CHAPTER 2

The Meaning of Long-Term Trends

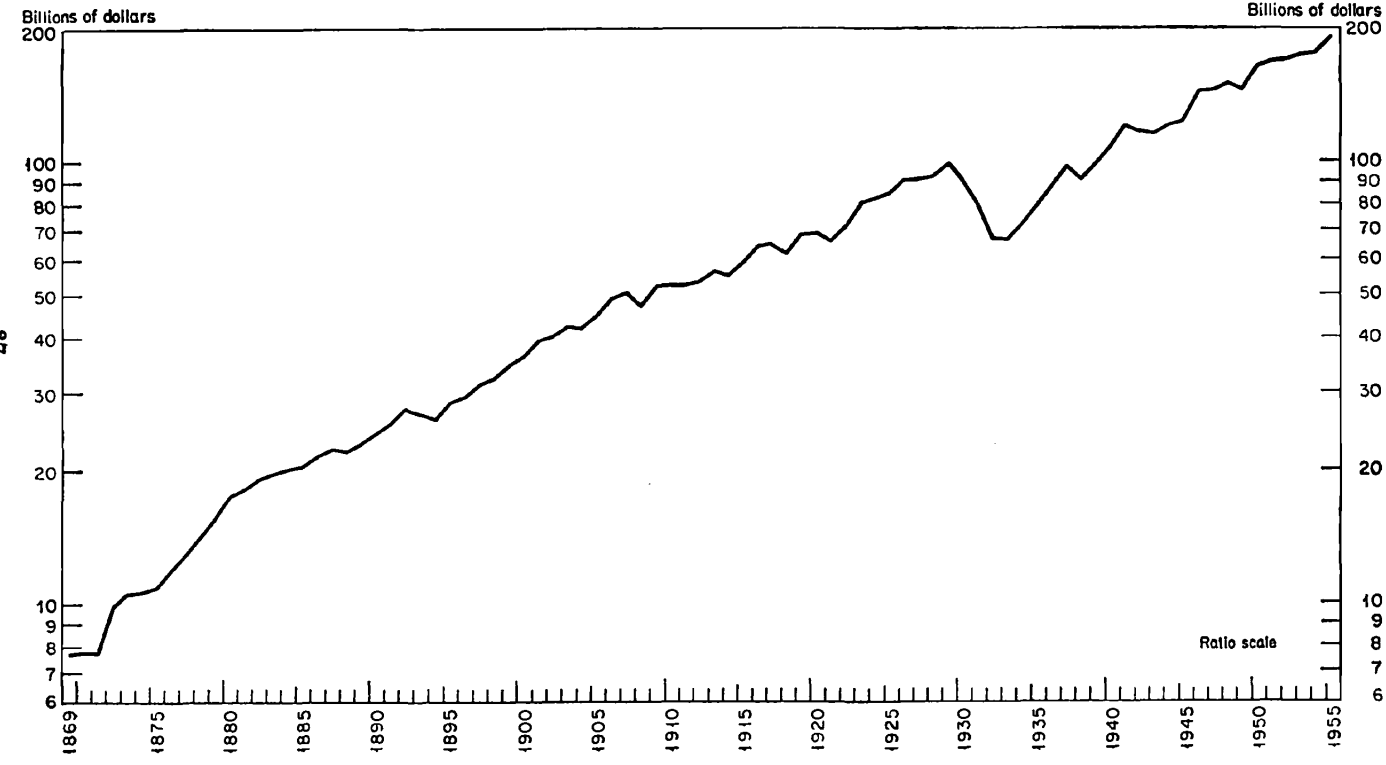
THE present analysis emphasizes long-term trends in capital formation and financing, as distinct from short-term changes associated with business cycles. Clarification of the meaning of long-term trends is, therefore, in order.

This is facilitated by a study of Chart 1, which portrays the volume of gross national product, in constant prices, in the United States annually from 1869 through 1955. We disregard for the moment questions as to the coverage of gross national product or as to the reliability of the series as a measure of the annual volume. The main point for the present is that the chart shows the movement over time in an economic flow that is a major topic of our analysis—a movement combining short-term, long-term, and all other kinds of change.

Looking at the chart, we may therefore ask what we mean by a long-term trend in the gross national product of the United States. The entries on the vertical scale show that the annual volume was below $8 billion in 1869–1871, and hovered close to $190 billion in 1955. Over this eighty-seven-year span there was a rise to almost 25 times the initial level. But are we justified in comparing national product in the 1870's with that in the 1950's, as if they were both of the same universe? Would we be as sure that this rise in gross national product represented a long-term trend if, instead of the rather gradual climb, Chart 1 showed an annual level close to $8 billion all the way from 1869 through 1954 and then a jump to $190 billion in 1955? And assuming that the answers to these two questions help us define long-term trends, what is the rationale for distinguishing the latter from short-term changes? Finally, if some worthy purpose justifies the cost

CHART 1

Gross National Product, Variant I, Regression Series, 1929 Prices, United States, 1869–1955



of distinguishing between long-term trends and short-term changes, how, precisely, do we make the distinction to ensure reasonably useful results?

Some of these questions may sound simple to the point of fatuity. But it is dangerous to assume that any aspect of social processes is simple. It may seem simple, but only because of our familiarity with it—the kind of familiarity that makes it impossible to see the forest for the trees. We must, therefore, deal with these questions explicitly. This chapter is devoted to a discussion of the following points needed to clarify the meaning of long-term trends: (1) comparability over the period; (2) continuity or persistence of trend; (3) rationale for distinguishing between long-term trends and short-term changes; (4) the general lines of the statistical procedures used to draw the distinction between them, and the variety of long-term change patterns.

Comparability over the Period

The central question here can be stated most strikingly by assuming that the record in Chart 1 runs not from 1869 but from 1569 to 1955, portraying the annual changes for the span of 387 years in the gross national product of societies inhabiting what is the present continental United States. (This is not out of the realm of possibility: one can never tell what some intrepid statistician may be able to accomplish some day!) Would we then draw a continuous line on the chart, and talk of the increase in the product from, say, $1 million per year to $190 billion? And if so, would it make sense to assume that the national product of the sixteenth-century Indians is comparable with that of twentieth-century United States?

The answer to the question is not as obvious as it may seem. We deal here, in this span of over three centuries, with human beings who belong to the same species and have the same elemental needs, instincts, and aspirations. And since we also deal with one territory, where climate and other natural conditions may have remained constant over the centuries, at least insofar as they have determined total economic product, there are grounds for treating the Indian society of the sixteenth century and the United States society of the twentieth as if they were links within one homogeneous period extending from 1569 to 1955.

Yet the balance of judgment is against it—not against comparing the economic product of the society of the Indians with that of the

United States on the ground that we are dealing with two distinct types of economic and social organization, but against treating the volumes as points on a single line of long-term trend. The judgment is based essentially on the conclusion, from whatever knowledge we have, that the size, technological levels, social institutions, and international relations of the sixteenth-century Indian society were vastly different from those of the United States economy during the last century, and the latter cannot therefore be regarded as a continuation or later expression of the forces that molded the former. By contrast, we assume that no such gulf separates the United States economy of the 1950's from that of the 1870's, and that the former can be better understood as the result of a process of growth from the 1870's than as a "new" era in the literal sense of that term—that is, without deep roots in the historical past stretching back a century or more.

This assumption is a kind of operating premise, the validity of which can be tested only by the effectiveness of the analysis it makes possible; and there is no assurance that a somewhat different assumption would not lead to even more effective analysis. Perhaps beginning our series in 1839—had it been statistically feasible—would have provided not only a longer and still relatively homogeneous period, but also one in which measurement of the long-term trends and analysis of the factors that determined them would have yielded richer and operationally more tenable conclusions. On the other hand, it may well be that limiting the single line of the long-term trend to a period extending back only to the 1890's would have led to a clearer view and better understanding of the long-term trends in national product prevailing today and of the factors that may determine them in the proximate future.

Given the data, these various alternatives are possible, and are, in fact, explored in any adequate analysis. But the major point to be noted is that in dealing with long-term trends we must determine the time span to be studied and establish homogeneous periods within it. The assumption that the processes under study are comparable throughout the period or periods is based essentially upon—and implies—some preliminary knowledge of those processes and some preliminary theory of the factors that mold them. It is the incompleteness of our knowledge and possible differences in theoretical hypotheses concerning the factors at play that lead to differences in the limits set to the period or periods in question, within the coverage of the data available for analysis.

Meaning of Long-Term Trends

Specifically, why do we, in this report, take the decades back to 1869 as a single period for study—subject to possible distinction of phases within it that may be revealed by further analysis? Presumably, we do so because whatever knowledge we have of this period suggests that the institutions and factors that we consider important in determining the levels of national product and its components have persisted throughout. Technological skills, domestic institutions, and international conditions prevailing today are of course different from those in the 1870's. But we still have the republican form of government, and even the same two major political parties. Our economy still operates under the aegis of free enterprise, and we still have the rights of private property extending to both consumer goods and tools of production. We still have individual freedom—no one is compelled to slave in labor camps. And the list of basic institutions still persisting could be extended through the money and credit mechanisms, distribution patterns, and so on. True, a good many examples of the differences between the 1870's and the 1950's could be cited—ranging from the income tax to the H-bomb. The judgment is then necessarily a matter of weighing the likenesses against the differences, and we assume that the balance is in favor of treating the 1870's and the 1950's in this country as belonging to the same historical epoch. To repeat, this is a working assumption, and its proof is in the results, just as the proof of the pudding is in the eating. All we attempted, and could achieve, in the preceding discussion was to bring the assumption into the light for explicit formulation.

Continuity of Trend

The assumption that a given period is homogeneous throughout may be regarded as applying equally to the long-term trend, in the sense that we can draw a single line for it, and to the short-term changes, in the sense, say, that business cycles at the beginning and end of the period are viewed as parts of the same universe. For while the assumption of homogeneity may have greater bearing upon long-term than upon short-term changes, the close relationship among the forces that affect the two, gives us, prima facie, a case for assuming that a period homogeneous with respect to one is likely to be homogeneous with respect to the other—although this is not necessarily so. But the point of this comment is that the arguments concerning the definition of homogeneity of a period apply *pari passu* to short-term changes.

Meaning of Long-Term Trends

We come now to the distinction between long-term trends and short-term changes. By the former, in terms of quantitative operation, we mean a change *in one direction,* over a period of time that is "long enough" in comparison with short-term changes. Thus, when we refer to a long-term rise, we usually mean a rise that extends over a period of time long enough to transcend the temporary rises occurring during cyclical expansions; and likewise, in referring to a long-term decline, we mean a decline distinct from a cyclical contraction. There are, therefore, two elements in the operational definition of long-term trends: (1) the unidirectional character of the movement; and (2) the extension of this movement over a period that is viewed as long enough. Both elements require further exploration. The second—what we mean by long enough—is best taken up later, when we deal more closely with the statistical procedures from which it will become evident that the *relative* meaning of long enough results in a variety of types of long-term movement. In the present section, we concentrate on what we mean by movement in one direction.

The problem involved can be illustrated by two questions. The first has already been stated: had Chart 1 shown a level of $8 billion from 1869 to 1954, and then a jump to $190 billion in 1955, would we still consider the rise evidence of a long-term trend? The second question is: had the average volume of national product shown successive rises over the successive decades, but violently fluctuating annual levels within each decade—say, from a lower limit of zero to an upper limit five to six times the average—would we assign much significance to the long-term rise in the decade averages?

The two questions are distinct, and each brings out a significant aspect of long-term trends. Each question has only one answer: the movement over any long period can be regarded as unidirectional only if it is sustained, i.e., occurs repeatedly within shorter segments of the period; and it is significant only if the short-term deviations from it do not dwarf the magnitude of the long-term rise or decline. These answers bear upon much that follows; but they can perhaps be perceived more clearly if we analyze the series in Chart 1 not only for the continuity of the long-term trend, but for the amplitude of the short-term changes as well.

In Table 1, part A, we deal with the continuity or steadiness of the long-term trend as reflected in levels for successive periods, each long enough for the average to be free from short-term changes. We use decade averages here, and with the 87 years in the series can calcu-

TABLE 1

MEASURES OF CONTINUITY OF LONG-TERM TREND IN GROSS NATIONAL PRODUCT, VARIANT I, REGRESSION SERIES, 1929 PRICES, 1869–1955

CLASSES BY SIZE OF PER CENT CHANGE OVER PRECEDING DECADE	PART OF PERIOD					
	First Half		*Second Half*		*Total*	
	Number (1)	Per Cent of Total (2)	Number (3)	Per Cent of Total (4)	Number (5)	Per Cent of Total (6)
A. FREQUENCY DISTRIBUTION OF DECADE AVERAGES						
Decline						
0 to 5	0	0	1	2.9	1	1.5
Rises						
0–5	0	0	3	8.8	3	4.4
5–10	0	0	2	5.9	2	2.9
10–15	0	0	1	2.9	1	1.5
15–20	0	0	2	5.9	2	2.9
20–25	0	0	2	5.9	2	2.9
25–30	0	0	1	2.9	1	1.5
30–40	7	20.6	13	38.2	20	29.4
40–50	14	41.2	2	5.9	16	23.5
50–60	9	26.5	7	20.6	16	23.5
60–80	2	5.9	0	0	2	2.9
80–100	2	5.9	0	0	2	2.9
Total	34	100.0	34	100.0	68	100.0
B. FREQUENCY DISTRIBUTION OF ANNUAL DATA						
Declines						
15–20	0	0	1	2.6	1	1.3
10–15	0	0	1	2.6	1	1.3
5–10	0	0	2	5.3	2	2.6
0–5	0	0	2	5.3	2	2.6
Rises						
0–5	0	0	1	2.6	1	1.3
5–10	0	0	1	2.6	1	1.3
10–15	0	0	0	0	0	0
15–20	0	0	1	2.6	1	1.3
20–25	0	0	2	5.3	2	2.6
25–30	2	5.1	1	2.6	3	3.9
30–40	10	25.6	7	18.4	17	22.1
40–50	9	23.1	10	26.3	19	24.7
50–60	6	15.4	4	10.5	10	13.0
60–80	5	12.8	5	13.2	10	13.0
80–100	4	10.3	0	0	4	5.2
100–125	1	2.6	0	0	1	1.3
125–150	2	5.1	0	0	2	2.6
Total	39	100.0	38	100.0	77	100.0

Because of rounding, detail will not necessarily add to total.
SOURCE: Calculated from the series given or described in Tables R-22 and R-26.

late 78 such averages, each removed from the next by one year. To test the steadiness we use the rate of secular change per decade—the minimum period over which to measure it. With 78 decade averages we can calculate the decade rate of change for 68 intervals; and it is these that are classified in Table 1, part A, by size of percentage change.

Of the 68 decade intervals there is just one with a decline in the secular levels, and there are only 5 with a rise of less than 10 per cent, which may be considered a minimum rise (columns 5 and 6). In other words, if during this historical period an observer had been continuously present, and had compared each decennial level of the economy's product with that ten years before, he would have found, 62 times out of 68, a rise of 10 per cent or more; and in only one case would he have observed a decline.

Interestingly enough, the series differs in its behavior between the first and the second half of the period (columns 1 and 3). In the first 34 decade intervals there is not a single decline, nor even a rise of less than 30 per cent; in the second group of decade intervals, there are one decline and several small rises. But even in the second half only 6 out of 34 intervals show changes algebraically less than +10 per cent.

A similar procedure is followed in part B of the table to test for the effects of short-term changes of the kind associated with business cycles. The latter are presumably reflected in annual data. If they were very prominent relative to the long-term trends, to the point of dominating the latter, the decennial intervals in the annual series would reveal a large number of declines or of slight rises. With really dominant short cycles, decennial interval changes calculated from annual data would not reveal many declines and other deviations from a consistent long-term rise unless the cycles were strictly periodic and the periods or phases a simple multiple of 10 (e.g., if the cycles were exactly ten or five years in duration). This condition is clearly not true of our series.

If we inspect the distribution of the 77 decade interval changes in the annual data, classified by size of percentage change, we find, as would be expected, more with declines or decennial rises of less than 10 per cent than we find in part A: the declines number 6, and the rises of less than 10 per cent, another 2, making 8 deviations in the total of 77. As in part A, these deviations are concentrated in the second half of the period. But, all in all, the consistency of the long-term rise in gross national product is high—despite the short-term fluctuations

in the annual data. Our observer, recording the level of the product each year and comparing it with the level ten years earlier, would have found, 69 times out of 77, that there had been a substantial rise over the preceding decade—a rise of 10 per cent or more (in fact, in excess of 15 per cent).

It can now be stated briefly why the continuity of successive changes, either in secular levels (as reflected in decennial averages) or in annual data (which reflect short-term changes), is necessary to give meaning and significance to the concept of long-term trends.

1. If, in successive decade intervals or in any other reasonably acceptable succession of intervals, the direction of the change is relatively constant and the magnitude of the change persists above a certain minimum, we can argue that the measures relate to a truly long-term process—a movement that has continued through a succession of periods. It is this continuity through different historical periods that lends significance to the established long-term trend. To come back to our illustration: gross national product increased at least 10 per cent per decade in almost every decade. During some of those decades the administration was Republican, and during some, it was Democratic; during some we had free immigration, during others we did not; during some the general price level was rising, and during others it was declining; and so on. Had our chart shown a level of $8 billion per year through 1954 and then a jump to $190 billion in 1955, we would have been forced to suspend judgment regarding the significance of that rise until we saw what happened for a large number of years after 1955.

2. Likewise, the fact that short-term changes in general, and business cycles in particular, rarely, if at all, cause the series to fall to levels low enough to wipe out the preceding rise (or to rise to levels high enough to wipe out the preceding decline, if the long-term trend is downward) lends significance to the long-term trend, in two ways. First, it implies that the forces that mold and determine the long-term trend resist, as it were, any counterforces that tend to alter the trend. Or, to put it differently, the forces that determine the long-term trend also provide, over any given short period, a kind of floor and ceiling, and tend to control the extent of deviations from the current secular level. Second—and related to the point just made—limited amplitude of the short-term disturbances will, in turn, tend to minimize the variability over time in the rate of secular change calculated over any successive, not too long intervals. This conclusion assumes a

lack of strict periodicity or regularity in the short-term disturbances, whether or not associated with business cycles. With this lack of regularity, averages covering one or even two decades might still reflect some short-term changes since they would not completely offset each other. And short-term changes of wider amplitude than the rate of long-term trend might be reflected in decadal or even bi-decadal averages and thus introduce a lack of continuity in the rate of long-term rise or decline. This last point shows clearly that the two aspects of continuity of long-term changes discussed in this section are, in fact, interrelated—provided the short-term changes are not so regular as to permit one to determine the precise minimum period for which the averages would cancel these changes completely and thus yield secular levels unaffected by them.

Rationale for Distinguishing between Long-Term and Short-Term Movements

The preceding comments have already suggested the reason for distinguishing between long-term trends and short-term changes. If long-term trends are a persistent component of change over time, and in their cumulative effect produce movements that dwarf the short-term variations, they may well be due to some identifiable group of factors different from those that determine short-term changes. If so, it may be that the relations among various aspects of economic processes that come to light when we compare long-term trends are quite different from those found when we compare short-term changes. Consequently, distinguishing the two types of movement may be a more fruitful way of analyzing the total complex of economic change, because—being based upon a distinction between groups of operating determinants—it should lead more easily and directly to generalizations and proper bases for extrapolation and prediction than would the ostensibly more direct way of studying economic change as a whole.

The several links in the chain of argument just presented must be clearly differentiated. The first is the finding that long-term trends—movements characterized by persistent change in one direction over a "long enough" period—exist. The second link is the assumption, not proved and not fully provable, that the factors that determine a persistent change in one direction may perhaps be quite distinct from those that determine short-term changes; and correspondingly, relations among various aspects of the economy characteristic of long-

term trends may differ from those revealed by a study of short-term variations. Third, if this assumption is valid, a separate study of long-term trends should shed light on the factors determining them and on relations among long-term trends in various aspects of a living and growing economy. It should lead to a better understanding of the forces at play than would be attained without distinguishing between long-term and short-term changes. Fourth, if the promise indicated in the third link is fulfilled even in part, it should mean a better basis for generalization and extrapolation, at least of the long-term trends—and also of the short-term changes, if a similar analysis were carried through for them. The "better" is relative to what could be learned by trying to analyze the statistical record without distinguishing between long-term trends and short-term changes.

The first link in this argument can be proved for various long series, by devices like those employed in Table 1 (and many others can be contrived). It is the second link, the assumption upon whose validity everything that follows hinges, that cannot be demonstrated. But it is strongly supported by two considerations. One is quite general: if we observe different patterns of change, different patterns of behavior, we should proceed upon the assumption that the forces, factors, or whatever name we wish to assign to the determinants of these different types of observed results, are also different. Certainly, it is safer to start with such an assumption than with the opposite—that despite differences in the patterns of change, i.e., differences in results, the antecedent factors are the same. We may eventually come to the latter conclusion, possibly in the sense that the one set of forces in the background works through different sets of conditions to produce different patterns of change over time. Even then the analysis would have to show some differentiation of the antecedent factors to account for differences in the resulting patterns of movement.

The second consideration supporting that link in our argument—and, in the present connection, the more telling one—is that we know that certain institutions in our society operate in full recognition of the difference between long-term trends and short-term changes. They thus directly "produce" much of the former, in ways in which they do not, at least consciously, produce the latter. Even an individual, short as the span of his life may be compared with that of a country, considers the long-term trend of his active life, prepares for it, and allows for it, distinguishing it as best he can from transitory, short-term changes which must be expected but usually cannot be forecast. And

an individual's active life, including professional or other preparation for it, may last over forty years, which is not an insignificant segment in the long stretch we consider in this report. If one also takes into account the plans of parents for their children, and the succession of generations of family units cognizant of the long-term trend as distinct from the short-term variations, we can see that, insofar as economic change is a matter of decisions by family units, the considerations behind those decisions—and hence the determining factors—are quite different from those involved in producing or responding to short-term changes.

A similar argument can be advanced, with even greater force, regarding decisions and actions by individuals in their capacity as members of business enterprises, or of other institutional units (nonprofit, or government). It should be noted at once that in theory, and often in actual practice, these nonfamily institutions act as if endowed with eternal life. Their time horizon, therefore, can be, and often is, much wider than that of individuals acting as members of family units; they are even more cognizant of the difference between the long and the short run; and they can, at least to some extent, weigh differently the costs and returns of decisions that are temporary and of decisions that are more lasting in effect.

The argument is reinforced by the fact that relations among many aspects of the economy observed in long-term trends have already been found to differ from those observed in short-term changes. Thus, in short-term changes associated with business cycles, increases in aggregate income per capita are usually accompanied by increases in the countrywide savings-income proportion, whereas, in the long run, an increase in aggregate income per capita is not necessarily followed by a secular rise in the countrywide savings-income proportion. In the short run, changes in prices and in quantity of output tend to be positively associated—at least where entrepreneurs have technical control over output, that is, excluding agriculture. In the long run, a downward movement in prices may be associated with an extraordinarily high rate of secular growth, as in this country from the 1870's to the 1890's—growth in the output of all products, not just agricultural.

One reason for these perhaps obvious remarks is the fact that since the distinction between long-term trends and short-term changes, like any other abstraction, is a distortion of reality, it involves certain costs, and must, therefore, be justified. But the main reason here is to challenge the inclination, not uncommon among observers of cur-

rent events, to view anything beyond the immediate yesterday as having little relevance, and to look forward only to tomorrow, and not to the day after. Both tendencies were given support by the late Lord Keynes in an unfortunate remark to the effect that in the long run we are all dead. Justified as it may have been by the urge for immediate short-term action, this less-than-half-truth overlooks the obvious fact that, if long run means more than the next few years, a good many of us will still be alive, and even more of our children will be. In any case, even if one is interested in only the next short run, the understanding of it will be dangerously incomplete unless, currently, one can distinguish the secular level from the shorter-term changes, which cannot be done without adequate knowledge of the long run of the past. In view of the quantitatively dominant effects of cumulative long-term trends in modern economies, and of the importance of better knowledge of their characteristics and implications for decisions by the many economic institutions that are, and must be, concerned with the longer future, the value of properly distinguishing the long-term trends from the short-term variations can hardly be gainsaid.

The Statistical Distinction

In drawing the statistical distinction between long-term movements and short-term variations, we must specify what we mean by long and short. As we do so, it becomes apparent that the terms are relative. If by a long-term trend we mean movement in one direction over a period "long enough" to transcend temporary rises (or declines) in the short-term variations, the meaning of long enough obviously depends upon the meaning of short-term. If by the latter we mean business cycles, ranging in duration from, say, 4 to 11 years, then long enough means a period that substantially exceeds in duration any single expansion or contraction, and preferably covers several of them so that the direction and magnitude of the trend can be ascertained. In this case, a period of 20 years or longer is sufficient. If by short-term changes we mean cycles of, say, 20 years, then for statistical analysis the period is long enough only if it contains several 20-year units. And if we think of the major historical epochs as themselves being variations around the long-term trend of history, then the medieval economy, merchant capitalism, and industrial capitalism in Western Europe must be viewed as long historical waves, and the

trend can be determined only if the period analyzed covers many centuries.

By definition, the "long" in a long-term trend must exceed the time span of the longest unit of change viewed as short term. But in the statistical practice of measuring long-term trends, even this is not enough, for we must cover more than one unit of short-term change (i.e., more than a single upturn and downturn) to be able to measure the magnitude of a long-term trend reliably. In economic and social statistics particularly, the pattern of short-term changes is so irregular that a single unit will not suffice to establish and measure the underlying movement with any degree of reliability.

Given the relative element in the definition of long-term movements, the specification of what *long* means may be approached in one of two ways. In the first, the analyst may already know, on the basis of some information concerning the processes that shape the long-term movement, not only the length of the period over which it extends, but even some of its characteristics which he can embody in a mathematical equation. For example, in the study of the processes of human growth, biologists may have found the steady increase from birth in weight and height to reach its optimum within a fairly narrowly defined span of time—but long, compared with short-term fluctuations that may occur because of disease, nutritional variations, and so on. It may follow a pattern easily expressible by a simple mathematical curve which, in its characteristics, embodies the requirement of a unidirectional sustained movement.

In the other approach, the analysis begins with a specification of what short-term changes are, a specification based either upon some theory and the general characteristics of the changes (for example, that they are periodic cycles), or upon observation of the specific features of the short-term changes in the record being analyzed. Next, the short-term changes, being by definition variations that offset each other, are canceled by an appropriate procedure, usually by taking some type of moving average. This moving average, therefore, represents changes that are not short-term: by definition it approximates the long-term movements.

It is the second approach that we adopt in this report, because we do not have sufficient knowledge to attempt a direct description of the long-term movements in the form of simple mathematical curves. This is particularly true since we are interested, not just in those movements that, for one reason or another, perhaps could be described by

such curves, but rather in long-term changes in both quantity volumes and financial flows—that is, in a wide variety of the aspects of a growing economy. Besides, it is a matter of advisable caution, in our emphasis on the study of long-term movements, to begin with the most complete description of them, including everything except the elements directly identifiable as short-term variations. And so we follow the procedure that attempts to eliminate the latter by some type of moving average.

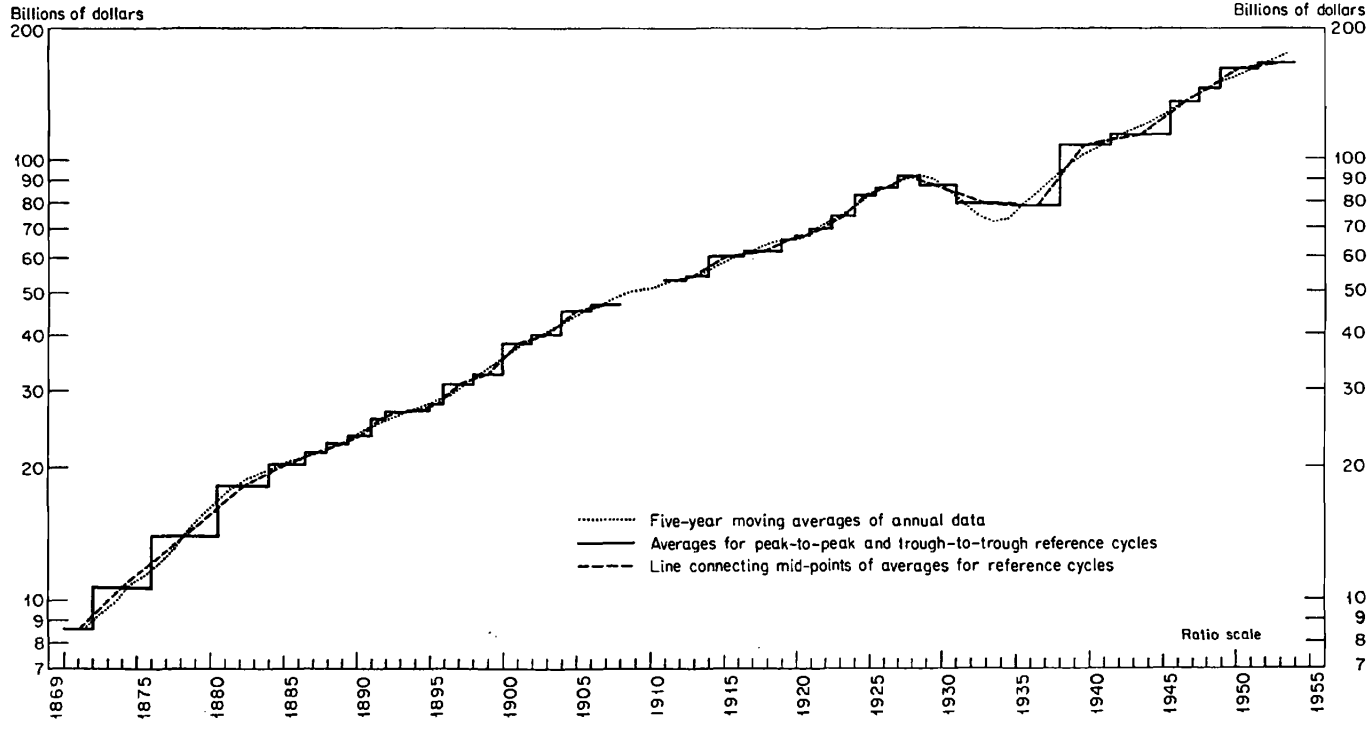
The results of two such attempts are shown in Chart 2. In one, we use the reference chronology of business cycles in this country, prepared at the National Bureau of Economic Research, and convert the annual series of gross national product to averages representing complete reference cycles (either peak to peak or trough to trough). It might have been better to use the periods secured by identifying the specific cycles in the series. But changes in gross national product conform quite closely to the reference cycle chronology, as is indicated in Appendix C; and there is an advantage in using the standard chronology for all our series. Each average is then plotted as a line (*b*) extending from the mid-point of the first phase of the cycle to the mid-point of the second, and another line (*c*) connects the mid-point of the cycle with that of the next cycle. Since the points represent averages for complete cycles, line *c* connecting them is presumably free from the effects of the latter and of other short-term changes, and thus approximates the long-term movements.

Line *a* in Chart 2 represents a 5-year moving average of the annual estimates. Since the cycles in general business conditions and in gross national product average during the period somewhat under 4 years in duration, a 5-year moving average should remove almost all the cyclical element and any other short-term changes (of less than 5 years' duration). Even when the cycle is longer than 5 years, which occurs once or twice, the moving averages are free from most of the amplitude of these cycles—retaining and reflecting only a minor portion of them. A more complicated moving average would cancel more completely the short-term variations and yield a more precise description of long-term movements; but the additional labor involved in attaining greater precision is not warranted here.

Chart 2 shows that most of the up-and-down movements associated with the short-term changes observed in Chart 1 have been eliminated; and some of the declines or irregularities that remain would have been removed by a more elaborate moving average. But, even if we

CHART 2

Averages for Successive Peak-to-Peak and Trough-to-Trough Reference Cycles and Five-Year Moving Averages of Annual Data, Gross National Product, Variant I, Regression Series, 1929 Prices, 1869–1955



NOTE: No entries are shown for the 1907–1910 and 1908–1911 reference cycles because of the difference in procedure underlying the estimates for 1908 and preceding years and that underlying the estimates for 1909 and following years.

were to assume the complete removal of short-term changes, i.e., that the changes would cancel each other within a period of some 5 to 13 years, variations in the rate of change would still be noticeable in the residual lines descriptive of the long-term movements. Since distances on the vertical scale in Chart 2 measure relative or percentage changes, any conspicuous oscillations or swings in the slope of the lines mean correspondingly conspicuous alternations in the percentage rate of growth. And it is clear that, in addition to the sweep of the rise in gross national product, there are long swings or alternations in its rate of secular growth.

To point up the components of the long-term movement of the series in Chart 2, we use a simple device that yields the results presented in Chart 3. From the averages for reference cycles we calculate the rate of change per decade, for intervals approximating decades. Beginning with the average for the first cycle, 1869–1873, we calculate the rise to the average about a decade later (it happens to be the cycle for 1878–1885, 11.5 years later, but we reduce the increase proportionately to 10 years). We then follow with the change per decade from the average for the next cycle, 1870–1878, to that for 1882–1887, and so on, computing the intercycle rate of growth for a number of decade intervals. It is these rates, reduced to a decade basis and centered at the mid-points of the intervals from which they were calculated, that are plotted as line *a* in the upper part of Chart 3.

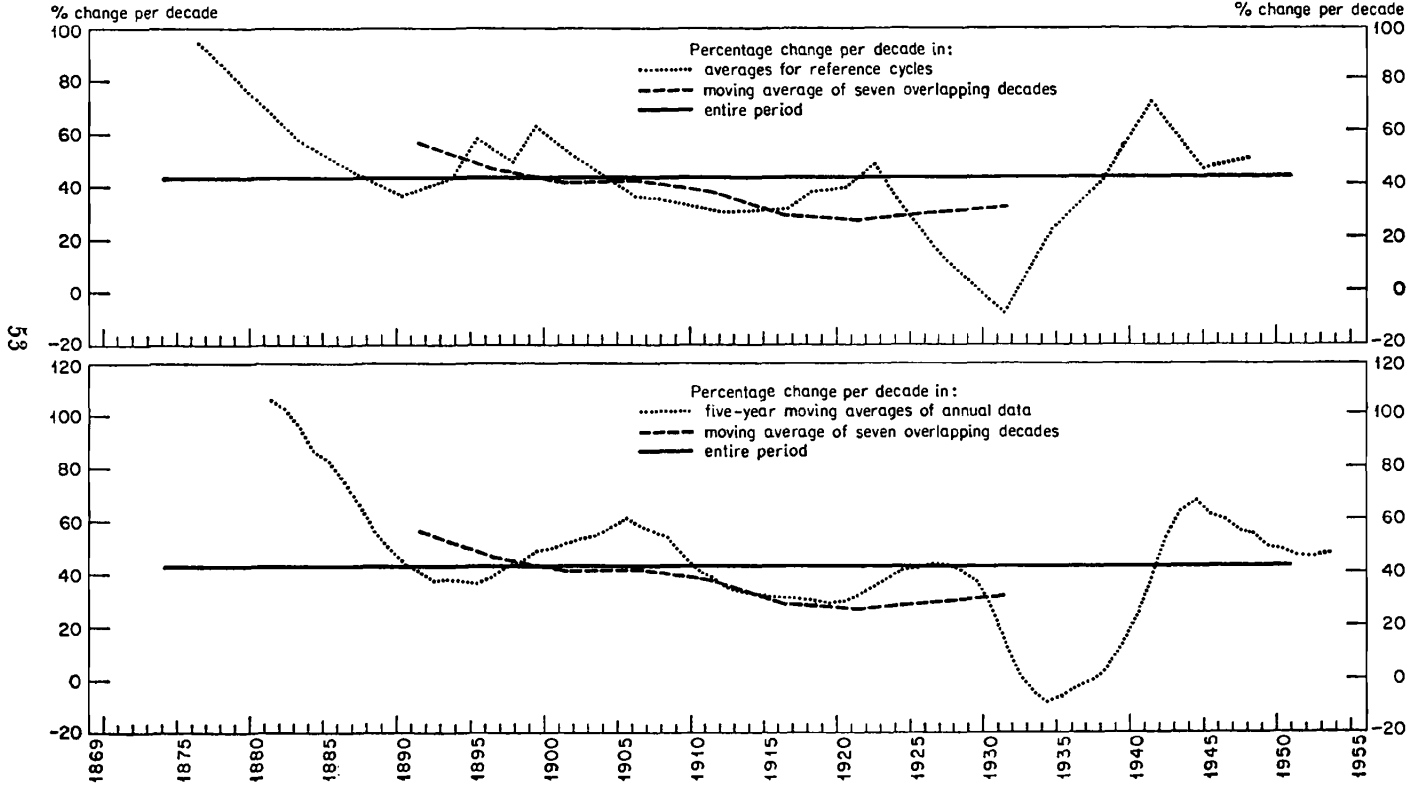
If the intercycle rates of change were constant, or steadily accelerating or decelerating, line *a*, described in the preceding paragraph, would fluctuate irregularly around either a horizontal line or an upward or downward sloping straight line. That the line in fact oscillates in long up-and-down movements is a clear indication that the rate of growth moves in long swings of fairly wide amplitude; it goes through alternations, which—judging at least by Chart 3—are over 20 years in duration.

A similar result emerges when we calculate the rate of change from each ordinate in the series of 5-year moving averages to the ordinate 10 years later. This decadal rate of change, centered at the mid-points of the intervals from which it was calculated, is plotted as line *a* in the lower part of Chart 3, and exhibits the same long swings as the decadal rate of change calculated from reference cycle averages.

Lines *b* and *c* in Chart 3 represent *the* underlying long-term trend. The horizontal line *c* (identical in both parts of Chart 3) is the average rate of growth per decade for the period as a whole; it was calculated

CHART 3

Percentage Change Per Decade in Averages for Reference Cycles and in Five-Year Moving Averages of Annual Data, Gross National Product, Variant I, Regression Series, 1929 Prices, 1869–1955



from the values for the first and last decades, 1869–1878 and 1946–1955. This is a geometric mean, and represents the rate in a simple compound interest line. Line *b* (also identical in both sections of Chart 3) is the decadal rate of change shown by successive ordinates of a seven-item moving average (geometric) of decade values overlapping by 5 years. Each ordinate covers a period of 45 years (but with different weights for the items within it) and should, therefore, be free from effects of any alternations in the rate of growth extending over 20 to 25 years. The percentage change per decade between successive ordinates should show whether there is, in general, acceleration, retardation, or constancy in the long-term trend. Chart 3 clearly reveals that the decadal rates of change in reference cycle averages and in 5-year moving averages describe long swings around a steadily declining rate of growth constituting the long-term trend—although this retardation in the rate of growth cannot be found after the 1920's.

We thus find at least two components in the long-term movements within our records: (1) the underlying movement, which for convenience we designate "long-term trend," and which may be constant, or continuously accelerating, or decelerating; and (2) long alternations in the rate of growth, which we designate "long swings"—not cycles, since we are far from sure that these are even a roughly recurrent type of variation. The finding of two such components is an unmitigated nuisance, because it complicates both our statistical analysis and our explanatory task. It would be much simpler if we could limit the description and analysis of long-term movements to what we designate long-term trend, but unfortunately it is only one component in the complex of long-term movements.

We retain this distinction throughout the discussion in the subsequent chapters. Those that follow immediately are limited to measurement and analysis of the long-term trends in capital formation and financing, and indeed, the major emphasis of this report is on long-term trends. The reason is twofold. First, in terms of magnitude, it is the long-term trend that is dominant—the long swings, though significant, being in a sense only qualifications of the long-term trend. Second, our data yield a much more detailed picture of the long-term trends than of the long swings. Study of the long swings requires records both continuous over time and available over a long period, while continuity of data over short intervals is not as important in measuring long-term trends. Nevertheless, we will turn later to the long swings to learn as much about them as we can from our limited records.