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STUDY PAPERS NOS. 12 AND 13

THE LOW INCOME POPULATION AND ECONOMIC GROWTH

BY

ROBERT J. LAMPMAN

THE ADEQUACY OF RESOURCES FOR ECONOMIC GROWTH IN THE UNITED STATES

BY

JOSEPH L. FISHER AND EDWARD BOORSTEIN

MATERIALS PREPARED IN CONNECTION WITH THE
STUDY OF EMPLOYMENT, GROWTH, AND PRICE LEVELS
FOR CONSIDERATION BY THE
JOINT ECONOMIC COMMITTEE
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II

These are part of a series of papers being prepared for consideration by the Joint Economic Committee in connection with their "Study of Employment, Growth, and Price Levels." The committee and the committee staff neither approve nor disapprove of the findings of the individual authors. The findings are being presented in this form to obtain the widest possible comment before the committee prepares its report.

LETTERS OF TRANSMITTAL

DECEMBER 14, 1959.

To Members of the Joint Economic Committee:

Submitted herewith for the consideration of the members of the Joint Economic Committee and others are study papers 12 and 13, "The Low Income Population and Economic Growth," and "The Adequacy of Resources for Economic Growth in the United States."

These are among the number of subjects which the Joint Economic Committee has requested individual scholars to examine and report on to provide factual and analytic materials for consideration in the preparation of the staff and committee reports for the "Study of Employment, Growth, and Price Levels."

The papers are being printed and distributed not only for the use of the committee members but also to obtain the review and comment of other experts during the committee's consideration of the materials. The findings are entirely those of the authors, and the committee and the committee staff indicate neither approval nor disapproval of this publication.

PAUL H. DOUGLAS,
Chairman, Joint Economic Committee.

DECEMBER 14, 1959.

Hon. PAUL H. DOUGLAS,
Chairman, Joint Economic Committee,
U.S. Senate, Washington, D.C.

DEAR SENATOR DOUGLAS: Transmitted herewith are two of the series of papers being prepared for the "Study of Employment, Growth, and Price Levels" by outside consultants and members of the staff. The authors of these papers are Robert J. Lampman, University of Wisconsin, Madison, Wis., and Joseph L. Fisher and Edward Boorstein, Resources for the Future, Inc., Washington, D.C.

All papers are presented as prepared by the authors, for consideration and comment by the committee and staff.

OTTO ECKSTEIN,
Technical Director,
Study of Employment, Growth, and Price Levels.

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STUDY PAPER NO. 12

THE LOW INCOME POPULATION AND ECONOMIC GROWTH

(BY ROBERT J. LAMPMAN)

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STUDY PAPER NO. 12

THE LOW INCOME POPULATION AND ECONOMIC GROWTH

(By Robert J. Lampman [1])

CHAPTER I. INTRODUCTION AND SUMMARY

Introduction

This study is directed to the general question of how much progress is being made in overcoming poverty in the United States. It is generally agreed that twin goals of national economic policy are an increase in income per person and a wide sharing of income among all persons. In a certain sense it is paradoxical that in this time of great prosperity in the richest nation in the world there should still be a substantial part of our population with incomes far below what is thought of as the American standard.

In the period since World War II great advance has been made in raising the total national income and the income per family and per person. Has similar progress been made in reducing the numbers in low-income status? What are the socioeconomic characteristics of the group that remains in low-income status? In what respects does this group differ from the total population? To what extent do "handicapping" characteristics of old age, nonwhite color, loss of breadwinner, and low education seem to explain the persistence of low incomes. Is the low-income problem peculiarly associated with any region or occupation or family size; are any important number of our children afflicted by low family income? These are questions that relate to an appraisal of the present low-income problem.

We gain further understanding of the nature of the problem by examination of changes which occurred in the 1947–57 period. In what parts of the population did the frequency of low income change and in what parts did it not change? What causes for change can be uncovered? Do the changes that have occurred indicate that there has been a fundamental shift in the nature of the low-income problem? Is it reasonable to expect that the future rate of change in numbers with low income will be about the same as it has been in the past?

A major purpose of any study of low income should be, of course, to provide background for policymaking aimed at elimination of poverty. Hence, a leading question which motivates all the others asked above is, what preventive and remedial programs can we improve or initiate to hasten the complete victory over poverty?

[1] The author is professor of economics at the University of Wisconsin. He was assisted in the preparation of the tables by Mr. Ahmad A. Murad and received helpful suggestions from Prof. Edwin E. Witte, Peter O. Steiner, and Elizabeth Brandeis. He is particularly indebted to Mr. John G. Myers for detailed and constructive criticisms.

Summary

For purposes of this study a "low-income person" is defined as one with an income equivalent to that of a member of a four-person family with total money income of not more than $2,500 in 1957 dollars. Thus an unattached individual would be classified as a low-income person if he had income under $1,157; a member of a six-person family, if his family had income under $3,236.

In line with this definition it is found that 32.2 million persons were in low-income status in 1957. This was 19 percent of all persons. Out of the total of 32.2 million low-income persons 8 million were 65 years of age or older; 6.4 million were nonwhite; 8 million were in consumer units headed by women; 21 million were in units headed by a person with educational attainment of eight grades or less. About 70 percent of the low-income population had one or more of the above-listed handicapping characteristics; about 50 percent had one or more of the first three characteristics. In the general population about 50 percent had one or more of the four characteristics; about 20 percent had one or more of the first three. Other characteristics found more commonly in the low-income population than in the total population are farm residence, nonemployment status, and unattached individual status.

Twenty-six percent of the population was in low-income status in 1947 as compared to 19 percent in 1957. Changes involved in this important reduction (over one-fourth of the way toward zero) include the following: reduced frequency of low income in almost every occupational and industrial group; greater than proportional growth in the numbers employed in relatively high-paying occupations and industries; movement off farms and out of farmwork; and increase in the number of workers per family. The shrinkage in numbers of low-income persons was accomplished in spite of unfavorable changes in family size, the aging of the adult population, and a shift by large numbers out of employment.

It is expected that smaller numbers of persons will be in low-income status in future years. Projection of past experience suggests that only 10 to 12 percent of the population will be low-income persons by 1977. It is alleged by some that modern poverty will not yield to economic growth in the future at the same rate it has in the past. We appraise this allegation as one having some merit and conclude that the numbers in poverty will fall with economic growth in a manner similar to, but slightly slower than that of the past.

It is notable that reduction of the numbers in poverty has been accomplished with little change in the share of total income going to the lowest income groups. Government policy aimed at moderating economic inequality seems merely to have prevented a fall in the share of income of the relatively poor. A more aggressive Government policy could hasten the elimination of poverty and bring about its virtual elimination in one generation.

A program directed against poverty should be of several parts. The basic part should be one of insuring high levels of employment and increasing average product per worker. This should be supplemented by special private and public programs for those groups who do not readily share in the benefits of economic progress. Among these groups are the aged, consumer units headed by women, non-

whites, and those in certain low-income rural areas. About a fifth of the Nation's children are being reared in low-income status and it is critical in the strategy against poverty that these children have educational opportunities that are not inferior to the national average.

The costs of such a program would be offset by positive gains in terms of both economic and human values.

CHAPTER II. WHO ARE THE LOW-INCOME PEOPLE?

Numbers Below a Selected Income Level [2]

The first problem in a discussion of low incomes is to select a minimum income level to use in marking out the group to be studied. It is obvious that the size of the group will be larger the lower the minimum income selected. It is not so obvious, but nonetheless true, that the characteristics of persons in the low-income group and the changes in the group over time will differ with the minimum income selected.

The income level chosen for purposes of this study is variable with family size using $2,500 of total money income for a family of four as a base. This figure is well below the $4,000 which the Bureau of Labor Statistics has estimated is necessary for an urban family of four to maintain an "adequate standard of living." On the other hand, it is well above the budget levels used in determining need in public assistance programs in most States.

If $2,500 is thought of as an appropriate minimum for a family of four, then some smaller income is appropriate to use for smaller consumer units, and a larger minimum is appropriate for families larger than four. A study of the variation of consumer needs by family size done by the Bureau of Labor Statistics [3] provides a guide for such a range of cutoffs. They are $1,157 for a single person, $1,638 for two persons, $2,106 for three, $2,516 for four, $2,888 for five, $3,236 for six, and $3,750 for a family of seven or more.

These several cutoffs for consumer units of different sizes were applied to the overall distribution of total money income as estimated by the Bureau of Census.[4] This leads to the finding that 32.2 million persons were in low-income status in 1957. This was 19 percent of all persons.

Composition of the Low-Income Group

There is interest in knowing who was in this group of 32.2 million persons in the prosperous year of 1957. If a person worked fifty 40-hour weeks during the year at an hourly wage of $1 he would receive $2,000 of income. This would place him above the minimum income for a family size of three or less. If a family unit had two persons receiving $1,900 each they would be above the selected cutoff for any size family.

What handicaps or limitations are keeping such a large part of our population at such relatively low income levels? Answers to this

[2] For a discussion of alternative measures of low-income see app. A.
[3] Monthly Labor Review, vol. 67, February 1948, p. 179.
[4] The sources used in constructing the following tables are, unless otherwise noted, Bureau of the Census publications, including Current Population Reports, Series P-20, P-50, and P-60. References to personal income data are articles by Selma F. Goldsmith in April 1958 and April 1959 issues of Survey of Current Business.

question will help us to understand (1) why these people are poor, and (2) what changes over time may be expected in the size and character of the low-income group, and (3) what remedial programs are most needed.

SIZE OF CONSUMER UNIT

The first point to be made in describing the low-income population is that low-income persons are scattered quite evenly among consumer units of all sizes. Between 12 and 15 percent of the total is found in each family size from one through six. See table I. However, there is some tendency for low-income status to be associated with the extremes of family size. Forty-three percent of all one-person units[5] and 34 percent of all units with seven or more persons had low-income status.

TABLE 1.—*Distribution of low income persons by family size, based on minimum income varying with family size, 1957*

	Family size							
	Total	1	2	3	4	5	6	7 or more
All consumer units (millions)	54.0	10.3	14.3	9.5	8.8	5.5	2.9	2.6
All persons (millions)	168.3	10.3	28.6	28.5	35.2	27.5	17.4	20.8
Minimum income for each family size		$1,157	$1,638	$2,106	$2,516	$2,888	$3,236	$3,750
Number of low-income persons (millions)	32.2	4.4	5.0	3.6	4.0	4.0	4.2	7.0
Low income persons percent of all persons in family size group	19.1	42.7	17.4	12.6	11.4	14.5	24.0	33.7
Percent of low income persons in each family size group	100.0	13.7	15.5	11.2	12.4	12.4	13.0	21.7

It is unfortunate that most tables showing a single characteristic of the low income population cannot, with presently available data, be presented with a cross-classification by family size. The reader who examines the following tables will do well to keep in mind the fact that such a cross-classification would in certain cases modify impressions about the composition of the low income group. One such case appears in the matter of age of head of consumer unit.

AGE

About 25 percent of the 32.2 million low income persons were 65 years of age or over. We have deduced this from the facts that 35 percent of family heads and 47 percent of unattached individuals with under $2,000 of income were in that age range. See table 2. Assuming a family size of 2.5 persons and multiplying that times the 2.3 million families headed by a person aged 65 or more yields 5.8 million persons. Adding 2.8 million unattached individuals gives a total of 8.6 million persons, which is 26 percent of all low income persons. For several reasons this is too high an estimate. For one thing it assumes all persons in families headed by an aged person similarly aged. For another, it uses a $2,000 minimum income for

[5] There is an important transitory element in the unattached individual population. A substantial part of people in this category have been unattached for less than 1 year. For many persons this is a status intermediate between leaving one family unit and joining another. Of all unattached individuals with income under $2,000 two-thirds are females and one-half are over 65. Perhaps 40 percent of them are females over 65.

unattached individuals rather than the $1,157 our method calls for. (Substituting the number under $1,100 reduces the number to 7.8 and the percentage to 24.) Furthermore, it tends to be an over-count because aged families own their homes more commonly than do younger families and hence their incomes are relatively understated because of the failure to count the value of owner-occupied housing as income. On the other hand, there is a tendency for this method to under-count aged persons among the low income population because it assumes that all aged persons are in consumer units headed by aged persons. In fact, of course, some of the multiperson families include aged persons who are not family heads. One way to cross-check the estimate of the low income aged is offered by table 14 which shows that out of the total of 4.6 million aged persons, 8.7 million had less than $1,000 of income. This is equal to 27 percent of all low income persons. However, the method followed in table 14 also tends to overstate the importance of aged persons because it reports income as received and not as shared. Hence, a woman whose husband received $5,000 of income might be reported as having zero income. According to the study from which table 14 was derived, 38 percent of the men and 79 percent of the women 65 years of age or older had less than $1,000 of total money income in 1957. Twenty-eight percent of the women were estimated to have zero income. Nearly half the women classified as without income were single, widowed or divorced and must have lived with adult children, other relatives, or friends who maintained them. The author asserts that even if the married women without income are considered to have one-half their husbands' incomes, the great majority would remain below the $1,000 level.[6]

We conclude that a fair estimate is that 25 percent of all low income persons were 65 years of age or older. While aged persons were only 8.5 percent of all persons they made up one-fourth of the low income population. Thus it seems clear that old age is an important causal factor with regard to low income status.

At the other end of the age range are children. Examination of the family-size table and the age of head table suggests that at least 11 million or one-third of all low income persons are children under 18. This means that in quantitative terms children are more important than aged persons within the low income group and that a considerable number of younger persons are starting life in a condition of "inherited poverty." These 11 million low income children are about one-fifth of all children.

RURAL-FARM RESIDENCE

About one-fourth of all low income persons were in rural farm residence. This conclusion is derived from the following facts. While only 11 percent of the Nation's families were farm families, 30 percent of the families, and 10 percent of the unattached individuals with under $2,000 of income in 1957 were in farm residence. See table 3. If a lower income cutoff were selected for farm than for nonfarm families on the grounds of low cash needs (ignoring the larger average size of farm families) then, of course, farm families would be a smaller part of the total with income under $2,000. It seems

[6] Lenore A. Epstein, "Money Income of Aged Persons, a 10-Year Review, 1948 to 1958," Social Security Bulletin, June 1959.

doubtful, however, that any large adjustment is called for on this account. A study using the personal income definition (which includes imputed rent, income in-kind and home produced food and fuel) produces the same general differences between farm and nonfarm families. Thirty percent of farm operator families and 5 percent of nonfarm families were found to have incomes below $2,000 of personal income.[7]

TABLE 2.—*Distribution of families with income under $2,000 and unattached individuals with income under $1,000, by age of head, 1957*

[Number in millions and percent under stated minimum income]

	All ages	Age of head					
		14–24	25–34	35–44	45–54	55–64	65 and over
Number of families with income under $2,000	6.6	0.4	0.7	0.9	1.2	1.1	2.3
Percent of families	100.0	5.4	11.0	14.0	17.7	16.9	35.0
Number of unattached individuals with income under $2,000	6.1	.5	.4	.4	.7	1.2	2.8
Percent	100.0	8.5	6.3	7.0	11.6	20.0	46.6
Number of unattached individuals under $1,000	3.8	.3	.2	.3	.4	.6	2.0
Percent	100.0	7.9	5.2	7.9	10.5	16.0	52.6

NONWHITE COLOR

About one-fifth of the 32.2 million low income persons were nonwhite. Nonwhite families are 10 percent of all families but they constitute 22 percent of all families with income under $2,000. See table 4. Thirty-six percent of all nonwhite families had incomes under $2,000 in 1957. Interestingly, this disproportionate representation of nonwhites among the low income group is not found in the case of the unattached individuals.

SOUTHERN REGION

While the South has less than one-third of the Nation's population, about 40 percent of the low income population is found there. See table 5. This is in part explained by the facts that low income status is strongly associated with rural residence and nonwhite color, both of which are more commonly found in the South than in other regions.

CONSUMER UNITS HEADED BY FEMALES

About one-fourth of the low income persons were in consumer units headed by females. While only 10 percent of all families were headed by women, 24 percent of the families with under $2,000 had women heads. Thirty-eight percent of all families headed by women had less than $2,000 of income. Here there is a strong overlap with the family size question. Families headed by females tend to be smaller than those headed by males so it is doubtless true that less than 24 percent of the persons in families with low income were in families headed by women. On the other hand, among unattached individuals as dis-

[7] Selma F. Goldsmith, Survey of Current Business.

tinct from multiperson families, females are strikingly important. Two-thirds of unattached individuals with under $2,000 of income were females. These facts lead us to the conclusion that about one-fourth of all low income persons are in consumer units headed by females.

TABLE 3.—*Distribution of all families and of families with total money income under $2,000, by residence, 1957*

[Numbers in millions]

	Total	Urban	Rural nonfarm	Rural farm
Total U.S. families	43.7	27.5	11.4	4.8
Percent of all U.S. families with income under $2,000	14.9	10.6	14.3	40.5
Number of families under $2,000 income	6.6	2.9	1.6	1.9
Percent distribution of all families under $2,000 income	100.0	44.9	25.1	29.8

TABLE 4.—*Distribution of all families and of families with total money income under $2,000, by color, 1957*

[Numbers in millions]

Number and percent	Total	White	Nonwhite
Total U.S. families	43.7	39.7	4.0
Percent of all U.S. families with under $2,000 income	14.9	12.3	36.0
Number of families with income under $2,000	6.5	5.1	1.4
Percent distribution of families with income under $2,000	100.0	78.0	22.0

TABLE 5.—*Percentage distribution of families with income under $2,000, by region, 1957*

Region:	*Percent of total*
Northeast	23
North Central	27
South	39
West	11
U.S. total	100

It is relevant here to note that in many families headed by men, women play an important role as secondary earners in lifting the family out of low income status. In the whole population, 35 percent of families had two or more income receivers, but among those families with income under $2,000 in 1957 only 24 percent had two or more income receivers.

EDUCATIONAL ATTAINMENT OF FAMILY HEAD

About two-thirds of low income families are headed by persons with no education beyond grammar school. Less than one-half of all family heads have such low educational attainment. The low level of education of the low income group is, of course, associated with old age, nonwhite color, and rural residence. Nonetheless, it is certainly an independent cause of low income status. To the extent that younger persons have more education than older persons we would expect the numbers of low income persons to diminish over time.

EMPLOYMENT STATUS AND OCCUPATION OF FAMILY HEAD

One of the most remarkable characteristics of the low income family heads is the low degree of participation in employment. We estimate that one-third of all low income persons are in consumer units headed by a person in nonemployed status. Out of the 8.7 million families with incomes under $2,500 4.2 million heads were in the Armed Forces or not employed. See table 6. One-third of low income family heads are retired. The figure of one-third in retired status corresponds closely with the proportion of heads over age 65. Here again, the question of family size should be taken into account. Since older persons have smaller families much less than one-third of all low income persons would be found in families headed by a retired person. (See discussion of age above.) The high number of those in nonemployed status is associated with sources of income. Transfer payments are over one-third of the income of the consumer units with income under $2,000, and wage and salary payments are less than half of all income in that group.

Employed heads of families with under $2,500 of income are found in all occupational groups. See table 6. However, one-half of them are unskilled workers or farmers. The largest single number are found in the farm operator category. Fifteen percent of all low income heads (and 25 percent of employed low income family heads) are found in the unskilled occupational groups of operatives, domestic service workers, service workers other than domestic, farm laborers, and laborers other than farm and mine. Unskilled workers as a group do not appear to be overrepresented in the low income population. Only a few occupations have more than 50 percent of all employed persons in low income status. These are the farm operator, farm laborer, and domestic service occupations.[8]

INDUSTRY OF FAMILY HEAD

One-third of employed heads of families with under $2,500 of income are in agriculture, forestry, and fishing, and the rest are widely scattered among industries. (See table 7.) Industry groups having the highest percent of all families with incomes under $2,500 are agriculture, forestry and fishing, and personal and domestic service.

[8] It is notable that in-kind income is more important in these occupations than in most.

TABLE 6.—*Distribution of families with total money income under $2,500, by occupational group of family head, 1957*

Occupational group	Number with under $2,500 total money income	Families with under $2,500 income as percent of all families in occupational group
	Millions	*Percent*
All occupations	8.66	20
In Armed Forces or not employed	4.17	45
Employed in 1957	4.49	13
Professional, technical, and kindred workers	.15	4
Farmers and farm managers	1.35	54
Proprietors, managers, and officials except farm	.47	9
Clerical	.13	5
Sales	.14	7
Craftsmen, foremen, and kindred workers	.42	6
Operatives	.59	9
Domestic service workers	.21	69
Service workers other than domestic	.38	18
Farm laborers and foremen	.30	60
Laborers except farm and mine	.44	22

TABLE 7.—*Distribution of families with employed family head and total money income under $2,500, by industry of head, 1957*

Industrial group	Number with income under $2,500	Families with income under $2,500 as percent of all families in industry group
	Millions	*Percent*
All industries	4.49	13
Agriculture, forestry, and fishing	1.52	52
Mining	.02	5
Construction	.35	12
Manufacturing	.52	5
Transportation	.22	7
Wholesale trade	.14	8
Retail trade	.59	13
Finance, insurance, and real estate	.10	8
Business and repair service	.18	14
Personal and domestic service	.44	34
Amusement, recreation, and related services	(1)	(1)
Professional	.28	11
Government	.08	4

[1] Not available.

SUMMARY STATEMENT ON COMPOSITION OF LOW-INCOME POPULATION

One purpose in seeking to characterize the low-income people is to identify the reasons for their inferior income status. What handicaps or limitations differentiate the low-income persons from the rest of the population? We have access to data on only a limited number of socio-economic variables. Of these, four which may be separated out as "handicapping" variables are old-age, nonwhite color, family headed by a female, and family headed by a person with education of 8 grades

or less. Table 8 shows our estimates of the numbers of low-income persons having each of these handicapping characteristics. Out of the total of 32.2 million low-income persons in 1957, 8 million were 65 years of age or older, 6.4 million were nonwhite, 8 million were in consumer units headed by a woman, 21 million were in units headed by a person with educational attainment of eighth grade or less.

Some part of the 32.2 million low-income persons have more than 1 of these handicapping characteristics and some have more. About 70 percent had 1 or more of the 4 characteristics listed. About 50 percent had 1 or more of the first 3 characteristics of old age, nonwhite color, and female head. (Another way to say this is that 50 percent were neither old aged, nonwhite, nor in units headed by females.)

TABLE 8.—*Numbers and percent of low-income population and percent of total population having specified characteristics, 1957* [1]

Characteristic	Low-income population	Low-income population	Total population
	Millions	*Percent*	*Percent*
Total	32.2	100.0	100.0
Handicapping characteristics:			
Age 65 or over	8.0	25.0	8.5
Nonwhite color	6.4	20.0	10.0
Unit headed by female	8.0	25.0	10.0
Unit headed by person with educational attainment of 8th grade or less	21.0	67.0	45.0
Descriptive characteristics:			
Farm residence	8.0	25.0	10.0
Head nonemployed	11.0	33.0	16.0
Head unskilled employed	7.0	21.0	25.0
Family size, 6 or over	11.2	34.0	23.0
Unattached individuals	4.4	16.0	6.0
Children	11.0	33.0	33.0

[1] The columns do not add to the total because some persons have more than one of the characteristics.

These findings are best understood in the perspective of how frequently these characteristics appear in the general population. If the 32.2 million under discussion had the same characteristics as the general population only 2.9 would be aged, 3.2 would be nonwhite, 3.2 would be in units headed by a female and 15 would be headed by a person with educational attainment of no more than 8 grades. From 45 percent to 60 percent would have one or more of the four characteristics, about 20 percent would have one or more of the first three characteristics.

We gain further understanding of who the low-income persons are by reference to a second set of variables. These are not handicapping in the basic sense—but may be thought of as descriptive characteristics. Striking differences appear between the composition of the low-income population and the composition of the total population with regard to farm residence, nonemployment status, and unattached individual status.

CHAPTER III. HOW HAS THE LOW INCOME PROBLEM CHANGED IN 10 YEARS?

Smaller Share of Population in Low Income Status

Substantial progress has been made in reducing the part of the population in what we have defined as low-income status. We have counted a person as having low-income status in 1957 if he was in a family of four persons with under $2,500 of total money income, or if he was in a family of larger or smaller size with larger or smaller income, with the several equivalent income cutoffs selected on the basis of the way consumer needs vary with family size. Similarly, we have counted a person as having low-income status in 1947 by the same method except that the whole range of income cutoffs is adjusted for price change. For example, the cutoff for a four-person family is $2,000 in 1947 and $2,500 in 1957.

Following these definitions we find that 26 percent of the population was in low-income status in 1947 as compared to 19 percent in 1957.[9] This noteworthy decrease means that the share of the population in low-income status fell over one-fourth of the way to zero. Another decade of similar progress would drop the percentage to 14.

Table 9.—*Percent of consumer units and persons having low-income status in selected years, 1947–58, estimated by alternative methods*

[In percent]

	Survey of consumer finances ($2,000 minimum)—Spending units		Census ($2,000 minimum)			Census (variable minimum for different family sizes)		Department of Commerce, OBE Personal Income Series ($2,000 minimum)	
	Current dollars	1947 dollars	Current dollars	1947 dollars	1948 dollars	Current dollars	1947 dollars	Current dollars	1947 dollars
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Consumer or spending units:									
1947	36	36	35	35		28	28	25	25
1948			33		33				
1954			29						
1957	21	26	23	28	26	17	21	14	20
1958	20								
All persons:									
1947			28	28	27	26	26		
1957			16	19	18	15	19	11	15
Families:									
1947								17	17
1948			25		25				
1954			20		22				
1957			15		19			8	13
Unattached individuals:									
1947								61	61
1948			73		73				
1954			64		68				
1957			59		65			41	54

[9] See the second panel in table 9, col. 9. The same general picture of considerable progress appears whether we make the comparison in terms of persons, consumer units, spending units, or families. The least progress seems to have been made with unattached individuals. See fourth panel of table 9, which shows that for that group the fall was only from 73 percent having less than $2,000 of income in 1947 to 65 percent in 1957. This is a fall of about one-tenth of the way toward zero. There was no less reduction in the share of all consumer units under $2,000 of income when income is defined as personal income than when it is defined as total money income. (Compare col. 4 and col. 9 of table 10.) This would indicate that the poor who have moved off farms have gained higher cash income in sufficient amounts to offset the loss of income in kind they may have had on the farm.

Process by Which Change Occurred

The reduction of the number of persons having low-income status is associated with a great rise in average income. It was, therefore, part of the process of general economic growth. Real (adjusted for price change) per capita disposable income rose from $1,525 in 1947 to $1,830 in 1957. The median real income of nonfarm families climbed from $2,500 in 1947 to $3,200 in 1957. This rise in income was made possible in turn by a great shift of the labor force among occupational and industrial groups, by a rise in the number of workers per family (from 1.48 to 1.54) and by increased production per worker within occupational and industrial groups. In part the latter change was due to generally rising levels of education and occupational skill and in part to such factors as more capital per worker, better management, and technological development.

Further understanding of the reduction in the frequency of low income may be gained from examination of changes in groups within the low-income class. Here we would call attention to six changes. Three changes worked against a reduction in the proportion of people in low-income status. These are changes in family size, changes in age of heads of consumer units, and changes in the rate of employment participation. It may be said that reduction of the frequency of low income occurred in spite of those changes. On the other hand, three changes that worked to accommodate a reduction are movement from rural-farm to nonfarm residence and shifts out of lower paying into higher paying occupations and industries. In examining each of these changes we will look with interest to see if there are groups that did not experience a fall in frequency of low income over the decade. Groups that maintained the same frequency of low income throughout the period may be thought of as having a special immunity to economic progress.

In estimating the effect of each of these changes we note that the number of low-income units will tend to rise as the population rises. Also, the number of low-income units will fall or rise as the population shifts among groups having different percentages of their total numbers in low-income status. Finally, the number of low-income units will fall if the percentage that low-income units are within any group (any age group, for example) falls.

Factors Encouraging Increase in Number of Low-Income Persons

Change among consumer unit size groups

Changes in family size encouraged an increase in the number of low-income units and low-income persons. The greatest increase in numbers of consumer units over the 10-year period occurred near the extremes of the family sizes where the frequency of low-income status was unusually high. These family sizes are one person, two, five, and six. (Compare cols. 1 and 2 in table 10.) The shift into these particular family sizes would have had the effect of raising the total number of low-income units if no other changes had occurred. However, the frequency of low income fell dramatically (i.e., by one-third or more) for three, four, and five person families and less dramatically for other family sizes, causing the share of low-income units in the total population to fall from 28 percent to 21 percent. (Compare

cols. 3 and 4.)[10] While the number of large families increased in the total population, the number of such families in the low-income population fell.

The increase in number of workers per family has been concentrated in families in moderate income ranges. (See table 15.) This means that many families moved out of the lowest fifth during the 1948–57 period by sending an additional family member into the labor force. At the same time, many families of small size or with a disabled member were unable to rise in the income ranking and this fact contributes to the characteristics of the contemporary low-income population.

TABLE 10.—*Distribution and frequency of low income consumer units, by size of unit, 1947 and 1957*

Size of consumer units	Number in group (millions)		Number of low income units [1] (millions)		Incidence of low income (percent)		Hypothetical number of low income units, 1957 (millions)	
	1947	1957	1947	1957	Col. 3÷ col. 1, 1947	Col. 4÷ col. 2, 1957	Holding incidence rates constant	Holding family sizes and incidence constant
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Total	45.3	54.0	12.7	11.6	28	21	15.4	15.1
1 person	8.1	10.3	4.1	4.4	51	43	----	----
2 persons	11.7	14.3	2.7	2.5	23	17	----	----
3 persons	9.6	9.5	1.8	1.2	19	13	----	----
4 persons	7.4	8.8	1.5	1.0	20	11	----	----
5 persons	4.2	5.5	.9	.8	21	14	----	----
6 persons	2.2	2.9	.7	.7	32	24	----	----
7 persons or more	2.3	2.6	1.0	1.0	44	38	----	----

[1] Low income units defined as those below variable minimum incomes for the several family sizes with $2,000 (1947 prices) for a family of 4 as a base.

Change in age

Aged heads of consumer units increased in number at twice the rate as did heads of all ages. This would have had the effect of increasing the number of low income units very substantially if no changes in the frequency of low income had occurred within any age group. In fact, however, there were large changes in incidence within some age groups, particularly in the 25–34 years group where the incidence rate fell from 24 percent to 12 percent.[11] It is notable that there was virtually no decline in the incidence rate for aged persons. Incidence rates did not fall much for any age groups of unattached individuals, with the consequence that the number of unattached individuals with under $2,000 (1947 prices) of income actually rose between 1947 and 1957.

[10] Some readers may be interested in a more specific answer as to the effects of the changes shown in table 10. Population change alone would have raised the number of low-income units from 12.7 million in 1947 to 15.1 million in 1957 (see cols. 3 and 8) and changes among the family size groups would have added another 0.3 million units (see col. 7). The changes in incidence offset both the population growth and the shift among the family size groups and dropped the number of low-income units from a potential of 15.4 million to the actual number of 11.6 million in 1957. The average size of low-income units (as defined in table 10) fell from 2.87 to 2.79 persons. Making the calculations in terms of the persons in these units gives the following findings: Population change alone would have increased the number of low-income persons from 36.6 million in 1947 to 43.6 million in 1957. The movement into different family size groups would have added another 2.6 million to raise the total to 46.2 million, but the low incidence rates noted above dropped the actual number of low-income persons to 32.3 million in 1957.

[11] As shown in table 11, top panel, population growth alone would have raised the number of low income families from 10.07 million to 11.80. Changes in ages of family heads would have raised the number to 12.09. Incidence changes dropped it to the actual number of 8.74 million families in 1957.

Thus, it would seem that an important factor in reducing the number of low income units and persons was the cutting of incidence of low income in those larger family sizes wherein a large part of the population is found. This development in turn is presumably due to (1) some realinement of fertility by income class, (2) some separation of aged persons from multiperson families of which they might otherwise be members, and (3) some increase in the number of earners per multiperson family.

In elaboration of these three points the following considerations may be mentioned. It would seem that the old proposition about the rich being outreproduced by the poor is in process of being negated. One scholar summarizes the studies of differential fertility as follows:

> The general consensus of demographers and other observers of population phenomena has been that differential fertility among various groupings within the American population has been in a process of contraction during recent decades * * * Should this trend continue in the future, students of differential fertility some day may well be seeking explanations of a direct rather than an inverse relationship between education, occupation, and fertility.[12]

See table 15 for data on changes in size of family, and number of children by family income level.

The point about separation of aged persons from multiperson families has to do with the "undoubling" of families. This again is part of a long trend, in this case associated with the shift from a rural to an urban and industrialized way of life. But higher average incomes and, in particular, higher social security benefits, may have accommodated the observably higher rate of undoubling in the postwar years. Since undoubling has the paradoxical effect of showing more low income units as income rises, it is important to measure changes in the low income population in terms of persons rather than consumer units.

Changing participation in employment

The proportion of family heads with employment declined from 1948 to 1957. This would tend to increase the number of low income families. This decline is, of course, related to the changes described above in age and family size. Between 1948 and 1957 the number of families headed by an employed civilian rose by 8 percent, while the number of families headed by a person in the Armed Forces or not employed rose by 40 percent. See table 12. Population change alone would have increased the number of low income families. The movement out of employment (unless offset by falling incidence rates) would have further raised the total of low income families. However, incidence rates fell, particularly for those families headed by an employed civilian, so that the number of low income families actually fell.[13]

[12] Charles W. Westoff, "Differential Fertility in the United States, 1900 to 1952," American Sociological Review, October 1954, p. 561.

[13] The population increase would have raised the number of low income units from 9.7 million to 10.9 million. The shift out of employment would have raised the number to 11.5 million. The changes in incidence rates dropped it to the actual number of 8.66 million families.

TABLE 11.—*Distribution and frequencies of low income families and single individuals, by age of head, 1947 and 1957*

FAMILIES

Age of head	Number in age group (millions)		Number of low income units (millions)		Incidence of low income (percent)		Hypothetical number of low income units, 1957 (millions)	
	1947	1957	1947 (under $2,000)	1957 (under $2,500)	Column 3÷column 1, 1947	Cclumn 4÷column 2, 1957	Holding incidence rates constant	Holding age composition and incidence constant
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
All families	37.3	43.7	10.07	8.74	27	20	12.09	11.80
Under 24	1.8	2.2	.67	.53	37	24		
25 to 34	8.1	9.1	1.94	1.09	24	12		
35 to 44	8.9	10.4	1.87	1.25	21	12		
45 to 54	8.0	9.5	1.67	1.61	21	17		
55 to 64	6.1	6.6	1.71	1.52	28	23		
65 and over	4.4	5.8	2.33	2.90	53	50		

SINGLE

All individuals	8.0	10.3	5.9	6.8	74	66	7.6	7.6
Under 24	.8	.8	.7	.6	82	71		
25 to 34	1.0	1.1	.7	.5	67	43		
35 to 44	1.1	1.1	.6	.5	56	48		
45 to 54	1.4	1.6	.9	.9	62	54		
55 to 64	1.4	2.2	1.0	1.4	73	62		
65 and over	2.3	3.4	2.1	3.0	90	88		

The rising importance of families headed by a person not employed as seen in table 12 is part of a longer trend since the 1930's. More and more the low income groups are identified with lack of employment. This change is in part explained by the long period of prosperity and inflation. The incomes of families headed by workers tend to rise with rising prices and wages, whereas the incomes of families living on pensions and other types of fixed incomes do not rise as rapidly as others. Similarly, the increase in number of workers per family is most likely to have occurred in those age groups where the head is typically in the labor force.

A tendency to identify a large part of this increase in the number of low income family heads with the increase in old-aged and low income heads is strengthened by a look back at table 11. There was a 32-percent increase in the number of aged family heads and virtually no change in the incidence of low income among the aged. The increase in old-aged and low income heads was 600,000 whereas the increase in the "Armed Forces or not employed" low income category was 1.2 million (table 13). Some part of the latter rise may be due to the recession of 1957–59. The only age-sex group showing important declines in extent of employment between 1950 and 1957 were young men under 25 and men over 65. (See table 15.) Among men 65 and over those with work experience fell from 49 to 47 percent; and the proportion of those who worked from 50 to 52 weeks at full-time jobs fell from 52 to 45 percent of the age group. This decline in

extent of employment may explain the fact that the incidence of low income stayed at about 50 percent of aged families over the period. It is striking that this incidence rate stayed constant during the period in which a remarkable change was going forward in the aggregate level of old-age benefits under social insurance. The number of persons 65 and over who were receiving benefits from social insurance and related programs rose from 2.3 million in 1948 to 10.4 million in 1958.[14] Benefit rates have been substantially raised so that benefit payments under social insurance, assistance and related programs probably account for more than one-third of the aggregate money income of all persons 65 years of age and older. As noted above, at the same time as benefits were being raised a decline in labor force participation of aged men was taking place.[15]

TABLE 12.—*Distribution and frequency of low income families, by employment status of head, 1948 and 1957*

Labor force status of family head	Number in employment status group (millions)		Number of low income families (millions)		Incidence of low income (percent)		Hypothetical number of low income families, 1957 (millions)	
					Col. 3÷1	Col. 4÷2	Holding incidence rates constant	Holding employment composition and incidence constant
	1948	1957	1948 under $2,000	1957 under $2,500	1948	1957	1957	1957
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Total	38.5	43.7	9.70	8.66	25	20	11.5	10.9
Employed civilians	31.9	34.5	6.38	4.49	20	13	----------	----------
In Armed Forces or not employed	6.6	9.2	3.32	4.17	50	45	----------	----------

Alternative and overlapping explanations of the lowered employment experience are—

(1) This is part of a long-term trend that reaches back at least to 1900.

(2) Men over 65 are older now on the average.

(3) Some increase in retirement was due to increased assets and planned dissaving of those assets.

(4) Increases in transfer payments and possibly higher wage rates for part-time work accommodated a desire for less employment.

Table 15, which is adapted from a recent study by Dr. Selma F. Goldsmith, offers another view of changes in family composition and labor force participation. It should be noted that unattached individuals are not included in the table.

[14] Lenore A. Epstein, "Money Income of Aged Persons: A Ten Year Review, 1948 to 1958," Social Security Bulletin, June 1959, p. 4. The average monthly OASI benefit paid to retired workers in June 1956 was $61.03.

[15] Ibid., p. 9.

TABLE 13.—*Percentage distribution of persons age 65 and over by total money income in 1948 and 1957 by sex*

Money income class	Total			Men			Women		
	1948		1957	1948		1957	1948		1957
	In 1948 dollars	In 1957 dollars		In 1948 dollars	In 1957 dollars		In 1948 dollars	In 1957 dollars	
Number (in thousands)	11,590	11,590	14,570	5,500	5,500	6,660	6,100	6,100	7,910
Total percent	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Less than $1,000	73.7	68.1	60.3	55.6	48.2	37.7	89.9	86.0	79.3
Zero	31.8	31.8	17.5	10.9	10.9	4.8	50.6	50.6	28.2
$1 to $499	21.1	19.1	16.0	20.7	19.1	9.1	21.4	19.1	21.8
$500 to $999	20.6	17.2	26.8	23.7	18.2	23.8	17.8	16.3	29.3
$1,000 to $1,999	13.1	16.5	20.2	20.0	23.8	28.3	6.8	10.0	13.4
$1,000 to $1,499	8.5	11.6	12.9	12.7	15.8	17.4	4.6	7.8	9.0
$1,500 to $1,999	4.6	4.9	7.3	7.3	8.0	10.9	2.2	2.2	4.4
$2,000 to $2,999	6.8	6.7	7.9	12.3	11.6	12.8	1.7	2.2	3.7
$3,000 to $4,999	4.3	5.7	6.9	8.1	10.7	12.5	1.0	1.1	2.3
$5,000 or more	2.2	3.0	4.7	3.9	5.5	8.7	.5	.7	1.4

Source: Lenore A. Epstein "Money Income of Aged Persons: A 10-Year Review, 1948 to 1958" Social Security Bulletin, June 1959, p. 9.

TABLE 14.—*Work experience during the year, by age and sex for the United States: 1957 and 1950*

Age and sex	1957						1950					
	Total with work experience		Distribution of those with work experience				Total with work experience		Distribution of those with work experience			
			Worked at full-time jobs						Worked at full-time jobs			
	Number (thousands)	Percent of population	50 to 52 weeks	27 to 49 weeks	1 to 26 weeks	Worked at part-time jobs	Number (thousands)	Percent of population	50 to 52 weeks	27 to 49 weeks	1 to 26 weeks	Worked at part-time jobs
Both sexes	77,664	65.4	55.1	15.5	10.4	19.0	68,876	63.1	55.7	17.1	11.6	15.5
Male	48,709	86.0	65.9	15.1	7.1	12.0	45,526	86.8	65.4	16.7	8.0	9.8
14 to 17 years	2,730	52.7	4.1	2.2	17.4	76.3	2,206	52.2	7.8	5.1	19.9	67.1
18 to 19 years	1,558	85.2	19.6	13.8	31.8	34.8	1,515	84.0	25.0	17.4	33 3	24.2
20 to 24 years	3,926	91.2	46.6	22.5	18.0	12.9	4,575	92.7	54.0	21.5	15.6	8.9
25 to 54 years	30,815	97.8	76.9	15.8	3.5	3.7	28,543	97.4	74.1	17.2	4.7	4.0
55 to 64 years	6,535	91.4	72.0	14.5	5.3	8.3	6,007	89.6	70.3	15.8	6.2	7.7
65 years and over	3,145	47.3	45.4	12.1	10.6	31.9	2,679	49.3	52.3	15.1	9.1	23.5
Female	28,955	44.6	37.0	16.0	16.0	31.0	23,350	41.1	36.8	17.9	18.7	26.6
14 to 17 years	1,987	38.9	1.7	2.3	20.9	75.2	1,389	33.3	2.6	5.4	30.0	61.9
18 to 19 years	1,511	67.3	19.3	18.0	35.3	27.5	1,303	61.6	24.9	17.1	35.3	22.6
20 to 24 years	3,356	62.5	35.5	22.1	26.7	15.7	3,383	58.7	42.0	22.3	22.8	13.0
25 to 34 years	5,610	47.3	38.9	17.0	18.2	25.9	5,291	43.7	37.8	17.8	22.3	22.0
25 to 44 years	6,364	53.5	42.0	16.1	13.2	28.7	5,070	47.2	40.5	18.7	14.6	26.2
45 to 64 years	8,938	50.3	44.7	16.5	9.1	29.7	6,192	39.4	41.0	18.5	11.7	28.8
65 years and over	1,189	15.1	30.4	9.7	9.4	50.5	724	11.8	29.7	11.1	12.0	47.4

Source: Bureau of the Census, U.S. Department of Commerce, Series P-50, No. 86, September 1958, p. 4.

TABLE 15.—*Family composition: Fifths of families ranked by size of money income, 1948 and 1957*

Fifths of families	Average size of family		Average number of children under 18 years living in the family		Median age of family head		Percent of family heads 65 years old and over		Percent of families with female heads		Average number of earners in family		Percent of husband-wife families in paid labor force		Heads not in labor force, unemployed, or in Armed Forces	
	1948	1957	1948	1957	1948	1957	1948	1957	1948	1957	1948	1957	1948	1957	1948	1957
Lowest	3.29	3.27	1.14	1.19	51.9	55.0	27.6	32.9	19.8	22.7	1.06	1.07	13.4	16.0	37.1	47.5
2	3.52	3.60	1.29	1.43	42.0	43.9	11.2	14.4	10.7	11.1	1.32	1.41	17.6	22.3	19.0	24.1
3	3.58	3.75	1.30	1.54	41.1	40.0	7.7	7.3	6.0	6.6	1.40	1.50	17.5	24.3	11.5	13.7
4	3.62	3.80	1.19	1.47	42.3	41.9	6.7	5.8	5.5	5.0	1.62	1.72	27.2	33.4	9.3	10.9
Highest	3.94	3.82	1.03	1.27	47.4	45.6	7.9	6.0	6.2	3.9	2.03	1.99	30.5	41.2	9.3	9.1
Total	3.59	3.65	1.19	1.38	44.5	45.1	12.2	13.3	9.6	9.9	1.48	1.54	21.5	28.1	17.2	21.1

Source: Survey of Current Business, April 1959, pp. 11, 12.

FACTORS ENCOURAGING REDUCTION OF LOW INCOME UNITS

Three factors which have made possible the fall in percent of all units in low income status are shifts from rural to nonrural residence, shifts into higher paying occupations, and shifts into higher paying industries. These three factors are obviously highly interrelated. The leading change of the period was the absolute fall in the number of rural-farm families from 6.5 million to 4.8 million. (See table 16.) Population change alone would have altered the total number of low income families from 10.1 million in 1947 to 11.8 million in 1957. The movement off farms alone would have dropped this back to 10.2 million, and incidence change (and incidence changed only in the case of urban families) dropped it to its actual 1957 count of 8.7 million families. It is worth special mention that the incidence of low income among both farm families and farm individuals did not fall at all over the decade. Progress on this count was achieved only by movement off farms and by simultaneously reducing the incidence of low income in nonfarm residence groups. The failure of farm incidence rates to fall is related in part to age. The younger persons have tended to leave and older persons have tended to stay on farms. The result is that the median age of farm family heads is considerably higher than of nonfarm heads.

Both occupational and industrial shifts of population contributed to the fall in the number of low income families. In both cases population change alone would have raised the number from 6.38 million to 6.90 million families (ignoring those out of the labor force) but movement (without incidence changes) would have dropped the number to 5.81 in the case of occupational shifts and 5.87 in the case of industry shifts. In fact, a whole series of drops in incidence in many occupations and industries (though not, notably, in agricultural groupings nor in finance) cut the number in low-income families to 4.49 million. (See tables 17 and 18.)

TABLE 16.—*Distribution and frequency of low income families and unattached individuals by place of residence, 1947 and 1957*

Residence	Number in group (millions)		Number of low income (millions)		Incidence rates (percent)		Hypothetical number of low income families (millions)	
	1947	1957	Under $2,000 1947	Under $2,500 1957	Col. 3÷1 1947	Col. 4÷2 1957	Holding incidence rates constant	Holding residence and incidence constant
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Total	37.3	43.7	10.1	8.7	27	20	10.2	11.8
Urban	22.5	27.5	4.5	4.1	20	15		
Rural nonfarm	8.3	11.4	1.7	2.3	20	20		
Rural farm	6.5	4.8	3.3	2.4	51	50		
INDIVIDUALS								
Total	8.1	10.3	6.0	6.8	74	66	7.5	7.6
Urban	5.8	7.9	4.0	4.0	69	62		
Rural nonfarm	1.3	1.8	1.1	1.3	84	74		
Rural farm	.9	.6	.8	.5	89	89		

TABLE 17.—*Distribution and frequency of low income families, by occupation of head 1948 and 1957*

Occupational group	Number in occupation (millions)		Number of low income families (millions)		Incidence rates (percent)		Hypothetical number of low income families (millions)	
	1948	1957	1948	1957	Col. 3÷1 1948	Col. 4÷2 1957	Holding incidence rates constant	Holding occupational composition and incidence constant
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Total employed civilians	31.9	34.5	6.38	4.49	20	13	5.81	6.90
Professional, technical and kindred	2.2	3.7	.13	.15	6	4		
Farmers and farm manager	4.0	2.5	2.04	1.35	51	54		
Property manager and official excluding farm	4.7	5.2	.51	.47	11	9		
Clerical and kindred	2.2	2.5	.15	.13	7	5		
Salesmen and saleswomen	1.6	2.0	.18	.14	11	7		
Craftsmen and kindred	6.1	7.0	.67	.42	11	6		
Operatives and kindred	6.3	6.6	.82	.59	13	9		
Domestic service	.3	.3	.23	.21	77	69		
Service workers, excluding domestic	1.9	2.1	.47	.38	25	18		
Farm laborers and foremen	.6	.5	.41	.30	68	60		
Laborers excluding farm and mine	2.0	2.0	.64	.44	32	22		

TABLE 18.—*Distribution and frequency of low income families, by industry of head, 1948 and 1957*

Industry	Number in industry (millions)		Number of low income families (millions)		Incidence rates (percent)		Hypothetical number of low income families, 1957 (millions)	
	1948	1957	1948 under $2,000	1957 under $2,500	Col. 3÷1 1948	Col. 4÷2 1957	Holding incidence rates constant	Industry composition and incidence held constant
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Total employed civilians	31.9	34.5	6.38	4.49	20	13	5.87	6.90
Agriculture and farm	4.8	3.2	2.54	1.52	53	52		
Mining	.7	.5	.06	.02	9	5		
Construction	2.4	2.9	.53	.35	21	12		
Manufacturing	8.8	10.3	.79	.52	9	5		
Transportation	3.1	3.1	.28	.22	9	7		
Wholesale	1.4	1.7	.17	.14	12	8		
Retail	4.3	4.5	.73	.59	17	13		
Finance	.9	1.2	.07	.10	8	8		
Business and repair service	.8	1.2	.16	.18	19	14		
Personal and domestic	1.1	1.3	.46	.44	42	34		
Amusement, recreation and related services	.2	.2	.00	(1)	9	(1)		
Professional	1.9	2.5	.29	.28	15	11		
Government	1.5	1.9	.09	.08	6	4		

[1] Not available.

SUMMARY OF CHANGES

In summary of the above material on the changes over the 1947 to 1957 period, the following points are made. The factors that led to the reduction in the numbers of low income persons include the following. (1) Reduced frequency of low income in almost every occupational and industrial group. (Notable exceptions were agriculture, domestic service, and finance.) (2) Greater than proportional growth in the numbers employed in relatively high-paying occupations and industries, namely professional, technical, and kindred occupations, sales, skilled crafts, construction, finance, business and repair services and government. (3) Movement out of farm residence and farm work. (4) Increase in the number of workers per family. This was associated with a remarkable drop in the frequency of low income among three, four, and five person families.

The factors that worked against the reduction in numbers of low income persons were these. (1) Disproportionate increases in numbers of very large and very small consumer units. (2) Disproportionate increases in the numbers of persons aged 65 and older and a particularly striking increase in the number of unattached individuals aged 55 and over. The latter change may be associated with a structural change in family organization, with more older persons living independently from their adult children. (3) A relative increase in the number of family heads in the Armed Forces or not employed. This decline in participation in employment is in turn associated with the increase in aged family heads.

In the 10-year period actual increases in the absolute numbers of low income persons were observed in the following groups: Unattached individuals (most clearly for those aged 55 or more); families with heads aged 65 or more; and families headed by a person in the Armed Forces or not employed.

CHAPTER IV. THE FUTURE OF LOW INCOME PROBLEM

Projections for the Future of Numbers in Low Income Status

One way to estimate what will happen in the future is to project the experience of the past. It will be recalled that it was found above that the share of all persons in low income status fell from 26 percent in 1947 to 19 percent in 1957. A similar fall in the succeeding 10-year period could result in a 14 percent figure in 1967 and 11.5 percent in 1977.

A different way to project past experience is to refer to changing levels of average income. The group of consumer units with income under $2,000 in 1957 was roughly the lowest one-fifth of consumer units. The median income of this group was $1,465.[16] Projecting past rates of growth in that median puts it at $2,000 within 30 years from 1957. This would mean 10 percent would have incomes under $2,000. A still different way to refer to experience is to call upon differences within the United States. New York, one of our wealthiest States, had a per capita income 23 percent higher than that of the United States in 1956—16 percent of consumer units in New York had incomes under $2,000, while 23 percent of the Nation's consumer units had incomes that low. This would suggest that when the national per capita income rises 23 percent, the national consumer units with under $2,000 of income would fall to 16 percent. This might be expected within 15 years from 1957.

These several methods of projection all yield approximately the same answer. By 1977–87 we would expect about 10 percent of the population to be in low income status as compared to about 20 percent now. These methods all assume that the process of growth and development of the economy will be as effective in reducing poverty in the future as it has been in the past.

Will Reduction of Poverty Be Slower in the Future?

It is argued by some that the future rate of change will be slower because present-day poverty is qualitatively different from the poverty found in earlier days. Whereas oldtime poverty was general, the new poverty, it is alleged, is specific and associated with a limited number of groups. These groups are in turn said to be those which are not likely to be improved by a generalized type of national economic growth because they are "immune" to such progress. This immunity arises out of personal characteristics or an environment which insulates them from opportunities for earning higher income.

Prof. John Kenneth Galbraith, in his book, "The Affluent Society," writes of three kinds of poverty—namely, generalized poverty, island poverty, and case poverty. The first is the kind which yields to

[16] It is interesting that increasing the average by $1,000 for 12 million units would only amount to $12 billion, or less than 5 percent of the national income.

the process of economic growth in which the average productivity of labor is increased. The latter two, he asserts, are the principal kinds of poverty remaining in the United States today and these are caused respectively by (1) inability or unwillingness to move out of low income areas or regions, and (2)—

> * * * some quality peculiar to the individual or family involved—mental deficiency, bad health, inability to adapt to the discipline of modern economic life, excessive procreation, alcohol, insufficient education, or perhaps a combination of several of these handicaps * * *.[17]

Galbraith states that in the early 1950's "The hard core of the very poor was declining, but not with great rapidity."[18] Further, he argues:

> The most certain thing about modern poverty is that it is not efficiently remedied by a general and tolerably well-distributed advance in income. Case poverty is not remedied because the specific individual inadequacy precludes employment and participation in the general advance. Insular poverty is not directly alleviated because the advance does not necessarily remove the specific frustrations of environment to which the people of these islands are subject. This is not to say it has no effect. Secure job opportunities elsewhere, a concomitant of industrial advance, work against the homing instinct. And so, even more directly, does the spread of industrialization. The appearance of industry in parts of the Tennessee Valley area has had a strong remedial effect on the insular poverty of those areas. But it remains that advance cannot improve the position of those who, by virtue of self or environment, cannot participate or are not reached.[19]

Evaluation of the Galbraith Thesis

We submit that Professor Galbraith has misinterpreted the low income problem in several ways. In the first place, our finding that the percent of the total population in low income status fell from 26 to 19 percent in 10 years would seem to contradict, or at least not to confirm, his statement that "the hard core of the very poor was declining but not with great rapidity." In the second place, with regard to island poverty, the record suggests that movement was a leading factor working for the reduction of numbers in low income status. For instance, the number of rural farm families with under $2,000 income (1947 dollars) actually fell during the 1947–57 period from 3.3 to 2.4 million because of movement off the farm. (See table 16.) Similarly, there were great shifts among occupations and industries which contributed to the reduction of low income units. Third, with respect to "case poverty," it should be pointed out that some of these characteristics of persons are moderated over time. For example, average educational attainment levels will rise in future years simply because younger people presently have better education than older people. Hence, as the current generation of old people pass from the scene, the percent of persons with low educational attainment will fall.[20]

[17] "The Affluent Society," p. 325.
[18] Ibid., p. 324.
[19] Ibid., p. 327.
[20] Between 1950 and 1957 the median educational level increased 1 full year. "Most of the improvement was due to the fact that persons reaching adult ages * * * had been better educated than their parents and grandparents, many of whom were leaving the population through death." (Current Population Reports, p. 20, No. 77.) "* * * the educational level of young persons considerably exceeds that of older workers. In March 1957, 18- to 34-year-old labor force members had completed over 12 years of school (on the average), as compared with only 9½ among middle-aged workers and 8½ years among those over 65" (p. 50, No. 78).

Whether the reduction of low incomes due to such improved levels of educational attainment should be attributed to economic growth or to social policy is a semantic problem. It is part of the adaptation to new and higher skill occupations and hard to separate from the whole process of growth. This process, in turn, pulls people into areas where educational opportunities are greater. This is not to deny that increased educational opportunity will not in itself contribute to the rate of growth.

Fourth, we would take exception to Professor Galbraith's list of causal variables since he excludes the important ones of age, color, and sex of head.

Suppose now we take up the question as Galbraith implicitly, if quite awkwardly, puts it. Which groups among the contemporary low income population are likely to diminish in the future, assuming a rising average level of income, and which ones are not likely to diminish? Do the answers to these questions suggest a slowing down of the rate at which we have been reducing the share of the population in low income status?

What Groups Do Not Benefit by Economic Growth?

It is true, of course, that some groups will not benefit from the process of growth in the same ways that others do. Those who are outside of the labor force tend to have an immunity to growth. (Here we are ignoring property income. Those who hold equity claims will tend to share in the growth of the economy thereby, even though they may be out of the labor force.) Those who cannot or will not move or change occupation, or who cannot otherwise adapt to changes in the economic environment, will run a greater risk of low income status at some time in their lives than will others. In general, consumer unit heads who are least mobile and adaptable are seen to have a handicapping characteristic such as old-age, nonwhite color, female sex, or low education. Old age is a handicap in the sense that older people typically have greater difficulty in getting reemployed than do younger people and in getting into new and rapidly growing occupations and industries. (In one sense, the aged group may be said to participate in growth if average old-age insurance and assistance payments rise with average income of the community. To the extent that the formula for computing old-age, survivors and disability insurance benefits accounts for rising average monthly wages, those benefits will rise over time.) Nonwhite color is a handicap to the extent that color is a bar to higher income occupations. Female sex also operates to limit occupational choice and even to some extent, geographic mobility. Low education limits mobility and adaptability by barring entry to and perhaps limiting knowledge of and motivation toward new occupational possibilities.

It is significant that the contemporary low income population is disproportionately made up of persons having one or more of these characteristics. In the discussion of "Who are the low income people?" above, it was concluded that while about 50 percent of the total population have one or more of the four handicapping characteristics, 70 percent of the low income population of 32.2 million persons had one or more of these characteristics.

There is plausibility in the idea that each one of these characteristics has causal significance in determining the numbers in low income status. As we have already mentioned, one can confidently predict that the numbers having low educational attainment will fall and from that deduce that the percent of persons having low income will fall.

While low educational attainment will diminish in importance over time, the other three "handicapping" characteristics of old-age, nonwhite status, and female headship will not. It was estimated that, while only 20 percent of the total population have one or more of these three characteristics, 50 percent of the low income population have one or more of them. Old-aged persons, who now make up 8.5 percent of the population, will be 9.5 percent of the population within 20 years. The importance of families with female heads changed very little and that of nonwhites increased slightly between 1947 and 1957. Since none of these groups will diminish in importance in the future, the question then is: Will economic growth reduce the incidence of low income within the old-aged group, the nonwhite group, and the female-head group?

With regard to the old-aged group, it is striking that the 1947–57 period saw virtually no reduction in the incidence of low income. Therefore, on the basis of past experience we may identify this group as one that is "immune" to economic growth.

The female head group shows little change in incidence of low income over the recent 10-year period. In 1947, 46 percent of the families headed by women had incomes under $2,000; in 1957, 38 percent had incomes that low. (This compares with percentages of 25 and 15 for all families.) The failure of this rate to fall very much is doubtless due in part to the lower labor force participation of women-heads. The latter in turn is associated with the higher proportion of aged among women and also with the fact that many of the younger women family-heads have children to care for in the home. Hence, units with aged or female heads would seem to be identifiable as having "immunity" to economic growth.

With respect to the third "handicapping" characteristic of nonwhite color the picture is different. Nonwhite persons have shared and no doubt will continue to share in the processes of growth, i.e., higher earnings on present jobs, shifts into higher paying employments, and increasing numbers of earners per family. Between 1947 and 1957 the percent of nonwhite families with income under $2,000 fell from 62 to 36. The comparable percentages for white families were 24 and 12. Hence, nonwhites are not immune to economic growth.

There are two other causal variables which should be accounted for in an appraisal of the "hard-core" nature of contemporary poverty. Some persons are disqualified from full participation in economic life because of physical or mental or emotional difficulties. Data are inadequate in this area, but some evidence is provided by a study of the prevalence of long-term disability. On the average day in 1954, it is estimated, there were 5.3 million persons with a disability lasting more than 6 months.[21] Of these persons 2.2 million were 65 years of age and over, and 2.9 million were aged 14 through 64 years. Of

[21] Social Security Bulletin, June 1955, pp. 20–21.

the latter group perhaps over half would have been in the labor force if they were not disabled. How many of these disabled persons were in fact low income persons is not known. Nor is there any good way of estimating the importance of other related "personal" causes of low income, such as antisocial habits and attitudes or what Galbraith refers to as "inability to adapt to the discipline of modern economic life." But we can say that disability does result in an important degree of immunity to economic growth.

Then there is the cause Galbraith refers to as "excessive procreation." While only one-fourth of the total population is found in families of six or over, one-third of low income persons are in such large families. Looking to the future, it does not seem that very large families will increase as a proportion of all families, so this will not in itself cause an increasing share of all persons to be found in poverty. Furtber, large families are not immune to economic growth. In 1947–57 the incidence of low income fell just about as much for large families as it did for all families. (See table 10.)

By way of summary of this discussion table 19 is presented. It serves to underline the idea that several factors are working against reduction, via economic growth, of the size of the low income population. These are old age, disability, and female head-ship. As persons having one or more of these three characteristics come to be a larger part of the remaining low income population it would seem probable, unless offsetting factors work in the other direction, that subsequent general growth would do proportionally less to reduce the number of low incomes. However, the composition of the low income population changes very gradually and it does not appear that the characteristics of old age, disability, and female-head, which now account for about one-third of the group, will account for as much as one-half of the low income population for many decades. Further, it should be recalled that these same factors had to be overcome in the 1947–57 period, and in fact were overcome by economic growth and social policy.

From this investigation of Galbraith's claim that "modern poverty" will not yield to general economic growth we conclude, for reasons quite different from his, that there is limited validity to his claim and that the future rate of reduction in the percent of the population in low income status will tend to be slightly slower than in the recent past.

Low Income Group's Share of Income

All of this thinking about extending past experience assumes that the lowest income groups will not increase their share of total income. The only way for their income to rise faster than the income of the rest of the population is, of course, for them to get a larger share of the total. To make faster progress in eliminating poverty than the above calculations suggest would require such an increasing share of income.

TABLE 19.—*Importance of selected characteristics in future determination of low income population*

Characteristic	Percent of low income population having this characteristic, 1957	Will numbers with characteristic increase or decrease with time?	Degree to which persons having this characteristic are immune to economic growth
Low education	67	Decrease	High.
Old age	25	Increase	Do.
Nonwhite color	20	do	Low.
Female head-ship	25	No change	High.
Disability	(1)	do	Do.
Large family size	33	do	Low.

[1] Not available.

The lowest fifth of income receivers now get 5 percent of all income. It received 5 percent of income in 1947. It apparently received about 5 percent of income in the 1930's. However, there has been some progress because the lowest fifth of income receivers (families and unattached individuals) now includes a smaller part of all persons than it once did. But no matter how one figures it the change in share of income has not been great. In general we have been overcoming poverty more by raising the general level of income than by increasing the share of the bottom fifth at the expense of upper income groups.

CHANGES IN ECONOMIC INEQUALITY

There is evidence for the belief that the distribution of income and wealth are less unequal now than in earlier days. But the greatest part of the change seems to have occurred within the top half of the distribution. That is, the top group's share has been lowered at the expense of a gain in share by the upper middle group. Two leading studies into changes of the size distribution of income have established that a noteworthy fall in the income share of the top 5 percent of income receivers took place between 1939 and 1945. Prof. Simon Kuznets found that the top 5 percent of persons' share of disposable income fell from 27 to 18 percent, or well over three-tenths.[22] Dr. Selma Goldsmith and colleagues found a similar fall in the share of the top 5 percent of families in personal income.[23]

A study by the present author into the share of wealth held by top wealthholders offers the finding of a gradual loss of share of wealth by topranking persons and families.[24] Between 1922 and 1953 the top 2 percent of families' (ranked by size of wealth holdings) share of wealth fell from 33 percent to 29 percent. However, it is found that the concentration of wealth is increasing in the years since 1949. The lesser fall in inequality of wealth than in inequality of personal income calls attention to the fact that disposable personal income has changed more in its distribution than has national income.[25] Apparently the top income group has been able to offset its losses on

[22] "Shares of Upper Income Groups in Income and Savings," National Bureau of Economic Research, New York, 1953, p. xxxvii.
[23] Selma F. Goldsmith, George Jaszi, Hyman Kaitz, and Maurice Liebenberg, "Size Distribution of Income Since the Mid-Thirties," Review of Economics and Statistics, February 1954.
[24] Review of Economics and Statistics, November 1959.
[25] Selma F. Goldsmith, "Change in the Size Distribution of Income," American Economic Review, May 1957, p. 506.

income account to some extent by gaining on capital account. This has occurred in large part through corporate saving.

Government Policy Toward Inequality

These changes toward less inequality of wealth and income are apparently in some part due to the workings of "the market" and private responses to economic changes. They are also in some part due to Government policies and programs. Principal among these Government activities are education, health, and welfare service programs which improve the ability and motivation of poorer persons to compete in the marketplace. Also important are tax and money transfer programs. Several studies have been made which confirm the fact that overall taxing and spending policies of Federal, State, and local governments operate to diminish the inequality which arises in the market.[26] Comparison of the overall tax systems of prewar and postwar years suggests that the historical trend is, while very moderate indeed, toward a more equalizing tax system. In both the depression period and the postwar period the combined tax burden of the lowest fifth of consumer units has been heavy; about 19 percent of their income going to taxes of all kinds in 1938–39 and about 25 percent in 1948–54. The tax burden on the top fifth in the same period moved from 22 percent to 34 percent. The relative tax burden on the lowest fifth of consumer units is perhaps overstated in the more recent period because of the structural changes in the composition of that group. In short, the lower fifth of units has come to contain a smaller part of the total population with less of the Nation's total of consumer needs than it once did.

In the same period Government transfer payments have become a more important part of the income of the lowest fifth of consumer units. According to the Survey of Consumer Finances, about half the spending units in the lowest fifth received some transfer payments and transfer payments were 40 percent of the total money income of the group.[27] It seems clear that both the composition of this group and its share of income would be very different were it not for the tremendous growth of social insurance and related programs in recent years. In the last 30 years Government transfer payments have increased from 1 percent to 5 percent of national income.

Possibilities for the Future

It is concluded, then, that progress in the elimination of poverty has been made with only a minor change in the share of income and wealth in the hands of the lowest fifth of consumer units. Continuation of past policies and past experience for another generation (30 years) or so may be expected to result in the virtual elimination of what may reasonably (by present standards) be thought of as "low-income status." On the other hand, a relaxation in the rate of economic growth or a drop in the rate of increase of Government transfer programs could make the goal of eliminating poverty recede into the

[26] See Richard A. Musgrave, "The Incidence of the Tax Structure and its Effects on Consumption," Federal Tax Policy for Economic Growth and Stability, Joint Committee on the Economic Report, Nov. 9, 1955, pp. 96–117. Also John H. Adler, ch. 8 in "Fiscal Policies and the American Economy," Kenyon Poole, ed. New York, 1951.

[27] Federal Reserve Bulletin, September 1958, p. 1030.

far distant future. A higher rate of growth in average incomes, or a more aggressive Government policy aimed at increasing the post-tax, post-transfer share of total income received by the lowest fifth of consumer units (or a combination of both growth and wide sharing), could lead to this result in less than a generation.

A Program To Hasten the Reduction of Poverty

The primary motive power in reducing the share of the total population in low income status has been and should continue to be a vital, progressive private economy yielding increasing average product per worker. Therefore the basic part of any program directed against poverty must be that of insuring high levels of employment and production. As part of this program efforts should be made to preserve and expand freedom and opportunities for individuals to move from low income areas and occupations to high income areas and occupations and, conversely, for capital to flow toward the lower income regions of the country. In a national market free from barriers to such movement it may be expected that economic self-interest will work as a powerful engine to propel many people out of low income status.

In the discussion above it was urged, however, that the groups within the low income population vary in susceptibility to or immunity against this process of economic growth. In general, those groups with low labor force participation are quite immune. The groups referred to under this heading are the aged and the family units headed by women. The long run private approaches to reducing the incidence of poverty within these groups are many, including more saving, more private insurance, improved family responsibility, and adaptation of employment opportunities to the needs and limitations of aged persons and women with family responsibilities. Public approaches, on the other hand, include the provision of more education and retraining opportunities and social insurance programs (particularly old age, survivors, and disability insurance) and public assistance programs (particularly old age assistance and aid-to-dependent children). These programs in turn can be associated with guidance and counseling and rehabilitation work aimed at increasing participation in the economic life of the community.

Similarly, increasing public effort should be made to encourage more efficient participation in economic progress by the nonwhites in the low income population. Negroes, Indians, and other nonwhite minorities are often barred or alienated from such participation. Elimination of occupational barriers and especially improved educational opportunities for these groups would seem to be minimum steps in the direction of reducing their disproportionate representation in the low income population.

It has been noted that low income status is particularly marked on farms, and, more particularly, on farms in certain regions of the country. Any program to overcome poverty must make special provision for this group, offering better opportunities to earn a satisfactory living. Such better opportunities may be brought about by (1) encouraging these low income farmers to move elsewhere, (2) by encouraging nonagricultural employers to move their operations into these areas, and (3) by technical and financial aid to improve their

farming productivity. Ability and motivation of the next generation of adults in the depressed agricultural communities to achieve greater economic well-being would be improved by a sharply expanded program of education for those currently of school age.

Probably no public program has made and can continue to make so important and fundamental a contribution to the elimination of poverty as free public education. Education offers children a way to rise in occupational status above their parents and hence is a way to break the vicious circle of poverty breeding poverty. About a fifth of the Nation's children are being reared in low income status and it is of critical importance that these children have educational opportunities that are not inferior to the national average. It is, of course, true that there is a tendency for children of low income families to have below average educational opportunity. We would agree with Galbraith that—

> * * * poverty is self-perpetuating because the poorest communities are poorest in the services which would eliminate it. To eliminate poverty efficiently we should invest more than proportionately in the children of the poor community. It is there that high quality schools, strong health services, special provision for nutrition and recreation are most needed to compensate for the very low investment which families are able to make in their own offspring. The effect of educational and related investment in individuals is to enable them to contend more effectively with their environment, to escape it and take up life elsewhere on more or less equal terms with others.[28]

In 1956 the Joint Economic Committee set forth a program for the low-income population at substandard levels of living.[29]

In that statement, which is still applicable to the situation today, they concluded that:

> To meet the problems effectively will require the concerted efforts of all segments of our national life—all levels of government working with labor and management and private community groups and organizations. With such coordinated, positive action, we are confident that, in overall terms, the total cost will be low when measured by the positive economic gains which will be generated throughout the total economy and also when measured by the resultant strengthening of the forces which produce an alert, productive, and democratic society.[30]

[28] "The Affluent Society," pp. 330-331.
[29] 84th Cong., 2d sess., S. Rept. 1311.
[30] Ibid., pp. 2 and 3.

APPENDIX

HOW MANY LOW-INCOME PERSONS ARE THERE IN THE UNITED STATES (ALTERNATIVE ESTIMATES)?

This would seem at first glance to be a straightforward question for which there must be a clear answer. It is, however, a question which can be answered only with facts well seasoned by judgment on such matters as the following: What is the minimum income below which a family of two or more persons can be said to be in poverty? How should that minimum compare with 10 years ago—should it rise not only with prices, but with the general standard of living as well? Should this minimum be the same for a single person living alone as for a multiperson family? Is the minimum money income appropriately thought of as the same for urban and rural families, for young and old, for families with and without children? Is 1 year's money income a good measure of low economic status when it covers a wide range of situations like the following? Income temporarily low because of a bad business or crop experience; income low because the head joined the labor force in the last half of the year; income low but family living well out of savings; money income low but family had adequate nonmoney income in the form of rent from owner-occupied house and home-produced food and fuel.

In the face of these and many related questions it is necessary to proceed with caution, but to proceed one must begin. A minimum income figure which was adopted for study purposes in 1949 by the Subcommittee on Low Income Families was $2,000 for urban families and $1,000 for rural families. They stated that "The $2,000 and $1,000 figures are not intended to be, and must not be interpreted to be, a definition of low income. The boundary line on the income scale between want and sufficiency is difficult to determine, particularly when the determination is attempted for purposes of a national study. For example, the Bureau of Labor Statistics has estimated that in 1947 the minimum budget necessary for a family of four persons to maintain an adequate standard of living varied from a low of $3,004 in New Orleans to a high of $3,458 in Washington, D.C., in the 34 cities studied. Using similar methods, the Social Security Administration estimated that a budget for an elderly couple living at the same level would have required $1,365 a year in Houston, Tex., and $1,767 a year in Washington, D.C., in June 1947. The cash-income levels chosen for the present report were selected only to designate an income group for intensive study. An important consideration in making the choice was to use amounts which would be realistic in even the lowest cost areas of the country. It is improbable that there will be more than a minor proportion of families able to purchase all their requirements with incomes below these amounts." [1]

In most discussions of low income, the minimum income is set well below the adequate standard of living level referred to above, and above the budgets used in determining need for public assistance. Such budgets always take account of variations in family size.

The 1955 study by the staff of the subcommittee continued the use of the $2,000 cutoff, but made reference to both current and 1948 dollars. This study mentioned that while any "arbitrary income limit admittedly is an inadequate definition of a poverty line, the existence of a significant number of Americans adjudged to be poor is a matter of serious concern." [2]

Numbers Under $2,000 Minimum

There is some precedent, then, for using $2,000 of total money income as the cutoff figure in making a rough estimate of the number of low-income units. In 1957, 21 percent of the Nation's spending units and 23 percent of the consumer

[1] "Low Income Families and Economic Stability," 81st Cong., 1st sess., p. 2.
[2] "Characteristics of the Low Income Population and Related Federal Programs," 84th Cong., 1st sess., p. 1.

units were found to have current total money income of less than $2,000.[3] (See table 1, col. 2.) In absolute numbers this was 11.9 million spending units and 12.3 million consumer units.

Adjusting the minimum income figure to $2,000 in 1947 prices (prices in 1957 were 126 percent of the 1947 level so the adjusted cutoff is $2,516) yields the substantially greater percentages of 26 percent of spending units and 28 percent of consumer units. While it is debatable whether one should draw the line in terms of 1957 or 1947 prices, it is important to take account of inflation in any comparison over recent years. If $2,000 was a reasonable cutoff figure in earlier years, then $2,000 adjusted upward for price change would seen reasonable for 1957. Hence 28 percent of consumer units, some of which are families and some of which are unattached individuals, would be a plausible, though very rough estimate of the dimensions of the low income problem. An important refinement of this estimate is made by taking account of family size variability. It will be noted in table 1, column 3, that while 28 percent of all consumer units are below the minimum, only 19 percent of families are so situated. Since the frequency of incomes below $2,000 is higher among unattached individuals and higher among small families than among moderate-sized families, it is not surprising that only 19 percent of all persons or 32 million persons are found to be in consumer units with total money income under $2,000 of 1947 purchasing power.[4]

TABLE A–1.—*Percentages of population groups having low-income status in 1957, estimated by alternative methods*

	Total number in millions	Percent having under $2,000 income		Percent having less than minimum income varying with family size [1]		
		Current dollars	1947 dollars	$2,000	$2,500	$4,000
	(1)	(2)	(3)	(4)	(5)	(6)
Survey of consumer finances: Spending units (total money income)	56.5	21	26	----	----	----
U.S. census (total money income):						
Consumer units (families and unattached individuals)	53.5	23	28	17	21	----
Families	43.7	15	19	12	17	----
Unattached individuals	9.8	59	66	37	42	----
Persons	171.2	16	19	15	19	36
Office of Business Economics (personal income):						
Consumer units	53.5	14	20	[2] 10	[2] 14	----
Families	43.7	8	13	8	12	----
Unattached individuals	9.8	41	54	17	25	----
Persons	171.2	11	15	9	13	----

[1] Col. 4 calculation based on $2,000 income for family of 4, varying from that as described in the text. Col. 5 based on $2,500 income for a family of 4. Col. 6 based on $4,000 income for family of 4.

[2] Only a rough adjustment was possible here. A $1,000 cutoff for single individuals and a $2,000 cutoff for all families was used in col. 4, and adjusted upward for price rise in col. 5. Number of families was multiplied by 3.7 for estimate of persons.

MINIMUM INCOME VARYING WITH FAMILY SIZE

Adjustment for family size can be pursued further by applying a different minimum income to each family size. If $2,000 is thought of as an appropriate minimum for a family of four, then some smaller minimum is appropriate for a single person living alone. A study of the variation of consumer needs by family size done by the Bureau of Labor Statistics [5] provides a guide for such a range of

[3] The smaller percentage found by the Survey of Consumer Finances is due to (1) the exclusions of transient, institutional, and military population, all of which are included in census surveys, and perhaps (2) more complete reporting of small and supplementary incomes. The Survey of Consumer Finances consumer universe consists of the population living in private households.

[4] This calculation was made by finding the number of consumer units under $2,500 in each family size and multiplying the number of such units by the family size.

[5] Monthly Labor Review, vol. 67, p. 179, February 1948.

cutoffs. They are: $920 for a single person, $1,302 for two persons, $1,674 for three, $2,000 for four, $2,296 for five, and $2,572 for six. Adjustment for price change since 1947 gives $2,516 for a family of four and so on. Applying these variable cutoffs to consumer units of different sizes leads to the finding of 19 percent of persons in consumer units with per capita-welfare equivalent to that attained by a family of four with $2,000 of 1947 purchasing power. (See col. 5.) The 19 percent figure is coincidentally the same as that found for persons by the simpler method of column 3. However, the persons are differently located in family sizes in the two methods. Use of the variable cutoffs reduces the percent in the smaller family sizes and increases the percent in the larger family sizes who are found to have low income status. Interestingly, the higher the cutoff, the more persons from larger families are included in the "low income" group. Thus, when we double the equivalent income figure to match up with $4,000 for a four-person family, a disproportionate number of multiperson families are added and few single person families are added. Hence, it may be observed that the higher the cutoff income selected, the more clearly it appears that relatively low income is a problem associated with families of all sizes and is not peculiarly identified with single persons and two-person units. Conversely, the lower the cutoff, the more striking the association appears between low income and small family size.

Some persons may elect to draw a poverty line through the income distribution from $4,000 for a four-person family. This would accord closely with present-day requirements for urban families according to Bureau of Labor Statistics definitions of an "adequate standard of living." This definition of a minimum leads to a finding of 36 percent of persons in consumer units having incomes equivalent to $4,000 of 1957 purchasing power for a family of four. (See table 1, col. 6.) Perhaps it would be fair to say that the range of reasonable estimates would then be between 16 percent of persons (col. 1) and 36 percent of persons (col. 4) having "low income status" when that status is defined in terms of total money income.

Income Defined as Personal Income

This range of estimates is seen to be on the high side when attention is paid to nonmoney income and underreporting of income. This is done in the Office of Business Economics' series on distribution of personal income. Personal income differs principally from total money income in that the former includes imputed rent and income in kind. These types of income are most frequently received by aged persons and by farm families and hence their inclusion substantially reduces the number of consumer units below the minimum income cutoffs. The percent of all persons below $2,000 of 1947 purchasing power is then found to be 15 percent (col. 3). The percent of persons found in low income units using variable cutoffs based upon $2,000 (1947 purchasing power) for a four-person family is only 13 percent. See column 5. Using $2,000 in 1957 dollars, the comparable figure is only 9 percent. Thus we have a wide range of estimates from 9 percent to 36 percent of persons.

It is highly doubtful if the lower end of this range of estimates would be lowered any more if we could account for the difference between those units having permanently depressed incomes or consumption levels and those experiencing only a temporary dip into the low income range. Eleanor Snyder made a study of urban families' 1950 incomes and expenditures with the aim of identifying those with permanently inadequate economic resources.[6]

She classified families and subfamilies by family size and as above or below adequate budget incomes. She then excluded dissavers except for aged dissavers, and with no adjustment made for those only temporarily above the adequate incomes the resultant count was almost identical with the number of urban consumer units under $2,000 in that year. The method described resulted in a slightly higher percent of persons (that is more multiperson families) than was found by a simple count of those units under $2,000.

[6] As cited in "Characteristics of the Low Income Population and Related Programs," p. 2 and pp. 43–52 For an intensive discussion of this and related questions, see panel discussion on "Income Distribution and Substandard Levels of Living," papers by Daniel Creamer, John G. Myers, Eleanor M. Snyder, and comments by Irving B. Kravis, Herman P. Miller, and Jacob Mincer. Proceedings of the Business and Economic Statistics Section, American Statistical Association, 117th annual meeting, August 1957, pp. 123–139. Also see Martin David, "Welfare, Income, and Budget Needs," Review of Economics and Statistics, November 1959, pp. 393–399.

The Range of Estimates

It is concluded that the range of plausible estimates of the share of the population in "low income status" is from 9 to 36 percent. The highest of the range of estimates arises from use of a cutoff income suggested by Bureau of Labor Statistics definition of an "adequate standard of living" in terms of $4,000 for a family of four. The lowest figure results from use of current rather than 1947 prices. If we leave the highest and the lowest estimate out of consideration, the range is narrowed from 13 to 19 percent of persons. The difference between 13 and 19 percent arises out of definition of income. The smaller figure is based on personal income and the larger figure is based on total money income. Both turn around the idea that a "low income" for a family of four persons is $2,000 of 1947 purchasing power, or $2,500 in 1957. In the judgment of this author, the 19 percent estimate is a fair summary figure to work with, although there are reasonable arguments for either raising or lowering it. We would conclude, then, that 19 percent of persons, or 32.2 million people, were in low income status in 1957.

STUDY PAPER NO. 13

THE ADEQUACY OF RESOURCES FOR ECONOMIC GROWTH IN THE UNITED STATES

(BY JOSEPH L. FISHER AND EDWARD BOORSTEIN)

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INTRODUCTION

There is much speculation about the adequacy of natural resources in this country to support an increasing population at higher and higher levels of living. Will we run out of oil, saw timber, fresh water, or some metal? Or, more realistically, will the cost of making them available rise so much that economic growth generally will be checked? Any responsible examination of these questions must be both broad and deep. The look ahead has to encompass new technology, world sources of supply as well as domestic, and changing economic and institutional situations. Especially the interrelations among the various resource materials are important since shortage of one thing usually can be met by substitution of another.

In this paper we can do little more than try to ask the question of the adequacy of resources for economic growth in such a way that historical evidence and future projections of demand can be brought to bear and some of the relevant policy considerations seen.[1] We shall consider, in turn, the historical background for the resource adequacy-economic growth question, some general indicators of adequacy, several important resource materials in particular, and some of the principal trends and problems ahead. Our examination of these matters will be brief and rather highly compressed.

CHAPTER 1. EARLIER HISTORICAL BACKGROUND

The rapid rate of economic growth in the United States has resulted from an interplay of many factors and cannot be ascribed to any single cause. The abundance and variety of natural resources plus political, social, and economic institutions, the traditions and character of the people, the relative freedom for long periods from destructive, costly wars, the impetus of technology, and other factors have been important. Throughout most of the colonial and national history, labor has been relatively scarce and costly and land relatively plentiful and cheap. The idea and expectation of growth was implanted early in the national psychology.

The key resources to begin with were the land and the forests, but several others such as the fisheries off the North Atlantic coast and

[1] Views expressed in this paper are those of the authors personally. In its preparation, they have drawn on parts of a study now in progress in Resources for the Future, Inc., provisionally called "Resources in the American Future," in which the resource situation and outlook in the United States is surveyed broadly.

the wild game were also important. The large supply of unused fertile land, existing in a variety of climatic conditions, was made to produce a wide variety of products including corn and wheat, livestock and dairy products, fruits and vegetables, indigo, tobacco, and cotton. It also served as the basis for subsistence farming as well as cash-crop farming and for a system of small farms as well as large farms and plantations.

The forests which covered much of the land provided an abundance of wood for fuel, construction, household and farm implements, railroad ties, mine props, ships, and other items. Hunting, trapping, and fishing were basic economic activities during the earlier years in many regions but have long since declined greatly in importance or disappeared altogether.

As settlement swept westward, land development remained the chief objective but took new forms. On the grasslands of Texas and the Southwest an enormous cattle enterprise was established. Water became the key to much agricultural expansion. Metal mining and later oil and natural gas in their turn gave a vertical dimension to land development. With the pushing through of transcontinental rail lines after the Civil War, the entire country was knit together and made ready for a tremendous spurt of industrial growth.

Thus, for a long time the economic growth of the United States was dominated by a great abundance of land for agriculture, grazing, and forest products plus a few other resources.

As modern industry, transport, and communication began their rapid development, growth was further favored by the abundance and variety of the resources used in a modern industrial economy. For the early cotton-textile industry, there was available raw cotton produced in the South, the water power of New England, and wood for mill machinery from many regions. For the early iron industry, there were widely scattered ore deposits and an abundance of wood to make charcoal for smelting. Iron was available for the arms-manufacturing industry in the early 1800's when the system of interchangeable parts was first applied.

The full richness, range, and variety of the resources of the United States did not become apparent till much later. To supply power to the railroads, meet the needs of the iron and steel industry, and to provide a heating and cooking fuel for the growing cities there were rich, easy-to-mine, favorably located coal seams. To provide ore for the iron and steel industry were the great ore ranges of the Lake Superior region, again rich and favorably located after completion of the original Soo Canal in 1855. There were also rich iron-ore deposits in the Birmingham region of Alabama, lying in close and favorable conjunction with coal. Iron and steel were the key materials for a number of other industries that were important in industrialization and development, notably machinery, locomotives, and other railroad equipment, and shipbuilding.

The many other resources that have been important in the industrial development of the United States can be mentioned briefly. Besides coal, there were the other main elements of a broad energy base: Oil, waterpower, natural gas. Besides iron ore, there were rich deposits of copper, as well as significant amounts of lead and zinc. Of the

more important metals only tin was lacking, though deposits of nickel and manganese were small. For other raw material based industries the United States could supply abundant amounts of cotton, wool, hides, wood and lumber, grains, meat, and tobacco. In addition to lumber and iron and steel for construction, there were sand, lime, slate, and many stones and clays.

These resources and resource industries have had a broad and varied impact on general economic growth. Some were important for the development of whole complexes of industries. Some helped trigger or promote the development of particular regions. The importance of their role in economic growth cannot be gainsaid. For much of our national history they were dominant; they still are fundamental to the whole industrial structure.

The rapid population increase in the United States (3.9 million in 1790, 31 million in 1860, 92 million in 1910, and about 180 million in 1960) has been both a reflection of abundant resources and a cause of growth. Increasing population meant a growing labor force, much of it drawn westward by cheap land, and a growing market for farm and industrial products. From the beginning there was a tendency to be economical with the scarce labor and generous with the abundant resources, which to some extent is still characteristic of the American economy. Unlike European farmers, American farmers until fairly recently made relatively little attempt to preserve fertility through the use of fertilizer or rotation of crops; land was farmed until it was exhausted and then new land was put under the plow. Trees were girdled and left to die and rot in order to clear land for planting, or they were cut down pellmell to supply wood for fuel or lumber.

Early in the 19th century Americans began to invent or develop and apply mechanical reapers, harvesters, threshers, improved plows, and cultivators, which greatly increased the productivity of labor on the land. The cotton gin enabled 1 picker to do what had required 50 before.

In manufacturing industry the situation was more complex, but scarcity and costliness of labor were of great importance in promoting invention, investment, and the progressive mechanization of industry. These efforts to save on labor through mechanization have continued strong to the present time. Corresponding efforts to husband the natural resources and manage them conservatively have lagged.

The foregoing sketch is intended to indicate the historical importance of resources to growth in the United States, but not to exaggerate this importance. It may be reiterated here that many other factors were clearly involved. For example, if the land had not been widely and cheaply available for general settlement, but had been reserved in large estates as in Spanish-American colonies, it would have played a different role. If the United States had remained a colony, it might not for a long time have developed manufacturing industry, despite the bountiful resource base. But recognition of the many other important factors should not obscure the great good fortune of the United States in being so well endowed with resources and the role these resources have played in growth and development.

CHAPTER 2. RESOURCES AND GROWTH IN THE MODERN U.S. ECONOMY

Since about the beginning of this century, the resource base has been playing a noticeably smaller, and in many respects different, role in growth than it did before then. General economic growth has been less closely and clearly tied to abundant resources than it was previously.

But while the resource base may no longer be the dominant dynamic factor it once was, neither has it been exercising any noticeable restraining influence on general growth. There is no longer the same simple superabundance of resources in relation to the size of the population and economy there used to be. However, this seems not to have resulted in any general rise in the cost of resources or pinch on overall growth. The relative costs of some resources have fallen while others have risen depending on a complex of factors, including technologic and general economic development, the possibility of substitutes or of imports, and the significance of the cost of the resource item in the price of the final product into which it enters.

Factors other than resources, such as the business cycle, the maintenance of demand and employment, the development of technology, the shift in consumption toward services, and changes in the level of net Government expenditures, have moved to the forefront as active determinants of growth. The effects of resources on general growth have been so mixed and diluted with other factors that they no longer can be easily isolated. These effects may be more clearly discerned in specific sectors and areas of the economy than in connection with overall growth.

Notwithstanding all this, it is obvious on the face of it that the availability of natural resources to an economy or to a region still has a great deal to do with the level and kind of economic development that can be achieved. Land, water, and minerals of themselves are of no account economically, but with labor and capital applied to them they become of basic importance in satisfying economic demands. This country, as well as most others, cannot expect to continue healthy economic growth except as a bountiful supply of raw materials, and products and services derived from them, are made available from domestic sources, or through imports. In a real sense resources remain basic to economic growth no matter how high a pyramid of refinement and processing may be erected on them.

TRENDS IN RESOURCES CONSUMPTION, OUTPUT, EMPLOYMENT, PRICES, AND TRADE

The following table indicates the change in absolute and per capita consumption of various raw materials in the United States since 1870 along with changes in price, net imports, and employment. Trends during the last 5 or 6 years have been in line with trends in the preceding 50 years.

Resource trends in the United States, 1870–1954

	1870	1880	1890	1900	1910	1920	1930	1940	1950	1954
Consumption of resources (1947–49=100)	17	23	30	41	53	62	68	86	103	110
Agriculture	19	27	32	43	54	63	70	92	100	108
Timber products		[1] 50.0	[2] 73.6	113.3	121.7	102.2	81.0	87.4	113.0	113.7
Minerals	3.0	6.4	12.9	19.7	37.9	52.4	60.5	73.4	108.8	116.8
Per capita resource consumption (1954 dollars)	174	191	195	221	237	238	226	266	279	279
Agriculture	125	138	132	147	152	152	148	179	171	172
Timber products	[3] 11	[1] 12	[2] 14	18	16	12.0	7.9	8.0	9.0	8.5
Minerals	8.72	14.8	23.8	30.1	47.6	57.1	56.9	64.4	83.1	83.4
Output of resources (as percent of GNP in 1954 prices)	36	32	29	27	22	21	17	16	13	12
Agriculture	27	25	21	19	15	14	11	10	8	8
Timber products	4.0	3.7	3.9	3.9	2.8	2.0	1.2	1.0	.77	.69
Minerals	1.5	2.0	2.8	3.4	4.2	4.9	4.3	4.1	3.6	3.3
Price of resources (deflated by BLS general wholesale index, 1947–49=100)	78	66	66	68	76	83	85	78	96	90
Agriculture	69	69	68	68	83	78	82	72	92	82
Timber products	26.6	29.3	35.9	39.7	40.6	62.1	53.8	70.5	108.5	104.2
Minerals	119	66.4	64.7	72.9	64.2	105	98.4	97.7	103	107
Net resource imports (1947–49=100)	−31	−75	−77	−107	−69	−56	16	294	76	88
Agriculture	−148	−394	−371	−495	−285	−310	−113	482	120	96
Timber products				−27.7	−28.0	8.0	−5.0	35.2	204.6	177.2
Minerals [4]	−1.2	7.8	−1.9	−6.3	−14.2	8.4	24.2	266.7	51.6	75.5
Employment in resource industries as percent of total employment	51.9	51.9	45.4	40.5	33.9	28.5	25.2	21.4	14.6	11.8
Agriculture	49.9	49.5	42.3	36.9	30.4	25.2	22.6	19.0	12.5	10.1
Timber products	.2	.3	.4	.4	.4	.4	.3	.3	.3	[5]
Minerals	1.5	1.8	2.4	2.9	2.9	2.7	2.1	1.9	1.6	1.2

[1] 1879 nearest year.
[2] 1889 nearest year.
[3] 1869 nearest year.
[4] Including gold (of which there were large movements in some years).
[5] Not available.

Source: Neal Potter and Francis Christy, Jr., "U.S. Natural Resource Statistics, 1870–1955," Resources for the Future, Inc., preliminary draft.

Taking the period since 1900, it will be noted that per capita consumption of renewable resources, agricultural and timber products together, shows a slight increase; a relatively small increase in the large item, agricultural products, is offset to a considerable extent by a relatively large decrease in the less important item, timber products. Minerals as a whole show a large per capita increase over this period, but with major disparities among the components. Per capita consumption of coal, not unexpectedly, has dropped, while that of oil and gas has increased tremendously. Metal ores have increased considerably, but building and chemical materials, at least since 1900, have increased quite a bit more. Historical statistics on water consumption admittedly are poor, but very recent trends indicate a per capita increase over the first half century somewhere between that of the producible raw materials and the minerals—perhaps an increase of 1½ times in per capita consumption. In absolute terms consumption of nearly all raw materials has increased greatly over the 8½ decades, especially in the minerals category.

Expressing resource output as a percent of gross national product (both in 1954 dollars), agricultural and timber products have dropped persistently and far during the 84-year period. Minerals taken as a whole increased to 1920, but since then have fallen each decade. Output of all raw materials as a percent of GNP has dropped by about one-half since 1900. Of course, during the same period, GNP per capita has increased more than 2½ times and the population has more than doubled, resulting in a very large increase in total absolute raw materials consumption.

For particular items trends have varied. Still measured in constant prices, the output of such major agricultural commodities as wheat, corn, cotton, and beef and veal has declined greatly as a percent of GNP since 1870. The absolute peak of wood and timber output was reached sometime between 1905 and 1910, so that the decline in the output of this item in relation to GNP has been especially sharp since then. The value of total coal output, both bituminous and anthracite, has generally been declining in relation to GNP since about World War I. On the other hand, the value of petroleum and natural gas output rose greatly in relation to GNP till about 1930, and since then has been moving up at roughly the same rate or slightly higher than GNP.

A number of reasons account for the great decline in the resources-GNP proportion. The costs of processing, fabrication, transportation, distribution, and selling of goods have increased relative to the costs of raw materials. Back in 1870, when agricultural output accounted for about 27 percent of GNP, farm products were sold to consumers in relatively simple form and farmers received the major part of the dollar spent by consumers for these products. Today the farmer receives less than 50 percent of the consumer dollar.

The same has happened to most industrial goods. There has been a rapid growth of consumer durable goods such as automobiles, refrigerators, washing machines, and radios in which the raw material component accounts for a smaller proportion of total output than in most agricultural products. Lumber accounts for only about 10 percent of the cost of construction of a typical dwelling unit, and in the cost of a new car iron ore is an insignificant part of the total.

Clearly economic growth today is much less a matter of the simple expansion of the output of resource-type goods and much more a matter of more processed items.

Finally, it should be noted that the proportion of GNP accounted for by resource output is not a sufficient index of the fundamental importance of resources to the economy. An analogy may illustrate this point: a family's outlay for water is only a small portion of its total expenditures, but without water the family would not last long. Just as the availability of water is a precondition for having a household at all, so the availability of resource materials is a precondition for industrial production.

Relative price movements are another indicator of the long-range trend in the resources situation. The picture here is mixed with no easily discernible general trend. Increases occurring during the recovery from the depression of the 1930's and the period of the Second World War and its immediate aftermath have been more or less sustained. For agriculture, which dominates the total resources picture quantitatively, the relative price index for 1954 was the same as for 1910 and 1930. Taking decade-end readings from 1870 to 1950, the timber products index has risen each time except for 1930. The rise was especially sharp in 1940 and 1950. The relative price index for minerals rose to a new and much higher plateau between 1910 and 1920 where it has remained ever since.

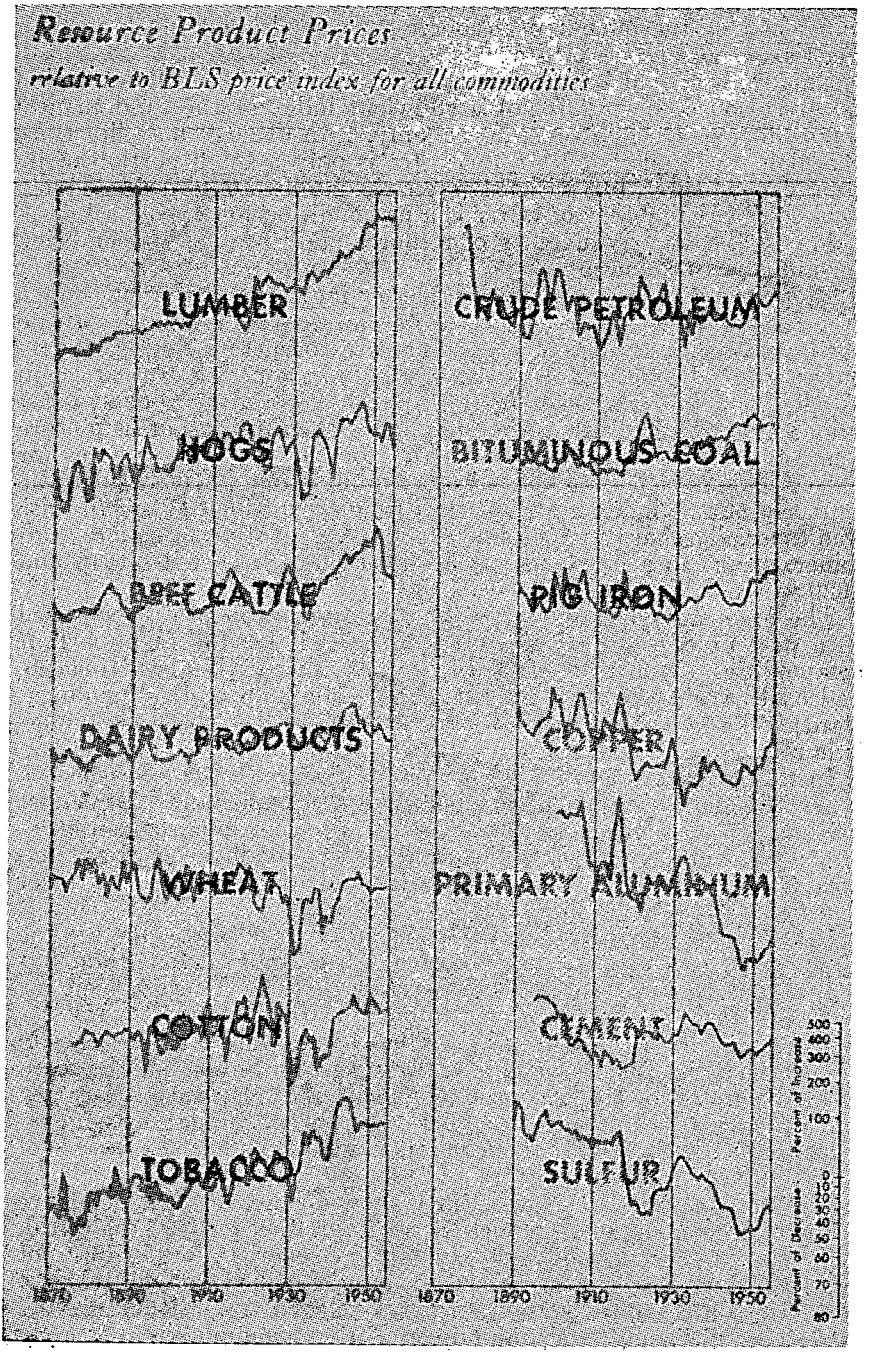
The following chart shows the long-term trend in prices expressed as a percent of the general wholesale price index for 14 important commodities. The trends shown here are mixed: lumber, tobacco, and coal have moved generally upward; aluminum and sulfur downward; while for others year-to-year fluctuations have been characteristic rather than long-term movements.

In the foreign trade of this country in resources, there has been a general tendency for imports to become more important. In timber products the United States first switched to a net import position in 1915; in several later years the country was again a small net exporter, but since 1934, has consistently and increasingly been a net importer.

Net imports of zinc began in 1935, and in 1940 for copper. The United States has been a net importer of iron ore for a long time, but the imports have been significant only since 1953. In crude oil the switch from a net export to a net import position occurred in 1948.

Since the turn of the century there has been a very large increase in imports of agricultural products relative to exports due mainly to increased imports of tropical products such as coffee, cocoa, bananas, and cane sugar. But although there have been fluctuations and interruptions, the United States has remained a substantial exporter of such products as wheat, cotton, and tobacco.

The foreign trade statistics clearly show an increasing dependence of the U.S. economy on resources drawn from other parts of the world. This presents certain problems for military security, but is does not necessarily mean increasing costs of materials since, as compared to domestic sources, foreign sources may yield to American users oil, iron ore, copper, pulpwood and pulp, and other commodities as cheaply or even more cheaply.


Resource Product Prices
relative to BLS price index for all commodities
LUMBER
HOGS
BEEF CATTLE
DAIRY PRODUCTS
WHEAT
COTTON
TOBACCO
CRUDE PETROLEUM
BITUMINOUS COAL
PIG IRON
COPPER
PRIMARY ALUMINUM
CEMENT
SULFUR
1870
1890
1910
1930
1950
Percent of Increase
500
400
300
200
100
Percent of Decrease
10
20
30
40
50
60
70
80

Another indicator of the interaction of resource supplies and economic growth is the trend in the amount of employment in extractive industries compared to total employment. The steady and large reduction from 1880 to 1954, from almost 50 percent to about 10 percent, is due mainly to the relative reduction in the agricultural work force and is associated with the diminishing relative importance of farm products in consumers' budgets and with increasing productivity per worker. The economy is getting more resource products and services out of its resource base than it used to, and with fewer workers.

The Future Economy and Resources

Turning now to the years ahead, it may readily be admitted that the size and shape of the future economy cannot be known with any exactness now. However, it may be projected on the basis of past trends and other factors. The following table indicates tentatively a range of possibilities for 1980 and 2000 depending on the number employed, the number of hours they work, and how productively they work. Incorporated in assumptions about productivity are notions about the future availability of raw materials, among other things.

Range of estimates of GNP and underlying factors—1959, 1980, and 2000

	1959	1980			2000		
		Low	Medium	High	Low	Medium	High
Population (million persons)	177	226	245	279	268	331	433
Civilian labor force (millions)	69.3	93	99	108	116	138	173
Civilian employment (millions)	65.7	88	95	105	110	132	168
Average hours per week:							
Agricultural employment	45.2	36.3	40.2	45.6	29.6	36.3	45.6
Private nonagricultural employment	40.6	34.2	37.4	40.5	29.2	34.8	40.5
Productivity (percent yearly increase in output per man-hour):							
Agricultural	[1] 5.2	3.8	4.2	4.8	3.6	4.2	4.9
Private nonagricultural	1.9	1.7	2.3	3.2	1.7	2.5	3.6
GNP (billions 1959 dollars)	484	933	1,030	1,220	1,630	2,140	3,210
GNP per capita (1959 dollars)	2,730	4,130	4,200	4,370	6,080	6,470	7,410

[1] Long term average.

Source: Estimates taken from work in progress by resources for the future and should be regarded as tentative only.

Looking ahead to 1975 from 1950, the President's Materials Policy Commission (Paley Commission) projected increases in consumption of raw materials as follows: food products, 41 percent; nonfood agricultural products, 25 percent; minerals taken as a whole, 90 percent; coal, 60 percent; oil and gas taken together, about 150 percent. It was suggested in 1956 that an upward revision averaging about 10 percent might be called for in these estimates of future consumption in view of the more rapid population and GNP increase which ensued in the 5 years following 1950. Furthermore, some internal revisions would have to be made among the specific materials which make up the overall estimates of the Paley Commission, although the larger groupings probably would remain in about the same proportion.[2]

[2] Arnold C. Harberger, "The Paley Report Four Years Later," Quarterly Review and Investment Survey, Model, Roland, and Stone, vol. 10, No. 2, 2d quarter, 1956. See also: Resources for Freedom, vol. II, "The Outlook for Key Commodities, President's Materials Policy Commission (Paley Commission)," June 1952, ch. 22; and "Raw Materials in the U.S. Economy: 1900–1952," U.S. Department of Commerce, Bureau of the Census, Working Paper No. 1, preliminary, 1954, pp 57–61.

Technology has moved forward rapidly during the years following the Paley report so that the underestimate of population and GNP growth made then has been offset to some extent by rapid development of substitute materials for those becoming scarcer and therefore tending to increase in price.

More recent tentative estimates of demand for selected raw materials in 1980 and 2000 are indicated in the following table. Low, medium, and high estimates are derived from a variety of assumptions regarding overall trends in the economy (population, households, labor force and employment, technology and productivity, investment and consumption-Government expenditures, etc.), as well as more specific assumptions about trend in those end product and service categories making large use of resources (construction, heat and power, food, clothing and apparel, hard goods, transportation, etc.).

Estimated demand for selected key materials, 1980 and 2000 [1]

	Current	1980			2000		
		Low	Medium	High	Low	Medium	High
Timber (billion board feet)	34.6 (1957)	44	66	103	49	100	215
Wheat (million bushels)	934 (1958)	930	1,120	1,310	1,110	1,480	1,880
Feed grains [2] (billion feed grain units)	245 (1956)	267	310	410	310	410	660
Cotton (million bales)	13.0 (1959)	11.9	16.7	23.2	12.7	23.2	44.9
Oil (billion barrels)	2.97 (1957)	4.65	5.94	7.43	6.92	11.13	17.90
Coal (million tons)	385 (1958)	497	756	1,071	383	978	1,921
Iron ore do	140 (1957)	132	197	330	125	270	690
Aluminum do	1.9 (1958)	4.1	10.6	23.9	6.7	24.3	77.0
Copper do	1.56 (1958)	2.1	4.1	7.6	2.9	8.9	23.9
Fresh water withdrawals (trillion gallons per year)	71.8 (1954)	120.5	125.7	149.0	162	178.8	263.6

[1] Estimated export demand is included for wheat, feed grains, and cotton. Export demand for the other items is insignificant, except for coal for which exports in recent years have been around 10 percent of total production.

[2] Includes corn, oats, barley, and grain sorghum. 1 feed grain unit has feed value of 1 pound of corn.

Source: Estimates taken from work in progress by "Resources for the Future" and should be regarded as tentative only.

The attempt to look ahead to 1980, or thereabouts, is full of pitfalls; to look beyond that to the end of the century is even more difficult. The birth rate may vary over a considerable range, yielding a larger or smaller labor force 20 years later. A change of 1 percentage point in overall labor productivity, or even a one-half or one-quarter percentage point change, which persists over a period of years will result in a very large change in GNP. Thus, GNP in 2000 may range from a low of around $1,600 billion to a high of around $3,200 billion in today's dollars depending on labor force, productivity, and other assumptions.

The derivation of demand for specific raw materials required to make possible a total output of given size opens up even wider ranges in many instances. The size of relevant components of GNP, higher or lower cost of particular materials resulting from technological advances, shifts in demand, and changes of imports and exports are important among the factors which make long-range estimates of demand for raw materials hazardous. For example, projections of demand for aluminum 40 years from now have to embrace an extremely wide range of possibilities. Expansion of present uses of this light, durable, corrosion-resistant metal plus new uses and adaptations may continue

at a rapid rate, although some slowing down seems inevitable. Widespread use of aluminum for automobile engine blocks, exterior building panels, roofing, and wrapping foil, plus possible new uses altogether could result in a fortyfold increase in demand for aluminum by 2000. On the other hand, less favorable technological developments in aluminum combined with more favorable changes in materials competitive with aluminum might limit the increase in demand to only 3½ times what it is now.

The adequacy of the domestic resource base to meet these and other demands is mixed. For some such as water it probably is adequate, assuming fairly large investments in developing new supplies, in preventing or abating pollution, in recycling in industrial uses, and in conservation generally. For others domestic sources obviously are inadequate now and will become increasingly so in the future. Many of the metals are in this category. More precise answer to the question of adequacy hinges on technologic and economic events yet to unfold.

The more important question of total adequacy of resources to support economic growth must include foreign sources as well as domestic. As has been pointed out, this country already imports large amounts of crude oil, iron ore, woodpulp, and other basic items. Trends of comparative costs of production in various countries will probably increasingly favor other parts of the world. Whether policy accommodates or resists these trends will be important in terms of supplying the U.S. economy with lower or higher cost new materials. Some restraint on growth, therefore, may arise from this source, but it need not.

In a static sense and making no allowance for technological responses to higher costs of particular materials, increasing shortage would tend to lead to higher costs and prices and ultimately to a reduction of total output of the economy, however slight. Admitting this as an ever-present tendency, one does not find historical evidence that this has happened in any general way. In the dynamic sense incipient shortages by and large have led to new discoveries, improvements in extraction, processing, and use, substitutions that turned out to be as cheap or cheaper, and increased imports.

One of the most notable features of the U.S. economy is the astonishingly numerous ways in which a threatening shortage for any particular material can be met. Substitute materials are usually available and frequently soon prove to be of lower cost. Engineers are very ingenious in figuring out ways to reuse formerly wasted materials and to redesign products and manufacturing processes so as to use less of the scarce material.

Consumers of the end products usually are ready to shift their allegiance to substitutes in response to price advantages. Frequently they do not greatly care which particular raw material is used as long as the resulting performance is satisfactory. For example, a family wants a dry house and will accept a roof made of wood shingles, composition shingles of various kinds, tile, or even aluminum. Or a family will accept oil, natural gas, electricity (produced by coal, oil, gas, water power, or atomic power), or coal used in a modern burner as a source of heat for its home. Beyond all these possibilities for substitution are the incredibly ingenious activities of the chemical industry, or other industries employing chemical engineering, in creat-

ing new products altogether by the rearrangement of atoms and molecules. Plastics, synthetic rubber, and new fertilizers may be mentioned.

Substitution in the broadest sense of the term is a pervading characteristic of the modern U.S. technologic economy. It especially characterizes the key raw material stages which lie between the resource base of land, water, and minerals, and the end products and services required by consumers. Distinctions between specific materials are becoming more and more blurred and this is beginning to be true even between whole categories of materials. This means that shortage of particular resource materials is not likely to check general economic growth, at least over any extended period of time. Temporary embarrassment may be acute. A short-run thrust toward inflation may result and for a time a disporportionate share of certain resources and efforts may have to be devoted to overcoming or bypassing the roadblock. Persons tied in some way to the shortage item may gain relatively for a while and then lose as demand turns into other channels. But in a rich and diverse economy such as that of the United States, it is hard to make a case for particular raw material shortage greatly restraining growth. Only when numerous shortgaes (as seen by relative price increases) occur more or less simultaneously, and continue, can the case be made persuasively. There is little evidence of any such combining at this time or any real prospect of it unless one assumes an extraordinary war or defense situation in which suddenly there would be a sharp and sustained increase in requirements for nearly all raw materials, plus an ability to use them in terms of available labor force, plant, and equipment.

In a basic sense, therefore, the best and perhaps only way to insure that economic growth is not hamstrung by resource shortages is to maintain and increase the flow of research, discovery, and innovation, to improve professional and technical education and the general education on which these rest, to encourage enterprise, ingenuity, and productive work in business, labor, and agriculture, and to improve the efficiency generally of the whole economy, and to organize the international economy more rationally. Policies across the board should favor these objectives. As a part of this, resource discoveries will be made, productivity in resource industries will increase, and substitutions for scarce items will be facilitated.

One is driven back, therefore, to the general indicators of the role of resources in the economy over time if one is to form an opinion as to whether resource scarcity will restrain growth. The upshot of all this seems to be that, despite the prospects for very rapid population increase during the next two or three decades, the outlook for resources supplies at reasonable prices is favorable for this country. Even with this generally optimistic picture, difficult problems of increase cost and shortage for particular resources materials and services undoubtedly will be encountered—for example, ground water in many places, a number of alloy and other metals, high grade saw timber, and desirable outdoor recreation areas. One, of course, cannot peer very far into future technological developments which admittedly would have important effects upon costs and prices of resource products. Nor can one look very far into the future regarding population change with any great degree of confidence, as recent experience has shown. But granting these uncertainties, it is necessary to try to see ahead, and

what appears to be there for the next generation or so regarding resources supplies in this country is not alarming. The last 20 or so years of the century can be seen only more dimly: Resource supply problems could cramp economic growth somewhat although with reasonably good foresight in Government and business and among other groups the problems should not be too difficult to handle.

CHAPTER 3. FUTURE ADEQUACY OF SELECTED RESOURCE MATERIALS

Having considered in broad terms the question of resources and economic growth, and having found a good chance that resources are not likely to restrain growth in any general way during the next 40 years, we turn now to a more detailed consideration of several important items.[3] Wood and lumber, oil, water, and more briefly copper and iron ore will be taken up, not in great depth or extensively, but merely to reveal some highlights for the future. This list by no means includes all of the major resource materials which conceivably could present problems of adequacy between now and 2000, but the items selected will serve to bring out significant aspects of the resource adequacy-economic growth question.

Wood and Lumber

Despite their relative decline in total national product and their virtual disappearance from certain uses, wood and lumber continue to be important materials. Lumber is still a key building material—for example, over 75 percent of new, nonfarm, one-family houses are of wood-frame construction and a substantial proportion of these have wood facing as well; lumber probably accounts for about 10 percent of the total construction cost in the average dwelling unit. Wood and lumber are also important as materials for paper, furniture, boxes and crates, and railroad ties.

In these uses the relative position of wood and lumber is constantly changing. Aluminum has already made substantial inroads on the use of wood in construction, and aluminum, plastics, and fiber glass will probably make further inroads in the future. Plastics and aluminum foil are cutting into the use of paper as a packaging material; much furniture is no longer of wood. Even so, dependence on wood will continue to be great for a long time to come.

To help determine the adequacy of the forest resource to meet the future demand for wood and lumber, we have made a detailed analysis based on a series of statistical projections of (*a*) different possible levels of future demand for wood and lumber, and (*b*) the effect of meeting these demands on the growing stock inventory in the forests and its capability to meet future demand. The statistics involved are extensive and complicated, and it is not possible to consider them in any detail in the present paper. We shall, therefore, limit ourselves to a summary of the main points and results of the analysis.

The following table presents projections of timber required to meet the demand for wood and lumber, both softwood and hardwood, for the years 1960, 1980, and 2000.[4]

[3] Much of the following material, both the statistical estimates and the analysis, comes from parts of a study already referred to as "Resources in the American Future." It should be emphasized particularly that the estimates of future demand and supply are tentative.

[4] These and other estimates of timber requirements are taken from work in progress in "Resources for the Future."

Estimated timber requirements—1960, 1980, and 2000

[Billion cubic feet]

	1960	1980	2000
Softwood:			
Low		9.9	11.1
Medium	8.7	13.7	19.6
High		20.3	39.8
Hardwood:			
Low		5.1	8.1
Medium	3.1	7.0	14.0
High		10.4	27.9

Of the three projections, the medium gives the best present indication of what is likely to happen. The low and high are intended to provide an idea of the limits of the range within which actual demand may reasonably be expected to fall; we consider it unlikely that demand will fall above the high or below the low projection. The reason for the wide range is the many uncertainties affecting the demand for wood and lumber as one moves further into the future. There are wide ranges both in the projections of demand for the items in which wood and lumber are used and in the amount used per unit of the item. For example, because of a wide projected range in the rate of increase of households there is a wide range in the projection of dwelling unit construction; and this, together with an allowance for uncertainty as to the amount of lumber that will be used per dwelling unit, makes for an even wider range in the use of lumber for housing. Similarly wide ranges in projections of GNP plus uncertainties as to technological advance and the substitution of one material for another, for example plastics for paper in packaging, create wide ranges in the projections of wood and lumber demand for paper, furniture, boxes and crates, and other products.

As can be seen from the table, there will probably be a substantial increase in overall demand for wood, especially for pulp, and lumber between 1960 and 2000. This increase will probably occur despite a decline in the average amount of wood used per unit of various specific products such as houses; the decline in unit use will be more than compensated by increased demand for the products resulting from an increasing population and a growing economy.

SOFTWOOD

Regarding softwood timber, the extent to which demand can be met depends in good part on a number of factors which cannot now be predicted with certainty, such as the division of cut between the Eastern and Western [5] forests of the United States, the effect on net growth of improved protection against losses from disease, pests, and fire, and the amount of imports.

The significance of the division of cut between the Eastern and Western forests can be appreciated from the following table which presents selected data on softwood commercial forest broken down between East and West and coastal Alaska. The data refer to the year 1952, but in essence the situation has remained the same to the present time.

[5] Western includes Pacific Northwest and California; Eastern includes the rest of the country.

Softwood inventory, growth, and cut—East, West, and coastal Alaska, 1952

[Billion cubic feet]

	Total	West	East	Coastal Alaska
Growing stock inventory	355	262	74	19
Volume of annual growth	7.0	2.6	4.4	.032
Annual rate of growth, percent	1.97	1.0	5.9	.17
Volume of annual cut	7.5	3.75	3.75	.013

Thus although the growing stock inventory of the West was about three and one half times as large as that of the East, the volume of growth was only 60 percent as large, because the rate of growth was only about one-sixth as large. The main explanation for this situation is that in the West a substantial part of the forest acreage consists of old growth virgin sawtimber stands with little or no net growth. The East, on the other hand, is somewhat understocked, and while this tends to increase the rate of growth, it reduces the absolute volume of growth.

In summary, it can be said that the volume of growth in the West is held down by a plethora of inventory and in the East by a shortage of inventory. As regards the future, for some time to come ability to meet demand can be increased by increasing the proportion of cut obtained from the West.

The potential effects on the rate of net growth of increased protection against fire, disease, and insects are great. According to the U.S. Forest Service the overall losses to growth from these causes in 1952 were larger than the cut in that year.[6] While in practice the complete elimination of these losses cannot be achieved, even small gains resulting in modest increases in rates of growth can with time have substantial effect on the size of forest inventory and ability to meet demand.

Because of the uncertainties with respect to the foregoing factors, we have projected the availability of timber to meet the various levels of demand on the basis of different assumptions, that is, different distributions of cut between East and West, different rates of net growth, and different levels of imports. The results of our projections and analysis can be summarized as follows:

(1) It is probable that the low level of demand can easily be met. Even with pessimistic assumptions as to distribution of cut, rates of growth and level of imports, the cuts necessary to meet this demand not only would not deplete the forest inventory, but improve it. There would be moderate decline in Western inventory and a substantial increase in Eastern inventory, both of which would be desirable.

(2) It is highly improbable that the high level of demand can be met without completely exhausting the growing stock inventory before 2000. This would be true even with the most optimistic assumptions that can prudently be made with respect to distribution of cut, rates of growth, and imports.

(3) The medium demand may be judged to be roughly at the level below which demand can be met, and above which it cannot be met without inventory depletion. On pessimistic assumptions, the

[6] "Timber Resources For America's Future," U.S. Department of Agriculture, Washington, D.C., 1958.

middle demand could not be met without some inventory depletion. On optimistic assumptions, it could be met fairly easily.

In short, there is roughly about a 50–50 chance that it will be possible to meet the projected future demand for wood and lumber. Since the range between the medium and high level of demand is wide, the gap between demand and availability could be large. Finally, the ability to meet demand in the neighborhood of the medium, or most probable level, can be substantially increased by measures which raise the proportion to which demand is met from the West and which in both East and West increase the rate of growth through greater protection against fire, disease, and pests.

HARDWOOD

As regard hardwood, the situation is simpler and clearer than with respect to softwood. Since well over 90 percent of the hardwood inventory is in the East, there is no need to differentiate the inventory and growth by region as was done for softwood. And although there are also uncertainties with respect to future rate of growth and level of imports of hardwoods, conclusions can be drawn which are far less dependent on specific and uncertain assumptions than in the case of softwood.

The conclusions derived from our projections and analysis with respect to hardwood are as follows:

(1) Both on the low and medium levels, demand not only can be met, but in such a way as to permit substantial growth of inventory. In each case this conclusion can be drawn despite the fact that the projections rest on the prudent assumption that with increasing inventory rates of growth would decline.

(2) The high level of demand for hardwood could probably only be met with some depletion of inventory. But even assuming no increase in net growth as a result of better protection and better forestry practices in general, the depletion would be not nearly as drastic as in the case of softwood. And even relatively modest year-to-year results from improved forestry could go a long way in reducing the inventory depletion on the high demand assumption.

Thus, while there is some possibility of pressure on the forest resource in the case of hardwood, the probability is that future demand will be substantially below what could be supplied from the forests.

SOME DIRECTIONS FOR POLICY

The foregoing considerations with respect to the adequacy of the forest resource to meet possible future demands for wood and lumber suggest a number of directions for policy.

For some time to come emphasis should be placed on increasing as much as possible the proportion of the cut from the West, where the large inventory of mature stands impedes growth. To some extent a continuation of recent trends will by itself make for an increasing proportion of cut from the West. The movement of population to the West and Southwest will mitigate and reduce the locational disadvantage of the Western forests. But to some extent, also, the proportion of cut to be obtained from the West is subject to deliberate policy. It can be affected by the building of access roads to inaccessi-

ble forest areas, and by appropriate management of the publicly owned forests which in the West contain about 60 percent of the total timber.

The fact that the chance of a supply difficulty is fairly high for softwood and low for hardwood suggests that it would generally be desirable, wherever and to the extent possible, to increase the proportion of softwood trees to hardwood trees, and to switch demand from softwood to hardwood. Thus, in programs for tree planting on understocked land, planting in general should be in softwood trees wherever conditions are suitable. Also in some forests in the South and New England where hardwood is encroaching on softwood, appropriate management measures, such as killing young hardwoods with herbicides, could help prevent the encroachment. As regards switching demand, hardwood is increasingly being used for pulp, and this tendency should be promoted as much as possible.

Finally, modest increases in growth rates through reduction in losses from disease, insects, and fire could with time produce substantial increase in inventory and volume of growth. Protection measures can pay large dividends in the future.

Oil

FUTURE DEMAND FOR OIL

On the basis of the overall projections for the growth of the economy and population cited above, the total demand for oil in the United States has been projected to rise from about 3.4 billion barrels in 1960 to 4.7–7.4 billion barrels in 1980 to 6.9–17.9 billion barrels in 2000. The medium, or most probable projection, is for a demand of about 5.9 billion barrels by 1980 and 11.1 by 2000. Aggregate demand during the whole 40-year period between 1960 and 2000 would be about 193 billion barrels on the low projection, 258 billion on the medium projection, and 348 billion on the high projection.

These projections are of course subject to considerable uncertainties and what actually occurs may deviate even from the broad range covered by the projections. A major change, for example, in the method of powering automobiles, trucks, and locomotives could reduce the demand even below the lower limits indicated by the projections.

Despite the uncertainties, however, the projections do give a reasonable indication of the range within which the demand for oil is likely to fall.

THE AVAILABILITY OF DOMESTIC CRUDE OIL

How much natural petroleum is there available in the United States to meet this projected demand? The uncertainties with respect to this are far greater than for the demand. As is well known by now, past estimates of reserves have tended, more or less systematically, to understate greatly the amount of oil that would be available; there have been large and frequent revisions of the estimates. As has also become increasingly clear, the estimates are dependent upon and limited by the current state of geologic appraisal and current technology. Only a small portion of the sedimentary basins of the United States have been thoroughly explored. Knowledge and estimates of oil reserves have in the past been increased by bringing offshore deposits into the picture, and may in the future be further substantially in-

creased by greater concentration in exploration on stratigraphic, nonstructural traps for oil which have hitherto been somewhat neglected. Technological advance in methods of exploration and identification, and in the ability to economically bring a higher proportion of the underground oil to the surface, also increases reserves. One distinguished petroleum geologist goes as far as to say:

> The fact is that nobody knows the ultimate petroleum reserve of the United States or of any other country. All such predictions are made on the basis of what is then known of the geological conditions underground, yet we discover new and unsuspected geological conditions every year.[7]

Yet despite these strictures estimates of oil availability can and should be made. It is true that the repeated dire predictions of the past that within about 10 or 15 years the oil reserves would give out have all been false. But these predictions were based on a simple misinterpretation and misuse of the term "proved reserves," namely, taking them to refer to long-term ultimate reserves rather than short-term working inventory. It does not follow from past errors that current and future judgments based on a concept more appropriate to long-run availability than proved reserves will also prove consistently wrong. It is by a process of making estimates—including grossly erroneous ones—and checking, correcting, and refining them that we get a progressively truer picture of our resource position with respect to oil. Finally, there are a number of policy problems and actions with respect to them which of necessity involve, either explicitly or implicitly, judgments about future oil availability. While we are far from knowing everything about our oil reserves, it does not follow that we do not know anything. There is a large element of guess in all the estimates, but some guesses are more well grounded than others. Provided proper allowance is made for the uncertainties involved, it is best to have our policy judgments and action on the best guesses we can make.

We shall base our judgments on the availability of oil on estimates of the "resource base" and "ultimate reserves" presented by Bruce C. Netschert in "The Future Supply of Oil and Gas." [8] Dr. Netschert states that the "resource base for future production" or "total crude oil awaiting future recovery in the United States can be inferred from expert opinion to be on the order of 500 billion barrels." The range of specific estimates on which the foregoing summary estimate is based and which it is supposed to represent, runs from roughly 350 to 700 billion barrels. These figures are conceptually intended to include "present proved reserves, the currently nonrecoverable content of known reservoirs, and the total content of undiscovered reservoirs, without regard to present or future technologic feasibility of discovery and recovery." In short, these estimates purport to include all the crude oil present in the earth's crust in the United States.

Dr. Netschert also presents a series of expert estimates of "ultimate reserves," which after allowing for oil already produced, ranges from about 90 to 200 billion barrels. Conceptually, these estimates of "ultimate reserves" refer to the amount of oil that it would ultimately prove feasible to recover, given technology and costs prevailing at the time of the estimate.

[7] Levorsen, "Outlook for Petroleum Exploration," Paper 23, Fifth World Petroleum Congress, 1959.
[8] "The Future Supply of Oil and Gas," Bruce C. Netschert, Resources for the Future, Inc., 1958.

Thus, to sum up, the total amount of oil present is estimated at between 350 to 700 billion barrels, while the amount it would prove feasible to recover with current technology and costs is about 90 to 200 billion. Since oil technology is constantly improving, the latter range can be regarded as providing minimal estimates of the oil ultimately recoverable at a cost no higher than that at the time of estimation.

These estimates of availability can be compared in various ways to the demand projections. The aggregate 40-year demand of 190 billion barrels on the low projection is in the general vicinity of the high ultimate reserve estimate of 200 billion barrels. Aggregate 40-year demand on the medium and high projections—about 260 and 350 billion barrels—are much higher than the high estimate of ultimate reserves. The high demand estimate is in the general vicinity of the low estimate of resource base which covers all oil nonrecoverable as well as recoverable. And finally, whereas current recovery may average roughly a third of the oil in the ground, aggregate demand on the medium and high projection are 37 percent and 50 percent respectively of the high resource base estimate.

Because of advancing technology, the estimates of ultimate reserves may prove low. Amounts higher than those indicated by the estimates could also be recovered, if there were willingness to pay costs higher than those assumed in the estimates. Technologic advance could substantially increase the amount subject to secondary recovery. Advancing geologic knowledge and appraisal may cause all the estimates including those for the resource base to be revised upward.

But granted all this, the estimates do indicate, as a contingency which is sufficiently possible to warrant considering seriously, that sometime before the end of this century our natural oil resources may begin to be inadequate to meet the demand. Since it may be inferred from estimates of proved reserves and related data that there is little danger of inadequacy for the next 10 to 15 years, it can be said that the inadequacy would occur sometime in the last quarter of the century.

The possible inadequacy of oil reserves could manifest itself in a variety of patterns. There could, for example, be an early, high production peak, followed by a fairly rapid tapering off of output thereafter; or there could be a long, moderate rise in output, followed by a gradual decline. Because of the many uncertain factors involved, in particular, the level of imports, it is not possible to delineate the pattern. But it is clear, nevertheless, that because of the economics of size and quantity in the oil industry, the effects of lowered reserves would begin to make themselves felt on ability to produce well before effective exhaustion of the reserves was reached. Beginning sometime after 1975, there could be a significant and growing gap between the demand for oil and the capacity to meet it with domestic output.

OIL IMPORTS

Of the different means by which the possible gap could be filled, we shall begin with a consideration of imports, since roughly about 15 percent of our overall demand is already being filled from this source. The first point to be made is that being dependent for a

substantial portion of supply on foreign oil is, regardless of costs and prices, just not the same thing as being able to meet demand from domestic sources. The availability of oil from abroad is obviously subject to a number of uncertain contingencies to which domestic oil is not. This may not apply with great practical force to such sources as Canada, but it does apply to oil from the Middle East, the Sahara, or even Venezuela.

On the other hand, as far as simple physical and economic availability is concerned, a large proportion of U.S. demand could be met with oil from abroad for a long time in the future. The Middle East alone could probably supply the U.S. demand for many years besides meeting demands from other markets. Recent estimates of just the "proved reserves" of the Middle East range from roughly 200 to 230 billion barrels. But these reserves have been established on the basis of less than 1,500 wells drilled both for exploration and development—less than one-thousandth the number drilled in the United States. The Middle East is very far from being fully explored and there do not seem to be any indications that the limits to further discovery are being reached. The ultimate reserves of the Middle East are clearly far larger than the large amounts already in the "proved reserves."

Aside from the Middle East, a substantial portion of U.S. demand could probably be met from increased Venezuelan output and perhaps also from such relatively undeveloped but promising areas as Western Canada and the Sahara.

Middle East and Venezuelan oil are not only present in large quantities, but can on the average be produced at a much lower cost than oil in the United States. The available evidence indicates that the total cost of producing oil in these areas and transporting it to the United States is no higher and perhaps significantly lower than the cost of U.S. domestic oil. There seems to be no reason why this should not continue well into the future. But the cost of producing and transporting oil is of course but one of the factors determining the price charged for it; if the United States became clearly and substantially dependent on foreign oil, its bargaining position would tend to weaken, and it might have to pay a high price for the oil regardless of cost.

It is not impossible that with time greatly increased demand for oil in Asia or Latin America would compete with U.S. demand for the available supplies and keep the United States from getting all it would like. But while oil demand is growing rapidly, so is oil discovery and development. The judgment may be ventured that for say about 25 to 30 years from now no new demand large enough to preempt the bulk of supplies potentially as large as those of the Middle East is likely to arise.

Thus, it may be said in summary that the Middle East and other oil surplus areas could probably fill the gap between U.S. demand and supply that might arise; that the cost of such oil to the United States cannot now be determined and that the supply of such oil would be subject, at least in part and temporarily, to interruption as a result of various possible political and other contingencies.

OIL FROM SHALE AND OTHER SOURCES

Another possible source of additional oil is shale. The U.S. reserves of shale oil are very large, much larger than its reserves of crude. It has been estimated, for example, that in the most important deposit—the Green River formation in Colorado, Utah, and Wyoming—the portions yielding at least 15 gallons of oil per ton of rock contain about 1½ trillion barrels of oil, and that the recoverable oil is about 1.1 billion barrels.[9] The technical feasibility of recovering oil from shale has been clearly demonstrated, and beyond this, it has been stated by both the Union Oil Co. and the Denver Research Institute that shale oil produced by processes they are respectively investigating could be laid down at the west coast at prices competitive with present posted domestic crude prices.

Still, there remain unanswered questions and the feasibility of economically supplying a substantial portion of the U.S. oil demand from shale is far from having been clearly demonstrated. Ordinary Colorado shale oil is difficult to transport by pipeline because its heavy wax content makes it thick at ordinary temperatures; a special refining process is required to make it transportable by pipeline. How much this costs and how it might affect the cost of shale oil in a number of different geographic areas around the United States is not clear. There also seems to be some question as to the availability and cost of water for large scale operations; for a time at least problems of water supply might limit the scale of operations. Actual attempts at large-scale production and distribution might turn up other problems not apparent from pilot operations.

There seems to be little reason to doubt that with time for research and development the various problems could be mastered and a substantial—perhaps the major—portion of the U.S. demand for oil could be supplied from shale. But the ability to do this does not yet fully exist, and may require considerable further time and effort to acquire.

A third possible method of meeting oil demand can be mentioned briefly. Some years ago considerable emphasis and effort was placed in the production of oil from coal. At present, this method no longer looks economically promising in the light of the alternative possible methods for meeting the oil demand. It remains, however, a possibility which could still be explored further in case of need. Extraction of oil from the large deposits of tar sands in the prairie Provinces of Canada is another possibility.

AN OVERALL ASSESSMENT

Taking into account the foregoing aspects of the possible future situation with respect to oil, the following overall assessment is ventured.

It seems hard to avoid the conclusion that a basic, continuing shortage of oil to meet U.S. demand over the next 40 years or so is unlikely. No single method provides at present any full assurance of being able to take care of demand; but the sum of the different methods constitutes an impressive array of possibilities. That the United States may run short of ordinary domestic crude oil is a contingency sufficiently possible to be worth cons dering although it may not occur, especially

[9] "Oil Shale-Energy for the Future," Paper 4, Fifth World Petroleum Congress, p. 3.

if the more optimistic estimates of secondary recovery prove true. If it does happen, the chances are good that the gap could be filled by imports alone or shale oil alone. And, beyond this, there remains the possibility of further exploring the production of oil from coal and tar sands.

Beyond all of these possibilities lie numerous other lines of substitution should the cost and price of oil rise very much. Coal, gas, and electricity can take over oil's portion of the space heating job. Other fuels, especially coal, can replace oil when oil is used in the generation of electric power. Atomic reactors probably can soon be used instead of oil to propel naval and other vessels.

The probability of a basically adequate supply does not insure against relative transitory supply difficulties, which could be serious. The capability of the Middle East to supply large amounts of oil to the United States does not insure that the flow of such oil could not be interrupted in certain political or military situations. The basic likelihood that a large part of U.S. demand could be met economically from shale does not insure that the capabilities or facilities for doing so will exist as soon as they are required.

Nor is there assurance that a rise in the cost of oil will not occur. Regardless of costs of output and transport, foreign oil may be priced higher for the United States, if it becomes greatly dependent on imported oil. The possibility of shale oil would tend to put a ceiling on the price of imported oil, but it is too early to judge where this ceiling might be.

Given all this, it seems unlikely that economic growth in the United States will be restrained by inadequate supplies of oil, except possibly sporadically in crisis situations. A rise in the price of oil is not likely to be sufficiently large as to have a significant effect on the overall rate of economic growth; and is, moreover, likely to be compensated, at least in good part, by technological advances such as, for example improved thermal efficiency of engines, better design of motor vehicles, locomotives, and ships.

The foregoing obviously does not mean that there are no problems with respect to the oil resource. There are many problems which not only touch on resources, but are intertwined with foreign economic policy generally and with our relations with particular foreign countries.

As an example of a relatively simple problem we may note the question of how much further we should go in developing shale oil technology in the absence of actual urgent need. In view of the great importance of oil, it would seem wise to proceed even further with the investigation of shale oil technology in order to eliminate any remaining doubts about our ability to supply ourselves from this source.

As a few examples of more complicated and difficult questions, we may note the following: To what extent should we permit increased imports of oil in order to preserve and extend our domestic resources? Conversely, to what extent should we restrict imports in order to encourage exploration, discovery, and the construction of production facilities? To what extent should the desirability that the United States have a certain amount of facilities within its borders be balanced against the effect of import restrictions on other countries such as Venezuela?

Thus even though reasonably satisfactory answers can be found to the basic resource questions, there remain a large number of difficult questions relating to the supply of oil.

SELECTED METALS

METAL IMPORTS

For a large number of important metals this country during the last 10 or 15 years has passed from a position of net exporter, or net importer only on a very small scale, to a position of net importer on a considerable scale. The following table summarizes this significant transition.

Certain industrial materials: Ratio of net imports to U.S. supply,[1] 1937–39, 1956

[In percent]

	1937-39 (average)	1956		1937-39 (average)	1956
Aluminum	0	11.3	Zinc	6.3	57.8
Bauxite	53.0	78.1	Fluorspar, all grades	13.4	59.5
Petroleum	0	13.5	Tungsten [2]	41.8	59.7
Iron ore	2.6	20.3	Manganese [3]	(4)	82.7
Copper	0	22.4	Nickel	99.2	95.5
Lead	.2	56.5			

[1] Supply=production+imports—exports. Scrap and other reclaimed material have been omitted.
[2] Excluding ferrotungsten.
[3] Excluding ferromanganese.
[4] Not available.

Source: U.S. Bureau of Mines and U.S. Bureau of the Census, as presented in Percy W. Bidwell, "Raw Materials, A Study of American Policy" (New York: Harper & Bros., 1958).

Anything remotely approaching self-sufficiency in metals and other basic raw materials has definitely and completely passed so far as this country is concerned. It could be regained for most of these items, but only at a cost to the U.S. economy and to foreign supplying countries which would have to undergo severe dislocation frequently in their entire economic structure and balance of payments.

By drawing much more heavily upon foreign sources for such items as iron ore, copper, lead, zinc, fluorspar, the United States has been able to furnish raw materials for economic growth at little or no increase in relative costs. Costs of production in other countries have been sufficiently lower than in this country that, even with transportation and handling charges and in some instances import duties, using industries here have not been greatly handicapped by the increasing reliance on overseas sources.

This means that for this country any realistic appraisal of supply adequacy in most of the metals has to examine the supply outlook in other countries as well. That is, one must look at supply prospects for bauxite in Surinam, for lead, zinc, and nickel in Canada, for copper in South America and Africa, for petroleum in Venezuela and the Middle East, and for iron ore in Labrador, Quebec, and in northern South America.

PRICE AND COST TRENDS

Long-term trends in the real cost of obtaining metals for the American economy are difficult to assemble. This is due partly to

the fact that prices for which there is a long historical record are frequently a poor indicator of real cost and partly to the fact that it is almost impossible to piece together directly from cost records of individual firms a consistent long-term cost trend. The following table, however, does indicate the change in prices in this country of a number of important metals relative to general wholesale prices. It reveals sharp and erratic fluctuations in most of the items, but no clear and strong general tendency upward or downward.

Price trends of selected metals, 1900–55

[1947–49=100]

	1900	1905	1910	1915	1920	1925	1930	1935	1940	1945	1950	1955
Bauxite	157	190	156	167	92	139	154	190	172	150	95	104
Iron ore	173	122	138	98	104	100	127	137	138	105	118	145
Copper	212	188	134	184	84	101	112	80	107	83	99	163
Lead	77	77	61	64	51	85	61	50	63	60	81	85
Zinc	95	121	97	250	64	94	69	71	104	99	112	91
Fluorspar, all grades	41	48	40	36	74	79	95	85	117	130	101	119
Tungsten	43	56	66	257	19	62	85	101	159	133	108	220
Nickel	242	266	255	290	95	91	134	145	146	118	122	183
All metals	145	137	108	132	85	90	91	87	110	90	105	134

[8]

Source: Neal Potter and Francis T. Christy, Jr., "U.S. Natural Resource Statistics, 1870–1955," Resource for the Future, Inc., preliminary draft.

Recently a significant effort has been made to trace the long-term trend in the real cost of copper.[10] In this study the price of copper in New York for the period 1870–1957 was deflated by the Wholesale Price Index to give a long-term relative price trend. By taking selected years during which it was thought that prices would measure reasonably well against costs (that is, there was minimum "distortion" due to monopolistic or price and output control arrangements), it was observed that for a long period of time prior to World War I and then for the period since World War I the relative price trend was stable. During the latter period the relatively stable prices were at a lower level due to the introduction, roughly during the World War I years, of significant technologic advances in the mining and processing of the copper ore. The real cost trend based on selected years, therefore, indicates that the flow of cost-reducing improvements in the production of copper over long periods of time have just about balanced the tendencies for costs to increase because of having to mine lower grade ores, frequently at greater depths. In the 1860's copper mined in this country probably averaged about 8 percent pure copper in the ores; by the early part of this century, this had sunk to 2 percent; and during the present decade of the 1950's it has been about 0.8 percent. Of course, this country is able to draw on the richer ores now being mined in Africa and South America, and this is an important part of the story. This study does not permit any sure inference concerning the deterioration in the resource copper but it does suggest that the process of finding and developing copper deposits has regularity and responds to cost and price tendencies. It is essentially unsafe to make predictions about future adequacy on the basis of a carefully circumscribed look at the problem such as this study, but it is significant to note the stability of the long-term trend in real cost and the flexibilities that seem to exist in terms of new

[10] Oris E. Herfindahl, "Copper Costs and Prices: 1870–1957." The Johns Hopkins Press. In press.

technology, of discovering and developing new sources, and of drawing upon lower cost production in other parts of the world. For copper as for other raw materials, a broadly based economy with a rich and diverse technology and with channels of foreign trade kept reasonably free from obstruction, the supply outlook is not a bleak one.

In connection with copper it is worth noting that during the years since World War II aluminum production has expanded rapidly and aluminum products have largely displaced copper in several important uses, such as important types of wire and a variety of utensils. Had not aluminum become available rather widely as a copper substitute, it is possible that the higher demand which would have been placed on copper would have led to higher costs and prices relative to commodity costs and prices generally. This is not a certainty but it is a distinct possibility. But this serves to illustrate another pervasive characteristic of resource materials; namely, that substitutes are available for most of them, usually at no great increase in cost and frequently at lower cost.

PROBLEMS OF FUTURE ADEQUACY

In this country large reserves for most of the metals are available but only in low concentrations which would require heavy applications of capital and newer technology if they are to be tapped extensively. For example, enormous reserves of low-grade iron ore are known to exist in the Minnesota and nearby iron ranges. Furthermore, techniques for beneficiation of low-grade ore are not only known but are now in operation in a few plants. The extent to which we draw on these enormous low-grade reserves will depend upon the comparative economics of upgrading domestic ores against importing higher grade ores from Canada and South America. Undoubtedly the course of future development will see increases both from low-grade domestic ores and from imports, with the proportion to be determined by comparative costs and by the dictates of trade policy. The same general story could be told for copper, lead, zinc, and other items. In the case of bauxite for aluminum the story is slightly different. Higher cost bauxite deposits do exist in this country which could be drawn upon, but in addition aluminum can be produced from very plentiful clay materials through the application of large amounts of electric power. Costs here are not yet favorable but might become so in the future, especially should the price of bauxite from abroad rise appreciably.

For many of the metals, as for other resource materials, it remains hazardous to say much about supply adequacy too far ahead. The rate of economic growth in this country, and possibly an even higher rate of growth in many other countries, during the next few decades will place extremely large demands upon the entire world resource base, and especially upon such things as iron ore, bauxite, copper, lead, and zinc. One can only say regarding this country that the historical record of trends so far as they can be pieced together out of scanty evidence does not portend disaster. By including lower grade ores reserves are enormous. All that is required is sufficient application of technology and of fuels and electric power. What may be found deeper in the earth (perhaps by piercing through the so-called moho layer under certain parts of the ocean) or by resort to synthetic

substitutes (such as new and reinforced plastics) one can only imagine. The implications for future supply of conventional metals could be great indeed. Left out of account altogether here is the possibility of obtaining a variety of metals from sea water where they are known to occur in very low concentrations.

WATER

Of all the basic resources essential in the American economy, water is now widely thought to present the most serious problems of adequate supply for the future. This general concern results partly from the dramatic nature of occasional water shortages such as for agriculture in the arid West or for domestic and industrial supplies in a few eastern and midwestern cities at certain times of the year. The seriousness of water shortage is brought home literally to every family which has faced the fact or even the prospect of water rationing. At the other extreme, many communities have experienced sudden and great water surplus in the form of floods which, once out of hand, have wrought terrible damage and frequently caused drownings.

WATER SUPPLY AND ITS UNEVEN DISTRIBUTION

Actually in an overall sense there is plenty of fresh water in this country and probably there will continue to be plenty for the remaining years of this century. In broad strokes the average annual rainfall over the whole country is about 30 inches. Of this some 22 inches evaporate from plants, the ground, and water surfaces, or are transpired by plants. The remaining 8 inches is runoff, much of which must continue to flow down the streams for navigation, fish and wildlife habitat, recreation, and dilution of pollutants. The remainder is available for use in the ordinary sense. Of course, quite a bit of other water may be withdrawn from lakes, streams, and underground sources, used in industry or elsewhere and then returned to these sources for reuse. Thus, there is a difference between total amount of water withdrawn for use, and total amount that actually disappears. Disappearance statistics are probably of more critical importance from the point of view of longrun supply as a support to economic growth, although water that is withdrawn, used, and then returned in polluted condition may not be useful again for some length of time and for some considerable distance downstream from the point of discharge.

This most general look at water across the country is only useful as background to the problem. More realistically water supply and use is a regional matter, although interbasin transfers of water are now accomplished at a number of places in the country on a large scale and this can be expected to be duplicated many times over in future years. One long-range prospect to which some attention has already been given would link the waters of the Colorado, California, Central Valley, Columbia, and the Klamath Rivers in one great interconnected water supply system. Further than this, the upper Arkansas and Platte Rivers, which ultimately drain into the Mississippi, would be linked in, although here the exchanges would be one way from west to east due to difference in elevations. Despite these

exciting prospects the question of future adequacy of water supply has to be addressed in regional terms, ultimately in river basin and subbasin terms.

In addition to the uneven distribution of water regionally, water is distributed unevenly over time. Some of this time unevenness is seasonal: for example, the average spring and summer flow of the Columbia River is considerably larger than the average winter flow. Some of the unevenness is associated with floods and droughts. For the Potomac River the maximum recorded flow is 48,000 cubic feet per second, the minimum is 800, and the average 11,000. Different rivers vary in time unevenness of flow, but on many of them there is perenially the possibility of severe shortage during dry seasons and surplus and floods during wet periods. The development of rivers to even out the flow over the seasons therefore becomes a major task. The more fully the river becomes developed through the construction of dams and reservoirs and by other means, the more certainty there will be of higher minimum reliable amounts of water for domestic, irrigation, industrial, and other uses. It is important to note also that the cost of additions to minimum reliable flow tends to increase sharply.

In broadest terms, therefore, the problem of water supply for the future in this country is a problem of development for more even flow over the seasons and to permit the water to be distributed more widely to points of most economic use. Beyond this are the problems of pollution abatement and prevention in many parts of the country and the need for conservation of water all along the line from where it exists in nature in lakes, rivers, and underground pools to the ultimate industrial, agricultural, and domestic users. The artificial inducement of rainfall, as more is learned about its theory and practice, may serve to redistribute water supply somewhat more favorably.

ESTIMATES OF FUTURE WITHDRAWAL

The statistics on water supply and use are not good from the point of view of coverage of uses or parts of the country. Neither are the statistics available over many years in the past. Such as they are, the data indicate that all major water uses (irrigation, industrial, domestic, and steam electric power) have increased greatly over past decades. The following table indicates water use by major uses in 1954 for which there is a fairly complete record, along with projections of water use in 1980 and 2000, based on general assumtions regarding population and economic growth. In 1954 total withdrawals were about 18 percent of runoff (8.5 inches a year on the average); total disappearance was about 6 percent. As can be seen from the table, quite a wide range around the medium estimates for 1980 and 2000 is entirely possible, depending on many factors such as new technology of water development and use, growth of the large water-consuming industries, and public policy. The projections merely provide some indication of what the demand for water might be in the future; they are not predictions in any sense. Research presently underway will attempt to refine the projections in several ways, especially to present them on a river-basin breakdown.[11]

[11] Research underway in Resources for the Future on future water demand and supply.

Estimated fresh. water withdrawal and disappearance, 1954, 1980, 2000

[In trillion gallons per year[

	1954	1980			2000		
		Low	Medium	High	Low	Medium	High
Municipal	3.8		8.8			15.6	
Thermal and nuclear power	17.7		34.3			58.9	
Industry	10.1		22.5			41.3	
Agriculture	40.1		60.1			63.0	
U.S. total withdrawal	71.8	120.5	125.7	149.0	162.0	178.8	263.6
U.S. total disappearance	26.4	41.2	41.9	47.3	48.6	48.9	56.5

Source: Work in progress in Resources for the Future, Inc.

WATER PROBLEMS IN THE WEST AND IN THE EAST

For purposes of this general discussion it is helpful to consider water problems in Western United States and in Eastern United States, understanding that most of the West is characterized by rather arid conditions and most of the East by fairly humid conditions although this is not true uniformly in either case.

In the West, which is roughly defined as west of the 20-inch line of average rainfall (coinciding more or less with the 100th meridian running generally north and south from the eastern part of the Dakotas down through central Texas), water problems evolved as part of the land settlement policy. A primary objective of national policy and of private action through most of the 19th century was to migrate and settle the western lands. Settlement during this time meant primarily agricultural settlement. Water was a necessary adjunct to the establishment of agriculture over most of this broad region. Alternative uses of water beyond domestic and irrigation uses and for mining operations were given little attention, and this became imbedded in the western water law based on prior appropriation. As a result, to this day nearly 90 percent of water used in the West is used in irrigation agriculture. Most of the developed supply has already been claimed for agriculture.

Recent studies however, indicate that water used in industry and even for recreation in many places would yield higher values than water used for irrigation farming. These conclusions result from economic analyses which attempt to estimate the net returns which may be expected from use of water for different purposes and the effect of the alternative uses of water upon State and regional income. A recent study of the value of alternative uses of water from a further development of the San Juan River in northwestern New Mexico, some of which might be transported eastward into the Gio Grande Basin for use there, indicates that the new water supply used in industry might result in an increase in incomes in that State of some many times what using the same water for irrigation might do. The same study indicates that use of some of the water for recreational purposes would yield income returns which considerably exceed those resulting from use of the water in agriculture.[12]

The idea of multiple purpose use of water is now widely recognized and accepted, but the idea of allocating the water among its various

[12] Nathaniel Wollman, "The Value of Water in Alternative Uses," to be published by the New Mexico University Press.

possible uses in accord with standards of economic efficiency is not widely accepted. This points to some desirable objectives for both further study and for policy. In addition to programs for increasing water storage and supply, interbasin transfer, and conservation both of surface and underground water, there is need for moving in the direction of a better allocation of water to the more important economic uses. Wider employment of prices as a means of directing water to essential uses might be given further attention.

In the eastern half of the country, water problems are less dramatic, except for floods, but nevertheless exceedingly important and growing more so with each passing year. In most Eastern States riparian law governs by which those who own land abutting streams have the right to withdraw and use water. Since water in many eastern streams is no longer unlimited relative to amounts users would like, it becomes important that profligate withdrawals be avoided and that water be returned to streams in a reasonably unpolluted condition. Use practices and legal sanctions which would require that water be returned in reusable condition seem to need strengthening. Limited Federal aid is now available for planning and for actual installation of purification works, at least on a limited scale. The pollution problem is mounting so rapidly that further efforts and inducements on the part of government may well become necessary. Schemes for interstate cooperation toward this end offer some promise.

OPPORTUNITIES FOR INCREASING FUTURE AVAILABILITY OF WATER

Turning finally to the question of whether or not water supply difficulties may restrain general economic growth, the answer seems to be that it need not but could if timely steps are not taken to develop additional supply where that is feasible, to arrange for interbasin transfers where that can ease supply difficulties in particular places, to encourage the installation of facilities for recycling and reusing water especially in industry, to press forward with pollution abatement, especially in the eastern half of the country, and to conserve water across the board perhaps under the stimulus of higher water charges to users. The possibilities for reducing losses from evaporation in the West by the spreading of monomolecular film materials over reservoir surfaces merit further research and experimentation. Also efforts to increase runoff from higher elevations and to control and reduce phreatophytes (plants which require large amounts of water) should also be mentioned. In particular places, despite strenuous efforts, water shortage and high cost could impede economic growth by discouraging the location of new or expanded industrial or agricultural operations.

Possibly the most exciting prospect for reducing water withdrawals, comes in recent developments for recycling water in industrial use. For example, in certain uses such as for steam generation of electricity where the water is used partly for producing steam but much more for cooling, it is now economically feasible in high cost water areas to install recycling equipment which can reduce withdrawal from the streams or other sources by as much as 90 percent. Similar though possibly less striking opportunities exist in other major water using industries such as pulp and paper, steel, and many branches of the chemical industry.

For the long term future the prospect for desalinization of ocean and brackish water offers promise. A considerable program of research, principally under Government auspices, is now underway in this country, and experiments are going on in other parts of the world. Presently known and tested methods will yield fresh water but at costs considerably higher than cost of obtaining water from natural sources, except in a few isolated parts of the world where the cost of fresh water is exceptionally high. Whether discoveries and technologic improvements will be made during the remaining years of this century which will make desalinization economic for many uses and in many areas is quite problematical. No allowance should probably be made for this happening over the next 40 years, although key developments might come within this period. Already, of course, saline water has been substituted for fresh water for cooling purposes.

The problem of assuring water adequacy therefore boils down to this: long range estimates of demand and supply should be improved, plans for developing needed supplies and for abating pollution and conserving water generally should be pressed forward, necessary investments and regulatory and inducement policies should be installed as needed. Strenuous efforts should be made in various ways to promote the use of new supplies of water, and where possible existing supplies, in the most economically efficient ways. This will mean in many parts of the West more industrial use of water, compared to agricultural.

CHAPTER 4. SUMMARY OF TRENDS AND PROBLEMS AHEAD

In casting a fairly long look ahead to 1980 and 2000 and trying to see the future demands the economy may place on resources and the problems that may be involved, several important features stand out.

1. The demand for nearly all raw materials may be expected to increase in absolute amounts, for some much more than others, depending on the rate and composition of total economic growth. In per capita terms, consumption of most resource materials will most likely rise, although for a few agricultural products and possibly other things it will fall.

2. As a percent of GNP, resource output will probably continue downward, though perhaps more slowly than in the past. The same thing will probably be true of employment in resource industries expressed as a percent of total employment. Capital will continue to be substituted for labor in agriculture, mining, forestry, water development, and other resource industries.

3. Reliance upon imports of many raw materials can be expected to continue to increase, the extent and nature of which will be greatly influenced by foreign trade policy and international policy generally. Already this country imports large amounts of such important materials as oil, iron ore, copper, bauxite, pulpwood and pulp, sugar, and coffee.

4. Military security problems will obviously have a bearing on the resource segments of the economy; for forecasting and planning purposes the bearing they have will depend on the particular assumptions made about such matters as the nature of any attack on this country,

the duration of any war, the rate of recovery from war damage, access to foreign sources of supply, and amount and kind of preparedness activities. The amounts of many of the basic raw materials required for a *high level defense* economy without war may not be greatly unlike the amounts required for a *high output, high employment low defense* economy.

5. The statistical record over the past eight decades does not reveal any general trend up or down in the price of resource products compared to prices generally. A few specific products have tended upward, a few downward, but most have moved sideways, frequently with fairly large but erratic year-to-year fluctuations. While these long-term price trends provide no absolute guarantee against general shortage of raw materials in the future, they are a kind of assurance of a strong likelihood that what has held for seven or eight past decades will continue to hold for a few more.

6. In its technologic and economic evolution this country has passed from a close dependence on basic resources, such as agricultural and forest land and mineral ores, to one geared much more to highly processed and variegated intermediate and final goods and to services. As the range of possible substitutions has broadened and as more has become known about the chemistry of raw materials, dependence on any one material has lessened. Molecules can now be rearranged to produce the specification in an astonishingly large number of instances. Furthermore, techniques for conservation and reuse of materials are improving.

7. Several particular resources have been considered in more detail: Oil, lumber, and water, and more briefly several of the nine widely used metals. These present a somewhat mixed picture, but in each case, assuming appropriate policy and management, shortages should not result in a restraint on economic growth at least over the next few decades. Substitute materials and new sources at home or abroad, frequently at no great increase in cost, furnish ceilings against any tendency for costs of conventional items to rise very much.

8. The cursory examination of historical trends in the resource industries plus the equally cursory look ahead to 1980 and 2000 do not reveal significant danger of general resource shortage in this country, although sharp supply difficulties undoubtedly will appear for particular raw materials at particular times and in particular industries and places. Nor can one find a clear and simple case that anything in the resource situation and outlook will initiate or persistently feed inflation. However, brief attention may be given now to the possibility that raw material price movements may stimulate inflation.

9. Undoubtedly the price of specific raw materials will rise, perhaps sharply, from time to time as demand increases suddenly. This may be due to any one or combination of factors: rapid inventory buying during upward cyclical movement of business, speculative buying in time of a war scare, a capital goods boom calling for large amounts of metals or other items. Price increases of this nature, one would think, would normally be followed by price drops, each intensified by the sluggishness of supply adjustments characteristic of the extractive industries. The faster capacity and production can be adjusted, the less extreme such movements will tend to be. Also the more successful are buffer stock and other supply stabilization schemes, the greater chance there will be to hold such price fluctuations within limits.

10. Shorter run price instability of this sort may exert a longer term inflationary influence in certain situations. For example, a large and sudden jump in demand for one, or, more likely, several raw materials (say copper, lead, zinc, iron and steel, and bauxite and aluminum), given the supply inelastic nature of these industries, would undoubtedly lead quickly to relative price increases. Such increases might well be transmitted via higher costs or expected higher costs to the prices of intermediate and final goods, and hence to prices generally. This chain of events would be more likely if managements in the key firms and industries were able and chose to "administer" prices upward, with or without the acquiescence of unions. In a general atmosphere of business upswing and prosperity in which most consumers are sharing by way of wage and salary raises, the "pass through" of price increases of raw materials to finished products ordinarily meets with only feeble opposition. The "cost push" from raw materials can combine with or be closely followed by the "demand pull" of higher consumer incomes and increasing purchases of raw materials by processors in ways that inevitably spell inflation in materials' prices and an impetus to general price inflation.

11. Such inflationary courses may not be reversible as adjustments in raw materials supplies and inventories are reached, or overreached, because of a one-way ratchet underneath prices which permits them to be boosted up but prevents their being hauled down. This ratchet, by now well known, is a part of the structure of many industries and apparently is strong enough to hold against all but the heaviest downward pressures. Part of the strength of the ratchet arises from the power and vigor of unions in many of the materials industries to press wage and related demands especially during periods of expansion, part from the oligopolistic (at least less than fully competitive) nature of some of these industries which permits price advances to be made fairly promptly following any actual or even expected cost increase and which provides discipline against competitive price adjustments downward, and part from the increasing need for firms in the materials industries (as well as others) to keep increases in the fixed and overhead portions of total costs covered during threatened downswings in business.

12. The result of these shorter run forces, particularly the "price ratchet" effect in raw materials industries, may well be an intermittent but one-way upward pressure on materials' prices and to a less but still significant extent on prices generally. This kind of inflationary pressure does not arise from any underlying and long run tendency for raw materials as a whole, or even any one large category of them, to increase in scarcity, cost, and price. Rather it arises from the more general structural characteristics of modern industry as it responds to the upward and downward tendencies of business and from the special characteristics of the raw materials industries themselves.

13. Finally, it must be borne in mind that resource materials will not automatically insure long run growth or exert only minimum effects on short run stability. On both fronts careful analytical attention to trends and events will be needed to spot difficulties before they become unmanageable. Policies and actions in government, business, and labor undoubtedly will require changing from time to time. It

is perfectly clear, for instance, that a steadily increasing flow of research, discovery, invention, technologic refinement, and adoption in industry will be necessary if the prediction that resources will not restrain economic growth is to prove accurate. Maintenance of this flow implies a host of policies and activities in education, science, and investment. It is perfectly clear also that the requirements of both military security policy and foreign economic policy bear importantly on resources. Ultimately what is desirable is a world assured of peace in which individual countries and regions trade with one another on a wide and unencumbered scale. Meantime careful but adjustable balances will have to be struck. Lastly, it is also perfectly clear that efforts to make possible greater stability of many resource industries need to be strengthened if the contribution these industries conceivably may make to inflation, short or long run, is to be reduced.

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