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LETTERS OF TRANSMITTAL

DECEMBER 23, 1980.

To the Members of the Joint Economic Committee:

Transmitted herewith is a staff study, printed separately, and technical papers which together form Volume 10 of the Special Study on Economic Change (SSEC).

Volume 10 is entitled "Productivity: The Foundation of Growth" and is one of 10 areas on different aspects of the economy published by the SSEC. The SSEC was initiated in 1978 under the direction of the former Chairman of the Joint Economic Committee, Representative Richard Bolling, then Vice Chairman Senator Hubert H. Humphrey, and the former Ranking Minority Member, Senator Jacob K. Javits. It is intended to identify major changes in the economy and to analyze their implications for policymakers. The successful completion of this Study will, I believe, help provide an economic agenda for the United States for the decade of the 1980's.

The views expressed in the technical papers are exclusively those of the authors and do not necessarily represent the views of the Joint Economic Committee or of individual members. The staff study was approved by the Chairman's Special Study Review Committee formed by the Chairman, Representative Bolling, Ranking Minority Member Representative Clarence J. Brown, and Senator Javits.

Sincerely,

LLOYD BENTSEN,
Chairman, Joint Economic Committee.

DECEMBER 19, 1980.

HON. LLOYD BENTSEN,
Chairman, Joint Economic Committee,
Congress of the United States,
Washington, D.C.

DEAR MR. CHAIRMAN: Transmitted herewith is a staff study, printed separately, and technical papers entitled "Productivity: The Foundation of Growth," which constitute Volume 10 of the Special Study on Economic Change (SSEC).

The SSEC was initiated under the leadership of former Chairman of the Joint Economic Committee, Representative Richard Bolling, Vice Chairman Senator Hubert H. Humphrey, and former Ranking Minority Member, Senator Jacob K. Javits. The Study is divided into 10 substantive areas. which together chart major changes in the economy and analyze their implications for policymakers. Volume 10 comprises an analysis of why U.S. productivity growth has declined and a description of those areas where improvements in productivity growth can be realized.

Most of the major issues dealing with the U.S. economy as a whole eventually get down to the problem of America's stagnant productivity growth. Issues such as stagflation, Federal budget priorities, energy conservation, research and development, government regulation, and labor policy all have their counterpart in a discussion of productivity growth. This study looks at all these factors as a means of emphasizing the multifaceted aspect of the productivity problem and of the many different policies which the United States will need to address in order to restore the kind of growth which translates into a rising standard of living for the average American.

It should be understood that the views expressed in the technical papers are exclusively those of the authors and do not necessarily represent the views of the Joint Economic Committee or of individual members. The staff study was approved by the Chairman's Special Study Review Committee formed by the Chairman, Representative Bolling, Ranking Minority Member Representative Clarence J. Brown, and Senator Javits.

Sincerely,

JOHN M. ALBERTINE,
Executive Director, Joint Economic Committee.

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THE DETERMINANTS OF THE DECLINE IN MEASURED PRODUCTIVITY GROWTH: AN EVALUATION

By Gregory B. Christainsen and Robert H. Haveman*

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I. Introduction

Since 1965, measured productivity in the United States has had a disappointing and largely unexplained performance. Over the entire period, the rate of productivity change has been lower than in preceding periods. Moreover, the upward trend in labor productivity has been broken at least twice during this period.

In this paper, we will focus on this adverse productivity pattern and seek to understand its nature and causes. In section II, we will describe the course of changes in productivity over the 1965–79 period. Three time series indices of productivity will be discussed, and a description of discrepancies among them will be presented. Section III will present a catalogue of the determinants of productivity. Changes in any of these determinants could alter measured productivity change and account for the post-1965 performance of this variable.

Then, in section IV, studies which have addressed the determinants of recent productivity change will be described and critiqued. These studies differ in their data and methods, and hence in their findings. We will seek to understand these differences and to explain them.

In section V, we will seek to appraise the likely role of environmental regulations in the observed decrease in productivity growth, for it is with respect to environmental policy that the concern over productivity growth and its relationship to real economic welfare can perhaps best be put in perspective. Our appraisal will be based on the

* University of Wisconsin-Madison.

studies discussed in section IV, and will implicitly reflect our judgment of the biases and reliability of these various studies. In this discussion, we will introduce a number of other considerations relevant to forming an overall judgment on the role of environmental policy on measured economic performance.

II. The Facts of the Post–1965 Reduction in Productivity Growth

In concept, a Nation's productivity can be defined simply as its aggregate final output per unit of input. However, because of difficulties in aggregating the diverse outputs and inputs of a modern economy, the measurement of productivity performance is not a straightforward matter. The most common—though by no means the most analytically sound—procedure has been to measure productivity by obtaining an estimate of final aggregate private sector output divided by the number of person-hours of labor input used in producing this output.[1] This concept could be called a single-factor productivity measure, and because it does not reflect in its denominator the full set of inputs, it has clear weaknesses. Recently, however, economists have attempted to compile series for private sector output per total factor input and several related measures. These are designed to avoid some of the weaknesses of single-factor productivity measures.

By any of the above measures, productivity growth in the United States has undergone a sharp decline since the mid-1960's. From 1947 to 1966, output per person-hour in the private sector grew at an average annual rate of 3.44 percent.[2] During this period there were cyclical deviations from the trend rate of growth, but otherwise the series was a relatively smooth one. Then, beginning in 1966 or 1967, there appears to have been a break in the time trend. From 1966 to 1973, private sector output per person-hour grew at an average annual rate of 2.15 percent, a decline of almost 1.3 percentage points from the earlier period. In 1973, a further break seems to have occurred, and from 1973 to 1978 an annual rate of only 1.15 percent was registered—only one-third of the recorded rate for the immediate post-War period and a further decline of a full percentage point from the years of 1966–73. Estimates for 1979 suggest a very weak performance, one well below the rate of the 1973–78 period. An estimate from the Council of Economic Advisers puts the 1979 rate at −0.9 percent.[3]

If one confines attention to the private sector's nonfarm component, a similar story emerges. Output per person-hour in this subsector grew at an average annual rate of 2.83 percent from 1947 to 1966, averaging about 2.8 percent between the peak years of 1948 and 1955 and about 2.7 percent between the peak years of 1955 and 1965. From 1966 to 1973, the figure fell to 1.8 percent, and the years from 1973 to

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[1] A more satisfying procedure for measuring productivity and changes in it would be based on a full production function analysis in which all inputs were accounted for and in which price changes of and substitution among these inputs were also reflected. Such an accounting of the output growth process, and indirectly, an evaluation of technical change is found in Gollop and Jorgenson (1979) and Gollop and Roberts (1979).

[2] Taken from Mark (1978), p. 486.

[3] Economic Report of the President (1980). Such short-term changes in the productivity index should be heavily discounted, however. In a period in which changes in the rate of growth of output are large, such as at the start of a recession, quarter-to-quarter changes in the rate of measured productivity growth are not likely to reflect underlying technical changes.

1978 saw a further decline to 1.02 percent. Again, the average for recent years is well under one-half of the corresponding figure for the immediate post-war period. As the economy approached peak levels of resource utilization in 1978, the results were truly startling. Nonfarm output per person-hour grew only 0.5 percent for the year, one of the lowest expansion year figures on record. And during 1979, the nonfarm component fell by 1.2 percent.

The use of nonresidential business income per person employed as a measure of productivity performance implies an even more dramatic decline. This measure, which ignores changes in hours worked by the labor force, showed an average annual growth rate of 2.9 percent for 1947–66. For 1966–73, it averaged 1.3 percent and for 1973–78, it actually declined by an average of 0.1 percent per year.[4]

Although single-factor productivity measures (e.g., output per person-hour) have serious weaknesses, the picture of productivity change which they yield is not greatly different from that of more complete measures. While total factor productivity in the domestic business economy grew at an average annual rate of 2.9 percent for the 1948–66 period, it grew only at a 1.4 percent rate for the 1966–76 period—once again, the average for recent years is less than one-half that for the immediate post-war period. The deceleration in "labor productivity" growth was somewhat greater due to the deceleration in the growth of capital per unit of labor which occurred after 1966. These post-war patterns in productivity growth are summarized in table 1.

TABLE 1.— POST-WAR ANNUAL PRODUCTIVITY GROWTH RATES IN THE UNITED STATES, VARIOUS MEASURES OF PRODUCTIVITY

[In percent]

	Output per person-hour, private sector	Output per person-hour, nonfarm private sector	Nonresidential business income per person employed	Total factor productivity in domestic private business
1947 to 1966	3.44	2.83	2.9	[1] 2.9
1966 to 1973	2.15	1.87	1.3	[2] 1.4
1973 to 1978	1.15	1.02	−.1	
1979	−.9	−1.2	NA	NA

[1] For years 1948–66.
[2] For years 1966–76.

Source: Figures for output per person-hour, private sector and output per person-hour, nonfarm private sector were taken from Mark (1978), p. 486. Figures for nonresidential business income per person employed were taken from Denison (1979c), p. 21. Figures for total factor productivity in domestic private business were taken from Kendrick (1978), p. 511.

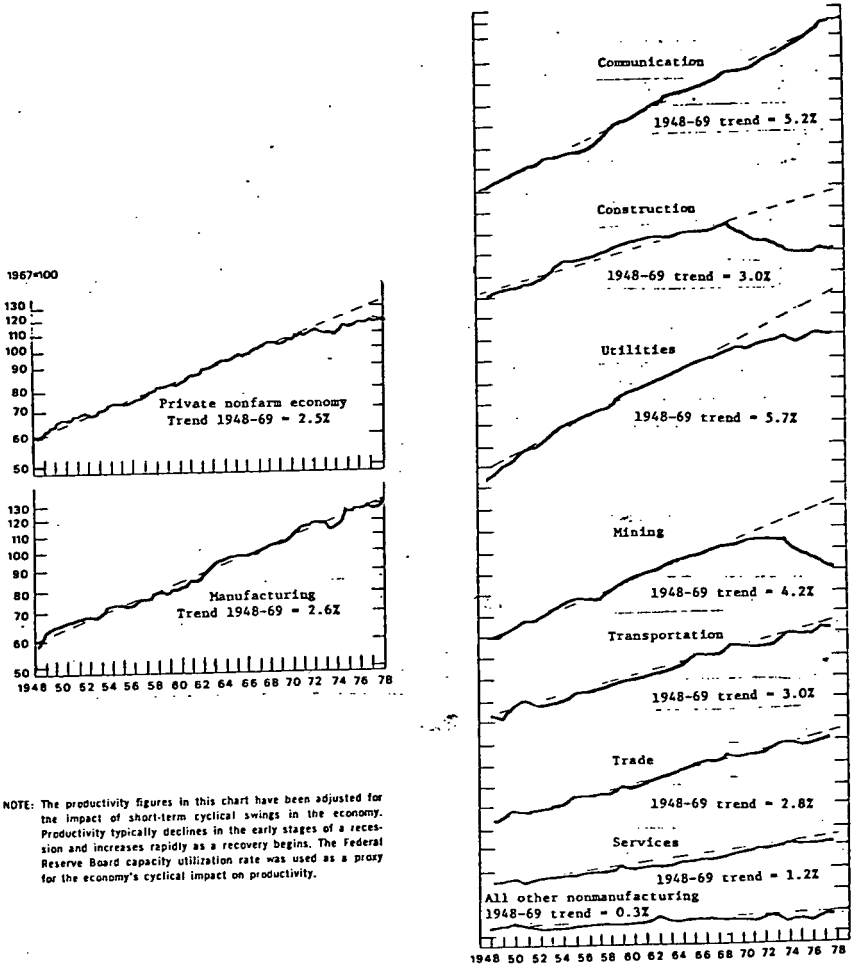
For the past three decades taken as a whole then, labor productivity in the private business sector has grown at an average annual rate of about 2.8 percent. However, if the trend of the first two decades had continued, the index of labor productivity in 1980 would be about 15 percent above the level actually attained.

Significantly, there appears to have been less deceleration in productivity growth in the economy's manufacturing sector than in other sectors. In 1978 productivity growth was 2.4 percent, which is close to the 1948–69 trend rate of 2.6 percent. For 1978, nonfarm, nonmanu-

[4] Taken from Denison (1979c), p. 21.

facturing productivity actually fell 0.3 percent so that the index of manufacturing productivity had risen over 12 percent more than the total nonfarm index since the base year of 1967. Productivity growth in manufacturing was 1.8 percent during 1979—a respectable performance compared to that of the economy as a whole. In the nonmanufacturing sector, the most dramatic slowdown in productivity growth has occurred in mining, construction, and utilities. Declines in these industries account for more than half the productivity deceleration in the private nonfarm sector during the past decade. These patterns are summarized in figure 1, which shows the pattern of productivity growth in the private nonfarm economy and some of its component sectors.

FIGURE 1.—Productivity indexes, by sector, 1948–78



NOTE: The productivity figures in this chart have been adjusted for the impact of short-term cyclical swings in the economy. Productivity typically declines in the early stages of a recession and increases rapidly as a recovery begins. The Federal Reserve Board capacity utilization rate was used as a proxy for the economy's cyclical impact on productivity.

Source : Morgan Guarantee Survey, November 1978, p. 8.

Comparing productivity trends in the United States with those in other countries is difficult because of differences in the nature and quantities of statistics among the countries. There is a consensus among the numerous studies undertaken, however, that the average annual growth rate in labor productivity has been lower in the United States during the post-War period than in most other industrialized countries. And according to the Bureau of Labor Statistics study of manufacturing productivity for 1970–74, the performance of the United States was exceeded by all of the 11 other non-Communist countries studied and also by 1971–75 estimates for the Soviet Union.[5] Output per person-hour is still higher in the United States than in any of these other countries, but the gap has been closing.

III. Causes of the Post–1965 Slowdown in Measured Productivity Growth

The conventional productivity index for the economy is a ratio of two aggregate time series—total output and total person-hours of input. As a consequence, there are numerous changes in the economy which might affect the index—some operating through the output variable and some through the input variable. Moreover, because both numerator and denominator are aggregate measures, compositional changes (e.g., by industry or occupation) within either aggregate could affect the overall productivity index.

In part because of the composite nature of this index, numerous conjectures have been put forward in an attempt to account for the deceleration that has been experienced. In this section, we identify those factors which seem most likely to have contributed to the slowdown. Then, we review the available quantitative studies which have sought to decompose the deceleration into its component parts.

The Composition of Output

Two major sectoral shifts in the composition of output have been recorded in recent decades. The first is the shift from the farm to the nonfarm sector. Second, within the nonfarm sector, output has shifted from manufactured goods to services.

The first shift—from the farm to the nonfarm sectors—is reflected in the divergence in productivity change between indexes reflecting total private sector output per person-hour and private nonfarm output per person-hour. As table 1 shows, the former index has fallen more rapidly than the latter. Because the level of labor productivity in the farming sector has been much lower than that for nonfarm labor, this shift has contributed to the rise in overall labor productivity which has occurred. However, most of this shift in the labor force occurred before 1966. Since 1967, very little additional movement has taken place. Moreover, levels of labor productivity in the farm and nonfarm sectors are now much closer than they have been in the past. For this reason alone, then, one of the major sources of productivity growth in the two decades after the War was no longer available in the third decade. And, as a consequence, few gains in total private

[5] See Fabricant (1978), p. 511.

sector labor productivity have resulted from this source in recent years.

The second shift—from manufactured goods to services—has also contributed to the slowdown in productivity growth in the nonfarm private business sector. The relative share of manufacturing in total employment has been declining steadily now for two decades. And in the most recent period from 1972–77, output in services rose 45.8 percent (in terms of 1972 dollars) while manufacturing output rose only 39.9 percent. GNP rose 41.29 percent. Since productivity in services has been, on average, below that in manufacturing, overall productivity may have slowed as a result of the shifts to services. (This slower growth in productivity in the services sector is seen in figure 1.)

Advances in Knowledge, R. & D.

Advances in knowledge can enhance productivity in either of two ways. They can directly enhance the quality of inputs, or they may enable producers to combine inputs of existing quality in a more efficient manner. It is, of course, very difficult to say how much more we now "know" compared with 1967 or 1973. Undoubtedly, however, a major contributing factor to past advances in knowledge has been research and development (R. & D.) outlays.

As a percentage of gross national product, R. & D. spending reached a peak in the mid-1960's during the high-water years of the NASA space effort. At that time R. & D. accounted for roughly 3 percent of GNP. Since 1966, however, R. & D. has undergone a slow decline until it now accounts for only about 2 percent of the Nation's spending. R. & D. spending by the private sector has grown steadily with GNP, but government-financed efforts have not.

The Composition of the Labor Force

Many investigators have pointed to the changing demographic nature of the Nation's work force as a major factor in the decline in productivity growth. During the post-1966 period there have been sharp increases in the labor force and in labor force participation rates, and the age-sex composition of these increases has been heavily weighted toward women and teenagers. In 1964, prime-age males (those 25–54) composed 46 percent of the labor force. For 1978, the figure was 36 percent. In part this has been due to the fact that persons born during the "baby boom" reached working age and entered the labor force. It also reflects the recent explosion in labor force participation by women.

Because they lack experience and have average education levels below the prime-age working groups, new entrants into the labor force are typically less productive than their more experienced counterparts. This is most apparent in the case of teenagers. In the case of women, barriers have existed into the more productive lines of work, irrespective of age, and women have also had relatively fewer opportunities for training.

Moreover, with the rapid growth of women and teenagers in the labor force, part-time employment has grown relative to full-time

employment. For this reason alone, then, measures of productivity change which focus on people working rather than the hours they work—such as nonresidential business income per person employed—will show much larger declines in productivity than indicators with more precise input measures in the denominator.[6]

In the future, the composition of net increments to the labor force is expected to have a positive efiect on productivity. Because of a large drop in the birth rate in the 1960's, relatively fewer youths will reach working age in the 1980's. It has been estimated that the population aged 16 to 24 will decline by a full 6 million people. At the same time, the number of persons 25–54—the years of peak productivity—will be increasing substantially. In addition, women are expected to gain incereasing access to training and more productive lines of work.

The Capital-Labor Ratio

An economy's capital-labor ratio is of substantial importance for achieving increases in productivity, regardless of the measure used. It is largely through new plant and equipment that more advanced technologies are introduced into the production process. Moreover, in the absence of increases in capital inputs, producers will experience diminishing marginal returns to each additional unit of labor employed. One of the most striking features of those countries which have achieved high levels of productivity has been the accompanying increases that have occurred in these countries' capital-labor ratios.

At the same time that the labor force in the United States has experienced an increase in its growth rate, the country's capital stock has grown at a somewhat reduced rate. From 1947 to 1973, the capital stock grew at an average annual rate of 4.0 percent. Since 1973, however, this average has been less than 2.5 percent. Net of depreciation, capital per employed person rose at an average annual rate of about 2.0 percent from 1948 to 1969, but fell to about 1.2 percent thereafter.

Returns to capital (profits, net interest, rental income, and depreciation) have represented about one-third of private sector income throughout most of the post-war period. According to growth theory, a 1 percent decline in the capital stock will then produce a one-third percent decline in the economy's overall growth rate. A 1.5 percent annual decline in capital stock would thus have produced a 0.5 percent annual decline in the Nation's overall growth rate.

As previously mentioned, the decline in the growth of labor productivity has exceeded that of measures which consider total factor input because of recent declines in the growth rate of the aggregate capital-labor ratio.

Economies of Scale

In many industries there is a range of output levels within which the average cost of producing a unit of output declines as output expands. At a particular point in time, however, the demand for output may be insufficient to justify output levels which would make it

[6] It is largely for this reason that productivity growth for the 1973–78 period was negative for this measure. See table 1.

possible for these "economies of scale" to be realized. One benefit of economic growth, then, is that over time, it may bring with it the requisite expansion of demand that lowers average costs of production. Put alternatively, output per unit of input may increase with the aggregate size of the economy. Thus, economies of scale can be seen as both a cause and an effect of productivity growth.

Energy Prices

While for many years, United States citizens enjoyed the availability of cheap sources of energy (largely because of public policy measures), 1973 brought an abrupt end to this situation. The quadrupling of the world price of crude oil by the OPEC cartel undoubtedly had a severe effect on the productivity of the economies of the world's industrialized nations.

Changes in relative prices may occur daily without tremendous strain to whole economies. But the magnitude of the energy price change, combined with the complementary nature of energy and capital, was a serious blow. The sharp hike in energy prices increased the obsolescence rate of much of the capital already invested. Plant and equipment intended to be used over a period of years suddenly became less profitable to use. Moreover, there were adjustment costs as businesses had to employ resources, first, to learn how to operate in the new energy environment, and second, to actually make the necessary adjustments in the structure of production. Moreover, while rapidly expanding demands can lead to economies of scale which increase productivity and offset the effect of rising energy prices, it is precisely those sectors with high energy usage that have been confronted with stagnant demands. Electric utilities are a case in point.

Environmental and Health-Safety Regulations

Over the past few years, government regulations have required that an increasing proportion of the labor and capital employed by business be devoted to the protection of employee health and safety and to pollution abatement. While such regulations may involve substantial benefits, their contribution to measured output—the marketed goods and services produced—is minimal. Capital spending as a percentage of gross national product, which has fallen to less than 9.5 percent from a peak of 11 percent in the mid-1960's, drops to no more than 8.7 percent if one considers the investments mandated by these regulations to be nonproductive.

Since 1967, there have been numerous regulations issued governing worker health and safety. The Occupational Safety and Health Act (OSHA) was perhaps the most noteworthy piece of legislation in this regard. Also to be considered are safety regulations with respect to motor vehicles and legislation to protect employee health and safety in coal, metal, and nonmetal mining. The increase in health and safety regulations in the mining industry has been particularly striking.

As for pollution control measures, these were certainly undertaken prior to the mid-1960's (the Water Pollution Control Act of 1948, the Air Pollution Control Act of 1955, and the Clean Air Act of 1963), but early legislation did not affect business costs the way subsequent

measures did. The measures undertaken in the more recent period include the Water Quality Act of 1965, the Motor Vehicle Air Pollution Control Act of 1965, and the Air Quality Act of 1967, the Clear Air Amendments of 1970, and numerous other amendments to these basic air and water pollution laws. State and local governments have also passed a variety of measures and have enforced existing provisions more strictly.

Finally, the effects of rising crime should be mentioned. The number and costs of criminal acts in the United States have caused an increased share of the Nation's resources to be devoted to protection against criminal acts instead of the production of measured output. Thefts of merchandise directly reduce measured output.

If it is indeed the case that adapting to these changes in regulations and criminal acts has caused inputs to be employed which make little contribution to measured output, then measured productivity has suffered on this account. Of course, if these changes have produced benefits which are not captured by conventional measures, then "true" output and, hence, productivity have actually been somewhat higher than the official statistics indicate.

Other Factors

There have been several other factors cited as possible causes of the slowdown in productivity growth. The possible disincentive effects of the percentage of incomes taken by taxes, the disruption of expectations brought about by rapidly changing rates of inflation, and negative attitudes toward work are just a few of the many items which might be mentioned. In general, however, the investigations which have been made to date have relegated a minor role to these factors. The factors we have discussed above are thought to have been among the more decisive.

IV. Studies Allocating Productivity Change Among Its Determinants

Studies of the decrease in productivity growth which have attempted to allocate the observed change among its determinants have, by and large, focused on the factors discussed in section III. There are two basic techniques employed in these studies. One approach is that employed by Denison in his important work on accounting for the sources of economic growth.[7] In it, separate estimates of the role of various determinants are made, often on the basis of rough, ad hoc analyses along with a good dose of judgment. Then the remaining, unaccounted for residual is assigned to a broad catch-all category. The second approach is a good bit more systematic. In it, the time series of productivity is observed and breaks in the series are identified using statistical analysis. Then, using a time series regression framework, the determinants of the breaks are statistically estimated and the contribution of each is measured.

Because the studies allocating productivity change among its determinants are numerous, only two will be described here. The first, an

[7] Denison (1974).

allocation study by Denison, characterizes the first approach. The second, by Siegel, is representative of the more satistical approach.

In his allocation study, Denison considers productivity in terms of nonresidential business income per person employed and estimates the contribution of various determinants to its growth during the 1948–69, 1969–73, and 1973–76 periods.[8] The central problem, of course, is to account for the slowdown in productivity growth during the latter two periods relative to the first period. Estimates for 1948–69 are taken from the author's "Accounting for United States Economic Growth, 1929–1969" with minor changes resulting from the measurement of output in 1972 prices instead of 1958 prices and from revisions in the data. The estimates for 1969–73 and 1973–76 are preliminary ones which the author has undertaken as part of an effort to update his earlier work.

Denison begins by adjusting his productivity data for what he terms "irregular factors"—weather, work stoppages, and cyclical factors. These factors are estimated to have had a trivial effect on productivity growth during 1948–69 and 1973–76, but they account for about half of the 1-percentage point difference in the growth rates for 1948–69 and 1969–73.

Changes in labor force characteristics are the first major set of factors to be considered. Given the author's productivity measure—which ignores changes in the hours worked by the labor force—hours worked is one obvious factor to consider in explaining the recent deceleration in productivity growth. This is found to have had a negative impact during all three of the periods under study, and this impact appears to have increased over time. The same can be said for changes in the labor force's age-sex composition. By way of contrast, education has had a consistent positive impact, and its effects also appear to have increased over time. Presumably, the health of the labor force has improved over time, but this factor is not considered as it is by others.

The amount of capital and land with which the labor force works is the next major category Denison examines. This, in comparison to other studies, is not estimated to have undergone much of a decline in its contribution to productivity growth. The reallocation of labor out of agriculture and out of self-employment appears to have had a more significant effect. This allocation appears to have made no contribution to productivity growth during 1973–76, whereas it made a 0.4 percentage-point-per-year contribution during 1948–69.

Changes in environmental and other regulations are also estimated to have played a significant role. While these regulations—or the absence thereof—are estimated to have had no impact on 1948–69 growth, by 1973–76 they are estimated to have caused an annual reduction of 0.4 percentage points.

Economies of scale arising from expanded markets are estimated to have made a smaller contribution in recent years than they did in the past. What is truly striking is that Denison is left with a huge residual factor which he labels "advances in knowledge and not elsewhere classified." This residual factor accounts for over half of 1948–69 productivity growth. For 1969–73, the figure of 1.6 percent (at an annual

[8] Denison (1979b).

rate) equals the measured rate of productivity growth for that period. And for 1973–76, the residual factor suddenly drops to −0.7, which is greater in absolute value than the −0.5 rate of productivity growth which occurred during these years.

Denison argues plausibly that, although advances in knowledge may have contributed less to recent growth, his study leaves unanswered the question as to why his final category shows such a sudden decline during the most recent period. Denison considers several alternative explanations. He dismisses some of them—e.g., "people don't want to work anymore"—on the grounds that they were also operative during high-productivity periods or have only operated gradually in comparison to the sharp downturn in productivity growth. Inflation is admitted to be a possible explanation, but Denison says he simply does not know how much of a factor it has been.

The sudden increase in energy prices is estimated to have only contributed 0.1–0.2 percentage points annually to the decline. But Denison's analysis does not consider the long-run (dynamic) effects of the energy problem. These involve plant adaptation costs required by the need for fuel substitution and the increased obsolescence of some plants and equipment attributable to energy price induced factor substitutions. Denison's estimate also ignores the enormous diversions of labor and capital to the redesign of products and the retooling for production of them when energy prices induce a switch in the pattern of consumer demand (e.g., from large to small, fuel-efficient cars).

Also troublesome are difficulties in capturing changes in technological advance. To some extent, technological change is embodied in physical capital, and its rate of change depends in part on the rate of change in the stock of physical capital. By the same token, Denison's estimate of the contribution of physical capital may be entangled with the contributions of technology and other factors which lower the real price of capital goods. In any case, inclusion of a variable to capture change in R. & D. spending might have been appropriate.

Clearly, Denison's study attributes a negative and—at least through 1975—increasing impact on productivity change to environmental and other regulations, but these regulations still appear to account for a relatively small portion of the slowdown in measured productivity growth. And more recent estimates done by Denison of the impact of environmental regulations attribute only a .08 percentage point decline to them for 1975–78.[9]

The second approach is illustrated by a recent article by Robin Siegel. In it, Siegel has attempted to identify statistically breaks in the trend of productivity growth and to account for the slowdown in trend.[10] Utilizing Chow tests, the author found significant breaks in both 1967 and 1973. In her statistical analysis, the change in the demographic composition of the labor force was a consistent contributor to the productivity slowdown. From 1973 on, however, changes in relative energy prices were found to be the single most important factor. Expenditures for pollution abatement control were a significant negative factor in the post-1967 slowdown, and continued to contribute to

[9] Denison (1979a).
[10] Siegel (1979).

the productivity slowdown until 1975. After 1975, these expenditures declined as a percentage of the gross national product.

Output per person-hour in the private nonfarm sector served as the dependent variable for Siegel's regressions. Regressing this on a time trend variable and the inverse of the GNP gap (in order to control for cyclical factors) produced a good fit for quarterly data covering most of the post-war period. But F-statistics on Chow tests were consistently high, with severe breaks in the productivity trend indicated for 1967 and 1973.

The goal of the analysis was thus to identify variables which could be added to the equation to produce a consistent time trend. The change in the composition of output away from manufactured goods and toward services is one obvious factor to be considered, but it was found that productivity in manufacturing had itself experienced a break in trend.

In any case, the share of manufacturing in total output was added as a variable. Also added were the percentage of prime-age males in the labor force, relative energy prices, pollution abatement expenditures as a percentage of GNP, the capital-labor ratio, and other variables. The capital-labor ratio was found to have had a significant, positive effect on productivity growth until 1973, but the ratio declined thereafter and made no contribution.

It is noteworthy that the addition of these variables still could not prevent F-statistics on Chow tests from being significant at the 5 percent level, but Siegel points out that they are "barely significant." Previously, they were highly significant even at the 1 percent level.

Thus, Siegel's analysis does account for a large portion of the productivity slowdown, but the sharpness of the decline and the breaks in trend remain unexplained. Siegel suggests looking at the age of the capital stock, certain government regulations, and changes in attitudes toward work. In addition to these variables, one should also employ variables to control for education and training expenditures, expenditures on research and development, and changes in scale economies. These variables have typically been included in other analyses. Of course, data for these variables may be difficult to obtain on a quarterly basis, but their inclusion is likely to alter the results. It would also be of interest to estimate the impact of the New Jobs Tax Credit, which went into effect at the end of 1976, and which encouraged the hiring of low-skilled workers.

Table 2 summarizes the results of the allocation studies we have been able to identify. Each of these studies seeks to account for the difference in productivity growth from a pre-1970's period to a 1970's period. The varying periods of comparison and varying definitions of productivity account for differences in the percentage points of the decrease in productivity growth which are being allocated (see the bottom row). Across all of the studies, 25 separate determinants of productivity growth are identified.

In the studies which identified cyclical and weather effects, these determinants generally played a noticeable role. The largest role was assigned by Kendrick, who estimated that cyclical changes accounted for 40 percent of change he was analyzing—0.6 out of 1.5. A somewhat more significant role was assigned to changes in the sectoral composi-

tion of output or the age-sex composition of the labor force. These factors have been allocated from 11 to 40 percent of the change, with the bulk of the estimates in the 20–30 percent range. The range of estimated effects due to changes in the capital stock is large. One of the analysts (Kendrick) assigns it a zero role, three assign it a 10–15 percent role, and two of the analysts (Siegel and Evans) attribute about one-third of the total decline to the decrease in the capital stock. Most of the researchers did not explicitly consider the role of energy prices, wrapping it into their "residual" category. However, those studies that did consider it allocated it a substantial role—up to one-third of the total decrease. For environmental and other regulations, the percentage point changes range from 0.4 (Denison) to 0.1–0.2. In no case are pollution abatement regulations assigned more than 20 percent of the responsibility for the decrease in productivity growth. The typical estimate of the role of environmental regulations is in the range of 5–15 percent.

TABLE 2.—CHANGE IN THE EFFECT OF VARIOUS FACTORS ON PRODUCTIVITY GROWTH

[Contribution in percentage points of various factors to the growth rate of productivity in recent years minus the contribution in past years (numbers in parentheses indicate the percentage of the change in productivity growth explained by the factor in question)]

Factor/author	Denison (1)[a]	Denison (2)[b]	Kendrick[c]	Siegel[d]	Kutscher, Mark[e] & Norsworthy	Mark[f]	Evans[g]	Clark[h]	Norsworthy, Harper[i] & Kunze
1. Labor market tightness				0.2 (11.1)					
2. Cyclical effects	0.2 (6.5)	−0.4 (−40)	−0.6 (−40)	−0.4 (−2.22)				−0.2 (−10.5)	
3. Weather, work stoppages									
4. Shifts from manufacturing to services.			−0.1 (−6.7)	0 (0)	0 to −0.1 (0 to −8.3).	0.1 to −0.1 (6.7 to −6.7).			
5. Shift from farm to nonfarm	−0.4 (−12.9)	−0.3 (−30)			−0.3 (−25)	−0.3 (−20)			−0.2 (−9.5).
6. Shift out of selfemployment			−0.1 (−6.7)						
7. Changes in hours worked	−0.3 (−9.7)	−0.1 (−10)							
8. Labor force composition	−0.1 (−3.2)	−0.3 (−30)	−0.3 (−20)	0.2 (11.1)	−0.2 to −0.3 (−16.6 to −25).	−0.2 to −0.3 (−13.3 to −20).	−0.5 (−33.3)	0.1 (5.3)	0 (0).
9. Education	0.4 (12.9)	0.2 (20)	0.2 (13.3)						
10. Health and vitality			0 (0)						
11. Nonresidential structures and equipment.	−0.1 (−3.2)	−0.1 (−10)		−0.6 (−33.3)	0 to −0.1 (0 to −8.3).	−0.2[k] (12.8)	−0.5 (−33.3)	−0.3 to −1.2 (−15.8 to −63.2).	−0.7 (−33.3).
12. Inventories	−0.1 (−3.2)	0 (0)							
13. Other capital									
14. Economies of scale	−0.2 (−6.5)	0 (0)	−0.2 (−13.3)						
15. Land	0 (0)	−0.1 (−10)	−0.1 (−6.7)						
16. Energy prices				−0.7 (−38.9)					
17. Pollution abatement	−0.4 (−12.9)	−0.2 (−20)		0 (0)	−0.1 to −0.2 (−8.3 to −16.6).		−0.3 (−20)		−0.1 (−4.8).
18. Other regulation									
19. Government services			−0.1 (−6.7)						
20. Taxes				0 (0)					
21. Expectations				−0.4 (22.2)					
22. Formal advances in knowledge.	−2.1 (−67.7)	0.2 (20)	−0.15 (−10)				−0.2 (−13.3)		−0.2 (−9.5).
23. Informal advances in knowledge.			0 (0)						
24. Diffusion of knowledge			−0.15 (−10)						−1.1(−52.4)
25. Residual factors			0.1 (6.7)		−0.2 to −0.9[k] (−16.6 to −50.)	−0.6 to −0.9[k] (−40 to −60)	−1.1(−52.4)	−0.6 to −1.6 (−31.6 to −84.2).	
Total change explained.	−3.1	−1 [l]	−1.5	−1.8 [l]	−1.2	−1.5	−1.5	−1.9 [l]	−2.1.

[a] Compares nonresidential business income per employed person in 1973–76 versus 1948–69.
[b] Compares nonresidential business income per employed person in 1969–73 versus 1948–69.
[c] Compares private sector output per total factor input in 1976–76 versus 1948–66.
[d] Compares private nonfarm output per person-hour in 1973–78 versus 1955–65.
[e] Compares private output per person-hour in 1966–77 versus 1947–66.
[f] Compares private output per person-hour in 1966–77 versus 1947–66.
[g] Compares private nonfarm output per person-hour in 1968–77 versus 1947–68.
[h] Compares 1973–77 versus 1966–73 and is emphasized as a tentative estimate.
[i] Compares private nonfarm output per person-hour in 1973: II–1976: IV versus 1955: IV–1965: II.
[j] Compares private output per person-hour in 1973–78 versus 1948–65.
[k] The portion of the decline in productivity growth not accounted for by the authors was assigned to the "residuals factors" category.
[l] The sum of the component parts does not equal the total because of rounding errors.

Sources: Denison (1979b), Kendrick (1978), Siegel (1979), Kutscher, Mark, and Norsworthy (1977), Mark (1978), Evans (1978), Clark (1978), and Norsworthy, Harper, and Kunze (1979).

V. Productivity Growth, Environmental Regulations, and Economic Welfare

Our survey of the studies which have investigated the causes of the post-1965 slowdown in productivity growth has produced no real consensus on the relative magnitudes of the contribution of the factors studied. The changing demographic composition of the labor force and hours worked together with sectoral shifts seems to receive substantial weight in most estimates, accounting for between 20 to 30 percent of the observed slowdown. Not unrelated to this is the slowdown in the rate of capital investment, resulting in a declining capital-labor ratio and a capital stock which embodies a technology which increasingly deviates from what is possible. Studies attribute about 20–30 percent of the slowdown to these factors as well. The third important factor appears to be cyclical—for much of the late 1960's and the 1970's the economy has shown many characteristics of a quasi-permanent recession. High unemployment and low utilization of the capital stock has persisted. These factors together with weather and work stoppages account for another 20–30 percent of the productivity slowdown.

If this characterization is correct, between 10 and 40 pecent of the slowdown is to be allocated to the large number of other determinants, of which environmental regulations are one. It seems clear that these regulations cannot escape some of the blame. However, little evidence exists to suggest that as much as 15–20 percent of the contribution to the slowdown can be attributed to them. This is based in part on the results of macroeconometric model estimates such as those of Data Resources (1979) which emphasize that until now environmental regulations have had both productivity increasing and productivity reducing effects which largely offset each other. A reasonable estimate, then, would attribute, say, 8–12 percent of the aggregate slowdown in productivity growth to these regulations.

In arriving at this estimate, which is somewhat lower than that of some other observers, several points should be made. First, our estimate is of the effect of only environmental regulations, and not public regulations in total. In addition to rules for residuals emissions, government has imposed mandates in a large number of other areas during the last decade—occupational health and safety, energy usage, new product introduction, plant location, transportation, and forest management are all examples. Clearly, the total impact of these measures is in excess of that for pollution control regulations themselves.

Second, studies which have attributed substantially productivity effects to environmental regulations have often done so in a framework which omits the potential effects of numerous other factors. In our view, the role assigned to the economic dislocations caused by the unprecedented rise in energy prices has been far too small in many of these analyses. Not only does the energy price rise induce a reduction in energy use per unit of output, but it also requires increases in other factors—labor, capital, and land—simply to maintain a constant level of output. These latter inputs are included in the denominator of the standard productivity change indicators.

Still other factors should also be mentioned. The uncertainties introduced and operating adjustments required by periods of double-

digit inflation are additional independent factors in any full appraisal of the causes of the productivity slowdown. These have been emphasized recently by Malkiel (Malkiel, 1979). Similarly, the last decade has also seen an unprecedented rise in employment and total labor force participation, even though the unemployment rate has not fallen substantially. Increments to employment of this magnitude are bound to encounter diminishing marginal productivities, which diminutions will be reflected in measured aggregate labor productivity. Indeed, the same periods in which productivity growth has decreased have seen policies subsidizing incremental private sector employment. Because such policies induce the hiring of workers whose productivity is below market wage rates, the fall in measured productivity may actually signal the success of these programs (Bishop and Haveman, 1979). All of these factors have been given too little weight.

Third, it is quite possible that some portion of the observed decline in labor productivity growth reflects a measurement problem. In a period of rapid product price increases, aggregate time-series statistics on changes in labor inputs may be more reliable than those for changes in real output. Estimates of the latter variable over time must be based on deflations using composite price indices which may contain substantial distortions in a period with rapid relative price shifts.

Our bottom line estimate, we would note, accounts for both the direct and the indirect effects of environmental regulations. As a result, whatever effects environmental regulations have on capital investment and the capital-labor ratio are included in the estimate assigned to the regulations. In this vein, the evidence on the adverse impact of environmental regulations on the capital stock and its productivity appears very weak.[11] Environmental regulations—for example, those affecting the copper industry—can have major adverse output and productivity impacts on certain sectors or industries. These impacts tend to be localized, however, and because of the small size of these sectors relative to the national economy, they appear to have a rather trivial impact on macroeconomic performance.

One basic and overriding point should be made with respect to environmental regulations. The contributions to economic welfare which they are intended to make are, by and large, not reflected in marketed or measured output. These effects include improved health (implying less demand for medical care services), longer lives, expanded outdoor recreation opportunities, greater enjoyment of existing recreation opportunities, and reduced demands for cleaning and other "defensive" activities. Were the standard productivity measures effective indicators of economic welfare, these outputs would be included in the numerator of the measure. Although they are difficult to quantify, let alone value, numerous studies have indicated that market increases in these outputs have resulted from environmental policy. The few benefit-cost analyses which have been made of them suggest benefit-cost ratios in excess of one.[12] If this is in fact the case, the effect of these regulations on "true" productivity would be positive and not negative, and the inclusion of the outputs of these regulations in the numerator of standard productivity measures would both offset

[11] See Christainsen, Gollop, and Haveman (1980).
[12] See, for example, Lave and Seskin (1977), Chapter 10, and Freeman (1979).

the negative effects of other factors on productivity growth and change the sign of the effect attributed to environmental regulations. Given that it is a reliable measure of "true" productivity which is desired, it is essential that additional benefit-cost analyses of environmental and other regulations be undertaken.

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THE U.S. ECONOMY AND PRODUCTIVITY: WHERE DO WE GO FROM HERE?

By C. Jackson Grayson, Jr.*

CONTENTS

The objective of this paper is to provide an analysis of the U.S. economy in a context of productivity dynamics. It discusses the nature of our current productivity crisis and how we got there; and provides some comments on both where we might go and where we should go.

I. Where Are We?

Starkly stated:

We are in a national economic crisis which threatens not only the future standard of living of our children, but also our very survival as a leading world power. There are policy options available to us; but time is very short. Economic historians might be able to identify a period of economic disturbance comparable to the decade of the 1970's—where a slowdown in the initial year was followed by two sharp recessions in a 10-year span—but it is doubtful. In any event, it has become clear that economic policies which appeared somewhat successful in the past several decades are no longer viable. Our national economy and the confidence of our populace have been shaken deeply.

The economic crisis is manifested most visibly in our incredibly high rates of inflation and unemployment.

1. The United States has the highest peacetime "core" rate of inflation in our national history. It has been steadily rising all through the 1970's to levels that were unheard of, unacceptable, and unthinkable years ago. And, unless something is done, it shows little sign of subsidence in the 1980's.

The severity of the inflationary cycle which has afflicted the nation during the past decade is clearly reflected in the figures shown below. During the 16 years, 1951–67, the CPI had not risen more than 3 percent in any single year and reached that modest level only twice (in 1957 and 1967). The pace accelerated during 1967–73, to an aver-

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age annual rate of 4.9 percent. Then it took off, with a 73–77 rate of 8.1 percent; 77–78, 9.0 percent; 78–79, 13.3 percent; and for the first 6 months of 1980, an average annual rate of 15.3 percent, with a peak rate of 18.1 percent in March.

The rates for 1979 and for the first half of 1980 thus exceeded even the extreme inflation rate recorded in calendar 1974 (12.2 percent). The following computations reflect not only the Consumer Price Index, but also the Producer Price Index, the GNP Implicit Price and Personal Consumption deflators:

Indicator	Average annual percent of change			
	67 to 73	73 to 77	77 to 78	78 to 79
Producer price index	[1] 4.2	[1] 9.0	[2] 9.2	[2] 12.5
GNP price deflator [1]	5.0	7.6	7.3	8.8
Consumer price index	[1] 4.9	[1] 8.1	[2] 9.0	[2] 13.3
Personal consumption deflator [1]	4.4	7.4	6.8	8.9

[1] Change from preceding period, computed from yearly indexes.
[2] Annual change from December to December.

Sources: Earlier-year data: 1980 Economic Report of President. Current data: Economic Indicators, July 1980.

2. The average unemployment rate for the decade of the 70's was over 6 percent, peaking at 8.5 percent in 1975—the highest since the Great Depression of the 1930's. This experience contrasts sharply with the picture of the two prior decades: in the 1950's, the average unemployment rate was 4.5 percent, and in the 1960's, 4.8 percent.

As the recession has taken hold in the first half of 1980, the unemployment rate has leaped to nearly 8 percent and may top the 8.5 percent level recorded in the depths of the 74–75 recession, far above the level in any other year since the Great Depression.

3. While high inflation and unemployment rates dominate the news, there is another economic factor—our productivity decline—which is probably of greater long range danger to the United States than the other two.

4. There has been a collapse in productivity growth which began in the mid-60's and accelerated rapidly after the 1973 oil shock. The growth slowdown transmuted into a decline after 1978. The extent of the collapse after 1965 appears in sharp focus in the following figures:

U.S. PRIVATE BUSINESS ECONOMY

Productivity measure	Average annual productivity growth rate				
	1948–65	1965–73	1973–78	1978–79	1979–80 (1st half)
Total factor	3.0	2.1	0.5r	−0.9	−2.3
Labor [1]	3.6	2.7	.3r	−1.4	−1.1
Capital [2]	1.2	.8	.9	.1	−3.4

[1] Output per hour.
[2] Output per unit of capital input.

Source: American Productivity Center, "Total Factor Productivity Indexes," Houston, Tex., August 1980

All current indications are that the present recessionary phase of the business cycle will persist through the remainder of calendar 1980, with only slight recovery in national output and employment

likely in calendar 1981. This business cycle performance is likely to generate a continuing stultification in productivity performance, as low utilization of plant capacity, coupled with high, fixed indirect labor and capital inputs, yields low ratios of output per unit of input.

4. Directly related to our productivity stagnation is an alarming decline in the competitiveness of the United States in the international markets. For many years, the United States has been the world's leading exporter of manufactured products. However, West Germany has topped our annual totals throughout the decade of the 1970's. Germany's lead was only a narrow $1.4 billion in 1970, but had risen to $33.9 billion in 1979, a percentage differential of only 0.5 percent in 1970, but 22 percent in 1979. Japan's export value in 1970 was 62 percent of the U.S. level, but had risen to 85 percent in 1979. If current trends continue, the United States will soon become No. 3 in the manufactured goods export market. For France, with a 1970 manufactured export volume only 46 percent of that of the United States, the 1979 exports had risen to 65 percent of the U.S. level:

EXPORTS OF MANUFACTURED GOODS

[Value in billions of U.S. dollars]

Period	United States	France	Federal Republic of Germany	Italy	Nether-lands	United Kingdom	Japan	Canada
1970	29.3	13.5	30.7	11.1	6.8	16.6	18.1	9.7
1975	71.0	39.6	79.6	29.2	19.4	37.0	53.2	16.7
1976	77.2	42.5	90.7	31.3	22.3	39.0	64.6	20.6
1977	80.2	48.7	104.3	38.1	23.9	47.4	77.7	23.1
1978	94.5	58.8	125.2	47.6	27.8	57.6	94.2	27.1
1979	116.7	75.6	150.6	49.0E	34.5	70.2	99.1	30.2

These startling gains by key European nations and by Japan developed despite rapid gains in labor costs for these nations, as compared to the United States. (The 1960–79 annual increase in hourly compensation was 6.5 percent for the U.S., 15.3 percent for Japan, 10.4 percent for Germany, 15.7 percent for Italy, and 11.5 percent for France.) The gains were clearly due not to a great labor cost advantage, but rather to their more rapidly rising productivity, coupled with effective industry-government collaboration for export promotion.

Increasingly, effective competition in the world marketplace for manufactured goods also has been mounted by the smaller but rapidly developing East Asian nations, including Korea, the Republic of China, Hong Kong, and Singapore, which still enjoy relatively low wage rates.

5. As U.S. industry has struggled against these complex difficulties, growing losses in many industries have led to a decline—almost a collapse—in a number of them, such as cutlery and flatware, ceramics and dinnerware, motorcycles, bicycles, footwear, hats, radios, televisions and some textiles. Of perhaps even more long-run significance, inroads have been made on both the domestic and the international markets in some of our largest and most basic industries—such as steel, machine tools, industrial equipment, household electric appliances and automobiles.

The impact of these market losses upon U.S. civilian employment has been noted increasingly in the U.S. news media. As the international productivity differential continues or increases still further, other U.S. basic industries appear likely to suffer increasing market and employment losses.

II. How Did We Get Here?

What happened after 1965, and especially after 1973, to plunge us into this dismal and extremely dangerous situation?

Our current situation did not "happen all at once." It is the result of events occurring over a period of a good many years after the termination of World War II, but with a rapid build-up following 1965.

During the two decades after World War II, the U.S. economy continued to grow, not as rapidly as other leading industrial nations, but at a healthy clip (figures 1, 2, and 3). But seeds were being sown for a slowdown. Most of our industry had become industrially mature, with only a limited potential for continuing rapid productivity gains in some industries. Our earlier youthful zing and dedication to continuing rapid industrial improvement slackened. Leaders of both the Government and the private sector tended to rest on past laurels, convinced that U.S. technical, scientific and managerial leadership could not be challenged.

Concurrently, large segments of the population demanded larger slices of the economic pie, coupled with broadened assurances of "the good life." The euphoria of a continually growing economy, higher earnings and more leisure time to enjoy them, bigger bank accounts, bigger cars, better roads, larger homes, and continually rising profits lulled both the population and the leaders of the Government, labor, and industry into a false sense of security. Danger signals in the economic picture were scoffed at or overlooked.

Without realizing it, we fell increasingly behind our leading overseas competitors in productivity growth and international trade competition during the 1950's and 1960's. By the mid-1960's, the United States was already in economic trouble, especially in terms of international competition.

While it was certainly not generally understood as it was happening, "hindsight" now tells us the nation was then beginning to reap an economic problem stemming not only from our national over-complacency and our conviction that we were the strongest and greatest nation in the world, but also from:

1. A national tendency to consume rather than to save, resulting in a national average ratio of savings to disposable personal income below that of any other major industrial nation—less than one-fourth the averages for Italy and Japan; only one-third that of France, Germany and the United Kingdom; and less than half that of Canada (figure 4).

2. A tendency on the part of too many business leaders to think and act on a short-term basis, at the expense of future productivity capability. Too often, earnings have been disbursed as dividends which should have been reserved for plant modernization. Marketing strate-

gies, too often, have been directed to immediate, large payoff, while little planning has been devoted to future market potentials.

3. Adversary relationships between management and labor have made difficult the achievement of productivity-enhancing technological change. Distrust and antagonism have also tended to choke off potential labor-management cooperation in identifying both large and small ways to improve productive efficiency on a day-to-day basis, with an accompanying reduction in worker morale and quality of work life.

4. Greatly expanded health services, industrial safety, environmental protection, and economic security for all the nation's citizens, that have not been accompanied by adequate evaluation of their effects. While these actions are socially desirable, they have not contributed to productivity as conventionally measured. Edward Denison has estimated that expenditures for many of the socially beneficial services (together with costs of crime prevention) lowered the nation's productivity growth rate by a full 0.5 percent per year by 1975.

Additionally, the manner in which regulations have been applied has often magnified their economic costs, without corresponding benefits (figure 10).

5. Efforts to serve as the world's economic savior and its political policeman, efforts which involved the expenditure of many billions of dollars; and reached nearly 80 nations. This program included a substantial transfer to other nations of the best of U.S. scientific, managerial and industrial know-how and techniques, use of U.S. patented processes and technology on extremely favorable terms, and help in starting up the host-country factories.

6. A growing neglect of the investment of capital needed for improved plant and equipment. As a result, the nation has fallen increasingly behind its major industrial competitors. During the quarter-century after World War II, roughly one-third of Japan's growing national product flowed directly into new machinery and equipment in its factories. For Germany, France and Italy, fixed capital investment ranged from one-fifth to one-fourth their GNP during the same period. In sharp contrast, U.S. industrial investment was dead last among all major industrial nations, with a capital to GNP ratio only roughly half that of Japan (figures 4 and 5).

As a result, many of our competitors have maintained an average age of industrial equipment ranging from roughly 10 to 12 or 14 years. In the United States, in sharp contrast, estimated average age of industrial equipment is now over 20 years. For some major, mature industries (steel, paper and pulp, foundries and forge shops) much of the equipment is 50 or more years old. With rare exceptions, such aging machinery cannot compete in productivity with newer items utilizing the latest technology. Good examples are the large basic oxygen furnaces which constitute over 80 percent of Japan's total steel capacity—and roughly 56 percent of that of the U.S. industry.

7. An energy crisis which has been growing for years. The crude petroleum embargo and the subsequent price escalation dramatized an already-existing world shortage of proved economically exploitable natural energy resources. The supply-price shock disrupted normal productive operations; forced radical reevaluations of ways of doing business; and affected productivity in ways that are not yet fully understood.

It is increasingly obvious that the revolution in energy prices and the absolute and increasing shortages of energy supply is causing a substitution of labor for capital and energy, with a direct, adverse impact on productivity.

According to Edward Denison's calculations, nearly three-fourths of the shortfall in average productivity growth between 1948–73 and 1973–76 was due to a negative "contribution" of "advances in knowledge and miscellaneous determinants." [1]

Dale Jorgenson and Shirley Burggraf identify the energy crisis as the primary contributor to this shortfall.[2] Included in the problems are:

Major energy-saving changes and adjustments in the operating divisions of key industries;

Sudden obsolescence of about 2.5 percent of the machinery in the top 10 industrial nations, as the most energy-intensive equipment had to be overhauled, withdrawn from operation, or replaced;

Product design and production method changes;

Increasing labor-for-energy tradeoffs, involving modifications in both production techniques and product specifications, and cancelling out the planned introduction of new high technology but energy-intensive machinery and equipment.

8. Determined national efforts of our international competitors to expand their economy through exports. The outstanding examples most frequently cited are Japan, West Germany and France—and to a somewhat lesser extent, Canada. Others, not so well-known but of increasing importance are Korea, Taiwan, Hong Kong, Singapore, Belgium, and Denmark.

All have demonstrated a high degree of competitive ability in the international market. All of them have achieved high productivity growth rates.

In all instances, the governments of these nations have devoted continuing support for sound industrialization, with emphasis upon high-technology products and those with the highest export potential. These governments have assisted private industry export efforts with substantial low-interest loans and credit guarantees, tax credits, differential domestic versus export pricing and other actions.

9. Sluggish R&D growth in the U.S. characterized the past decade, with a drop from a 1965 high of 3 percent of GNP to 2.2 percent in 1978 and 1979. During the same period, R&D–GNP ratios have been rising substantially in Japan, France, and Germany, our most vigorous international trade competitors (figures 6 and 7). Further, a large portion of U.S. R&D has been devoted to defense and space research, in contrast to Japan and some European nations which have concentrated primarily on industrial R&D.

Most experts on economic growth and productivity agree that expenditures for research and development make a significant contribution to productivity growth. The relationship has been described thus: R&D, innovation and productivity growth constitute a closed

[1] Edward F. Denison, "Accounting for Slower Economic Growth: The United States in the 1970's." Brookings, 1979.

[2] Shirley Burggraf, "The Case of the Missing Productivity." U.S. Dept. of Commerce, Economic Research Division. Occasional Paper, January 1980.

loop: without innovation, productivity growth is unlikely to occur; without productivity growth, capital necessary to spur further innovation and improve producing equipment is difficult to assemble.

10. There has been a slow diffusion within the nation of "best practice" productivity. The existing variations in levels of productivity as between individual plants with any industry is not generally noted, due at least in part to the paucity of adequate data covering recent years. This is the specific area, however, where substantial increases in productivity may be achieved most rapidly, through the accelerated diffusion of "best practice". The extent of the productivity differential in various industries is highly evident in presentations made in figures 8 and 9.

III. What Can We Do About Our Economic Crisis? Where Do We Go From Here?

The Nation has various options as to what to do about our current economic crisis. Currently, top officials of the federal government, Congress, industry and academia are suggesting different approaches to its solution.

One way is to follow traditional paths, and set up more commissions or "study groups to identify the specific problems and establish sound plans for action." Another is to keep discussing the problem in substantial depth, in the hope that in due course it will correct itself. And one used in recent years is to increase government involvement in the functioning of the economy, trying more vigorously to "fine tune" it—an approach which in the past appeared at times to work satisfactorily. But, our experience today says these will not solve the problem.

The United States has arrived now at a point where further delay in action or continued application of traditional fine tuning of fiscal and monetary policies jeopardizes our economic future. We MUST undertake corrective action—action which is carefully organized, broad in scope, and continuing. And, it must also be taken at the earliest possible date.

This means that we must move away from almost singular attention on a "demand focus" and balance it with a focus on that most fundamental cornerstone of a nation's economy—a strong productivity growth.

And, it must not focus on one aspect of productivity improvement only, but be a broad program executed by both the private and public sectors—and at all levels. What is needed is a "National Productivity Program."

A National Productivity Program, involving the dedicated efforts of both the private and public sectors, must be launched. It must operate on four levels:

1. Government—Federal, State, and local.
2. Industry.
3. Individual firms.
4. International.

Government

1. Establish a focal point in the executive branch for a national productivity program, charged with the responsibility for creating and implementing an action program.

2. Charge the Joint Economic Committee of Congress with responsibility for serving as a productivity focal point in the legislative branch, with responsibility for conducting investigations and overseeing needed productivity improving legislation.

3. Execute legislative and administrative action to increase capital investment for improved industrial machinery, equipment and methods, all of which are essential for restoration of productivity growth. This should include specific action to: accelerate depreciation allowances on capital equipment, increase the investment tax credit and expand its coverage, reduce the corporate income tax rate, eliminate double taxation of dividends, assure rapid reductions in the rate of interest on industrial fixed capital investment, and stimulate the rate of private savings.

4. Remove contradictory and ill-conceived regulatory actions currently impacting productivity, including those relating to energy conservation, environmental protection and worker health and safety. Require all regulatory action (existing and future) to be subjected to "productivity impact" analysis. Equally, make certain that regulations outline the desired results, with flexibility to assure that conformance is based on the most efficient, least costly approaches. This does not mean that all regulations should be dropped or altered. Some regulations are economically and socially justified, and need not be altered.

5. Expand rapidly both basic and applied research and disseminate the results—an essential for the accelerated technological improvements required for restoration of productivity growth.

6. The Department of Commerce should carry out, in collaboration with private industry, a systematic program of export promotion and marketing.

7. Through all appropriate means, take action to improve the productivity of the federal government itself, and provide assistance to state and local governments.

Industry

1. Encourage the development of industry-wide productivity improvement programs, including government, business, trade associations, labor unions, professional societies, management consultants and academia.

2. Help develop inter-firm and inter-plant productivity measurement systems, and stimulate and facilitate the use of the results by individual firms in the industry.

3. Help industrial associations and/or other relevant entities to establish programs for the collection and dissemination of "best practices" of individual industries.

4. Encourage and support classroom-type and in-plant training of personnel in the skills and techniques needed for a high productivity economy.

5. Assist in the establishment of labor/management cooperation programs suited to the needs of specific industries. Test various approaches, and transfer know-how on both a regional/local and in-plant basis.

6. Assist employers in industries with fading productivity to re-train themselves for new jobs, provide relocation assistance, and help protect the incomes during these adjustment periods.

Individual Firms

1. Organize and operate formal, sustained productivity programs, involving management and employees.

2. Create local productivity educational programs, broadcasting the productivity message to other firms, to community groups, and to government employees.

3. Organize and conduct training programs for unskilled, semi-skilled, crafts and supervisory categories to assure a supply of personnel competent to cope with the demands of modern high-technology industry. In particular, create re-training and other employee-adjustment programs for those displaced by productivity-improvement actions.

4. Organize "quality of working life" programs as an integral part of productivity improvement programs.

5. As a part of programs for improving productivity, analyze productivity patterns and seek out specific means for entering or expanding existing participation in export markets. To this end, actively seek out and utilize available government support services relating to export promotion.

International

1. Seek out specific opportunities for closer contacts with productivity centers in other nations. An international productivity information network might be a possibility.

The organization of international productivity tours would be a logical element in this program, targeting exchanges with those nations identified as of particular importance, such as Japan, France, Italy, the United Kingdom and Germany in the developed nations group, plus developing countries such as Mexico, Brazil, Spain and Korea.

2. Identify and participate in programs for the extension and improvement of existing measurement systems for productivity at both the macro and micro levels.

3. Develop specific programs for providing developing nations with broadening information on U.S. products, processes and management concepts. Provide them, upon request, specific technical assistance in identifying opportunities for local industrial development to improve standards of living, and help them make contact with U.S. international companies and other U.S. organizations which are interested in participating in such ventures.

IV. What Do We Need To Know About Productivity?

The American Productivity Center (APC) held a Conference on Productivity Research in April 1980 to identify the priority needs in productivity research. Over 50 papers were presented and discussed before an audience of 350 researchers and users of productivity research.

Among the most basic and urgent research needs identified at the Conference were:

A. National

1. PRODUCTIVITY DECLINE

a. Reduce the size of "residual" (unexplained portion of decline) especially 1973–79.

The largest part of the "residual" is assigned to increase in knowledge and technological advance. Variables should be tested for their association with these factors. Regional and industry studies should be undertaken to corroborate the knowledge-technological advance hypothesis.

b. Establish the role of energy price changes and the process through which they affect productivity.

A review of the studies done on energy-productivity relationships should be undertaken to compare methodology and findings. The linkage to productivity and the means through which energy prices exert their effects must be better understood.

2. GOVERNMENT REGULATIONS

a. Establish the direct and indirect impact of government regulation on productivity.

Studies have estimated the productivity effects of regulation operating through increased costs, displacement of productivity improving expenditures by firms and related variables. These "direct" effects should be reaffirmed and "indirect" effects investigated, such as encouragement of a defensive posture by firms and diversion of resources to non-productive purposes.

b. Identify the productivity impact by regulatory objective, measuring benefits in relation to costs.

A methodology should be created to measure the productivity impacts of regulations by looking at the benefits and costs of regulatory objectives such as pollution abatement, industry stabilization, antitrust and occupational health and safety.

3. ECONOMIC POLICIES

a. The role of federal taxation and investment incentives in promoting productivity growth.

A comprehensive review should be made of the Federal Revenue Code to identify the productivity effects of various provisions affecting business savings, investment incentives, tax rate structure and other similar factors. Comparisons should be made with major trading competitors of the United States.

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b. Analyze the effects of government policies on private sector research and development.

A review should be conducted of the factors bearing upon private sector R&D, emphasizing the effects of government policies—including government funding levels for R&D. Alternative policies should be evaluated to stimulate private sector R&D.

4. MEASUREMENT

a. Multiple input measures which include labor, capital, materials, and energy, are needed for the private domestic business economy, for major sectors, and for individual industries.

At present, national statistics are for "labor" productivity only and it would be helpful if all inputs were explicitly included.

b. Improvement is needed in the reliability of input and output measures in existing productivity series. The Bureau of Labor Statistics (BLS) is currently planning the conduct of further research on the improvement of aggregate hours input series for its program, involving weighting to reflect varying degrees of capability, etc., of the work force. Further research will also be required.

Substantial improvement is needed in reliability and coverage of existing productivity measures for major non-manufacturing industry sectors, including construction, transportation, and the service industries.

c. Improved service industry and information worker productivity measures.

Information workers account for half the labor force and more than half the labor compensation costs. Measures of productivity for these workers are urgently needed. The concept of productivity must be adapted to the kinds of output produced by information workers and measures developed for use by a wide range of organizations.

B. Industry

1. INDUSTRY STUDIES

a. Regulatory impacts by industry:

Regulation has historically affected only those industries such as railroad transportation, that were deemed to be in the public interest. The regulatory process has, in recent years, moved to embrace nearly all industries. Some, such as coal mining, have suffered substantial declines in productivity due to imposed safety and health requirements. The degree of effect among industries varies and a determination should be made of relative effects in a sample of manufacturing and non-manufacturing industries.

b. Comparison of regulated to non-regulated industries.

Regulated and non-regulated industries should be studied in a comparative framework, keeping as many factors controlled as possible, to determine differential effects upon productivity.

c. Technological transfer and diffusion, differences across industries and within industries.

Review the process of technological diffusion and transfer. Examine industry data and test for differences across industries and within industries.

2. INTERFIRM COMPARISON

a. Development of standard data requirements, and a model for inter-firm comparisons.

A "model" data set (input and output formats) for inter-firm productivity comparisons should be specified and groups of firms in an industry encouraged to adopt it. The data set should include price indexes, conventions about output definition, and related plant characteristic information.

Such measures are needed so that managers in various firms can compare the productivity of their operations with those of others. Similarly, it would be useful to have measures among industries on a comparable basis.

b. Programs are needed to accelerate the diffusions of "best practice" among establishments, firms, and industries. Past studies have identified the existence of major productivity differences (in both levels and trends) among units within any industry—even those with the same characteristics (see, for example, figures 8 and 9).

A parallel effort should involve the development of effective ways to tap "best practice" developed in other nations, a "reverse flow" of know-how on innovation and sound adaptation to capitalize on the accumulated experience of both East Asian and European nations.

C. Firm

1. MEASUREMENT

a. Individual firm measurement systems need great improvement. Currently, only a limited number of companies carry forward any type of productivity measurement. Even for those which do, the measure is often either too general (corporate level, or even total plant level), or only a single input measure, such as labor productivity, is used.

For most effective use as a management tool, productivity analysis should relate to the lowest level in the firm for which decisions are made about productivity. This may be different for different firms.

Measurement systems are needed which relate physical productivity to input and output cost and pricing data so that physical and financial systems are tied together. With such systems, managers can pinpoint problem areas to identify whether physical productivity improvement is being accompanied by proper pricing and input cost decisions to increase profitability.

b. Inter-establishment productivity comparison systems are needed for those firms operating a number of different establishments in the same industry (chemicals and banks, for example). They can gain a great deal from the conduct of productivity comparisons among the various units.

c. Adaptation of accounting and managerial control systems to productivity analysis.

Cost accounting and productivity analysis are closely allied crafts. Study of the relationships offers the possibility to develop productivity measures with adaptations of cost accounting data.

Also, rarely is productivity analysis of specific part of the managerial planning and control process in most organizations. Design of a comprehensive planning and control system to include productivity analysis would help meet this need.

2. IMPROVEMENT

a. Identification of leverage points for productivity improvement.

Case studies, models of the firm, and organization interviews should be employed to identify the leverage points (activities, functions, conditions) that promise the most significant increase in productivity.

Information systems and models specifying the relationships among the variables should be developed. In particular, analytical tools must be developed to estimate the effects upon productivity of rapid changes in input prices. Studies should investigate ways to increase organization adaptability to rapid price changes.

b. Criteria for effective employment of incentives and gainsharing.

Guidelines should be constructed to indicate conditions necessary for successful adoption of incentive and gainsharing programs. Case studies should be reviewed and a sample of firms using the program surveyed.

c. Diagnostic instruments for productivity analysis—social and technical systems.

Diagnostic instruments are needed to probe attitudes and behavioral responses in work situations. Among subjects of interest are responses to supervision, co-worker relationships, compensation, working conditions, participation in decisions about work, appropriateness of the work site, adequacy of technological support, networks of employee interaction.

d. Critical variables involved in establishing of cooperative (joint-effort) productivity programs.

e. Information technology will impose changes not customary among managerial, professional and technical workers. Means of easing the introduction of these requirements must be identified and a program of preparation developed for use by organizations contemplating introduction of office system technology.

3. ADJUSTMENT

a. Adjustment policies for rapid productivity increase and decline.

Organizations face conditions of operation that may vary beyond the ranges expected in former years. Unusual changes in productivity may require different policies with respect to supervision, personnel training, and relocation. Guidelines to such adjustment policies should be developed based upon successful practices implemented by representative companies, new concepts, and logical extension of existing policies.

b. Factors affecting adaptability of an organization to change.

An operating environment that is increasingly subject to change places a premium on the ability of an organization to adapt effectively and accomplish its objectives. Adaptability is frequently mentioned as the most important characteristic of an organization. Factors that are associated with adaptability should be identified and means to foster adaptability developed.

D. International

1. MEASURES

a. Improvement of international productivity measures is needed (both levels and trends). Existing measures of productivity compar-

ing various industrial nations leave a great deal to be desired, in both coverage and quality. The BLS publishes, on an annual basis, manufacturing industry trend indexes for the top eleven industrial nations. Occasional studies are published by the OECD, by Angus Maddison, and by other individual researchers. None, however, provides on a current basis guidance on relative levels and trends both for entire economies and individual sectors.

b. International comparison of enterprises in the same industry.

Comparisons across national boundaries of productivity measures for enterprises conducting similar operations would provide information on the range of productivity achievement. A methodology needs to be created to obtain comparable data and to create valid comparisons, allowing for differences in currencies, operating systems, and product quality and mix.

2. OTHER

a. Comparison of economic policies undertaken by the U.S. and major trading competitor countries.

A common set of problems has afflicted the major industrial countries during the decade of the 1970's—rising energy costs, inflation, technological competition, rise of a post-industrial society, pressure for expanded social services, etc. Countries have met these problems with different degrees of success through different policy choices. Policy effectiveness of the U.S. and its major trading rivals should be studied and comparisons made.

b. Government-business relationships.

A description and analysis of government-business relationships in other nations is needed to determine patterns associated with productivity growth. Cultural and institutional factors should be studied to analyze the desirability and feasibility of adopting them in the U.S.

c. Effects of government policies upon U.S. international competitiveness.

The basic elements in a coordinated national policy commitment to productivity growth should be identified and major policy provisions designated. Policy areas should include natural resource management, labor/management relations, taxation and expenditure, antitrust enforcement, and education.

There are hundreds of research topics relating to economic and productivity growth that need to be done. The above seemed, to participants in the American Productivity Center Conference on Productivity Research, to be among the most pressing and to promise the greatest rewards.

V. What Happens If We Don't Act?

A continuation of traditional economic policies of recent years, continued complacency, inattention to productivity, and ignorance of the realities of the world situation is the path to virtual national economic suicide. That scenario would involve:

Continuing escalation of inflation, cutting ever more deeply into the value of the U.S. dollar, forcing growing inequities for persons with fixed incomes, and reducing the international marketing capability of our industry;

Continuing declines in innovation, R&D and essential investment of capital for new plant and equipment;

Accelerating decline of our industrial productivity, for most, if not all, of our major industries;

Growing unemployment, based in part on larger losses of world market share plus losses in the real purchasing power of individual U.S. citizens; and

Continually smaller increases in real national output, with rapidly escalating conflict between the several claimants to the ever smaller economic pie.

The result? Growing economic and political strife, with increasing antagonisms, work stoppages, deteriorating living standards, and increasing governmental intervention into the market economy. This is a path down which the United Kingdom has been traveling—and it could happen here. If so, the worldwide economic impact would likely be even larger than Britain's, since our economy is much larger.

The above speculation may sound extreme. However, it is not all that much different from warnings recently made by members of the Council of Economic Advisors (CEA), Professor John Kendrick, William Freund, and other productivity analysts. Labor productivity projections for the decade of the 80's by the CEA, made even before the 1980 dropoff, were for a possible future growth of only 1 percent per year. William Freund's more recent analysis has a "low-investment case" productivity increase rate of 0.9 percent for the decade of the 1980's, or only an increase of 1.1 percent for his "base case," which assumes a continuation of current policies, largely unchanged (figure 11).

FIGURE 1.—LONG-TERM INTERNATIONAL PRODUCTIVITY DYNAMICS: LEVELS AND TRENDS OF REAL GROSS DOMESTIC PRODUCTS PER EMPLOYEE-HOUR, 1870–1977

Nation	GDP/hour [1]				Average annual growth rate				
	1870	1950	1977	1978	1870–1913	1913–50	1950–60	1960–73	1973–78
Australia	183	71	78	85	0.9	1.4	2.8	2.5	4.2
Austria	62	29	66	72	1.7	.8	5.9	6.0	3.8
Belgium	110	51	94	91	1.2	1.4	3.1	5.4	4.3
Canada	89	78	88	89	2.0	2.3	3.1	3.0	1.4
Denmark	65	43	66	64	1.9	1.6	3.0	5.3	1.3
Finland	45	32	66	67	1.8	2.0	4.1	6.4	2.7
France	62	44	79	87	1.8	2.0	4.4	5.5	3.9
Germany	63	33	84	83	1.9	1.0	6.8	5.4	4.2
Italy	60	30	68	71	1.2	1.7	4.3	6.8	4.1
Japan	23	13	52	51	1.9	1.3	5.8	9.8	3.9
Netherlands	107	53	84	90	1.2	1.7	3.4	5.5	3.4
Norway	60	48	86	86	1.6	2.5	4.1	4.8	4.0
Sweden	45	55	79	79	2.4	2.8	3.5	4.6	1.4
Switzerland	80	52	65	66	1.5	2.1	3.0	3.8	1.4
United Kingdom	122	57	61	67	1.1	1.6	2.2	3.7	2.0
United States	100	100	100	100	2.1	2.6	2.4	2.6	1.1
Arithmetic average	78	46	74	77	1.6	1.8	3.9	5.1	2.9

[1] GDP is measured in constant 1970 U.S. price and exchange rates.

Source: Angus Maddison, "International Productivity Comparisons—National Differentials." Paper presented at APC Productivity Research Conference, April 1980.

The message seems clear. An early, determined and broad action program to improve productivity, to control escalating inflation, to reduce unemployment, and to improve our economic competitiveness, is an absolute MUST. We should have already started.

FIGURE 2.—INTERNATIONAL COMPARISON OF POST-WAR GROWTH RATES IN MANUFACTURING INDUSTRY OUTPUT PER HOUR, 1950–79

Country	Average annual percent change for—			
	1950–79	1950–67	1967–73	1973–79
United States	2.4	2.6	2.9	1.5
Canada	3.9	4.1	5.1	2.5
Japan	8.5	9.5	10.4	4.1
Belgium	[1] 6.8	[2] 5.3	9.0	NA
Denmark	5.0	4.2	8.1	4.3
France	5.2	4.9	6.1	4.9
Germany	5.7	6.1	5.3	5.1
Italy	6.0	6.4	7.2	3.6
United Kingdom	2.7	3.0	4.2	.6

[1] 1960–79, earlier data not available.
[2] 1960–67, earlier data not available.

Basic data: U.S. Bureau of Labor Statistics.

FIGURE 3.—TRENDS IN OUTPUT PER HOUR: MANUFACTURING, MINING, UTILITIES, AND SELECTED MANUFACTURING GROUPS, 1960–78

Industry group	Relative average annual output/hour growth rates							
	1960–72		1972–75		1975–78		1978–79	
	United States	Japan	United States	Japan	United States	Japan	United States	Japan
All manufacturing	3.1	9.8	0.9	4.7	2.6	8.4	0.9	[1] 12.1
Iron and steel	[2] 2.4	[2] 10.4	−.1	6.4	3.9	6.7	NA	15.4
Fabricated metal products	2.0	9.6	−.9	2.2	2.3	12.1	1.0	−.1
Machinery [3]	1.7	11.8	0	6.4	.5	9.6	1.2	19.4
Stone, clay, and glass products	1.4	7.5	−.5	3.0	4.0	9.5	.2	10.3
Chemicals and allied products	4.5	14.0	0	3.5	3.5	11.0	3.6	11.9
Petroleum products [4]	3.6	14.9	2.3	1.9	3.7	1.7	−3.9	5.0
Rubber products	2.4	7.7	.7	9.0	.2	11.5	1.5	11.8
Leather and leather products	1.7	3.5	5.8	3.8	.2	.8	3.7	3.6
Paper and pulp	5.4	8.9	0	5.6	3.4	9.1	3.5	10.4
Textiles	4.6	4.4	1.7	3.2	4.6	7.5	3.4	3.9
Lumber and wood products	3.8	4.2	4.0	−2.3	−1.1	2.9	.6	.3
Food			2.0		4.0		2.2	
Tobacco [5]	3.0	6.4	2.2	4.9	3.9	.3	−7.1	.4
Mining	2.8	NA	−5.5	6.2	−1.8	7.1	−8.7	1.7
Public utilities	4.0	NA	2.0	5.1	0	5.1	−3.8	5.3

[1] Figure shown is the JPC figure, to assure consistency with the several industry group data shown. In the U.S. Bureau of Labor Statistics' release dated May 22, 1980, this figure was 8.3 percent. (APC has requested a technical explanation for the variance, as earlier years data appeared similar in both source publications.)
[2] 1964–72.
[3] For the United States, machinery except electrical for years after 1972. For Japan, includes electrical and other machinery for all periods.
[4] For Japan, includes petroleum and coal products.
[5] Data sources: United States and Japan, and 1960–72, U.S. Bureau of Labor Statistics. United States, 1972–79, American Productivity Center (Grossman total factor productivity series, labor productivity measures Japan, 1972–79, "Quarterly Journal of Productivity Statistics," Productivity Research Institute, Japan Productivity Center, October–December 1979 and earlier issues.

Source: American Productivity Center.

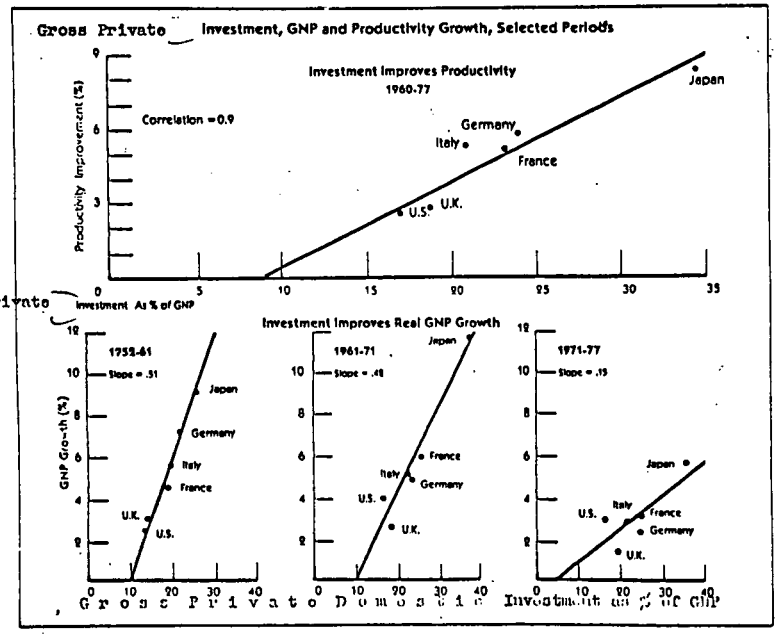
FIGURE 4.—RATIOS OF SAVINGS TO DISPOSABLE PERSONAL INCOME: AND RATIOS OF GROSS FIXED CAPITAL TO GNP, SELECTED NATIONS, 1970–79

[In percent]

Period	United States	France	Federal Republic of Germany	Italy	Nether-lands	United Kingdom	Japan	Canada
I. Ratio of savings to disposable personal income:								
1970	7.4	16.7	14.6	18.8	14.0	9.0	18.1	5.3
1971	7.7	16.8	14.3	20.6	15.0	8.5	17.5	5.9
1972	6.2	16.8	15.5	21.4	15.4	10.4	18.0	7.4
1973	7.8	17.3	14.9	20.9	16.5	11.9	20.5	9.1
1974	7.3	17.4	16.1	19.2	16.6	14.4	23.7	9.9
1975	7.7	18.6	16.4	23.0	14.5	14.0	22.5	10.9
1976	5.8	16.4	14.7	21.8	14.6	13.4	22.4	10.2
1977	5.0	17.3	13.7	23.1	12.8	13.3	21.1	10.0
1978	4.9	18.2	13.8	NA	12.9	14.1	20.1	10.4
1979	4.5	17.1	14.6	NA	NA	15.7	NA	10.3
II. Ratio of gross fixed capital formation to GNP:								
1969	18.1	25.4	24.1	20.1	24.3	18.3	35.1	21.0
1970	17.3	23.3	25.6	23.1	25.6	18.4	35.4	21.0
1971	17.7	23.6	26.4	20.2	25.7	18.3	34.2	22.0
1972	18.3	23.6	25.9	19.7	23.6	18.2	34.0	21.9
1973	18.4	23.8	24.5	21.2	22.8	19.1	36.6	22.5
1974	17.8	24.5	21.9	22.5	21.6	20.3	34.8	23.2
1975	16.3	23.2	20.7	20.6	20.8	19.6	32.2	24.2
1976	16.4	23.3	20.6	20.1	19.2	18.9	31.0	23.5
1977	17.4	22.2	20.8	19.7	20.9	18.3	30.1	23.0
1978	18.1	21.4	21.5	18.8	21.2	18.0	30.2	22.6
1979	17.9	NA	22.9	NA	NA	17.5	31.7	22.7

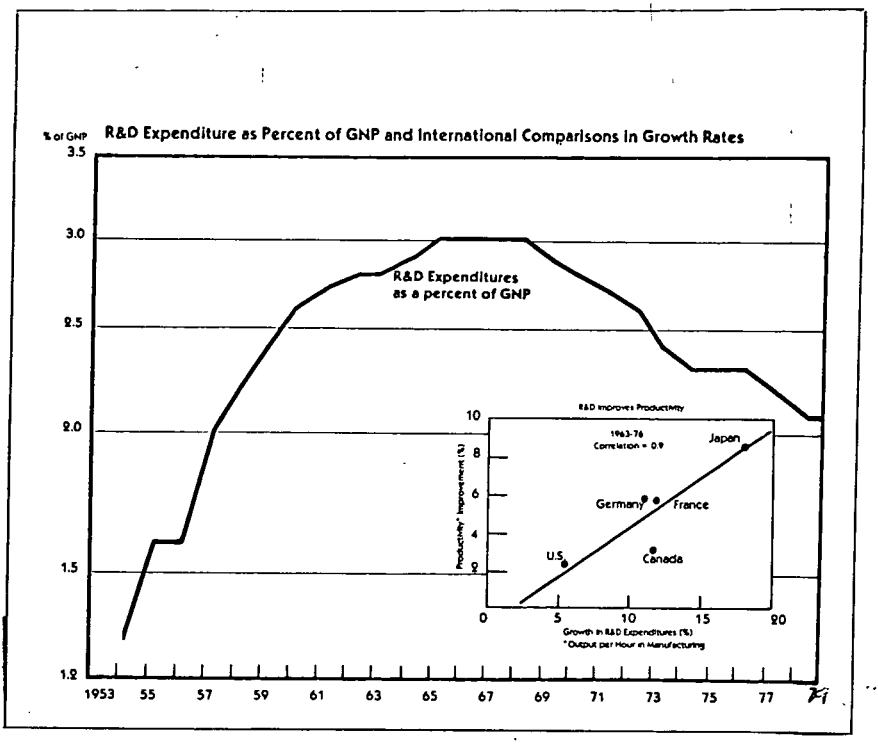
Basic data: U.S. Department of Commerce, International Trade Administration, "International Economic Indicators", June 1979 and June 1980.

FIGURE 5



Source: "Productivity and Growth: A Graphical Approach." Vladi Catto on Business Economics, May 1979—as presented in ABC's Productivity Perspectives, 1980.

FIGURE 6



Sources: National Science Foundation & Vladi Catto, "Productivity Growth: A Graphical Approach."

FIGURE 7.—EXPENDITURES FOR R. & D. AS PERCENT OF GROSS NATIONAL PRODUCT IN VARIOUS COUNTRIES, 1961–77

Year	France	West Germany	Japan	United Kingdom	United States	U.S.S.R.
1961	1.38	[1] 1.25	1.39	2.39	2.74	2.64
1964	1.81	1.57	1.48	2.30	2.97	2.87
1967	2.13	1.97	1.53	2.33	2.92	2.91
1970	1.91	2.18	1.79	[2] 2.23	2.64	3.23
1973	1.77	2.32	1.89	2.05	2.34	3.66
1976	1.78	2.28	1.94	NA	2.27	3.55
1977	1.79	2.26	1.92	NA	2.27	3.47
1978					2.2	
1962–1979					2.2	
1969						

Source: National Science Foundation.

FIGURE 8.—PRODUCTIVITY LEVELS (VALUE ADDED PER PRODUCTION WORKER HOUR) FOR SELECTED INDUSTRIES IN 1976

IC Code No.: Industry	Average all plants	Low quartile average	2d quartile			3d quartile			4th quartile average
			Average	High	Low	Average	High	Low	
Men's and boys' shirts	9.11	4.56	7.10	8.40	5.91	9.59	10.36	8.40	17.67
Wood household furniture	8.55	5.99	8.29	9.12	7.42	10.01	11.22	9.12	14.44
Petroleum refining	78.73	16.87	39.83	58.94	26.27	80.77	106.50	58.94	184.02
Footwear, men's and women's	8.06	4.54	6.48	7.19	5.70	8.09	9.09	7.20	11.75
3312: Blast furnaces, steel works and rolling mills	21.71	9.63	17.32	19.74	14.44	22.73	25.99	19.70	34.00
3511: Machine tools (metal cutting)	21.66	8.56	15.57	17.38	11.82	19.52	21.77	17.38	29.56
3542: Machine tools (metal forming)	19.01	11.45	16.44	17.93	14.95	21.79	26.92	17.98	35.05
3573: Electronic computing equipment	42.95	4.74	14.52	21.26	6.09	30.27	40.40	21.26	86.21

Source: American Productivity Center. Based on a special printout by Bureau of the Census from Annual Survey of Manufactures establishment tapes.

FIGURE 9.—INDICATIONS OF PRODUCTIVITY[1] VARIANCE AMONG PLANTS IN 14 INDUSTRIES, 1967

	Mean ratio of productivity in most efficient quartile—	
	To average	To least efficient quartile
Hydraulic cement	1.71	2.97
Blast furnaces and steel mills	1.41	2.96
Steel pipe and tubes	1.58	2.89
Aircraft	1.28	4.54
Aircraft engines and engine parts	1.58	4.05
Other aircraft equipment	1.65	3.57
Cotton weaving	1.50	2.40
Women's hosiery, except socks	1.60	2.80
Knit fabric	2.20	4.90
Tufted carpets	1.90	5.20
Sawmills	1.70	4.10
Tires	1.40	3.20
Aluminum rolling and drawing	1.50	4.00
Footwear, except rubber	1.50	2.50

[1] Value added per production worker hour.

Source: U.S. Bureau of Labor Statistics, "Technological Change and Its Labor Impact in Selected Industries." Bulletin 1856 and 2005.

FIGURE 10.—CAPITAL EXPENDITURE BY BUSINESS FOR POLLUTION ABATEMENT BY INDUSTRY, 1976–79

[Business pollution abatement expenditures as percent of total capital expenditures for plant and equipment]

	1976	1977	1978	1979[1]
All industries	5.6	5.1	4.5	4.3
Manufacturing	8.3	7.0	5.8	5.5
Nonmanufacturing	3.5	3.5	3.5	3.4
Selected industries:				
Primary metals	15.7	15.7	12.6	12.5
Stone, clay, glass	6.1	7.3	6.6	5.7
Paper	14.7	13.8	7.1	7.2
Chemicals	11.4	10.2	7.8	7.2
Petroleum	10.9	8.2	8.3	8.0
Public utilities	9.1	8.8	8.6	8.4

[1] Preliminary.

Source: U.S. Bureau of Economic Analysis.

FIGURE 11.—PROJECTIONS OF PRODUCTIVITY FOR PRIVATE BUSINESS ECONOMY, 1980–90

Source	Time period	Average annual percent change	Assumption
1. Labor productivity: Output per hour:			
Bureau of Labor statistics	1980–85	1.9–2.1	
	1985–90	2.3–2.5	
Council of Economic Advisers	1980–82	1.0	
	1982–85	1.5–2.0	
Data Resources, Inc	1979–85	1.5	
	1986–90	1.9	
	(1979–90)	1.7	
Fortune Magazine (A. Greenspan)	1979–89	2.1	No economic upsets now evident.
J. W. Kendrick	1980–90	2.1	Basic scenario.
	1980–90	3.4	High-growth.
New York Stock Exchange (William Freund)	1980–90	.9	Low investment.
	1980–90	1.1	Base case.
	1980–90	2.0	High investment.
2. Total factor productivity; J. W. Kendrick	1980–90	1.6	Basic scenario.
	1980–90	2.6	High growth scenario.

Sources: U.S. Bureau of Labor Stastics, Monthly Labor Review, December 1978. Data Resources, Inc., "U.S. Long-Term Review", fall 1979. Bowen, Wm., in "Better Prospects for Our Ailing Productivity", Fortune, December 3, 1979. Kendrick, John, "Productivity Trends and the Recent Slowdown: Historical Perspective, Causal Factors, and Policy Options" in "Contemporary Economic Problems: 1979", the American Enterprise Institute, Washington, D.C. Freund Wm., "Building a Better Future—Economic Choices for the 1980's" New York Stock Exchange, New York.

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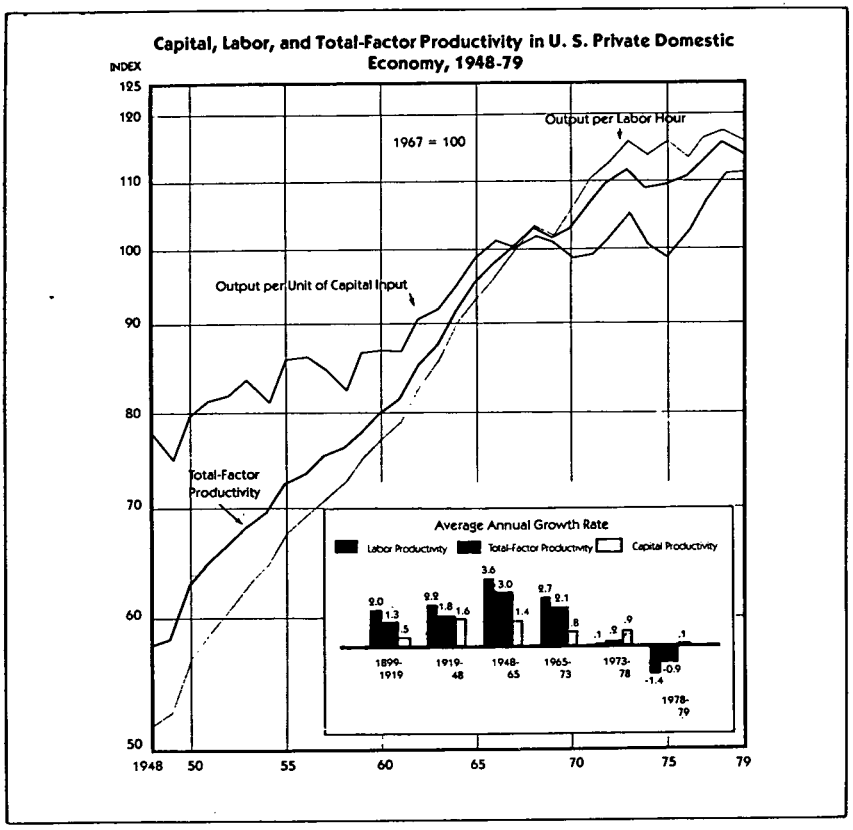
Appendix

Appendix Figure 1



Source : American Productivity Center.

APPENDIX FIGURE 2.—TABLE OF SUPPORTING DATA (FOR APPEND'X FIGURE 1)

CAPITAL, LABOR, AND TOTAL-FACTOR PRODUCTIVITY IN THE U.S. PRIVATE DOMESTIC ECONOMY, 1948–79

[1967=100]

	Output per unit of capital input	Output per unit of labor	Total-factor productivity
1948	77.7	51.7	57.9
1949	74.9	52.7	58.2
1950	79.1	57.1	62.7
1951	81.0	59.0	64.6
1952	81.8	61.0	66.4
1953	83.9	63.3	68.7
1954	81.4	65.0	69.5
1955	85.5	67.8	72.6
1956	85.6	69.2	73.7
1957	84.7	71.5	75.2
1958	81.9	73.4	76.0
1959	86.2	75.6	78.7
1960	86.5	77.1	79.9
1961	86.5	79.6	81.7
1962	90.1	83.2	85.3
1963	92.1	86.7	88.4
1964	94.9	90.3	91.7
1965	98.8	93.6	95.3
1966	100.7	96.8	98.0
1967	100.0	100.0	100.0
1968	102.1	104.5	103.7
1969	101.9	103.1	102.7
1970	98.7	106.1	103.6
1971	99.1	110.2	106.4
1972	102.9	113.6	109.9
1973	105.7	115.9	112.4
1974	101.3	113.9	109.5
1975	98.8	115.9	109.8
1976	103.3	113.8	110.2
1977	107.4	116.4	113.4
1978	110.5	117.7	115.3
1979	110.6	116.1	114.3

Source: American Productivity Center and Kendrick and Grossman.

APPENDIX FIGURE 3.—TRENDS IN OUTPUT PER HOUR AND CAPITAL/LABOR RATIO, PRIVATE BUSINESS SECTOR, 1948–79

[1967=100]

	Output per hour	Capital/labor ratio
1948	51.7	66.6
1949	52.7	70.5
1950	57.1	72.2
1951	59.0	72.9
1952	61.0	74.6
1953	63.3	75.5
1954	65.0	79.8
1955	67.8	79.4
1956	69.2	80.8
1957	71.5	84.3
1958	73.4	89.6
1959	75.6	87.6
1960	77.1	89.2
1961	79.6	92.0
1962	83.2	92.4
1963	86.7	94.1
1964	90.3	95.1
1965	93.6	94.7
1966	96.8	96.1
1967	100.0	100.0
1968	104.5	102.4
1969	103.1	101.2
1970	106.1	107.4
1971	110.2	111.2
1972	113.6	110.4
1973	115.9	109.7
1974	113.9	112.4
1975	115.9	117.3
1976	113.8	110.2
1977	116.4	108.4
1978	117.7	106.6
1979	116.1	105.0

Source American Productivity Center.

APPENDIX FIGURE 4.—TOTAL-FACTOR PRODUCTIVITY BY MAJOR INDUSTRIES OF THE ECONOMY

[Selected periods, 1948–78]

	Average annual rates of change			
	1948–78	1948–65	1965–73	1973–78
Manufacturing	2.0	2.5	1.8	1.0
Food	2.8	2.7	2.6	3.2
Tobacco	2.3	2.4	3.2	.7
Textiles	3.2	3.7	2.3	3.1
Apparel	2.6	2.0	3.2	3.5
Lumber	2.9	4.8	.8	−.1
Furniture	1.8	2.2	1.3	1.1
Paper	2.1	2.1	3.9	−1.0
Printing and publishing	1.6	2.5	.6	.2
Chemicals	2.9	3.5	3.6	−.2
Petroleum	2.3	3.0	1.3	1.5
Rubber	1.7	2.2	1.8	−.1
Leather	1.2	.9	1.8	1.0
Stone, clay and glass	1.4	1.9	.6	1.2
Primary metals	−.1	.7	.4	−3.4
Fabricated metals	1.1	1.5	.9	.1
Machinery, excludes electrical	1.0	1.3	1.1	−.4
Electrical machinery	3.5	4.3	3.1	1.8
Transportation equipment	2.7	3.3	1.4	2.8
Instruments	2.4	3.4	2.0	−.1
Miscellaneous manufactures	2.6	2.1	3.0	3.6

[1] The new APC total-factor productivity series relates to weighted inputs of labor and of capital (land, buildings, machinery and equipment, inventories and financial capital) to the outputs—for the total private business economy, for major segments and sectors, and for the 20 manufacturing industry groups. The outputs in this series are those computed and published in the U.S. Department of Commerce's national product/national income accounts, as expressed in real (inflation adjusted) value added by each segment of the economy, cumulative to the total real gross national product. The real input costs of materials, components, and fuels consumed by each designated segment is excluded from both the output and the input sides.

APPENDIX FIGURE 5.—AVERAGE ANNUAL CHANGE IN OUTPUT PER EMPLOYEE-HOUR, IN SELECTED INDUSTRIES

Industry title	1947–73	1973–78
Iron mining, usable ore	4.1	−1.3
Copper mining, recoverable metal	2.9	7.0
Coal mining	5.0	−3.5
Nonmetallic minerals	[1] 4.1	.8
Crushed and broken stone	[2] 4.4	1.6
Fluid milk	[3] 4.0	3.1
Preserved fruits and vegetables	2.9	1.5
Flour and other grain mill products	4.0	3.7
Cereal breakfast foods	2.1	[4] .8
Rice milling	[5] 2.9	[4] 3.8
Wet corn milling	[5] 3.9	[4] 11.2
Prepared feed for animals and fowls	[5] 4.1	[4] 6.2
Bakery products	2.4	2.1
Sugar	4.0	.4
Candy and other confectionary products	3.6	.2
Malt beverages	5.2	7.5
Bottles and canned soft drinks	[3] 1.8	6.2
Tobacco products	3.2	3.2
Hosiery	5.6	8.1
Sawmills and planing mills	[3] 3.1	1.4
Paper, paperboard and pulp mills	4.0	2.1
Corrugated and solid fiber boxes	[3] 3.5	2.6
Synthetic fibers	[6] 5.8	6.4
Paints and allied products	[3] 2.7	3.9
Petroleum refining	5.7	1.1
Tires and inner tubes	4.0	2.8
Footwear	1.3	.6
Glass containers	1.7	2.0
Hydraulic cement	4.5	1.2
Clay construction products	[3] 3.5	3.4
Concrete products	3.3	[4] .8
Steel	1.8	−.7
Primary copper, lead, and zinc	2.3	1.5
Primary aluminum	4.3	−1.5
Copper rolling and drawing	[3] 3.0	1.5
Aluminum rolling and drawing	[3] 5.5	1.8
Metal cans	2.3	4.6
Major household appliances	[3] 5.5	3.0
Radio and television receiving sets	[3] 4.8	[4] 2.2
Motor vehicles and equipment	[6] 3.7	3.9
Railroad transportation	4.1	.9
Intercity trucking	[1] 2.7	1.4
Air transportation	7.5	5.1
Petroleum pipeline	9.9	[4] .5
Telephone communications	[7] 6.3	8.1
Gas and electric utilities	6.7	1.4
Retail food stores	[3] 2.8	−.2
Gasoline service stations	[3] 3.8	4.9
Eating and drinking places	[3] 1.8	−1.5
Hotels, motels and tourist courts	[3] 2.4	.6
Laundry and cleaning services	[3] 1.7	1.0

[1] 1954–73.
[2] 1956–73.
[3] 1958–73.
[4] 1973–77.
[5] 1963–73.
[6] 1957–73.
[7] 1951–73.

APPENDIX FIGURE 6.—GROWTH OF OUTPUT PER PERSON AND EMPLOYMENT BY SECTOR

[Average annual compound growth rates]

	Output per person employed 1870–1950				Rate of growth of employment 1870–1950			
	Agriculture	Industry	Services	GDP	Agriculture	Industry	Services	Total
(a) 1870–1950:								
Germany[1]	0.2	1.3	0.7	1.2	−0.1	1.4	1.5	0.9
Italy	.5	1.4	.6	.9	.1	.7	1.2	.5
Japan[2]	.7	1.7	.5	1.1	.1	1.7	1.9	.8
United Kingdom	1.4	1.2	.2	.8	−1.1	.9	1.3	.8
Arithmetic average	.7	1.4	.5	1.0	−.3	1.2	1.5	.8

[1] 1871–1950; [2] 1906–50.

Data source: Monographic studies on growth in these countries, Germany from W. Hoffmann & Associates, Italy from G. Fua, Japan from Ohkawa & Associates and from employment data supplied by Umemura, United Kingdom from Feinstein.

	Output per person employed 1950–76				Rate of growth of employment 1950–76			
	Agriculture	Industry	Services	GDP	Agriculture	Industry	Services	Total
(b) 1950–76:								
Austria	6.0	5.2	2.9	5.1	−3.8	0.5	1.7	0.0
Denmark	3.7	3.6	1.6	2.8	−3.0	.5	2.2	.8
Finland	5.6	4.1	1.9	4.3	−4.2	1.2	3.1	.4
France	4.7	5.0	2.8	4.4	−3.3	.7	1.8	.5
Germany	5.8	5.4	2.9	4.7	−3.8	.8	2.0	.7
Italy	5.6	4.3	1.8	4.2	−3.4	2.3	2.6	.7
Japan	6.2	8.3	4.0	7.2	−3.7	3.3	3.8	1.5
Netherlands	4.8	5.3	2.0	3.4	−1.8	.4	2.2	1.2
Norway	4.3	3.7	2.3	3.4	−3.5	.9	2.6	.9
Sweden	4.6	3.9	1.6	2.8	−3.8	.2	2.3	.7
United Kingdom	4.0	2.6	1.3	2.3	−2.1	−.3	1.0	.3
United States	5.1	2.8	1.4	1.8	−3.3	.9	2.4	1.5
Arithmetic average	5.0	4.5	2.2	3.9	−3.3	1.0	2.3	.8

Data source: GDP by sector from "National Accounts of OECD Countries" 1950–68 edition for 1950–60, 1960–71 edition for 1960–70, and 1970–76 edition for 1970–76. GDP measured at 1963 prices for 1950–70 and at 1970 prices from 1970 onward. In some cases adjustments were necessary to achieve consistency of treatment in the linked series. Official figures of Japanese output by sector in constant prices are not published and our estimate is derived from physical output indicators for agriculture and industry, with service output treated as a residual. The distribution of employment between sectors in 1950 was derived from OECD publications for Austria, Netherlands, Norway and the United States, from P. Bairoch, The Working Population and Its Structure," Brussels, 1968 for Denmark, Finland, Germany and Sweden, and from monographic material elsewhere—France, (Malinvaud), Italy (Fua), Japan (Bank of Japan), United Kingdom (Feinstein). The German figures are adjusted to include West Berlin throughout.

Reprinted from Angus Maddison, "Long Run Dynamics of Productivity Growth", Banca Nazonale del Lavoro Quarterly Review, March 1979.

APPENDIX FIGURE 7.—DIRECT RELATION OF PRODUCTIVITY AND UNIT LABOR COST GROWTH

[In percent]

	Compensation per hour	—	Output per hour	=	Unit labor cost
Selected years changes in:					
1955	3.7		4.1		−0.4
1957	5.9		2.2		3.7
1963	3.7		3.5		.2
1967	5.8		1.9		3.9
1969	6.5		−.2		6.7
1973	7.5		1.5		6.0
1975	9.9		1.9		7.9
1979	9.3		−.9		10.3

Source: William Freund, New York Stock Exchange, "Research a Higher Standard of Living," 1979.

APPENDIX FIGURE 8.—WAGES, REAL EARNINGS, OUTPUT PER HOUR, AND UNIT LABOR COSTS, 1947–79

	Output per man-hour		Compensation per hour		Unit labor cost		Real hourly earnings	
	Private business	Manufacturing	Private business	Manufacturing	Private business	Manufacturing	Private business	Manufacturing
1947	52.3	55.6	35.1	36.8	67.1	66.2	52.5	55.0
1948	54.4	59.2	38.1	41.0	70.1	69.2	52.9	56.8
1949	55.3	61.4	38.8	42.8	70.2	69.7	54.4	60.0
1950	59.7	64.9	41.6	45.0	69.6	69.4	57.7	62.4
1951	61.5	67.0	45.6	49.5	74.3	73.9	58.6	63.7
1952	63.0	68.2	48.6	52.7	77.1	77.3	61.1	66.3
1953	65.3	69.4	51.8	55.7	79.3	80.2	64.6	69.5
1954	66.5	70.5	53.5	58.2	80.5	82.5	66.5	72.3
1955	69.2	74.0	54.9	60.4	79.3	81.6	68.5	75.4
1956	70.2	73.5	58.6	64.3	83.5	87.5	72.0	79.0
1957	72.3	75.0	62.5	68.1	86.5	90.8	74.2	80.8
1958	74.2	74.6	65.4	71.1	88.2	95.4	75.6	82.2
1959	76.8	78.1	68.5	74.0	89.1	94.8	78.5	84.8
1960	78.1	78.8	71.4	77.0	91.4	97.7	80.5	86.9
1961	80.6	80.7	74.2	79.3	92.1	98.3	82.8	88.5
1962	84.4	84.5	77.7	82.5	92.1	97.7	85.7	91.1
1963	87.7	90.4	80.7	85.1	92.0	94.2	88.0	92.7
1964	91.3	95.2	85.1	88.9	93.2	93.4	91.6	95.7
1965	94.7	98.2	88.4	90.9	93.4	92.6	93.6	96.8
1966	98.0	99.7	94.9	95.2	96.8	95.4	97.3	97.8
1967	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1968	103.3	103.6	107.6	107.0	104.1	103.3	103.3	102.7
1969	103.5	104.9	114.9	114.0	111.0	108.7	104.8	103.8
1970	104.2	104.5	123.1	121.7	118.2	116.5	106.0	104.7
1971	107.7	110.4	131.4	129.8	122.0	117.6	108.4	107.0
1972	111.4	116.0	137.7	137.0	125.4	118.1	110.9	109.3
1973	113.6	119.4	151.1	147.0	133.1	123.2	112.9	110.5
1974	110.1	112.8	164.9	161.4	149.8	143.1	111.8	109.3
1975	112.4	116.3	181.3	179.4	161.3	154.3	111.8	111.3
1976	116.4	123.4	197.2	195.1	169.4	158.2	115.6	114.5
1977	118.6	127.5	213.0	212.4	179.6	166.6	117.4	117.0
1978	119.2	198.0	231.2	229.5	194.0	179.4	118.3	117.5
1979	118.1	130.2	252.8	250.5	214.0	199.4	116.3	115.2

Source: U.S. Bureau of Labor Statistics.

APPENDIX FIGURE 9.—IMPORTANT DETERMINANTS OF FUTURE PRODUCTIVITY GROWTH

1. The level of economic activity and plant capital utilization.
2. Capital investment (for improvement of capital-labor ratio and application of newer technology).
3. R&D (for advancement of methods and making capital more productive).
4. Investment in environmental and safety improvements (a short-term deterrent to growth of measured productivity).
5. Government regulation (could inhibit innovation and adds "paperwork" not countable as output).
6. Age of industrial plant (related to degree of use of newer technology and to potential for further diffusion).
7. Age-sex-education mix of the labor force.
8. Labor and management attitudes, values, and styles.
9. Structural composition of output (shift of workers from agriculture essentially completed, but shift to services, for example, could still be significant).
10. Energy cost (influences to capital design and capital-labor ratio).
11. General economic distortions (e.g., inflation or possible substantial diversion of capital and R&D to defense).

APPENDIX FIGURE 10.—TRENDS AND PROJECTIONS OF CAPITAL/LABOR RATIO AND LABOR INPUTS

Period	Capital/labor ratio	Average annual percent change in civilian labor force			
		Total	Men under 25	Women	Persons with 1 or more years of college
Actual:					
1950–65	2.6	1.2	1.4	2.4	3.7
1965–73	3.1	2.0	4.8	3.5	5.4
1973–79	.6	2.4	2.7	3.9	6.2
Projected:					
1977–85		1.9	.4	2.8	
1980–85	1.0–1.5				
1985–90	2.0–2.4	1.1	1.7	1.7	
1980–90	1.5–2.0				2.6

Source: U.S. Bureau of Labor Statistics.

APPENDIX FIGURE 11.—SOURCES OF GROWTH IN TOTAL-FACTOR PRODUCTIVITY, PRIVATE DOMESTIC ECONOMY, 1948–78

Item	Average annual percent of change			Change from 1948–66 to 1973–78
	1948–66	1966–73	1973–78	
Real gross product	3.9	3.5	2.4	−1.5
Total-factor input	1.1	1.9	1.6	
Labor	.4	1.4	1.3	
Capital	2.8	3.3	2.3	
Real product per unit of labor	3.5	2.1	1.1	
Capital/labor substitution	.7	.5	.3	
Total-factor productivity	2.8	1.6	.8	2.0
Advances in knowledge	1.4	1.1	.8	.6
R.&D. stock	.9	.7	.6	
Informal	.3	.3	.2	
Rate of diffusion	.2	.2		
Changes in labor quality	.6	.4	.7	.1
Education and training	.6	.7	.8	
Health	.1	.1	.1	
Age/sex composition	.1	.4	.2	
Changes in quality of land		.1	−.2	.2
Resource reallocations	.8	.7	.3	−.5
Labor	.4	.2	.1	
Capital	.4	.5	.2	
Volume changes	.4	.2	−.1	−.5
Economies of scale	.4	.3	.2	
Intensity of demand		−.1	−.3	
Net Government impact		−1	−.3	.3
Services to business	.1	.1	.1	
Regulations	−.1	−.2	−.4	
Actual/potential efficiency and not elsewhere classified	−.4	−.6	−.4	

Source: John W. Kendrick, "Productivity Trends and the Recent Slowdown: Historical Perspective, Causal Factors, and Policy Options", 1979, in "Contemporary Economic Problems, the American Enterprise Institute, Washington, D.C.

APPENDIX FIGURE 12.—U.S. PRIVATE DOMESTIC BUSINESS ECONOMY: ALTERNATIVE PROJECTIONS OF REAL PRODUCT AND PRODUCTIVITY, BY COMPONENTS, 1980–90

	Basic	High growth
Average annual rates of change:		
Real gross product	3.4	4.8
Total factor input	1.8	2.2
Labor	1.3	1.4
Capital	3.2	4.5
Real product per labor hour	2.1	3.4
Capital/labor substitution	.5	.8
Total factor productivity	1.6	2.6
Sources of productivity growth: Percentage point contribution:		
Advances in knowledge	.9	1.3
R. & D. stock	.6	.8
Informal	.2	.3
Rate of diffusion	.1	.2
Changes in labor quality	1.0	1.1
Education and training	.8	.9
Health	.1	.1
Age/sex composition	.1	.1
Changes in quality of land	−.3	−.3
Resource reallocations	.2	.2
Labor	.1	.1
Capital	.1	.1
Volume changes	.4	.6
Economies of scale	.3	.5
Intensity of demand	.1	.1
Net Government impact	−.2	(1)
Services to business	(1)	.1
Regulations	−.2	−.1
Actual/potential efficiency and n.e.c.	−.4	−.3

[1] Zero or negligible.

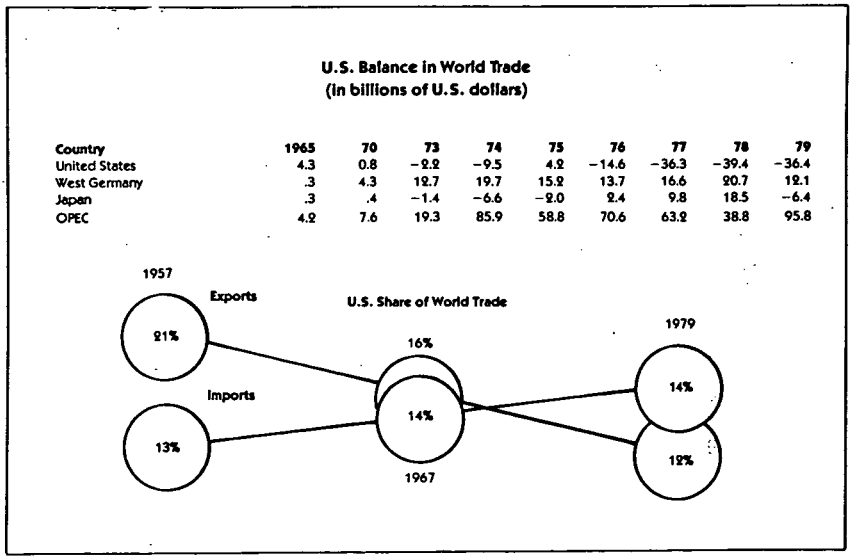
APPENDIX FIGURE 13.—PROJECTED INTERNATIONAL PRODUCTIVITY TRENDS, GDP PER EMPLOYEE

[Constant dollar basis, international price weights]

Year	United States	France	Germany	Japan	Canada
1. Level of productivity (1978 U.S.= 100):					
1978	100.0	85.6	85.6	63.0	96.1
1979	99.1	88.2	88.1	65.8	95.1
1980	98.6	89.9	90.3	68.1	95.1
1981	98.9	92.6	93.0	70.9	96.6
1982	99.9	95.7	96.7	73.8	98.5
1983	101.4	99.2	100.6	77.2	100.5
1984	103.2	103.2	104.0	80.8	102.5
1985	105.3	107.3	108.8	84.7	104.5
1986	107.4	111.6	113.1	88.7	106.6
1987	109.5	116.0	117.1	93.0	108.8
1988	111.7	120.6	122.4	97.8	111.0
1989	113.9	125.5	127.3	103.1	113.2
1990	116.2	130.5	132.4	108.8	115.5
1991	118.5	135.7	137.6	114.8	117.8
1992	120.9	141.1	143.2	121.1	120.1
2. Productivity growth rates:					
1979	−.9	3.0	3.5	4.5	−1.0
1980	−.5	2.0	2.5	3.5	0
1981	.3	3.0	3.0	4.0	1.5
1982	1.0	3.3	4.0	4.2	2.0
1983	1.5	3.7	↓	4.5	2.0
1984	1.8	4.0	↓	4.7	↓
1985	2.0	↓	↓	4.8	↓
1986	↓	↓	↓	4.8	↓
1987	↓	↓	↓	4.8	↓
1988	↓	↓	↓	5.2	↓
1989	↓	↓	↓	5.4	↓
1990	↓	↓	↓	5.5	↓
1991	↓	↓	↓	5.5	↓
1992	↓	↓	↓	5.5	↓
Average rates:					
1979–85	1.0	3.3	3.6	4.3	1.6
1985–92	2.0	4.0	4.0	5.2	2.0

Sources: 1979, actuals, OECD. 1980, best estimates using Economic Report of the President and OECD. 1981–84, best estimates based on OECD and work of J. Kendrick, L. Klein, and W. Freund. 1985–92, best estimates based on various reports of probable economic patterns. Basic data from U.S. Bureau of Labor Statistics, 1978.

APPENDIX FIGURE 14



Sources: Economic Report of the President: 1978 and 1980.

PRODUCTIVITY, INFLATION, AND ECONOMIC GROWTH

By L. Douglas Lee

CONTENTS

Productivity's Role in the Economy

One of the primary sources of a rising standard of living for all Americans has been our ability to produce more goods and services with less labor. This comes about by increasing the inputs of capital, materials, and energy relative to labor and by combining all inputs more and more efficiently. In recent years the ability to raise our standard of living has faltered. In particular, the way we combine the various production inputs, productivity, has shown no improvement. After experiencing productivity growth of 2.3 percent per year for the 20 years following World War II, it grew about 2.0 percent from 1965 to 1973 and just over 1.0 percent from 1973 to 1979. Based on the most recent data, we actually produced less efficiently in 1979 than in earlier years. Reversing this decline in productivity growth is the greatest challenge facing our economy today. This is the only way we can simultaneously solve the problems of inflation and unemployment and restore hope to the American people for a brighter future.

This paper seeks to explain the interactions among productivity growth and various other aspects of our economy: economic growth, inflation, taxes, employment, and international trade. While many of these relationships are implicitly understood by economists, it is very difficult to find a clear exposition of them in economic literature. Productivity growth was such a stable and predictable factor in the economy for so many years that when it was discussed at all, the discussion was confined to those final chapters in the economics books which students never seemed to get around to reading. Now that productivity has become a "problem," a new examination of the subject is in order.

Productivity and Inflation

Various studies by the Joint Economic Committee, the New York Stock Exchange, and others have established the link between productivity and inflation. Too often this link has been inadequately understood. A common failing is to explain the link by referring to a

definitional relationship which states that the growth in unit labor costs is equal to the difference between the growth in employee compensation and the growth in labor productivity. By showing a high statistical correlation between the growth in output prices and growth in unit labor costs, one conclusion seems all but inevitable: Slower productivity growth will result in an accelerated rate of inflation.

Actually, this "explanation" is not an explanation at all. The definition tells us nothing more than that the growth in unit labor costs must equal the difference between the growth of employee compensation and the growth of labor productivity. Thus, if the decline in productivity growth is accompanied by a corresponding decline in employee compensation, unit labor costs will not increase.

Growth of employee compensation is determined by a whole host of complex factors including, among other things, people's inflationary expectations and general labor market conditions. Of immediate concern here is the nature of the relationship between productivity growth and the growth of employee compensation. The relevant question is, what effect might a decline in productivity have on employee compensation?

There is a common view that the productivity slowdown has been an important factor responsible for the accelerated growth of employee compensation. The argument runs as follows. When sizable real wage increases are realized year after year, as they were in the 1950's and 1960's, people come to expect that this will be continued. The mechanism for achieving these expected real gains takes the form of nominal wage increases in excess of the rate of inflation. However, if actual productivity growth falls short of the expected increase in real wages, the expected real gains will not be realized. The increased growth of nominal wages will simply be withheld down in real size through higher-than-expected increases in prices.

The failure of workers to experience the real wage increases expected induces them, so it is argued, to press for still higher nominal wage increases. Of course, since it is impossible for those expected real income gains to be realized in the absence of sufficient productivity growth, those higher nominal wage increases will simply be translated into yet higher rates of inflation in unit labor costs and prices. In this manner, slower productivity growth becomes one of the contributing factors to the all-too-familiar wage-price spiral.

If workers set their nominal wage demands to achieve a given growth in their real after-tax incomes, slowed productivity growth may result in even greater wage inflation. This is simply the result of a tax system that pushes people into higher tax brackets when their nominal incomes rise. In order to achieve a target rate of growth in real after-tax income, workers must raise their nominal wage demands to offset both the expected rate of inflation and the larger tax bite. If productivity growth is not large enough to pay for both the higher taxes and the expected inflation, then workers will again see their hopes frustrated as their demands for higher nominal wages are translated into more inflation.

The validity of the argument that slower productivity growth results in an accelerated increase in employee compensation rests square-

ly on the proposition that workers do not adjust their expectations for real income growth downward when productivity growth slows. The situation is further aggravated if workers are trying to achieve an after-tax income target.

While this argument has a certain intuitive appeal, it is extremely difficult to find empirical evidence that the deteriorating productivity performance has been an important cause of accelerating inflation. In fact a recent study by Freund and Manchester [1] found that the impact of productivity growth on compensation was not statistically significant. Another study by Eckstein [2] examined the core rate of inflation from 1965 to 1979. This study found that from 1970 to 1973, the declining productivity trend was a significant factor in worsening core inflation; but over the entire period, other factors which determine the cost of capital (interest rates, price expectation, equity values) were far more important. In moving from the core rate of inflation to the actual rate of inflation, the impact shocks (farm price increases, tax hikes, currency devaluations, and minimum wage increases) and demand pressures must be added—again factors unresponsive to productivity growth.[3] Other studies have placed larger emphasis on the growth of the money supply as the primary causal factor in accelerating inflation.

On the whole, there is little evidence to support the increasingly popular notion that the productivity decline has been the major explanatory factor in our deteriorating inflation performance. Furthermore, even if it is true that a slowed rate of productivity growth adds to inflation in the manner described above, it does not follow necessarily that an increase in productivity growth will slow inflation. In theory, the adjustment of workers' real income expectations may be asymmetrical; that is, they may steadfastly resist downward revisions in their real income expectations but readily adjust them upwards in the face of more rapid productivity growth. If this is true, the reduction in unit labor costs brought about by higher productivity growth would be offset, at least in part, by a higher rate of increase in nominal wages. Thus, it is possible that reduced rates of productivity growth will exacerbate inflationary pressure, but that higher productivity growth rates will not provide an equal measure of relief.[4]

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[1] U.S. Congress, Joint Economic Committee, "Productivity and Inflation," by William C. Freund and Paul B. Manchester (Washington, D.C.: Government Printing Office, 1980).

[2] U.S. Congress, Joint Economic Committee, "Tax Policy and Core Inflation," by Otto Eckstein (Washington, D.C.: Government Printing Office, 1980).

[3] The actual inflation rate is the sum of the core, shock and demand inflation rates. The core rate is the trend increase of the costs of the factors of production. It originates in the long-term expectations of inflation in the minds of households and businesses, in the contractual arrangements which sustain the wage-price momentum, and in the tax system. Inflationary expectations and, therefore, the core rate, are influenced by the shock and demand inflation rates. The demand inflation rate is dependent upon the utilization rates of resources derived from the level of aggregate demand and factor supplies. The shock inflation rate is, by definition, exogenous to the analysis. It is determined primarily by noncontrollable conditions: OPEC political-economic decisions, weather and crop conditions, and so forth. Ibid.

[4] It is in any case true that workers' real income expectations are an important determinant of inflationary pressures. Wages and salaries constitute 75 percent (and sometimes more) of the Gross National Product. Self-employed farmers and small businessmen, whose incomes are essentially wages, generate as much as 6–7 percent of national income. With profits making up perhaps 12 percent, there is only 6–7 percent left for capital costs. In short, labor costs in the form of wages and salaries are a key component of total costs and are, therefore, a major determinant of prices.

Inflation and Productivity

The link between productivity and inflation goes in both directions. Just as a slowdown in productivity growth may increase inflation through the behavior of wages, an increase in inflation may slow productivity growth through the behavior of profits. This latter phenomenon is rather complicated and requires special attention.

Begin with the tax treatment of depreciation expenses and inventories. Under current law, firms are allowed to expense their plant and equipment on a "historic cost" basis only. But if inflation is pushing current replacement costs above the historic level, then the tax allowance designed to finance the replacement of this equipment when it becomes obsolete will be too small, and current profits will be too large. If profits are too large, then the taxes paid on those profits will also be too large, leaving less money to be distributed to shareholders or reinvested for future growth.

A similar phenomenon occurs when inflation pushes up the value of goods held in inventory. Because the "profits" generated by inflated inventories must be used to replace those inventories at the higher current prices, taxing these illusory profits also reduces the funds available to the firm for distribution to its shareholders or reinvestment.[5] Thus, the interaction between inflation and the tax treatment of depreciation and inventories can reduce the funds available to finance future growth.

The magnitude of the overstatement of corporate profits caused by inflation and the effect this has on real after-tax returns are matters of considerable dispute. Many argue that just as profits are overstated because the replacement cost of capital and inventories have risen, they are understated because rising inflation rates reduce the real value of corporate debt. In an inflationary environment, the nominal interest costs deducted by corporations in calculating their taxable profits reduce dramatically the real cost of borrowed funds. By itself, this results in the understatement of real profits and, in addition, apparently enhances the attractiveness of debt as opposed to equity financing of corporate expenditures.[6]

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[5] Many firms value their materials-goods inventories at prices corresponding to the oldest items in inventory; hence the reason for the accounting name FIFO—first in, first out. Under existing tax laws, the increase in the price of inventories between the date of purchase and use in production is treated as a realized gain and is included in the taxable profits of firms using the FIFO accounting method. However, if inventory levels are to be maintained, these gains will be absorbed by currently purchased higher priced replacement material inputs. This has led some to conclude that such capital gains should be treated, not as part of current operating profits, but as a change in the liquidation value of firms using FIFO. (See, for example, Henry Aaron, ed., "Inflation and the Income Tax" (Washington, D.C.: The Brookings Institution, 1976, p. 13.). For firms using the FIFO method, these holding gains on inventories are largely eliminated.

Interestingly, only 30 percent of combined manufacturing and trade inventories are covered by LIFO (last in, first out) at present; the other 70 percent are broken down as follows: FIFO, 25 percent; average cost 17 percent; actual cost, 6 percent; standard cost, 18 percent; and other, 4 percent. All methods other than LIFO result in some degree of profit over-reporting during periods of inflation. From "Manufacturers' Shipments, Inventories and Orders." Publication M3–1.8, the Annual Benchmark Publication for 1967 through 1978.

[6] The increased relative reliance on debt financing by corporations in an inflationary environment is emphasized by Robert Eisner, "The Outlook for Business Investment," in "Capital for Productivity and Jobs," E. Shaprio and W. Shite, eds. (Englewood-Cliffs, N.J.: Prentice-Hall, 1977) and N. F. Tideman and D. P. Tucker, "The Tax Treatment of Business Profits under Inflationary Conditions," in Henry Aaron, *op. cit.* As an illustration, we note that corporate net interest payments as a percent of total corporate income (measured as the sum of inflation-adjusted, before-tax profits plus net interest payments of nonfinancial corporations) rose from an average of about 9 percent in the period 1960 to 1965, to 25 percent in the 1970s, reaching a high of nearly 33 percent in 1975.

It turns out that in recent years the decline in real corporate indebtedness has been huge. It has been estimated by George Von Furstenburg and Burton Malkiel that the inflation-induced reduction in real indebtedness of corporations caused by the higher volume of nominal interest payments amounted to about $28 billion in 1977.[7] This decline in real indebtedness offsets almost exactly the estimated increase in the real tax burden caused by the inadequacy of depreciation allowances and the illusory inventory profits gains during 1977.[8] This means that inflation during 1977 did not result in a reduction in real after-tax returns for the corporate sector as a whole.

A number of economists, the most notable being Martin Feldstein and Lawrence Summers, dispute this contention.[9] They argue that, for a correct treatment of corporate debt, we need to consider more than the tax paid by corporations; we need to include as well the tax paid by the individuals and institutions that supply capital to the corporate sector. According to this view, the lower effective tax rate for corporations caused by reductions in the real value of corporate debt is offset, more or less, by the higher effective tax rates levied on those individuals and institutions who purchase corporate debt. Corporate lenders are taxed on their full interest income. including that part of their return that merely reflects an inflation premium. The higher taxes paid by lenders almost exactly offset the lower taxes paid by borrowers. Thus, putting both the lending and borrowing sides together, it is appropriate to ignore the debt side of the corporate balance sheet.[10]

If one accepts the Feldstein-Summers argument, there can be little doubt that recent high inflation rates have substantially increased the effective tax rate on corporate source capital income. However, not everyone agrees that the correct treatment of corporate debt necessitates the integration of the taxes paid by corporate borrowers and corporate lenders. An integration of the two taxes may be deemed appropriate from the point of view of tax equity (on the grounds that the ability-to-pay principle can be applied legitimately to individuals only and that all taxes therefore should be imputed to them), but when the concern is with investment incentives, the case is far from clear. As Richard Musgrave argues, ". . . the corporation is not merely a conduit. Far from it. It is the major decisionmaking unit. Investment decisions are made by managers whose primary concern is with the corporation tax, and not the taxes paid by suppliers of outside funds."[11]

If, following Musgrave, we reject the Feldstein-Summers argument, then the inflation-induced overstatement of profits arising from historic cost depreciation and illusory "inventory profits" must be netted against the inflation-induced understatement of profits arising

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[7] George M. Von Furstenburg and Burton G. Malkiel, "Financial Analysis in an Inflationary Environment," *The Journal of Finance,* XXXII, 2 (May 1977) : 159.

[8] See, for example, Martin Feldstein and Lawrence Summers, "Inflation and the Taxation of Capital Income in the Corporate Sector," Discussion Paper No. 698, Harvard Institute of Economic Research, Harvard University, April 1979.

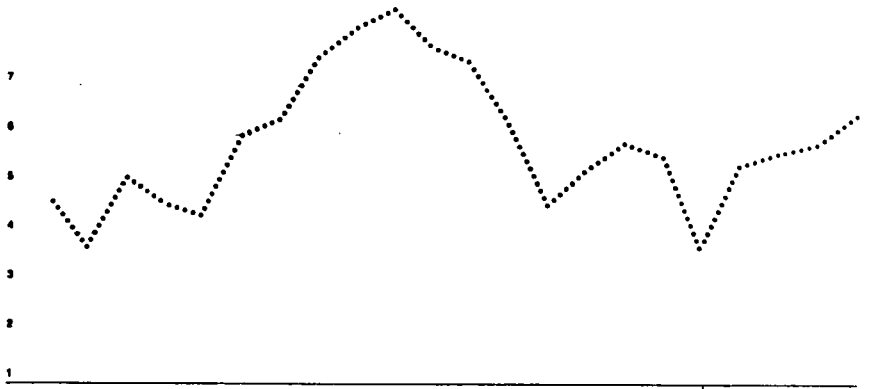
[9] *Ibid.*

[10] This treatment implicitly assumes that taxes paid by corporations are not shifted back through lower profits and dividends to their shareholders. To the extent that this is not the case, and to the extent that corporate shareholders are also lenders, this conclusion would have to be modified.

[11] Richard A. Musgrave, "Tax Policy and Capital Formation," A paper presented at the NTA–TIA Conference on Tax Policy, Washington, D.C., May 15, 1979.

from the reduction in real corporate indebtedness to arrive at a more accurate measure of the effect of inflation of real after-tax returns. What then has been the net effect of inflation on real after-tax returns in the post World War II era? Based on this adjustment, chart 1 suggests there is little evidence that aggregate real after-tax profits have been severely and persistently damaged as a result of inflation.[12]

CHART 1.—Inflation-adjusted profits related to replacement value of equity capital.



After-tax returns on equity capital

1957	4.8%	1960	4.7	1965	8.1	1970	4.7	1975	5.5
1958	3.8	1961	4.4	1966	8.7	1971	5.2	1976	5.7
1959	5.1	1962	6.0	1967	7.8	1972	5.9	1977	5.9
		1963	6.3	1968	7.5	1973	5.7	1978	6.4
		1964	7.5	1969	6.2	1974	3.8		

Note: The after-tax profits of nonfinancial corporations are also adjusted to exclude inventory profits and to put depreciation on a replacement-cost basis. As inflation reduces the real value of corporate debt, this reduction is added back to profits. These adjusted profits are then divided by the nonfinancial corporate capital owned by equity holders (and valued at replacement cost). The latter figure is determined by subtracting from the replacement value of nonfinancial corporate assets the total amount of all debt.

As shown below, the real after-tax return, measured as the ratio of after-tax, inflation-adjusted profits to the replacement value of equity capital invested in business, stood up remarkably well in 1977 and 1978 when compared with historical figures. True, real after-tax returns in 1977 and 1978 were substantially below the rates experienced during the Vietnam war years, and they took a real beating in 1969 and again in 1974 but, as Malkiel concludes: "There is no evidence of a persistent deterioration in the profit picture." [13]

The conclusion that the after-tax return on capital investment has been unaffected by inflation is also supported by Fraumein and Jorgenson. After examining rates of return by industrial sector for the entire postwar period, they concluded that there are surprisingly large differences in the rates of return among sectors and that these differences had persisted with very little change throughout the 1948–76 period.[14]

Nevertheless, if the rates of the past couple of years persist into the future, we are still left with the nagging question: What factors were

[12] Burton G. Malkiel, "Productivity—The Problem Behind the Headlines," *Harvard Business Review* (May-June 1979) : 85.
[13] *Ibid.*, p. 84.
[14] Barbara M. Fraumein and Dale W. Jorgenson, "Rates of Return by Industrial Sector in the United States, 1948–1976," Paper presented to the annual meetings of the American Economic Association, December 28–30, 1979.

responsible for the very sharp increase in real after-tax returns during the 1960s, and what accounts for their decline in the late 1970s to levels approaching those witnessed in the 1950s? There are, unfortunately, no clear-cut answers to this question. However, in our estimation, tax policy changes enacted in the early 1960s, most notably the liberalization of depreciation allowances for tax purposes and the investment tax credit, were major contributing factors to the improved profit picture of the corporate sector in the mid-1960s. Since that time, a number of events occurred that served to nullify the effects of the earlier more liberal tax policy changes.

It is not entirely clear what conclusions we should draw from the profit picture represented in chart 1. Feldstein and Summers would argue that because the tax liabilities of corporate creditors were ignored in the calculations, the real after-tax returns reported above are overstated, the degree of overstatement being larger the higher the rate of inflation. Thus, it is not at all obvious that the returns for 1977 and 1978 "stood up remarkably well" by historical standards. Moreover, even if we reject the Feldstein-Summers argument, the *actual* profits performance of the corporate sector is not the only, or even the most important, determinant of business investment spending. The most important consideration, and this point is recognized by Malkiel, among others, is the profits firms expect from their investments. Thus, the sluggish pace of investment spending during the recovery from the 1973–75 recession might well be explained by relatively low *expected* profits.

Expected profits, of course, are much more elusive conceptually than actual profits because so many complex factors enter into the formulation of a businessman's expectations. The question that is of immediate concern here is the extent to which profits expectations deteriorate in an environment characterized by high and variable rates of inflation.

Although there are no clear-cut answers to this query, there exists some indirect evidence to suggest that high and variable rates of inflation increase the riskiness of business investment. The effects of increased risk premiums are many. First, the minimally acceptable rates of return that must be surpassed by new investment projects is raised in response to increased risk premiums; many investment projects that would otherwise have been undertaken in the absence of increased risk premiums are now abandoned. Second, increased risk tends to alter the structure of investment spending away from projects that yield a revenue stream over an extended period of time in favor of projects that promise short-time gains and quick payoffs. Third, increased risk premiums increase the relative attractivness of real estate shelters and municipal bonds and other financial investments.

Because risk premiums are not directly measurable, it is necessary to resort to indirect methods. One method commonly employed is to measure risk as the spread between the yield on the highest quality security of a given maturity and the yields on lower quality bonds of comparable maturity. If we compare the yield on high quality long-term government bonds with the yields on high- and medium-quality, long-term corporate bonds, the spread in yields can be used as a measure of the market's assessment of the additional risk attaching to corporate securities. The spread itself may not be an especially good

measure of the risk premium in an absolute sense, but movements in the spread over time are widely viewed as being highly correlated with changing risk premiums.

The movement of these spreads is documented for the period 1960 to 1979. As is apparent from both series, the spreads narrowed through the mid-1960's and then increased sharply reaching a peak in 1974, narrowing again in the period of 1975 to 1978 and widening once again in 1979. It is probably no coincidence that the movement of these spreads is rather closely correlated with changes in the overall rate of inflation though one needs to add that the variability in the risk premiums could also have been the result of, among other things, changing health and safety regulations and uncertainties with respect to future energy policies. Nevertheless, high and variable rates of inflation are probably an important factor.

In summary it doesn't make much difference whether the rate of return has been substantially unchanged or whether it has fallen, the result is the same. If inflation causes profits and taxes to be overstated, that means inflation will reduce funds available for future investment and growth. If inflation raises the risk premium, that, too, means that some projects, particularly those with a long payoff, will not be undertaken. In either case the capital-to-labor ratio is likely to fall, and long-term productivity growth will decline as a result.

The relationship between inflation, profits, productivity, and capital formation is more complicated than the above discussion implies. First, policies designed to step up the rate of investment spending must be set in the overall context of general macroeconomic policies. Yet these macroeconomic policies are, themselves, influenced by inflation and productivity growth. An earlier report of the Joint Economic Committee explores in some detail the automatic response of monetary and fiscal policy to an increase in the rate of inflation and in the impact of inflation on the policymaking process itself.[15]

Second, after adjusting for the automatic restriction in fiscal and monetary policies induced by inflation, policymakers must be alert to the danger that actions intended to produce a long-range improvement in capital spending could, in the short run at least, exacerbate inflationary pressures. If the economy is operating at or near its potential, the increase in aggregate demand occasioned by an increase in investment could contribute to inflation directly unless offset by lower spending elsewhere. The design of macroeconomic policies to ensure that overall demand pressures do not mount becomes critical in this context; at or near full capacity, macroeconomic policy must be aimed at changing the mix of output, not the overall level of aggregate spending.

Third, even with properly adjusted macroeconomic policies, if the capital goods industry is operating at or near capacity, increased investment spending could cause a rapid escalation of capital goods prices that might not be offset by price declines elsewhere. Therefore, the magnitude of the policy-induced stimulus to investment spending must be conditioned by the state of demand in the capital goods sector as well as in the overall economy.

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[15] See *The 1977 Midyear Review of the Economy*, Joint Economic Committee, September 26, 1977 for a complete discussion.

The energy problem confronting the United States and the world economy further complicates the relationship between inflation, profits, productivity, and the rate of capital formation. Independent of its influence on our general rate of inflation, higher energy prices affect capital expenditure decisions directly. The available empirical evidence suggests that energy and capital are, in the short run at least, complementary as opposed to substitutable inputs. In other words, an increase in the price of one decreases the quantity demanded for *both*.

As energy and capital costs have risen, several things have happened. The increase in capital costs relative to labor costs has spurred the search for technologies that are more labor intensive. This directly reduces productivity growth. At the same time, rising energy costs have made a significant part of the capital stock economically obsolete. This has caused a larger than normal fraction of new investment to be devoted to the replacement of the existing capital stock. It has also made businessmen unwilling to commit significant resources to capital investment when they know that investment may rapidly become obsolete.[16] This creates real problems for productivity growth, but it also creates measurement problems with the conventional depreciation formulas used by the Bureau of Economic Analysis. The result is that productivity growth may actually be worse than indicated by the current statistical measures.[17] Finally, to the extent that higher energy prices have shortened the economic life of capital equipment, the problems discussed earlier concerning the interaction of taxes and depreciation are worse than indicated.[18]

Productivity and the International Sector

The decline in the growth of U.S. labor productivity, most notably its decline relative to the productivity growth performances turned in by our trading partners, is often identified as a major factor responsible for both the dollar's weakness on the world's currency exchanges and the large U.S. trade deficit. There is undoubtedly some truth to this view, but the relationship is not as simple and direct as many would have us believe.

In general, it cannot be argued that slower productivity growth necessarily causes a deterioration in our balance of trade or a weakening of the dollar internationally. For example, since a slowed rate of productivity growth relative to the rates recorded abroad implies a correspondingly slower relative rate of growth of domestic income, the demand for imported goods by U.S. residents will, other things constant, grow less rapidly than the demand for our goods abroad.[19] This results in an improved trade balance and a stronger dollar internationally. Conversely, an acceleration of our productivity growth, by accelerating the growth of domestic relative to foreign incomes to that extent will worsen our trade balance and weaken the dollar.

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[16] For further evidence on this, see Ernst R. Berndt and Dale W. Jorgenson, "How Energy, and Its Cost, Enter the Productivity Equation," IEEE Spectrum, October 1978.

[17] J. R. Norsworthy and Michael J. Harper, "The Role of Capital Formation in the Recent Slowdown in Productivity Growth," Working Paper 87, Office of Productivity and Technology, Bureau of Labor Statistics, U.S. Department of Labor, January 1979.

[18] The importance of the role energy has played in the U.S. productivity decline is subject to debate within the economics profession. See the paper by Christainsen and Haveman in this volume for a discussion of the conclusions reached by different researchers.

[19] The relationship between aggregate productivity growth and aggregate income growth is not as direct as this sentence implies. To the extent that a slowdown in productivity growth stimulates an increase in the labor force, the loss of income may be recouped.

In other respects, however, a slower relative rate of productivity growth will cause our balance of trade to deteriorate and bring downward pressure on the foreign exchange value of the dollar. To the extent that a slowdown in U.S. productivity growth causes the prices of U.S. goods to rise relative to the prices of foreign goods, the resultant substitutions on the part of both domestic and foreign residents in favor of foreign goods will cause the U.S. trade balance to deteriorate. Of course, if the foreign exchange value of the dollar falls as a consequence of the trade balance deterioration, this will help stem the deterioration itself by lowering the relative price of U.S. goods in foreign markets.

The role of the dollar in international energy trade further complicates the situation. Since international contracts to buy and sell oil are normally denominated in dollars, a fall in the foreign exchange value of the dollar means that energy prices for oil importers (except the United States) fall. It also means that the purchasing power of oil exporters falls. If exporters respond by raising the dollar price of their oil to offset the drop in the foreign exchange value of the dollar, inflation in the U.S. will be higher relative to other oil importing countries. This would cause a further deterioration in our balance-of-trade position. The increase in the dollar price of oil would also increase the demand for dollars in the foreign exchange markets by non-U.S. oil importers. The impact of this on the foreign exchange value of the dollar will depend upon how the oil importing countries spend their dollars.

It is important to recognize in this whole discussion that it is the relative rates of productivity growth in our actual and prospective export- and import-competing industries that are most important. The impact of a decline in the overall productivity growth rate is indirect and affects the export- and import-competing industries only through its effect on the overall level of prices and wages. It is, therefore, quite possible for a decline in the economy's overall productivity performance to have relatively little impact on the foreign trade sector.

Again, to the extent that the value of the dollar declines in response to these trade developments, at least part of the relative increase in the price of U.S. goods will be offset, a development that will serve to limit the adverse trade balance effects. Moreover, even though some industries might experience a loss in competitiveness in world markets, the balance-of-trade effects could be partly neutralized by an increase in the relative competitiveness of other industries whose productivity and price performance are more favorable.[20] The conclusion of these considerations is that there is no direct and unambiguous relationship between productivity growth and our balance of trade.

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[20] It is worthwhile putting this point somewhat differently. Had there been no overall productivity growth decline or any decline in the growth of productivity in our existing export- and import-com e ing industries, the fact that some industries were experiencing an increase in their relative competitiveness means there would probably have been an improved trade balance. In the face of a decline in productivity growth, the trade balance might fail to improve, or even deteriorate, though the adverse effects will be smaller because of our increased relative competitiveness in certain goods. To the extent that the trade balance effects are neutralized in this manner, there will be no observable deterioration in our trade balance as a consequence of the productivity slowdown.

Although the argument is theoretically true, to the extent that U.S. relative competitiveness is improving in industries which have not been traditionally export oriented, there may be a considerable time lag before these industries realize their potential international market and begin to exploit it. Information costs may be very high here. Therefore, it is reasonable to conclude that the quantitative impact of this factor will be much more significant in a long-run equilibrium than in a short-term disequilibrium state.

The relationship between U.S. productivity growth and the foreign exchange value of the dollar is somewhat clearer. The value of the dollar is determined by the demand for and supply of dollars on the world's currency exchanges. U.S. productivity growth is but one of the innumerable forces that affect the demand for and supply of dollars, and its influence is registered indirectly, not directly.[21] Nevertheless, there is considerable evidence in support of the proposition that higher inflation rates in the United States (relative to inflation rates abroad) will cause the foreign exchange value of the dollar to decline. Thus, to the extent that a slower rate of productivity growth accelerates the United States inflation rate, it will cause the dollar to depreciate in value.

Unfortunately, the effect of a slowed rate of productivity growth does not end with a decline in the value of the dollar. Dollar depreciation, by boosting import prices, further aggravates domestic inflation. In the short run this causes an even sharper decline in the dollar and higher rates of inflation. Appropriately, this process has been dubbed a "vicious circle." [22] Of course, this process cannot go on forever. The higher relative prices of foreign goods will eventually cause a reduction in consumption as buyers shift to domestically produced import-competing goods. Also, to be perpetuated, the higher rate of inflation must be validated by a more rapid expansion of the domestic money supply. This is not an entirely unrealistic prospect in view of the "real" (i.e., employment and output) adjustments the economy would have to suffer in order to arrest and partially reverse the excessive dollar depreciation. In any event, the inflation problems caused by a slowed rate of productivity growth are exacerbated by the resultant foreign exchange pressures on the value of the dollar.

Productivity, Growth, and Employment

The foregoing discussion has considered the interactions between productivity, inflation, taxes, profits, and foreign trade. Underlying this discussion has been an implicit notion that all of this has an impact on economic growth. Without repeating all of the arguments aluded to in earlier contexts, that notion needs to be made more explicit.

Economic growth is nothing more or less than the output that results from the combination of a series of physical inputs: labor, capital, materials, and energy. The manner in which these inputs are combined determines productivity. One might view productivity as the glue that holds everything else together.

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[21] For a detailed discussion of the forces affecting the foreign exchange value of the dollar, see the Joint Economic Committee, "Review of the Economy, October 1978," Chapters 1 and 2.

[22] One must be careful not to confuse "vicious circle" symptoms with the differences in the inflation performance of an economy under fixed versus flexible rates. It is a well-known proposition that an economy that pursues policies resulting in a higher rate of inflation domestically than abroad will discover that its domestic rate of inflation will be lower under fixed as opposed to freely floating (or partially managed) exchange rates. Under fixed rates of exchange, it will "export" some of its inflationary pressures abroad, the consequence of expanding monetary reserves in foreign countries brought about by the intervention operations of foreign monetary authorities. For a detailed discussion of these matters, see, for example, the JEC "Review of the Economy, October 1978," and Thomas D. Willett, "Floating Exchange Rates and International Monetary Reform," (Washington, D.C.: The American Enterprise Institute, 1977).

Taking this approach, one can easily see that changes in any of the material inputs can change economic growth. If, for example, high taxes reduce profits and raise the cost of capital, this would discourage the use of capital and would result in lower economic growth. But one can also see that changes in productivity, changes in the strength of the glue that holds things together, can also result in changes in economic growth.

In recent years there has been a variety of changes in the inputs that produce economic growth. Large increases in the real price of energy have upset the normal production relationships rendering large parts of our capital stock obsolete. Changes in the age structure of our population and in social attitudes toward work have produced large increases in the labor input relative to the other inputs. The physical scarcity of many resources has reduced our freedom to consume these resources. All of these factors have contributed to unsticking some of the productivity glue that helps to produce economic growth.

The situation has gotten so bad, in fact that for the past few years there has been no productivity glue. From 1973 to 1979 productivity did not grow. This meant that all economic growth had to come from growth in one or more of those physical inputs: labor, capital, materials, or energy. And we know that most of the increase in growth has come from the increase in the labor input.

While there is nothing wrong, per se, in increasing growth by increasing the labor input, this does not allow for any rise in the standard of living of the American people. An increase in our living standards might be achieved by increasing other inputs, but limits on our physical resources make this unlikely. All that remains is productivity. If we want to raise the standard of living for Americans, we must restore the productivity growth that holds everything else together. And, thus, total economic growth and productivity growth must go hand in hand if we are to continue to enjoy a rising standard of living.

PROBLEMS WITH THE MEASUREMENT OF PRODUCTIVITY

By James L. McIntire

CONTENTS

Our daily lives are surrounded with measures of productivity, measures that relate one or more inputs to output. At breakfast we may worry about the number of calories per serving. On the way to work, miles per gallon. And at work, widgets per employee hour or perhaps bushels per acre. Each of these measures presents us with a ratio that compares a well defined output to a specified input.

But what does a well known business magazine mean when it says that "[T]he increase in the output of the American workforce during the past six years has proved a disappointment."? Or to what inputs and outputs is the Bureau of Labor Statistics (BLS) referring when it puts out a press release that begins with : "Productivity in the private business sector decreased 1.6 percent at a seasonally adjusted rate in the fourth quarter of 1979."?

Is the business magazine implying that American workers are getting lazy? Does the Government mean to imply that the private business sector simply produced less in the fourth quarter than in the third quarter? Of course, neither of these inferences is necessarily correct, but these examples of how the term "productivity" is bandied about by economists and the press serve to illustrate the need for a clear understanding of just exactly what it is we are talking about in the Great Productivity Debate.

What is Productivity?

Most general references to "productivity" are to the rate of change in labor productivity, that is the rate of change in real output per hour of labor input in the private business sector. This is the most comprehensive measurement published by the Federal Government for relating inputs to outputs in our Nation's economy. However, it is certainly not the most comprehensive measurement possible and should be more accurately identified as a "partial productivity" measurement.

The production of goods and services in any economy, industry, or firm requires a range of resources used as inputs which are commonly grouped in three categories: Land, labor, and capital. For example,

the production of a copper tube requires several gradations of inputs from each of these categories: Copper ore is a highly specialized land input; the labor inputs of miners, foundry workers, and office managers cover a broad spectrum of skill levels; and the various types of machinery, from bulldozers and smelting furnaces to typewriters, involve an equally broad spectrum of capital inputs. Thus, a measure of labor productivity for the private business sector is a broad aggregate measure in the sense that it pits a wide range of labor inputs against a wide range of goods and services outputs, and yet it is a limited measure in the sense that it does not include capital or land, the other primary inputs, to any production function.

This is not to say that inferences cannot be made about these other inputs based on an output-to-labor productivity ratio. A decline or even a slowdown in the growth of this ratio, for example, may imply several different things about the other primary inputs. One source of the decline may be a rapid growth of relatively unskilled labor inputs. Another source might be a failure of capital or possibly even land inputs to grow at a pace properly matched to the rate of labor inputs. And yet another source might be a decline or slower growth in the productivity of capital inputs, which may be due to technology advance, energy costs, health and safety improvements, or a host of other factors. In any case, the lack of clarity provided by the official labor productivity measures about the behavior of other primary inputs to production have led some economists, most notably those of the Joint Economic Committee and the National Academy of Sciences' Panel to Review Productivity Statistics, to recommend that the BLS provide measures of "multi-factor" (that is multi-input) productivity.

The focus of this paper is on the problems of measuring labor productivity. It will not seek to make the case for new measures of multifactor productivity but instead will attempt to summarize the problems we now confront in our present BLS measures of labor productivity.

Current State of the Art: Labor Productivity Measurement

Measurements of productivity, in order to be accurate, must fulfill two basic requirements. First, the input and output data must refer to the same specific productive activities. And second, outputs must be measured independently of inputs. Of course, these are theoretical requirements and are not always met in practice.

The BLS series on changes in output per worker hour in the private business sector consists of a ratio where the numerator measures changes in the real output of the sector and the denominator measures changes in the total hours of all people who produce this output.

The numerator of the private business sector series is derived from measures of the gross national product (GNP) and its components, as compiled by the Bureau of Economic Analysis (BEA). The GNP measures the market value of the output, the capital and labor resources that generate servable income transactions, plus the imputed product of some resources for which here are no observable market transactions, such as the benefits of owner-occupied homes and food produced and consumed on farms. However, BLS subtracts the measures of output for household employment of domestic workers, employees hired directly by government, and not-for-profit organiza-

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tions from GNP because the present measures of output for these sectors are based only on the amounts of labor inputs that are used. BLS also excludes from ouput the imputed rental value of the benefits of owner-occupied homes because there is no way to obtain good measures of the maintenance labor input associated with this output. Thus, the numerator of the BLS output measure is equal to the gross domestic business product in constant dollars minus the constant dollar imputed value of the benefits of owner-occupied homes.

The denominator of the private business sector series is the unweighted sum of the hours of all workers in the production of the output measured in the numerator of the productivity ratio. The hours data contained in the denominator are based primarily on sample data from two sources: The current employment statistics (CES) program, which covers about 80 percent of the private business sector, and the Current Population Survey (CPS) which includes the remainder, primarily agriculture and self-employed workers.

It should be pointed out that both the input and the output measures used for the private business sector series come from different sources and sometimes involve imputations or assumptions. In contrast to only two sources used for measuring labor input, the output data comes from several different sources such as the Census Bureau's Survey of Retail Trade, the Monthly Selected Receipts Survey, the Annual Housing Survey, and several other surveys.

In fact, about 5 percent of the output measure included in the private business sector labor productivity ratio consists of activities where measurement of output is based on labor input. These are activities for which an hourly earnings index is used as a proxy for a price index to deflate current dollar spending and include such activities as shoe repair, household services, insurance, bank services to individuals, spectator sports, clubs, and the services of proprietary hospitals and schools. This is a clear example of where current practice in measuring productivity departs from our second theoretical requirement of such measurements, that is that measurements of inputs and outputs be independent of one another.

In addition to the broad measure of labor productivity in the private business sector, the BLS also produces measures of output per worker hour for the various divisions that make up the sector, although only those for the manufacturing industries are published. The numerators (output) of these measures are based on the BEA measures of real gross product originating (value added) by industry. These output measures depend on the use of a detailed input-output analysis using the annual Survey of Manufactures data on the current dollar value of total shipments deflated by the appropriate Producer Price Index figures. One-half of the manufacturing data on real value-added outputs requires the deflation of both production and purchases, hence the origin of the "double deflation" method about which more will be said later.

Problems With Current Measurement Methods

Generally speaking, there are several areas where the measurement of both outputs and labor inputs involve conceptual as well as informational gaps. Output measures provoke questions about treatment

of capital, quality-of-life, and quality-of-product measures as well as unaccounted-for shifts in the composition of output and factors of production. Input measures raise questions about the use of hours unweighted by skill level and the inclusion of paid vacations, as well as the exclusion of some supervisory work hours.

One area of controversy in the measurement of output is how capital investments should be treated. At the present, the BLS output measure is defined as gross rather than net of capital depreciation. There would be no difference between the effects of a gross and a net output measure on the growth rate of the resulting productivity ratio if net output and depreciation grow at the same rate in real terms. However, if real net output and real depreciation grow at different rates, there would be a difference in the resulting productivity growth rates. While present evidence indicates that gross and net productivity show similar secular rates of growth, an analysis of the sources of growth would show a larger contribution from capital and a smaller contribution from other sources if the gross rather than the net measure is used. Proponents of the net-of-depreciation output measure argue that depreciation represents a "using up" of capital goods that have previously been produced and hence should not be included in the output measure. On the other hand, the proponents of the gross output measure argue that there is no more reason to exclude capital consumption from the output measure than there is to exclude other goods and services that do not contribute directly to well being, such as national defense, crime protection, and antipollution equipment. These goods and services are part of the output of marketed labor input whether or not they are desired for their own sakes.

Some would take this argument further, pointing out that research and development is presently treated as consumption or an intermediate good rather than being included in final output. The exclusion of research activity from real output lowers measured productivity in the short run until the benefits of the research are realized in conventional output.

Some critics have argued that the concept of economic output used in the National Income and Product Account (NIPA) does not provide a consistent measure of welfare or quality of life. Some activities that contribute to the quality of life, such as parental care for children, are excluded from the NIPA, while the costs of such necessary evils as crime prevention are included in output measures. The same is true of unmeasured outputs of cleaner air and water and safer workplaces, all of which have associated costs that are included in the NIPA output measures. For example, some research indicates that if the output of homemakers were included in the NIPA measurements of output, the large numbers of women leaving homemaker roles for jobs in the business sector would have resulted in a noticable productivity increase. However, while it is generally agreed that these outputs are valuable, it is very difficult to get timely and objective measures of their value.

Another set of problems in measuring output arises from the treatment of quality changes in the price indexes used to deflate current-dollar output. When a product is replaced by an improved product that sells for a higher price, the improved quality must be measured or

else the price increase will tend to bias real output and productivity downward. BLS price indexes presently account only for improvements in products and services that are associated with higher costs to the producer. For example, a car that used to include a radio only as optional equipment but now includes the radio as standard equipment is judged to be improved by the cost of the radio to the producer. On the other hand, no allowances are made for higher research and development costs or technological changes not associated with production costs. One good example of this was the replacement of the large mechanical electric desk calculators which cost about $1,000 by pocket electronic calculators which cost about $200 when first introduced. The pocket calculators, which performed more functions more quickly and quietly, were treated as a new product by the Consumer Price Index and hence show no price change at the transition. If the total number of calculators produced remained the same during transition, this would have meant that BLS measures would have shown an 80 percent drop in the output of calculators, while in reality, the output of calculators actually stayed the same, or it could be argued, improved.

As mentioned earlier, about 5 percent of private business sector output measurements depend on hourly wage indices, primarily in consumer services industries. By compromising the principle of independent measurement of inputs and outputs, some measurement error is inevitable in this portion of the private business sector productivity. While this would not appear to create much bias when measuring productivity changes from period to period using this same methodology, changes in the composition of demand over time could raise or lower the proportion of private business sector output that would be subject to measurement using this "compromised" methodology. Thus, there is the potential for some bias in the private business sector productivity measure over time.

Shifts among factors of production also create the possibility for some error in output measurement, particularly in industry measures. Estimating changes in the real volume of purchased materials and services used per unit of output is difficult, since existing data sources seldom contain direct data on the current product mix of the purchased inputs. This creates measurement problems even for industries where the preferred "double-deflation" measure is used, since deflators are constructed from information in past input-output matrices which may not reflect the current mix of purchased inputs. This problem is perhaps most important in relation to the changing relative prices of energy and energy-intensive products. Most presently used input-output matrices are based on data gathered in 1967; and although these matrices will soon be updated, they will be updated only through 1972.

Most of the problems in the denominator of the labor productivity ratio have to do with developing more precise measurements of hourly labor inputs. These inputs are estimated as the product of the number of workers and average hours per worker. At present, average hours include all hours paid for by employers, rather than all hours spent working. The basic difference between the two concepts is paid leave, including paid vacations, holidays and sick leave. Inclusion of this

difference biases the productivity measurement downward, particularly since paid leave time has been on the rise during recent years.

Another difficulty with the hours input data is that they do not now include all workers. For example, both mining and manufacturing data cover all production workers, while data for other industries cover all nonsupervisory workers. Average nonproduction worker hours in manufacturing are presently estimated by holding them constant since 1962, while average supervisory worker hours in all other industries are assumed to be equal to nonsupervisory average hours. These methods were used to estimate about 18 percent of the total nonagricultural workers' hours in 1977, and 28 percent of all workers on the payroll in mining and manufacturing.

A third area of difficulty with labor input data is that BLS uses measures of hours that are unweighted for skill levels. As a result, one hour of unskilled labor, such as a ditch digger using a pick and shovel, is treated equally with one hour of skilled labor, such as a construction worker operating a backhoe. If labor inputs were skill weighted, then measured productivity would generally increase if businesses were able to substitute lower skilled labor for higher skilled labor through capital investments and technological advancements. The weighting of labor inputs for skill levels is also particularly important with reference to demographic trends, where the recent infusion of relatively inexperienced and unskilled youth into the labor force has had a significant effect on labor productivity measures. Some private investigators have used wage rates to determine the weights for different skill levels, assuming that prevailing wage differentials reflect the different productive capacities of different types of workers. However, this assumption may not be entirely accurate, particularly with respect to the effects of race and sex discrimination on wage rates.

Net Effect of Conceptual Bias and Measurement Error

In light of the various problems of measuring productivity discussed above, the obvious and most important question is: What is the net effect? Estimating the net effect created by these problems is extremely difficult and in some respects almost begs the question—if the net effect were known, then there would be little difficulty in compensating for these problems. However, based on a conceptual analysis of the problems inherent in the present productivity measures, some comments about the direction of the resulting measurement bias can be made.

While the inclusion of some "quality of life" measures would certainly cause current measures of labor productivity to increase, it is neither theoretically imperative nor practically possible that they be included. Rather, some of the improvements in the quality of life resulting from "negative" expenditures necessarily included in the measurement of output, such as pollution abatement, crime control, national defense, and other things, are reflected in lower health and income costs, greater economic stability (and lower interest rates), and the opportunity to translate these savings into other more productive investments. In this sense, the direction of bias created by the current practice of excluding some measures of quality of life improvement from output is indeterminant. While labor productivity may grow

more slowly in the short run because of the "negative" expenditures, many of these expenditures are one-time costs and if they are effective, they may result in higher future output levels.

Problems associated with changes in product quality generally exert a downward bias on the rate of labor productivity. This is true not only of such small items as calculators, but also of housing, where improvements in the size, structure type, and standard accessories have been quite substantial in recent years. In both cases, changes in quality are not always appropriately reflected in the price index used for deflating output, hence causing a general tendency toward a downward bias in the real output measure. Although any attempt to determine the magnitude of this bias would be subjective, it is not likely that it would be very large. Furthermore, while the absolute size of this bias may be increasing over time, its relative size, that is relative to total output, is likely to be fairly constant over time. Thus, the net effect of this type of measurement problem on the rate of labor productivity growth would not be significant.

One problem that has been growing larger over time is in cases where the measurement of output is based on labor input. While this problem affects only about 5 percent of final demand, generally in consumer services, this sector has been increasing as a proportion of final demand over time. One clear indication of this is the fact that the proportion of personal consumption expenditures for services has increased by over 15 percent during the last 20 years.

The error resulting from the problem is likely to bias the productivity measurement downward. Since an hourly earnings index is used to deflate final demand in this sector of the economy, any increases in wages that might be due to greater productivity on the part of the wage earners in these consumer service industries would be treated as price increases. And although it is generally recognized that the output of these industries is closely related to the labor input, improvements in service worker skills and productivity are not unlikely, particularly in light of recent large increases of young people and women employed in these industries and their potential for skill development as their experience increases.

Industry measures of output also suffer from a downward bias that has been increasing over time, particularly because of the effects of relative price changes on the input-output matrices used to derive industry output. The sharp increases in the real price of energy in 1973 and more recently in 1979 can be expected to cause industries to shift away from energy-intensive inputs. However, since the present input-output matrices are based on pre-1973 data, the intermediate inputs that are netted out of industry output measurements may be significantly overestimated, hence creating a downward bias for industry productivity growth measures.

In the denominator of the labor productivity ratio, the trend toward increasing paid leave for employees also tends to bias the rate of labor productivity growth downward. This trend may not be very significant, particularly since it may be offset by the large influx of new and young workers into the labor force. These workers have low seniority and hence are not entitled to as much of these leisure benefits as older workers. However, while the trend in paid-leave hours may not be significant now, it may increase in importance in the future as young or new workers increase their entitlements to paid leave.

Another more controversial issue relating to the measurement of inputs is whether or not these inputs should be weighted according to skill levels. If some such weighting scheme were implemented, some of the recent declines in the rate of productivity growth would be erased. For example, if hours of labor input during the past decade were weighted in relation to the average skill level of the labor force in 1970, then the large influx of youth and women into the labor force during the last 10 years which created a sizable addition of hours by workers with generally below-average, on-the-job-specific skills would have lowered the total labor input and hence raised the rate of productivity growth.

While it could be argued that the education and training skills of these new labor force entrants rose considerably during this time, it should be noted that education and other formal training are not perfect substitutes for on-the-job-specific skills, even though they are factors that affect the long-term productive potential of the work force. Opponents of the skill-weighted labor input approach argue that the labor productivity measure is intended to reflect changes in the overall skill level of the labor inputs to the economy, and any skill-weighted adjustment to those measured inputs would defeat the purpose of the labor productivity measure. However, other intended objectives of the labor productivity measure should also be considered, such as the measure's ability to focus on the behavior of policy-sensitive variables, that is those factors which policy decisions can alter to either improve or discourage the rate or productivity increases. In this sense, the skill-weighted labor input method would be preferable because it would separate the effects of exogenous demographic changes on the rate of productivity growth.

Implicit in such a measure would be a skill-adjustment factor, which, when added back in, would permit both a policy-focused labor productivity measure and the broader total labor productivity measure to be calculated. However, it is important to remember that the bias created in the present labor productivity growth measure by the lack of a skill-weighted method arises from a conceptual distinction about the purpose of the measure rather than a shortcoming between theory and practice.

One additional factor affecting the accuracy of productivity statistics not previously discussed is what is more narrowly defined as "measurement error." Measurement error is not a conceptual problem but rather is a more mechanical problem related to the collection of data and the aggregation of data from various sources and surveys used in the labor productivity measure. Since all surveys are accompanied by some margin of error in observation, whether they rely on sampling procedures or universal reporting, the labor productivity measures are not immune from measurement error. However, this difficulty becomes compounded when the results of several different surveys are aggregated to produce a single estimate, as in the case of most published labor productivity measures. As a result, the well established methodologies for estimating sampling error that are applied to other official statistics like the unemployment rate cannot be applied to official productivity measures, and new methods for making such an estimate are necessary. Furthermore, the direction of this error is not a known factor. Presumably the errors of observation in the different surveys would be distributed randomly, creating an equal

likelihood for error in either direction. Thus, the magnitude of the measurement error, as well as the direction of this error, is indeterminant, although it is likely that the margin of error on both sides of the "true" productivity measure is at least as large as the widest margin of error in any of the individual surveys used to compile the productivity estimate.

What is the net effect of the conceptual biases and measurement error for official labor productivity measures? Clearly, the above discussion suggests that there is a noticeable downward bias in productivity measures. Since the areas where these biases appear are in the growing sectors of the economy, this suggests a downward bias in the rate of labor productivity growth over time. How large this bias may be is unclear; it is entirely likely that it is within the range of statistical significance. Since this is not an empirical analysis, further research would be necessary to substantiate the conceptual analysis presented here and to determine the relative magnitude of the bias, if in fact it exists. Additional research would also be necessary to determine the breadth of the margin of error in official productivity measures.

International Labor Productivity Comparisons

As a general rule, the problems associated with measuring domestic productivity are compounded in any attempt to make international comparisons of productivity growth rates. While this does not mean that such comparisons are not useful—indeed they are—it does mean that they should be used with a somewhat larger grain of salt.

Briefly, international comparisons have been prepared by the Organization of European Economic Cooperation in the 1950s, the International Comparisons Project of the United Nations and the World Bank in the late 1960's and 1970's, and the Bureau of Labor Statistics in 1978. The BLS study was the most extensive, showing international comparisons for the years 1950, 1955, and 1960 to 1976 that include the United States, Canada, Japan, France, Germany, Italy, and the United Kingdom. Most of these productivity growth measures are presented in terms of changes in gross domestic product (GDP) per employed civilian, with the GDP measures deflated by measures of purchasing power parity in each country.

Although there are several problems associated with these comparisons, such as the use of different types of surveys in different countries to come up with price and output measurements of similar products, one of the clearest examples of these problems is the measure of labor inputs used. By expressing the productivity growth ratio in terms of GDP per employed civilian, many labor market factors and trends are obfuscated. For example, any diverging trends in different countries in employment-to-population ratios, labor market participation by youth and women, migrant labor, part-time versus full-time work, average weekly hours, and paid leave are all overlooked in this kind of rough estimate of productivity. As a result, much caution should be used in interpreting and drawing any conclusions from these international comparisons.

INCREASING PRODUCTIVITY IN THE UNITED STATES: WAYS IN WHICH THE PRIVATE AND PUBLIC SECTORS CAN CONTRIBUTE TO PRODUCTIVITY IMPROVEMENT

By Julius W. Allen*

CONTENTS

Abstract

This report describes ways that have been proposed for raising productivity in the United States, divided into policies and practices of the private sector and of the public sector. Introductory chapters

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discuss the concept of productivity and the various factors which influence changes in productivity. The report concludes that productivity improvement merits high priority in both private and public sectors, and the costs and benefits of the various means of raising productivity need careful assessment, and that there is much room for improvement in the measurement of productivity and in an understanding of the factors that contribute to productivity growth.

Introduction

Focus of the Report

Three propositions underlie this report. First, increases in productivity are desirable. Productivity, according to most experts, is a major, if not most important, factor in the increases in living standards in the western world. John W. Kendrick, a leading expert on productivity trends in the United States, opens his 1977 study, "Understanding Productivity" with the sentence: "The chief means whereby humankind can raise itself out of poverty to a condition of relative material affluence is by increasing productivity." [1] Solomon Fabricant, author of *A Primer On Productivity*, writes, "Everybody in the economy stands to gain directly from higher productivity or to lose from lower productivity." [2] Similarly, Lester Thurow of the Massachusetts Institute of Technology states:

> Since productivity determines how fast standards of living can rise, any decline in the rate of growth of productivity has potentially serious implications for the future. Each of us in particular, and all of us in general, are going to be able to afford fewer goods and services (including leisure) than we would be able to afford it productivity were growing more rapidly.[3]

Other factors that contribute significantly to economic welfare include of course increases in employment and utilization of productive capacity.

While higher productivity is an important goal of public policy, it is not necessarily at any given time the most important. There are observers who feel that present emphasis on higher productivity may be excessive. Thus, for example, the M.I.T. management professor, Jay Forrester, recently suggested that improving productivity is of little help when U.S. productivity is at the highest level in history; instead he advised business leaders to concern themselves with the threat of growing economic, social, and political turmoil outside their corporations, instead of working on internal changes to create productivity gains.[4]

Michael Maccoby in *The Gamesman* suggests that the emphasis in corporate business generally on increases in output and profits, which are in large measure dependent on rising productivity, often

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[1] Kendrick, John W. Understanding Productivity; An Introduction to the Dynamics of Productivity Change. Baltimore, The Johns Hopkins Press, 1977. p. 1.

[2] Fabricant, Solomon. Testimony Before the Joint Economic Committee, June 8, 1978 in U.S. Congress, Joint Economic Committee. Special Study on Economic Change. Hearing, Part 2, June 8–14, 1979. p. 499.

[3] Thurow, Lester. The U.S. Productivity Problem. Data Resources U.S. Review, August 1979, p. 1.14.

[4] Jones, William H. Relatively minor gains predicted in productivity. Washington Post, October 3, 1979. p. D12.

conflicts with such important human values as compassion, friendship, and satisfying craftsmanship.[5]

The second proposition underlying this report is that recent declines, in the rate of increase in productivity have had adverse effects on the United States and its economy. This lag in productivity growth is widely believed to increase production costs, encourage the inefficient use of increasingly scarce resources, lower U.S. competitive capability in world markets, excerbate inflation, jeopardize job security, and increase labor-management tensions. Even though the level of U.S. productivity is high compared to that of the rest of the world, the decline in the rate of productivity growth is of serious concern to many in public and private life.

The third propostion is that there is a vast array of ways in which productivity can be increased. Many can be undertaken by individuals, firms, and organizations in the private sector; others require government action.

It should be stressed that improving productivity is not a costless endeavor and that many of the ways of increasing productivity take a long time to be effective. They require the investment of resources in research and development, education and training, and plant and equipment. Many efforts to raise productivity are resisted because of their negative impact on employment, at least in the short run, and because they may add to pollution and accelerate the depletion of resources. Solomon Fabricant noted in a 1978 paper:

> One of the most significant sources of resistance to productivity improvement is the widespread association of the concept with the loss of jobs and unemployment. The question of labor displacement has troubled people since the early days of the machine age. There is no doubt that automation, mechanization, or any advance which makes for higher labor productivity can wipe out jobs. The immediate effect of increases in output per hour is to reduce employment per unit of output. If output is unchanged and hours of work remain the same, this reduction in employment per unit makes for a reduction in the industry's aggregate employment. However, if output is increased, employment can remain the same or be expanded.[6]

It has, in fact, been demonstrated that industries with above-average productivity gains have tended to increase employment more than those with below-average productivity increases. Similarly there is greater danger of lay-offs in firms with technologically backward managements than where managements are innovative and progressive.[7] Nevertheless, the fear of job loss is real and the impact on particular workers may be serious, unless adequate provisions are made for retraining, retirement, and severance pay. This fear is a main factor in much of the opposition of many labor unions to a good many private and public sector endeavors to raise productivity.

The interactions of productivity and other economic phenomena are often complex and difficult to trace. For example, productivity advances are widely considered to contribute importantly to a lessening

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[5] Maccoby, Michael. The Gamesman, New York, Simon and Schuster, 1976. Ch. 7, The Head and the Heart.

[6] Fabricant, Solomon. Productivity Growth: Purpose, Process, Prospects, and Policy, in U.S. Congress. Joint Economic Committee. Special Study on Economic Change. Hearing . . . Part 2. June 8–14, 1978. p. 525.

[7] Ibid., p. 525.

of inflation. At the same time, inflation is seen as a cause of lower productivity because of its adverse effect on capital formation and risk-taking. Similarly, increases in productivity are likely to encourage greater capital formation and oputput closer to productive capacity. At the same time, increased capital formation and higher capacity utilization are seen as tending to raise productivity. "Strong productivity growth lifts G.N.P. growth, and strong G.N.P. growth feeds back on productivity." [8]

Structure of the Report

There are many ways in which the various means to increase productivity might be classified, such as short-run and long-term; macroeconomic and microeconomic in nature; and political, economic, and social measures. In this paper, the primary distinction to be made is between private sector and public sector means of raising productivity, Chapter III dealing with the private sector and Chapter IV dealing with the public sector comprise the major part of this report. There chapters also include a brief consideration of the principal institutional and organizational provisions, private and public, that have been undertaken in the United States to increase productivity. Introductory to these two chapters are two brief chapters, one outlining the concept of productivity and its significance, and second providing an indication of what various analysts consider to be the major factors that account for and contribute to increases in productivity.

I. The Concept of Productivity

Productivity is a term used to measure the efficiency of the utilization of resources. In a fundamental sense, therefore, productivity is an expression of the relationship between the output of goods and services and inputs of resources—labor, capital, and natural resources. It can be expressed by the ratio O/I, where O designates output, and I inputs.[9] More specifically, the denominator of this ratio consists of the weighted sum of all of the inputs used in production. Such a ratio may refer to the entire national economy, to a specific industry, or to a particular enterprise or plant. However, the empirical measurement of total factor productivity, in particular the weighting of inputs, is so complex and difficult that it is rarely attempted on any broad scale.

Instead, a number of partial measures of productivity are generally used. Of these the most common is labor productivity, or output per unit of labor input, usually measured by number of hours worked. This is the earliest form of productivity measurement, originating in the Bureau of Labor of the Interior Department in the 1880s. It is still the mostly widely cited indicator of productivity.

Other partial productivity measures include capital productivity, the ratio of output to amounts of capital input, and output per unit

[8] Bowen, William. "Better Prospects for Our Ailing Productivity." Fortune, v. 100, December 3, 1979, p. 77.

[9] Efficiency and productive efficiency are sometimes used as synonyms for productivity as defined here. Herbert Simon has noted, for example, "In recent years, 'efficiency' has acquired a second meaning: the ratio between input and output." Simon, Herbert. Administrative Behavior. (2nd ed.) p. 180.

of land. The latter is frequently expressed in terms of yield per acre, one of the most common measures of agricultural productivity.

A particular productivity ratio, taken by itself, is not as significant as the changes in that ratio over time, or that ratio as related to comparable productivity ratios in comparable industrial firms, economic sectors, or different countries. "Productivity measures assume significance in *comparisons*—intertemporal and interspatial." [10]

II. Factors Influencing Productivity

A necessary condition for adoption of policies, private and public, to raise productivity is an understanding of the factors that enter into changes in productivity. These range from long-range characteristics of a nation's people to immediate specific actions of an individual or group.

On a fundamental level, social values, institutions, and the legal framework of a nation are key determinants of productivity. They are often cited to explain differences in productivity among nations, regions, and other social groups. They involve such attributes as desire for material advancement, innovativeness, ability and willingness to save, and attitudes towards work and workmanship. These values are translated into such determinants of productivity as capital investment, research and development, education and training, health, safety and mobility.

In a direct sense, as Solomon Fabricant has pointed out, rising productivity depends on better quality of labor, more tangible capital goods, and on the greater efficiency in the use of labor and tangible capital goods. Of these three, Fabricant claims that it is the last that bulks largest as source of increased output per man hour in the United States.[11] William Bowen, writing in Fortune of December 3, 1979, states, "Let it be firmly said that improvements in productivity come largely from nonlabor factors, notably technology and tangible capital." [12]

Productivity is also affected by such economic considerations as economies of scale, degree of capacity utilization, availability of resources, extent and type of domestic and foreign competition, government monetary, fiscal, and regulatory policies, business cycles, and labor-management relations.

In short, as Solomon Fabricant has pointed out:

> ... the high productivity of the American economy is the end result of a great many different activities involving decisions by millions of scientists, engineers, and technicians in laboratories and industries, educators in schools, universities and training centers; managers and owners of production of facilities; workers and their families and unions; and government officials. Increases of this country's output per hour over the long run is the result of the energy, ingenuity, and skill with which all of us, individually and as a Nation, manage our resources of production.[13]

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[10] Kendrick, John W. Understanding Productivity. p. 13. For further information on the concept of productivity, see: Fabricant, Solomon. A Primer on Productivity, 1969. Ch. 1,-"What Productivity Is," p. 3–11; and Kendrick, John W. Understanding Productivity, 1977. Ch. 2 "The Concept, Measurement and Meaning of Productivity," p. 12–18.

[11] Fabricant, Solomon. A Primer on Productivity, 1969. p. 73.

[12] Bowen, William, op. cit., p. 70.

[13] Fabricant, Solomon. A Primer on Productivity, 1969. p. 73.

The measurement of these factors presents formidable difficulties. Many of the factors are closely linked, such as capital investment and the technology in which it is invested. Productivity trends vary greatly by industry and occupation. In some, notably many of the industries in the service sector, satisfactory measurement standards are still lacking. Likewise, such intangible factors as work ethic, worker morale, and a nation's social values defy numerical measurement, although they may be highly significant.

Further, as noted above, a satisfactory measurement of total factor productivity is rarely achievable on any broad scale, and the limitations of partial factor productivity, such as output per hour of labor input, are often overlooked.

Substantial progress has nonetheless been made in measuring many of the essential elements of productivity change. Recently, the work of Edward Denison has attracted particular attention. Denison has attempted to estimate the impact of the following factors on productivity in the United States, as reflected in national income per person employed in nonresidential business:

Changes in labor utilization rates.
Changes in sex-age composition of labor.
Changes in education of labor force.
Changes in work experience of labor force.
Changes in allocations of resources.
Changes in scale of operations.
New or strengthened government regulations in the areas of pollution abatement and the protection of worker safety and health.
Resources devoted to crime prevention, and the cost of dishonesty and crime.
Fluctuations in demand, including shifts in demand between high-productivity and low productivity industries.
Changes in weather.
Changes in work stoppages.[14]

Denison calculates that all of these posited factors account for less than half of the drop in productivity growth since 1973, the remainder being attributed to a residual consisting of advances in knowledge and miscellaneous determinants.[15]

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[14] Denison, Edward F. Explanations of Declining Productivity Growth. Survey of Current Business. v. 59, August 1979: 1–24.

[15] Edward Denison lists the following 17 possible factors for the sharp decline in productivity since 1973 which he did not measure, and no one of which seemed to him able to provide a probable explanation of drop:

(1) Curtailment of expenditures on research and development.
(2) Decline in opportunity for major new advances in knowledge.
(3) Decline of Yankee ingenuity and deterioration of American technology.
(4) Increased lag in application of knowledge due to aging of capital.
(5) Diversion of input to comply with government regulations, except for pollution and safety.
(6) Government imposed paper work.
(7) Regulation and taxation: Diversion of executive attention.
(8) Government regulation: Delay of new projects.
(9) Regulation and taxation: Misallocation of resources.
(10) Effects of high tax rates on incentives and efficiency.
(11) Capital gains provisions of the Revenue Act of 1969.
(12) "People don't want to work anymore."
(13) Impairment of Efficiency due to inflation.
(14) Lessening of competitive pressure and changes in the quality of management.
(15) Rise in energy prices.
(16) Shift to the services and other structural changes.
(17) Possible errors in data.

Not surprisingly other economists differ with Denison on the weight to be placed on the various factors contributing to the decline in productivity growth since 1973. For example, some place considerably more emphasis on energy prices and others on a decline in the rate of capital formation.[16]

Certain demographic and economic trends may have a beneficial impact on productivity in the 1980s, even without specific productivity initiatives within the public and private sector, such as those outlined below in this report. The expected decrease in the number of young people entering the labor force in the early 1980s and the growing experience of the large number of women who entered the labor force in the 1970s, will result in a more productive work force. An increase in the growth rate of the gross national product and in the capital-labor ratio is expected by several economic analysts in the 1980s, especially if the rate of inflation can be lowered.

Both trends would tend to raise productivity, as would lowering inflation itself. Some, although far from all, economists believe that the burden of regulatory costs which had a substantial negative impact on productivity in the late 1960s and 1970s will lessen in the 1980s.[17]

On the other hand, important factors that contributed to vigorous productivity gains in the two decades between 1947 and 1966 are unlikely to be repeated in the 1980s. These include the shift of farm populations to urban areas, the rising levels of education, and the availability of cheap energy.[18]

While Denison, Fabricant and others mentioned thus far have looked at factors of productivity change largely from a macro-economic perspective, important contributions towards explaining changes in productivity have been made at the micro-economic level of the firm.

Significant exploration of essentially micro-economic reasons for variations in productivity in various firms has been undertaken by Harvey Leibenstein in the process of which he has developed a concept he has termed X-inefficiency.[19] Leibenstein noted that differences in productivity among firms are great, greater than could be reasonably accounted for by traditional micro-economic theory which assumes that firms will minimize costs for any given output, or that with given inputs the greatest number of outputs would be produced.

Leibenstein differentiates between allocative efficiency and X-efficiency. Allocative inefficiency is the inefficiency caused by market prices which fail to allocate inputs and outputs in the most efficient manner, due to such factors as monopoly and trade restrictions. He notes that these misallocations are relatively small, according to most empirical

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[16] See: Fisk, John. U.S. Labor Productivity: Trends and Economic Impact. (Report No. 79-248E). Washington, Library of Congress, Congressional Research Service, Dec. 6, 1979. 42 p. On energy prices, see: Siegel, Robin. Why Has Productivity Slowed Down? Data Resources U.S. Review, March 1979, pp. 1.59–1.65. On capital formation, see Norsworthy, J. R. and others. The Slowdown in Productivity Growth: Analysis of Some Contributing Factors. Brookings Papers on Economic Activity, no. 2, 1979: 387–421, and Clark, Peter K. Capital Formation and the Recent Productivity Slowdown. Journal of Finance, v. 33, June 1978: 965–75.

[17] Bowen, William. op. cit., pp. 70, 74.

[18] Ibid., p. 74, 77, 83.

[19] See especially his Beyond Economic Man: A New Foundation for Microeconomics. 1976. 297 p.

studies. X-inefficiencies are those usually associated with factors inside an enterprise and consist of inefficiencies in: (1) labor utilization; (2) capital utilization; (3) time sequence; (4) extent of employee cooperation; (5) information flow; (6) bargaining; (7) credit availability utilization; and (8) heuristic procedures.[20] In short, "X-efficiency theory is concerned with the relation of differential motivation to effort and consequently to cost and quality of output." [21]

It may be suggested that some of this inefficiency may result from passive or negative attitudes within segments of management and labor. In some firms, most frequently in mature industries, stress on improving productivity appears to be subordinate to a reluctance to take risks and a willingness to be satisfied with maintaining an acceptable share of the market. Some observers also argue that in recent years many workers have adopted a more casual attitude toward their work with a resultant decline in care and attention to qualify and quantity of output and in workplace discipline.

As a result of the prevalence of various forms of X-inefficiency, production in general will not be at the point of optimum output. As a corollary, in general firms can increase output without increasing the number of employees or technical knowledge.

III. Private Sector Ways to Raise Productivity

Introduction

The concern with the decline in the growth rate of productivity has resulted in considerable agitation for a broad series of governmental measures to bring about an upswing in productivity. While some such measures may well be desirable, it is generally agreed that most increases in productivity are attributable to private enterprise.[22] Solomon Fabricant refers to this often neglected fundamental fact as follows:

> The main sources of increase in the productivity of labor are, by far, actions by individuals in pursuit of their private interests. It is to improve their own knowledge that students spend their time and energy and their parents' money on education. It is to add to their own capital that families and corporations save. And they seek ways to increase the efficiency with which their labor and capital are used in order to get more for themselves.[23]

Similarly, Mark Perlman has recently concluded:

> Our national concern should shift from the macro indexes to an emphasis on the micro process of improving the performance of individual production units. Whether the individual solutions will depend upon improved capital inputs via new technology or better utilization of the present capital stock, the decisions will be made by managements concentrating on raising the output/input ratios. Thus, one key to the solution is clearly at the plant or firm level; macro analysis may reflect what is happening, *but one major part of the solutions is on the micro level.*[24]

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[20] Leibenstein, Harvey. X-efficiency: From Concept to Theory. Challenge, v. 22, September-October 1979, p. 14.

[21] Ibid., p. 22.

[22] The private sector accounted for 89 percent of gross national product in 1979.

[23] Fabricant, Solomon. A Primer on Productivity, 1969, p. 151.

[24] Perlman, Mark. One Man's Baedeker to Productivity Growth Discussions, American Enterprise Institute. Contemporary Economic Problems, 1979. Washington, American Enterprise Institute for Public Policy Research, p. 112.

Despite the self-interest which would suggest a strong move toward high productivity on the micro level, there is evidence that many individuals and enterprises customarily operate at far less than optimum productivity levels. For example, it has been shown that in many industries the productivity of the best practice firms during the 1960s was often more than twice as large as for the average firm.[25]

E. E. Lawler III, an organization specialist at the University of Michigan, claims: "Even the most conservative studies seem to suggest that individual incentive plans can increase productivity from 10 to 20 percent." [26]

This apparent failure of many firms to reach anything approaching optimal productive efficiency has led to attempts to find plausible reasons for this phenomenon and to a broad range of recommendations for increasing productivity within the firm. There are many "how to" books and articles designed to help interested persons, particularly management personnel, improve productivity within their organizations. There are also a growing number of productivity centers in the private and governmental sectors which are available to assist businesses in increasing their productivity.

Responsibility for Raising Productivity

The chief responsibility for raising productivity in the private sector is usually seen as residing in management. This view prevails in many manuals on how to increase productivity. Management consultant John Patton has said:

> Declining productivity is not entirely the fault of organized labor . . . it is not entirely the fault of our patronizing, interfering government . . . it is not entirely the fault of shifting attitudes of our younger generation . . . the real fault lies squarely at the feet of management, for not seizing the initiative to take remedial action.[27]

More succinctly, in the words of former chairman of the board of General Motors, Richard C. Gerstenberg, "Better productivity results from better management." [28]

Others feel that workers must assume a greater share of the responsibility for improving productivity. Paul Mali, a management consultant, argues:

> Because American workers want quality in the work life and are demanding more from the economy than it can produce, they must accept, along with management, the responsibility for the consequences of their demands. They must join with management for improved productivity. They will share the gains. American workers want a higher standard of living, more leisure time, higher quality of work life, cleaner air, and better education. Merely raising wages, taxes, and prices won't get these; they will only produce inflation. What is needed is to distribute the responsibility for productivity to all parts of our work society.[29]

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[25] Salter, W. E. G. Productivity and Technical Change. 2nd ed. Cambridge, England, Cambridge University Press, 1966. Similar findings based on earlier data are found in: Davison, J. P. and others. Productivity and Economic Incentives. London, Allen C. Unwin, 1958. Ch. 1 and ch. 8.

[26] *In* Katzell, Mildred. Productivity: The Measure and the Myth. New York, AMACOM, 1975. p. 5.

[27] Ross, Joel E. Managing Productivity. Reston, Va., Reston Publishing Co., 1977, p. 6.

[28] Ibid., p. 6.

[29] Mali, Paul. Improving Total Productivity. New York, John Wiley, 1978, p. 16. See pp. 19–28 below for ways of obtaining greater worker involvement in raising productivity.

Regardless of the extent of responsibility for raising productivity that may rest with labor, the government, and the consuming public, the main focus continues to rest with management. The effectiveness of the use of incentives, communication, planning, measurement, and all other specific means available for raising productivity, several of which are outlined below, depends basically on the policies and actions of all levels of management. The quality of supervision and the priorities given by management to specific efforts to raise productivity related to other organizational goals will be prime determinants of productivity gains.

It has been suggested that supervisors who are supportive of their staff and demonstrate leadership that is employee-centered rather than job-centered are likely to achieve appreciable productivity gains.

Management must also be alert to the need for organizational changes when a business or service enterprise grows and expands its functions or scope of operations. Unless specifically controlled, organizational growth can lead to complexity, wasted time, burdensome paperwork, and rising costs that can have serious adverse impacts on productivity.

List of Recommendations for Private Sector Ways To Raise Productivity

The following list of steps individuals, firms, and institutions in the private sector can take on their own to to raise productivity is more illustrative than comprehensive. It includes recommendations and proposals which have been found to have been instrumental in improving productivity in various situations in the past. Some of the recommendations will, of course, be more cost-effective than others in any given case. Many of them are broad in scope and can be subdivided to a considerable degree. Some overlap among them is also to be expected. Most of them are considered in more detail below.[30]

(1) Improvement in tools and other technology.
(2) Improvements in procedures, including layout and workflow.
(3) Greater stress on and allocation of resources to research and development.
(4) Higher capital investment in plant and equipment with potential for higher productivity.
(5) Greater managerial ability, effort and focus on productivity.
(6) More rapid adjustment to changing supply and demand factors.
(7) More effective motivation of employees.
(8) Better communication with and among employees.
(9) Provision of safe, clean, and well designed work places.
(10) Effective training and promotion programs for employees.
(11) More accurate and meaningful measurement of productivity.

Factors Influencing the Quality and Quantity of Labor Output

Much of the stress on productivity improvement in the private sector is on raising labor productivity. Such a direction is to be expected, first because, in most firms and industries, labor costs are the largest

[30] See especially the chart below which points up many of these factors and how they interact with one another.

component of total costs, and second because there appear to be a large number of ways in which labor productivity can be increased. However, it should be recalled that non-labor factors, such as technology and tangible capital are widely considered to be the major sources of productivity increases.[31]

The means for such increases in productivity that are outlined below are derived, for the most part, from a number of manuals and texts that focus on how to lift productivity at the firm or plant level,[32] publications of the National Center for Productivity and Quality of Working Life, and a few of the major private productivity centers in operation, particularly the American Productivity Center, Houston, Texas, and the Work in America Institute, Scarsdale, N.Y. Most are directed at the various levels of management which are in the best position to put productivity recommendations into effect.

Labor productivity is heavily determined by the various factors that influence the quality and quantity of labor output, including such basic elements as rates of pay, working conditions, education, and training of workers, and worker motivation. The chart presents, in graphic form, many of the factors which contribute to labor productivity and some of the relationships among them.

One can begin with such obvious elements of productivity as technology, management skills, and labor skills. The role of technology in raising productivity has been abundantly illustrated. Improving the quality of tools and machinery has been a factor in increasing productivity throughout human history. Firms which are alert to technological innovation and devote resources to such innovation are more likely to increase productivity than those that remain satisfied with the status quo. "Organizations that invest higher proportions of revenues and time for R. & D. are the organizations that have a greater leverage toward productivity gain." [33]

Clearly technological innovation and expanded research and development require investment of capital. In fact, of all public policy recommendations for increasing productivity, those related to expanding the availability of capital are the most common (see below). But to a substantial extent, private management has considerable discretion in determining the timing and volume of new capital investment and in the direction such investment should take.

Closely related to encouragement and adoption of new technology, and sometimes even more important, is better utilization of given technology. As James Utterback, a specialist industrial innovation at the Massachusetts Institute of Technology, recently stated: "Small step-by-step changes in product and process often add up to much greater advances in product quality, performance, and productivity than do this initial more dramatic changes." [34] These shop floor improvements include such elements as improved work-flow and layout, and redesigning of work patterns, among other reasons to reduce boredom and

[31] See, II. Factors Influencing Productivity, above.

[32] The following are the primary sources consulted: Hinrichs, John R. Practical Management for Productivity. New York, Van Nostrand Reinhold, 1978. 192 p.; Hornbruch, Frederick W. Raising Productivity. New York. McGraw-Hill, 1977. 339 p.; Mali, Paul. Improving Total Productivity. New York, Wiley, 1978. 409 p.; Ross, Joel E. Managing Productivity. Reston, Va., Reston Publishing Co., 1977. 191 p.; Sutermeister, Robert A. People and Productivity. (3rd edition). New York, McGraw-Hill, 1976, 475 p.

[33] Mali, Paul. Improving Total Productivity, p. 32.

[34] Bowen, William, op. cit., p. 86.

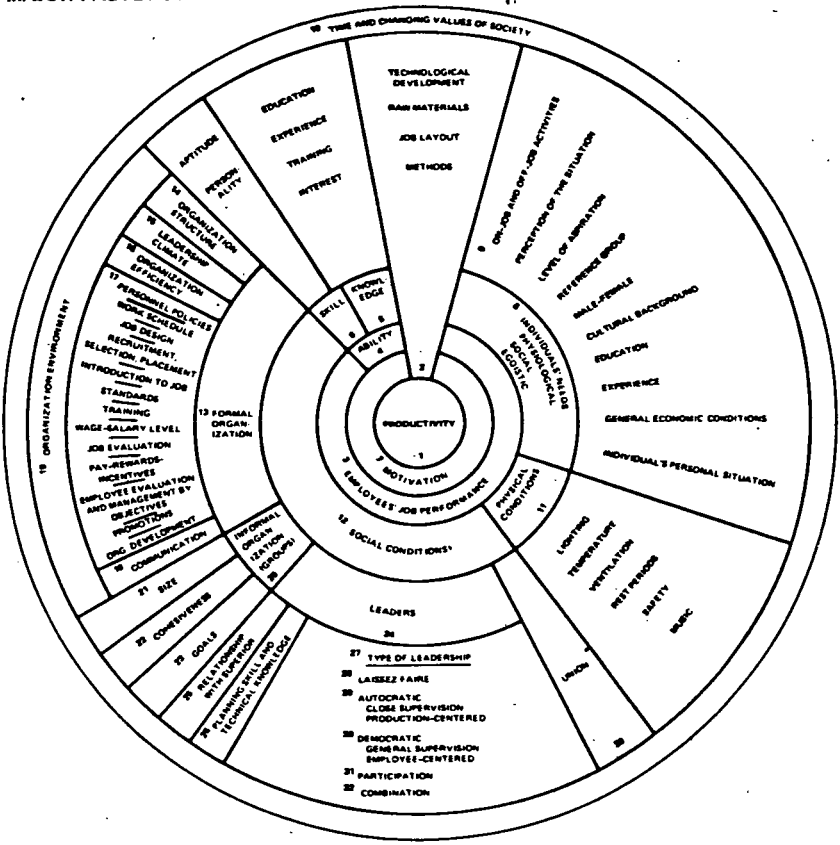
tedium. In a good many production processes it has been found that productivity increases when the scope of workers' responsibility increases, when they are given responsibility for a more complete part of the production process, one with a clearly defined beginning, middle, and end.

Higher productivity also calls for managerial ability to adjust rapidly to changing supply and demand situations. In a period, such as the present, in which unforeseen supply shortages in energy and raw materials can develop over a short period of time, the importance of such practices as recycling of materials, substitution of materials, and adjustment of delivery schedules is increased.

With respect to labor compensation, the importance of tying rewards and benefits to productivity increases is often stressed. A frequent source of employee unrest and dissatisfaction arises when management fails to let workers share tangibly in the gains resulting from increases in productivity.

The contribution to productivity of work places that are clean, well lighted and ventilated, and which create lower risks of accident and illness is generally recognized. On the other hand, not all measures aimed at safer and more healthful working conditions necessarily raise productivity. The most efficient speed for operating a given piece of machinery may not be the same as that that would minimize the risk of accident. (The same dilemma is confronted in determining acceptable speed limits on the nation's highways—the advantages of greater speed having to be offset against the increased risks of more material damage, more severe accidental injury and more deaths.) Further, the degree of acceptable risk and discomfort will vary by industry and occupation. In any case, the incentives for managements to improve safety and health conditions at work sites as economically as possible are strong and are enhanced by union and other social pressures for improved environmental, health, and safety standards. Failure of firms to abide by such standards is likely to be reflected in worker dissatisfaction and unrest and consequently in lowered output.

MAJOR FACTORS AFFECTING EMPLOYEES' JOB PERFORMANCE AND PRODUCTIVITY



1. The size of each segment has no relationship to its relative importance, which would vary with different organizations, different departments, and even different individuals with their own distinct needs.
2. The factors in each segment affect factors in the corresponding segment of the next smaller circle; they may also affect and be affected by other segments in the same circle or other circles.

Source: Sutermeister, Robert A. People and Productivity. 3d ed. New York, McGraw-Hill Book Co., 1976. p. 1.

Motivation

The importance of motivation as a force for productivity gains is stressed by many experts in productivity management in the firm. Leibenstein, whose x-efficiency concept has been referred to above, puts primary emphasis on differences in motivation, or in the motivational system, to explain differences in productivity among establishments. He states:

> I suggest that the main differences [in productivity] can be explained by the motivations of the firm's members during their work, by the motivational atmosphere they find on the job, and on the type of interactions and influences toward work and production that people have on each other as well as the attitudes they bring to the work context. These factors are probably the most significant ones in explaining differences in productivity in the same industry and between countries at roughly similar stages of development.[35]

At another point, he develops this emphasis on the importance of motivation as follows:

> A major element to be kept in mind is that although productivity depends on motivation, motivation is not a purchasable input in the marketplace. Managers must regard motivation as an input in the production process. It is as important to production as steel or nails or raw materials or energy. For different degrees of motivation different outputs result for the same other inputs. Although what managers do is part of the motivation-creating process, it is only part of it. Managers must know not only how they influence motivation but how the activities that they do not normally associate with motivation in fact contribute to the motivational structure of the firm. In other words, problems may be created by management not only by the problems they recognize but by the problems they create but fail to recognize because they do not inquire about the consequences on motivation that results from decisions, changes, and general behavior. Although these may be intrinsically difficult to handle, they certainly cannot be answered if they are not asked.[36]

However, practical means of utilizing different forms of motivation (or motivators) to achieve higher productivity are often difficult to put into effect. There are good reasons for this difficulty. People vary in their response to particular incentives or motivators. What energizes some individuals may turn others off. Further, key motivators for a given individual will vary in importance over time. Where more money in a job may be a prime motivator at the beginning of a career, often this is replaced in degree of importance by such other incentives as opportunities for advancement, opportunities to demonstrate creativity and particular skills, recognition for accomplishment, and more leisure time. Similarly, motivations at various levels in an organization will differ in relative importance. Finally, indivduals respond to many different kinds of motivation simultaneously; no one or two will be adequate. Some motivators are effective for extended periods of time, others erode quickly. Those concerned with motivation will need to be alert to the effectiveness of the various kinds of incentives to productivity and to be willing to make changes and adjustments in motivation as needed. In essence, increasing productivity requires as high degree of alignment as possible between the needs and expectations of employees and the objectives and targets of the organization.

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[35] Liebenstein, Harvey. Beyond Economic Man; A New Foundation for Microeconomics, 1976. p. 270.
[36] Ibid., p. 257.

The importance of respect as a motive was stressed by James F. Lincoln, founder of the Lincoln Electric Company, Cleveland, Ohio, a medium-sized company which has engaged in a number of innovative management practices. In 1946, he wrote:

> The incentive that is most insistent in all people is the development of self-respect and the respect of their contemporaries. The worker wants most of all to be a man among men. Earnings that are the reward for outstanding performance are one evidence of this ability. Progress in his position and responsibility are others. He wants the feeling that he is part of the team. He wants to feel that his efforts are necessary to make the activity a success. He wants to feel that he has been a part in a project that is worthwhile and has succeeded because his ability was needed in it. Money alone will not do the job.[37]

Joel Ross lists the following nine important motivators that he maintains need to be taken into account if an organization is to bring about changes that are necessary to increase productivity and profitability:

(1) *Work* that is challenging, creative, and interesting and provides as opportunity for "stretch" performance.
(2) *Participation* in decisions that have a direct effect on the individual's job.
(3) *Compensation* that is tied to performance and to sharing in productivity gains. This requires realistic *appraisal.*
(4) *Communication and authority* channels that are simplified.
(5) *Supervision* that is competent.
(6) *Recognition* of achievement.
(7) *Self-development* opportunity.
(8) Opportunity for *stewardship,* care of and attention to customer and co-worker needs.
(9) *Organizational styles* and patterns that are more flexible.[38]

Quality of Working Life

It will be seen that many of these motivators are elements in the concept, "quality of working life," a concept that has spawned a considerable literature and organizational changes in the past decade. According to Paul Mali, "The chief component of the quality of work life is the strong desire for workers to influence and have some say in connection with how their own work is planned, distributed, executed, and evaluated." [39]

Katzell and Yankelovich list the following strategies for improving the quality of working life:

> . . . giving them [workers] work which more completely utilizes their aptitudes and skills, providing helpful and considerate supervision, composing harmonious work groups, affording opportunities for upward and lateral mobility, giving workers a voice in decisions which affect them, and improving working conditions so as to increase comfort, health, and safety.[40]

While improving the quality of working life has, in many instances, contributed to a rise in productivity, the relationship between the two is complex and variable. As Katzell and Yankelovich conclude on the basis of a large number of case studies:

> If there is any one fact that stands out clearly from the massive accumulation of data, it is that worker job satisfaction and productivity do not necessarily

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[37] Lincoln, James F. Lincoln's Incentive System. New York, McGraw-Hill, 1946. pp. 46–47.
[38] Ross, Joel. Managing Productivity, pp. 27–28.
[39] Mali, Paul. Improving Total Productivity, p. 14.
[40] Katzell, Raymond A. and Daniel Yankelovich. Work, Productivity, and Job Satisfaction. New York, Psychological Corporation, 1975, pp. 4–5.

follow parallel paths. This does not mean that the two objectives are incompatible, for there is evidence that it may be possible to achieve them together. Nor does it mean that the two goals are totally independent of one another. Under certain conditions, improving productivity will enhance worker satisfaction and improvements in job satisfaction will contribute to productivity. What it does mean is that there is no automatic and invarient relationship between the two. Indeed, the two objectives are so loosely coupled, there are so many intervening links between them, and the relationship is so indirect, that efforts which aim primarily at improving worker satisfaction on the assumption that productivity will thereby automatically increase are more likely than not to leave productivity unchanged, or at best to improve it marginally, and may even cause it to decline. . . . Substantial and enduring improvements in performance as well as job satisfaction appear to require that an integrated combination of methods that relate the human to the economic concerns must be employed in order to bring about large-scale and enduring improvements in both domains simultaneously. Thus, there may be ways to achieve both goals, even though they are functionally independent, but not by means of any single-target program or standard formula that can be applied uniformly to any and all situations.[41]

Improved Communication

Ranking near motivation in importance as a factor in labor productivity is improved communication at all levels of supervision and among workers. This is a multi-faceted recommendation that appears in various guises. Some have given it top ranking as a way to raise productivity. Thus the National Center for Productivity and Quality of Working Life in its final report (1978) states that in the construction industry, "the greatest potential for productivity improvement lies not in the area of increased capital and technology, but rather in the area of increased communications and information." [42] Similarly in coal mining, "Cooperative discussion with managers and union officials has made it clear that the primary need at the present time is for improved communications throughout the industry." [43]

The following are some of the productivity recommendations that relate to improved communications. Sharing of information related to the operation and future of a company or industry, particularly as it affects the worker, both in the short-run and the long-run, is generally beneficial. "Employees produce more when they know the score." [44]

Employee participation in decisionmaking heightens their sense of responsibility and willingness to improve their output.

In general, employees respond favorably to clear statements of the goals of the organization as well as the goals expected of them. A corollary is the need for feedback about the results of their work and a system of appropriate rewards for desired accomplishments.

Communication among peers can help provide support and reinforcement for desired performance. It also can be used to foster competition among teams that will frequently be an incentive for higher outputs. As a rule, the likelihood of such competition being successful depends on the assurance to the worker that he will be appropriately rewarded for the additional output resulting from the competitive effort.

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[41] *Ibid.*, pp. 12 and 13.
[42] National Center for Productivity and Quality of Working Life. Productivity in the Changing World of the 1980's: The Final Report of the National Center for Productivity and Quality of Working Life. 1978. p. 79.
[43] *Ibid.*, pp. 74–75.
[44] Hornbruch, Frederick W. Raising Productivity, p. 76.

Measurement of Productivity

The importance of measurement as an aid toward increasing productivity is widely recognized. Paul Mali, in *Improving Total Productivity*, stresses the idea "that productivity must be measured before it can be improved." [45]

Productivity data are useful for a variety of purposes. They can signal the need for corrective action if targeted goals or norms are not reached. They can provide the means for measuring the effects of initiatives taken to improve productivity performance. They permit comparison of performances of various organizational units and of other companies in the industry or industries in which the firm operates. They are essential for sound budgeting and planning in such areas as personnel recruitment, training, investment, and procurement programs.

Perhaps the chief benefit of a productivity measurement system is its psychological effect—increasing the productivity-consciousness of the employees, particularly the management and supervisory personnel. If the measurement system is linked to company-wide productivity improvement programs, benefit can be derived by channeling increased productivity-mindedness into efficiency-promoting efforts throughout the work force.[46]

Quantitative measurement greatly facilitates objectives and fair evaluation of work performance. Admittedly not all work can be quantified in a meaningful way. Quantified measurement tends to be best suited for structured repetitive tasks. Qualitative evaluation is required for creative, abstract, and non-repetitive tasks. In practice, both qualitative and quantitative measures are useful for evaluating most work performance.

The kinds of measurement undertaken in a firm or organization vary widely in meaningfulness and utility. Meaningful measurement relates to the objectives of a firm or organization. Where these goals are difficult to quantify—as is the case in many services and non-profit organizations—measures of output or other activity have sometimes been used that bear little relation to objectives. For example, mileage logged by police vehicles or number of traffic summons issued are often used as measures of the effectiveness of police programs, but are actually very poor criteria for measuring success in crime prevention.

Some management experts hold that productivity measurement rather than hours worked on the job should be the basis for compensation to employees.

Productivity data on individuals should be the basis on which to justify price increases, wage hikes, and salary adjustments. Performance contracting with employees rather than time contracting opens up a viable direction to control inflation while providing benefits to organizations and their employees.[47]

It should be recognized that in many industries and trades prevailing production methods make it difficult to achieve this objective. Stress on productivity can lead to sacrificing quality in the interest of raising output. In addition, alleged misuse of productivitiy measurement by management has been the rationale for union opposition to such measurement as the basis for compensation in a number of instances.

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[45] Mali, Paul. Improving Total Productivity, pp. 102–103.
[46] Kendrick, John. Understanding Productivity, p. 123.
[47] Mali, Paul. Improving Total Productivity, p. 27.

Institutional Structures Within the Private Sector To Increase Productivity

As already noted, productivity increases are more dependent upon the degree of efficiency and innovativeness within private enterprises than on specific acts of government. Beyond the prevailing business structures and practices geared to achieve higher productivity, there have been a number of further organizational developments which focus specifically on productivity gains. One such is the establishment of in-plant joint labor-management committees in many corporations and other businesses. Usually such committees are formed as a result of some crisis within the firm or industry which makes clear the need for joint efforts to increase productivity. A major impetus to such joint committees came during World War II when there was a strong demand for increased production to meet war requirements. Many of these committees were dropped after the war.

Beginning in the 1950s, a new plan of labor-management cooperation, called the Scanlon Plan, evolved in the interests of greater efficiency and productivity. It involved a system of plant-wide bonus payments based on estimated savings in labor costs. A committee structure to obtain worker participation in cost reduction was a key feature of the plan. About 500 plants in the United States and Canada have adopted the plan, but it has made little headway in the largest firms, where the relationship between individual performance and reward is more difficult to demonstrate and group incentives lose their impact.[48]

Other types of joint committees are included in labor-management contracts between companies and unions, many of them major ones in their respective industries. The prototype of most of these agreements was in the contract agreed upon in 1971 by the United Steelworkers of America and major steel companies. It provided for establishment of a joint advisory committee on employment security and plant productivity at each plant of the signatory companies. By 1975, there were 230 such committees and their concerns had been extended to a number of matters beyond the original scope. However, they are still found in only a small fraction of all collective bargaining contracts. They appear to have been most successful in such industries as steel, automobiles, railroads, and retail food where competitive pressures or industrial relations have been difficult. The failure to achieve further growth is due in part to mistrust by union representatives of productivity efforts, which have been equated with speed-up time and motion tactics, and of failure to distribute productivity gains equitably. As a rule union-management cooperation appears to be more likely to succeed when dealing with productivity and quality of work than with such issues as job security, earnings, and fringe benefits, which are the traditional subjects of collective bargaining.

Productivity efforts have also expanded at the community level, with the establishment of area labor-management committees. During World War II, about 5,000 such committees were formed to boost war production, but almost all were disbanded at the end of the war. A re-

[48] U.S. National Commission on Productivity and Work Quality. A Plant-Wide Productivity Plan in Action : Three Years of Experience with the Scanlon Plan. Washington, 1975. 54p.

cent resurgence has resulted in the establishment of an estimated 300 such committees, the largest in Pittsburgh, Pennsylvania and Buffalo, New York. A National Association of Area Labor-Management Committees was formed in 1978. These committees have been successful in such endeavors as preventing strikes, attracting new industries, designing plant expansion, engaging in skills-training programs, improving communications between management and labor, and campaigning against burdensome regulations.[49]

One of the most widely publicized community labor-management committees was established in 1973 in Jamestown, New York. It was able to turn around the decline of business and employment in the community, reduce strikes and grievances, increase employment and training, and attract new businesses to the community.

Another institutional approach to raise productivity, beyond the plant and community level, is seen in the establishment of productivity centers in many parts of the country. These centers, many of which are affiliated with colleges and universities and have a State or regional focus, attempt to disseminate information in the interests of raising productivity and often quality of working life as well. By 1978, there were a total of 20 such centers, as listed by the National Center for Productivity and Quality of Working Life.[50] Most are less than ten years old. Perhaps the largest and best known are the American Productivity Center of Houston, Texas, and the Work in America Institute in Scarsdale, New York.

The American Productivity Center, Houston, Texas, was established in February 1977. By 1979, it had obtained funds totaling $13 million from over 100 corporations and foundations. It has a staff of 50, which was expected to grow to 75 by the end of 1979, 20 of whom are associates detailed from corporations and other institutions for limited periods of time. Its services to individual companies or industry groups include information, research and development, education and training, and assistance in the design and implementation of appropriate productivity measurement and improvement programs.[51]

Among its programs and activities to improve productivity are publications and other communications media with information on productivity and productivity awareness, appraisals as to where productivity improvements can be made, briefings for individual companies on productivity improvement programs, development of productivity data, and sponsorship of labor-management conferences.

The Work in America Institute is a non-profit organization supported by a wide spectrum of corporations, foundations, unions, and the Federal Government. It is organized into three divisions. The Communications and Clearinghouse Division collects, develops, and disseminates information about issues affecting productivity. Its Education and Training Division provides education and special training for union leaders, managers, government officials, and educators through conferences, seminars and special briefings. Its Technical As-

[49] Popular, John J. Solution: a Community Labor Management Committee. Labor-Management Relations Service Newsletter, v. 10, November 1979, p. 2.
[50] National Center for Productivity and Quality of Working Life. Directory of Productivity and Quality of Working Life Centers. Fall, 1978. 79 p.
[51] U.S. Congress. House Committee on Small Business. Productivity and the U.S. Economy. Hearing . . . , March 14, 1979. pp. 24–42.

sistance and Policy Studies Division provides guidance to interested organizations in applying tested techniques for improving productivity. Its publications and activities have received considerable attention.

During the almost three years of its existence (November 1975–September 1978) the National Center for Productivity and Quality of Working Life, a Federal governmental agency, conducted and coordinated a range of activities that bear considerable resemblance to those of the two private productivity centers just described.

In its final report, the National Center summarized the scope of its activities as follows:

> To explore the major opportunities for improving productivity, the Center has convened panels of experts from business, labor, consumer groups, the universities, and governments; it has conducted and commissioned studies to supplement existing information; it has held conferences and workshops on various aspects of productivity; and it has sponsored demonstration projects to encourage the adoption of "best" practices in the public and private sectors. The Center's Board of Directors has identified four broad policy areas in which labor, management, and Government could develop and implement programs to improve productivity: (1) accelerating technological changes; (2) encouraging capital investments; (3) developing human potentials; (4) improving relationships between business and government.[52]

IV. Public Sector Ways To Increase Productivity

Introduction

There is no clear dichotomy between governmental and non-governmental steps to raise productivity. Many of the proposals mentioned above for raising productivity in the private sector apply equally to the public sector. Governmental organizations and private institutions alike are actively engaged in such productivity programs as dissemination of information on productivity techniques by means of publications, presentations in other media, workshops and seminars, encouragement of research and development, and developing better methods for measuring productivity. Government and private enterprise alike have contributed to productivity gains in such endeavors as the space, national defense, and agricultural research programs.

Several of the factors which determine changes in the nation's productivity, up or down, do not lend themselves to desirable or even acceptable governmental action in a democratic society. A review of the causes for recent declines in productivity by Edward Denison (see above) demonstrates this point.

Thus, a growing proportion of youth and women in the labor force has been found to be a contributing factor in the decline of productivity since 1966. There seems no socially accepted reason for having the Government take steps to reverse this trend. This does not, of course, preclude the possibility of the Government providing incentives for education and training of new workers, among others.

Some have argued that the shift in the proportion of output away from the goods sector to the service sector may have had a negative

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[52] U.S. National Center for Productivity and Quality of Working Life. Productivity in the Changing World of the 1980's. The final report of the National Center . . . 1978, pp. 25–26. See pp. 51–52 below for the place of the National Center for Productivity and Quality of Working Life in the chronology of recent government agencies focusing on productivity, and for the present role of the Federal Government in furthering productivity.

impact on productivity. Although the validity of this claim has been disputed by others, at least in recent years, and the inconclusiveness of productivity data in the service sector makes it difficult to warrant any firm conclusion on this trend, there would seem to be no sound reason for the Government to attempt to reverse or modify this movement towards the service sector.

The rise in energy prices has been a contributing factor to inflation, to higher production costs, and to a slackening of demand for large automobiles and other items whose production or use requires high energy consumption. All of these developments tend to have a negative impact on productivity, at least in the short-term. However, given the present and prospective shortages of cheap energy sources, any short-run attempts of the Government to lower such prices would appear to be counterproductive. On the contrary, productivity increases in the face of high and rising energy costs, require shifts to production and consumption of goods and services with smaller energy requirements.

A number of Government policies and programs can have a favorable impact on productivity, even though they are primarily designed to fulfill other primary objectives. Thus monetary and fiscal policies designed to curb inflation and to ameliorate business cycles, to the extent they are successful, can be expected to have a favorable impact on productivity. Programs that stimulate economic growth will make possible productivity gains resulting from larger amounts of savings and investment in new and more efficient plants and equipment and from economies of scale. Federal expenditures on the space program and on development of national defense hardware often have spinoffs that add to productivity in the private sector.

List of Recommendations for Public Sector Ways to Raise Productivity

A partial listing of the "menu of choices" open to governments, and in particular the Federal Government, for raising productivity follows. No attempt is made in this listing to assess the relative importance of the various entrees and side dishes in the menu, their digestibility, or the extent to which they will satisfy the appetite. The choices are rarely easy, in part because of the lack of knowledge as to which policies and programs will be most effective. Solomon Fabricant illustrated this dilemma neatly when he wrote:

> We are not certain, for example, what an additional tax dollar invested in elementary education would yield in higher national productivity as compared with what that dollar would yield if invested in higher education, or in education as compared with roads, or with roads as compared with antitrust or anti-discrimination enforcement; or what the dollar would yield if taxes were not raised and the dollar were left in private hands. Even when we are pretty sure that another dollar (or million dollars) would raise productivity most effectively if invested in education, we may have doubts about investing a second dollar (or million dollars), for expenditure in any direction usually encounters the "law of diminishing returns". We may believe that mergers tend to reduce competition and thus to discourage innovation, but we may also believe that large firms are better able to invest in the risky business of research and development and we may therefore be uncertain just when the social advantages of a merger are offset by its social disadvantages.[53]

[53] Fabricant, Solomon. A Primer on Productivity, pp. 153–154.

Sometimes measures to raise productivity in one sector of the economy may have adverse effects on another or on the economy at large. For example, tax concessions that reduce Federal revenue or increased Federal expenditures for specific programs, such as education and training, may make more difficult the stemming of inflation. Further, the costs of some of the ways to boost productivity may bear disproportionately on particular segments of the population. Reduction of tariffs or of farm price supports may be cited as examples.

Thus this list of 18 proposals is only a partial checklist of alternatives for consideration, not a list of recommendations. Following this list is a further discussions of the first ten items. These ten are the most frequently mentioned, and/or are those that warrant more discussion.

(1) Monetary and fiscal policy to promote economic growth and fight inflation.

(2) Incentives to increase capital formation, such as reduction or elimination of the corporate income tax, elimination of double taxation of dividends, accelerated depreciation allowances, investment tax credits, shifting of taxes on savings to taxes on consumption.

(3) Incentives to increase research and development expenditures, including tax concessions for research and development outlays, subsidies for research and development outlays, direct Federal research and development expenditures, and patent reform.

(4) Reform and where appropriate reduction or elimination of Federal regulations and regulatory programs that have adverse effects on productivity.

(5) A central productivity agency to focus greater government and public attention and effort on productivity.

(6) Increasing productivity within the Federal, State, and local governments.

(7) Promoting the shift from low-productivity to high-productivity industries.

(8) Greater support of education and vocational and occupational training, and redirection of such support in the direction of increasing their impact on productivity raising.

(9) Assisting small business by management aids, productivity councis and centers, and other incentives for innovation.

(10) Reducing crime.

(11) Programs to improve measurement of productivity.

(12) Enforcement and possible expansion of anti-trust legislation and administration to combat inefficiencies due to monopoly and oligopoly.

(13) Establishment of production goals or "bogeys" for public utilities and natural monopolies which would enable firms to earn rates of return at the upper limit of an established range.

(14) Improving the infrastructure of the nation by building of roads, water and sewage facilities, waterways, and other utilities.

(15) Reducing barriers to international trade, such as quotas and tariffs.

(16) Reducing constraints to job mobility.

(17) Reducing racial and other discrimination.

(18) Permitting the immigration of larger numbers of skilled workers.

Monetary and Fiscal Policy to Promote Economic Growth and Fight Inflation

Creating an economic climate that encourages productivity growth in the private sector is basic and as important as any of the other measures which focus more specifically on productivity per se. To the extent that fiscal and monetary policy is successful in lowering the rate of inflation and in stimulating economic growth, productivity gains are highly probable. On the other hand, policies which permit the continuation of a high rate of inflation and economic stagnation or recession can be expected to act as deterrents to productivity growth. Of course, monetary and fiscal policies encompass so many specific Federal actions that they inevitably include many of the specific narrower recommendations that follow, such as tax incentives and increased Government outlays for specific productivity raising purposes.

Incentives To Increase Capital Formation

An estimated 20 percent of the postwar improvement in productivity is derived from the increase in tangible capital (including structures, equipment, and inventories) per labor hour.[54] Thus, the decline in the rate of capital accumulation and investment has been one of the most widely cited reasons for the drop in productivity. From 1968 to 1978, the annual average increase in plant and equipment investment was 2.6 percent in constant dollars, compared to 6.2 percent in the previous decade.[55] Between 1948 and 1973, the ratio of capital to labor grew an average of nearly 3 percent a year. Since 1973, the annual rate of increase has dropped to 1¾ percent.[56] In addition, the share of capital investment devoted to environmental compliance has increased, leaving less to be devoted to increasing output. For the past 20 years, the rate of capital investment in the United States has been lower than in those industrial nations having higher productivity growth rates.

Since a prime determinant of the rate of capital formation is the state of the economy and the outlook for economic growth, the whole arsenal of Government measures to combat inflation and unemployment and to encourage economic growth come into play as major policy options to be considered as ways to increase capital investment, and thereby productivity.

There have been many proposals specifically geared to encouraging greater capital formation, including a large number of Congressional recommendations for favorable tax treatment and other incentives. Tax proposals to stimulate private investment and saving include the following:

(1) Reducing the effective corporate income tax rates by one or more of the following measures: (a) further acceleration of depreciation charges for tax purposes; (b) reduction of corporate income tax rates by decreasing the 22 percent normal rate, decreasing or graduating the present 26 percent surtax applicable to incomes above the $25 thousand surtax exemption, increasing the

[54] U.S. National Center for Productivity and Quality of Working Life. Final Report, 1978. p. 35. The Center notes: "The effect of capital investment, of course, cannot be disentangled from that of the technology it carries."

[55] Committee for Economic Development. Stimulating Technological Progress. New York, 1980. p. 2.

[56] U.S. Economic Report of the President, January 1979, p. 68.

surtax exemption, or by some combination of these alternatives; (c) elimination or reduction of the double taxation of corporate dividends; (d) increase of the investment tax credit from 10 percent to, possibly, 15 percent, preferably on a permanent basis.

(2) Adjustments of the personal income tax such as (a) extension of the 50 percent maximum marginal rate on "earned" income to property or capital income; (b) reducing personal income taxes generally, and reducing the steepness of graduation of marginal rates; (c) strengthening tax incentives for personal saving.

(3) Revision of capital gains tax including reduction of capital gains tax rates, annual exemption of a specific amount, and more symetrical treatment of capital gains and losses.[57]

Kendrick notes that to be effective, these tax incentives require that complementary macro-economic policies be expansive, and not offsetting.[58]

Other governmental incentives designed to add to the availability of savings and investment funds have been advocated. Again, combatting inflation is given high priority, since the current inflation with expectations of its continuation tends to encourage individuals to make purchases before prices rise further, even at the cost of reducing their savings with the result that investment funds are diminished. Various tax proposals, in particular the value added tax (VAT), have as a principal objective making savings more attractive and consumption less so. VAT is a tax imposed on each stage of production and distribution (manufacturing, wholesaling, and retailing) and thus can be considered as a multi-stage sales tax. It has been advocated not only as a way to increase the incentives to save and invest, but also to make possible the reduction of other taxes and improvement in the U.S. balance of trade.

Incentives for greater savings also include reducing or eliminating the tax on income from various forms of saving, e.g., interest and dividends. In addition, reduction of the Federal deficit and resultant need to borrow in capital markets is seen as a way to encourage investment. To the extent that Government borrowing competes with private investment needs, it tends to push up interest rates, and thus acts as a drag on private investment.

It needs to be recognized that achievement of the higher investment by any of the means mentioned above will require a diminution of current consumption. As Robert J. Samuelson recently said, "We have neglected the future and now it's neglecting us." [59]

Finally, it needs to be noted that greater capital investment will not necessarily increase productivity. The effectiveness of capital investment as a stimulus to productivity thus depends largely on its integration with technological innovation and managerial leadership. As Bowen notes in Fortune, December 3, 1979, "For example, when a manufacturing plant adds capacity by acquiring more of the same kinds of machines it's already using, there is no obvious gain in productivity except for whatever improvement in efficiency is associated with the newness of the additional machines, and perhaps some econ-

[57] Kendrick, John W. Productivity: A Program for Improvement. U.S. Congress, Joint Economic Committee. Special Study on Economic Change. Hearings . . . Part 2, June 8–14, 1978. Washington, U.S. Government Printing Office, 1978, pp. 627–628.

[58] Ibid., p. 628.

[59] Samuelson, Robert J. A Skeptical Look at Productivity. National Journal, v. 11, August 18, 1979, p. 1376.

omies of scale. When there is a large productivity-enhancing content in capital investment, it usually involves the introduction or diffusion of technological improvements of some kind." [60]

In addition, the productivity potential of investment will vary by industry. For example, Lester Thurow has pointed out that if more investment went to construction, "we would be allocating more resources to an industry with a negative rate of growth of productivity. This negative effect on aggregate productivity could easily be larger than the positive effects of a larger capital stock in other industries." [61]

Incentives To Increase Research and Development Expenditures

The importance of research and development to advances in productivity is generally agreed upon, although it is often difficult to determine the time span before results of research and development are actually transformed into productivity gains. Some observers feel that declines in research and development expenditures in relation to total output have been a factor in lower productivity in the 1960's and 1970's. Others are skeptical that the sharp drop in productivity since 1973 can be attributed significantly to lower research and development outlays or suport by the Federal Government, but agree that greater emphasis on R. & D. could be helpful in raising productivity in the 1980's.

> . . . expansion of R&D is a promising way of promoting future productivity growth. Available studies, though limited in scope, indicate that the social rate of return on R&D is high. This, when combined with the inability of firms financing successful R&D to capture more than a fraction of that return for themselves, provides justification for policies either to raise that fraction or to increase Governmental support.[62]

Federal support for research and development can include: (1) tax credits for research developments; (2) Federal contracts and grants in support of civilian technology; (3) relevant research and development work in its own laboratories and experiment stations; (4) insurance of a portion of private credit to firms for R. & D. and other innovation costs; (5) purchasing policies and procedures to encourage technological change in the private sector; and (6) regulatory policies to encourage R. & D. in the private sector.

The Federal Government is already actively engaged in several of these ways to encourage productivity-raising R. & D. Its investment tax credits and other forms of tax expenditures to increase capital investment are used in part by firms to undertake more research and development than they otherwise would. According to the National Science Foundation, Federal Government obligations for research and development amounted to an estimated $26.3 billion in 1978, compared to $14.6 billion in 1965. The largest proportion of these Federal funds were utilized by private industry, followed by the Federal Government itself, universities and colleges, and other non-profit institutions.

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[60] Bowen, William. op. cit., p. 86.
[61] Thurow, Lester. The U.S. Productivity Problem. Data Resources U.S. Review, v. 7, August 1979. p. 1.19.
[62] Denison, Edward F. Explanations of Declining Productivity Growth. Survey of Current Business, August 1979. pp. 7–8.

There is evidence that other countries are providing greater incentives for research than the United States, including tax incentives for the establishment of research facilities, subsidies, cash grants, interest-free loans, guarantees and greater than 100 percent deductibility of research expenses. Canada offers tax-free grants-in-aid for up to 50 percent of the cost of new research facilities (including land) and operating costs, reimbursement of the salaries of technical personnel on approved research projects, and current deductibility of all research costs undiluted by the grant. Japan's research incentives include subsidies, cash grants repayable only from successful projects, long-term low-interest loans from special development banks, a 25 percent tax credit for increases in industrial research over base period expenditures, and exclusion from taxable income of 70 percent of royalties received from export of technology. Many European countries have extensive programs for tax credits, accelerated depreciation allowances, low-interest loans, and outright grants for performance of research and development.[63]

While it is not to be expected that these foreign incentive programs can be transplanted directly to the United States, they do suggest the kind of expanded incentives for research and development assistance that may have a positive effect on productivity.

In addition the American Chemical Society proposes the following other approaches particularly applicable to U.S. industrial and economic systems that should be considered and evaluated:

Inclusion of R&D expenses under the 10-percent investment tax credit provision.

Initiation of a technological depletion allowance program.

Deduction (or accelerated depreciation) of the cost of new technology or patents.

Special, low capital gains taxation for small businesses engaged in R&D.

Institution of an option for small businesses to capitalize their research expenditures.

Direct deduction from federal income taxes of all expenses incurred in the performance of research associated with federal regulations. This deduction can be prorated, at 80 percent for example, so that the federal government and companies can share the expenditures roughly in proportion to the direct benefits obtained from the research.

Increase of federal support of basic research in universities to compensate for decreased basic research in industries.

Encouragement of cooperative research between universities and private industries.[64]

Other suggestions for encouraging research and development could include modification of antitrust regulations to permit easier pooling of research efforts, for example by joint ventures,[65] a uniform patent and licensing policy for Government-sponsored research, strengthening of the present patent system better integration of antitrust and patent laws.

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[63] American Chemical Society. Innovation and Private Investment in R. & D. Chemical and Engineering News, v. 57, April 30, 1979. p. 43.

[64] Ibid., p. 43.

[65] It may be noted that most applications for joint ventures are approved by the Antitrust Division of the Department of Justice. It has also been argued that in many instances pooling of resources may not be essential for the encouragement of research and development. Pooling seems to be most desirable for high-cost, high-risk "breakthrough" oriented projects. (National Academy of Engineering. Advisory Subcommittee on Regulation of Industry Structure and Competition. Draft Report, December 20, 1978. p. 35.)

Some steps in this direction are under consideration. On October 31, 1979 President Carter submitted to the Congress proposed legislation to establish a uniform policy for patents developed with Federal research funds. On October 30, the Senate passed S. 1477, 96th Congress, which included a provision for a new Federal appeals court for patents. In December 1979, the Senate Judiciary Committee approved a bill, S. 414, 96th Congress, that would give small businesses and universities exclusive rights to market products arising from Federally funded research.[66]

The effectiveness of these various ways of stimulating research and development is not easy to determine. Some methods are believed to be relatively undesirable as Government policy. For example, many economists believe that a general tax credit for research and development would be fairly ineffective, since it would reward many firms for doing what they would have done anyway, and would encourage the same kinds of R. & D. that are already being done. They believe that a more selective technique would be preferable. Similarly, some economists and others believe that the present patent policy of the United States, by providing patent holders with a monopoly right to exploit their patents, in fact slows down the dissemination of inventions and of related technology, thereby impeding potential gains in productivity.

Others believe that the direct contribution of publicly financed R. & D. contributes little to growth of output, because of its specificity and concentration on a small number of defense-oriented industries. On the other hand, at least one study (by Chase Econometrics) reports high rates of return for expenditure on space-related R. & D.[67]

Government Regulation and Productivity

Regulatory policies of the Federal Government have in many cases had an adverse effect on productivity by discouraging innovation, by adding production costs that cannot be utilized for increasing output, and by reducing labor's efficiency. On the other hand, in certain cases, some regulations have stimulated new industries and processes that have had a positive effect on productivity.[68]

It also needs to be recognized that there are differing universes for measurement of productivity and often difficulties in making measurements accurate enough to be significant. Frequently cited are the increased outlays plants and companies are forced to make to comply with environmental regulations that are therefore not available to increase output; this diversion has the effect of lowering the measurable productivity of the plant or company. On the other hand the social productivity, which takes into account the economic gains derived by workers from improved health and lower accident rates and by other plants and communities whose anti-pollution expenditure can be re-

[66] See also: Committee on Economic Development. Stimulating Technological Progress. New York, January 1980. pp. 51–57.

[67] Evans, Michael. The Economic Impact of NASA R&D Spending. Bala Cynwyd, Pa., Chase Econometric Associates, Inc., April 1976.

[68] Grabowski, Henry and John M. Vernon. The Impact of Regulation on Industrial Innovation. Washington. National Academy of Sciences, 1979. 64 p. Examples of industries whose innovativeness is affected by regulation are given on pp. 51–52.

duced and whose attract labor and capital enhanced may, in whole or in part, offset the productivity loss to the individual plant or company.

Even with acceptance of many of the goals of regulation—improved air and water quality, safer work places, and control of natural monopolies, for example—there appear to be ways in which regulatory programs can be modified in ways which would be advantageous to productivity. Less reliance on direct controls and standards, and more on economic incentives to reach regulatory objectives—for example effluent charges—has been widely recommended. Regulatory agencies could make greater efforts to determine costs of compliance with proposed regulations as compared to anticipated benefits before promulgating them. They should also determine the extent to which such regulations act as a deterrent to innovation and increased productivity. Reduction of regulatory delays and uncertainty would have a similar positive effect. Finally, outright deregulation in several areas can be considered, especially in situations where regulatory policies stifle incipient competition, and where such competition could be expected to encourage innovation and greater emphasis on productivity. Moves towards deregulation of various transportation modes and cable television are efforts currently underway in this direction.

Central Federal Agency To Coordinate and Foster Efforts to Raise Productivity

Several observers maintain that the Federal Government is not concentrating sufficient resources and effort to raising productivity. They feel that there should be a strong central agency to assume leadership in this field. They point to a positive relationship between national productivity programs and sustained productivity growth in foreign countries that have such programs. They suggest that the conspicuous success of U.S. Governmental promotion of productivity in agriculture should be followed in other areas.

A number of steps in this direction have already been taken by the Federal Government in the last decade. On June 17, 1970, President Nixon announced appointment of a National Commission on Productivity, with representatives of business, labor, the public, and Government. It was given legislative sanction by the Economic Stabilization Act of 1971. In 1974, the name of the agency was changed to the National Commission on Productivity and Work Quality. In 1975, its functions were assumed by the National Center for Productivity and the Quality of Working Life under the National Productivity and Quality of Working Life Act of 1975.[69] However, this center was abolished as of September 30, 1978, after reports of the Government Accounting Office and study by the Office of Management and Budget concluded that it was not sufficiently effective to warrant continuation. This lack of effectiveness was due, it is claimed, in part at least to lack of internal government support, inadequate authority, internal management deficiencies, and to some degree of opposition by organized labor.[70] In its place President Carter, by Executive Order 12089,

[69] See above.

[70] See: U.S. Comptroller General. Report of the Congress of the United States. The Federal Role of Improving Productivity—Is the National Center for Productivity and Quality of Working Life the Proper Mechanism? (FGMSD–78–26). Washington, D.C. General Accounting Office, May 23, 1978. 78 p., especially pp. iii–iv, 37–42.

October 23, 1978, established a National Productivity Council consisting of representatives of 10 Federal agencies with responsibilities for productivity, under the chairmanship of the Office of Management and Budget.[71] Its first order of business was determination of the appropriate role of the Federal Government in improving productivity in the private and public sectors, support of productivity efforts of State and local governments, and a survey of measurements of productivity and study of ways to improve them.

In establishing the National Productivity Council by executive order, President Carter indicated that the major responsibilities for productivity improvement will fall upon the Department of Commerce, the Department of Labor, the Office of Personnel Management, and the Office of Management and Budget. The Department of Commerce's responsibility is overview and promotion of technological innovation, including improved management systems and production methods, and collection and dissemination of information on productivity and productivity improvement. That of the Department of Labor includes productivity measurement and productivity growth through improved and innovative utilization of employee skills and capability, and labor management cooperation in productivity growth. The Office of Personnel Management is responsible for improvements in productivity of the Federal work force. The Office of Management and Budget is responsible for assuring that productivity concerns are taken into account in regulatory policy and regulatory analyses.

Critics of the National Productivity Council regret the dispersal of productivity functions among various agencies and lack of a single focal agency to promote productivity gains. They point to the fact that the National Productivity Council has only met three times since it was established in October 1978. They note that, thus far, the council is working primarily toward improving productivity within Government. They feel that the Federal Government now lacks sufficient commitment to encourage greater productivity in the economy as a whole, specifically in the private sector. Whether the Federal Government is now exercising adequate leadership and involvement in productivity improvement remains open to debate.

Steps To Improve Productivity Within the Government Sector

Since Federal, State, and local governments in the aggregate account for a large segment of the Nation's output of goods and services, the Nation's productivity is significantly affected by productivity in the public sector. Increases in Government productivity will have a positive effect on over-all productivity performance. It must be recognized, however, that published measures of productivity almost always exclude Federal, State, and local government services. Therefore, improvements in Government productivity will not be reflected directly in available productivity statistics.

[71] These agencies are the Office of Management and Budget, the Department of the Treasury, the Department of Commerce, the Department of Labor, the Council of Economic Advisers, the Council on Environmental Quality, the Council on Wage & Price Stability, the Office of Personnel Management, the Office of Science and Technology, and the Office of the Special Representative for Trade Negotiation.

Even though the profit incentive for raising productivity may be lacking in Government operations, there are many steps that governments at all levels can take to increase their efficiency and productivity.

These include such measures as: (1) faster adoption of new technology; (2) greater capital commitments for investments that would expedite technological improvements; (3) better management control and stronger incentives for productivity improvement; (4) analyzing operations to discover and adopt more efficient methods; and (5) improved personnel management.

In essence, many of these recommendations are, of course, similar to those discussed above for the private economy.

Many of these and related steps are being undertaken to some extent. In the Federal Government, the Office of Personnel Management is actively involved in programs to enhance Federal productivity. Some believe that the Federal Government could utilize the system of grants-in-aid and loans to State and local governments to foster better management of federally assisted State and local programs.

This approach is being recommended by the National Productivity Council study team examining Federal actions to support state and local government productivity improvement.

The two priority items recommended by this study team are improving the grants system and rationalizing existing and future productivity support activities. Three other specific efforts that the study team recommends for the Federal Government are:

Increasing the ability of State and local management to identify and implement productivity improvements;

Finding solutions to State and local service delivery problems through research and development of improved methods and technologies; and

Providing information and assistance on improved methods and technologies to help State and local governments effect productivity improvements.[72]

Promoting Shifts From Low- to High-Productivity Industries

To the extent that increasing productivity lowers unit costs and prices to consumers, it can be expected that high-productivity industries will be able to increase their share of the consumer's dollar while low production industries will find their share shrinking.[73] Such shifts are often slow to materialize while low-productivity industries resort to such actions as asking for protection against imports and for other forms of Government assistance, and resorting to advertising and other publicity campaigns. Following the lead of Japan and other countries, some experts have suggested that the United States Government should not attempt to rescue firms in the less productive sectors of the economy,

[72] National Productivity Council Study Team. Report to the National Productivity Council. Federal Actions to Support State and Local Government Productivity Improvement. Draft. August 1979. p. 99.

[73] See: Fabricant. Solomon. Productivity Growth: Purpose, Process Prospects and Policy, in U.S. Congress. Joint Economic Committee. Special Study on Economic Change. Hearings, Part 2, June 8–14, 1978. p. 522.

but rather encourage the shift of human and capital resources into new and expanding industries. Along this line Carl Madden, formerly Chief Economist of the United States Chamber of Commerce, maintained that:

> . . . productivity gains will depend on the speed with which labor and capital can be moved from industries in which the costs of energy, resources and pollution are high relative to the value of output to industries where the ratios are lower. Shifts of capital and labor to recycling, to substitutes of communications for transportation, to move information, images, and ideas with far less expenditure of energy, seem likely.[74]

Assistance to Small Business

Although the productivity record of small business is necessarily mixed, it is plausible to believe that Government assistance can do a good deal to increase the productivity of smaller firms. Many small businesses have made impressive productivity gains through introduction of inventions, innovations in production or marketing techniques, good labor-management relations, and drive for economic growth and profit. Nonetheless, there is in much small business a potential for increases in productivity that would benefit significantly from various kinds of Government assistance. Productivity centers and councils can provide helpful information and guidance to small business management and serve as a clearing house for information on ways to raise productivity in a broad variety of ways. Government can provide incentives for innovation that have already been cited above. Through patent and antitrust enforcement, it can help protect small businesses against unfair competition from, or dominance by, large firms in their particular fields.[75] While not all government assistance to small business will raise productivity, the net impact of the kinds of measures indicated here is likely to be favorable.

Greater Support of Education and Vocational Training

In the long run, increasing education and vocational training have been shown to be highly effective in raising productivity. Admittedly there is some evidence to suggest that in the 1980s the productivity gains to be derived from more education may be less than in recent decades since the increase in the average number of years of schools is expected to be very slight, much less than the post-war period to date.[76] It seems likely, however, that greater attention of many educational and training programs to productivity and productivity gain possibilities would have a positive impact on productivity. Options open to the Government include more favorable tax treatment of family and firm expenditures for education and of contributions to educational institutions, and judicious grants or loans to educational institutions, their facilities and their students.

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[74] Madden, Carl H. Toward a New Concept of Growth: Capital Needs of a Post-Industrial Society. In U.S. Congress. Joint Economic Committee. U.S. Economic Growth From 1976 to 1986: Prospects, Problems, and Patterns. Volume 8, Capital Formation: An Alternative View. Studies . . . December 27, 1976. (94th Congress, 2d Session. Joint Committee Print.) Washington, D.C. 1976. p. 24

[75] See above

[76] See Bowen, William, op. cit. p. 74.

Reducing Crime

Crimes, such as pilferage, shoplifting, vandalism, and embezzlement, have had adverse effects on productivity, necessitating as they do added inputs, such as employment of guards, watchmen, and detectives, purchase of electric surveillance equipment, and construction of more crime-resistance facilities, without adding to outputs. For the economy at large, it means devoting more resources to secure law and order. Reducing crime involves multipronged approaches that may take some time before it can be reflected in higher productivity. Approaches that have been suggested include more efficient and equitable administration of criminal justice, better education, greater employment opportunities, particularly for disadvantaged youth, and rehabilitation of slum and rundown urban neighborhoods, and greater employee involvement in business decisions and profit sharing.

Programs To Improve Measurement of Productivity

Improving the measurement of productivity has already been stressed as one of the important ways in which private enterprise can contribute to better productivity. Interest in problems of productivity measurement has intensified with the low rate of productivity growth in recent years. Consequently a Panel to Review Productivity Statistics in the National Academy of Sciences, under the chairmanship of Albert Rees of Princeton University, was commissioned to prepare a critical report on concepts and techniques of productivity measurement. Its report, "The Measurement and Interpretation of Productivity," issued late in 1979, concluded that problems of measurement error did not contribute significantly to the lag in the measured growth of productivity. It did suggest the development of multifactor productivity series. A study team of the National Productivity Council, headed by a representative from the Bureau of Labor Statistics, is preparing an assessment of the technical feasibility, costs, and value of implementing the Panel's recommendation.

V. Conclusion

This report has set forth a broad spectrum of measures that have been advocated and often given favorable consideration in the interest of raising productivity. As has been shown, many steps can be taken to raise productivity by individuals and firms in the private sector without Government involvement or sanction; others involve Government leadership or participation.

The limitations of this paper bear repetition. It does not set forth a recommended program or package of programs on productivity. It does not advocate any specific measure or group of measures. It tries to emphasize that all measures have their limitations and their costs. Some measures may have a positive impact on productivity in the short run and no effect or even a negative effect in the longer run. For many of the measures, the impact on productivity is difficult to measure or uncertain. Some measures may raise productivity in a particular industry or firm, but their favorable impact may be offset in other segments of the economy. Sometimes productivity gains are won at the expense of other societal values.

Recent research on productivity reemphasizes that there is a great deal of uncertainty and some disagreements as to the causes for the decline in U.S. productivity in the past decade. This uncertainty and disagreement is naturally reflected in the uncertainty and disagreements on particular measures to raise productivity.

Thus, from the productivity literature surveyed in the course of preparation of this report, the three following general conclusions would appear warranted:

(1) Continuing concern with productivity in the United States and with ways to increase it is justified in view of the importance of productivity increases to the health of the American economy and the welfare of the American people.

(2) Productivity improvement needs to be undertaken on a broad front, by the public and private sector alike. No single approach toward increasing productivity can be safely pursued. The costs and benefits of the various measures need to be carefully assessed and evaluated.

(3) An ongoing need remains for improvements in the measurement of productivity and for a much broader understanding of the factors that contribute to changes in productivity.

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IMPACT OF SELECTED CAPITAL INVESTMENT INCENTIVES ON U.S. INDUSTRIAL GROWTH

By Vijaya G. Duggal, Michael McCarthy, Anthony Haidorfer, and Mark Killion*

CONTENTS

I. Introduction

The purpose of this paper is twofold. It will present and interpret the results of four policy proposals aimed at stimulating capital investment through alterations in the Federal tax structures as measured by the Wharton Annual and Industry Econometric Forecasting Model.[1] An evaluation and comparison of the four proposals will follow, with the main focus centered on absolute and relative effects of policy changes upon productivity, inflation, corporate profits, unemployment, and other major barometers of the economic climate. The impacts of the policy changes on manufacturing industries and contract construction will be highlighted. To achieve these goals the paper will outline assumptions common to all four policy scenarios, make comparisons of particular policies with the control solution (the basecase), and make a comparison between the four scenarios to assess relative impacts on various policies. The four tax policy proposals include decreasing the Federal corporate tax rate by 8 percent, increasing the investment tax credit rate on equipment from 10 to 20 percent (plus extending the 20 percent credit rate to structures and automobiles), and accelerating the depreciation allowance rates on capital stock by first 50 percent and then 70 percent. It will be seen below that the investment tax credit rate was found to have the strongest impact of the four experiments, followed by the 70 percent reduction in useful lives for tax purposes. The other experiments tied for last in terms of strength of impacts.

II. The Policy Simulations

The nature of econometric modeling requires a formulation of assumptions for variables exogenous to this model. For the present study, reasonable assumptions were first drawn for the basecase sce-

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[1] Information concerning the structure of the Wharton Annual and Industrial Model is contained in the Wharton Annual Model Equation Book.

nario to estimate the most likely play of events, and then altered to implement the desired policy changes. To simulate the four policy proposals, it was necessary to alter five of the assumptions used in the basecase. Four of these alterations in assumptions are common to all four policy scenarios, differing in magnitude but not direction.

Policy Assumptions Common to All Experiments

The following is a list of the common assumptions:

(*a*) *Discount rate, Federal Reserve Bank* (*FRMDNY*).—One of the primary results of increasing productivity should be a reduction in the underlying inflation rate. Under these circumstances the discount rate (at which the Federal Reserve lends to member banks) is projected to fall, reflecting the Federal Reserve's attempts to maintain a real rate of interest at the 3½ to 4 percent historical level. Assumed reductions in the discount rate imply reductions in short and long term bond rates, raising the present discounted value of future income streams and depreciation deductions. Any move in this direction by the monetary authorities would therefore stimulate business investment and be in line with administrative goals.

(*b*) *Balance of payments, exports, and imports.*—An increase in real GNP by 1 percent is normally accompanied by an associated growth in imports of approximately 1 percent. The corresponding growth in exports, however, depends on both the price of domestic goods relative to foreign prices and the levels of output being achieved by the U.S. trading partners. Due to limitations in the trade sector of the model, the improvements in the U.S. export position, due to increased domestic productivity and the associated lower U.S. inflation, were entered into the model by judgmentally increasing the export trade variables to reflect the amount of productivity achieved by each policy.

(*c*) *Federal Government expenditures, grants-in-aid* (*GVGIA$*).—Nominal grants-in-aid to State and local governments are decreased (from the base solution) over the forecast period. This reduction comes from the necessity of the Federal Government to reduce some of its financial obligations as it experiences a loss in corporate tax revenues. At the same time, the improvements in the general economy, along with maintaining existing tax structures for States, result in increases in the funds flowing into the State treasuries. This enables a reduction to occur in the grants-in-aid while State governments continue to enjoy a net surplus of funds over the forecast period.

(*d*) *Federal Government expenditures, net interest paid* (*YINIGF$*).—Reductions in Federal revenues caused by decreasing corporate tax accruals are initially expected to increase the Federal deficit. Even if the corporate tax base eventually increases enough (due to the stimulative effect of the policies) to offset the tax rate reductions, Federal borrowing will need to be increased temporarily from the basecase unless substantial cutbacks are made on the expenditure side.

Scenario Descriptions

1. A CORPORATE TAX CUT OF 8 PERCENTAGE POINTS

The first proposed method for stimulating investment and increasing productivity is to decrease the Federal tax rate on corporate earning by 8 percent.

The theory behind such legislation states that the tax cut would lower the cost of capital relative to labor (and other costs) thereby creating an incentive for firms to choose more capital intensive and higher labor productivity production methods. The increased corporate tax flow from the legislation will be largely absorbed by increased corporate fixed investment. As noted above, the increased productivity associated with each piece of tax legislation would be reflected in lower rates of inflation.

To assess the effects of this proposal, the effective tax rates of each sector were reduced by a factor of 0.174, i.e., by 0.38/0.46, where 0.46 is the base line effective tax rate. The results for this simulation are summarized in table 1.

It can be seen from the table that cutting corporate taxes has only a relatively weak effect on increasing real productivity. Over the first 5 years of the forecast, productivity (real output per person in manufacturing (XVGMFPP)) grows at an average annual rate of 2.5 percent in the alternate, while growing at 2.48 percent in the basecase solution. Investment and productivity in both the durable and nondurable goods industry, as well as productivity per person for all industries, show similar moderate real gains.

The forecasted "relatively mild" productivity growth increase is not inconsistent with the extensive empirical evidence that suggests that "capital deepening" has not been and can not be expected to be a major source of increased productivity growth. On this point see Edward F. Dennison, "Accounting for the United States Economic Growth" (the Brookings Institution, 1974).

TABLE 1.—A CORPORATE TAX CUT OF 8 PERCENTAGE POINTS

[Growth rate in percent]

	1980	1985	5-yr growth rate	1990	5-yr growth rate	1995	5-yr growth rate	2000	5-yr growth rate
Selected indicators:									
Real gross national product (billions, 1972 dollars):									
Base case	1,407.7	1,599.7	2.59	1,863.1	3.10	2,163.0	3.03	2,499.0	2.93
CTC8	1,408.5	1,609.9	2.70	1,877.1	3.11	2,179.7	3.03	2,518.9	2.93
Real per capita disposable income (thousands, 1972 dollars):									
Base case	4.382	4.384	0.01	5.412	4.30	6.119	2.49	6.927	2.51
CTC8	4.385	4.857	2.07	5.439	2.28	6.147	2.47	6.953	2.50
Productivity per person, all manufacturing (thousands, 1972 dollars):									
Base case	8.326	9.411	2.48	10.808	2.80	12.407	2.80	14.434	3.07
CTC8	8.329	9.449	2.55	10.876	2.85	12.511	2.84	14.562	3.03
Corporate profits before taxes (billions, current dollars):									
Base case	229.0	332.9	7.77	572.9	11.46	1,015.6	12.13	1,559.2	8.95
CTC8	230.1	344.2	8.38	599.8	11.70	1,076.4	12.40	1,681.3	9.30
Unemployment rate (percent):									
Base case	7.99	8.63	1.55	5.57	−8.38	4.09	−5.99	3.98	−0.54
CTC8	7.97	8.31	0.84	5.29	−8.60	3.99	−5.40	3.91	−0.40
Federal Government surplus or deficit (billions, current dollars):									
Base case	−25.9	6.3		17.9		19.3		27.3	
CTC8	−43.1	−14.8		−25.6		−68.2		−115.4	
Net change	−17.2	−21.1		−43.5		−87.5		−142.7	
Real output:									
Durables:									
Base case	214.1	250.6	3.19	295.1	3.32	334.7	2.52	369.8	2.05
CTC8	214.4	253.6	3.42	299.0	3.34	338.3	2.50	374.3	2.04
Nondurables:									
Base case	143.4	168.5	3.28	207.8	4.28	255.3	4.20	323.8	4.87
CTC8	143.4	169.5	3.40	209.2	4.30	257.1	4.21	325.0	4.80
Primary metals:									
Base case	21.7	24.0	2.04	27.1	2.46	28.9	1.29	31.2	1.54
CTC8	21.7	24.2	2.20	27.3	2.43	28.4	1.14	30.9	1.35
Contract construction, nonresidential:									
Base case	12.1	10.6	−0.26	11.6	1.81	12.1	0.84	12.3	0.32
CTC8	12.1	10.9	−0.20	11.9	1.77	12.5	0.98	12.8	0.47
Fabricated metal:									
Base case	22.0	24.1	1.80	25.9	1.45	26.0	0.07	24.6	−1.10
CTC8	22.1	24.4	2.00	26.3	1.51	26.5	0.15	25.1	−1.07
Motor vehicles:									
Base case	35.5	40.9	2.90	47.0	2.81	54.5	3.00	62.5	2.78
CTC8	35.5	41.4	3.10	47.8	2.91	55.2	2.92	63.5	2.84

It should be noted that the increase in the productivity growth rate as a consequence of the hypothesized corporate tax cut is not only mild, it is largely transitory. When averaged over the entire 21-year period of the forecast, the difference in the growth rates for the two forecasts rounded to 0.0 percent. Note that the transitory nature of the growth rate increase is wholely consistent with the dictates of neoclassical growth theory.

While the overall effect on the economy of the corporate tax rate decrease is forecasted to be slight, the 1980–85 impact is somewhat stronger in the areas where one would expect it to be. The 5-year output growth rates (1980–85) for durables are generally stronger than for nondurables, with fabricated metal products and motor vehicles showing increased growth rates of .2 percent per year. In contrast to these results, note that the forecasted impact on contract construction (nonresidential) is virtually zero. The results for this policy experiment are summarized in table 1.

2. AN INCREASE IN THE INVESTMENT TAX CREDIT TO 20 PERCENT

The next policy proposal seeks to increase the marginal investment tax credit rate on equipment structures, and automobiles to 20 percent. The rationale for this type of tax incentive (and all other incentives schemes discussed herein) is essentially the same. Lowering the investment tax credit reduces the (user) cost of capital relative to labor, thereby creating a tendency for firms to pursue capital deepening. The results are summarized in table 2.

While the increase in real GNP over the base case amounts to 21 billion after 21 years of policy simulation, most of the increases occur in the first 10 years. The initial effects of the investment tax credit on business investment decisions take roughly one year to be seen.

In general the forecasted impacts of the investment tax credit changes described above are somewhat stronger than for the corporate tax cut, but still relatively mild and transitory as they were found to be for the latter case. The 1980–85 forecasted average manufacturing productivity growth rate was found to be increased by nearly 0.3 percent. This was accompanied by a comparable reduction in the rate of GNP inflation. Durable manufacturing output received the greatest stimulus with the real output growth rate for that sector increasing by 0.7 percent over 1980–85 period. This compares to a 0.3 percent increase for nondurable manufacturing. The non-residential contract construction output growth rate showed a moderate 1980–85 average growth rate increase, approximately 0.2 percent. The output growth rate increases for the durable two digit manufacturing sectors are roughly in line with that for total durables.

TABLE 2.—AN INCREASE IN THE INVESTMENT TAX CREDIT TO 20 PERCENT

[Growth rate in percent]

	1980	1985	5-yr growth rate	1990	5-yr growth rate	1995	5-yr growth rate	2000	5-yr growth rate
Selected indicators:									
Real gross national product (billions, 1972 dollars):									
Base case	1,407.7	1,599.7	2.59	1,803.1	3.10	2,163.0	3.03	2,499.0	2.93
ITC 20	1,410.2	1,630.1	2.94	1,896.0	3.07	2,188.1	2.90	2,520.0	2.86
Real per capita disposable income (thousands, 1972 dollars):									
Base case	4.382	4.384	0.01	5.412	4.30	6.119	2.49	6.927	2.51
ITC 20	4.388	4.889	2.18	5.456	2.22	6.121	2.32	6.898	2.42
Productivity per person, all manufacturing (thousands, 1972 dollars):									
Base case	8.326	9.411	2.48	10.808	2.80	12.407	2.80	14.434	3.07
ITC 20	8.337	9.553	2.76	11.069	2.98	12.733	2.84	14.768	3.00
Corporate profits before taxes (billions, current dollars):									
Base case	229.0	332.9	7.77	572.9	11.46	1,015.6	12.13	1,559.2	0.95
ITC 20	230.2	361.6	9.45	647.7	12.36	1,184.3	12.83	1,883.5	9.72
Unemployment rate (percent):									
Base case	7.99	8.63	1.55	5.57	−8.38	4.09	−5.99	3.98	−0.59
ITC 20	7.94	8.04	0.25	5.71	−6.62	4.96	−2.78	4.93	−0.12
Federal Government surplus or deficit (billions, current dollars):									
Base case	−25.9	6.3	----------	17.9	----------	19.3	----------	27.3	----------
ITC 20	−40.6	−32.6	----------	−74.2	----------	−151.1	----------	−231.1	----------
Net change	−14.7	−38.9	----------	−92.1	----------	−170.4	----------	−258.4	----------
Real output:									
Durables:									
Base case	214.1	250.6	3.19	295.1	3.32	334.2	2.52	369.8	2.05
ITC 20	215.0	260.5	3.91	305.2	3.22	341.5	2.27	376.5	1.97
Nondurables:									
Base case	143.4	168.5	3.28	207.8	4.28	255.3	4.20	323.8	4.87
ITC 20	143.5	171.3	3.60	211.0	4.26	257.3	4.05	322.7	4.63
Primary metals:									
Base case	21.8	24.2	2.11	27.0	2.21	28.2	0.87	30.0	1.25
ITC 20	21.8	24.8	2.61	27.7	2.24	28.8	0.78	30.5	1.15
Contract construction, nonresidential:									
Base case	12.1	10.6	−0.26	11.6	1.81	12.1	0.84	12.3	0.32
ITC 20	12.2	11.7	−0.08	12.9	1.97	13.4	0.76	13.7	0.44
Fabricated metal:									
Base case	22.0	24.1	1.80	25.9	1.45	26.0	0.07	24.6	−1.10
ITC 20	22.1	25.0	2.49	27.0	1.55	27.2	0.15	26.0	−0.90
Motor vehicles:									
Base case	35.5	40.9	2.80	47.0	2.82	54.5	3.00	62.5	2.78
ITC 20	35.6	42.6	3.65	48.4	2.85	54.5	2.40	61.5	2.45

3. A 50-PERCENT DECREASE IN THE ALLOWABLE USEFUL LIVES FOR TAX PURPOSES

The results for this simulation were virtually identical to those for the corporate tax cut. These two experiments showed the weakest impacts of the four experiments reported and the reader is referred to the table 3.

TABLE 3.—A 50-PERCENT DECREASE IN THE ALLOWABLE USEFUL LIVES FOR TAX PURPOSES

	1980	1985	5-yr growth rate	1990	5-yr growth rate	1995	5-yr growth rate	2000	5-yr growth rate
Selected indicators:									
Real gross national product (billions, 1972 dollars):									
Base case	1,407.7	1,599.7	2.59	1,863.1	3.10	2,163.0	3.03	2,499.0	2.83
ADR50	1,411.8	1,610.0	2.66	1,873.4	3.08	2,174.1	3.02	2,508.1	2.90
Real per capita disposable income (thousands, 1972 dollars):									
Base case	4.382	4.384	0.01	5.412	4.30	6.119	2.49	6.927	2.51
ADR50	4.387	4.861	2.07	5.434	2.25	6.126	2.43	6.919	2.56
Productivity per person, all manufacturing (thousands, 1972 dollars):									
Base case	8.326	9.411	2.48	10.808	2.80	12.407	2.80	14.434	3.07
ADR50	8.331	9.462	2.57	10.900	2.86	12.521	2.81	14.514	2.99
Corporate profits before taxes (billions, current dollars):									
Base case	229.0	332.9	7.77	572.9	11.46	1,015.6	12.13	1,559.2	8.95
ADR50	227.5	340.0	8.37	596.6	11.90	1,077.6	12.55	1,676.5	9.24
Unemployment rate (percent):									
Base case	7.99	8.63	1.55	5.57	−8.38	4.09	−5.99	3.98	−0.54
ADR50	7.46	8.37	2.33	5.52	−7.99	4.19	−5.36	4.14	−0.24
Federal Government surplus or deficit (billions, current dollars):									
Base case	−25.9	6.3		17.9		19.3		27.3	
ADR50	−30.9	−18.4		−30.3		−43.7		−57.1	
Net change	−5.0	−24.7		−48.2		−63.0		−84.4	
Real output:									
Durables:									
Base case	214.1	250.6	3.19	295.1	3.32	334.2	2.52	369.8	2.05
ADR50	214.6	253.5	3.38	297.2	3.23	335.3	2.44	369.4	1.96
Nondurables:									
Base case	143.4	168.5	3.28	207.8	4.28	255.3	4.20	323.8	4.87
ADR50	143.4	169.3	3.37	208.4	4.24	255.5	4.16	320.5	4.64
Primary metals:									
Base case	21.7	24.0	2.04	27.1	2.46	28.9	1.29	31.2	1.54
ADR50	21.8	24.2	2.11	27.0	2.21	28.2	0.87	30.0	1.25
Contract construction, nonresidential:									
Base case	12.1	10.6	−0.20	11.6	1.81	12.1	0.84	12.3	0.32
ADR50	12.1	11.0	−0.18	11.9	1.58	12.5	0.99	12.7	0.31
Fabricated metal:									
Base case	22.0	24.1	1.80	25.9	1.45	26.0	0.07	24.6	−1.10
ADR50	22.1	24.4	2.00	26.2	1.43	26.4	0.15	25.0	1.08
Motor vehicles:									
Base case	35.5	40.9	2.80	47.0	2.82	54.5	3.00	62.5	2.78
ADR50	35.6	41.4	3.06	47.3	2.70	54.4	2.84	61.8	2.58

4. A 70-PERCENT DECREASE IN THE ALLOWABLE USEFUL LIVES FOR TAX PURPOSES

The impacts reported for this case are probably closest to those reported for the Investment Tax Credit case, but slightly weaker. The reported 1980–85 increase in productivity growth was 0.2 percent for this experiment compared to 0.3 percent for the Investment Tax Credit case. The real GNP growth rate differential between the two experiments is the same (about 0.1 percent). Again, manufacturing durables output receives greater stimulus than nondurables. The durables growth rate (1980–85) increase 0.5 percent compared to about 0.3 percent for nondurables. Again, contract construction output growth rates show essentially no change (see table 4).

TABLE 4.—A 70-PERCENT DECREASE IN THE ALLOWABLE USEFUL TAX LIVES FOR TAX PURPOSES

[Growth rate in percent]

	1980	1985	5-yr growth rate	1990	5-yr growth rate	1995	5-yr growth rate	2000	5-yr growth rate
Selected indicators:									
Real gross national product (billions, 1972 dollars):									
base case	1,407.7	1,599.7	2.59	1,863.1	3.10	2,163.0	3.03	2,499.0	2.93
ADR70	1,409.9	1,623.4	2.86	1,889.9	3.09	2,185.0	2.94	2,522.4	2.92
Real per capita disposable income (thousands, 1972 dollars):									
Base case	4.382	4.384	0.091	5.412	4.30	6.119	2.49	6.927	2.51
ADR70	4.392	4.888	2.18	5.459	2.23	6.138	2.37	6.931	2.46
Productivity per person, all manufacturing (thousands, 1972 dollars):									
Base case	8,326	9.411	2.48	10.808	2.81	12,407	2.80	14,434	3.07
ADR70	8,336	9.614	2.68	10.996	2.93	12,030	2.81	14,661	3.03
Corporate profits before taxes (billions, current dollars):									
Base case	229.0	332.9	7.77	572.9	11.46	1,015.6	12.13	1,559.2	8.95
ADR70	225.6	357.4	9.63	037.6	12.27	1,141.3	12.30	1,777.6	9.26
Unemployment rate (percent):									
Base case	7.99	8.63	1.55	5.57	−8.38	4.09	−5.99	3.98	−0.54
ADR70	7.94	7.97	0.07	5.23	−8.08	4.26	−4.02	4.15	−0.52
Federal Government surplus or deficit (billions, current dollars):									
Base case	−25.9	6.3		17.9		19.3		27.3	
ADR70	−37.2	−41.8		−55.7		−93.2		−120.5	
Net change	−13.3	48.1		−73.6		−112.5		−147.8	
Real output:									
Durables:									
Base case	214.1	250.6	3.19	295.1	3.32	334.2	2.52	369.8	2.05
ADR70	214.8	257.1	3.66	302.0	3.27	339.0	2.34	374.3	2.00
Nondurables:									
Base case	143.4	168.5	3.28	207.8	4.28	255.3	4.20	323.8	4.87
ADR70	143.5	170.8	3.55	210.5	4.27	257.0	4.07	322.8	4.66
Primary metals:									
Base case	21.7	24.0	2.04	27.6	2.46	28.9	1.29	31.2	1.54
ADR70	21.8	24.5	2.36	27.3	2.18	28.5	0.86	30.3	1.23
Contract construction, nonresidential:									
Base case	12.1	10.6	−0.26	11.6	1.81	12.1	0.84	12.3	0.32
ADR70	12.1	11.3	−0.14	12.4	1.87	12.9	0.79	13.2	0.46
Fabricated metal:									
Base case	22.0	24.1	0.18	25.9	1.45	26.0	0.07	24.6	−1.10
ADR70	22.1	24.7	0.20	26.7	1.57	26.8	0.07	25.5	−0.98
Motor vehicles:									
Base case	35.5	40.9	2.87	47.0	2.82	54.5	3.00	62.5	2.78
ADR70	35.7	42.1	3.35	48.2	2.74	54.8	2.60	62.3	2.60

POLICIES TO BRING CORE INFLATION DOWN TO 5 PERCENT

By Otto Eckstein*

CONTENTS

The recent report, "Tax Policy and Core Inflation" [1] explored the effects of limited tax measures designed to stimulate corporate capital formation. Reductions in the economic lives used for depreciation and modest increases in investment tax credits were applied in an economy benefiting from cautious demand management. The tax measures represented a $10.3 billion reduction in the 1980 economy. The results were encouraging but moderate: even with unemployment held in the 6½ to 7 percent range, the improvement in the core inflation rate was only 1 percent by the mid-1980's. That exercise followed the methodology of using demand management to hold the unemployment rate unchanged in order to isolate the pure supply economics effects. It also assumed that the real increase of energy prices was beyond policy influence, which put quite discouraging limits on any improvement in the core inflation rate.

Following completion of that study, the Joint Economic Committee has requested a fuller exploration of possibilities, setting aside the political and budget constraints which limit tax actions to modest scale. The question was posed: What would it take to bring the core inflation rate down dramatically, not allowing political constraints to rule out possible solutions?

Making the variations in policy much larger, DRI has run a series of simulations with its 800-equation Model of the U.S. Economy and its Core Inflation Model to explore a broader range of policy options. For this study, the problem is posed as follows: What would it take to lower the core inflation rate to less than 5 percent by 1990? With that objective, the goal becomes how to minimize the unemployment required to achieve it, using various policy alternatives.

Three cases were analyzed through a series of policy simulations to find the best solutions that would meet the fixed anti-inflation goal.

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[1] Otto Eckstein, "Tax Policy and Core Inflation," Joint Economic Committee print, Congress of the United States, April 10, 1980. (U.S. Government Printing Office, Washington: 1980), 65 pp.

In case 1, policy is confined to the traditional demand management. Government spending is reduced to hold down aggregate demand to such a degree that the specified objective of core inflation is reached. In case 2, a very large tax reduction to stimulate corporate capital formation is applied at the beginning of the period, large enough to bring down the core inflation to the specified goal of less than 5 percent by the end of the decade. In case 3, it is assumed that enough progress is made on the oil problem to hold OPEC prices to a constant real level defined in terms of U.S. inflation. The same supply-side tax cut is then applied, but because the shock element of inflation from OPEC is reduced, unemployment does not have to be kept so high though still above the goals considered desirable in the past.

The conclusions of this set of exercises are clear:

(1) Demand management alone—budget and money supply control—imposes enormous social burdens to achieve the desired goal of bringing core inflation down to 5 percent by 1990.

(2) Supply measures to boost industrial capital formation make it possible to reach the core inflation goal with considerably less unemployment, but the measures are very large and unemployment is above historical rates.

(3) A solution to the energy problem would open up a far more attractive set of choices, and would allow policy to operate the economy if not at full employment, at least with unemployment that is in the range of historical experience. The task left to new manpower policies would be of a magnitude that should be doable.

Case 1. Demand Management Only

A series of model simulations identified the necessary budget policy, one that is very restrictive, with Federal Government spending as a whole down to 19.7 percent of GNP. This is much lower than the 1980's estimated 23.0 percent Federal share. It implies an increase in total spending of just 0.5 percent a year in real terms. Its attainment is inconsistent with maintaining existing commitments for benefit programs and increases in real military outlays. If this spending path cannot be achieved, as is most probable, personal taxes could be raised or monetary policy tightened to accomplish the same demand reduction.

Government spending for goods and services was set at a level sufficiently low to achieve the prespecified target of a core inflation rate of less than 5 percent by 1990. With such policies, the economy would operate with considerable slack throughout the decade. High unemployment and low utilization rates of industrial capacity would serve to disinflate gradually the economy. Sensitive prices would remain relatively low. The wage increases of unorganized workers would slow down because of continuing excess unemployment. The more sluggish, cost-based prices would gradually respond to lower labor costs. Ultimately, even the contracts of the most strongly organized workers would show diminishing gains because of the improved price performance (table 1).

Monetary policy in this and the subsequent exercises is managed to accommodate the goals of fiscal policy. Real short-term interest rates are maintained at the same values as in the recent DRI trend projection. This interest rate path keeps real short-term rates in the range of −1.12 to 0.56 percent. Thus, the looser economy is not allowed to produce lower real interest rates which would gradually reverse the demand weakness. The growth in the narrow money supply in case 1 is 4.1 percent in the first five years of the decade, considerably less than the 6.1 percent figure of the last five years, and consistent with the monetarist prescription of an orderly reduction in the long run money supply target.

The results of this classic, Keynesian exercise of restraining demand management are successful in the sense of achieving the 5 percent core inflation target, but are a failure in other terms. Unemployment averages 8.9 percent in the first half of the decade, remaining near the peak of the current recession levels, and can be allowed to improve to only 8.4 percent in the second five years. In the absence of dramatic innovations in the labor market, the unemployment rates of nonwhite workers would be averaging 16.1 percent for the decade, the rate for teenagers would be 19.8 percent. There is no need to spell out the social implications or the political impossibility of pursuing this approach.

TABLE 1.—COMPARISON OF SIMULATIONS

[In percent]

	1960–69	1970–80	1981–85	1986–90
Unemployment rate:				
Demand restraint only	4.8	6.3	8.9	8.4
Corporate tax incentives			7.8	7.3
Constant real energy price			7.2	6.0
Potential real GNP growth:				
Demand restraint only	3.9	3.1	2.3	2.0
Corporate tax incentives			2.8	2.6
Constant real energy price			3.0	2.7
Productivity:				
Demand restraint only	2.5	.9	.7	1.1
Corporate tax incentives			1.2	1.4
Constant real energy price			1.5	1.6
Capital Stock Growth:				
Demand restraint only	4.5	3.0	1.4	1.7
Corporate tax incentives			3.6	2.5
Constant real energy price			4.3	3.3
Investment share of GNP:				
Demand restraint only	9.8	10.2	9.3	8.6
Corporate tax incentives			11.7	11.0
Constant real energy price			12.1	11.7
Core inflation:				
Demand restraint only	1.7	6.5	8.7	5.8
Corporate tax incentives			7.9	5.7
Constant real energy price			7.6	5.5

The poor results achieved by this method are not entirely due to the sluggish responsiveness of the price level to reduced aggregate demand. An economy operating far below its normal growth path also suffers on the supply side. The share of the gross national product that would be plowed back into nonresidential fixed investment would be held down to 9.0 percent, below the historical average of 9.8 percent for the postwar period, and obviously inadequate considering the special investment needs created by the search for domestic energy sources and the need for pollution abatement. Labor supply growth

would also be affected somewhat because of the inadequacy of job opportunities for potential new workers and some acceleration of worker retirements. The decline in the number of hours worked in the low-demand scenario, compared to the recent DRI Trend forecast is 6.8 billion hours, or 4.2 percent of all hours by 1990. Productivity performance would also be hurt. The low volume of capital formation would fail to equip workers with increasing amounts of capital. A slack economy would cause overhead labor to be used at less than full effectiveness and production processes to operate below the best volumes.

Case 2. Corporate Tax Incentives To Boost Investment

A core inflation rate of 5 percent or less can be reached at considerably less social cost if the tax system is used to stimulate capital formation. The core inflation rate depends critically on the productivity trend, which in turn can be improved by equipping workers with more capital and by reducing the average age of the capital stock. In addition, the cost of capital is an important determinant of core inflation, and tax incentives such as depreciation reform or investment tax credits can reduce the average effective cost of capital to business.

The DRI U.S. Macro and Core Models were used to search for the optimal magnitude of tax incentives to achieve the 5 percent core inflation goal. In determining this optimum—keeping in mind that this exercise was conducted without political constraints—it was discovered that tax incentives would be pushed to their maximum point where the corporate income tax produces virtually no revenue. This result was achieved by shortening economic lives of equipment to 5.1 years and buildings to 10.2 years, and by boosting the investment tax credit to an effective rate of 22.8 percent. The corporate income tax would be kept at the current rate of 46 percent, so business would have to engage in the investments in order to receive the benefits of the incentives.

In actuality, it would not be possible to use the corporate income tax to this extent because of the distribution of profits among companies. With depreciation lives and investment tax credits of the stipulated magnitude, there would be many companies where tax liability was exhausted before incentives could be fully applied, even with carryovers of losses. The deficit would be increased by $40 billion in 1985 and $104 billion in 1990, or an enlargement of 0.9 and 1.6 percent of GNP. If the extra deficits are unacceptable, monetary policy would have to be eased, which would create some extra inflation. Real government spending rises 1.0 percent a year.

As a result of the generous investment incentives, the share of the gross national product that is reinvested reaches 11.7 percent over the next five years, and remains high at 11.0 percent in the 1986–1990 period. In consequence, the capital stock grows by 3.6 percent in the first half and 2.5 percent in the second half of the decade. The productivity advance improves to 1.3 percent for the full interval, which is still below historical performance; various continuing damaging factors, such as demographic changes and high energy costs, prevent full productivity recovery. Potential GNP grows by 2.7 percent for the decade, which is more than half a point better than its growth under the demand restraint scenario.

Most important, the unemployment rate that can be reconciled with the achievement of the anti-inflation objective is improved dramatically. Whereas the demand policy required an average unemployment rate of 8.7 percent for the decade, the corporate tax incentives improve the supply side of the economy sufficiently to make a somewhat less restrictive demand policy possible and allow unemployment to improve to 7.8 percent in the first half of the decade and to 7.3 percent in the second half. Should new approaches to manpower policy be developed and applied, the unemployment goals could be improved, of course.

An increase in the investment share of GNP from the historical norm of 9.8 percent to an estimated 11.7 percent over the next five years raises the question whether the capital goods industries could meet the volume of demand with which they would be confronted. It has long been recognized in business cycle theory that a high volume of investment will drive up the price of capital goods, thereby lowering the profitability of investment and possibly terminating the investment boom.

The DRI model consists of equations derived from the data of the postwar period, when the investment ratio approached 11 percent only briefly. Consequently, the equations for the prices of capital goods do not fully reflect the potential inflationary effect which would be created by a sizable increase of the investment ratio beyond its historical range. Yet earlier econometric researches by Wilson,[2] performed for this Committee two decades ago indicated that machinery prices do respond quite strongly to variations in demand.

A small econometric investigation was undertaken to help define how the model would have to be modified to deal with this particular instance of a simulation exercise going well beyond the range of the historical experience. On the basis of this study, a simulation rule was entered into the model which assumed that the response of the relative price for machinery with respect to the investment ratio has an elasticity of 0.5, for example, a 10 percent increase in the investment ratio from say, 10.5 to 11.6 percent, would boost machinery prices by an extra 5 percent.

Case 3. Corporate Investment Incentives Plus Stability of Energy Prices

The previously discussed simulations carry over the DRI long-term forecast assumptions about OPEC prices. They assume that the real OPEC price, defined in terms of the U.S. price level, will be increasing by 6.1 percent a year until 1985, and by 2.9 percent thereafter. This assumption contributes to a shock inflation factor of 1.6 percent a year until 1985, and 1.2 percent thereafter. This must be overcome by increased weakness in the economy so that demand serves as an offset, or by supply policies which create offsetting cost reductions.

To take the OPEC assumption as given may be political realism, indeed it may even be overoptimistic. But in a study free of the limittations of administrative and political feasibility, it would certainly be inappropriate to take this assumption as if it were engraved in stone. The United States has a variety of options to escape the stran-

[2] Thomas A. Wilson, "The Analysis of Machinery Prices," Study of Employment Growth and Price Levels, Joint Economic Committee Print, 1959.

glehold of OPEC. Much has been done: The energy legislation passed in the last two years permits domestic oil and gas prices to move gradually toward world prices, to encourage the substitution of other energy sources for oil, and to encourage conservation. Progress on mandatory conservation standards for residential buildings and appliances has been slow, and government programs to develop new energy sources such as synthetic fuels are only now entering the beginnings of the development stages. If the United States were to place stability of world energy prices higher on its priority lists, we might well be able to achieve this goal through stronger incentives to domestic oil and gas producers and through policies to permit the greater use of coal or nuclear power.

Without attempting to detail a full energy scenario, a simulation was run in which the real price charged by OPEC is kept constant. This would not imply unchanging energy prices. The legislated domestic decontrol path is assumed to proceed. The greater substitution of natural gas and coal for oil would also imply bigger increases for those fuels. Thus, the assumption of real constant OPEC prices implies a nominal increase of the composite wholesale price for energy of 12.3 percent a year for the decade.

These energy price assumptions were combined with the corporate tax incentives of the previous solution. The fiscal policy required to achieve the predetermined goal of a core inflation rate below 5 percent by 1990 was then calculated by using the model in a series of optimizing runs. The resultant policy is less extreme than in the previous cases, but the trend in real government spending is still held to a modest 2.0 percent a year.

The conclusions of the resultant simulation are very positive. With the constant real OPEC price, unemployment can be brought down to an average of 7.2 percent for the first half of the decade, and 6.0 percent for the period 1986 to 1990. With shock inflation held down, there is a closer coincidence between the "natural" unemployment rate defined by normal search and turnover phenomena in the labor market and the "noninflationary" unemployment rate necessary to avoid a worsening of core inflation.

This solution produces an extraordinarily high rate of investment for the economy. The investment share of GNP is 12.1 percent for the first half of the decade, much beyond historical experience and 0.4 points higher than in case 2. For the second five years of the decade, the investment share is 11.7 percent, an even larger differential compared to case 2. Once the inflationary pressure from OPEC prices is taken out of the picture, the economy can handle a higher rate of investment while still achieving progress on core inflation. This is a vicious circle: the higher investment rate reinforces the progress on inflation through its effects on productivity.

The investment program triggered by the tax incentives and fostered by the better energy situation is very large. The 12.1 percent investment ratio produces a growth in the capital stock of 4.3 percent, which is higher than the historical record. This program really would be a "reindustrialization" of the American economy.

The effect on potential real GNP growth is also quite striking. With both strong supply policies and constant real OPEC prices, the growth

rate of potential GNP returns to a 3.0 percent rate in the first half of 1980, the rate which prevailed in the 1950's. The even higher potential growth of the 1960's and early 70's is not repeated because the growth of the labor force is smaller, technological progress is not fully restored, and the industrial mix of output is not as favorable. In the second half of the 1980's, when labor force growth slows considerably, the growth of potential GNP drops to 2.7 percent, but that is still sufficiently high to allow the achievement of large real wage gains that match historical performance.

Comparisons Summary

Table 1 and charts 1 to 3 contrast the various solutions. Chart 1 shows the three paths of unemployment under the three assumptions, showing that demand policies alone keep unemployment very high, that the tax incentives achieve a somewhat better unemployment path but not one that would be socially desirable. Only the combination of investment stimulus and solution of the OPEC price problem opens up the possibility of reconciling the postulated improvement of the core inflation rate to 5 percent by 1990 with an average unemployment rate of 6.0 percent for the second half of the decade.

Chart 1
Change in the Capital Stock

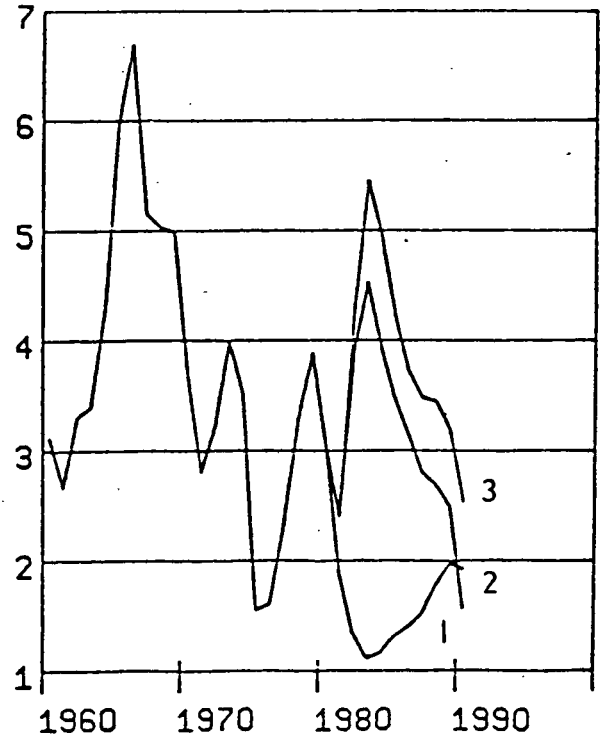
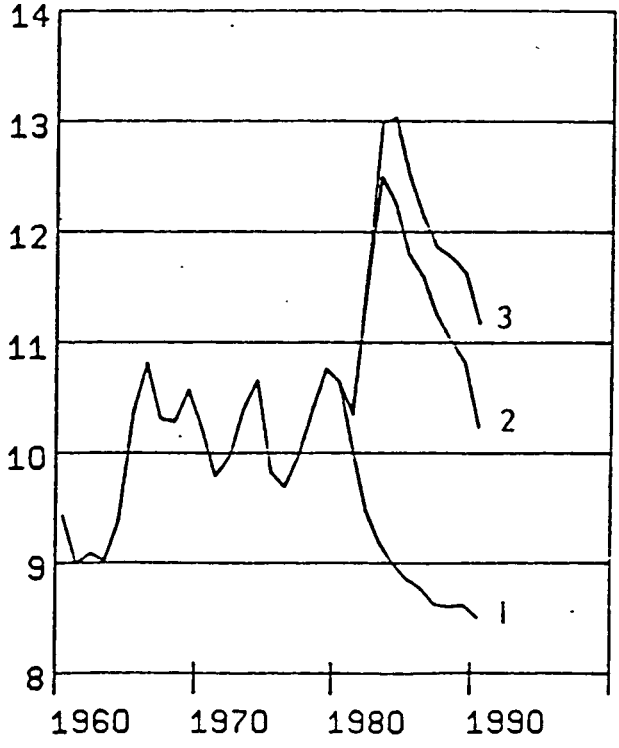


Chart 2 shows that the share of GNP invested in the capital stock is boosted to high rates by historical standards, through the use of the tax incentives, and is boosted even further if the policy can be applied in a context of constant real energy prices.

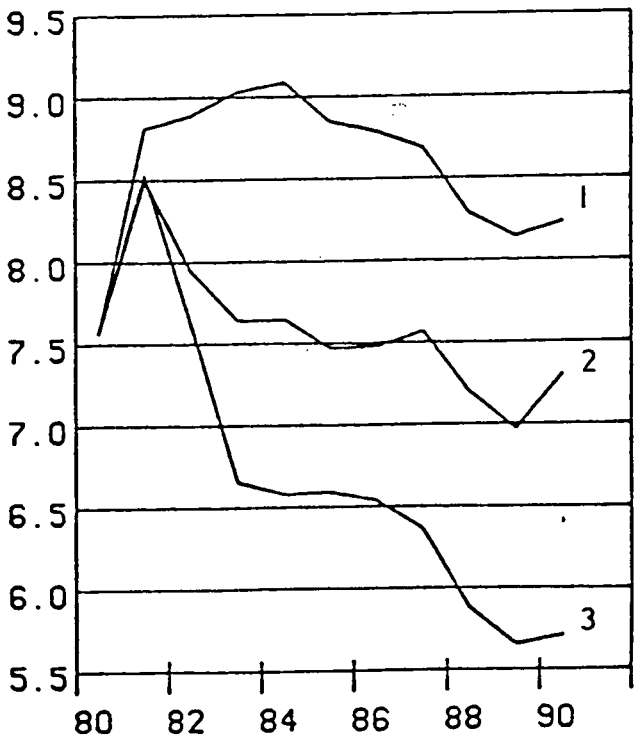
Chart 2
Investment Share of Total GNP
(Percent)



The increased level of investment converts into major increases in the capital stock. As chart 3 shows, the tax incentives restore the capital stock growth to the historical norm, and if applied in the constant real energy context, even boost it to rates that have not been seen in modern times.

The improved growth of the capital stock creates a restoration of the improvement in the capital-labor ratio that characterized the century-long high productivity trend that has been at the center of U.S. economic development. This improvement in the capital-labor ratio is at the root of the productivity improvements shown in table 1. A fuller summary of the solution results and of the historical data is shown in the tables in the appendix.

Chart 3
The Unemployment Rate
(Percent)



1 Demand restraint only
2 Corporate tax incentives
3 Constant real energy price

Appendix Tables

TABLE 1-A.—COMPARISON OF SIMULATIONS

[In percent]

	1960–69	1970–80	1981–85	1986–90
Unemployment rate:				
Demand restraint only	4.8	6.3	8.9	8.4
Corporate tax incentives			7.8	7.3
Constant real energy price			7.2	6.0
Potential real GNP growth:				
Demand restraint only	3.9	3.1	2.3	2.0
Corporate tax incentives			2.8	2.6
Constant real energy price			3.0	2.7
Productivity:				
Demand restraint only	2.5	.9	.7	1.1
Corporate tax incentives			1.2	1.4
Constant real energy price			1.5	1.6
Capital Stock Growth:				
Demand restraint only	4.5	3.0	1.4	1.7
Corporate tax incentives			3.6	2.5
Constant real energy price			4.3	3.3
Investment share of GNP:				
Demand restraint only	9.8	10.2	9.3	8.6
Corporate tax incentives			11.7	11.0
Constant real energy price			12.1	11.7
Core inflation:				
Demand restraint only	1.7	6.5	8.7	5.8
Corporate tax incentives			7.9	5.7
Constant real energy price			7.6	5.5

TABLE 2-A.—SIMULATION RESULTS: DEMAND MANAGEMENT ONLY

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Policy:											
Average tax lifetime, equipment (years)	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1
Average tax lifetime, buildings (years)	22.8	22.8	22.8	22.8	22.8	22.8	22.8	22.8	22.8	22.8	22.8
Investment tax credit rate (percent)	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6
Corporate profit tax accruals as a percent of cash flows	20.4	18.8	19.4	19.3	19.4	19.6	19.4	19.7	20.4	20.3	20.5
Energy:											
OPEC price	66.3	20.5	18.8	12.3	9.2	9.2	8.4	7.5	7.1	6.4	6.0
Composite energy price	47.4	30.2	22.8	13.3	10.4	11.2	10.8	10.0	9.9	9.4	9.1
Unemployment and inflation:											
Unemployment rate (percent)	7.6	8.8	8.9	9.0	9.1	8.8	8.8	8.7	8.3	8.1	8.2
Consumer Price Index	13.3	9.1	9.7	7.8	6.6	6.4	6.2	5.8	5.6	5.3	5.2
Core inflation rate	8.9	9.1	9.2	9.2	8.5	7.7	6.9	6.2	5.6	5.2	4.8
Shock inflation rate	2.3	2.1	1.7	1.0	0.8	0.8	0.8	0.8	0.7	0.6	0.6
Demand inflation rate	2.1	−2.1	−1.2	−2.4	−2.7	−2.1	−1.6	−1.1	−0.7	−0.5	−0.3
Investment, capital stock, and output:											
Investment share	10.6	10.0	9.5	9.2	9.0	8.9	8.8	8.6	8.6	8.6	8.5
Capital stock	3.0	1.9	1.3	1.1	1.2	1.3	1.4	1.5	1.8	2.0	1.9
Productivity	−2.1	−0.9	1.2	1.0	1.3	1.2	0.8	1.3	1.1	1.1	1.1
Real wages	−1.7	−0.8	0.3	1.3	1.5	1.2	1.0	1.0	1.1	1.1	0.9
Potential GNP	3.0	2.5	2.4	2.3	2.2	2.0	2.0	2.0	2.0	2.0	1.9

TABLE 3-A.—SIMULATION RESULTS: CORPORATE TAX INCENTIVES

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Policy:											
Average tax lifetime, equipment (years)	11.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1
Average tax lifetime, buildings (years)	22.8	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2
Investment tax credit rate (percent)	8.6	22.8	22.8	22.8	22.8	22.8	22.8	22.8	22.8	22.8	22.8
Corporate profit tax accruals as a percent of cash flows	20.4	8.9	8.1	5.5	2.1	0.6	0.1	0.1	1.0	1.1	0.3
Energy:											
OPEC price	66.3	20.8	21.6	17.2	11.8	10.5	10.1	9.0	8.7	8.1	7.4
Composite energy price	47.4	30.4	24.8	17.9	13.6	12.8	12.5	11.7	11.6	11.2	10.6
Unemployment and inflation:											
Unemployment rate (percent)	7.6	8.5	7.9	7.6	7.6	7.5	7.5	7.6	7.2	7.0	7.3
Consumer Price Index	13.3	9.3	10.4	9.4	8.1	7.5	7.1	6.6	6.3	6.2	6.2
Core inflation rate	8.9	8.5	7.6	8.0	8.0	7.4	6.8	6.1	5.6	5.2	4.8
Shock inflation rate	2.3	2.1	1.9	1.5	1.1	1.0	1.0	0.9	0.8	0.7	0.7
Demand inflation rate	2.1	−1.3	0.9	0	−0.9	−0.9	−0.7	−0.5	−0.1	0.3	0.7
Investment, capital stock, and output:											
Investment share	10.6	10.4	11.5	12.5	12.3	11.8	11.6	11.2	11.0	10.8	10.2
Capital stock	3.0	2.4	3.9	4.5	3.9	3.5	3.1	2.8	2.7	2.5	1.6
Productivity	−2.1	−0.6	1.8	1.3	1.4	2.1	1.5	1.8	1.5	1.3	1.1
Real wages	−1.7	−0.8	0	0.7	1.4	1.7	1.7	1.6	1.6	1.5	1.1
Potential GNP	3.0	2.5	2.5	2.9	3.1	3.0	2.9	2.7	2.6	2.5	2.3

TABLE 4-A.—SIMULATION RESULTS CORPORATE TAX INCENTIVES PLUS CONSTANT REAL OPEC PRICE

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Policy:											
Average tax lifetime, equipment (years)	11.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1
Average tax lifetime, buildings (years)	22.8	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2
Investment tax credit rate (percent)	8.6	22.8	22.8	22.8	22.8	22.8	22.8	22.8	22.8	22.8	22.8
Corporate profit tax accruals as a percent of cash flows	20.4	8.8	8.8	6.8	2.3	0.1	0	0.1	0.4	0.1	0
Energy:											
OPEC price	66.3	14.1	9.3	8.9	8.1	7.1	6.3	5.8	5.6	5.3	5.0
Composite energy price	47.4	27.2	15.7	10.5	10.7	10.6	9.9	9.6	9.9	9.8	9.7
Unemployment and inflation:											
Unemployment rate (percent)	7.6	8.5	7.6	6.7	6.6	6.6	6.5	6.4	5.9	5.7	5.7
Consumer Price Index	13.3	9.1	9.3	8.4	7.6	7.2	6.7	6.2	6.1	5.9	5.9
Core inflation rate	8.9	8.5	7.3	7.5	7.6	7.2	6.5	5.9	5.4	5.1	4.8
Shock inflation rate	2.3	1.9	1.5	1.2	1.0	0.9	0.9	0.8	0.8	0.7	0.7
Demand inflation rate	2.1	−1.4	0.5	−0.3	−0.9	−0.8	−0.7	−0.5	−0.1	0.1	0.4
Investment, capital stock, and output:											
Investment share	10.6	10.3	11.6	13.0	13.0	12.5	12.1	11.9	11.8	11.6	11.2
Capital stock	3.0	2.4	4.2	5.5	5.0	4.2	3.7	3.5	3.4	3.2	2.5
Productivity	−2.1	−0.5	3.0	2.0	0.7	2.0	1.9	2.0	1.6	1.3	1.4
Real wages	−1.7	−0.6	0.7	1.1	1.5	1.8	1.9	2.0	2.0	2.0	1.8
Potential GNP	3.0	2.5	2.6	3.1	3.5	3.4	3.1	2.8	2.7	2.6	2.5

TABLE 5-A.—SUMMARY OF HISTORICAL DATA

	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
Policy:										
Average tax lifetime, equipment (years)	15.1	15.1	14.1	13.1	13.1	13.1	13.1	13.1	13.1	13.1
Average tax lifetime, buildings (years)	22.8	22.8	22.8	22.8	22.8	22.8	22.8	22.8	22.8	22.8
Investment tax credit rate (percent)	0	0	3.3	4.1	4.9	5.8	4.7	4.8	6.1	1.1
Corporate profit tax accruals as a percent of cash flows	29.0	28.6	26.8	27.3	26.3	25.7	25.9	24.7	27.1	26.5
Energy:										
OPEC price	NA	0	−1.6	−1.1	−5.0	0	0.8	4.3	−1.7	7.1
Composite energy price	1.0	1.1	−0.5	−0.4	−2.7	1.8	2.5	2.3	−1.1	2.0
Unemployment and inflation:										
Unemployment rate (percent)	5.5	6.7	5.6	5.6	5.2	4.5	3.8	3.8	3.6	3.5
Consumer Price Index	1.5	1.1	1.2	1.2	1.3	1.6	3.0	2.8	4.2	5.4
Core inflation rate	3.1	2.1	1.3	1.1	1.0	0.6	0.9	1.6	1.9	3.0
Shock inflation rate	0.1	0	0.1	−0.1	−0.2	0.3	0.7	0	0.2	0.5
Demand inflation rate	−1.6	−1.1	−0.3	0.2	0.6	0.7	1.4	1.2	2.1	1.9
Investment, capital stock, and output:										
Investment share	9.4	9.0	9.1	9.0	9.4	10.4	10.8	10.3	10.3	10.6
Capital stock	3.1	2.7	3.3	3.4	4.3	6.0	6.7	5.1	5.0	5.0
Productivity	1.0	2.7	4.2	3.4	3.4	3.3	2.4	1.6	3.2	−0.2
Real wages	1.4	2.2	1.6	1.3	1.2	1.7	1.4	2.3	2.0	2.1
Potential GNP	3.5	3.5	3.5	3.4	3.4	3.5	4.2	4.9	4.6	4.2

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Policy:										
Average tax lifetime, equipment (years)	13.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1
Average tax lifetime, buildings (years)	22.8	22.8	22.8	22.8	22.8	22.8	22.8	22.8	22.8	22.8
Investment tax credit rate (percent)	0	3.1	5.3	5.6	5.6	8.1	8.1	8.1	8.1	8.4
Corporate profit tax accruals as a percent of cash flows	24.1	23.5	22.3	22.7	22.0	20.4	21.6	21.6	22.1	21.3
Energy:										
OPEC price	−1.7	5.0	5.4	23.7	204.9	11.6	−3.0	7.8	0.4	47.6
Composite energy price	5.3	8.5	3.0	13.2	55.0	17.7	8.3	13.8	6.7	26.5
Unemployment and inflation:										
Unemployment rate (percent)	5.0	6.0	5.6	4.9	5.6	8.5	7.7	7.0	6.0	5.8
Consumer Price Index	5.9	4.2	3.3	6.2	11.0	9.1	5.7	6.5	7.7	11.3
Core inflation rate	4.1	4.3	4.2	4.4	6.0	7.8	7.7	7.7	8.0	8.2
Shock inflation rate	0.4	0.7	0.8	2.9	3.8	1.2	0.6	0.8	1.0	2.2
Demand inflation rate	1.4	−0.7	−1.7	−1.1	1.2	0.2	−2.6	−2.0	−1.3	0.8
Investment, capital stock, and output:										
Investment share	10.2	9.8	10.0	10.4	10.7	9.8	9.7	10.0	10.4	10.8
Capital stock	3.7	2.8	3.2	4.0	3.5	1.6	1.6	2.3	3.3	3.9
Productivity	0.1	3.1	3.5	1.8	−3.1	2.0	3.5	1.6	0.5	−1.1
Real wages	2.0	2.6	2.9	0.6	−2.6	0.3	2.1	1.7	1.3	−0.8
Potential GNP	4.1	3.4	3.0	3.0	3.3	3.3	2.6	2.6	2.9	3.3

Technical Appendix

Theory of Core Inflation

While the full core inflation analysis was set forth in the earlier Joint Economic Committee print, *Tax Policy and Core Inflation*, April 10, 1980, it may useful here to summarize the underlying theoretical structure. Let the total inflation rate of a period be equal to the sum of the three separate inflation sources: core, demand, and shock.

$$(1)\quad p = p_c + p_d + p_s$$

where p is the inflation rate, p_c is the rate, p_d is the demand rate, and p_s is the shock rate.

The core rate of inflation can be viewed as the rate that would occur on the economy's long-term growth path, provided the path were free of shocks, and the state of demand were neutral in the sense that markets were in long-run equilibrium. The core rate reflects those price increases made necessary by increases in the trend costs of the inputs to production. Th ecost increases in turn are largely a function of underlying price expectations. These expectations are the result of previous experience, which, in turn, is created by the history of demand and shock inflation. In a competitive, Cobb-Douglas economy with Hicks-neutral technological change, the long-term equilibrium price, p_e can be written as,[3]

$$(2)\quad p^* = Aq^{a_1}w^{a_2}e^{-ht}$$

where q is the rental price of the capital required per unit of output, w is the wage rate of the unit labor requirement, h is the aggregate factor productivity rate of technological progress, and a_1 and a_2 are the Cobb-Douglas factor share weights which, under the assumption of constant returns to scale, must sum to unity.

The core inflation rate is the change in the long-term equilibrium price along the balanced growth path. It can be written

$$(3)\quad p_c = a_1 q + a_2 w - h$$

The rental price of capital depends on the relative price of capital goods, depreciation and tax parameters, and the financial cost of capital. Let

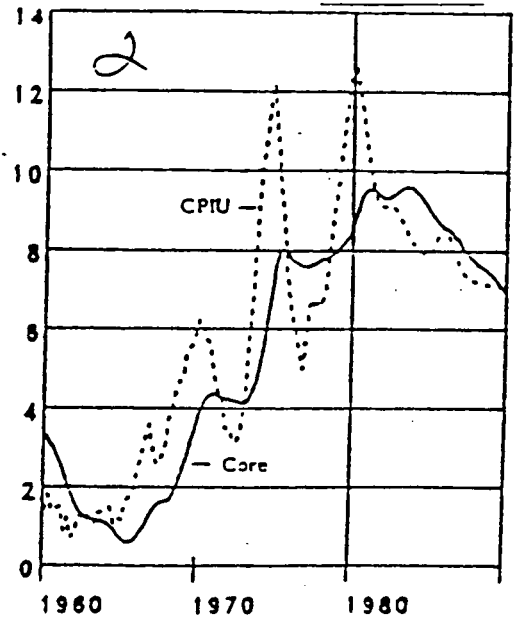
---

[3] For a fuller theoretical treatment of equilibrium price in this particular macro context, see William D. Nordhaus, "Recent Development in Price Dynamics," in Otto Eckstein, ed., *The Econometrics of Price Determination*. Federal Reserve Board, 1972, pp. 28–30, and James Tobin, "The Wage-Price Mechanism: Overview of the Conference," *ibid*, pp. 5–7. Nordhaus shows the equilibrium price results under various production functions besides the standard Cobb-Douglas case.

(4) $q=\alpha(r, J_q)$

where r is the composite cost of financial capital and J_q is the composite tax variable on capital and its income. Financial cost is determined by the long-

The Core Inflation Rate and
the Consumer Price Index
(Year-over-year percent change, SA)



term inflation expectations embodied in nominal interest rates and equity yields, so that

(5) $q=\alpha(p^e_q, J_q)$

Similarly, wages on the equilibrium path are determined by the price expectations underlying wage claims and possible tax effects J_w, or

(6) $w=\beta(p^e_w,\ J_w)$

Therefore, the core rate of inflation depends on long-term price expectations in labor and capital markets, tax provisions, and factor productivity, i.e.,

(7) $p_c=a_1\alpha(p^e_q,\ J_q)+a,\beta(p^e_w,\ J_w)-h$

Price expectations are formed on the basis of inflation experience, as measured by distributed lags on actual prices, and need not be the same for bond buyers as for workers. Thus,

(8) $p_c=a_1\left(\left(\sum_{t=1}^{-20}\lambda_c p_1\right),\ J_q\right)+a,\ \beta\left(\left(\sum_{t=0}^{-a}u_t p_t,\right)J_u\right)-h$

Since the actual inflation of a period, t, is composed of the three components,

(9) $p_t=p_{ct}+p_{dt}+p_{st},$

and the core inflation rate is affected by the actual record of inflation as processed into current expectations, the core inflation rate can be written in terms of previous demand and shock inflation, productivity and taxes,

(10) $p_{ct}=\delta(p_{dt},\ p_{dt-1}\ldots,\ p_{st},\ p_{st-1}\ldots,\ h_t,\ h_{t-1}\ldots,\ J_{qt},\ J_{qt-1}\ldots,\ J_{wt},\ J_{wt-1}\ldots).$

The demand inflation rate will depend on utilization rates of resources derived from the level of aggregate demand and factor supplies. Presumably both the unemployment rate and the operating rate of physical capital are pertinent, and the effects are nonlinear. Thus,

(11) $p_d=\gamma(u_t,\ u_{cap}).$

The shock inflation rate is, by definition, exogenous to the analysis. While, in fact, such shocks as OPEC and food prices are in part endogenous with aggregate demand playing the conventional price-lifting role, they are considered here to be determined primarily by noncontrollable conditions: OPEC political-economic decisions in one case, weather and crop conditions in the other. Government shocks, such as payroll taxes, are exogenous because they are considered to be policy levers.

Core inflation can be expressed, then, in terms of the previous history of aggregate demand, shocks, and productivity, where the latter two factors are mainly expressions of supply-side phenomena and exogenous cost shifts. Thus,

(12) $p_{ct}=f(u_{lt},\ u_{lt-1}\ldots,\ u_{capt},\ u_{capt-1}\ldots,\ p_{st},\ p_{st-1}\ h_t,\ h_{t-1}\ldots,$
$J_{qt},\ J_{qt-1}\ldots,\ J_{ut},\ J_{wt-1}\ldots).$

Shocks and the Noninflationary Unemployment Rate

The conceptual structure of equations (1–12) can be used to analyze various macro relationships, but the extensive lag structure hides significant analytical conclusions. A two-period simplification allows these conclusions to emerge.

Suppose the two periods are the present, t_0, and the past, t_{-1}. Also, suppose price expectations are formed in the same way by the suppliers of labor and capital, and the tax effects are excluded. Also, suppose utilization in labor and physical capital markets is the same and measured by u. As before.

(13) $p_o=p_{co}+p_{do}+p_{so}.$

The core inflation rate is formed from the expectations process.

(14) $p_{co}=\alpha p^e_o=\alpha\beta p_{-1}.$

The coefficient α subsumes the expectation of factor suppliers for a positive real return which may or may not be offset by actual factor productivity gains. The coefficient β is a measure of the completeness of the learning process in the formation of price expectations. Then,

(15) $p_o=\alpha\beta_{-1}+p_{do}+p_{so}$.

and

(16) $p_o/p_{-1}=\alpha\beta+p_{do}/p_{-1}+p_{so}/p_{-1}$.

Suppose $p_{jo}=O$ and $p_{so}=O$, i.e., demand at its equilibrium level and there are no shocks. Then,

(17) $p_o/p_{-1}=\alpha\beta$.

Under a unit elasticity of expectations which would be rational along the equilibrium path,

(18) $\alpha\beta=l$, *so* $p_o=p_{-1}$,

or the inflation rate remains unchanged and price expectations are fulfilled.

Suppose

(19) $p_d=\gamma(u^*-u)$

where u^* is the natural rate of unemployment based on friction and search phenomena in the labor market. Then,

(20) $p_o/p_{-1}=\alpha\beta+\gamma(u^*-u)/p_{-1}+p_{so}/p_{-1}$.

In order to leave the inflation rate unchanged, i.e., $p^\circ/p_{-1}=1$, with $\alpha\beta=1$.

(21) $\gamma(u^*-u)=p_{so}$,

or

(21a) $u=\Sigma(u^*, p_{so})=u^{**}$.

Let u^{**} be the solution of *21a*) for given u^* and p_{so}, and let us call it the noninflationary unemployment rate.

The Noninflationary and the Natural Unemployment Rates

The distinction between u^*, the natural unemployment rate, and u^{**}, the noninflationary unemployment rate is fundamental: u^* is the rate at which the level of demand does not add to inflation. It is derived from the organization of the labor market, the demographic situation, search, phenomena, the nature of tax and transfer incentives and other labor supply considerations. If unemployment is at the natural rate but there are shocks, the actual inflation rate will exceed the core rate and gradually worsen it. If inflation is not to become worse in the presence of shocks, unemployment must exceed the natural rate to serve as an offset, i.e., $u^{**}>u^*$.

The current structure of the economy, following nearly a decade of underinvestment, creates one other distinction: the natural rate of unemployment is not associated with equilibrium in total factor use. Thus, when the labor market is in equilibrium at u^*_e, the capital market is in diequilibrium, or $u_k\neq u^*_k$, and there is demand inflation originating in an excessively high rate of utilization of phyical capacity.

Tracing the Sources of the Inflation Process

The various inflation components must be pursued further to their root causes. The productivity trend in the core inflation rate is partly determined by the rate of capital formation, human resource investment, and technological progress. The resource utilization rates depend on private spending propensities and fiscal and monetary policies which determine aggregate demand. A theory of investment is needed for capital supply, a theory of labor-force participation for labor supply.

To trace fully the three components of inflation to their causes requires a full description of the economy such as is represented in a complete macroeconomic model. The core inflation model is drawn almost entirely out of the 800-equation DRI Quarterly Econometric Model of the U.S. Economy. Thus, there is no need to develop a special purpose theoretical or empirical model to conduct a full core inflation analysis.[4]

[4] The core inflation analysis can also be treated as a stand-alone analytical device in which its inputs—the level of aggregate demand, the shock rate, the rental price of capital, the rates of wage and productivity increase—are treated as exogenous.

Apart from the particular decomposition of the problem into its three components to provide analytical focus, the core model makes strong empirical statements only in one crucial regard: the formation of price expectations for determining long-run capital and labor costs is a gradual learning process rather than a quick response to policies or other particular events. The theory is consistent with a weak form of the rational expectations viewpoint that price expectations are free of bias in the long run, but it is inconsistent with the stronger viewpoint that these price expectations are formed quickly from particular announcements, exogenous events, or movements in such variables as the money supply or actual prices observed over a short time.

RESULTS OF SURVEYS

During the winter of 1979–80, the Joint Economic Committee undertook a survey to try to determine the impact that various tax proposals might have on capital spending. The questions were included in the capital spending survey made by McGraw-Hill and the survey of business executives made by the Gallup Economic Service. In each case businessmen were asked how various commonly discussed tax policy changes would affect their investment behavior over the short, intermediate, and long terms.

The results of these two surveys are interesting and are reported here. Although such surveys are necessarily subjective and do not produce definitive answers, when combined with other economic information, they can provide some useful insights. It is interesting, for example, that the survey results show the same conclusion as some recent econometric evidence which indicates that easing depreciation schedules may be preferable to the investment tax credit for encouraging long-run investment.[1]

In the McGraw-Hill survey, businessmen were asked to choose the tax cut which would have the greatest impact on their capital spending plans 3 to 5 years out and longer than 5 years. They were given five choices: A reduction in the overall tax rate; an increase in the current investment tax credit; faster depreciation; a reduction in the capital gains tax; or an expansion of the investment tax credit to include new and rehabilitated structures.

Looking at the intermediate term (3 to 5 years), very few businessmen chose a reduction in capital gains or an expansion of the investment tax credit to include new and rehabilitated structures as the tax reduction which would have the greatest impact on their spending plans. Only 2 percent of all business and 2 percent of all manufacturing chose a reduction in capital gains taxes; 7 percent of all business and 6 percent of all manufacturing chose an expansion of the credit. Among the remaining choices faster depreciation was thought to have the greatest impact; 42 percent of all the business category chose faster depreciation as compared to 22 percent choosing an increase in the investment credit; and 27 percent choosing a reduction in the overall corporate rate. Within the manufacturing sector, the durable goods producers showed a stronger preference for accelerated depreciation—49 percent—while 17 percent chose the investment credit and 27 percent chose the corporate rate reduction. The nondurable and nonmanufacturing industries showed about a 36 percent preference for accelerated depreciation.

[1] See, for example, U.S. Congress. Joint Economic Committee. *Tax Policy and Core Inflation* by Otto Eckstein (Washington, D.C.: Government Printing Office, 1980).

When the same question was asked with reference to the long run (greater than 5 years), there remained a substantial lack of interest in a reduction in capital gains or an expansion of the investment tax credit. The proposal which businessmen claimed would have the greatest impact was a reduction in the overall corporate rate (42 percent for all business; 45 percent for all manufacturing). Between the remaining choices, faster depreciation was strongly preferred over an increase in the investment credit (35 percent to 12 percent for all business, 34 percent to 11 percent for all manufacturing).

If the results of the two tax cuts aimed directly at encouraging investment—accelerated depreciation and the investment credit—are combined, the survey shows that these measures would have a stronger impact on business capital spending than a simple reduction in the corporate rate. This impact, however, diminishes as one looks further into the future.

The Gallup survey of business executives involves a sample roughly 2½ times as large as the McGraw-Hill survey and includes many small and medium sized businesses. The question was phrased somewhat differently—the size of the tax cut was specified to be about $15 billion. The same five tax cuts were used, but about 20 percent of the sample chose the new categories, "Don't know" or "none of the above will have an impact on investment plans." The results of the Gallup survey were qualitatively similar to those of the McGraw-Hill survey. The two preferred tax reductions were a reduction in the overall corporate tax rate and faster depreciation with faster depreciation showing a greater impact in the intermediate period and the corporate rate cut being more important for long-term investment. The investment tax credit was a poor third choice in its impact on the 3 to 5 year period and was indistinguishable from the other choices in influencing long-term investment behavior.

The results of the two surveys are shown in table 1.

TABLE 1

	Reduction in overall corporate tax-rate	Increase in current investment tax credit	Faster depreciation	Reduction in capital gains tax	Expansion of investment tax credit to include new and rehabilitated structures	Don't know or none will impact plans
McGraw-Hill:						
Intermediate term:						
Total durables	27	17	49	3	5	NA
Total nondurables	26	28	36	1	9	NA
All manufacturing	27	21	44	2	6	NA
All nonmanufacturing	29	25	36	1	9	NA
All business	27	22	42	2	7	NA
Long run:						
Total durables	43	10	35	4	8	NA
Total nondurables	48	13	33	3	4	NA
All manufacturing	45	11	34	4	6	NA
All nonmanufacturing	35	13	39	4	9	NA
All business	42	12	35	4	7	NA
Gallup:						
Intermediate term	29	19	32	11	12	21
Long run	30	11	27	13	11	24

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