretary: W. Root—Office of Science Affairs, State Department.
U.S.S.R. Executive Secretary: E. A. Aykazyan—Foreign Relations Division, SCST.

Cooperation Projects

1. Application of Computers to Management.
2. Chemical Catalysis.
3. Water Resources.
4. Microbiology.
5. Forestry.
6. Electrometallurgy.
7. Metrology.
8. Standardization.
9. Physics.
10. Intellectual Property.
11. Science Policy.
12. Scientific and Technical Information.

Agreement on Environmental Protection

U.S. Chairman: R. Train—Environmental Protection Agency.
U.S.S.R. Chairman: Y. Izrael—Soviet Hydrometerological Services.
U.S. Executive Secretary: W. A. Brown—E.P.A.
U.S.S.R. Executive Secretary: B. Kuvshinnikov—Hydrometerological Service.

Cooperation Projects

1. Air & water pollution.
2. Agricultural problems.
3. Urban environment.
4. Nature preserves.
5. Biological & genetic consequences of pollution.
6. Impact on climates.
7. Earthquake prediction.
8. Arctic ecosystems.
9. Legal aspects of policy.

Agreement on Medical Science and Public Health

U.S. Chairman: T. Cooper—H.E.W.
U.S.S.R. Chairman: D. D. Venediktov—Ministry of Health.
U.S. Executive Secretary: O. M. Korshin, H.E.W., Office of International Health.
U.S.S.R. Executive Secretary: M N. Saveliev, Ministry of Health, External Relations Department.

Cooperation Projects

1. Cardiovascular diseases.
2. Malignant Neoplasms.
3. Environmental Health.
4. Arthritides.
5. Influenza and Acute Respiratory diseases.

Agreement on Space Cooperation

U.S. Principal Coordinator: [1] G. M. Low—N.A.S.A.
U.S.S.R. Principal Coordinator: V. A. Kotelnikov—Soviet Academy of Sciences.

Cooperation Projects

1. Joint Apollo-Soyuz Project.
2. Space meteorology.
3. Study of natural environment.
4. Space biology and medicine.

Agreement on Agriculture

U.S. Chairman: R. Bell—U.S.D.A.
U.S.S.R. Chairman: B. A Runov—Ministry of Agriculture
U.S. Executive Secretary: Roger Euler—U.S.D.A.
U.S.S.R. Executive Secretary: A. I. Kovalev—Ministry of Agriculture

Cooperation Projects

1. Agricultural Economic Research and Information.
2. Agricultural Research and Technological Development.

Agreement on Transportation

U.S. Chairman: R. H. Binder—Department of Transportation.
U.S.S.R. Chairman: G. V. Aleksenko—State Committee on Science and Technology.
U.S. Executive Secretary: R. M. Ramundo—DOT Office of Policy Planning and International Affairs.
U.S.S.R. Executive Secretary: V. Y. Ishchenko—State Committee for Science & Technology.

Cooperation Projects

1. Transport construction.
2. Railway transport.
3. Civil aviation.
4. Marine transport.
5. Automobile transport.
6. Transport facilitation.

Agreement on Studies of the World Ocean

U.S. Chairman: R. M. White—National Oceanic and Atmospheric Administration.
U.S.S.R. Chairman: A. V. Siporenko—Soviet Academy of Sciences.
U.S. Executive Secretary: D. P. Martineau—NOAA, Office of Marine Resources.
U.S.S.R. Executive Secretary: A. Metal'nikov—Foreign Relations Division, SCST.

Cooperation Projects

1. Ocean-atmosphere interaction.
2. Ocean currents.
3. Geochemistry and marine chemistry.
4. Geological and geophysical investigation of the World Ocean.
5. Biological productivity of the World Ocean.
6. Standardization of oceanographic instrumentation.

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[1] No Joint Committee established.

Agreement on Atomic Energy

U.S. Chairman: R. Seamans—E.R.D.A.
U.S.S.R. Chairman: A. Petrosyants—State Committee for Utilization of Atomic Energy.
U.S. Executive Secretary: B. D. Hill—E.R.D.A.
US.S.R. Executive Secretary: J. K. Afonin—International Relations Division, SCAE.

Cooperation Projects

1. Controlled thermonuclear fusion.
2. Fast breeder reactors.
3. Research on the fundamental properties of matter.

Agreement on Energy

U.S. Chairman: F. G. Zarb—Federal Energy Administration.
U.S.S.R. Chairman: P. S. Neporozhniy—Minister for Power and Electrification (MPE).
U.S. Executive Secretary: W. Root—Department of State.
U.S.S.R. Executive Secretary: V. N. Mal'tsev—MPE.

Cooperation Projects

1. Thermal and hydropower stations.
2. Power plant pollution control.
3. UHV and HVDC technology.
4. Electric power system plans.
5. Superconducting technology.
6. Open cycle magnetohydrodynamic power plants.
7. Solar and geothermal technology.
8. Well drilling environmental protection.
9. Heat rejection systems.

Agreement on Artificial Heart Research

Administered as a cooperation project under the Health Agreement.
U.S. Coordinator: M. DeBakey—Baylor College of Medicine.
U.S.S.R. Coordinator: V. I. Shumakov—Institutes for Transplantation of Organs and Tissues.

Cooperation Projects

1. Diagnostic techniques.
2. Pediatric cardiac disease.
3. Cardiac pacemakers.
4. Cardiovascular support devices.
5. Exchange of artificial heart models.
6. Publication of R. & D. results.

Agreement on Housing and other Construction

U.S. Chairman: Carla Hills—Housing and Urban Development.
U.S.S.R. Chairman: I. T. Novikov—State Committee on Construction Affairs (SCCA).
U.S. Executive Secretary: D. Freeman—HUD.
U.S.S.R. Executive Secretary: O. M. Teerentiev—SCCA.

Cooperation Projects

1. Seismic area construction.
2. Techniques in safety, quality and economy of buildings.
3. Extreme climatic conditions building.
4. Services to housing.
5. New town construction.

Appendix B

Agreement Between the U.S. and the U.S.S.R. on Cooperation in the Fields of Science and Technology

ARTICLE 1	COMMENTS
Both Parties pledge themselves to assist and develop scientific and technical cooperation between both countries on the basis of mutual benefits, equality and reciprocity.	The reciprocity consideration is the basis underlying the automatic cut-off principle whereby all U.S. working groups are able to discontinue their activities if the Soviet side fails to carry out any part of its effort.
ARTICLE 2	
The main objective of this cooperation is to provide broad opportunities for both Parties to combine the efforts of their scientists and specialists in working on major problems, whose solution will promote the progress of science and technology for the benefit of both countries and of mankind.	Basic objective of the Agreement.
ARTICLE 3	
The forms of cooperation in science and technology may include the following: a. Exchange of scientists and specialists; b. Exchange of scientific and technical information and documentation; c. Joint development and implementation of programs and projects in the fields of basic and applied sciences; d. Joint research, development and testing, and exchange of research results and experience between scientific research institutions and organizations; e. Organization of joint courses, conferences and symposia; f. Rendering of help, as appropriate, on both sides in establishing contacts and arrangements between United States firms and Soviet enterprises where a mutual interest develops; and g. Other forms of scientific and technical cooperation as may be mutually agreed.	Established the specific activities for cooperation. Almost the exact wording is found in most of the CAs with private U.S. companies.

ARTICLE 4	COMMENTS
1. Pursuant to the aims of this Agreement, both Parties will, as appropriate, encourage and facilitate the establishment and development of direct contacts and cooperation between agencies, organizations and firms of both countries and the conclusion, as appropriate, of implementing agreements for particular cooperative activities engaged in under this Agreement. 2. Such agreements between agencies, organizations and enterprises will be concluded in accordance with the laws of both countries. Such agreements may cover the subjects of cooperation, organizations engaged in the implementation of projects and programs, the procedures which should be followed, and any other appropriate details.	Article four is central to the scope of this paper since it has been interpreted by the Soviets as an enabling article that provides a juridical basis for contacting and concluding CAs with private U.S. companies. Article four is most important since it has enabled the Soviets to contact U.S. firms directly without U.S.G. involvement. It reflects U.S. policy of encouraging commercially attractive transactions involving nonstrategic technology between the U.S.S.R. and U.S. companies. It is a principal objective of the intergovernmental program to facilitate eventual benefits for the private sector.[1] Section two is particularly important since it reflects the fact that any exports of U.S. technology or equipment must comply with the provisions of the Export Administration Act. Seven of the ten subsequent intergovernmental agreements contain an article similar to number four. Six of the agreements signed since mid 1973 include the word "monitor" after "facilitate" in Article four, Section one.

ARTICLE 5	
Unless otherwise provided in an implementing agreement, each party or participating agency, organization or enterprise shall bear the costs of its participation and that of its personnel in cooperative activities engaged in under this Agreement, in accordance with existing laws in both countries.	Article five has given rise to some disagreement since, in an effort to conserve hard currency expenditures, the Soviets have proposed receiving side pays" arrangements for exchanges of technicians. Problems arise because some U.S. agencies have no authority to fund travel for either Soviet or American experts under the program. Such difficulties as have arisen, have been satisfactorily resolved and no joint projects are currently being hampered by a lack of travel funding.[2]

ARTICLE 6	COMMENTS
Nothing in this Agreement shall be interpreted to prejudice other agreements in the fields of science and technology concluded between the Parties.	None.

[1] Kratzer testimony, op. cit.
[2] A Progress Report on U.S.-U.S.S.R. Cooperative Programs, Report by the GAO, 1975.

ARTICLE 7

1. For the implementation of this Agreement there shall be established a U.S.-U.S.S.R. Joint Commission on Scientific and Technical Cooperation. Meetings will be convened not less than once a year in Washington and Moscow, alternately.
2. The Commission shall consider proposals for the development of cooperation in specific areas; prepare suggestions and recommendations, as appropriate, for the two parties; develop and approve measures and programs for implementation of this Agreement; designate, as appropriate, the agencies, organizations or enterprises responsible for carrying out cooperative activities; and seek to assure their proper implementation.
3. The Executive Agent, which will be responsible for assuring the carrying out on its side of the Agreement, shall be, for the United States of America, the Office of Science and Technology in the Executive Office of the President and, for the Union of Soviet Socialist Republics, the State Committee of the U.S.S.R. Council of Ministers for Science and Technology. The Joint Commission will consist of United States and Soviet delegations established on an equal basis of which the chairmen and members are to be designated by the respective parties. Regulations regarding the operation of the Commission shall be agreed by the chairmen.
4. To carry out its functions the Commission may create temporary or permanent joint subcommittees, councils or working groups.
5. During the period between meetings of the Commissions additions or amendments may be made to already approve cooperative activities, as may be mutually agreed.

Article seven appoints the Office of Science and Technology in the White House, as executive agent for the agreement. The National Science Foundation assumed these responsibilities when the Science Office was abolished. New legislation reestablished the Office of the Presidential Science Advisor in 1976.

ARTICLE 8

1. This Agreement shall enter into force upon signature and shall remain in force for five years. It may be modified or extended by mutual agreement of the Parties.
2. The termination of this Agreement shall not affect the validity of agreements made hereunder between agencies, organizations and enterprises of both countries.

COMMENTS

Agreement due for renewal by May 1977.

Appendix C

CHART II

IMPACT OF 1973 MINISTERIAL REFORM ON ACQUISITION OF FOREIGN TECHNOLOGY IN THE CHEMICAL INDUSTRY

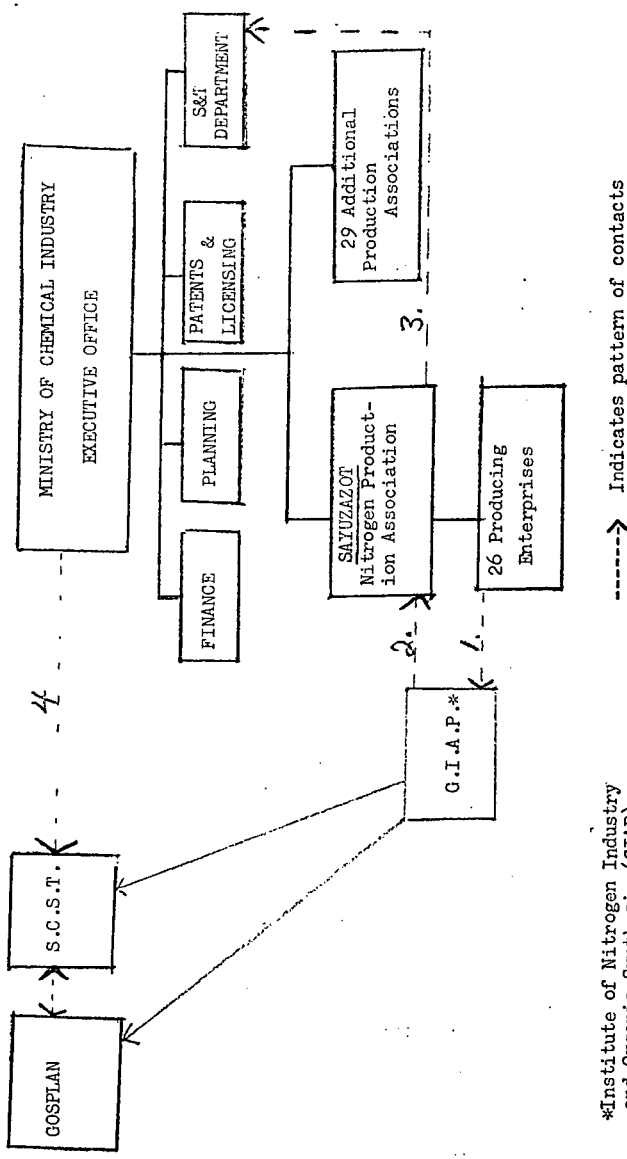

Chart II Explanation

The 1973 industrial reorganization has produced structural changes in USSR's organization in the S&T area. This impact has been largely on administrative levels below the SCST, except that the research institute has been established as an important channel of influence since it makes direct inputs into the planning process of both GOSPLAN and SCST. The chart describes the effects in the chemical industry, where the new system is mort fully implemented. The overall intent of the reorganization was to improve coordination of technological research in order to expand the implementation of innovative techniques.

Soviets Initiate Contact

1. A producing enterprise submits its long range plan to the appropriate industrial research institute; in this case, the Institute of Nitrogen Industry and Organic Synthesis (GIAP).
2. The Institute reviews these plans and recommends various means of fulfillment to the industrial association. GIAP acts as a clearing house between the enterprises and the SCST for resolution of plan inconsistencies and has direct access to both the SCST and GOSPLAN in accomplishing this end.
3. The industrial associations then submits the foreign technology purchase plans to the S&T Department of the Industrial Ministry.
4. The Ministry Executive Office then identifies and substantiates the necessary technology acquisitions and the process resumes the flow at point 2 in Chart I on p. 746.

Appendix D

American Companies Having Cooperation Agreements With State Committee for Science and Technology

Companies:	*1974 rank in fortune 500*
Abbott Laboratories	249
Allis-Chalmers	158
American Can Co	67
American Home Products	92
Armco Steel	51
Arthur Andersen	-----
Bechtel Corp	-----
Bendix Corp	77
Boeing Co	39
Bristol-Myers	125
Brown & Root	-----
Burroughs Corp	134
Coca-Cola	74
Colgate-Palmolive	69
Control Data Corp	187
Corning International	190
Deere & Co	75
Dresser Industries	146
FMC Corp	91
General Electric	8
General Dynamics	98
Gould, Inc	259
Gulf Oil	7
H. H. Robertson Co	-----
Hewlett-Packard	225
ITT Corporation	10
Industrial Nucleonics	-----
International Harvester	26
International Paper	56
Kaiser Industries	186
Litton Industries	53
Lockheed	49
R. J. Reynolds Industries	48
Rohm & Haas	196
Stanford Research Institute	-----
Singer Co	66
Sperry Rand	70
Standard Oil of Indiana	13
Union Oil Products	-----
Union Carbide	22
Varian Associates	492
Louis Berger, Inc	-----
McKinsey & Co	-----
Monsanto	48

APPENDIX D

AMERICAN COMPANIES HAVING COOPERATION AGREEMENTS WITH STATE COMMITTEE FOR SCIENCE AND TECHNOLOGY—Continued

Companies:	*1974 rank in fortune 500*
Norton Simon	123
Occidental Petroleum	20
Pepisco Inc	
Pfizer International, Inc	130
Phillip Morris	57
Phillips Petroleum	25
Raymond Loewy	
Reichold Chemicals	347
Revlon International	291

APPENDIX E

AREAS OF COOPERATION UNDER EXISTING CA's MANUFACTURING INDUSTRIES

SIC	Industry description	Number of known American company CA's	Number of known foreign company CA's
20	Food products		1
2026	Mills		1
2032	Fruit and vegetable canning	1	1
2084	Wines, brandy and spirits	1	1
2086	Bottled or canned soft drinks	2	
2099	Food preparations NEC	2	
2111	Cigarettes		1
226	Dyeing and finishing textiles		2
24	Lumber and wood products		1
2499	Wood products NEC	1	
261	Pulp mills	1	1
262	Paper mills	1	
2649	Converted paper and paperboard products NEC	1	
2731	Publishing and printing	1	
28	Chemicals	4	7
281	Industrial inorganic chemicals		2
2819	Industrial inorganic chemicals NEC	1	
282	Plastic materials, synthetic resins, rubber and manmade fibers	1	
2821	Plastic and synthetic resins	1	
2822	Synthetic rubber	1	
2833	Medical chemicals	2	2
2834	Pharmaceutical preparations	2	4
2841	Soap and detergents	1	2
2844	Perfumes and cosmetics	1	3
2851	Paint, varnishes, and lacquers	1	2
286	Industrial organic chemicals	1	
2865	Dyes and organic pigments	1	
287	Agricultural chemicals	1	1
2874	Fertilizers		1
2879	Pesticides		3
2891	Adhesives and sealants	1	
3011	Tires		2
322	Glass and glassware		1
3291	Abrasives		3
3312	Rolling and finishing steel mill		3
332	Iron and steel foundries		3
3334	Primary production of aluminum	1	
34	Fabricated metal products except machinery and transportation equipment.	1	
3433	Heating equipment	1	
3443	Fabricated plate work	2	3
3471	Electroplating, polishing and coloring	1	
3479	Coating, engraving and related services NEC	1	
3498	Fabricated pipe and fittings	1	1
35	Machinery except electrical	1	
351	Enzymes and turbines	1	
3519	Internal combustion engines	1	1
352	Farm and garden equipment	1	
3523	Farm machinery and equipment	−1	1
353	Construction, mining and materials handling equipment	1	
3532	Mining equipment	2	3
3533	Oil field machinery	2	
354	Metal working machinery	3	1
3541	Machine tools	4	6

AREAS OF COOPERATION UNDER EXISTING CA's MANUFACTURING INDUSTRIES—Continued

SIC	Industry description	Number of known American company CA's	Number of known foreign company CA's
355	Special industry machinery	1	—
3551	Food products machinery	4	1
3552	Textile machinery	1	1
3554	Paper industry machinery	1	—
3555	Printing trades machinery	—	1
3559	Special industry machinery NEC	1	—
3561	Pumps	1	1
3569	General industrial machinery NEC	1	1
357	Office, computing and accounting machines	2	—
3573	Electronic computing equipment	3	1
358	Refrigeration and services industry machinery	—	1
3585	Air-conditioning and refrigeration equipment	1	—
3589	Service industry machines NEC	1	—
362	Electrical industrial apparatus	—	1
3621	Motors and generators	2	2
3622	Industrial controls	1	—
3636	Sewing machines	1	—
3661	Telephone equipment	1	—
3662	Radio and television transmitting, detection and signaling equipment	9	2
365	Radio and television receiving equipment	—	1
366	Communication equipment	—	1
367	Electronic components and accessories	—	2
3711	Motor vehicles and passager cars	1	1
3714	Motor vehicle parts	—	1
372	Aircraft and parts	5	1
3731	Shipbuilding	3	—
3811	Engineering, laboratory, scientific and research equipment	2	—
3829	Measuring and controlling devices NEC	2	1
3841	Surgical and medical instruments	1	1
3861	Photographic equipment	1	1

AREAS OF COOPERATION UNDER EXISTING CA'S NONMANUFACTURING INDUSTRIES

0132	Tobacco	1	—
016	Vegetables	1	—
017	Fruits	1	—
13	Oil and gas extraction	—	1
1382	Oil and gas field exploration services	3	1
14	Mining of nonmetallic minerals	1	—
1499	Miscellaneous nonmetallic NEC	1	—
1514	General Contractor, industrial buildings	—	1
161	Road construction	—	1
1623	Water, sewer, pipeline, communication line construction	1	—
4582	Airport and flying fields services	1	—
4612	Crude petroleum pipeline	2	—
483	Radio and television broadcasting	—	1
4953	Refuse systems	1	—
7011	Hotels	1	—
7372	Computer programing and software services	5	—
7374	Data processing services	1	—
7391	Research and development laboratories	1	—
7392	Management consulting services	3	1
7399	Business services NEC	1	—
7813	Motion pictures	1	—
7814	Motion picture tape production	—	1
8911	Engineering, architectural and surveying	6	5
8931	Accounting, auditing, bookkeeping services	1	—
8999	Services NEC	1	—
91	Administration of environmental quality program	1	—
9511	Air, water, resource and solid waste management	1	1

Appendix F

Partial List of Foreign Companies[1] Having Cooperation Agreements With State Committee for Science and Technology

County and company:	*1974 rank in fortune 300 largest non-U.S. industrials*
West Germany	
Schering AG	283
Werkzeugmaschinen-Fabrik Gildemeister	---
Runrkohle AG	33
Krupp	51
Lurgi-Gesellschaften	---
Otto Wolff AG	---
Robert Bosch	63
Daimler-Benz	16
AEG-Telefunken	30
Kimsch	---
Thyssen-Roehenwerke	8
Bayer	15
Siemens	13
Hoeschst	10
Degussa	126
Henkel	108
BASF	9
Hemscheidt	---
Austria:	
Schoeller Bleckmann Stahlwerke	---
Voest	90
Manfred Swarovaki GMBH	
Italy:	
Pirelli-Dunlop	46
Sina Viscosa	237
Metenco	---
Liquichimica	---
Finmeccanica	---
Monticatini Edison	11
E.N.I.	---
Pressindustria	---
Canada:	
Polysar Ltd	---
Canadian Broadcasting Co	---
Netherlands:	
Synres Nederland Sigma	---
Verenigde Machinefabrieken	295
AKZO NV	---
Switzerland: Durisol AG	---
Belgium: Picanol	---
United Kingdom:	
Marconi Ltd	---
Dunlop-Pirelli	46
Lucas Industries	182
Rank Xerox	174
Rolls Royce	---
Beecham Group	188
Shell Oil	1
Sweden:	
Volvo	80
LKB Producter	----
Sandvik	256
Japan:	
Mitsubishi	----
Mitsui	214
Tokyo Boeki	----
Mayekawa	----
Teijin Co	----
C. Itoh Co	180
Finland: W. Rosenlew	----
France: Moet Hennessy	----

[1] List derived from published sources, therefore not exhaustive.

INDUSTRIAL COOPERATION AGREEMENTS: SOVIET EXPERIENCE AND PRACTICE

MAUREEN R. SMITH

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I. INTRODUCTION

The expansion of commercial relations between the Soviet Union and the major Western nations is more than the sum of a given number of discrete export/import transactions. Although the greatest number of individual exchanges are of this type, a substantial and increasing volume of commerce which gives promise for sustained, long-term growth has been generated by agreements that bind Western firms and Soviet enterprises into relatively complex, enduring relationships, or industrial cooperation arrangements.

In this context, industrial cooperation (IC) refers to the economic relations and activities arising from contracts extending over a number of years, between partners belonging to different economic systems, which go beyond the straightforward sale or purchase of goods and services. It includes those transactions in which the Eastern and Western parties engage in complementary or reciprocally matching

operations in production, in the development and exchange of technology and in marketing (including associated support services), but stops short of the joint venture or equity investment relationship as practiced in the West.

After years of rather slow but steadily mounting official acceptance of various modes of economic interaction with the West, the Soviet leadership has recently issued some rather unambiguous pronouncements ascribing a pivotal role to East-West industrial cooperation agreements in shaping the character and extent of Soviet commercial relations with the West in the years ahead.

The record of Soviet consideration of industrial cooperation with the West goes back at least to the late 1960's when the U.S.S.R. concluded several agreements with Western governments for scientific, technical and economic cooperation, using these as the bases for subsequent efforts to develop a rather broad-based network of relationships with leading private sector organizations in these countries.

Starting with West German organizations, expanding to the other major West European powers, Japan, and most recently, the United States, the Soviets are estimated to have concluded some 160 cooperation arrangements with Western firms in less than a decade.

These have evolved from relatively simple licensing arrangements to highly sophisticated types involving massive development projects and multi-tier redelivery systems. The learning experience associated with early projects produced an increasing level of Soviet sophistication in various forms of Western industrial organization.

By the mid 1970's industrial cooperation arrangements achieved a fair degree of maturity as instruments for accommodating differing East-West economic, industrial and ideological requirements. Although several East European CEMA members—most notably Romania and Poland—adopted policies which strongly encouraged industrial cooperation with the West, the U.S.S.R. did not yet actively promote such arrangements and, indeed, represented some resistance to the potential breach in CEMA's regional economic solidarity inherent in more advanced forms of cooperation with the West. In the interim, major international economic developments, and specifically, the shortage of raw materials (principally fossil fuels) in the Industrialized West and the persistence of worrisome Soviet trade deficits with hard currency areas, combined to produce an optimal environment for change in Soviet policies.

There is now mounting evidence that the Soviets are taking a new, more appreciative look at industrial cooperation arrangements, perhaps with a view toward reforms which would provide a longer-term relationship with the Western partner. The Soviet objective would be to obtain a continued update of technologies utilized in the manufacturing process through the offer of a vested interest in a joint undertaking.

Although such reforms have been rumored in the past, without apparent result, the high level attention now focused on this issue suggests that a substantive trend in Soviet economic policy may be emerging.

In the major economic address of the 25th Party Congress, Soviet Premier Kosygin linked an intensified level of industrial cooperation

to the policy of detente and stressed the importance of such arrangements in furthering internal economic development objectives as well as fostering increased economic interaction with the West: [1]

> In the context of detent, new qualitative aspects are being acquired by our economic relations with the industrialized capitalist countries, relations that can develop successfully on the basis of the principles set forth in the final Act of the Conference on Security and Cooperation in Europe (CSCE). We shall continue the practice of signing large scale agreements on cooperation in building of industrial enterprises in Western countries. Compensation agreements, especially those covering projects with a short recoupement period, various forms of industrial cooperation and joint research and development are promising forms. * * *

At the same meeting Secretary General Brezhnev elaborated still further on the new importance of industrial cooperation arrangements, indicating that there would be particular emphasis on compensation, or buy back features. His remarks at that time have been interpreted as an indication to Soviet ministries and FTOs that more substantial purchasing commitments will be sought from prospective Western suppliers, with the strong suggestion that preferences would be accorded those suppliers willing to accommodate the Soviet drive for exports associated with industrial projects.

As outlined by Brezhnev, new plants set up under buy back arrangements must remain the sole property of the state, indicating that the Soviets would not take the route of the Romanians in permitting joint ventures with foreign capital participation.[2]

II. Definitions

Although the number of East-West industrial cooperation arrangements has grown rapidly in recent years—there are perhaps more than 1,000 such arrangements in existence—their variety and dynamic, evolutionary character have made the permanent establishment of any internationally agreed definitions extremely difficult.

For purposes of this paper industrial cooperation will denote agreements between enterprises belonging to different economic systems which go beyond traditional export/import operations based on monetary settlement and include set reciprocal product/service flows extending over a number of years.

In order to analyze available data on industrial cooperation arrangements, they can be ranked and classified according to the degree of complexity which characterizes the relationship between the partners. The complexity of a given relationship may be examined in several dimensions, including the division of mutual responsibility; apportionment of risk, management rights and profits; provisions for repayment and income realization; and expected life cycle/term of the agreement.

The nearest approximation of internationally-agreed definitions has been provided by the United Nations Economic Commission for

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[1] Proceedings of the 25th CPSU Congress, Foreign Broadcast Information Service, Vol. VII, p. 8–9.

[2] Proceedings of the 25th CPSU Congress, Foreign Broadcast Information Service, Vol. I, p. 16–18.

Europe,[8] which recognizes six general classes of industrial cooperation arrangements, roughly in ascending order of complexity.

Licensing with payment in resultant product;
Supply of complete plants or product lines with payment in resultant product (turnkey arrangements);
Coproduction and specialization;
Subcontracting;
Joint ventures; and
Joint tendering or joint projects.

Although joint ventures involving equity participation are still not permitted in the Soviet Union, Soviet enterprises have participated in the five other forms of industrial cooperation, and these are examined in the following section.

A. Licensing With Payment in Product.—May include licenses granted by a Western partner for complete products or components, partial or full payment for which would be made in finished products or components manufactured under the license. It may also refer to a package of licenses, know-how and specified parts (supplied in diminishing percentages of the final product). These too would be repaid in complete products and/or components.

B. Turnkey With Payment in Product.—Involves a longer term, more substantive relationship between the partners than is characteristic of traditional turnkey contracts, in that the Western partner is normally committed to provide a complete facility, including training, technical assistance in achieving targeted production goals and, in some instances, technology updates as well. The greater involvement of the Western partner has the major advantage of familiarizing Soviet enterprises with Western management systems and, to the extent that it permits an acceptable level of quality control, also contributes to the Western partner's willingness to accept plant output in payment.

Soviet participation in this form of industrial cooperation has been most prominent in the development/exploitation of natural resources, whereby the Western partner may supply plant and/or equipment as well as technical services in exchange for a guaranteed share of the output, at agreed prices, for a predetermined period of time.

C. Coproduction and Specialization.—Each partner to this type arrangement specializes either in the production of certain parts of the final product—which is then assembled by one of the partners or both, each to meet the requirements of its assigned market area—or in the production of a limited number of items in the manufacturing program, which are then exchanged to complete each partner's range of products.

Within this general framework, several variations may be possible, depending on the source of manufacturing technology. Cooperative marketing arrangements for placement of joint or complementary products are typically included.

According to the ECE this is the most prevalent form of East-West industrial cooperation, accounting for over a third of all agreements

[8] The United Nations Economic Commission for Europe, Committee on the Development of Trade, has conducted a major part of the research in the field of East-West industrial cooperation. Much of the quantitative data in this paper is derived from two studies: "Analytical Report on Industrial Cooperation Among ECE Countries," Geneva, 1973; and "Preparations for the Second Meeting of Experts on Industrial Cooperation," Geneva, 1975.

in manufacturing and approximately half of those in the transport and mechanical engineering sectors.

D. Subcontracting.—Derives principally from the presumed lower wage costs prevailing in the socialist partner states and, particularly in those instances where government-backed export credits can be obtained, from favorable relative capital costs as well. Sub-contracting may occur merely as the mechanism for product delivery in the context of a larger industrial cooperation agreement, such as a turnkey project, or may serve as a supplement to the Western partner's production capability over the short/long term. In the latter instance it is clearly the form most vulnerable to business cycle changes in the West.

E. Joint Tendering or Joint Projects.—Involves collaboration in a third country—most frequently on engineering projects—with a high degree of complexity in the division of responsibility between the partners. It may also serve as a mechanism for joint venture arrangements which would otherwise not be permitted under Soviet law.

In addition to the foregoing generally recognized types of industrial cooperation arrangements, the Soviets also participate extensively in framework agreements for scientific and technological cooperation which might be classed as nascent or borderline industrial cooperation arrangements. Although such protocol or umbrella agreements are not, strictly speaking, industrial cooperation arrangements, since they are actually generalized agreements to agree rather than specifications of projects, they are instructive since they indicate areas in which Soviet authorities apparently feel cooperation with a Western enterprise may be desirable and are therefore probably predictive of future cooperation arrangements.[4]

III. Soviet Participation In Industrial Cooperation Arrangements

Based on the foregoing understanding of the nature of East-West industrial cooperation, it is estimated that the Soviets have concluded over 160 such arrangements with Western enterprises (in addition to well over 200 scientific and technical cooperation arrangements).[5]

Although this number would appear to be unexpectedly small in relation to a universe of some 1,000 such arrangements for CEMA as a whole, it should be viewed in light of the following considerations:

The Soviet's relatively late start in the industrial cooperation area. Other nations of Eastern Europe specifically Hungary, Romania and Poland have pioneered the development of industrial cooperation arrangements with the West and generally have a much wider range of agreements to their credit (Hungary alone has concluded more than 300 ICs with Western enterprises).[6]

The Soviet Union's belated endorsement of industrial cooperation with the West can probably be attributed to its relative ideological conservatism, absence of a current-generation heritage of close, normalized industrial relations with the West, a generally lower depend-

[4] For a further analysis of Soviet agreements for scientific and technological cooperation, see Lawrence Theriot, "U.S. Governmental and Private Industry Cooperation With the Soviet Union in the Fields of Science and Technology." (See p. 741 in this volume.)

[5] Business International, "Eastern Europe Reports," Dec. 13, 1974.

[6] United Nations Economic Commission for Europe, Committee on the Development of Trade. "Preparations for the Second Meeting of Experts on Industrial Cooperation," Geneva, 1975.

ence on foreign trade and relatively less critical hard currency reserve position.

The large scale of Soviet industrial cooperation projects. Although small in numbers, Soviet industrial cooperation agreements dwarf figures for any other country in terms of value. From this perspective, the dollar value of industrial cooperation in the Soviet Union far exceeds the comparable figure for Eastern Europe combined.

In addition, projects of the size and complexity of the Siberian gas program place heavy strains on the ability of the rest of the economy to provide required support. In terms of manpower, management capabilities and other inputs, the number of very large cooperation projects which the Soviets can undertake at any one time is thus severely resource-limited.

The following section analyzes Soviet industrial cooperation agreements by type of contract, significance for major sectors of the Soviet economy and most important Western partner states.

Distribution by type of agreement—There is a distinct difference between the pattern of industrial cooperation characteristic of Eastern Europe as a group and that characteristic of the Soviet Union. In general terms, Soviet industrial cooperation projects are concentrated most heavily in turnkey projects and involve the processing of raw materials and industrial supplies. Eastern European agreements, on the whole include a higher percentage of coproduction and licensing arrangements, and a commodity structure more heavily weighted toward finished products.

TABLE 1.—U.S.S.R.: DISTRIBUTION OF INDUSTRIAL COOPERATION AGREEMENTS BY TYPE OF AGREEMENT, COMPARISON WITH CEMA, 1975

Type of Agreement	Percent of total agreements	
	U.S.S.R.	CEMA
Licensing with payment in product		26.1
Turkey	56.6	21.7
Coproduction and specialization	34.8	33.3
Subcontracting	4.3	6.8
Joint venture		2.9
Joint tendering	4.3	9.2
Total	100.0	100.0

Source: Economic Commission for Europe, Committee on the Development of Trade, "Preparations for the Second Meeting of Experts on Industrial Cooperation, 26, August 1975."

TABLE 2.—U.S.S.R.: MAJOR TURNKEY PROJECTS, NATIONALITY OF WESTERN PARTICIPANT AND DESCRIPTION OF PROJECT/COMPENSATING PROJECT FLOWS, 1976

Partner/country	Project	Value (millions)	Soviet product payment
France	Gas field equipment	$250.0	Natural gas.
Austria	Large diameter pipe	400.0	Do.
Italy	do	190.0	Do.
Finland	Pipe	NA	Do.
West Germany	Large diameter pipe	1,500.0	Do.
France, Austria, West Germany.	Large diameter pipe and equipment	900.0	Do.
Japan	Forestry handling equipment	163.0	Timber products.
Do	Wood chip plant	45.0	Wood chips and pulp.
Do	Forestry handling equipment	500.0	Timber products.
France	Pulp paper complex	60.0	Wood pulp.
United Kingdom	Shoes	3.2	Food products, toys.
West Germany	Polyethylene plant	39.0	Polyethylene.
Do	do	61.0	Do.
France	Styrene/polystyrene	100.0	Polystyrene.
Italy	Chemical plants (7)	600.0	Ammonia.
United Kingdom/ United States.	Polyethylene plant	50.0	Polyethylene.
France	Ammonia plants (4)	220.0	Ammonia.
Italy	Chemical plants (6)	670.0	Chemical products.
United States	Ammonia plants (4)	200.0+	Ammonia.
Do	Fertilizer storage and handling facilities	100.0	Do.
France	Ammonia pipeline	200.0	Ammonia.
United States	do	100.0	Do.
Italy	Surface active detergent plant	NA	Organic chemicals, surface-active detergents.
Do	Polypropylene	100–130.0	Chemical intermediates.
United States	Equipment, cola concentrates	NA	Vodka.
Japan	Oil exploration	150–250.0	Oil and gas.
Italy	Large diameter pipe	1,500.0	Scrap metal, coal, iron ore.
Japan	Coal development equipment	450.0	Coal.
West Germany	Steel complex	1,200.0	Pellets, steel products.
France	Aluminum refinery	1,000.0	Aluminum.
West Germany	Ethylene, oxide/glycol plant	80.0	Related products.

Source: Central Intelligence Agency, February 1976.

Table 1 shows the distribution of Soviet industrial cooperation agreements by type, and compares this with average figures for the CEMA region as a whole.

As indicated in the table, of the 160 Soviet industrial cooperation agreements with the West, some 56 percent, or perhaps 90 agreements are turnkey projects of the complex type involving close cooperation with the Western partner and return payment in resultant product flows.

Table 2 lists some of the major Soviet turnkey projects, the nationality of the Western participant and the commodity composition of return product flows.

The Soviet emphasis on large scale turnkey type projects is well suited to the achievement of current development objectives. Among

these, accelerated oil and gas production from Siberian deposits; major technological improvements in domestic production of special steels, computers, cars and trucks; and the achievement of a significant breakthrough in livestock production all will require substantial and continuing inputs of Western technology, equipment, management skills and marketing capability. The turnkey approach, as developed in the Soviet context, is probably the most efficient of the industrial cooperation instruments for effectively importing these resources.

Ranking behind turnkey agreements, coproduction with specialization by the partners accounts for an additional 35 percent of Soviet industrial cooperation projects, or an estimated 56 agreements. Virtually all of these involve specialization at the component level, with assembly by both partners for marketing within assigned areas. Under most agreements, the Western participant maintains unique or principal access to Western hard currency markets; Soviet participation is normally limited to the CEMA regional market and perhaps, some designated third-world areas as well. The fact that the U.S.S.R. ranks behind several East European countries in the percent of industrial cooperation agreements in this category (comparable figures are 44.1 percent for Hungary and 37.5 percent for Poland)[7] may indicate a lower level of acceptability for Soviet manufactured components among potential partner enterprises in the West.

Joint projects or joint tendering in third countries accounts for approximately 9.2 percent of Soviet industrial cooperation agreements or some 15 projects. For the most part, these involve joint banking and marketing companies, (which may be established as joint ventures) but may also include some construction projects in third countries. Table 3 provides a listing of Soviet marketing companies in the West.

[7] UNECE, op. cit., p. 5.

TABLE 3.—U.S.S.R.: JOINT MARKETING COMPANIES IN THE WEST IDENTIFIED BY PARTNER COUNTRY AND PRODUCT, 1975

Partner country	Enterprise name	Soviet product
Belgium	Belso	Foodstuffs.
	Nafta-B	Petroleum and products.
	Scalda-Volga	Automobiles and parts.
	Almax	Diamonds.
Canada	Belarus	Tractors and agricultural equipment.
Finland	Koneisto	Machinery.
	Konelsa	Automobiles, tractors, trucks.
	Kokia	
	Finn-Eloro	
France	Actif-Auto	Agricultural and road building machinery.
	Russebois	Paper and timber.
	Slava	Optical, watches, and measuring instruments.
	Sogo	Chemicals and photographic products.
	Stankofrance	Machine tools.
	Gisofra	General trading.
FRG	Neo Type	Printing machinery.
	Techmashexport	Chemical, textile, pulp paper, electronics equipment.
Italy	Stanitaliana	Machine tools.
Netherlands	East-West Agencies	Photographic and optical equipment.
	Elorg	Computers.
Norway	Koneisto	Machinery of all types.
	Konela Norge	Automobiles.
Sweden	Matreco	Automobiles.
United Kingdom	Technical and optical equipment	Photographic equipment, microscopes, radios.
	Nafta (BG)	Petroleum products.
	UMO Plant	Road construction and earth moving equipment.

Although the number of joint construction projects in third countries is not substantial, there does appear to be serious Soviet interest in this area, and the State Committee for Foreign Economic Relations has indicated a particular interest in cooperating with U.S. firms on such projects.

Licensing with payment in product continues to be one of the main forms of industrial cooperation in almost all countries (accounting for 62.5 percent of agreements in Bulgaria; 35.7 percent in Czechoslovakia; 25 percent in Poland; and 22.9 percent in Romania).[8] Comparable figures for the Soviet Union are difficult to obtain.

Reverse licensing of Soviet technology into the U.S. typically has not included provisions for payment in product, since the Soviet licensor will normally seek to maximize hard currency earnings by insisting on monetary settlement.

Distribution by industry—Table 4 shows the industry distribution of Soviet industrial cooperation agreements, compared with figures for Eastern Europe.

TABLE 4.—U.S.S.R.: DISTRIBUTION OF INDUSTRIAL COOPERATION ARRANGEMENTS BY INDUSTRY, WITH COMPARISON FOR EASTERN EUROPE

Industry	Percent of agreements	
	U.S.S.R.	Eastern Europe
Chemicals	31.8	13.5
Transport equipment	13.6	15.0
Machine tools	9.1	5.7
Mechanical engineering (excluding machine tools)	4.6	30.0
Electrical engineering and electronics	18.2	11.6
Other	22.7	24.2
Total	100.0	100.0

Source: Economic Commission for Europe, Committee on the Development of Trade, "Preparations for the Second Meeting of Experts on Industrial Cooperation," 1975.

As indicated in the table, the chemical industry, with an estimated 32 percent of all Soviet agreements, or approximately 51 projects, occupies first place, followed at some distance by electrical engineering and electronics. The predominance of the chemical industry is understandable in view of the Soviet Union's relative natural resource endowment and is reflected in the heavy percentage of industrial supplies and materials comprising Soviet exports associated with industrial cooperation projects. It is also consistent with the ECE observation[9] that there is an affinity between certain forms of cooperation and industrial sectors and particularly between turnkey projects and the chemical industry.

The Soviet data also differ sharply from those for the rest of Eastern Europe in the relatively low percentage of industrial cooperation arrangements in the mechanical engineering sector. Although the aggregate figure for Eastern Europe as a whole is 30 percent (vice 4 percent for the Soviet Union) the difference may be even greater when compared with individual Eastern European countries, where the figurges range between 30 percent and 50 percent of total contracts.[10]

[8] UNECE, loc. cit.
[9] UNECE, op. cit., p. 5.
[10] UNECE, loc. cit.

The "affinity" analysis applied by the ECE would also appear to explain these figures. It has been noted that agreements in the mechanical engineering sector most commonly (in some 30 percent of cases) [11] involve licensing agreements. The low share of licensing agreements thus corresponds to the low share for mechanical engineering.

By the end of the current 1976–80 Plan period, but probably not before, the industry distribution of Soviet industrial cooperation arrangements can be expected to diversify away from heavy reliance on the chemical industry into such fields as transport equipment, machine tools and electronics. Further, the relatively recent decision to pursue an agribusiness approach to problems of agricultural efficiency may well produce an upsurge in the number of industrial cooperation agreements in this area as well.

A. Distribution by Major Western Partner.—The F.R.G. with a long-standing tradition of industrial relations with the nonmarket economies, is the leading Western partner in East West industrial cooperation agreements as a whole and with the Soviet Union in particular.

Although German firms are actively involved with Soviet organizations in all sectors, their presence is strongly felt in the chemical industry where the major West German chemical companies take large quantities of feedstock as compensation product. West Germany's Salzgitter, for example, has built four synthetic fiber plants in the U.S.S.R. over the past decade, and in exchange has purchased more than $100 million in Soviet products, mainly materials and fuels.

Although specific data on the relative ranking of other Soviet partners in the Industrialized West are not available, the listing provided in Table 2 indicates that France, the U.K., Italy, and Austria are relatively active in large scale turnkey type arrangements.

Due to its location and high degree of dependence on imported raw materials, Japan is one of the most active Western participants in Soviet industrial cooperation arrangements—ranging from Sakhalin oil through timber and consumer air conditioning units. Japanese/Soviet resource development projects alone could probably be valued at more than $2 billion.

Finland's special relationship to the Soviet Union is also reflected in the relatively large number of industrial cooperation agreements, most of them in the raw materials area, which involve Finnish enterprises. Finland probably also exceeds any other Western partner in the number of joint projects, most of them marketing enterprises for Soviet products.

Of the major nations of the Industrialized West, the United States probably ranks last in terms of the number of industrial cooperation agreements with the U.S.S.R. [12]

B. Distribution by Type of Agreement.—Table 5 shows U.S. industrial cooperation agreements with the Soviet Union (concluded or under serious negotiation) broken down by type of agreement and size

[11] Ibid.

[12] In terms of numbers of agreements, Paul Marer, "The U.S. Perspective on East-West Industrial Cooperation." (Unpublished). International Development Research Center, Indiana University, has estimated that for CEMA as a whole, combined Western Europe probably has seven or eight times as many industrial cooperation agreements as the United States. The UNECE, op. cit., p. 5, estimates that as much as 7.7 percent of total East-West industrial cooperation agreements involve U.S. participation.

of participating firm. Based on a Winter 1975 sampling by the International Development Research Center of Indiana University, there were approximately 96 such agreements in force and an additional 70 under negotiation.

The table conforms to the previous observations based on European data in yielding a high proportion of turnkey agreements: of 96 total signed agreements, slightly more than 75 percent involved turnkey projects.

Although a juxtaposition of the columns showing completed agreements and those under negotiation suggests little change in the rate of U.S. industrial cooperation with the U.S.S.R. there is a suggestion that the pattern may be changing, with a noticeable increase in potential licensing activity.

The table also indicates that industrial cooperation with the Soviet Union is largely the preserve of the largest U.S. companies: 105 of the 166 or almost two-thirds of the agreements either in force or under negotiation involve Fortune 500 firms. In most instances, these are multinational companies.

TABLE 5.—UNITED STATES: INDUSTRIAL COOPERATION AGREEMENTS WITH THE U.S.S.R.: DISTRIBUTION BY TYPE OF AGREEMENT, BREAKDOWN BY FIRM SIZE, 1975

Type of agreement	Agreements concluded [1]			Agreements under negotiation [1]		
	Fortune 500 firms	Other	All firms	Fortune 500 firms	Other	All firms
Licensing with payment in product	5	1	6	1	2	3
Indirect [2]	1		1			
Licensing payment not specified	3	2	5	17	4	21
Turnkey	43	31	74	24	15	39
Subcontracting	3	1	4	1		1
Coproduction	3	3	6	4	1	5
Joint venture					[3] 1	1
Total	58	38	96	47	23	70

[1] As of fall 1974 to winter 1975.
[2] Through a European subsidiary.
[3] Located in a 3d country.

Source: "The U.S. Perspective on East West Industrial Cooperation," Paul Marer et al., International Development Research Center, Indiana University, 1975 (unpublished).

The predominance of larger, multinational companies in this group is understandable in view of the magnitude of Soviet industrial cooperation projects, which generally require substantial capital outlays as well as important inputs of skilled manpower. An investment of this magnitude would place severe strains on all but the very largest companies.

Further, although small and medium-sized machinery producers might be interested in supplying equipment for Soviet projects, they normally do not have the capability of marketing resultant product, which requires the combined financing and distribution skills of a multinational enterprise.

Distribution by industry—Table 6 shows the distribution of U.S. industrial cooperation agreements with the Soviet Union by SIC category. According to the Indiana University census [13] non-electrical

[13] "The U.S. Perspective on East-West Industrial Cooperation," International Development Research Center, Indiana University, Paul Marer et al. (unpublished) October 1975. Chapter 4, p. 17.

machinery accounts for some 48 agreements; electrical equipment, 13; electronic components and accessories, 9; instruments, 11; and transportation equipment 8. The distribution of agreements under negotiation is not substantially different.

TABLE 6.—UNITED STATES: INDUSTRIAL COOPERATION AGREEMENTS WITH U.S.S.R.: DISTRIBUTION BY SIC CATEGORY, 1975 [1]

SIC No.	Industrial classification	Fortune 500	Other	All firms
011	Field crops	1	1	2
012	Fruits, tree nuts and vegetables	1		1
100	Metal mining	2		2
130	Oil and gas extraction	9	2	11
151	General building contractors	3		3
179	Miscellaneous trade contractors	12	9	21
200	Food and kindred products	5	1	6
211	Cigarettes	2	1	3
220	Textile mill products	1		1
240	Lumber and wood products	1		1
260	Paper and allied products	2	2	4
270	Printing and publishing		1	1
281	Industrial chemicals	16	4	20
282	Plastics and synthetics	3		3
283	Drugs	3	1	4
284	Toilet goods	2	1	3
286	Gum and wood chemicals	1		1
287	Agricultural chemicals	4		4
290	Petroleum and coal products	6	2	8
300	Rubber and plastics	1		1
320	Stone, clay and glass products	3		3
330	Primary metal industry	8		8
340	Fabricated metal products	5		5
350	Machinery except electric	32	16	48
360/366	Electrical equipment	12	1	13
367	Electronic components and accessories	9		9
370	Transport equipment	7	1	8
380	Instruments, et cetera	9	2	11
450	Air transport	4		4
490	Electricity, gas, et cetera	1	1	2
701	Hotels	1	1	2
730	Miscellaneous business services	1	4	5
790	Recreation	1		1
891	Engineering and architectural services	3	3	6
	Industry not specfied	4	9	13
	Total number of projects	175	63	238

[1] Numbers may not compare with table 5 due to: double counting of projects involving more than one industry; inclusion of S. & T. Agreements, straight licensing.

Source: "The U.S. Perspective on East-West Industrial Cooperation," Paul Marer, et al., International Development Research Center, Indiana University, 1975. Unpublished.

Table 7 shows the distribution of US industrial cooperation agreements with the Soviet Union by branch of industry as compared with the relevant figures derived by the ECE on the basis of Western European experience.

A comparison of the two sides indicates a very large proportion of U.S. agreements in the "other" category. These would include food processing projects, the oil and gas deals, and metal products.

The West Europeans (principally the West Germans) have a relatively heavier proportion of agreements in chemicals. Other areas where the West Europeans exceed the U.S. are transport equipment (the Fiat and Renault agreements, for example) and electrical engineering and electronics. The West European lead in this latter area may be attributable in part to a relatively less stringent position regarding export controls, an important factor in the electronics sector.

TABLE 7.—U.S. INDUSTRIAL COOPERATION AGREEMENTS WITH THE U.S.S.R.: DISTRIBUTION BY INDUSTRY COMPARISON WITH WESTERN EUROPE, 1975

Sector	United States		Western Europe (percent)
	Number of agreements	Percent	
Chemicals	15	18	32
Transport equipment	2	2	14
Machine tools	5	6	9
Mechanical Engineering	13	15	5
Electrical engineering and electronics	4	5	18
Other	45	54	23
Total	84	100	100

Source: "The U.S. Perspective on East-West Industrial Cooperation," Paul Marer, et al., International Development Research Center, Indiana University, 1976. Economic Commission for Europe, Committee on the Development of Trade, 'Preparations for the Second Meeting of Experts on Industrial Cooperation," Aug. 26, 1975.

When U.S. agreements are analyzed according to Soviet end-use it appears that some 50 percent of U.S. projects are investment oriented:[14] 30 percent intermediate industrial and only 12 percent consumer oriented. Using agreements under negotiation as a possible guide to the future, there does not appear to be a significant shift in the pattern, except for a slight decline in the share of investment oriented activity to 44 percent.

This pattern differs from that which typifies U.S. industrial cooperation arrangements with Eastern Europe: whereas in the U.S.S.R. one out of nine projects is consumer oriented, in Eastern Europe it is approximately one out of five. This is explainable in terms of the relatively higher priority ascribed to the consumer sector in Eastern Europe and, in some instances (such as Czechoslovakian crystal, Romanian glass, or Hungarian porcelain) the greater acceptability of East European consumer products in Western markets.

Although a relatively late entry to East-West industrial cooperation, the U.S. possesses competitive advantages in terms of technology, marketing capability and systems management performance which suggest a very significant potential for future industrial cooperation with the Soviet Union. Realization of this potential may well depend on evolving Soviet and U.S. policies regarding East-West trade in general and the implementation of CSCE undertakings[15] regarding the facilitation of industrial cooperation in particular.

IV. Main Directions of Soviet Policy Regarding Industrial Cooperation

Although the broad concept of industrial cooperation with the West has been endorsd by Soviet authorities, the preferred mode of such cooperation has been defined to meet Soviet requirements rather specifically as follows:

Contracts involving large sums that extend over lengthy periods and which are signed with a firm or group of firms in the capitalist countries, usually on

[14] The Indiana University study (op. cit., p. 19) establishes the following classification: Investment oriented—projects targeted to build general industrial capacity; intermediate industrial—sectors producing general purpose items; consumer oriented—projects (including agriculture and the building of industrial capacity) to produce consumer goods.

[15] Conference on Security and Cooperation in Europe: Final Act, Helsinki, 1975. Cooperation in the Field of Economics, of Science and Technology and of the Environment, No. 2, p. 93.

long term credit, for machines, equipment, development or construction of a project (natural resource or industrial enterprises). Credits are reimbursed by the delivery of products turned out by the project.[16]

Industrial cooperation with enterprises in the West will have the following characteristics:

The project is one with a major impact on the Soviet economy.

The cost is normally substantial.

The agreement covers a long (10–15 year) period.

Equipment requirements for the project are normally purchased on long-term credit.

Credits are reimbursed at least in part by the delivery of output from the project.

Export sales of the product continue after repayment of the original investment.

There is thus a fundamental difference between industrial cooperation arrangements of this type and earlier forms of commercial interaction. The new mechanism creates a qualitatively different relationship between Soviet enterprises and Western partners which encompasses several aspects of the undertaking and which is of relatively long duration. (For example, where provisions for technology update are included, the cooperation activity may extend over several "generations" of the given technology).

Major features of industrial cooperation arrangements which involve potentially significant issues in terms of Soviet policy toward future East-West industrial relations include: Compensation aspects; commodity composition; role of the Western partner; multilateral relationships; and administrative reform.

Compensation aspects—by Soviet definition, the compensation principle involves repayment through the export of product resultant from the industrial cooperation project; payment in non-resultant product is barter.

According to Deputy Foreign Trade Minister Sushkov [17] industrial cooperation arrangements will typically provide for Soviet exports of the resultant product amounting to some 20–30 percent of plant output, extending over some 10 to 15 years.

Variations outside this range may often be related to the priority attached to the project and to its status in the plan. For those projects which have lower priority or for which there has been no foreign exchange allocation made in the annual import plan, there may be a requirement to place a higher portion of plant output via the compensation mechanism.

The usefulness of the compensation mechanism for Soviet planners is twofold:

It reduces the requirement to generate foreign exchange from other sources by the amount of the product repayment. Given the extremely tight Soviet hard currency situation in recent years, this may well be the most important feature of compensation arrangements. Such agreements may also serve to generate a substantial volume of addi-

[16] A. Belov, "Agreements on Large Scale Compensatory Projects with Firms in the Capitalist Countries" U.S.–U.S.S.R. Trade and Economic Council Journal, No. 3, 1976, pp. 48–51. Mr. Belov is Deputy Chief of the Treaty and Law Department, U.S.S.R. Ministry of Foreign Trade.

[17] V. H. Sushkov, "Trade and Economic Cooperation with Capitalist Countries in the Construction of Large Industrial Projects in the U.S.S.R.," U.S.–U.S.S.R. Trade Deputy Minister, U.S.S.R. Ministry of Foreign Trade.

tive foreign exchange: It has been estimated [18] that realization of various compensation arrangements under discussion would return to the Soviets an additional $6 billion in hard currency earnings by 1985.

Indeed, many industrial cooperation projects undertaken on a compensation basis could not be undertaken otherwise, due to the scarcity of hard currency resources and the general reluctance of Soviet financial managers to assume substantial hard currency debt even in instances where there is a reasonable expectation that the project will generate sufficient hard currency income without reliance on compensation provisions. In this respect, compensation arrangements represent a partial solution to the chronic problem of limited Soviet hard currency resources and traditional Soviet conservatism regarding foreign-held debt.

It establishes markets for Soviet products in the West. Given the historically limited scale of Soviet participation in Western markets (particularly those involving technology-intensive products with a requirement for servicing, user training and other forms of customer support) the establishment of long-term markets in the West for Soviet products has proven extremely difficult. Under a compensation arrangement, however, the Western participant, who will normally have a previously-established position in the market for the product, assumes the marketing task. To the extent that deliveries of Soviet products to the Western participant and/or other customers in the West continue beyond the time required to finance the original undertaking (and this is the Soviet objective) compensation arrangements enhance the foreign exchange earning capacity of the project as a whole.

Given the magnitude of most Soviet compensation projects, return flows of product are substantial and can have a discernible impact on the volume and composition of two-way trade flow. According to the International Chamber of Commerce, the value of trade conducted under such agreements is growing more rapidly than that of ordinary commercial transactions.[19]

The two-way movement of equipment/raw materials under compensation deals has come to represent a substantial share of the bilateral trade between the Soviet Union and Japan, Italy, Austria, Finland, France and the F.R.G. Moreover, when production begins to flow under contracts already concluded, and particularly when Soviet deliveries of natural gas to Germany, Italy, Austria, and France begin on a large scale, the share of compensation arrangements in Soviet total trade with these countries is certain to increase.

For Japan, large-scale projects in areas such as forest products and coal have provided a solid basis for substantial sales of construction and mining equipment. Further, recent expansion of the timber industry and the prospect of future deliveries of natural gas products suggest that the compensation element in Soviet-Japanese trade will continue to increase.

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[18] U.S.S.R.: Long Range Prospects for Hard Currency Trade, Central Intelligence Agency, January 1975, p. 7.

[19] East-West Industrial Cooperation Agreements, Report by the ICC Liaison Committee with the Chambers of Commerce of Socialist Countries. The International Chamber of Commerce, Paris, 1974, p. 9.

Taking the Industrialized West [20] as a whole, it is estimated that as much as 15 percent of 1975 contracts for export of machinery and equipment to the Soviet Union, or as much as $615 million in exports, could be attributed to compensation arrangements.

Because the U.S. participates in fewer compensation arrangements with the Soviet Union, the impact on overall trade flows is not immediately apparent. However, an analysis of contract data for 1975 indicates that as much as 17 percent of U.S. exports to the Soviet Union or some $100 million in sales, can be associated with compensation arrangements.

For the future, the Soviets have indicated that any major and stable increment in U.S.-Soviet non-agricultural trade must be realized through compensation arrangements. The North Star and Yakutia natural gas projects, for example, would produce a sizeable increase in trade turnover. Citing the $1 billion 20-year Occidental agreement as an example, Deputy Minister Sushkov has estimated that perhaps 38 percent of U.S. Soviet trade in the 1976–80 period would be governed by compensation arrangements.[21] Even assuming that this estimate applies only to trade in machinery and equipment (and thus excludes substantial shipments of agricultural commodities) it would require markedly increased Soviet shipments toward the end of the period to realize this figure.

Commodity composition—A second major directive of Soviet policy regarding future industrial cooperation with the West is a restructuring of the commodity composition of such arrangements away from the present almost exclusive concentration on natural resources development projects in the direction of more industrial projects producing finished products. The principal product areas wherein the Soviets would seek to enter Western markets via compensation arrangements include automotive/transport equipment (airframes, trucks, tractors, passenger automobiles, motorcycles and bicycles) and industrial machinery (especially machine tools and power generating equipment). Soviet efforts (unsuccessful) to interest foreign firms on a compensation basis in such projects as the Kamaz Truck plant, Cheboksari tractor factory and the projected Siberian truck plant can be taken as further evidence of Soviet intentions.

Soviet efforts to focus industrial cooperation projects in this direction would have an obvious impact on the pattern and composition of compensation trade flows, and might also affect the willingness of Western firms to participate in such ventures.

Impact on trade flows—A change in the commodity composition of Soviet exports associated with industrial cooperation arrangements which involve an increased proportion of industrial products would raise the possibility of disruption to established market relationships in the West and, consequently, some degree of concern by affected Western governments. Faced with the ability of a centrally-directed economy to shift resources and establish prices in pursuit of hard currency earnings, Western governments may experience some conflict between a commitment to expanded East-West industrial cooperation and the protection of domestic markets.

In terms of U.S. trade, virtually all Soviet compensation proposals thus far considered by U.S. firms would provide raw and semi-proc-

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[20] Austria, Belgium-Luxembourg, Canada, Denmark, France, Italy, Japan, Netherlands, Norway, Sweden, Switzerland, United Kingdom, United States, West Germany.

[21] V. H. Sushkov, op. cit, p. 8.

essed products such as mineral fertilizers, chemicals, fuels, cellulose, steel and aluminum bars and shapes. The potential for disruption of domestic markets associated with imports of Soviet compensation products would therefore probably be relatively small so long as they remained concentrated in these areas. To the extent that such products are already being imported from other sources, the inflow of Soviet products will not adversely affect the U.S. trade balance. (Indeed, to the extent that compensation products are discounted vis a vis prevailing world market prices—a common practice—there may be a positive return to the U.S. in terms of trade.)

Neither do compensation arrangements already concluded or currently under discussion involve products which the U.S. exports in any appreciable quantity. The impact on U.S. sales to third markets therefore will probably be minimal.

Even given a change in the commodity composition of Soviet compensation projects, it is unlikely that the general conclusions of this analysis would change in any substantial way, principally because it is unlikely that Soviet industrial products would approach the level of technology, service and other quality features which would make them competitive with the major U.S. export products (although there may be some effects on individual products where these considerations do not apply.)

Participation by Western partners—A change in the commodity composition of Soviet exports on a compensation basis might affect the present interest of Western countries in participating in such arrangements.

Particularly for Western European and Japanese partners, access to Soviet raw materials supplies is a major motivation for participation in Soviet industrial cooperation ventures. The worldwide shortage of several basic industrial raw materials has in fact placed a premium on such arrangements which provide guaranteed long term supply and some element of predictability in pricing.

Additionally, several of the projects currently being undertaken on a compensation basis (e.g. chemicals) are those which probably could not be undertaken in the West for either energy or environmental reasons. The Soviet Union, with presumably more abundant energy resources and less stringent environmental controls may be viewed as an attractive site for industrial cooperation ventures involving chemical plants, smelters, and refineries which are subject to increasingly stringent regulation in the West. Shifting away from these industries would thus eliminate an important motivation for Western firms to enter industrial cooperation arrangements.

A strong Soviet push for cooperation (and export of product on a compensation basis) in the industrial sector might also be less attractive to Western suppliers who, while willing to acquire raw materials from the Soviet Union, may have some reluctance to provide technology which might permit a Soviet enterprise to become a potential competitor in the finished products market. Further, whereas the Western firm will ordinarily have a demonstrated requirement for specific raw materials, there may be no such need for the Soviet industrial product. On the contrary, in instances where there is an issue of quality control or suitability, the Western supplier may find the requirement to take a portion of payment in Soviet product unattractive.

Under these circumstances, a shift toward finished industrial products may require some alteration in the current format for industrial

cooperation which would provide additional incentives or enhanced control capability to the Western partner.

Role of the Western partner—A change in the commodity composition of Soviet industrial cooperation projects would also serve to reenforce existing pressures shaping a new role for the Western participant in such ventures. Shifting the focus away from raw materials and semi-processed goods will inevitably require a much closer relationship with the Western partner, including the possibility of downstream cooperation in such areas as marketing, spare parts and servicing.

At the same time, a move into finished industrial products would require direction of quality control by the Western partner, a function which cannot be effectively exercised by non-Soviet personnel under existing Soviet regulations. Before the Western participant could direct any meaningful quality control, Soviet policies would have to be altered to permit a management role for the Western enterprise.

Although the Brezhnev speech at the 25th Party Congress specifically indicated that joint ventures, or actual ownership by the Western partner, would not be permitted, there is evidence to suggest that reforms permitting some mode of non-equity participation by Western partners (perhaps on a consultant basis) may be forthcoming.[22]

In a June 1973 speech, Brezhnev spoke of large-scale, long-term economic cooperation with the West, apparently giving official sanction to serious consideration of appropriate forms of cooperation, including joint ventures in third countries.

In September 1973 Deputy Chairman of the State Committee for Science and Technology Gvishiani proposed cooperative arrangements whereby a portion of output would return to the Western partner, who would exercise authority for quality control and participate in management in an advisory or consultant status.

In 1974, the Soviet Academy of Sciences initiated research into the advisability of permitting U.S.-Soviet joint ventures. The final report, produced in 1975, reportedly recommended that current Soviet policies be revised to permit such arrangements, but there has been no report of official acceptance of the Academy's recommendation.

There is thus a pattern suggesting that new forms are being considered which, while stopping short of an equity or ownership position for the Western partner, might provide a measure of participation which would approximate long term contractual arrangements traditional in the West.

A major issue in any such reform will undoubtedly be provision of an appropriate definition of the Western partner's interest in the enterprise after his original "investment" has been liquidated through shipments of product. This might be accomplished through modifications to the pricing structure which would provide an agreed level of profit for the Western participant, without explicitly identifying it in the cooperation agreement.

The exercise of direct management control will also remain an issue, and it is possible that some measure of quality control activity perhaps in a consultant or advisory capacity, may be permitted.

Multilateral relationships—In its simplest form, an industrial cooperation arrangement (with compensating product flows) can be

[22] For a further analysis of potential Soviet reforms in this area, see Harold J. Berman, "Joint Ventures Between United States Firms and Soviet Economic Organizations" Presentation delivered at Colloquium of the Harvard University Russian Research Center, Oct. 31, 1974.

viewed as an attempt to carry the Soviet penchant for bilateralism in trade to the enterprise level: imports from the Western partner are matched, as nearly as possible, by return exports to the same firm.

However, the massive size of Soviet projects exceeds the resources of many individual firms, with the result that it is becoming increasingly necessary to establish project-oriented multinational consortia to manage Western participation. Additionally, the mechanics of financing such projects and marketing the product (particularly of basic raw materials for which a world market often exists) normally involves a web of multinational relationships. Thus, although bilateralism may remain a desideratum for Soviet foreign trade planners, the growing size and complexity of major industrial cooperation projects may result in essentially multilateral trade patterns.

Administrative reform within the Soviet system—As currently organized, the Soviet process for negotiation and implementation of any given industrial cooperation agreement involves several potentially overlapping organs of the Soviet bureaucracy.

Many proposals for specific industrial cooperation projects originate with joint commissions established pursuant to intergovernmental agreements on scientific, technical and economic cooperation. Once accepted by both governments, however, the actual industrial cooperation instrument is negotiated outside the commission framework by the participating enterprises.

Although the State Committee for Science and Technology is designated as the focal point for all forms of technical cooperation with the West, industrial cooperation agreements are frequently negotiated by the appropriate FTO and/or industrial ministry. To the extent that compensation elements are involved, Deputy Minister of Foreign Trade Sushkov is also believed to exercise senior-level responsibility and, for joint undertakings with Western firms in third countries, it appears that the State Committee for Foreign Economic Relations may also become involved.

This fragmentation of decisionmaking regarding industrial cooperation arrangements has been recognized as a contributing factor in the relatively small number of Soviet industrial cooperation ventures concluded to date and accounts in part for the extraordinarily long lead time required for negotiation of large scale agreements.

At the enterprise level, the system provides substantial incentives to facilitate or encourage industrial cooperation with the West, including privileged access to domestic raw materials, skilled labor and other resources; and special bonuses for both management and workers in firms which have acquired Western technology. For these reasons, managers at the enterprise level have a vested interest in the timely conclusion of industrial cooperation agreements which conflicts with the bureaucratic delays built into the current system.

Several of the East European countries have dealt with this problem by establishing a single authority (such as the Committee for Foreign Economic Cooperation in Poland) with responsibility for the conclusion of industrial cooperation agreements including the coordination of imports of Western technology and the clearance of compensatory product flows. It may well be that a similar reform of the Soviet system will be required before the negotiation of industrial cooperation agreements by Soviet enterprises can keep pace with development plan requirements.

INTERNATIONAL TECHNOLOGY TRANSFER FROM THE WEST OF THE U.S.S.R.

PHILIP HANSON

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I. INTRODUCTION

This paper reviews the state of our knowledge of the recent Soviet import of Western technology. The review is confined to certain basic economic questions. First, what do we mean by technology transfer; what forms does it take, and which of those forms are subject to Western government policy? Second, how can we characterise recent Soviet policy on the acquisition of Western technology? Third, what is the impact of imported Western technology on Soviet economic performance? The three central sections of the paper are devoted to these three topics, in the order just given. In the final section some policy implications are briefly considered.

II. THE NATURE OF INTERNATIONAL TECHNOLOGY TRANSFER

II.1. Definitions

Economists writing about technology transfer have not yet settled on an agreed terminology. It is probably best to follow the literature on innovation and technical change in which the phrase 'technology transfer' is used with no special transnational connotation. In this literature a distinction is made between vertical transfer between stages of the product cycle (e.g. going from applied research to development and from development to production), and horizontal transfer, meaning transfer between places or institutions at a given stage of the product cycle. (Mansfield 1975 (b), p. 372).

International technology transfer is then defined as a special case of technology transfer, and one can distinguish between international transfer which is purely horizontal (a chemical plant built in the U.S.S.R. by a Western contractor, for example, which incorporates processes already incorporated in plants built in the West).

The latter is often less conspicuous, but it is very important. When Western research results or technical documentation are used in Soviet development and design, or a Western product is treated as a prototype and 'reverse engineered' (copied) for Soviet production, the international transfer involved is a vertical one—even if it merely replicates a vertical transfer that has already been effected in the West. It is common knowledge that this has been a standard Soviet practice, and Sutton has provided many detailed examples. (Sutton 1973).

If we consider all the forms of vertical as well as horizontal international technology transfer it is clear that we are looking at a more or less universal phenomenon in which all countries are deeply involved. And all industrial countries, at least, are in some degree donors as well as recipients. Fundamentally, international technology transfer occurs whenever production in one country benefits from technical knowledge previously available only abroad.

The transfer of Western technology to the U.S.S.R. will be considered here on the basis of this very broad definition. The evidence would be easier to assess if we confined ourselves exclusively to, say, machinery and knowhow trade. But the danger of doing this is that one loses sight of the many other ways in which the Soviet economy acquires Western technology. These other channels have been and still are of great importance, and they generally constitute alternatives (though often only second best alternatives from the Soviet point of view) to substantial trade.

The distinction between vertical and horizontal transfer has already been made. In the remainder of this section I shall draw attention to some other distinctions that are helpful in understanding and assessing international technology transfer: first of all, the economic distinctions between embodied and disembodied transfer and between different levels or phases of transfer; secondly, a distinction of particular political significance in East-West technology transfer between negotiable and nonnegotitable channels of transfer. Finally in this section, I shall note some of the general propositions that have been advanced about the role of international technology transfer in economic growth.

The distinction between embodied and disembodied transfer is analogous to that between embodied and disembodied technical change. For our present purposes we can think of embodied transfer as the transfer of technology embodied in products, especially machines. Disembodied transfer will then refer to useful technical knowledge carried by persons or documents. Embodied transfer, to be effective, usually needs to be accompanied by some disembodied transfer. But the degree of emphasis on one or the other has implications for the domestic R and D sector. If a technology is transferred as know-how, blueprints, etc. without the actual hardware that embodies that technology, a substantial contribution will probably be needed from the domestic R and D sector before the new product can actually be produced or the new process used. Buying in the necessary hardware (embodied diffusion) will generally reduce the domestic R and D outputs required; but it will usually have a higher balance-of-payments cost.

In the Soviet case the mix of embodied and disembodied transfer which the planners should choose is therefore likely to vary over time and between sectors of the economy. It should depend on their assessments of three things: the capabilities of their R and D sector in a particular field, the balance of payments, and the prospects for product payback in the industry being considered.

Another important distinction concerns the precise capability that is transferred. This is the distinction between phases or levels of transfer and is best illustrated by an example. Mineral fertilisers can usually be most cost-effectively applied at planting time if they are available as complex (polynutrient) granulated fertiliser. Time is then saved in handling and application, and losses due to wind and rain are less. A country which does not produce complex granular fertiliser might increase its overall productivity by importing the product. In the medium-term it might gain more by importing a plant to make complex granular fertilisers (e.g. as a turnkey project). It would gain still more if, along with the turnkey project, its technologists, engineers and managers learnt how to reproduce similar plants without further recourse to foreign suppliers.

These three different phases or levels of transfer are referred to by Mansfield as material transfer, design transfer and capacity transfer, respectively. (Mansfield 1975 (b)).[1] These distinctions are useful because they help us to think more clearly about the impact of the transfer process. Again, a progressively greater contribution will generally be needed from domestic R and D as we move from material to design to capacity transfer. Capacity transfer entails an ability to diffuse an imported technology by indigenous effort. It will be argued below that in the Soviet case our assessment of their ability is crucial to our assessment of the consequences of Soviet import of Western technology.

It has already been pointed out that there are many different channels of technology transfer. Not all of them can really be controlled by governments. To discuss East-West policy coherently it is important to be clear what is and what is not within the competence of Western policy makers. Here the distinction between negotiable and non-negotiable channels of transfer is useful.

On the one hand we have channels of transfer such as occasional visits of scientists, technologists, technicians and managers; the perusal of Western technical literature, including patents; industrial espionage, and the reverse engineering of single imported machines or components. These all involve only small expenditures of foreign currency and can be used even between two countries which are dealing with one another 'at arm's length.' For practical purposes these channels are beyond government control except in a war or an acute international crisis. That is to say, they could be significantly reduced only by total blockade and the ending of diplomatic relations. I have suggested elsewhere that it is useful to classify these as 'non-negotiable' channels of transfer. (Hanson 1975 (b), p. 26).

[1] My own distinction between technology "acquisition" (material and design transfer) and technology "assimilation" (capacity transfer) serves a similar purpose (Hanson 1975 (b)). Mansfield's terminology is preferable, however, because it draws an additional useful distinction and also fits more neatly into the general terminology of the subject.

On the other hand there are channels of transfer such as frequent and regular visits by scientists, technologists and others; the training of managers and operatives abroad or by visitors from abroad; substantial imports, especially of machinery; license and know-how trade; industrial cooperation, and direct foreign investment. These, in contrast, can be termed 'negotiable' channels. They tend to require 'framework' commercial and other agreements between governments. They also need a certain minimum of trust and amiability betweeen governments—in the present case, that baffling political entity that used to be called detente.

II.2. The Importance of International Technology Transfer

Views on the importance of international technology transfer as a determinant of international differences in productivity levels and economic growth rates vary widely.

There is no doubt that in the early stages of the product cycle—applied research and invention—there tends to be a great deal of movement of people, ideas, documents, etc. across national boundaries (Jewkes, Sawers and Stillerman (1969)). It is equally clear that in the postwar world major successful innovations (first commercial production of a new product or with the use of a new process) have come predominantly in the United States, with a fair number also coming from Western Europe, notably the United Kingdom and West Germany (OECD (1970). If technical change is the major source of economic growth that it is now generally thought to be, the process of international technology transfer would therefore appear to be of great importance to the growth of the world economy as a whole and also to the growth of all national economies—with the possible exception of the U.S. economy. This proposition should perhaps be modified to allow for the possible importance of firm-specific—and therefore often indigenous—minor adaptations and incremental improvements of a basic technology).

Yet this commonsense observation tends to be neglected in the analysis of the economic growth of particular countries. International transfer certainly figures in much of the literature on the 'sources of growth' and also in the literature on multinational companies. But it is probably fair to say that the analysis of national economic growth performance tends to put more stress on investment and capital-formation, entrepreneurship and domestic innovation and diffusion as determinants of national growth rates than on the international transfer of technology.

The work of S. Gomulka is a striking exception (Gomulka 1971, 1973, 1974). In his model of international economic growth Gomulka puts international technology gaps and technology transfer at the centre of the stage (Gomulka 1971). He argues that the gap in general technology level between any given country and the technologically most advanced country is a major determinant of international differences in growth. In his view the embodied and disembodied diffusion of technology from the most advanced countries tends to be the major determinant of technical change (and hence, in his model, of economic

growth) in medium-developed countries. As he points out, it is the medium-developed economies which tend to grow fastest, and he ascribes this to the powerful effect on them of diffusion from economies at or near the world technology frontier. This powerful effect tends to lessen, however, when the gap becomes very narrow.

On this view, a country's openness to the diffusion of advanced technology from abroad (once it has developed sufficiently to absorb such technology) becomes a more important determinant of long-run growth performance than the rate of capital formation or the size of the domestic R and D sector.

It may be noted here à propos of the Soviet case, that Gomulka's model of international economic growth does not include differences of economic system as an independent variable. Indeed the differences in national economic growth rates over forty years or more, cited in support of his approach, suggest that differences in level of development are more powerful influences on long-run growth rates than differences of economic system. However there is a good deal of evidence of a micro-economic kind that in the past twenty years or so the Soviet economic system has been technologically less dynamic than the capitalist West. (Amann and Davies (1974), Slama and Vogel (1976), Sutton (1973)). Insofar as this lack of dynamism shows up in the sort of macro-economic evidence that Gomulka considers, it would be ascribed in his 1971 model to a relative lack of 'openness' to foreign technology. In this respect Gomulka's approach may fail to bring out important aspects of the Soviet experience in absorbing Western technology.

In later work Gomulka treats embodied diffusion in the form of machinery trade as a key, and possibly dominant, form of international technology transfer. (Gomulka 1973 and 1974). The share in domestic investment of machinery imported from more advanced countries becomes in this work a major determinant of economic growth: it will usually be possible to raise the growth rate in a medium-developed country by increasing that share. (The present author, looking at Soviet machinery imports from the West, also treated this share as significant but was inclined to attribute to it effects less powerful than those posited in Gromulka's model (Hanson 1975(b)).

Work of a very different kind by Sutton, using an accumulation of case-studies rather than a macroeconomic model, also treats the transfer of technology as the major determinant of economic growth. Here, however, the discussion is focussed exclusively on the particular case of the transfer of Western technology to the U.S.S.R. (Sutton 1973, and two earlier volumes dealing with the period up to 1945).

Sutton argues that almost all civilian technical change in the USSR and a good deal of military technology, too, is more or less directly 'borrowed' from the West and that significant domestic innovation, at least in the civilian sphere, has been almost entirely absent. He presents a great deal of detailed evidence for this. One great merit of his case-studies for the 1945–1965 period is that they show the importance of inconspicuous modes of transfer, particularly the reverse engineering scaling-up of Western treated as prototypes.

He does not ask, however, whether Soviet experience is really very different from that of other late-industrialising countries. (Gomulka's work, of course, treats Soviet long-run productivity growth as funda-

mentally similar to that of Japan or Italy, and explicable in the same terms). If we consider Sutton's case-studies and Gomulka's international macro-economic model together, we can draw from them a useful general perspective on the Soviet acquisition and use of Western technology.

First, the Soviet Union shares with other late-industrialising countries a pervasive utilization of technology developed in the most advanced countries. Second, the Soviet Union's political semi-isolation from the West has led it to acquire and utilise American and West European technology in ways rather different from those used by, say, Japan. A predominant use of non-negotiable, disembodied transfer was, at least until recently, only to be expected. That so much of Soviet civilian R and D has been devoted to reverse engineering, modifying and scaling-up Western products is therefore less of an indictment of the Soviet economic system that Sutton suggests. Arguably, Soviet civilian R and D has been performing an adaptive and imitative role that was appropriate to the level of Soviet development, given the absence of Western direct investment and the relatively low level of trade with the West.

What matters now, so far as Western policy is concerned, is the precise role that negotiable technology transfer from the West plays in Soviet growth strategy, the efficiency of Soviet institutions in implementing that strategy, and the broader social consequences of negotiable transfer. This raises first of all the question of what recent Soviet policy has been—a question to which we now turn.

III. Soviet Policy

III.1. Soviet Technological Levels

Soviet policymakers and planners seek Western technology for the obvious reason that the U.S.S.R. is relatively backward in many areas. It has long been common knowledge that there was an East-West civilian technology gap. A systematic general picture of the extent and nature of the Soviet problem, however, is only just beginning to emerge from recent research. Soviet top policymakers themselves have probably begun to grasp many aspects of the problem only over the past fifteen years or so, and this is reflected in policy changes over transfer from the West.

A recently-completed study by a Birmingham University team has produced the following preliminary conclusion: "in most of the technologies we have studied there is no evidence of a substantial diminution of the technological gap between the U.S.S.R. and the West in the past 15–20 years (early 1950's to around 1970), either at the prototype/commercial application stages or in the diffusion of advanced technology." (Amann and Davies 1974, p. 10).[2]

The areas of civilian technology studied were reasonably representative; electric power transmission, chemicals, computers, iron and steel, machine tools, motor vehicles, oil drilling and process control instruments. The assessment of comparative levels was done primarily by establishing the Soviet lead or lag (in years) at several different

[2] This is a preliminary account of the study, which will be published in full in a forthcoming book from Yale University Press.

points of time between the early 1950's and early 1970's. Leads and lags were assessed separately for different stages in the product cycle: as far as possible, for research, prototype/pilot-plant stage, first commercial production and diffusion. Comparison was made with a number of Western countries but principally with the USA, West Germany and Japan.

Relative weaknesses (vis-a-vis the West) were particularly apparent in the vertical transfer to commercial production and in diffusion. The reasons for these weaknesses remain to be examined in a further study. It seems a fairly safe bet, however, that the weaknesses are "systemic"—attributable in large part to the lack of competitive pressures in the Soviet administrative economic system.

Comparative assessments of this kind are not straightforward. There is always some scope for differences in the interpretation of the evidence. In most areas there are some aspects of Soviet performance which are comparatively strong, and there are a few areas where Soviet overall performance seems as good as that of any Western country (e.g. high voltage electric-power transmission). But the conclusion of an overall lag is clear, and is supported, broadly speaking, by other studies using somewhat different approaches (e.g. Slama and Vogel 1975 and 1976). It is also reinforced by studies of sectors not covered in the Birmingham project (e.g. Campbell 1976).

More unexpected is the tentative finding of the Birmingham study that by and large the gap has not been narrowing. But no detailed study known to the present author contradicts this finding.

This, then, is the situation which Soviet policymakers are trying to alter by international transfer. There is nothing new about it. Russia has been trying to catch up by importing Western technology, as several writers have pointed out, at least since Peter the Great. Many observers, including the present author, believe, however, that the Soviet strategy has changed significantly in recent years. In the remainder of this section I shall consider first the timing and political significance of this change and then its economic-policy significance.

III.2. The Timing and Political Context of the Policy Change

The usual view is that there was a more or less abrupt shift at some point in the late 1960's towards a greater emphasis on large-scale commercial imports of Western machinery and know-how: in other words, towards what I have termed "negotiable" technology transfer from the West. Some writers have gone on to argue that this shift in trade policy was a major Soviet motive for seeking détente with the West.

Wiles, looking at Soviet leadership speeches and key foreign policy decisions, locates a crucial change in Brezhnev's thinking somewhere in 1969–1970. (Wiles, 1976, pp. 1–5). Green and Levine place the turning-point a few years earlier. They note a surge in Soviet machinery imports from the West in 1968–1969 which is not well "explained" statistically within their econometric model (though such imports are well explained for earlier years). They conclude that this is the result of a major policy shift. (Green and Levine 1976, pp. 18–19). This conclusion would entail that the crucial policy decision was made 1966–1967. Both the time taken by negotiation with Western suppliers and the time from contract to delivery vary widely for ma-

chinery imports, but the modal figure for each of these two time lags is probably around a year. So it is reasonable to assume a two-year lag between a policy decision and the resulting machinery imports actually being shipped into the U.S.S.R.

My own view is that the change in Soviet policy is a more gradual one and can be traced back to the early 1960's. This view is based on a reading of Soviet specialist literature and of leadership speeches at Party Congresses, on machinery import data and on institutional changes such as the creation of a specialist foreign trade organisation, Litsenzintorg, to deal in licences and know-how (1962) and the Soviet accession to the Paris Convention on the Protection of Industrial Property (1965). (Hanson 1975 (b), pp. 19–23; on the Soviet accession to the Paris Convention see also Maggs and Jerz 1966).

These disagreements about the dating of Soviet policy changes are not just academic quibbling. The precise date of the policy shift is not in itself important now, but our reading of how Soviet trade policy works is important. What decisions go to Politburo level? Which commercial policy decisions are seen as purely technical, and which are seen as requiring foreign-policy decisions as well?

It seems plausible to say that the perception of a need for a more direct, substantial and continuous infusion of Western technology became more widespread among Soviet planners and officials in the late 1950's and early 1960's. Kosygin, and possibly some other members of the leadership group, probably came to share this view well before the fall of Khrushchev. Some significant but narrowly technical decisions like the decision to set up Litsenzintorg, were made at this early stage. Major developments such as the Fiat Tolyatti deal may have been under discussion as early as 1962, with preliminary contacts between Kosygin and the Fiat President, Valletta, following between 1962 and 1965. (U.S. House of Representatives . . . Subcommittee on International Trade, 1967, p. 4.)

Accession to the Paris Convention (1965), the initial technological cooperation agreement with Fiat (1965) and the Tolyatti contract (1966) all come after the ousting of Khrushchev. They are all in some degree politically sensitive decisions. Even the apparently technical matter of acceding to the Paris Convention required various formal guarantees to foreigners (see below) which probably went against both the nationalist and the ideological grain. The Fiat agreements, at least, reflected top-level decisions in which Kosygin seems to have played a major role (Hardt and Holliday 1975, pp. 55–59). It may well be that only Kosygin's elevation to the premiership enabled these decisions to go through.

The surge in imports of Western machinery in 1969 is probably attributable to the Tolyatti deal, deliveries for which peaked in that year. Total purchases of Western machinery for Tolyatti totalled $550 mn—spread over several years but in sum exceeding Soviet total imports of Western machinery in any year before 1968. All this could well have happened, however, with only the acquiescence, rather than the active support, of most Politburo members. It is quite consistent with Wiles' view that Brezhnev did not begin until slightly later to endorse the 'Kosygin' view of the urgency of technology imports in general.

It might be argued, therefore, that the notion of a foreign policy deliberately tailored to promote such imports would not have been seriously considered by the Soviet leadership before 1969 or 1970. But this can only be a very tentative argument. It remains a matter of dispute whether any of the subsequent political developments—substantial Jewish emigration, SALT 1 and the agreement over Berlin—were primarily quid pro quo's for better trade relations with the United States.

III.3. The Increased Role of Negotiable Transfer

At all events, the essence of the policy change, in comparison with the 1950's, is that emphasis has shifted from non-negotiable to negotiable channels of technology transfer from the West. This is primarily a shift in favour of embodied transfer, exemplified by machinery imports, and the commercial purchase of licences and know-how. Hardt and Holliday argue persuasively that there has also been a change to what they call the "modified systems approach" to international technology transfer. By this they mean a new emphasis on long-term or continuous links with Western suppliers, project-oriented industrial cooperation, the use of Western general contractors to oversee the installation of a whole complex system (from plant construction through to product distribution) and greater Western direct involvement in training and management. (Hardt and Holliday 1975; see also Sushkov, 1976).

The older style of limited, once-off machinery purchases plus a great deal of literature-scanning, imitative development and reverse engineering, probably continues. It is simply that the emphasis seems to have changed. Reverse engineering is no doubt still heavily in use, for example, for products covered by the strategic embargo; these products can often be obtained by the Russians, but at high cost and usually in small quantities (Schneiderman 1976).

The motives for the change of strategy were clearly and publicly stated by Kosygin in the mid-1960's, notably in his report to the XXII Party Congress. They have been repeated—usually less clearly—in a number of recent Soviet writings (e.g. Bogomolov 1974, Gorodisskii 1972, Naido and Simanovskii 1975, Vlaskin and Simanovskii 1975, Volynets-Russet 1973). The gist is simply that it is expensive to reinvent the wheel.

In the language of our previous section, non-negotiable transfer tends to require substantial domestic R and D and production inputs to reverse engineer, do copy designs from Western literature, to modify, and to introduce into series production. The potential savings from outright purchase of whole plants, licenses, etc. are enormous. (These savings are, of course, merely a particular example of the gains from trade). Once it was widely grasped by Soviet managers and planners that catching up with Western technology meant chasing a rapidly moving target over an ever-increasing product range, this shift in policy was almost inevitable.

It was probably hastened by a growing recognition that the Soviet administrative economy was much less effective than Western market economies in at least one crucial stage in the product cycle: the transfer from development or prototype work to commercial production. In Soviet publications this last point is normally made only indirectly,

but the implication is usually clear and does not seem to be treated among specialists as controversial. (See, e.g. Naido and Simanovskii 1975, p. 69, where they refer to the 'development-assimilation-production cycle' being 'rather protracted (dlitel'nyi) for our countries' (sc. CMEA)

III.4. Balance of Payments Aspects

The Soviet hard-currency balance of payments sets limits to the translation of these perceptions into policy. It appears, though, that at some point in the recent past a decision was taken to make more active use of Western credit and allow a rather higher hard-currency debt-service ratio to result. 1971–72 may well be the turning point in this respect.[3] Looking at Soviet hard-currency imports of machinery from the West (roughly, OECD less Finland) between the mid-1950's and the early 1970's, I found that for 1955–71 the simple hypothesis that machinery imports in any given year (MK_t) were determined by total exports to the West in that year (X_t) and (negatively) by grain imports from the West in the previous year (MG_{t-1}), fitted the facts remarkably well.

$$MK_t = \underset{(0.934)}{-72.42} + \underset{(8.086)}{0.386\,X_t} - \underset{(-2.502)}{0.394\,MG_{t-1}} \qquad (R^2 = 0.916)$$

(The bracketed figures under the coefficients are to statistics, and the X_t and MG_{t-1} coefficients are both significant at the 1 percent level). Even if the time trend is removed from X and MK, the relationship over 1955–71 is still quite strong. The implication is that variations in indebtedness to the West, or indeed in machinery imports in this period.

In 1972 the pattern changed. The U.S.-Soviet trade agreement offered a major new source of credit, and emergency grain imports (on credit) were made while (unlike 1963–64) machinery orders and deliveries continued sharply upwards. (See Hanson 1975 (b)).

Greater use of credit was no doubt in part a response to the acceleration of Western inflation, which provided the Russians with credit at negative real interest rates. But, taken in conjunction with the other changes considered, it is surely also part of the more general policy change under discussion.

IV. The Impact of International Transfer on the Soviet Economy

IV.1. The Forms of Transfer Considered

Ultimately the most important question about the policies we have been considering is what their effects are. I shall focus here on negotiable transfer, for the reason given in section 2 above: there is not very much that Western governments can do in normal times about non-negotiable transfer.

Within the sphere of negotiable transfer I shall concentrate on machinery and know-how trade, including some account of Soviet decisionmaking procedures in these areas, and deferring a discussion of the

[3] Green and Levine locate this point somewhat earlier, in 1968–69, but the disagreement over the date is less important than the agreement that such a change occurred.

key issue of diffusion of imported technology to the end of this section. Scientific and technological cooperation agreements with Western firms and governments could also become important but there is no clear evidence that they have yet had much effect on production. The agreements between Western firms and the State Committee for Science and Technology seem to be mostly important in providing firms with an entree for negotiating product and know-how sales (Hanson 1975 (a)). The inter-governmental agreements are mostly of a kind whose economic consequences, if any, will be rather long-run (Graham 1974).

IV.2. Machinery Imports

To begin, then, with machinery trade: Table 1 shows the growth of aggregate machinery (SITC 7) imports from the West since 1955 and their relationship to Soviet investment. The machinery import figures come from Western (OECD and U.S. Dept. of Commerce) sources. Purchases from Finland are excluded on the ground that Finland's special relationship and soft-currency settlements with the U.S.S.R. make it a non-Western country so far as the politics of East-West trade are concerned.

TABLE 1.—SOVIET IMPORTS OF WESTERN MACHINERY AND TRANSPORT EQUIPMENT 1955–75

	Imports of Western machinery (millions of U.S. dollars) f.o.b. current prices	Machinery imports at 1969 estimate prices, millions of rubles [1]	Col. 2 as a percent of domestic machinery investment of the following year	Col. 3 adjusted for a machinery conversion rate twice as favorable to the dollar
	(1)	(2)	(3)	(4)
1955	104	74.0	1.0	2.0
1956	139	93.9	1.2	2.4
1957	128	82.8	.9	1.8
1958	123	79.0	.8	1.6
1959	717	113.6	1.1	2.2
1960	310	196.3	1.7	3.4
1961	390	236.1	1.8	3.6
1962	436	255.2	1.8	3.6
1963	402	233.7	1.4	2.8
1964	489	280.7	1.6	3.2
1965	366	210.3	1.1	2.2
1966	395	218.2	1.1	2.2
1967	457	249.6	1.2	2.4
1968	639	360.7	1.6	3.2
1969	889	482.9	1.9	3.8
1970	905	456.6	1.7	3.4
1971	840	398.1	1.4	2.8
1972	1,113	473.6	1.5	3.0
1973	1,566	543.0	1.6	3.2
1974	2,100	[3] 660.0	1.7	3.4
1975	[2] (4,000)	[3] (1,044)	[4] (2.4)	[4] (4.8)

[1] Conversion into rubles on the basis of Boretsky 1964 machinery conversion rate, adjusting for intra-Western price differences and inflation.

[2] Author's rough estimate on the basis of incomplete OECD data.

[3] Accepting the CIA estimate of a 10-percent increase in average prices in 1974 over 1973 and assuming (arbitrarily) a 20-percent increase in 1975.

[4] Related to plan 1976 machinery and equipment investment. The latter has been reported in 1973 prices and is converted here to 42.7 billion rubles in 1969 prices. The col. 4 conversion rate for 1975 is $1.6=1 ruble.

Source: Hanson 1975 (b), p. 31; updated through 1974 and 1975 using recent OECD and Narkhoz data; CIA, "Recent Developments in Soviet Hard Currency Trade," January 1976; Pravda, December 3, 1975 and February 1, 1976, and Planovoe Khozyaistvo, 1976, No. 1, p. 48.

NOTE ON METHODS

The methods used in compiling table I are explained in full in the first source cited. For present purposes it is sufficient to note that a price index for these machinery imports was constructed on the basis,

primarily, of domestic wholesale machinery price indexes for the supplier countries and using weights reflecting the supplier countries' shares in the total. These weights were altered to reflect changes in country shares, the weight changing as between 1955–59, 1965–70 and 1971–73. (1974 and 1975 price changes were assessed ad hoc, as indicated in the notes to the table). The conversion rates in column 3 pivot on a Boretsky conversion rate between 1964 US engineering products and Soviet 1955 prices. (Boretsky 1970). This is adjusted both for machinery price differences between the USA and other Western suppliers in 1964 and for Soviet 1955–69 price differences.

Two main implications are apparent in table 1. First, Soviet imports of machinery and transport equipment have been a small ingredient in the Soviet investment programme. Secondly, their contribution to Soviet investment has increased only modestly in the past twenty years.

The first conclusion holds whether or not we consider the percentages in column 4 to be more 'realistic' than those in column 3. My own view is that enough is known about the defects of Soviet civilian machinery in quality, reliability and durability (for machines with specifications equal to those of Western machines) to cast doubt on the column 3 conversion rates and make column 4 more plausible. (Hanson 1955 (b); Hill 1970 and 1973). This question of what rate is 'realistic' is separate from the question of the conversion rates of which imported machinery is actually priced into the accounts of Soviet enterprises.

High-level planners appear to feel that these latter rates tend to be too low and should be raised (Zakharov and Sulyagin 1974). For the early 1970's, Soviet official statistics appear to use conversion rates of the order of those used in column 4 at any rate for aggregate recording purposes; this is implied by the attribution of about 5 percent of industrial equipment invested in the early 1970's to Western sources (Planovoe khozyaistvo 1974, No. 12, p. 31). But in any case, the share of Western equipment is small. The share of imported machinery (excluding cars) from other Western countries in US equipment investment in 1970–71 was about 11 percent. The share in the early 1970's in the Soviet case is, strikingly, fairly close to the share of imported Western machinery in equipment investment in the same period in the People's Republic of China (December 1975).

The second conclusion from the table, that the share of imported Western machinery has risen very little, needs to be modified. The figures in columns 3 and 4 are calculated on the assumption that Soviet official 'constant price' investment series really are at constant prices. There is abundant evidence that in fact they contain an element of price inflation. Becker's assessment suggests that the figures for the later years in columns 3 and 4 should on this account be raised somewhat (Becker 1974). A plausible adjustment of the column 4 series might put the 1970 figure at 4 percent and the 1975 figure at between 5.5 and 6.0. This makes the increase since the mid-1950's look a little more consequential; it is still hardly a dramatic rise.

I think it is clear from these figures that the aggregate, direct impact of this embodied technology transfer from the West cannot, even in the mid-1970's, constitute a dominant source of aggregate Soviet economic growth. The direct effect of imported machinery would be the flow of output from it, net of the cost of cooperating inputs. This can certainly be expected to be greater than would be obtained from do-

mestically-produced machinery of similar domestic-ruble value. Foreign currency is only allocated for imported machinery if the application for it is backed by statements from the relevant Soviet machine-building ministry that it cannot itself supply machinery of equal quality, (and sufficient quantity) in the period required. (Metodicheskie ukazaniya 1974, p. 595). Still, the productivity of imported Western machines can hardly be so much greater than that of domestic (or East European) machinery that a mere five-percent ingredient of such imports can produce a very large share of the increase in output attributable to new machinery.

Moreover, any invigorating effects on Soviet GNP growth that the modest increase in the Western machinery share may have had (following Gomulkas' analysis) over the past twenty years, seems to have been swamped by other factors working in the other direction. Soviet economic growth over this period has, after all, tended on the whole to decelerate, not accelerate.

Does it follow that the whole business of embodied transfer from the West has been given an exaggerated importance? That it can really have only a minor influence on Soviet production? Not necessarily. The figures in table I are certainly a salutary reminder that the flows of Western machinery into the Soviet Union are trivial in size beside the other inputs into that vast economy. (This would not be the case for the smaller East European economies). But their indirect effects, and their impact on particular industries, could nonetheless be considerable.

IV.3. The Indirect Impact of Machinery Imports

Let us take the question of indirect impact first. This would presumably consist of (a) productivity increase attributable to new materials, components and machines produced on the imported machinery; (b) new and improved Soviet-built machinery embodying some or all of the new technology incorporated in the original imported machines, and (c) "ripple" or feedback effects on the technical level of Soviet material and component suppliers for an imported plant—these would be pressures for change rather than direct contributions to it.

It is likely that in an economy as large as that of the Soviet Union the greatest potential for indirect gains from imported hardware comes from the second of these three effects, namely, diffusion. This is one of the fields of Soviet endeavour in which statements of intent abound but clear-cut examples of implementation are not easy to trace. Campbell refers to plans, whose execution does not seem to have been reported, to produce ten offshore oil-drilling rigs for the Caspian, designed on the lines of an imported Dutch rig (Campbell 1976, p. 19). The present author has quoted references to what appears to be an imported complex granular fertiliser plant which came on stream in Vinnitsa in 1968; statements that this was a pilot plant to be followed shortly by two scaled-up (and apparently domestically-built) plants of the same type were made at the time, though the subsequent completion of these plants does not appear to have been reported (Hanson 1976, p. 18).

The whole question of diffusion is of vital importance and will be taken up again at the end of this section. There it will be considered

in relation to technology both embodied in imported machines and transferred under license and know-how contracts. Let us first, however, consider overall indirect impact. Clearly, this could be a great deal larger than the direct production gains, alone, from imported hardware.

Green and Levine have provided an estimate of the total (direct plus indirect) contribution of imported Western machinery to Soviet production in recent years (Green and Levine 1976. A slightly earlier paper by Green and Jarsulic (1975) presents some closely related estimates. (These will not be discussed separately here.) They have done this by constructing a separate annual capital stock series (in 1955 rubles) for imported Western capital equivalent in use in Soviet industry (and also in the chemicals and petrochemicals branch alone) over the period 1960–72. They then estimate a Cobb-Douglas production function with labour, domestically produced (plus East European) capital stock, and imported Western capital stock as the inputs, and obtain separate measures of the output elasticity (marginal productivity) of domestic and "Western" capital stocks.

These estimates, as the authors note, are based on a number of debatable assumptions, quite apart from the doubts that surround the procedures of production function estimation as such. The "Western" capital stock series is derived from import data; the assumptions made about the initial stock, conversion into 1955 rubles and retirement rates could all be queried. The results, however, do not appear to be very sensitive to changes in these assumptions.

One query is, however, worth raising. For industry as a whole, 1960–72, Green and Levine show an average share of Western machinery in total capital stock of four percent. This figure seems surprisingly high in view of (a) the figures in Table 1 above (b) the rather low share of machinery and equipment in the Soviet capital stock generally. Industry probably accounted in the 1960's for something like three-fifths of the total Soviet machinery stock. On that basis, the figures in Table 1, column 4 would suggest that imports of Western machinery (which went overwhelmingly to the Soviet industrial sector) might have made up around five percent of the industrial capital stock of machinery in the 1960's. But it is not easy to believe that they accounted for more than two percent of total industrial capital stock including structures, etc. So the Green-Levine share of imported machinery in total industrial capital stock may be too high.[4]

The key estimate of the Green-Levine paper, however, is the marginal productivity of the stock of imported Western capital goods. This comes out very high: fifteen times the marginal productivity of the rest of the industrial capital stock.

This is, to repeat, a measure of direct plus indirect impact. It enables the authors, using their econometric model of the Soviet economy, to test for the effects of hypothetical changes in the rate of Soviet import of Western machinery. One such scenario is a 'retrospective repeal of détente' in 1968–73. In this calculation the shift in import policy ascribed to 1968–69 is taken out. Machinery imports from the West trace out a path ending in a 1973 level some 19 percent below

[4] Since writing this paragraph I have been informed by Professor Green that he agrees that the average share figure is too high, and is currently revising this calculation.

the actual 1973 level, with the result that Soviet industrial production grows (hypothetically) by only 5.1 percent a year between 1968 and 1973 instead of the 6 percent a year actually observed.

These are very striking results. They suggest that the indirect impact of imported Western machinery is very large indeed. It should be made clear at once that the authors treat these estimates as experimental and illustrative only, and point to some serious problems of interpretation. One is that the scale of machinery imports is so small. The projects for which Western machinery is imported should therefore be the top candidates in the planners' lists of such projects: if correctly selected, they will be precisely those projects in which the marginal productivity (direct plus indirect) of imported capital goods is highest. An increased share of imported Western machinery would be associated with a less striking disparity between the marginal productivity of imported Western and domestically produced capital goods. Indeed the import share is so small that this disparity might fall very sharply as the share was raised.

A second difficulty about the interpretation of these estimates is that the indirect impact of the imported hardware is of course achieved by a combination of the imported technology with domestic resources: e.g., R and D and production inputs to replicate (diffuse) imported plant. The imported technology is a necessary but not sufficient condition of these indirect gains and should not be credited with all of them. In the production-function estimates, however, this may well have happened.

In the absence of these machinery imports substantial domestic resources would probably be released from utilisation and diffusion of the imported technology and could be re-allocated to indigenous innovation and diffusion (and the diffusion of disembodied technology transfer from abroad). The results might substantially offset the losses from the absence of embodied transfer. On this account, too, one must be cautious in interpreting these estimates. A 'true' estimate might well be considerably smaller.

At all events, the Green-Levine calculations raise some crucial questions. Do we really believe that the indirect impact of recent technology transfer from the West is as large as they indicate? On intuitive grounds, and from anecdotal evidence, one is inclined to be sceptical. Is the cumbersome Soviet administrative system really so much better, for example, at diffusing technology embodied in imports than in diffusing technology derived in other ways? This question will be taken up again in sub-section IV.6 below.

IV.4. The Sectoral Impact of Machinery Imports

The other question to be asked about imports of Western machinery is what their impact has been on particular branches of the Soviet economy. Using Soviet trade data, which are more helpful than Western data for identifying machinery imports by branch-user, I have compared branch-user shares in imports of Western machinery with branch shares in total 'productive investment' in the Soviet economy in 1955–56, 1960–61, 1965–66 and 1970–71. (Hanson 1975 (b)

pp. 37–40). If the former share exceeds the latter, there is prima facie evidence that the branch made above-average use of embodied Western technology, and was (in a relative sense) 'dependent' on it. If the latter share exceeds the former, the branch is relatively 'independent'.

This method of assessment is crude, and it can only be carried out for a limited number of fairly broadly-defined Soviet industries. It does, however, produce a plausible general picture in coal-mining, iron and steel, the oil industry, building materials and agriculture were all relatively independent throughout. So were electric power supply and food-processing in three out of the four bench-mark periods.

Light industry, timber, paper and pulp and shipping were consistently 'dependent'. The chemical industry was heavily dependent except in 1955–56. The machine-building and metal-working sector looked relatively dependent in the first and last periods but not in the two intermediate periods. In addition we can be quite sure that if more disaggregated investment and trade data were available, computers and motor-vehicles would emerge as relatively dependent industries since the early 1960's. (Computers considered as a type of imported machine, not computer-production as a branch-user of imported machinery).

From this it can be concluded that chemicals, computers, shipping, the motor industry, timber, paper and pulp and light industry are branches in which imports of Western machinery have been concentrated. The chemical industry is probably the outstanding example. Western machinery probably accounted for around 30 percent of its equipment investment programme in the 1960's, during the belated modernisation drive stemming from Khrushchev's 'chemicalisation' campaign. In most of the more advanced branches of the chemical industry the role if imported machinery remains predominant. In 1973, 74 percent of Soviet complex fertiliser production, 50 percent of ammonia, 62 percent of urea and 84 percent of high-pressure polyethylene output from imported equipment. (Luk'yanov 1974). The bulk of this would be Western, rather than East European, plant.

On the other hand, the upgrading of a previously neglected industry does not guarantee that imported Western machinery will be concentrated on it. This has not happened in the cases of food-processing or agriculture. The explanation may be that these are not research-intensive industries; greater indigenous effort plus the use of East European machinery and know-how may have been judged adequate.

Nor does an above-average use of Western machinery guarantee an above-average rate of factor productivity growth (Desai 1974; Hanson 1975 (b)). It does however emerge that the industry whose measured rate of "technical progress" in 1955–1971 stands out in Desai's estimates is also the industry whose usage of Western machinery stands out: the chemical industry. A plausible conclusion is that a high (and sharply innceasing) usage of Western machinery can produce very rapid improvement in a particular branch but that the overall level of machinery imports has not been high enough to allow this influence to dominate other influences on productivity change in more than a very few branches.

Campbell's study of the energy sector suggests comparable conclusions (Campbell 1976). He contrasts the technological performance (relatively to the USA) of the coal and electric power industries: both have been relatively independent of international transfer (at least in the form of machinery imports) but the coal industry has performed poorly and the electricity supply relatively well. The explanation, he suggests, lies in their differing organizational structures and hence their differing reflections of the innovational strengths and weaknesses of the Soviet system. In other words, these branches, too, illustrate the importance for Soviet technological performance of influences other than embodied transfer from the West.

IV.5. License and Know-How Imports

None of this discussion deals with the other major form of negotiable transfer: license and know-how trade. Here basic data are sparse. Most Western governments do not systematically record such sales by country of destination. The Soviet government may have reasonably reliable figures for Soviet purchases but it does not report them.

Indeed, it may even be doubted if the Soviet authorities have reliable information. Many license and know-how deals are included in "package deals" along with machinery (e.g. in turnkey projects). The details of these packages, such as the price tags put on know-how, may be juggled with for negotiating purposes so that the value figures in the accounts of Soviet foreign trade organisations (f.t.o.'s) may be misleading.

(Litsenzintorg, the specialist f.t.o. dealing with licences, handles 'pure' licence and know-how trade, i.e. transactions in which other ingredients are minimal. Licence and know-how sales under package deals with other f.t.o.'s may not be separately reported to Central Statistical Administration or the Ministry of Foreign Trade. The figures for numbers of licence transactions occasionally reported in the Soviet press, e.g. 120 new products and processes assimilated into production in 'the past eight years' on the basis of licence purchases, (Pravda, March 12, 1974), almost certainly refer only to licences bought by Litsenzintorg. The judgment of well-informed Western practitioners in this field is that the total number of licences sold would be much higher.[5] Such evidence as there is suggests that total CMEA annual expenditure on licences and know-how in the early 1970's may have been equivalent to around five percent of the value of machinery purchases from the West. This would be not dissimilar to the ratio in world trade generally. One difficulty is to know what share in the total is formed by intra-CMEA licence payments. These are probably minor but have existed since the late 1960's, when the system of free exchange of technical information within CMEA broke down (Campbell 1969).

Of the CMEA countries, the USSR is certainly a less active user of licences than some other countries either in product-payback deals (ECE 1973 and 1975) or in total (Vlaskin and Simanovskii 1975). On the export side, Litsenzintorg have sold a number of licenses in the West for Soviet patented processes, mainly in the metallurgical field (Kiser 1976). It is nonetheless reasonably clear that Soviet licence trade with the West shows a strong negative balance in value terms.

[5] I am indebted to Mr. David Winter for this information.

For CMEA as a whole we have Wilczynski's estimates that payments to the West exceeded receipts eleven-fold in the 1960's and about fourfold in 1970 (Wilczyski 1974, p. 308, citing a DDR source). For an unspecified date, probably in the early 1970's, and again for CMEA as a whole, a ratio of payments to receipts of about 12:1 is implied by a Soviet source (Naido and Simanovskii 1975, pp. 67–68). It is unlikely that the picture would be markedly more favourable for the USSR than for CMEA as a whole. Various scattered pieces of information on the value of CMEA licence transactions are assembled in Table 2.

The available evidence suggests that Soviet licence-purchasing is still on a small scale compared to that of medium-developed Western economies. The implied total annual expenditure on licences for CMEA as a whole: in the article by Naido and Simanovski just cited is of the order of $360 mn. This may be compared to in figure of $346 mn. for receipts by U.S. firms alone from licence agreements with affiliated and unaffiliated companies in Japan in 1972 (Wilson n.d.). The Soviet figure will of course be far below the CMEA total, in which Czechoslovakia alone may well have accounted for . . . around $200 mn. (Vlaskin and Simanovskii 1975). The evidence is however a bit shaky because the figures are only inferred from the Soviet texts, and the extent to which they would cover licences under package deals is not clear.

At all events, Soviet licence purchases have risen sharply since Soviet accession to the Paris Convention for the Protection of Industrial Property in 1975. This step probably reflected a Soviet decision that there was more to be gained by offering some patent protection in the U.S.S.R. to foreign patentees and encouraging them to sell licences than by persisting with the devious and costly practice of unlicenced (but legally immune) copying.

It does not follow, as is sometimes suggested, that a top-level decision was taken to cease all unlicensed copying. However, there seems to be a censensus among Western businessmen that the Russians do generally play the game according to the rules, and formal channels exist for foreign licensors to take action in Soviet courts (Debelius 1975). It may be noted nonetheless that the 1973 polozhenie on patents includes, probably for emergency use, a provision (Point 35) that the U.S.S.R. Council of Ministries may make compulsory the purchase and use (i.e. use and make a unilaterally-determined payment for) a patent covering an invention of special importance to the Soviet government which the patentee refuses to license (Shatrov 1975, p. 10). (One rather different aspect of Soviet treatment of Western patents will be discussed in sub-section IV.6 below).

TABLE 2.—THE VALUE OF CMEA LICENCE TRANSACTIONS WITH THE DEVELOPED WEST—SOME ESTIMATES

[Dollars in millions]

Country or group of countries	Time period	Revenue from West	Payments to West	Sources and comments
Czechoslovakia	1968–72	51	c. 200	Vlaskin, G. A., Simanovskii, S., "Litsenzionnaya praktika v ChSSR" "Voprosy izobretal'stva," 1975, no. 2, pp. 57–61. Revenue figures given in source; payments "recently" said to be "about 4 times" the value of receipts.
Hungary	1968–71	1.52	9.38	UN ECE E/ECE/844, addendum 1, p. 9.
Poland	1970	----------	About 3 times receipts	Ibid., p. 8.
Total CMEA	1960–69	----------	11.2 times receipts	Wilczynski, J., "Technology in Comecon," p. 308, citing DDR source.
Do	1970	----------	4.0 times receipts	Do.
Do	(1)	30	(360)	Naido, Yu., Simanovskii, S., "Uchastie stran SEVa v mirovol torgovle litsen ii," "Voprosy ekonomiki," 1975, No. 3, pp. 67–77 "current" (no date) annual revenue figure from p. 67, where it is stated to be about 1 percent of total world licence trade excluding (p. 68) intra-CMEA trade. Total East-West licence trade put (p. 68) at about 10 percent world total including the national value of intra-CMEA licence exchanges (period not specified), which is but at 24 percent of world total including intra-CMEA. Hence (apparently) payments to West=about (10—$7\frac{1}{100}$) times $7\frac{1}{100}$ times receipts, or about 12 times receipts.
U.S.S.R. and Eastern Europe with United Kingdom only (incomplete).	1972	0.2	5.9	International Business Unit, Dept, of Management Studies, UMIST (private communication). Data are derived from a sample survey of United Kingdom firms. They cover "technological and mineral royalties" excluding licence receipts on whole-plant deals which were not separately reported.

[1] 7 early 1970's, approximate annual averages.

The Soviet use of licences appears to be rather inefficient. This may be partly because the planning system is still adapting to this new technique; licence purchases were not included in annual or five-year plans until 1971 (Volynets-Russet 1973, p. 129).

There are several instances of difficulties over the use of licences. The Russians took longer than any other of sixteen licences of the Pilkington float-glass (up to May 1970) to go from license purchase to production (GF Ray in Nabseth and Ray 1974, p. 205). They took 41 months compared with an average of 27 months for all the licensees over that period and a best time of 15 months (by a Japanese company, of course). Construction delays prevented the use within the term of the licence deal of a licence to manufacture disc brakes (Pravda 12th March 1974). The fact that the early (1959) purchase of the Burmeister og Wain marine diesel engine licence remains the standard success story in the Soviet literature, is intriguing.

The planning procedures that are supposed to be followed show the familiar concern to limit hard-currency expenditure to imports with a clear new-technology content. The vetting of applications to buy licences and the planning of their purchase and use is a joint responsibility of USSR Gosplan and the State Committee for Science and Technology. An interesting business game for Soviet managers in the leading Soviet management journal suggests that the achievement of a foreign currency earning capacity will often be a criterion even at the ministry or enterprise level and that licensing deals with restrictive export clauses may on this account sometimes be avoided ('Chto vygodnee:... ?' 1974).

Production planned under the licence must be shown to cost at least one third less (for a given volume of output) than production based on domestic R and D. The cost comparison is in present value terms using a discount rate of 8 percent. Conversion of foreign exchange costs from foreign to domestic currency is at shadow, not official, exchange rates. Production is supposed to start not less than two years from the licence purchase (Metodicheskie ukazaniya 1974, pp. 9, 12 and 17–20; Volynets-Russet 1973). The extent to which these procedures are adhered to and, more generally, the overall impact of Soviet licence and know-how purchases seem quite impossible to assess from available information.

IV.6. Diffusion

Finally in this section, the question of diffusion. The Soviet capacity to diffuse foreign technology within the domestic economy has come up repeatedly in our discussion of both machinery and know-how imports. It is inherently likely that, in an economy so large in relation to foreign trade flows, this capacity is of crucial importance to the total impact of international technology transfer.

Micro-economic evidence suggests that Soviet domestic diffusion of imported technology is likely to be inefficient by Western standards. I have discussed the grounds for expecting this in another paper (Hanson 1976). They are briefly as follows.

First of all, there are the well-known institutional hindrances to innovation and diffusion generally in the Soviet system: the institutional separation of research from production; the lack of incentives

for producers to alter the product-mix; problems of new-product pricing; the inhibiting influence of low depreciation rates.

Then there are problems in the diffusion of technical information, a process which must precede the diffusion of the new-products and processes themselves but which appears in Western Europe to proceed at about the same speed (between firms) as subsequent process innovation (Nabseth and Ray 1974, p. 300). In the U.S.S.R. there has been sharp criticism of many technical information services, such as the All-Union Institute of Interbranch Information (VIMI) (Artamonov 1975). Another and more technical hindrance to the spread of information is the scarcity of photocopying and microfilm equipment. (Their widespread availability would weaken the censorship by raising productivity in the samizdat industry). Tracing paper and Indian ink are still used for most design copying in Soviet industry. (Pravda Jan. 3, 1975).

A former Soviet scientist now in Israel, Professor M. Perakh, has provided some striking insights into some of these problems (Perakh 1976). He stresses the importance of information barriers, both against the outside world and between Soviet institutions. He points to three particularly interesting motives for such barriers between Soviet institutions: fear of disclosing to other Soviet citizens the lag behind the West in one's own particular field; fear (on the part of scientists and technologists) of the 'uneducated rulers'; and the desire to hide the widespread illicit use of foreign patents and other know-how (Perakh, p. 10).

This last motive is connected with a mechanism which in Perakh's experience is of some importance in Soviet research. He states that Soviet scientists often use Western patent or other data as a basis for research proposals without disclosing this fact to fund-giving bodies or their own superior authorities. 'The original patent (or other source of information) is generally not mentioned, as if the idea were his own and was worked out in his laboratory.' (Perakh, p. 8). The research then replicates results already achieved in the West without superior authorities or potential Soviet users of the research being aware of this fact.

Insofar as this happens, it presumably leads to the formation of groups in the scientific and technological community with a vested interest in halting or slowing both the introduction and diffusion of foreign technological information which would expose or render futile their own activities. The phenomenon is probably not peculiar to the Soviet system—it sounds not unlike the NIH (Not Invented Here) syndrome in British industry—but it will surely be encouraged by the closed, bureaucratic and rather uncompetitive nature of Soviet society.

In the last resort the lack of competitive pressure in the Soviet economic system is probably the most powerful underlying reason to expect a lack of technological dynamism. That there is, on the whole, a lack of such dynamism is suggested by the case-studies of Soviet technology referred to earlier (notably Sutton 1973; Amann and Davies 1974; Slama and Vogel 1975 and 1976).

Many of the above arguments, however, apply to Soviet technical change generally. Is it not possible that the diffusion of imported technology (in the sense of negotiable transfer) is an activity that is

carried out much more efficiently in the USSR than innovation and diffusion of indigenous technology or technology transferred from abroad by non-negotiable channels? A study of the Soviet chemical industry, for example, shows several cases of indigenous innovations which stalled at the pilot-plant stage and were then replaced by close-substitute imported products and processes, which were then diffused (Amann 1974). A markedly better performance in diffusing embodied technology imports than in diffusing other technology of different origins might account for the Green-Levine findings discussed above.

Here it is important to introduce a consideration that goes against much of what has just been said about the Soviet system's lack of technological dynamism. This is pressure from above. Campaigns, initiated at Politburo level, to deal with particular problems, are themselves part of the Soviet system. To a considerable extent they must counter its tendencies to stagnation and inefficiency in routine operation. Pressure from above cannot, by definition, be universally applied, and will typically incur costs because of its disruption of those activities that are not the subject of the campaign. But it is probably an important reason why a lot of things do in the end get tolerably well done in the Soviet Union. The weaknesses of the "system" in normal or routine operation are in some degree misleading about its overall performance.

Perhaps pressure from above can and does facilitate the diffusion of imported technologies. After all, technologies imported via negotiable channels of transfer have by definition been considered important enough to have substantial amounts of scarce hard currency spent on them. It seems plausible that special effort would subsequently be devoted to diffusing them. Furthermore, such special attention would not be impracticable in view of the relatively small scale of negotiable transfer from the West.

The Green-Levine macroeconomic evidence supports the idea of especially effective diffusion in the case of technology embodied in imported hardware. Sutton's case-studies also support it, though with this difference, that Sutton stresses Soviet efficiency in reverse engineering and scaling-up from single Western machines treated as prototypes (Sutton 1973). These are activities which I would classify as diffusion from non-negotiable transfer. But they involve skills and procedures broadly applicable to the diffusion of technology imported in the form of whole plants, large machinery orders or licences and know-how. So perhaps Sutton's evidence, too, favours the view that Soviet diffusion of technology transferred via negotiable channels is relatively efficient—compared at least to the diffusion of indigenous technology.

On the other hand, there are certainly cases where the planners have aimed at diffusing imported technology but implementation has either been slow or has failed entirely. Some instances were quoted above of slow utilisation of licences (which is itself a form of diffusion). Apparent failures or delays in replicating imported foreign oil rigs and complex fertiliser plants have also been mentioned.

A case-study at present under way of the diffusion of imported mineral fertiliser technology has not yet produced conclusive results. A preliminary discussion suggests, however, that there has been at

least some success in the Soviet diffusion of imported technology in the production of urea and complex fertilisers between 1960 and 1973 (Hanson 1976). The question is, how good is this performance?

In the case of complex fertilisers, there was no Soviet production at all in 1960. In the early 1960's plants to manufacture complex fertilisers began to be imported. Production rose to around 13 mn. tonnes in 1975 (still a small share of total mineral fertiliser output by Western standards). By 1973 some 26 percent of complex fertiliser output was reportedly being produced from domestically-built plant (Luk'yanov 1974). In early 1976 Soviet officials were nonetheless making enquiries about further supply of complex fertiliser plant. Whether this is or is not a "good" performance in diffusion is hard to say. Comparison with other countries and/or expert evaluation is required. On the face of it, though, it does not appear to be an example of rapid or dramatic success in diffusion.

A final example is provided by the Tolyatti plant. This has apparently exerted pressure on the technology of Soviet supplies of components and material for the Tolyatti complex by raising quality and performance requirement (the "triple" or feedback type of indirect effect mentioned earlier). This pressure appears to have produced some substantial improvements (Hanson 1976).

Diffusion from Tolyatti, however, seems to be more problematic. A recent Soviet article on the Tolyatti complex raises some extremely interesting questions on this score (Golland 1976). The author is concerned both about the maintenance of "contemporary" levels of technology at the VAZ works itself and about the diffusion (rasprostranenie) to other Soviet factories of the still relatively advanced technology which VAZ incorporates. He mentions a number of recent developments in motor industry technology, such as higher-speed spraying, which have not been adopted at Tolyatti. Reconstruction and modernisation are in his view necessary.

Golland argues that technology embodied in the VAZ works is not being diffused sufficiently to other factories. " * * * leading experience, even such as that of VAZ, will not diffuse by itself." (Golland, p. 81.) A special system for diffusing VAZ technology should be created. He links this with the issue of the modernisation of VAZ itself as part of the general need to maintain VAZ as a centre of technical excellence and keep up the morale of its staff.

The basic options in the re-equipping of VAZ, he says, are a renewed large-scale purchase of foreign machinery and licenses or the creation of a domestic machine-building sector capable of supplying motor-industry machinery of contemporary technological standards. Since 70 percent by value of the equipment at VAZ is imported (Golland, p. 85), the dilemma is acute. The author clearly sees the present situation as one in which the technology installed at Tolyatti is being neither substantially updated nor widely diffused.

This evidence may be anecdotal, but the preceding anecdote covers some $550 mn. of imported Western machinery (at late 1960's prices) and a factory complex responsible for the assembly (and much of the subassembly and component manufacture) of 55 percent of the current output of Soviet passenger cars.

Such evidence suggests to me that we should be very cautious about the Soviet capacity to diffuse imported technology. The subject is one that deserves further investigation by means of both case-studies and further econometric work. At present, I am sceptical about Soviet performance in this area. In any event, there seem to be strong a priori reasons to expect that performance in diffusion would tend to become relatively less good as the volume of imported technology increased relative to domestic production: the limited resources available for "pressure from above" would have to cover a greater number of products and processes.

More generally, if pressure from above is a major source of technical change in the Soviet economy, the ability of top policymakers to see key technological developments early and act swiftly to exploit them is important. There is room for a good deal of scepticism about Soviet performance in this respect too. Both semi-independent Soviet domestic development and Soviet import of major new technologies tend to start late: computers, plastics and synthetic fibres are all clear examples. To take a technology of narrower importance: the Soviet purchase of a Pilkington float glass license, mentioned above, was not made until 1967, well after many Western firms had bought it.

Finally, the Tolyatti example, just discussed, raises the question of capacity not merely to diffuse an imported technology but to update it by indigenous effort and perhaps even to move ahead of other countries by independent adaptation or the independent development of radically new technologies. This is ultimately what "catching up and overtaking" is, in large part, about, and it will be considered in the final section.

V. Conclusions

We have seen that the import of Western technology by negotiable channels—principally, machinery and license purchases—remains small and has not increased dramatically relative to Soviet domestic investment. It is concentrated on relatively few industries and has had a major impact on the growth and product-mix of some of them.

Its total impact on Soviet economic performance remains uncertain. Some macroeconomic calculations suggest that the total impact in recent years may have been substantial. Microeconomic evidence tends to raise doubts on this score. The degree of success in diffusing imported technology is likely to be very important in determining whether, in the Soviet case, the total impact of negotiable transfer on Soviet growth is or is not large. The evidence is that some successful diffusion occurs, but it is doubtful whether Soviet diffusion is generally very effective. It is arguable, further, that diffusion would tend to become less effective, on the whole, if the rate of direct technology import were to rise substantially.

Whether Western governments should maintain or modify their policies on negotiable transfer is a contentious issue. It depends on a number of subsidiary issues, several of which are beyond the scope of this paper. What are the political quid pro quo's, if any, for negotiable West-East transfer, and what are they worth? What are the benefits to Western economies in employment; incomes, the reverse flow of

Soviet technology (which is not insignificant); the learning by doing that may come from tackling Soviet projects of a scale unheard of in the West, and the energy supplies with which the USSR can repay some of its technology imports?

Will greater East-West technology flows create an interdependence favourable to peace? Will they promote or, on the contrary, provide a substitute for Soviet economic reform? Will they tend to draw Soviet policymakers into unplanned complementary resource commitments at the expense of military expenditure? Will they lock the Soviet Union into a pattern of technological dependence on the West?

Amongst all these questions, the question of the economic consequences for the U.S.S.R. of greater international transfer from the West is the only one with which this paper is concerned. The underlying issue is whether technology transfer involves the West in selling cheaply a critical capability which we shall subsequently regret sharing with the Soviet Union.

Wiles has argued that this is precisely the case (Wiles 1976). Vernon and Goldman (Vernon 1974; Goldman 1976) have asked whether U.S. companies may not be selling technology too cheaply because of false expectations about the Soviet market and because of the bargaining power of Soviet f.t.o.'s.

It seems inescapable that a buyer of a new technology dealing with competing suppliers stands to make savings much greater than the price he pays. In this sense the Soviet Union is likely to be the greater beneficiary of such deals obtaining a large "consumer surplus". But that is in the nature of technology sales. Two points should, however, be noted. First, Soviet f.t.o.'s are usually far from being the only potential buyers of a technology and hence are seldom able to exert monopoly bargaining power. Second, if there are competing suppliers of a technology it is probably not a very new technology; the very latest technologies are commonly monopolised by their originators for a while, so that a Soviet purchaser wanting the latest technology may often have in fact to pay a monopoly rent above the supply price.

More generally, a centrally planned economy purchasing technology on the world market would seem to be in a position akin to that of a firm in a market economy adopting an "imitative" rather than an "offensive" or "defensive innovation" strategy (Freeman 1974, chapter 8). In the Soviet case, at least, a technology lag seems almost to be built into the arrangement.

The sharp imbalance in Soviet trade with the West in technology and sophisticated products, the lack of technological dynamism of the Soviet system and the inhibiting influence of balance of payments problems must be considered along with the small scale of West-East flows in relation to the Soviet economy and the doubts about Soviet diffusion. All this suggests that, though the Soviet economy probably benefits substantially from international technology transfer, the Soviet gains do not seem likely to transform the Soviet position. In civilian technology catching up, let alone overtaking, still seems a remote prospect.

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SOVIET AGRICULTURAL TRADE AND THE FEED-LIVESTOCK ECONOMY

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I. TRENDS IN U.S.S.R. FOREIGN AGRICULTURAL TRADE

A. Aggregate Trends

Soviet agricultural imports, on the average, have grown apace with total imports. During 1971–75, imports of agricultural products accounted for 23 percent of the total—about the same as during 1961–65. During the intervening 5-year period, 1966–70, agricultural imports slipped to about 22 percent.

Year-to-year movements in agricultural imports have been more erratic, however. As a share of the total, agricultural imports jumped from 20 percent in 1962 to a peak 27 percent in 1965 and 1966, then slid to a low 19 percent in 1968 and 1969. The more recent highs were 25 percent in 1973 and 26 percent in 1975. Prior to 1972, the value of agricultural imports had not exceeded $2.5 billion. The value surged to over $5 billion in 1973 and almost hit $10 billion in 1975 (table 1).

Soviet agricultural exports, on the whole, have slipped in relative importance. As a share of the total, exports have fallen from about 17 percent during 1961–65 to 14 percent during 1966–70 and 9 percent during 1971–75. Except for one resurgence in the mid-1960's—to 17 percent in 1967—exports have fallen rather consistently as a share of the total. Although the absolute value of agricultural exports reached a peak $2.7 billion in 1974, the share of total exports was only 10 percent, and a new low of 7 percent was set in 1975.

Agricultural imports have exceeded exports in every year since 1962. The agricultural trade deficit was more than $7 billion in 1975.

B. Key Commodities

The leading agricultural import categories over time, when ranked by 19 SITC (Standard International Trade Classification) categories, have alternated among grains, sugar, fruits and vegetables, and textile fibers. Grains were the leading agricultural import during 1964 through 1966 and again during 1972 through 1975, reaching a record $2.9 billion

in 1975. Sugar led the import list in 1962, 1967, and 1970, but the value of sugar imports rose sharply after 1972 and also reached a record of $2.2 billion in 1975. Fruit and vegetable imports have climbed steadily. They were the leading agricultural import category in 1968 and 1969 and hit a record of $800 million in 1975. Textile fibers (mainly cotton and wool) led the way in 1963 and 1971, peaked at about $700 million in 1974, but slipped to about $550 million in 1975. Other import categories valued at about $500 million or more in 1975 were beverages (primarily wines); tobacco and products; coffee, tea, and cocoa; and meat and products.

Grains and textile fibers have dominated Soviet agricultural exports, ranking first or second in every year from 1962 on. Grains and products led in 1962, 1963, 1967, 1969 through 1971, and 1974. The peak value of grain exports was reached in 1974 at $1 billion, slipping to less than $700 million in 1975. Textile fibers (largely cotton) have shown the most consistent growth, leading exports in 1964 through 1966, 1968, 1972, 1973, and 1975, and peaking at almost $1 billion in 1975. The only other agricultural commodity grouping reaching a substantial export level has been vegetable oils, valued at over $300 million in 1974 and 1975.

C. U.S. Agricultural Trade With the U.S.S.R.

Between the end of World War II and 1970, U.S. agricultural exports to the U.S.S.R. generally remained at very low levels. The value of U.S. agricultural exports hit $137 million, largely from grain, in 1964, but did not reach as high as $35 million in any other year. No significant quantities of grain were exported from the United States to the U.S.S.R. during this period, except for the 1.8 million tons [1] of wheat and 55,000 tons of rice in 1964. The principal U.S. export during much of this period was cattle hides. U.S. agricultural imports from the U.S.S.R. have been negligible—$7 million in 1975.

Initial Soviet grain purchases began in the late fall of 1971 and U.S. exports have jumped sharply, but erratically, in the 1970's. U.S. agricultural exports to the U.S.S.R. peaked at $1 billion in 1973 (following the poor 1972 grain crop in the U.S.S.R.) and again at $1.2 billion in 1975 (as a consequence of the 1975 Soviet drought). These exports have consisted largely of grain (table 2). Nongrain values were boosted by some soybean exports in 1973.

On the basis of a July–June year, which more closely approximates a grain marketing year, a new record export value of close to $2.0 billion was reached in the year ending June 1976, compared with the previous high of about $950 million in the year ending June 1973. The quantity of grain exported was about 14 million tons in each year. One major change besides the price, however, was the reversal of the dominance of wheat in the earlier year to corn in the more recent year.

In October 1975, the United States and U.S.S.R. signed a grain agreement, which stipulated that the U.S.S.R. will buy at least 6 to 8 million tons of corn and wheat, in approximately equal amounts, annually from the United States during each of the 5 years beginning October 1976. During the 5 years preceding the agreement, Soviet grain imports from the United States have averaged about 8 million tons annually, but quantities have varied sharply from year to year.

[1] All tonnages are metric.

II. Trade and the Feed-Livestock Economy

A. Analysis of 1971–75 Policies

In its policies during the 1971–75 Economic Plan, the Soviet leadership apparently attempted to satisfy from internal livestock production the growth in consumer demands for livestock products. Feed production possibilities in the U.S.S.R. were inadequate, however, thus leading the U.S.S.R. to turn to imports of grains in an attempt to cover the deficit. The Soviet leadership turned to massive grain imports during 1972/73, when feed production was further curtailed by poor weather, and again during 1975/76, when the country was struck by an extremely severe and widespread drought. During 1975/76, however, the deficit was so great that it could not be offset entirely by imports (table 3) and, as a result, sizable cutbacks were made in livestock inventories, especially hogs, and poultry.

The shifts in Soviet grain trade and the possible impact of a cutback in livestock product output are best understood within the context of an overall analysis of the feed-livestock economy. A detailed analysis of the Soviet feed-livestock economy was undertaken in 1973 and relationships were projected ahead for about a decade with the focus expecially on 1980.[2] The principal economic relationships examined were: (1) The demand for livestock products; (2) the supply of livestock products and the related demand for feeds; and (3) the production of feeds in the U.S.S.R. and the imbalance between feed demand and production.

In the study, the demand analysis and projections of livestock product demand were the principal bases for the projections of livestock product supply and, hence, feed requirements. Future per capita levels of consumption of livestock products were projected using income elasticities of demand calculated largely from time-series regression analysis. Although such calculations may understate true elasticities in an economy of queues and shortages, such as the U.S.S.R., it was found that most calculated elasticities appeared quite reasonable in international comparisons with countries of Southern and Eastern Europe. The selected income elasticity on meat was about 0.7.

Calculation of aggregate consumption required the use of projections both of population and per capita consumption. The former assumed constant fertility. The latter was based on an assumed 5-percent annual growth in per capita disposable money incomes. The 1975 per capita projections approximated the 1975 plans and the 1985 projections generally approached the long-term norms specified by the U.S.S.R. Academy of Medical Sciences.

Livestock production projections in the study generally were set at the level required to cover projected consumption. The projected 1980 requirements, compared with original 1975 plans and accomplishments and the 1976–80 average plan, were:

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[2] Schoonover, David M. "The Soviet Feed-Livestock Economy: Preliminary Findings on Performance and Trade Implications" in "Prospects for Agricultural Trade with the U.S.S.R." U.S. Dept. Agr., ERS-Foreign 356, April 1974.

Item	Million tons		
	Meat	Milk	Eggs (billions)
1975 plans	16.0	100.0	52.0
1975 actual	15.2	90.8	57.7
1976–80 plan average	15.0–15.6	94–96.0	58–61.0
1980 projections	19.0	114.0	63.0

Feed supplies were determined by constructing balances of grains, other concentrates, milk, and forage crops. Feed was aggregated in terms of oat-equivalent feed units and digestible protein, using Soviet standards. Livestock products were aggregated in terms of total feed- and concentrate-consuming livestock production units, similar to those in use in U.S. feed balance statistics, using Soviet feeding rates for 1970 or other recent years. Aggregate total feed supplies were divided by aggregate livestock production units to determine patterns or trends in aggregate feeding rates. The calculations indicated that there has been very little change over time in aggregate feed consumption per total feed-consuming livestock production unit, but there has been a marked increase since the mid-1960's in concentrate use per concentrate-consuming livestock production unit. According to these calculations, the ratio of digestible protein per oat-equivalent feed unit has improved only slightly during the past 15 to 20 years.

In the projections of feed requirements, total feed per livestock unit was assumed to remain constant at the 1960–71 average level. The uptrend in concentrate feed units per concentrate-consuming livestock unit, however, was extrapolated to 1980 and 1985. The required ratio of digestible protein was calculated using Soviet norms. The calculated absolute protein deficit in 1970/71 was 3.5 million tons—roughly equivalent to the digestible protein content of 10 million tons of soybeans.

Determination of expected future feed supplies required projection of feed crop production, which largely was based on separate linear extrapolations of area and yield data. The extrapolated downtrends in grain and uptrends in forage crop areas were shifted as a result of the structural changes in 1973, but the trend rate was left unchanged. The grain area trend, for example, was shifted upward by 8 million hectares and extrapolated from this revised position.

In the grain yield projections, the steeper uptrends of 1960–71 were preferred over the longer-term trends of 1955–71. Alternative regressions of yields on fertilizer and their projection based on fertilizer plans suggested that linear extrapolations over the next decade are relatively conservative. The 1973 projections of grain output suggested that it was reasonable to expect production of at least 240 million tons by 1980. Using the less steep long-term yield trend, about the same level of output was projected, assuming that grain area will be maintained at the post-1972 level. Since aggregate food use of grain is not increasing, and per capita consumption is actually declining, most of the increase in grain output can be expected to go into feed use.

Although uptrends in forage crop yields were evident, in contrast to grain yields little acceleration was apparent. The forage production projections diverged greatly from Soviet plans on feed availabilities from forages, suggesting a probable major feed deficit in this area.

The separate projections of feed production and requirements indicated a substantial and growing deficit of feed units and a continuing

chronic deficit of digestible protein over the next decade. This growing deficit was expected to evoke a response. The initial response of Soviet policymakers was feed imports. Other policies were expected, however, to eventually close the gap or prevent it from widening beyond bearable limits. On the supply side, policies to sharply improve forage crop production and use in the U.S.S.R. seemed a good possibility. On the requirement side, increased efficiency through modernization of the livestock industry and increased emphasis on the protein balance in feed seemed likely. As a last resort, of course, requirements can be reduced by a reduction in consumption through price changes or shortages, but these are not popular policies.

A number of policies were in fact undertaken by the Soviet Government during 1971–75 to speed up the rate of increase in feed supplies and decrease in feed demand. On the supply side, they included the nonchernozem program, the expansion of grain areas, the increase of fertilizer deliveries to agriculture, an irrigation program, and work on higher-protein feeds. On the demand side, policies included specialized livestock enterprises (including inter-farm associations), development of a mixed-feed industry, and an effort to improve the breeding herd. The impact from many of these policies was expected to be slight at first, but considerable progress seemed likely by 1980.[3]

B. Possible Implications of the 1976–80 Plan

A comparative summary of the just completed and current 5-year plans suggests that each has contained a major inconsistency in the feed-livestock area. During 1971–75, it appeared that planners intended to meet the growth in demand for livestock products through increased livestock production, but the possibilities for expanding feed output were inadequate to cover growing needs. The early impressions of the 1976–80 Plan suggest that the inconsistency now has been reversed. Feed production goals and possibilities appear more consistent with livestock production targets, but it is questionable whether livestock product supply will be adequate to cover demand unless other policy changes are made.

The expansion of feed production receives principal attention in the commodity programs for 1976–80. Attention is focused not only on grain, but also on high-protein crops and roughages.

Grain production during 1976–80 is to average 215 to 220 million tons (table 4). Although this is 35 to 40 million tons more than the 1971–75 average of 181 million tons, that average reflects the disastrous 1975 crop. Production during 1971–75 would have averaged about 195 million tons with normal weather in 1975. Of the 1976–80 growth in production, improved technology or increased resources will need to account for about 20 to 25 million tons. This is not an unreasonable goal, and there is a good chance that production will average at least 215 million tons if there is an even distribution of years of good and bad weather—in contrast to the less favorable weather pattern of 1971–75. An extrapolation of the 1955–74 yield trend on an area of 125 million hectares would permit attainment of the mid-point of the grain goal. Area has slightly exceeded 125 million hectares since 1972. In fact, the Soviets plan an average grain area of 128.5 million hectares during 1976–80.

[3] Schoonover, David M. "The Soviet Feed-Livestock Economy: Projections and Policies" in "Economic Development in the Soviet Union and Eastern Europe, Volume 2, Sectoral Analysis." ed. Zbigniew M. Fallenbuchl. Praeger Publishers, New York, 1976.

The draft plan encourages maximum expansion of seedings of feed peas, lupines, alfalfa, and other high-protein crops. It also calls for the organization of soybean production on irrigated lands in the southern part of the RSFSR (Russian Federation), the Ukraine, Moldavia, and Transcaucasus.

The plan recommends growth of roughage feed production to cover not only the needs of the socialized sector, but also the private livestock holdings. Each farm is expected to establish a feed reserve. Expansion of irrigated pastures and meadows is planned.

Despite the future attention slated for feed production, planned growth of livestock output is weak. The 1976–80 average goals for meat and milk production are only slightly above the original 1971–75 goals. Even compared with actual accomplishments during the past 5 years, meat production is planned to increase only 7 to 11 percent, and milk only 7 to 10 percent. With an expected population growth of about 5 percent, the planned gain in production over the 5 years on a per capita basis is 2 to 6 percent on meat, and 2 to 5 percent on milk. Per capita consumption in 1975 was 58 kilograms of meat and 315 kilograms of milk and products (including milk-equivalent of butter). In the livestock area, growth is strongest in egg production but some slowdown apparently is planned there also. The low milk growth target may represent a more realistic assessment of output opportunities given the current quality of the dairy herd. The low meat production target, however, undoubtedly considers likely a substantial falling off of production during the first part of the 5-year plan, as a consequence of distress slaughter and reduced breedings in 1975. If meat production dropped even 10 percent in 1976, then production probably would have to reach 16.5 to 17 million tons by 1980 to accomplish the planned average output.

A key question is how well the livestock goals match up with prospective feed production. Only a tentative conclusion can be drawn from the information available at this time. Attainment of the grain production target could make available on the average about 115 million tons of grain for feed annually and still permit a moderate rebuilding of stocks. Specific targets are not available for each of the other types of feed, nor are specific targets available for meat production by type of livestock or poultry. Based on assumptions about the distribution of meat by type and on projections of the level of availability of roughages and other feeds (largely linear extrapolation of past performance), however, a preliminary conclusion can be made: The livestock and feed production plans generally are consistent. If the Soviets hold to the livestock targets and if weather permits attainment of expected feed production, the U.S.S.R. may well approach self-sufficiency in feeds.

Prospects for grain trade with the U.S.S.R. have been clouded by release of relatively low livestock production goals for 1976–80. Soviet grain imports seem likely to be affected most strongly by the following elements:

1. Present and long-term commitments to import grain;
2. Effects of year-to-year weather variability on grain output;
3. Decisions concerning U.S.S.R. grain reserve stockpiling;
4. Pace of livestock herd rebuilding and the degree to which goals may be exceeded.

The 5-year grain agreement with the U.S.S.R. for the 1976–80 marketing years seemingly puts the United States in a strong position

to maintain grain exports of 6 to 8 million tons to that country. These exports may be boosted when poor weather affects Soviet crops. There is some suggestion in the announced plan to increase grain storage capacity and also in an objective cited in the 1976–80 plan—"creation of the necessary reserves of agricultural products"—that Soviet policy may elect to bolster grain reserves. Imports to cover some stock rebuilding are especially likely in 1976 unless another major shortfall is experienced in the U.S.S.R. grain harvest. Slow rebuilding of livestock herds would tend to restrain grain import needs. The Soviets apparently intend to rebuild hog inventories rapidly, however—to January 1, 1975, levels by early 1977. The U.S.S.R. may well resume moderate amounts of grain exports in the years ahead, thus offsetting a portion of the grain purchased from the world market.

The emphasis in the plan on improving efficient use of resources, however, may augur well for development of a market in the U.S.S.R. for oilseeds or oilseed meals—at least until progress can be made toward the objective of increasing high-protein feed output. Owing to limited potential for increasing oilseed area, it does not appear that a major expansion in high-protein feed production in the U.S.S.R. is possible during the next several years.

If the livestock and feed production plans are consistent, still a major inconsistency may exist in the plan for 1976–80. Wages are scheduled to increase 16 to 18 percent, but the planned increase in per capita livestock production is only 2 to 6 percent on meat and 2 to 5 percent on milk. The previously-cited research study suggested that for each 10-percent increase in per capita incomes, demand for meat in the U.S.S.R. increases about 7 percent and for butter (still the principal component of dairy product consumption) increases about 6 percent. Results of this study suggest that the repressed demand for livestock products in the U.S.S.R. may increase substantially during the remainder of this decade.

The Soviets may consider other alternatives besides livestock product supply increases to reduce this repressed demand. An increase in retail prices of livestock products is one possibility. The announced policy to maintain stable retail prices on major foods, however, indicates that this is not now intended. A more likely alternative is a substantial increase in imports of meat and other livestock products. Large meat imports are especially likely in 1976 as production slumps as a result of reduced herds. It is more difficult to foretell whether the U.S.S.R. will continue as a major meat importer in subsequent years.

All in all, the 1976–80 plan seems relatively realistic in the agricultural sector in terms of matching planned outputs with resources. The plan, however, seems to call for considerable restraint on the part of the Soviet consumer and may result in an aggravation of repressed inflation. The sum effect on Soviet agricultural trade, assuming normal weather, is likely to be a less strong demand for grain imports, compared with the demand of the past few years, but perhaps a strengthened demand for livestock product imports. But then weather is rarely normal. Actual trade is likely to continue to be greatly affected by weather at least during the next several years. Both grain and meat imports seem likely to continue strong in 1976 as grain reserves and hog herds are rebuilt and meat production slumps.[4]

[4] Economic Research Service, "The Agricultural Situation in the Soviet Union: Review of 1975 and Outlook for 1976." U.S. Dept. Agr., FAER No. 118, April 1976.

TABLE 1.—SOVIET FOREIGN TRADE IN AGRICULTURAL COMMODITIES, 1962–75 [1]

[Dollar amounts in millions]

Year	Imports						Exports					
	Total						Total					
	Value	Share of all imports (percent)	Grains and products	Livestock and edible products	Textile fibers	Sugar and honey	Value	Share of all exports (percent)	Grains and products	Livestock and edible products	Textile fibers	Vegetable oils
1962 [2]	$1,270	19.7	$55	$102	$219	$240	$1,350	19.2	$557	$148	$329	$48
1963 [2]	1,474	20.9	267	50	270	163	1,324	18.2	450	168	320	72
1964 [2]	2,032	26.3	628	122	227	255	1,003	13.1	271	67	366	54
1965 [2]	2,202	27.3	464	219	271	316	1,123	13.8	298	75	403	72
1966	2,159	27.3	574	134	274	259	1,294	14.6	267	140	441	127
1967	1,876	22.0	246	105	214	345	1,593	16.6	492	183	427	180
1968	1,808	19.2	192	96	238	247	1,562	14.7	441	156	459	168
1969	1,926	18.7	124	99	278	187	1,608	13.8	562	142	374	161
1970	2,501	21.3	215	154	384	413	1,478	11.5	494	118	418	111
1971	2,472	19.8	289	202	375	211	1,655	12.0	670	70	438	147
1972	3,499	21.6	968	202	321	276	1,453	9.4	386	94	569	146
1973	5,212	24.8	1,622	324	586	655	1,824	8.5	585	130	675	146
1974 [3]	5,400	21.7	850	650	710	820	2,700	9.9	1,030	110	900	350
1975 [3]	9,700	26.1	2,900	770	555	2,190	2,450	7.3	660	115	960	320

[1] Data through 1973 are from Food and Agriculture Organization of the United Nations, "Trade Yearbook 1974" and selected previous issues. Data for 1974 and 1975 are from Ministry of Foreign Trade, U.S.S.R., "Vneshnyaya Torgovlya" 1975g. The following exchange rates were used to convert from rubles to U.S. dollars: 1962–71—1.11; 1972—1.22; 1973—1.35; 1974—1.32; 1975—1.39.

[2] Definition apparently varies slightly from more recent series.

[3] Preliminary.

TABLE 2.—U.S. EXPORTS OF AGRICULTURAL PRODUCTS TO THE U.S.S.R., 1970–75[1]

Year	Value (millions)						Quantities of grain (thousand metric tons)			
	Total	Grain				Non-grain	Total	Wheat	Corn	Other grains
		Total	Wheat	Corn	Other grains					
Calendar year:										
1970	$15.9					$15.9				
1971	44.6	$27.8	$0.7	$25.2	$1.9	16.8	515	3	471	41
1972	457.6	391.0	160.0	184.9	46.1	66.6	7,262	2,733	3,410	1,119
1973	1,017.1	917.4	556.6	294.5	66.3	99.7	14,332	8,727	4,816	789
1974	323.7	301.7	124.1	159.4	18.2	22.0	3,379.	1,063	2,155	161
1975	1,166.7	1,128.4	666.6	452.6	9.2	38.3	7,539	4,084	3,433	22
July–June fiscal year:										
1970	17.8					17.8				
1971	12.4					12.4				
1972	157.1	146.9	.7	106.5	39.7	10.2	2,948	3	1,977	968
1973	954.4	802.6	566.4	209.5	26.7	151.8	13,685	9,485	3,718	482
1974	584.8	563.1	219.0	283.5	60.6	21.7	7,883	2,725	4,519	639
1975	409.7	373.8	194.2	171.9	7.7	35.9	2,280	978	1,262	40

[1] Includes transshipments through Canada.

TABLE 3.—TOTAL SUPPLY AND ESTIMATED UTILIZATION OF GRAIN, U.S.S.R., 1964/65 TO 1975/76[1]

[In millions of metric tons]

Year	Production	Net trade[2]	Availability	Utilization						Stock change[2]
				Total	Seed	Industrial	Food	Waste	Feed	
1964/65	152	−1	151	132	22	3	45	17	45	+19
1965/66	121	+4	125	139	24	3	44	12	56	−14
1966/67	171	−1	170	144	24	3	44	14	59	+26
1967/68	148	−4	144	147	24	3	44	12	64	−3
1968/69	170	−6	164	161	25	3	44	17	72	+3
1969/70	162	−5	157	177	23	3	45	23	83	−20
1970/71	187	−7	180	187	25	3	45	22	92	−7
1971/72	181	+2	183	180	26	3	45	13	93	+3
1972/73	168	+20	188	188	27	3	45	15	98	0
1973/74	222	+6	228	213	27	3	45	33	105	+15
1974/75	196	0	196	206	27	3	45	24	107	−10
1975/76	140	+25	165	173	27	3	44	14	85	−8

[1] U.S. Department of Agriculture estimates.
[2] Minus indicates net exports or drawdown of stocks.

TABLE 4.—OUTPUT OF SELECTED AGRICULTURAL PRODUCTS, U.S.S.R., AVERAGE, 1966–75, AND PLANS, 1971–80

Item	Quantity or value				Increase over previous 5 yr			
	Actual 1966–70	Actual 1971–75[1]	Plan 1971–75	Plan 1976–80	Actual 1966–70	Actual 1971–75	Plan 1971–75	Plan 1976–80
	Billion rubles				Percent			
Gross output:								
1973 prices	[1]100.0	[1]113.0	NA	[1]129–132.0	NA	13	NA	14–17
1965 prices	80.5	91.0	98.0	104–106.0	21	13	22	14–17
	Million metric tons				Percent			
Grain[2]	167.6	181.5	195.0	215–220.0	29	8	16	18–21
Cotton (unginned)	6.1	7.7	6.8	[3]8.5	22	26	11	10
Sunflower seeds	6.4	6.0	7.0	7.6	26	−6	9	27
Sugarbeets	81.1	[4]76.0	87.4	95–98.0	37	[4]−6	8	25–29
Meat[5]	11.6	14.1	14.3	15.0–15.6	24	21	23	7–11
Milk	80.6	87.5	92.3	94–96.0	24	9	15	7–10
Eggs[6]	35.8	51.5	46.7	58–61.0	25	44	30	13–18

[1] Calculated from information on 1976 plan.
[2] Gross weight, including excess moisture and waste.
[3] The announced target for 1980 is 9,000,000 metric tons.
[4] Calculated from 1971–74 data and 1975 estimates.
[5] Including slaughter fats.
[6] Billions.

NA—Not Available.