LONG-TERM ECONOMIC GROWTH

A New Census Report

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S U M M A R Y

A new Census Bureau report, Long-Term Economic Growth, presents in convenient form the principal annual time series needed by students of economic growth. It is intended to simplify the task of analysts in this field, whatever their explanations of economic growth and standards for judging performance happen to be, by providing a broad base of information related to economic growth and relieving those concerned with theoretical issues and economic policies of a large part of the laborious task of compiling basic data and making computations from them.

The new report provides annual data over a long span of years for each series, often back to 1860. In addition to almost 400 basic time series and almost 800 component series, the report contains numerous charts, growth rate "triangles," and scatter diagrams to facilitate the summarization, analysis, and interpretation of long-term trends in the U.S. economy. This compendium is the third phase of the Census Bureau work on economic fluctuations, which also includes the seasonal adjustment program and Business Cycle Developments.

I. Objectives

The Census Bureau will soon publish a new statistical report, Long-Term Economic Growth. This report is designed to show in convenient form the principal annual economic time series needed by students of economic growth. It represents a response to the increasing interest in expanding economic welfare, both in developed and developing countries; the economic competition among countries with different economic systems; and the establishment of economic growth as a major policy objective of the U.S. Government. It supplements many descriptive studies and causal analyses on this subject that have been prepared in recent years. It is expected to simplify the task of students in this field, whatever their explanations of economic growth and standards for judging performance happen to be, by providing a broad base of information related to economic growth and relieving those concerned with theoretical issues and economic policies of a large part of the laborious task of compiling basic data and making computations from them.

There is, at present, considerable uncertainty regarding the appropriate measures of economic growth, the methods of compiling the measures, and the accuracy of the historical records. While there is some agreement about the factors which affect long-term economic growth, there is less about their quantitative importance. In fact, there is only one comprehensive series of estimates of the quantitative importance of these factors--that by Edward F. Denison. Denison's study has had a major impact on investigations of economic growth, with one of its many contributions being the demonstration of the tenuousness of many of the estimates that are available and the need for more basic information. Another major objective of this Census Bureau publication, therefore, is to encourage and facilitate the development of better estimates by providing a convenient framework for such work and by bringing the statistical gaps out into the open.

Thus we hope that this report will provide an information base that will facilitate judgments on economic performance, aid in the formulation of economic policy to accelerate growth, contribute to development of the theory of economic growth, and point up some of the gaps in the statistical intelligence system.

The objective of this paper is to describe this new report and invite suggestions for improving it. Limited resources and experience have confined this first edition to those data most readily available. For this reason and because of the large task of inspecting and appraising all the series that could have been included, it is recognized that this issue will have to serve as a working document to break the ground and set a pattern for subsequent reports.

Our plan is to issue a revised edition in about a year. Experience with similar new reports indicates that substantial changes may be expected as a result of suggestions made by those making practical uses of such material. We, therefore, welcome the comments and criticisms of those who make use of our report. As in the case of many other Census reports, we expect future issues to be considerably different and more useful.

Before discussing the new report itself, however, I would like to make a few observations on the relations of our seasonality and business cycle work to this new "growth" report.

ACKNOWLEDGEMENTS: During the past two years the technical work for this new Census report has been under the immediate supervision of Allan H. Young, who was assisted by Gerald Donahoe, Norman Bakka and Robert Taylor. The early planning work was under the immediate supervision of Samuel L. Brown, who contributed substantially to the basic organization of the report. He was assisted during this period by James Hines and Judith Faust. Mr. Young also contributed substantially in the preparation of this paper, especially Part III, Problems of Measurement. Murray D. Dessel provided valuable technical advice throughout.

For the many other persons in other Government agencies and private research organizations and universities who also contributed, see the acknowledgements to the Census Bureau publication, Long-Term Economic Growth.

II. The Census Bureau Program for the Analysis of Economic Fluctuations

This new statistical report on economic growth may be considered as the third phase of our research and development work on economic fluctuations, conducted over a period of more than 10 years. The first phase was the development of computer programs for analyzing seasonal, trading-day, and irregular fluctuations in economic time series. The second phase was the development of a set of statistical tools, including Business Cycle Developments, for analyzing intermediate fluctuations lasting from about 3 to 8 years. Each of these three projects should be considered in relation to the others, not as independent undertakings. As a result of this continuing research program, the Census Bureau can now provide facilities for studying nearly all types of economic fluctuations in the United States.

The first of these facilities is our time series analysis program--Census Method II--designed for the intensive study of short-term movements. The latest variant of this program, X-11, has greater generality and scope than any of the earlier programs. It has a separate routine for quarterly as well as monthly series, and for series with negative and positive numbers as well as those with positive numbers alone. The X-11 version not only measures and adjusts for seasonal variations, but also for trading-day variations. Further, it computes many summary and analytical measures of the behavior of each series and includes various techniques--such as spectral analysis, F-tests, and variance analysis--for use in extending the scope of time series studies.

The second of these Census Bureau facilities, our Business Cycle Developments (BCD) report, permits the timely yet comprehensive study of intermediate economic movements. This monthly report brings together several hundred monthly and quarterly "economic indicator" series for the analysis of short-term economic trends and prospects. These particular series have been selected, tested, and evaluated, after half a century of continuing research, as the most useful and reliable for this purpose. The publication not only provides the basic data, but also various charts and analytical tables to facilitate studies of intermediate-term fluctuations. In addition, a time series punch card file, a diffusion index program, and a separate summary measures program are available for those who wish to carry on further research in business cycle analysis.

The third and latest facility is this "growth" report, modeled after BCD, and designed specifically for the study of long-term economic movements. Since the remainder of this paper is concerned with the content of this new report, I shall defer discussion of it for a few moments. Suffice it to say here that the experience we have already had with the Census Method II seasonal adjustment program and with BCD indicates that the new report on economic growth will be widely used by government, business, and research organizations.

The capabilities that have been developed for this "time series analyzer facility" are available to the public in various forms: (a) periodic publication of the basic data required for studies of economic fluctuations; (b) published computer-generated charts and analytical measures which present and summarize conveniently the underlying trends of the basic data; (c) computer programs (written in a simplified computer language, Fortran IV) which permit further analysis of the fluctuations; and (d) data files in the form of punched cards and computer tapes, which provide the statistical raw material for these computer programs and publications.

Taken together, this Census Bureau "system" will help to improve and extend the techniques used by economic analysts in their study and understanding of economic fluctuations. This "system" makes it possible for the academic or business economist, who has a computer available, but not a research staff or programmers, to carry out extensive research in the field of economic fluctuations.

III. Problems of Measurement

Many conceptual and statistical problems beset the measurement of economic growth and analysis of its sources. Some of them are briefly reviewed below. The purpose of this review is only to indicate the nature of the problems and the many uncertainties that now surround them. More comprehensive statements of these problems, the alternative solutions and their implications, especially for data compilation, appear in the references.[1]

1. Concepts for Judging Economic Growth

Economic growth is usually considered to be growth in the output of the economy. Such growth can be measured in terms of output either on a total, a per capita, or a per worker basis, with the choice depending on the problem at hand. Alternatively, economic growth is sometimes defined in terms of per capita consumption or personal welfare. Another alternative view is in terms of changes which take place in the economic and social structure of a nation as it undergoes economic growth, for example, the changes in the rate of population growth and the amount of the labor force in agriculture which a nation about

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[1] For the most part this review is based on more detailed discussions of the same problems in The Sources of Economic Growth in the United States and the Alternatives Before Us, by Edward F. Denison, Supplementary Paper No. 13, Committee for Economic Development, January 1962, and "The Measurement of Aggregate Economic Growth" by George Jaszi, Review of Economics and Statistics, November 1961. Also, see The Study of Economic Growth by Solomon Fabricant, Thirty-Ninth Annual Report, National Bureau of Economic Research, pp. 1-13, May 1959, and Six Lectures on Economic Growth by Simon Kuznets, The Free Press, 1959; and the additional references given in the bibliography to the new Census Bureau publication.

to begin economic development may experience. All the above definitions are directed to the long-term, that is, to the changes or trends which occur over several years, perhaps a decade or longer, and sometimes a century.

2. Definition and Measurement of Output and Related Economic Processes

There are many problems in defining and measuring total output and the other economic activities presented in this report. Some of the principal ones concerning total output are indicated below. Similar problems affect many of the other types of measures presented in the report.

All growth analysts consider real gross national product, as distinguished from money gross national product, as the appropriate measure of output. However, money data are sometimes used as a proxy for data on the physical volume of output because of the difficulties of compiling "real" data, either directly or through price deflation. For the most part data on real output are derived through price deflation. In many areas there is a paucity of actual output data so that physical volume measures cannot be built up directly. This is particularly true for the service industries and government services. Therefore, the indirect way of measuring output is used, that is, dollar volume figures are divided by price deflators. In some sectors where physical volume data are available the advantages of the price deflation method are illusory, because price data are no more abundant nor any more accurate than physical volume data. However, some direct measures of physical volume are included in this report, for example, the Federal Reserve index of industrial production.

Total output as compiled in the U.S. National Income and Product Accounts, prepared by the Office of Business Economics, is the market value of the final output of goods and services produced by the Nation's economy. In addition to the sales of final products to their ultimate consumer, the value of total output includes additions to business inventories and the value of force account construction.[2] The services of housewives and similar nonmarket items are excluded. The effect of this may lead to some overstatement in the long run growth of output since many services which were previously performed in households and excluded from GNP are now included. A similar problem is inherent in international comparisons, where in many countries a larger portion of productive activity occurs outside the market economy than in the U.S.

There is also the point of view, held most notably by Simon Kuznets, that the concept of total output should be less inclusive than that used by OBE. Kuznets defines total output as final output intended to satisfy wants of individual consumers. Under this definition he excludes those government expenditures which represent services to business enterprises and many national defense expenditures.

In addition there are the conceptual and practical problems of taking quality changes into account. While there is general agreement that improvements in product quality should be considered as increases in the quantity of output, quality changes cannot be fully taken into account in practice. It is generally believed that the price deflators do not completely reflect quality changes, since the relative quality of new products must be higher than their relative prices for them to replace the old products in the market place. Consequently, there is a tendency for the rate of growth to be understated in the output measures.

Several related problems may be mentioned. One is that of deflating the output of the construction industry. The present price deflators measure in general the costs of inputs rather than the outputs of the construction industry. The result is generally an understatement of the rate of growth of construction, since productivity increases are not adequately allowed for. Another problem is that the output of government is not directly measured, but is based on compensation of government employees. The deflated value of government output, obtained by adjusting for changes in the government wage level, does not include productivity changes. Similar methods are used to obtain the "output" of domestics and nonprofit institutions. As is well known, GNP is often used in place of net output because of difficult conceptual and measurement problems in arriving at the capital consumption allowance; that is, the amount of capital used up in the production process, especially when the replacement capital embodies newer technology.

Still another problem is that of weighting the components of aggregate output. Since relative prices change over time, the selection of the base year determines the weighting of the various components of national product and affects its trend. Studies show that those output components growing most rapidly tend to show the smallest price increases while those growing least rapidly tend to show the largest price increases. Thus, a recent price base gives greater weight to the slowly growing components than does an earlier price base, and vice versa.

Finally, earlier data are less comprehensive and less accurate than recent data, themselves still subject to important limitations. From 1810 to 1899 industrial censuses were decennial, and from 1899 to 1919 they were quinquennial. Also, relatively fewer data were compiled on activities other than manufacturing in the early years of the period covered by the report and these are

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[2]Also, imputations are made for four nonmarket items. They are: (1) employee compensation received in kind; (2) food and fuel produced and consumed on farms; (3) services derived from owner-occupied residences; and (4) the services rendered by financial intermediaries without explicit charge. The resulting net addition is about 7 percent.

still inadequate in various respects. World Wars I and II and the depression of the 1930's demonstrated the need for more information, and the passage of the Employment Act of 1946 stimulated further interest in statistics and their uses. In addition, the increasing interdependence of economic activities and the growth of the economics and statistics professions led to the development of improved methods of statistical compilation. In many cases the government has taken over the series and methods of private investigators and provided better current statistics through the use of more comprehensive and more accurate underlying data it is able to collect.

In this connection it is to be noted that the effects of estimating errors are reduced as the span of comparison is extended. Thus an error in the figures involved in a comparison, which affects the year-to-year percentage change by 5 percentage points, will affect the average annual percentage change over 50 years by only one-tenth of 1 percentage point. Similarly, the longer the period over which the comparison is made, the smaller the effects of cyclical and irregular factors. Because there may be persistent biases in some measurements of change, however, and because significant differences in trends may take place during a nation's economic history, a single measure of the average long-term trend must be used with caution.

3. Selection of Statistical Indicators

The selection of statistical indicators useful in studying the sources of economic growth is beset with many difficulties. One is that a comprehensive theory of economic growth is at an early stage of development and does not yet provide adequate guidelines. A second is that despite the relative abundance of our statistics, there is a paucity of data in certain key areas. For example, our national wealth data are piecemeal, particularly on the age and efficiency of capital. Also, few data are available on quality of education or quality of labor. A third difficulty is that many of the series available cover only a relatively short span of years. This point is true of our series on capacity (which start in the late 1940's) and research and development (which start in the 1930's).

The series included in this report as measures of the sources of economic growth represent a selection which several experts in the field of economic growth now consider most relevant. To a large extent the selection relies on the list of 31 factors presented by Edward F. Denison which potentially could affect the rate of growth (some to a much greater degree than others). Many of these factors are presented in Parts I and II of the report. Several, however, are not directly presented in this report because data are not available. They include the elimination of several types of institutional barriers to the most efficient use of resources, the increased mobility of labor, the reduction of crime, and an increase in the advance of knowledge.

Some studies emphasize other sources of growth such as the availability and utilization of natural resources and energy; or the intangibles such as the role of the innovator and risk-taker and our method of economic organization, dominated by free markets and competition. In general, series for such additional factors have not been included in this report principally because adequate relevant data do not now exist.

4. Separation of Long-Term Growth from the Business Cycle

Since 1834, the American economy has experienced 31 business cycles from about 3 to 8 years' duration. These cycles have been characterized by alternating periods of expansion and contraction. In addition, there have been four wars with major effects upon the pace of economic activity. The measurement of economic growth and long-term trends in many of the series is greatly complicated by the presence of fluctuations associated with business cycles and the types of irregular movements caused by wars.

For example, from 1919 to 1965, the annual percentage changes in total real GNP ranged from -14.7 to +16.1 a year. These changes primarily represent the year-to-year effect of the business cycle as the economy shifts from high to low level operation or vice versa. Such shifts do not represent growth in output in the sense that we are concerned with in the report. Rather, growth is represented by various types of measures which "adjust" for business cycles and long-term irregular movements. Thus, year-to-year changes in measures of potential GNP, that is, estimates of GNP assuming reasonably full employment, range from -0.2 to 6.5 with most measures concentrated in the interval from 0.1 to 3.9 as can be seen from the table on the following page.

Four techniques are used in our report to show measures of long-term trends as distinguished from cyclical and irregular fluctuations.

(1) Potential GNP estimates made by the Council of Economic Advisers and by the staff of the Joint Economic Committee of Congress (Knowles) are presented. These measures show estimates of GNP assuming reasonably full employment.

(2) A new technique was developed to distinguish rates of change which may be taken as "true" measures of growth from those that are biased from this point of view. This technique, suggested by Denison, is used in the presentation of the growth rate triangles in Part V. The total unemployment rate is used as a measure of how close the economy is operating to its potential output in selecting appropriate years for comparison. Comparisons between years with similar unemployment rates are taken as more valid measures of economic growth than (1) comparisons between years of relatively high unemployment rates and years with relatively low rates, or conversely, (2) between years of relatively low unemployment rates and years with relatively high rates.

Distribution of Year-to-Year Growth Rates in Actual and Potential Real GNP

Interval of percent change	Actual GNP 1909 to 1965		Potential GNP (JEC,Knowles) 1909 to 1964		Potential GNP (CEA) 1952 to 1965	
	No. of measures	Percent	No. of measures	Percent	No. of measures	Percent
All intervals....	56	100.0	55	100.0	13	100.0
-4.0 and lower...	8	14.3				
-0.1 to -3.9.....	8	14.3	1	1.8		
0.0.....	1	1.8	0	0.0		
0.1 to 3.9.....	11	19.6	34	61.8	13	100.0
4.0 to 7.9.....	15	26.8	20	36.4		
8.0 to 11.9.....	6	10.7				
12.0 and greater.	7	12.5				

Note: Source of actual GNP data is OBE for the years 1909 to 1965.

(3) An averaging technique was used to combine annual data into measures of the average level of activity over each business cycle. These business cycle averages then provide the basic data in computing growth rates and in showing the relative importance of geographic divisions and industries in Part III. They minimize the effects of the varying cyclical amplitudes of the geographic divisions and industries. These cycle averages, unlike the comparison of selected years in which the unemployment rates are equal, measure the average level over the business cycle, thus reflecting an "output" rather than a "capacity" concept of growth.

(4) Growth rate comparisons of U.S. geographic divisions and industries and of the U.S. and foreign countries are presented only for long spans where the terminal dates have been picked carefully in order to minimize the effect of cyclical fluctuations. In general, growth rates were computed from one cycle average to another or between years of approximately equal unemployment. In some instances, the standards have been relaxed a little to include comparisons based on the current period which does not include a complete business cycle. Therefore, current comparisons may be influenced more than longer, historical comparisons by the business cycle and other short-term effects.

Although it is highly useful to separate the short-term from the long-term fluctuations in measuring economic growth, as is done in this report, the two types of economic movements are interrelated to some extent. For example, cyclical fluctuations often influence business and government decisions concerning the timing and scope of long-term investment commitments. In the 1930's, they also affected the birth rate with a consequent effect on today's labor force. Likewise, expected long-run increases in economic activity, foreshadowed by such indicators as population, affect the patterns and magnitude of cyclical fluctuations.

5. Selection of Growth-Rate Formulas

A growth rate can be defined as the slope of the trend line of a historical series. A constant rate of growth over a period of years is usually expressed as the "average percentage increase per year." A trend line with a constant rate of growth appears as a straight line on a ratio scale chart. Two widely accepted alternatives for computing such growth rates are (1) the method of selected points, and (2) a linear trend fitted by least squares to the logarithms of the data.

The method of selected points, the most frequently used technique, does not take account of intervening values; it estimates the growth rate by simply connecting with a straight line the logarithms of the beginning and terminal values of the period of years considered.[3] It is not influenced by the particular pattern of cyclical variations which occur between the initial and terminal years.

A linear trend fitted by least squares to the logarithms of the data minimizes the sum of the squared deviations of the logarithms of the data from the logarithms of the trend and equates the sum of the logarithms of the data with the sum of the logarithms of the trend. Thus, it is influenced by the particular pattern of cyclical variations between the initial and terminal years.

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[3] The trend line is given by the compound interest rate formula which in logarithms is $\log X_t = \log X_1 + n \log (1 + r')$ where X_1 is the initial value and X_t the terminal value of the series, n is the span of years, and $r = r' \times 100$ is the percentage rate of growth. To calculate the rate of growth the formula is rearranged $r = (\sqrt[n]{X_t/X_1} - 1.0) \times 100$.

There are several alternatives to the more common technique described above of fitting a linear trend to the logarithms by least squares, which involve fitting an exponential curve directly to the data themselves. The advantage of these alternatives is that they equate the sum of the data with the sum of the trend values rather than with the sums of the logarithms (sums are more meaningful for economic data than products, i.e., sums of logarithms). However, the results are usually quite similar to those obtained by the standard technique. [4]

In estimating growth rates, the time period to be covered should be carefully selected. If the period is too short, say 5 to 10 years, the estimated growth rate may be greatly influenced by transitory conditions in the economy. In such instances, the estimated rate will not actually represent the long-term trend of the series. On the other hand, a growth rate can be computed over too long a period. The path of development of some series over long periods cannot be approximated by a trend line representing a constant percentage rate of increase. In such cases, it may be more meaningful to compute growth rates for various sub-periods or to fit a trend line which does not have a constant rate of growth. In addition, the time period should be selected in such a way that short-term cyclical fluctuations do not bias the calculated growth rate, particularly for a relatively short period where the effect of the business cycle may be large.

Trend lines for GNP in the U.S., derived by various methods of computing growth rates, are shown for selected periods in Chart I of this paper.

It seems appropriate to close our section on Problems of Measurement with a quotation from Simon Kuznets, an outstanding authority in this field:

". . . the conceptual and other difficulties of measurement do not justify the refusal to measure and the substitution of a cavalier treatment of uncontrolled impressions . . . for the strenuous task of empirical corroboration and testing. Despite the limitations resulting from a scarcity of basic, underlying data and from concepts that are outmoded because of a serious cultural lag, much can be learned by a determined scrutiny of the data--provided that one looks at them with significant questions in mind and is sufficiently familiar with the characteristics of both the data and the underlying processes. Whatever mistakes one may make in the process--and they will be many--can at least be corrected by others; cumulative improvement and learning are possible so long as the data are mobilized to serve as a basis of one set of generalizations and as a check on another." */

IV. Description of the Report

1. General Plan

Long-Term Economic Growth brings together almost 400 aggregate annual economic time series and almost 800 additional component series that seem useful for this purpose. The report carries each series far back in history--sometimes to 1860--and will update them in subsequent editions. Future issues will also incorporate all revisions of source data as they become available. The adequacy and appropriateness of particular series are undergoing a continuing review by the Census Bureau research personnel, in consultation with specialists in the field of long-term economic growth. It is expected that new series will be added to future editions, while some of the present group may be dropped after further review. Annual publication is planned until the expected suggestions of users are incorporated and the report is stabilized in this sense. Subsequently, less frequent publication may suffice.

The report is organized into five major parts. The first part presents about 150 annual time series, measuring aggregate output, input and productivity. These are the basic measures of economic growth.

First, various measures of the growth of actual output of goods and services along with measures of potential output are presented. These are followed by measures of the growth of inputs of various human and material productive factors. The input measures indicate the changing levels of economic resources which have been used, or are available, over the time period covered. Finally, measures of productivity, obtained simply by dividing the volume of output by the number of units of input, are presented.

The second major section covers economic processes importantly related to economic growth. In some cases the relation to economic growth is clear. This is true for the series on education, health, and research and development. Other series

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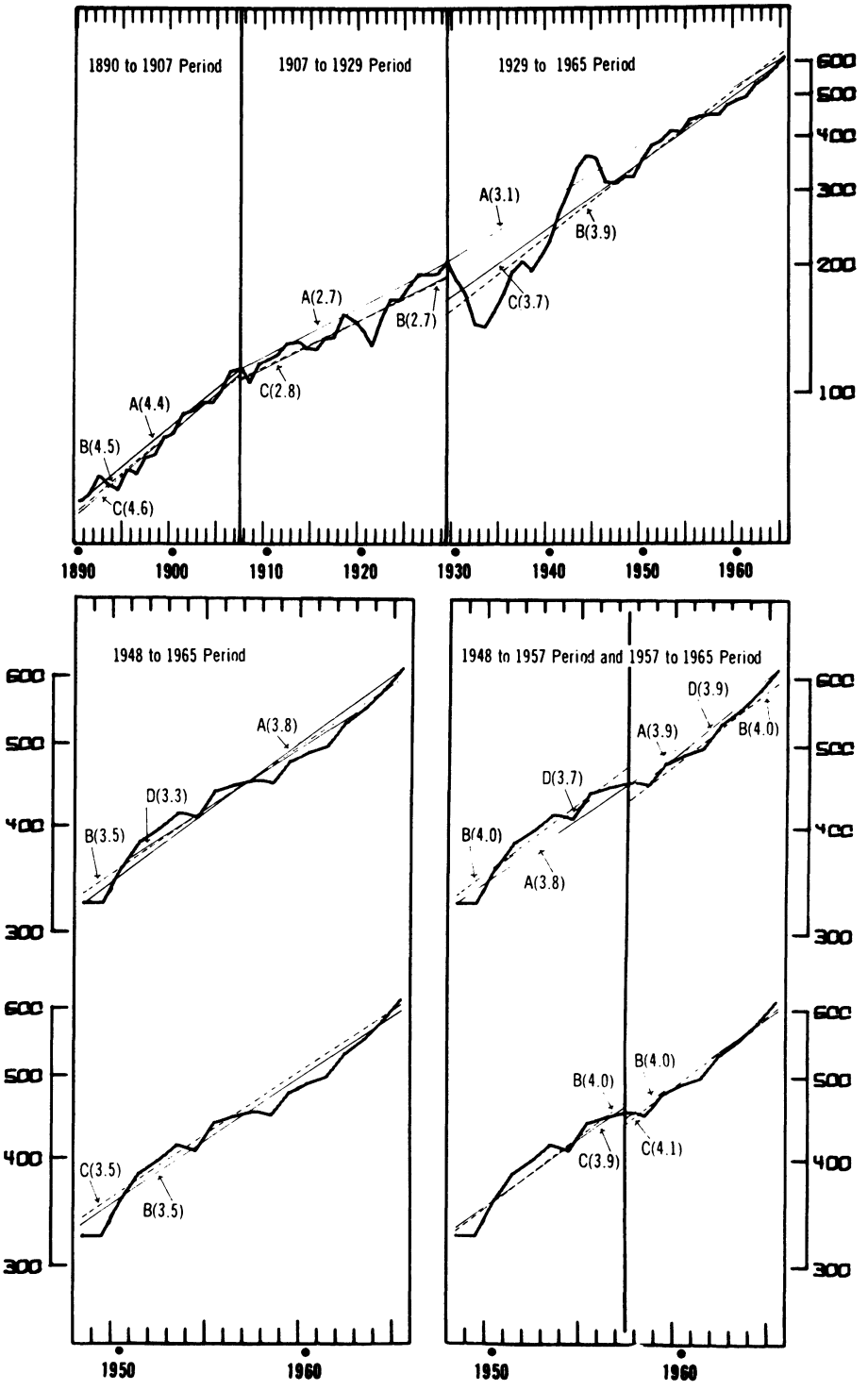
[4] Two methods of fitting an exponential trend to the actual data are discussed by Neville L. Rucker and Dudley J. Cowden in Tables for Fitting an Exponential Trend by the Method of Least Squares, Technical Paper 6, University of North Carolina School of Business Administration. Other procedures for fitting an exponential trend directly to the data are described by Boris P. Pesek in "Economic Growth and Its Measurement," Economic Development and Cultural Change, Vol. IX, No. 3, April 1961.

*/ Simon Kuznets, Six Lectures on Economic Growth, The Crowell-Collier Publishing Company, 1961.

Chart 1

COMPARISON OF ALTERNATIVE GROWTH RATE FORMULAS, U.S. GNP, 1890 TO 1965

Charted below are the trend lines fitted by four alternative growth rate formulas. The growth rates are shown in parentheses after the letters designating the formulas.



A. Trend line calculated using initial and terminal years of annual data as selected points.
B. Trend line calculated by fitting an exponential equation to logarithms of annual data.
C. Trend line calculated by fitting an exponential equation to annual data -- Pesek.
D. Trend line calculated using initial and terminal business cycle averages as selected points.

represent background economic activities which certainly affect long-term economic growth, though how is less clear. These include data on prices and interest rates, savings and debt, the assets of financial institutions, the balance of payments, and monetary gold stock. The measures of the intensity of utilization of labor and capital resources and of the magnitude of seasonal and cyclical forces which are also included in this section, provide quantitative information which furnishes a perspective against which the measures of long-term growth can be better appraised.

In the third section are measures below the aggregate level which can be used to understand and interpret economic growth more effectively. Both regional and industry series are shown.

The fourth section shows measures of output, input, and productivity for six foreign countries. The countries are United Kingdom, Canada, West Germany, Italy, France, and Japan.

Various analytical aids are included in Section V and the appendixes: (1) Growth triangles, which make it possible to compare growth rates in the United States for any pair of years between 1890 and 1965, for GNP, manhours, and productivity. Criteria are provided to help in making judgments regarding the comparability of any two years used in the comparison. (2) A growth rate conversion table, which facilitates similar computations for the many other series in which the user may be interested. To use this table all that is needed is the ratio of the values for last and first years to be compared. The growth rate can then be found in this table. (3) Basic data and brief descriptions with references to more detailed explanations.

Since growth is essentially a long-term phenomenon, it cannot be considered in terms of developments since last year, the year before, 5 years ago, or perhaps even 10 years ago. Consequently, data in this report go back many years, wherever possible, to 1860.

In order to observe such long-term trends, we have had to build up series from different sources. Official Government series on gross national product extend back only to 1909 and the components only to 1929. However, various research students, particularly those at the National Bureau of Economic Research, have provided estimates extending back to the beginning of the industrial history of the United States, and these have been brought together with corresponding official government figures. Even when they are intended to measure the same thing, these series, being estimates, are often somewhat different. In addition, since different investigators were involved, there are some differences in concepts. Thus the series are not strictly comparable. In order to indicate the extent of differences, an overlap of about 10 years is provided, and a detailed description of each series and references to the author's original discussion are given in the descriptive appendix.

For this first edition we have not been able to consider data prior to 1860. We may do so for the next issue.

2. Aggregate Output, Input and Productivity

Altogether 58 output series are included in the first section. Gross national product data are used to measure output throughout this report, because of the difficulties of taking out depreciation. However, a single series on national income is shown so that we do not lose sight of the fact that this is the more ideal measure. Then some of the principal breakdowns of gross national product are presented--e.g., the gross private domestic product, gross nonagricultural product, gross manufacturing product, gross farm product, personal consumption expenditures, gross private domestic investment, and so on. Series on industrial production and personal income are also included. Finally, various income distributions are provided.

Next we turn to the input factors. These are viewed in broad terms and cover the supply and utilization of labor and capital. Two basic sets of total input estimates are available, one prepared by the National Bureau under the direction of John Kendrick and the other prepared by Edward Denison. The principal difference is that Denison allows for changes in the quality of labor. Unfortunately, the record for these series is not so long as that for output. Kendrick has decade estimates for 1869-78 and 1879-88, and then provides an annual series beginning in 1899. His series extend only to 1957, but we understand that he will bring these series up to date in the not too distant future. Denison's series start in 1909 and extend only to 1958.

In addition to these comprehensive measures of input, separate series for labor and capital input are also shown, not only at the aggregate level, but also for major components. Thus, series for total private manhours as well as manhours in nonagricultural, manufacturing, and agricultural industries are shown. Similar breakdowns are also shown for total employment. An occupational distribution of the labor force shows on a percentage basis the number of farm workers, manual workers, and white collar workers. Lebergott's early series for the labor force are included along with recent BLS data. Next, total population, the farm and nonfarm population, and the age distribution of the population are shown. These are followed by series for the birth, death, and immigration rates. Finally, Goldsmith's estimates of the civilian tangible wealth and many of its components (for example, the net reproducible private business wealth, the net stock of private residential nonfarm structures, and the stock of private inventories) are shown. The estimates available from the Office of Business Economics for the stock of fixed business capital, on alternative service lives, and business depreciation schedules for the period 1929-61 are

also included.

The final part of the first section shows indexes of productivity. Here are included Kendrick's and Denison's series on output per unit of total input and details for labor input and capital input. These are followed by various series on output per employee and output per man-hour.

3. Economic Processes Importantly Related to Economic Growth

The next section of this report presents measures of processes that appear to be strategic in determining the rate of productivity, that is, the factors which explain why output has grown more rapidly than input. Many scholars in this field hold the view that it is not a matter of one, two, or even three key factors, but rather that a large number of different factors have been responsible for the high productivity in the United States. Unfortunately, data are not available for many of them, and we are able to present information for only a few of the most strategic--in particular, education, health, and research and development. For education, such series as school enrollment, the average length of the public school term, and total expenditures in the education system are shown. Improvements in health represent another way of expanding the input of human resources, both in terms of quantity and quality. Under health, there are data for public expenditures for medical research, days lost by employed persons due to illness, and average life expectancy at birth. Research and development has increasingly been looked to as a way of improving the quality of capital; for this area, data on funds for scientific research and development, and applications for patents are given.

This section also includes a large number of series which provide a broad background of information which is helpful in making judgments of past and prospective performance. These include data on the money supply, both narrowly defined to include currency and demand deposits and broadly defined to include also time deposits. Two series on the velocity of the money supply are also shown here. Prices of commodities, money, and equities are included; and the implicit price deflators for total GNP and its major components. Series on profits, savings, the balance of payments, and the monetary gold stock follow.

Third, data on the utilization of resources, both of labor and of capital, which show how close to capacity the economy actually operated in particular periods of our history, and measures of the magnitude of cyclical fluctuations are also given here. These data are expected to contribute to good judgments about the validity of growth estimates over various time periods.

4. Regional and Industry Trends

The presentation up to this point is at the aggregate level and provides some relatively simple guidelines of overall performance. It is commonly recognized, however, that an aggregate is only a convenient summary of a large variety of activities that take place below this level, and detailed inspections of the pattern of events beneath is required for a thorough appreciation of factors affecting economic growth.

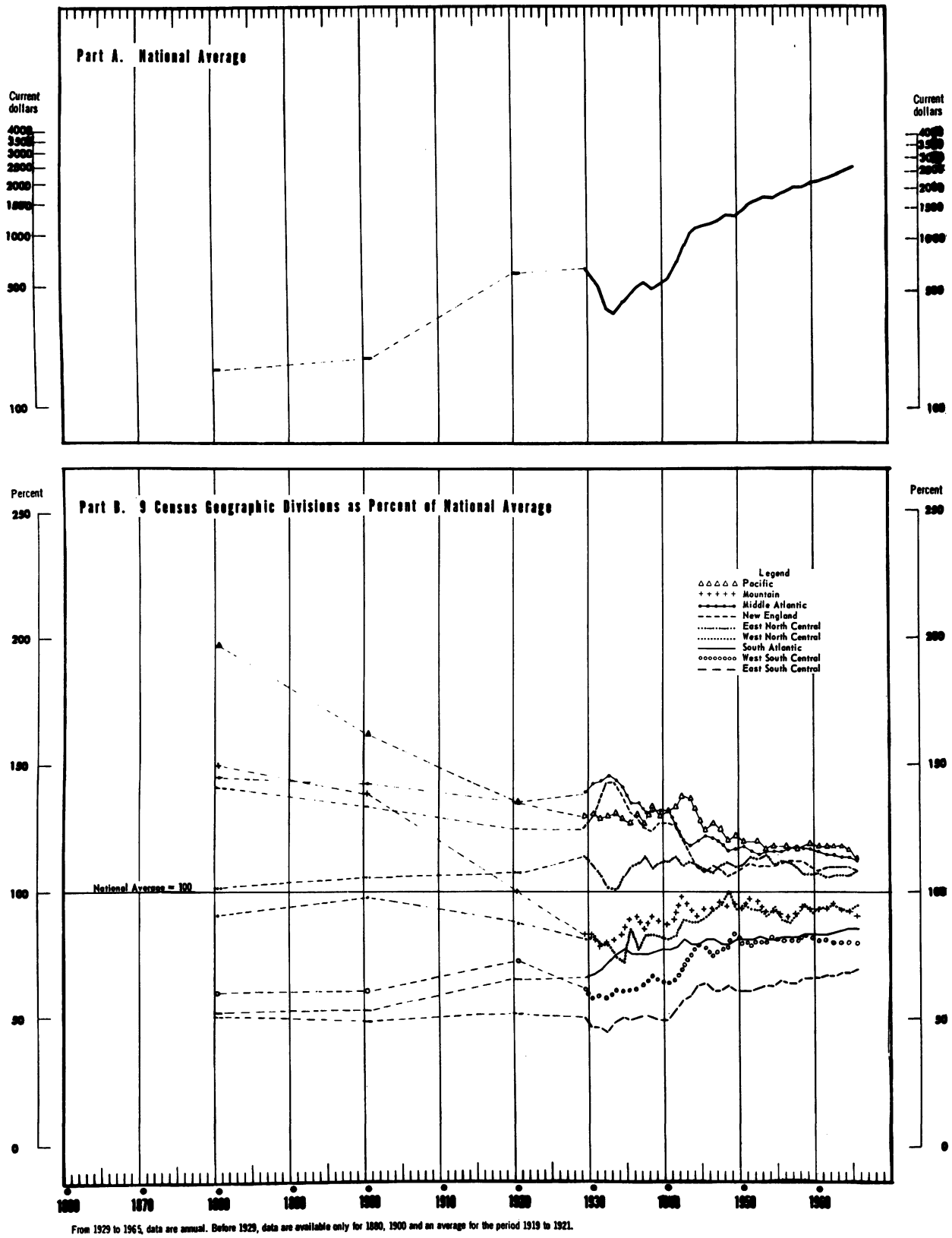
There are, of course, great volumes of U.S. data for regions and industries. To provide all such information in detail would swamp this whole report. Therefore, in order to bring out the principal regional and industrial developments without taking an undue amount of space in this volume, two presentation techniques have been employed in the third section of the report:

The first is the familiar method of plotting all the data for all the regions on the same time scale, and such charts for the 9 Census Geographic Divisions are shown for several measures including population, per capita personal income, and value added per employee in manufacturing. To indicate the relative importance of the development of the different geographic divisions, however, the data for each are shown as a percentage of the national average. As a result, most of the charts are quite similar to that illustrated below (Chart II) for per capita personal income, with fairly broad gaps among the divisions in the earlier periods of our history, 1880 and 1890, gradually being narrowed over the years until they are fairly close together now.

The second technique is a special type of scatter diagram. Here the growth rate for one period is plotted against the growth rate for another. For example, the growth rate for each State and Census Division for the period from 1929 to 1965 (vertical scale) is plotted against the growth rate for the period from 1880 to 1929 (horizontal scale). In this kind of chart the national average for the latter period is shown as a line drawn parallel to the horizontal scale, and the national average for the earlier period as a line drawn parallel to the vertical scale. For States falling in the area above the diagonal, the recent growth rate has been greater than the earlier growth rate. For States (or Divisions) shown in the upper left-hand boxed-off portion of the chart, the recent rate of growth has been greater than the national average in the recent period and below the national average in the early period. For States falling in the upper right boxed-off portion, growth rates were above the national average both in the recent and early periods. States shown in the lower left-hand portion were below the national average in both periods. States shown in the lower right-hand portion were below the national average in the recent period, but above in the early period. Thus this chart shows that, on a per capita basis, Florida, North Caroline, Texas, and West Virginia fared well in both periods. South Carolina, Arkansas, and Georgia did especially well in the recent period, but not so well in the early period. California was below the national average in both periods. In considering this statistic, it is to be borne

Chart II

PER CAPITA PERSONAL INCOME, UNITED STATES AND 9 CENSUS GEOGRAPHIC DIVISIONS, 1880 TO PRESENT



From 1929 to 1965, data are annual. Before 1929, data are available only for 1880, 1900 and an average for the period 1919 to 1921.

in mind, of course, that it is the changes which have been plotted. In terms of the level of per capita income, California, of course, rates very high.

Similar charts are shown for other comparison periods and for the various manufacturing industries. Thus, our chart for the manufacturing industries will show that, compared to total GNP, the best growth record since 1948 has been for the transportation, communication, and public utilities industries; the services industries; and the finance, insurance and real estate industries both since 1960, and also from 1948 to 1960. Construction has done relatively poorly. Among the individual manufacturing industries the recent record of the chemical industries, electrical machinery, and rubber is especially good.

5. International Comparisons

The interest in economic growth has come to the fore in recent years partly because of the greater awareness of the importance of this factor in determining the welfare of our own population and in resolving many of the difficult social problems affecting the poor, but also because economic growth has become an international issue. Thus accelerating economic growth has become a principal objective of economic policy in many of the under-developed countries. Adversary nations have pointed with pride to their rapid rates of economic growth and challenged our economic system to demonstrate that it can match theirs. In addition, the relatively poor economic performance in the U.S. during the later years of the fifties and the first few years of the sixties, compared to economic performance in Japan, Germany, France, and other Western nations, has been a cause of considerable concern here, and led to a careful re-examination of our own economic policy. For these reasons, a section showing the rates of growth in the United States and the principal industrialized countries with which we trade is included--United Kingdom, Canada, West Germany, Italy, France, and Japan. The number of countries covered in this section has been limited partly because fewer historical data are available for foreign countries than for the United States, partly because there are serious problems of comparability, and partly because of our own staff resources. In later editions we hope to add other countries to this section.

6. Analytical Measures

In this publication we depart from the more familiar types of statistical publications in several respects. First, the basic data are supported by computer-generated charts. Today charts are, of course, a common feature of many statistical publications. The fact that they are computer generated means that they can be used in much larger quantities. Indeed, they have become the primary method of presentation with tables occupying a relatively minor role. Most charts in this new publication are the familiar time series charts. Others are special types of charts, such as the scatter diagrams which provide a great deal of information in a small amount of space.

But, in addition to charts, we have included special "analytical" tables to facilitate studies of economic growth. The first of these are growth triangles. Growth triangles, now a familiar tool in growth presentations, show the same years along the horizontal and vertical scales. The growth rate between any two years can be found at the point of intersection between two lines perpendicular to the dates. Thus it is possible to find growth rates in GNP for any pair of years from 1890 to 1965 in our first growth triangle.

We have also introduced a new type of criterion, suggested by Edward F. Denison, in this table. Because of differences in the extent to which resources are utilized, or in other words, differences in the stage of the business cycle, every pair of years is not comparable from the point of view of measuring economic growth. For instance, the growth rate computed from a business cycle trough year to a business cycle peak year will be higher than the true rate of growth. Similarly, if we start with a business cycle peak year and end up with a business cycle trough year, the growth rate computed between these two years will be lower than the true rate of growth.

A measure that would be suitable for this purpose would be percent of total capacity with appropriate comparisons being those periods in which the economy operated at about the same rate of capacity. But such data are not available. The unemployment rate may be considered a measure of the extent to which the labor force is utilized and, therefore, when inverted, can serve as a proxy for a measure of capacity operation. Since data on the unemployment rate are available back to 1890, it has been used to call attention to those spans of years that will result in biased growth rates and to indicate years that are essentially comparable. Growth rates between years for which the unemployment rate is about the same are printed in black on a white background. Growth rates for which the unemployment rate in the initial year exceeds the rate in the terminal year are printed in black on a shaded background; these growth rates are likely to be greater than the true rate of economic growth. Growth rates for years in which the unemployment rate in the terminal year exceeds that in the initial year are printed in brown on a shaded background; for these the growth rate shown is likely to be less than the true rate of economic growth.

Two different standards have been used in preparing these tables. In one case we have had fairly exacting standards and in another more relaxed standards. Consequently, 13 percent of the 2850 possible comparisons in the first table show growth rates which are comparable under our assumptions. In the table with the more relaxed standards, 35 percent of the 2850 possible comparisons show growth rates that are comparable under our assumptions. In addition to these two growth triangles for GNP, there are also included growth triangles for total manhours and gross private product per manhour. In these four tables the compound interest rate formula is used to compute the growth rates between the initial and

terminal year. As an alternative the growth rate computed with a linear trend fitted to the logarithms of the data is shown for total output.

One of the principal requests made by those who reviewed earlier editions of our new report was for more growth rate triangles. Since these are very space consuming and we could have had one for just about every series in the book, we sought a simple way of meeting this interest without unduly expanding the volume. Our solution was the preparation of a growth rate conversion table. Here the familiar compound interest rate table is modified so that the user no longer has to interpolate between tabled values. To use this new type of table, three simple steps are necessary: to (1) compute the ratio of the value in the later year to the value in the earlier year; (2) check the stub of the table to find the number of years over which the comparison is being made; and (3) search on that line for the two values between which this ratio falls. The rate of growth is then given on the top row between these two values. For example: GNP was $452.5 billion in 1957 and $614.4 billion in 1965. The ratio of 614.4 to 452.5 is 1.35779, and the number of years spanned from 1965-1957 is 8. The average annual growth rate is then found by locating the interval within which 1.35779 falls on the 8-year horizontal line, i.e., 3.9%.

This table covers 70 years and the growth rate is shown to one decimal. We have also prepared, and can make available on a cost basis, similar tables showing the growth rate to two decimal places or growth rates above the 10% limit in the present table. In addition we have provided a formula for computing growth rates for periods longer than 70 years but less than 140.

The growth rate conversion table is useful for computing the growth rate for any series between any pair of historical years. For extrapolating growth rates we have also provided a standard compound interest rate table for periods from 1 to 20 years. More detailed compound interest tables can be obtained from other sources.

V. Long-Term Projections

The report to be published next month is a statistical history of economic growth in the United States. Such a history is of interest for its own sake, but the information it presents also may reveal important knowledge that can be helpful in stimulating growth in future years. A related use of these data is to provide the basis for forecasts of future growth in the U.S. These in turn are helpful in a large variety of necessary long-range planning projects, such as the aggregate demand for goods and services, urban development, transportation facilities, educational requirements, and so on.

To close this paper, I thought it might be helpful to provide one illustration of how this new report can be used by presenting a few representative long-term projections.

Chart III and Tables 2 and 3 show two types of projections of GNP to 1980. First are analytical projections, which attempt to allow explicitly for factors that may affect future economic growth. They have been prepared by various Government agencies and private planning organizations.[5]

Two major assumptions underlie all these analytical projections: (1) there will be no deep or prolonged depressions, and (2) the unemployment rate will fall in the range 4.0 to 4.5 percent in the terminal year.

The second type are "naive" projections, which assume that the trend of a given historical period will continue into the future. They do not take into account in a systematic way prospective policy changes and structural shifts in the economy, and for this reason are not forecasts in an economic sense. But they do provide a broad perspective for judging future prospects. At a minimum they provide a standard against which analytical projections can be judged, by establishing a range within which an analytical projection would be expected to fall, if past conditions do not change much. Conversely, the "naive" projections can help to indicate the impact of any major change in past conditions assumed in preparing an analytical projection.

The figures used to make up these projections are provided in Tables 2 and 3 and, in addition, corresponding projections for labor input and productivity are shown. First, an observation about the relations between the analytical and "naive" projections--the "naive" projections fall over a wider range than the analytical projections. If our recorded history is used as the basis for projecting, the range of possibilities in the future would appear to be greater than if the analytical projections are used. Most experts believe the analytical projections will prove to be more accurate than the "naive" projections. One reason is some of the underlying conditions, particularly the future population of working age, can be fairly accurately estimated on the basis of the present population. The "naive" projections implicitly allow for more variation because the population of working age has grown at different rates in different historical periods. However, we have learned from experience that it is very difficult to make accurate projections. One danger of the analytical projections is that most forecasters are heavily swayed by the conventional wisdom of the day, and base their work on similar assumptions. This may be part of the explanation why the range is smaller than that of the "naive" projections.

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[5]The Government agencies are the Council of Economic Advisers and Joint Economic Committee of Congress and the non-Government agencies are the Committee for Economic Development, National Planning Association, Resources for the Future, McGraw-Hill, and National Industrial Conference Board.

Chart III

GROSS NATIONAL PRODUCT IN 1965 DOLLARS PROJECTED TO 1980

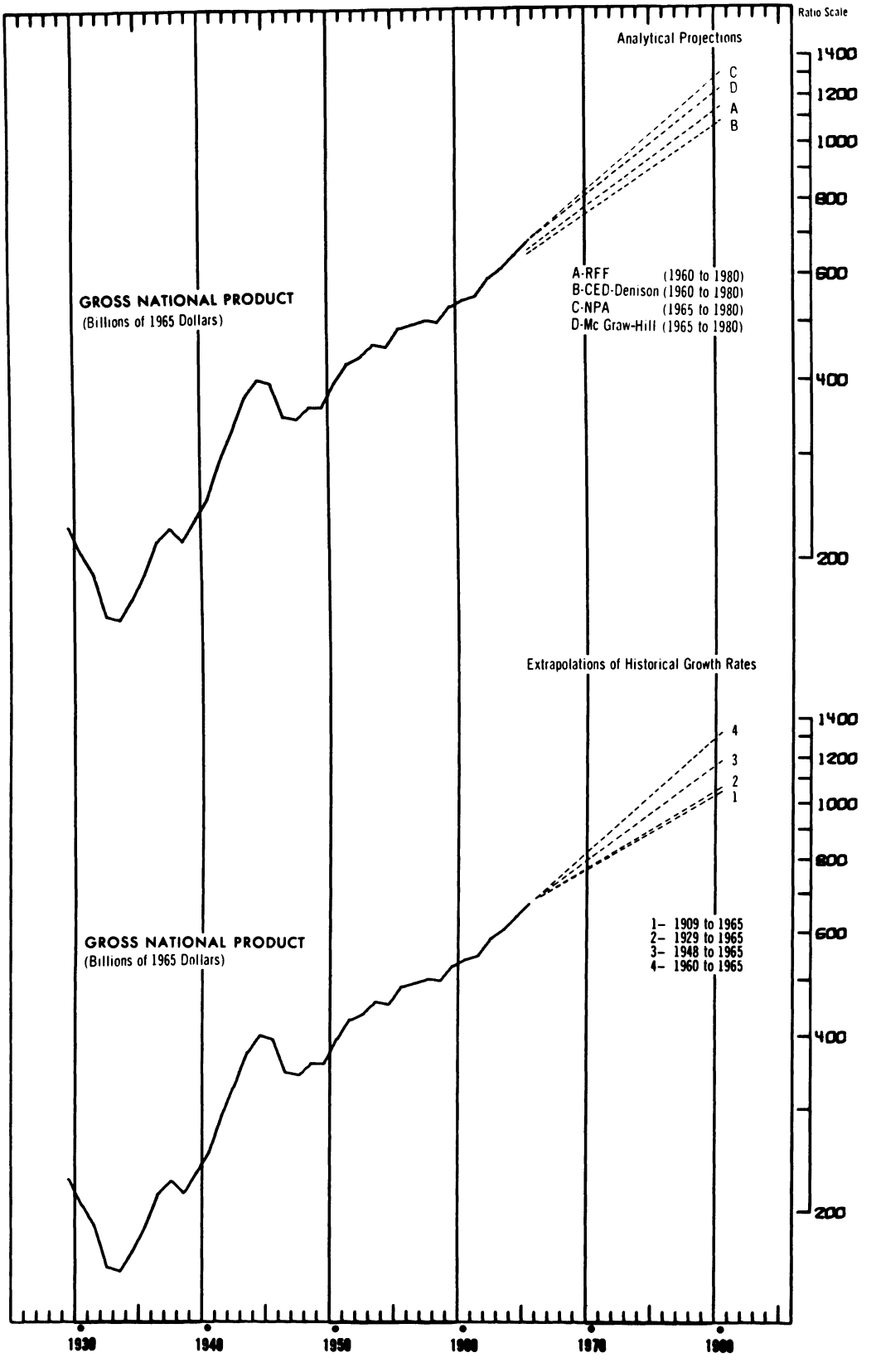

Table 2.--Analytical Projections to 1975 and 1980 Compared With Historical Growth Rates

PART A.--Analytical Projections -- Average Annual Growth Rates

	CEA 1964 to 1970	CED-Denison 1960 to 1975	CED-Denison 1960 to 1980	JEC-Knowles 1959 to 1975	NPA 1965 to 1975	NPA 1965 to 1980	RFF 1960 to 1980	NICB 1964 to 1975	McGraw-Hill 1965 to 1980
Total Labor Force.....	1.7	--	1.7	1.7	1.8	1.7	1.7	1.8	1.7
Total Employment.....	--	--	1.68	1.7	1.9	1.8	1.8	1.9	1.9
Average Weekly Hours									
Private.....	--	--	--	--	-0.4	-0.4	-0.3	-0.4	--
Total.....	--	--	-0.53	-0.5	-0.4	-0.4	--	-0.4	-0.5
Man-Hours									
Private.....	--	--	--	--	1.3	1.2	1.1	--	--
Total.....	--	--	--	1.2	1.5	1.4	--	1.5	1.3
Output Per Man-Hour									
Private.....	--	--	--	--	3.3	3.4	2.7	3.0	--
Total.....	--	--	--	3.5	3.0	3.0	--	2.8	2.75
Output									
Private.....	--	--	--	--	4.7	4.5	3.8	--	4.1
GNP									
[1]Actual.....	4.7	3.55	3.52	4.7	4.5	4.4	3.8	4.35	4.1
[2]Potential.....	4.0	3.30	3.33	4.0	4.3	4.3	--	--	--

PART B.--Historical Average Annual Growth Rates

	1909 to 1965	1929 to 1965	1948 to 1965	1960 to 1965
Total Labor Force.....	1.4	1.3	1.3	1.4
Total Employment.....	1.4	1.3	1.3	1.6
Average Weekly Hours				
Civilian.....	-0.4	-0.5	-0.3	0.0
Total (NPA).....	-0.5[3]	-0.5[4]	-0.4	-0.1
Man-Hours				
Private.....	0.6	0.3	0.5	1.3
Total (NPA).....	0.9	0.6	0.9	1.6
Output Per Man-Hour				
Private.....	2.3	2.7	3.4	3.5
Total (NPA).....	2.1	2.5	2.9	3.1
Output				
Private.....	2.9	3.1	3.9	4.9
GNP.....	3.0	3.1	3.8	4.7
Per Capita Disposable Income (1965 $).....	--	1.6	2.1	3.3
Industrial Production (Index: 1957-59 = 100).....	3.8	3.7	4.4	5.7

[1]Four percent unemployment rate assumed in terminal year, except for NICB which assumes 4.5 percent.

[2]Potential defined as the GNP which would be produced if unemployment were 4.0 percent in initial and terminal year.

[3]Initial year is 1910.

[4]Initial year is 1930.

Table 3.--Levels in 1975 and 1980 Implied by Analytical Projections and by Extrapolation of Historical Growth Rates

(The levels shown below were calculated by extrapolating the currently published data with the growth rates shown in Table 2. For Part B the extrapolations were made from 1965 and for Part A from the years enclosed in parenthesis.)

PART A.--Analytical Projections

	1965 Value	1975				1980			
		JEC Knowles (1959)	CED Denison (1960)	NPA (1965)	NICB (1964)	RFF (1960)	CED Denison (1960)	NPA (1965)	McGraw-Hill (1965)
Total Labor Force (thousands).	78,357	94,220	--	93,930	93,000	102,445	102,445	101,400	101,400
Total Employment (thousands)..	74,901	89,226	--	90,280	89,000	98,862	96,557	97,500	94,900
Average Weekly Hours									
Private (hours)(NPA).....	38.86	--	--	37.28	--	36.8	--	36.52	--
Total (hours)(NPA).....	38.69	35.8	--	37.17	36.7	--	35.0	36.43	35.5
Man-Hours									
Private (index: 1965=100)...	100.0	--	--	113.7	--	116.6	--	118.8	--
Total (index: 1965=100)(NPA)	100.0			115.8	117.6	--	--	122.6	121.6
Output Per Man-Hour									
Private (index: 1965=100)...	100.0	--	--	139.0	138.4	144.8	--	164.1	--
Total (index: 1965=100)(NPA)..	100.0			134.4	135.5	--	--	155.8	150.2
Output									
Private (index: 1965=100)...	100.0	--	--	158.0	--	168.0	--	194.9	--
GNP (index: 1965 = 100).....	100.0	162.9	135.0	155.6	159.3	168.7	159.8	191.0	--
GNP (bil. of 1965 $).....	681.2	1101.4	913.0	1057.9	1027.5	1140.6	1080.6	1299.5	1244.6

PART B.--Extrapolation of Historical Growth Rates

	1965 Value	1975				1980			
		1909 to 1965	1929 to 1965	1948 to 1965	1960 to 1965	1909 to 1965	1929 to 1965	1948 to 1965	1960 to 1965
Total Labor Force (thousands).	78,357	90,045	89,160	89,160	90,045	96,526	95,108	95,108	96,526
Total Employment (thousands)..	74,901	86,073	85,228	85,228	87,786	92,269	90,913	90,913	95,037
Average Weekly Hours									
Civilian (hours).....	40.5	38.9	38.5	39.3	40.5	38.1	37.6	38.7	40.5
Total (hours)(NPA).....	38.69	36.81	36.81	37.18	38.31	35.90	35.90	36.44	38.11
Man-Hours									
Private (index: 1965=100)...	100.0	106.2	103.0	105.1	113.8	109.4	104.6	107.8	121.4
Total (index: 1965=100)(NPA)	100.0	109.4	106.2	109.4	117.2	114.4	109.4	114.4	126.9
Output Per Man-Hour									
Private (index: 1965=100)...	100.0	125.5	130.5	139.7	141.1	140.6	149.1	165.1	167.5
Total (index: 1965=100)(NPA)	100.0	123.1	128.0	133.1	135.7	136.6	144.8	153.5	158.1
Output									
Private (index: 1965=100)...	100.0	133.1	135.7	146.6	161.3	153.5	158.1	177.5	204.9
GNP (index: 1965 = 100).....	100.0	134.4	135.7	145.2	158.3	155.8	158.1	175.0	199.2
GNP (bil. of 1965 $).....	681.2	915.5	924.4	989.1	1078.3	1061.3	1076.8	1191.9	1356.7
Per Capita Disposable Income (1965 $).....	2411	--	2826	2968	3336	--	3059	3293	3924
Industrial Production (Index: 1957-59 = 100)	143.3	208.1	206.1	220.4	249.5	250.7	247.1	273.4	329.1

The sources of the projections shown in Tables 2 and 3 are shown at end of text.

To consider some of the prospects, I have selected three different projections. One is the highest among them, the other is one of the lowest among them and the third is the median. These all turn out to be "naive" projections, but similar conclusions could be drawn from the analytical projections.

The implications of the recent improvement in economic growth and stability are staggering to the imagination. A continuation of recent trends will carry us to unbelievable levels of economic activity in our own lifetimes.

The divergence of these various curves as they approach 1980 indicates how important relatively small difference in annual growth rates can be when cumulated over longer periods of time. However, even if we repeat the experience since 1929, one of the slowest growth rates projected, we shall have by 1980 a 58 percent growth in gross national product in constant dollars and 27 percent growth in per capita disposable personal income. A continuation of the record since 1948 will yield an increase of about 75 percent in GNP and 35 percent in per capita disposable income. If we have, indeed, conquered the business cycle, we shall do far better. The increase in gross national product in constant dollars will be almost double and the increase in per capita disposable personal income about 60 percent. Industrial production could increase even more rapidly, 70 percent on the most unfavorable assumption and 130 percent on the most favorable. It seems most unlikely, however, that consumers would want to take so much of their increased income in terms of goods. What would we do with all of them? More likely there will be substantial shifts from goods to more services and from goods and services to more leisure.

Thus there is in sight, within our own lifetimes, the prospect of another vast improvement in economic welfare. This is not to say that by 1980 we shall have enough to meet all our economic aspirations. But we shall have a great deal more than we have now, even though we encounter many unexpected pitfalls which impede our progress.

This projection exercise illustrates one important way of exploiting some of the data brought together in this report. We are hopeful that it will facilitate the preparation of new and better projections and that it will be put to many different additional uses. We shall be very glad to hear of your experiences with it.

The sources of the projections shown in Tables 2 and 3 are listed below.

CEA	Council of Economic Advisers, Annual Report, January 1965.
JEC-Knowles	James W. Knowles, The Potential Economic Growth in the United States, prepared for the Study of Employment Growth, and Price Levels, Joint Economic Committee, Congress of the United States, January 30, 1960.
CED-Denison	Edward F. Denison, The Sources of Economic Growth in the United States and The Alternatives Before Us, Committee for Economic Development, 1962.
NPA	National Economic Projections to 1976-77, National Economic Projections Series, National Planning Association, to be published in September 1966. The 1980 figures were taken from NPA worksheets.
RFF	Hans H. Landsberg, Leonard L. Fischman and Joseph L. Fisher, Resources in America's Future, Resources for the Future, Inc.
NICB	Supplied by the National Industrial Conference Board. See also, "Economic Potentials of the United States for the Next Decade," reprinted from The Conference Board Record, December 1965, NICB.
McGraw-Hill	American Prospects For Growth Through 1980, McGraw-Hill Economics Department, McGraw-Hill, Inc.