AgEcon SEARCH
RESEARCH IN AGRICULTURAL & APPLIED ECONOMICS

The World's Largest Open Access Agricultural & Applied Economics Digital Library

This document is discoverable and free to researchers across the globe due to the work of AgEcon Search.

Help ensure our sustainability.

Give to AgEcon Search

AgEcon Search
http://ageconsearch.umn.edu
aesearch@umn.edu

*Papers downloaded from **AgEcon Search** may be used for non-commercial purposes and personal study only. No other use, including posting to another Internet site, is permitted without permission from the copyright owner (not AgEcon Search), or as allowed under the provisions of Fair Use, U.S. Copyright Act, Title 17 U.S.C.*

Long-Run Economic Projections: A Review and Appraisal

By Rex F. Daly

This paper has three major objectives: First, to outline the general nature of economic projections, including methodology, limitations, and uses in policy appraisal; second, to review a recent projection published by Resources for the Future; and third, to propose a general-purpose economic projection for use by Government agencies in resource development work. The general-purpose projection would serve primarily as a reference for sector analyses and more detailed regional, river basin, or similar smaller area resource development studies.

ECONOMIC PROJECTIONS are widely used by businessmen looking to new markets and plant expansion; by Government administrators faced with long-run policy decisions; and by congressional committees and commissions. A virtually insatiable demand for a peek at the future—albeit clouded by uncertainty—has given rise to a host of longer run economic appraisals. Most of them are similar in coverage, methodology, and results. Some have been elaborate investigations culminating in long, published reports. More often, they are simple administrative documents. Unfortunately many of the more detailed studies consist largely of collections of data for past years and "numbers" projected on the basis of past trends.

Much of the subject matter of economics is economic projection. Long-run decisions and policy questions frequently involve commitments extending over several decades. The work of every division of the Economic Research Service is concerned with economic projection. Likewise, the work of most Services of USDA and such agencies as the Department of Health, Education, and Welfare; the Corps of Engineers; and the Department of the Interior either carry on or contract for considerable research work in long-run economic appraisals. In addition to Government agencies, many other public and private research groups, universities, study commissions, business firms, and most international agencies do research involving long-run judgments about future economic growth.

An examination of recently published long-run projections and preparation of such appraisals over a period of years prompt the following general observations:

1. Decisions involving long-run commitments force appraisals of the future, though they may be only implicit in the decision made. The tools of economics have been helpful in appraising long-run economic prospects.

2. Neither the economist nor any one else can foresee the future. The economist above all must appreciate the limitations of his tools and should be quite candid in pointing out the nature and limitations of economic projections.

3. Elaborate, detailed, published economic projections probably require much more time and effort than can be justified, even in an affluent society.

4. Some coordination of long-run economic projections is needed, at least among Government agencies. A projection of economic growth which fits the needs of various agencies for use in resource development research would greatly facilitate comparisons among projects, speed up the work, and reduce costs.

5. Most long-run decisions have many facets—economic, social, welfare, national security, etc.—and no economic or other analytical framework can be expected to give unequivocal conclusions regarding the whole picture of the future. Accordingly, judgment by the administrator, the "board," or other policymakers must play the key role.

Nature, Use, and Limitations

The need for long-run economic projections as an aid in policy formulation is fairly obvious. Most economic decisions—whether to invest in a new plant, build a dam, or reforest a cut-over area—involve judgments about the future. To the extent that it is effective, the long-run appraisal may be proven incorrect, if problem areas are revealed and action is taken to correct them. Thus, the economic projection in influencing long-run judgments and policy formulation may generate the conditions which prove it wrong.

The economic projection attempts a view of the future based primarily on present knowledge and relationships of the recent past. Usually the strategic assumptions are given and much of the projection follows logically from the assumptions. Accordingly, the project is not an uncondi-

tional "forecast" of the future, but is an appraisal based on a number of specific assumptions. Such assumptions make the projection job manageable, but they are partly a dodge which simplifies the job and limits its usefulness to some extent. Few, if any, economic forces can be impounded in the assumption, "other things being equal." Moreover, the contribution of these forces to economic growth varies from one time to another. The long-run economic projection, consequently, can be little more than a rough sketch of future growth based on past trends and economic relationships. Such projections seldom reveal new problem areas, though they may help to roughly quantify known problems.

Methodology and Assumptions

The scientific appraisal of the future must rely heavily on historical trends and relationships. Even the most sophisticated growth models greatly oversimplify relationships involved in the changing system of cause and effect. Thus, the scientific projection is chained to the present and usually to the more recent past. Acceptable projections do not deviate far from persistent long-run trends in population, general economic growth, consumption, productivity, technological developments, and relative prices. They seldom reveal turning points or great technological developments.

Even if we could foresee the future with accuracy, we probably would not be taken seriously. For example, the world of the 1960's is probably beyond the most far-out dreams of economic and social philosophers of three and four decades ago. Would most administrators or boards of directors of 30 to 40 years ago have seriously considered an economic projection for today based on atomic energy, space flight, TV, and many other developments playing a key role in economic activity? Such common economic magnitudes as the gross national product or the national debt probably would have been considered astronomical some three to four decades back. Recent surveys of major manufacturing firms indicate that about one-fourth of their 1962 sales were new commodities not in production just 10 years ago. Technically feasible developments in energy production, construction, food preservation and preparation, and other areas indicate the almost fantastic new possibilities already on the horizon.

Few attempts have been made to develop a theoretical and empirical framework in which to explain and measure the influence of factors contributing to population growth. Population projections are usually based largely on past trends and judgments regarding future trends in mortality and fertility rates. Likewise, trends in labor force participation, hours worked, and productivity usually provide the basis for projecting potential economic growth. Estimates of the propensity to consume, investment multiplier, marginal productivity of capital and labor, etc., are usually based on relationships in recent years. These provide a rough basis for projecting total consumption, investment, capital requirements, labor inputs, and output for the major sectors of the economy.

Appraisals for a major sector such as agriculture often attempt a general price equilibrium framework integrating demand, the supply response, and prices. Although considerable research has been done on the measurement of demand for farm products, there are no complete analytical frameworks. For most industries or economic sectors, our tools of analysis are probably weakest in the area of producer response to prices and economic programs. Because of these and other gaps, economic projections must rely on empirical analyses for major commodities and sectors as well as the judgment of experienced specialists.

Review of Recent Economic Projections

Some of the better known studies include *Resources for Freedom*, published by the President's Materials Policy Commission ("Paley report" after its Chairman, William S. Paley), 1952; and *America's Needs And Resources*, a Twentieth Century Fund Study published in 1955. More recently a series of reports has been issued by the Outdoor Recreation Resources Review Commission, covering virtually the whole gamut of economic projections. This Commission reported to Congress in January 1962. Resources for the Future, Inc., also has recently published a number of major studies, results of which are summarized in *Resources in America's Future*, by Hans H. Landsberg, Leonard L. Fischman, and Joseph L. Fisher. In addition to these general studies, many others have been prepared for sectors or industries, such as the *Timber Resources Review* by the Forest Service, 1958.

This section is primarily a review of *Resources in America's Future*. In connection with the review, comparisons are made with recent similar studies.

It is relatively easy to point out the many limitations of such economic projections and to take issue with methodology and projected results. However, many of the major conclusions of the study appear reasonable, though possible variations in projected results make unequivocal conclusions and policy implications difficult. Possibly the first major question raised by the study is, "was such a big undertaking worth while?" The report states that "to predict what will happen in the next 40 years is a feat beyond the powers of social science" (p. 17). The major conclusions reached in the study (p. 53) could have been reached on the basis of much less projected detail. The very long-run policy recommendations often bear virtually no discernible relationship to such details as projected purchases of autos, military aircraft, electric ranges, styrene moldings, etc., some of which may not be in use 40 to 50 years hence.

After the "Study in Brief," covering some 68 pages in this large book, chapter 1 deals with basic economic patterns. New population projections seem to be primarily a shuffling of some major assumptions used in Census Bureau projections. The labor force projection is based on the usual technique—trends in age-sex participation rates applied to corresponding groups in the projected population. The employment level and rate of unemployment were assumed. It is interesting to note that such a detail as the number in the Armed Forces is projected to the year 2000—low for low economic growth and high for high economic growth.

Apparently the gross national product is computed directly from projected employment and assumed trends in GNP per worker. The authors state that recent experience, "carefully interpreted," does not suggest radical reduction in hours worked per week and in weeks worked per year. This conclusion may largely account for a comparatively high gross product per worker. Nevertheless, the medium projection of the gross national product is reasonable compared with results based on different techniques. The authors state that "the pace of man's social and economic evolution—even when it seems to falter—has come to resemble the compound interest curve" (p. 69). But this stability is considered a hazard because of background data available for only a couple of past decades. The observed stability in growth of some major economic variables is convenient. But it is largely a crutch which tells us little about the inner workings of cause and effect. Unfortunately we come out about where Mark Twain did in his comment on projections: [1]

> In the space of one hundred and seventy-six years the Lower Mississippi has shortened itself two hundred and forty-two miles. That is an average of a trifle over one mile and a third per year. Therefore, any calm person, who is not blind or idiotic, can see that in the Old Oölitic Silurian Period, just a million years ago next November, the Lower Mississippi River was upward of one million three hundred thousand miles long, and stuck out over the Gulf of Mexico like a fishing-rod. And by the same token any person can see that seven hundred and forty-two years from now the Lower Mississippi will be only a mile and three-quarters long, and Cairo and New Orleans will have joined their streets together, and be plodding comfortably along under a single mayor and a mutual board of aldermen. There is something fascinating about science. One gets such wholesale returns of conjecture out of such a trifling investment of fact.

Economic methodology relies heavily on growth trends, as indicated earlier, but results become very thin for the tremendous projected detail produced in this volume. For example, appendix tables A1–29 and A1–30 contain 22 pages of data showing low, medium, and high projections for all principal components of the industrial production index. The report includes a mass of projected results as well as background data available in other publications. In addition to abundant statistics, it includes extensive notes and cross-references rather artistically deployed on 1,017 two-column pages. Similar criticism might be leveled at many economic projections. The economist is often forced into more detail than is justified by available techniques and more detail than can be related to the problem.

The chapter on food is very general and concerns itself little with the nature of the demand for food. Projections of per capita consumption are based on past trends. Very few projections have been attempted in such detail for such a period into the future. In any event, it would be difficult to take issue with specific projections and give persuasive reasons for differences. The cal-

[1] Mark Twain, "Life on the Mississippi," *The Family Mark Twain*, Harper & Brothers, New York, p. 86.

orie intake looks reasonable, as do pounds of food consumed per person. Recent trends and some analyses for the future suggest that the medium projection of per capita consumption of lamb and possibly of pork and eggs may be a little high. On the other hand, the projection for wheat appears comparatively low.

The chapter on crops is concerned primarily with feed grains, wheat, soybeans, and cotton. Much of the discussion centers about feeding rates and the demand for feed. The authors conclude that "continued rapid advance in animal husbandry is in prospect" (p. 236). Accordingly they project substantial gains in "feeding efficiency" under medium-level economic conditions. There are a number of difficult statistical and conceptual problems in projecting feeding rates and feeding efficiency. Undoubtedly, feeding efficiency has improved materially in recent years, but feeding rates have increased substantially. It is quite possible, even with rapid technological developments, that relative feed supplies and prices may result in continued heavy feeding of livestock. This would seem logically consistent with prospects for a sizable surplus of cropland. The net effect could mean actual feeding rates closer to the "low efficiency" projections and thus to higher requirements for feed.

The appendix to the chapter on crops consists of some 25 pages, mostly of statistics relating to livestock units and feed. In addition to background data, five projected levels of demand and feed use are attempted—a Low-low, High-low, Medium, Low-high, and High-high. In view of the crude data and tools of analysis, differentiation between these five projected levels is indeed a heroic effort.

A shortage of forest products is projected by the authors with apparently little reservation (p. 46). They anticipate a sharp step-up in demand, starting in the relatively near future, and eventually heavy pressures on U.S. forest resources (p. 257). Undoubtedly, there will be a substantial expansion in the demand for new construction, containers, paper, and other products now using timber resources. Nevertheless, it is quite easy to justify projections of only moderate increases in the next few decades in demand for timber, particularly if prices of forest products should rise in relation to prices of other materials. Rising costs associated with the use of lumber, changes in architectural design of housing, the trend toward multiunit construction, and generally increased use of competitive materials will probably continue to limit the demand for lumber.

Better management practices, improved disease and insect control, and possible developments in forest genetics are expected to improve net annual growth in timber supplies. Technological developments effecting more efficient use of smaller logs and increased use of the more plentiful hardwoods will help to extend the annual supply of timber. In addition, if substantial pressure develops, potential supplies from imports are relatively large. A case can be made for no substantial worsening in the general utilization-supply balance for timber during the next few decades.

"Adequacy of the Resource Base," Part III, includes a chapter on land drawn primarily from *Land for the Future*, by Marion Clawson, R. Burnell Held, and Charles H. Stoddard, 1960. They conclude that there will be a surplus of cropland during much of the projection period, but only if we get continued substantial improvements in yields. Looking ahead to 1980, the authors see a surplus of cropland of perhaps as much as 25 to 30 million acres, but more likely less than this. Surplus cropland through 1980 is sufficiently large to permit expansion in other uses, particularly recreational uses of land. Prospects for the year 2000, on the other hand, point to a net deficit of possibly 50 million acres. In addition to the need for more cropland, substantial expansion in recreation and other nonagricultural uses is projected.

As the economy grows over the next 40 to 50 years, surely some increase in pressures on the fixed land base would be likely, particularly under the technology of today. However, an indicated shortfall of 50 million acres out of a total of some 1.9 billion acres, in view of all the uncertainties, hardly points conclusively to a serious situation and the immediate need for greatly accelerated programs. An examination of trends of recent years and a knowledge of the past also would suggest the need for conservation in the use of our exhaustible resources as well as the need for continued improvement in crop yields, management of range and forest resources, and technology affecting the use of wood products and substitute materials.

Comparisons Based on Recent Studies

As indicated earlier, many groups and organizations are in the business of economic projections. Among the recent monumental works are the reports of the Outdoor Recreation Resources Review Commission. This Commission was charged with the responsibility of determining recreational needs of the American people in 1976 and 2000, recreational resources available, and policies and programs to meet those needs. In addition to many staff reports, the Commission obtained special reports from public agencies, universities, research organizations, and individual authorities. There were some 27 ORRRC study reports containing, by rough count, nearly 5,000 pages. Most of these reports were concerned, at least in part, with economic projections. Study Report No. 23, "Projections to the Years 1976 and 2000: Economic Growth, Population, Labor Force and Leisure, and Transportation," seems to contain both staff reports and reports of the National Planning Association in part covering the same ground.

A sample of results of some recent economic projection studies was brought together for comparison (table 1). Projections for a few important economic variables point out the similarities, particularly in projections for some two to five decades into the future. Virtually all population projections began with basic Census Bureau projections, but there are some differences in the choice of basic assumptions and in the projected range. Observa-

TABLE 1.—*Population and general economic growth, 1960 and projections for 1976, 1980, and 2000*

Item	1960	Projected		
		1976 (medium)	1980 (medium)	2000 (medium)
Population (million):				
RFF [1]	[2] 179. 9	[3] 230	245	331
ORRRC [4]	180. 7	231	----------	351
NPA [5]	180. 7	240	----------	350
BDSA [6]	180. 7	235	----------	380
FS [7]	[2] 179. 9	230	----------	356
ERS [8]	180. 7	[3] 236	254	358
Census Bureau [9]	180. 7	236	254	358
Labor force (million):				
RFF [1]	[2] 72. 8	[3] 96	102	142
ORRRC [4]	[2] 72. 8	95. 3	----------	142
NPA [5]	72. 8	96. 2	----------	142
BDSA [6]	72. 8	----------	----------	----------
ERS [8]	73. 1	[3] 97	104	147
Employment (million):				
RFF [1]	[2] 68. 9	[3] 93	98	137
ORRRC [4]	[2] 68. 9	89. 1	----------	----------
NPA [5]	[2] 68. 9	92. 4	----------	137
BDSA [6]	[2] 68. 9	83. 5	----------	131
FS [7]	69. 2	89	----------	137
ERS [8]	69. 2	[3] 93	100	141
Gross national product (billion 1960 dollars):				
RFF [1]	504	[3] 910	1, 060	2, 200
ORRRC [4]	504	----------	----------	----------
NPA [5]	504	1, 035	----------	2, 039
BDSA [6]	504	870	----------	2, 070
FS [7]	504	890	----------	2, 061
ERS [8]	504	[3] 938	1, 068	2, 175

[1] *Resources in America's Future*, Resources for the Future, Inc., 1962, p. 517.
[2] In 48 States (excluding Alaska and Hawaii).
[3] Interpolated for 1976 between 1970 and 1980.
[4] *Projections to the Years 1976 and 2000*, Outdoor Recreation Resources Review Commission, Study Report No. 23.
[5] National Planning Commission studies included in ORRRC Study Report No. 23.
[6] Business and Defense Services Administration, U.S. Department of Commerce, *Construction Review*, Vol. 7, No. 9, 1961.
[7] Preliminary Forest Service projections, 1963.
[8] *Notes and Assumptions for Illustrative Projections*, ERS.
[9] Select Committee on National Water Resources, U.S Senate Committee Print No. 5, 1960.

tions during the postwar years suggest that the "time of setting" the population assumption may have as much influence on the choice of level as the logic of selecting among alternative assumptions.

Labor force projections were usually based on labor force participation rates in the major age-sex groups of the population. Although considerable variation might be introduced, projected results are very similar. Note the similarities among the studies in projected employment and gross national product. There are a number of differences in detail among these studies. But the results are not significantly different for most purposes. Some of them, as indicated, are elaborate published reports based on the work of a large research staff. Other studies, similar though less detailed, were prepared in a short time by small staffs.

Another example of similar projected results was reported in a recent issue of the Washington Post.[2] This article reported on a study of Metropolitan Washington's prospective growth prepared by Economic Associates (Ecasso) for the National Capital Transportation Agency. The author of the news article points out that the findings of that study largely agree with (1) a study done by CEIR Inc., as a part of the 1959 Mass Transportation Survey; (2) work done by the National Capital Planning Commission for its Year 2000 Plan; (3) the Potomac River Basin Study of the Army Corps of Engineers; and (4) other similar reports.

General Purpose Projections for Resource Development Studies: a Proposal

A review of general economic projections points up the similarity of results and the oversimplified methodology necessary in long-run appraisals. Detailed projected views of an unknown future have a limited use as an aid in policy formulation and other long-run decisions. Nevertheless, decisions of this type will continue to be made and projections of economic growth will be employed extensively. This widespread need for economic projections multiplies the possibility of unnecessary duplication of effort. In addition to staff research, Government agencies also contract with research organizations for long-run appraisals in connection with resource development projects. Such studies are seldom completely independent jobs. They are often based in large part on Government projections of population or economic growth. Moreover, the contracting agencies must check the reasonableness of projected results.

With several agencies involved in nationwide programs of resource development and extensive private contracting, the number of economic projections could quickly proliferate. The advantages of a uniform general economic projection framework, which might be made a part of cooperative agreements or private contracts, is obvious from the standpoint of cost, efficiency in comparing alternative projects, supervision, and the saving of time. Accordingly, an effort was made to develop such a general-purpose economic projection. A report of the essential assumptions, methodology, and main facets of such a projection for the general economy was prepared at the request of the Economic Task Group of the Interim Water Resources Council.[3]

Very briefly the report concludes that population and the economy will continue to grow in the next four or five decades—probably much as it has in recent decades. A growing and increasingly prosperous population expands the demand for consumer goods and services, both private and public as well as business demand for supporting capital goods. The medium-level projections show a population increase of about 40 percent in two decades. The gross national product approximately doubles and per capita output increases about 50 percent in two decades.[4]

Major Assumptions

Population (P) projections for this appraisal are given in table 2. They were based on Census Bureau projections extended to 2000. The higher level is the Census Bureau No. II projection which, among other things, assumes that fertility rates will continue around the 1955–57 average until

[2] *The Washington Post*, Aug. 18, 1963, "Area Population of 5 Million Predicted by Year 2000," a news article by Jack Eisen.

[3] This group includes representatives of USDA, Department of the Army, Department of the Interior, and Department of Health, Education, and Welfare.

[4] Complete results of this appraisal can be made available on request. The study projects for three economic levels the GNP, employment, hours worked per man-year, total hours worked, output per man-hour, and output per man for agriculture, the private nonfarm sector, the Government sector, and the total economy to the year 2020.

around 1980, then decline to the level of about 1949–51. The lower figure is the Census No. III projection, preferred by some analysts, which assumes that fertility rates would decline gradually to the levels existing in 1940–42.

The labor force (F) follows very closely population growth. However, there are a number of pronounced trends in labor force participation by age and sex groups of the population—toward more women workers, toward fewer workers in the lower age groups, and toward more workers in the higher age groups. These trends result in the labor force making up a fairly stable percentage of the population (table 2).

Employment (L) will reflect, among other things, the rate of expansion in economic activity, trends in hours worked per man, productivity trends, and the size of the labor force. Accordingly, unemployment rates may vary secularly over time as well as cyclically with short-run variation in economic activity. However, with the simple analytical frameworks used for long-run projections, unemployment levels are generally specified by assumption. In general, the projections assume relatively high employment rates; the low projection assumes unemployment at 5½ percent of the labor force, the high 3½ percent, and the middle projection 4½ percent.

Hours worked per man (W) reflect the trend toward more and longer vacations as well as the gradual downtrend in the length of the workweek. For the economy as a whole, average hours worked per man declined at a rate of 0.6 percent per year from 1940 to 1960. For the period 1960 to 1980, the downtrend was assumed at 0.5 percent per year and for the period beyond, around 0.4 percent per year. These projections need not imply a workweek shorter than 30 to 35 hours.

Productivity (R) trends are among the most steady and persistent trends observed in the economy. Output per man-hour or per man is the most convenient and widely used measure of "productivity," loosely defined. Obviously, output per man-hour does not measure the contribution of labor only. The uptrend in output per man-hour, particularly since the 1930's, has reflected a very rapid rise in productivity in agriculture. Trends assumed in this study are directly related to the trends of the past two decades. Specific assumptions for the private nonfarm sector, agriculture, and the total economy are shown in table 3.

TABLE 2.—*Population and labor force, selected years, 1940 to 1960 and projections to 1980 and 2000*

Year	Population [1]	Labor force [2]
	Million	*Million*
1940	132. 1	56. 2
1950	151. 7	64. 7
1960	[3] 180. 7	73. 1
Projected: [3]		
1980:		
Low	247	101
Medium	254	104
High	261	108
2000:		
Low	333	136
Medium	358	147
High	384	159

[1] Projections based on *Illustrative Projections of The Population of the U.S. by Age and Sex: 1960 to 1980,* U.S. Bureau of the Census, Current Population Reports, Series P–25, No. 187, November 1958; and *Population Projections and Economic Assumptions,* Senate Select Committee on National Water Resources, Committee Print No. 5, March 1960.

[2] Based on population growth and labor force participation rates by sex and age groups to 1980 and labor force as a percent of population for 2000.

[3] Includes Alaska and Hawaii.

TABLE 3.—*Productivity trends and assumptions: Annual increase in output per man-hour*

Period	Private nonfarm	Agriculture [1]	Total economy
	Percent	*Percent*	*Percent*
1940 to 1961	2. 35	4. 74	2. 62
1950 to 1961	2. 44	5. 68	2. 60
1956 to 1961	2. 06	4. 94	2. 24
Projected:			
1960 to 1980:			
Low	2. 1	4. 6	2. 3
Medium	2. 3	5. 0	2. 5
High	2. 5	5. 4	2. 7
1980 to 2000:			
Low	2. 1	3. 3	2. 2
Medium	2. 3	3. 4	2. 4
High	2. 5	3. 5	2. 6

[1] Recent rapid increases in output per man-hour in agriculture were extended until they approached and blended into productivity rates for the nonfarm sector around 1990.

Projection Framework

The projected GNP (Y) is the product of employment, hours worked, and productivity ($Y=LWR$). Such projections were built up by major sectors of the economy. Output of farm products reflects primarily the growth in population and the demand for farm products. The moderate in-

crease in projected demand for farm products and the continued rise in inputs of machinery, equipment, fertilizer, and other nonfarm goods and services results in a relatively slow growth in the net contribution of agriculture—about 1¼ percent per year. Given this rise in the gross product of agriculture (Y_a), together with output per man-hour and hours worked per man, it is possible to compute total hours worked and employment in agriculture.

$$\frac{Y_a}{R_a}=L_aW_a \text{ and } \frac{L_aW_a}{W_a}=L_a$$

The Government gross product (Y_g) reflects the assumption that employment in the Government sector would rise at the same rate as total employment for the economy. Employment determined accordingly, together with productivity and hours worked, determines the Government gross national product (Y_g).

The private nonfarm gross product (Y_n) was computed also from projected private nonfarm employment, hours worked, and productivity. Private nonfarm employment is determined as the difference between total employment and projected employment in the agricultural and the Government sectors.

$$L_n=L-(L_a+L_g)$$

This and the projected increase in hours worked (W_n) and productivity (R_n) determine the potential nonfarm gross product.

The gross national product is a comprehensive measure of the economy's output of all goods and services. In 1960 it was more than twice the output in 1940. Major elements in projected growth are compared, on the basis of rates of change, with changes in the past two decades (table 4). Medium growth assumptions result in a growth in GNP of about 3.8 percent per year in the next two decades from 1959–61 when unemployment was relatively high. The same assumptions result in annual growth around 3.6 percent for the period 1980 to 2000 (table 5).

Spending Pattern and Capital Requirements

The gross output projection was roughly split into major expenditures and investment rates. For this purpose the analytical framework reflected relationships of recent years and the economy's legal and institutional framework. These, of course, could change materially in a period of 40 to 50 years. Consumption (C) was defined for this purpose to include consumer expenditures as well as all Government expenditures other than those for construction. Similarly, investment (I) includes private domestic investment and Government expenditures for public construction. Such grouping avoids the determination of "private and public" consumption and investment.

Data fitted for the years 1947 to 1961 indicated an overall consumption function around 0.8, a gross savings rate of 0.2, and an investment multiplier around 5.0. Because of difficulties in defin-

TABLE 4.—*Output, employment, and productivity: Projected medium annual growth rates for selected periods*

Item	1940 to 1960	1960 to 1980 [1]	1980 to 2000
	Percent	*Percent*	*Percent*
Gross national product	3. 87	3. 85	3. 62
Employment	1. 84	1. 87	1. 73
Hours worked per man	—. 61	—. 50	—. 43
Total hours worked	1. 19	1. 28	1. 26
Output per man hour	2. 65	2. 54	2. 33

[1] The base year is the 1959–61 average. Unemployment averaged 5.7 percent of the labor force in this period, while projected rates assume unemployment at 4½ percent. This accounts for the relatively high projected growth in employment and the gross national product from 1960 to 1980.

TABLE 5.—*Gross national product, population, employment, and productivity, 1959–61 and projections to 2000* [1]

[Gross national product in 1954 dollars]

Item	Average 1959–61	Medium-level projection	
		1980	2000
Population—Mil	180. 8	254. 0	358. 0
Labor force—do	73. 1	104. 5	147. 3
Employment—do	68. 9	99. 8	140. 6
Unemployment—do	4. 2	4. 7	6. 9
Gross national product—Bil	438. 9	934	1, 901
Private nonfarm—do	382. 6	836	1, 722
Agriculture—do	21. 6	27	35
Government—do	34. 7	71	144
Gross product per capita—Dol	2, 428	3, 677	5, 310

[1] The GNP projections can be converted to approximate 1962 prices by applying the following price level adjustment: Total GNP×1.174; private nonfarm ×1.156; agriculture ×0.960; and Government ×1.479.

ing Government investment, the consumption function and investment multiplier may be somewhat overstated.

$$Y=C+I$$

$$C=a+bY$$

$$Y=\frac{a}{1-b}+\frac{1}{1-b}I$$

$$Y=25.2+5.2I \qquad r_{12}=0.84$$

And

$$C=4.83+0.808Y$$

$$I=-4.83+0.192Y$$

Consumption and investment spending, projected on the basis of the above relationship, results in annual gross savings and investment spending accounting for nearly one-fifth of total annual output (table 6).

Capital Requirements

Approximations of stocks of fixed capital have been made on the basis of estimated economic service life of assets and annual new investment. The "gross stocks concept" used assumes some acceleration in depreciation of the service life of plant and equipment.[5] A production function for the private nonfarm sector, approximated on the basis of relationships in the postwar years, shows an index of technological change (A) which rises nearly 1½ percent per year during the 1946–61 period.[6] Production elasticities were assumed at 0.3 for capital and 0.7 for labor. The following relationship expresses output as a function of capital and labor inputs shifted upward by technological change:

$$O=AK^kL^w, \text{ where } k=0.3 \text{ and } w=0.7$$

Capital growth in the private nonfarm sector implied by the above production function would rise around 4½ percent per year. Accordingly, projected gross stocks of fixed capital rise to a level

[5] *Survey of Current Business*, November 1962, p. 11.

[6] R. M. Solow, "Technical Change and The Aggregate Production Function," *Rev. Econ. and Statis.*, Vol. 39, No. 3, August 1957, p. 313.

TABLE 6.—*Consumption and investment, 1959–61 average and projections to 2000*

[Billions of 1954 dollars]

Item	1959–61 average	Medium level projection	
		1980	2000
Gross national product	438. 9	934	1, 901
Consumption, total [1]	364. 4	760	1, 541
Investment, total [2]	74. 5	174	360

[1] Consumption, both private and public.

[2] Investment includes gross private domestic, net foreign investment, and public construction.

in 1980 nearly 2½ times the 1959–61 average. This increase in investment and a rise of around 40 percent in labor input, in the above framework, would be roughly consistent with an annual gross product by 1980 a little more than twice the 1959–61 average.

Much of the gain in labor productivity in agriculture reflects increased capital inputs and technological developments. An index of technological change (A_a), computed by the same technique used for the nonfarm sector, increased about 90 percent, or about 4.4 percent per year, from 1946 to 1961.[7] A production function similar to that used for the nonfarm sector was assumed as a basis for appraising possible changes in capital requirements in agriculture.

$$O_a=A_aK_a^kL_a^w, \text{ where } k=0.2 \text{ and } w=0.8$$

These relationships, together with projected demand, output per man-hour, and technological change, suggest that total capital needs in agriculture could decline somewhat, though average investment per farm is expected to continue to rise. A further decline in the number of farms and the possibility of land diversion to other uses should step up efficiency in the use of labor and capital.

[7] See also C. A. Chandler, "The Relative Contributions of Capital Intensity and Productivity to Changes in Output and Income in the U.S. Economy," *Jour. Farm Econ.*, Vol. 44, No. 2, May 1962, p. 340, and L. B. Lave, "Empirical Estimates of Technological Change in United States Agriculture, 1850–1958," *Jour. Farm Econ.*, Vol. 44, No. 4, November 1962, p. 944.

705–703—63——2