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Dating American Growth Cycles

Ilse Mintz

1. THE PURPOSE OF THE STUDY

The Revision of the Business Cycle Concept

Business cycles are a thing of the past, comparable to dinosaurs, some believe. Others, on the contrary, call the 1969-70 swing in the U.S. economy a traumatic experience. Why these differences in views?

Economic fluctuations have, since World War II, become much milder than they used to be.[1] A recession in the sense of an absolute and sustained decline in aggregate economic activity is a rare exception nowadays. Alternations of periods of fast growth with periods of slow growth have replaced, in most instances, the alternations between the rise and fall of economic activity which constituted the classical business cycle. This holds for most countries, including the United States. Here recessions prevailed in less than 17 per cent of the months, 1948–68, and in the later part of this period expansion was unbroken for eight years whether or not the later part of 1969 is classified as recession.

Note: This paper is a report on research in progress. Except for the Conclusions and the Postscript its coverage of data extends only through March 1970. Also, some findings have been obtained by short-cut methods rather than by complete analysis. The contemplated extension and revision is not likely to change the main findings, but some adjustments of detail are to be expected.

[1] See Arthur F. Burns, *The Business Cycle in a Changing World*, New York, NBER, 1969, pp. 50, 102. Also C. A. Blyth, *American Business Cycles 1945–50*, New York, Praeger, 1968, pp. 19, 22.

But the mildness of the fluctuations does not prevent experts and laymen, both in the United States and abroad, from paying great attention to them and from regarding periods of slow growth much as periods of decline used to be viewed in former days. Here, as everywhere, expectations have risen with achievements, and rising aggregate economic activity today does not preclude concern about subnormal performance.[2]

A period of low growth is, of course, in many ways quite different from a period of absolute decline. But in other ways the two are similar. Alternations between periods of, say, 4 per cent rises and 2 per cent falls (which qualify as classical business cycles) and alternations between periods of, say, 8 per cent rises and 2 per cent rises may be expected to show considerable family resemblance,[3] and this resemblance in duration, pervasiveness, and other aspects, will be affirmed by the findings of this study.

The time has come, therefore, to adjust the tools of business cycle analysis to the moderation of the cycle and this, essentially, is the task of the study of which the present paper is a preliminary report. The study tries to develop a working concept which can do for the analysis of growth cycles, as I shall call them, what the Burns-Mitchell definition has done for the analysis of classical cycles. It seems reasonable to expect that dating the phases of growth cycles will give precision to the variety of notions and impressions now encountered and will help in measuring the behavior and the interrelationships of the various sectors and aspects of the economy.

The proposed chronology will, moreover, facilitate comparisons between U.S. fluctuations and those in foreign economies which have had almost no experience with classical cycles after World War II.

The new chronology is not intended, it should be stressed, to supplant the traditional one. The treasure we possess in our knowledge of business cycles, cast in the framework of classical cycles, will continue to be used and

[2] "The American people have of late been more conscious of the business cycle, more sensitive to every wrinkle of economic curves, more alert to the possible need for contracyclical action on the part of government, than ever before in our history" (Burns, *Business Cycle*, p. 101).

"Only in relatively few cases (the United States, Canada, Switzerland and Belgium) can we register significant absolute declines in one or more years. However, we must refer these instability experiences to the much greater postwar ambitions with regard to full employment, as well as to the new ambitions of rapid and stable growth, that have become accepted more or less explicitly by all countries after the war. From this point of view a retardation of growth from a normal rate of 5 per cent to 1 per cent is regarded as quite a serious affair . . ." Erik Lundberg, *Instability and Economic Growth*, New Haven, Yale University Press, 1968, p. 87).

[3] For references to others who stress the similarity of relative and absolute decline, see Ilse Mintz, *Dating Postwar Business Cycles, Methods and Their Application to Western Germany, 1950–67*, New York, NBER, Occasional Paper 107, 1970, pp. 3,4.

elaborated further. The idea is to supplement it gradually by a similar body of information about growth cycles.

The existence of two cycle concepts and two chronologies creates however, a certain confusion, which is already evident in discussions of the subject today. To guard against this, it is most important to distinguish carefully between the two types of cycles by using different terms for them and for their phases and turning points. Labeling a period as a recession means that it is covered by all our generalizations about and measures of recessions and thus is definitely not just a matter of semantics. Whatever progress has been made at the NBER in the analysis of business cycles would have been impossible without Burns and Mitchell's insistence on the use and application of precisely defined concepts.

In this study economic fluctuations described by the revised definition are called growth cycles. The word is chosen for want of a better one and despite the disadvantage of its having served previously to designate certain long cycles. The growth cycle consists of a high-rate phase and a low-rate phase, terms suggested to me by Leonard H. Lempert. The endpoints of the phases are termed downturns and upturns, rather than peaks and troughs.

The Burns-Mitchell definition of business cycles[4] as adjusted for growth cycles is as follows: Growth cycles are fluctuations in aggregate economic activity. A growth cycle consists of a period of relatively high growth rates occurring at about the same time in many economic activities, followed by a period of similarly widespread low growth rates which merges into the high-growth phase of the next cycle.[5]

Two independent methods serve to distinguish between "high" and "low" growth rates. The long-run trend of economic activities is used as a criterion in the first method. Growth which is more rapid than the trend is classified as "relatively high." This method involves fitting a trend to the indicators and analyzing the deviations from this trend, the "deviation cycles."

The second method requires no trend fitting. It focuses directly on rates of change and distinguishes between high and low rates by comparing average rates of change in economic activities during successive time periods in a fashion which will be explained later on. The alternations between high- and low-rate periods are termed "step cycles."

[4] Arthur F. Burns and Wesley C. Mitchell, *Measuring Business Cycles*, New York, NBER, 1946, p. 3.

[5] It has been argued recently that what really matters are not fluctuations in aggregage activity but fluctuations in subdivisions of the economy, especially in "socially important" ones. However, it will hardly be denied that analysis of a part of the economy, say the construction industry, will not get far without relating that part to the whole.

The two-pronged approach provides a check on the reliability and stability of the growth cycle chronology which is most desirable in view of the exploratory nature of our undertaking. Since both methods refer to the same cycle concept they should, and actually do, yield approximately the same growth cycle turning dates.

An Objection to the New Concept

Problems of definition and measurement aside, the growth cycle concept encounters a serious objection: namely, its implications for economic policy. Recognition of growth cycles, it is argued, can impart an inflationary bias to economic policies. Labeling a period as a low-rate phase might be interpreted as a criticism of policy makers and as a recommendation of expansionary policies, but labeling it as a traditional expansion would not be interpreted this way.

Such an effect would, indeed, be unfortunate. But is it likely to occur? Classification of a period as one phase or the other involves no value judgment. Two observers who accept the same classification may hold opposite views regarding the desirability of a certain situation. It seems to me that it should be possible to make this clear and to prevent the new terms and new classification schema from affecting the judgment of policy makers and the public.

European reaction to the recognition of growth cycles is encouraging. Germany, for instance, has not experienced more inflation than other countries. Low-rate phases are not generally condemned. On the contrary, such phases are often termed "recovery of economic stability," or "cooling-off period," while high-rate phases may be designated as "imbalanced" and "overstraining."

Which of the phases of growth cycles is desirable depends, of course, on the attendant circumstances and on the observer's point of view. The situation is not really different from that encountered with classical cycles. Here too some recommend expansionary policies not only during recessions, but also during slow expansions; and others prefer mild recessions to the evils of inflation.

Computerized Cycle Dating

In addition to the development of the growth cycle chronology this study has a second purpose: to establish the feasibility of mechanical reference cycle dating.

Traditionally the determination of cycle turns by the NBER relies on a set of rules devised by Burns and Mitchell.[6] These rules, however, are meant to

[6] Burns and Mitchell, *Measuring Business Cycles*, Ch. 4.

aid, not to replace, the analysts' judgment. This goes for determination of "specific" turns in individual time series. But the role of judgment is very much greater when it comes to selecting reference dates. Decisions are required, for instance, on the weight to be attached to each economic class of indicators and then to each series within a class. Thus it takes the enormous expertise of members of the NBER staff to select the business cycle turns which have come to be accepted not only nationally but all over the globe.

The flexibility of the traditional method was virtually indispensable as long as detailed knowledge of business cycles was lacking; even today, it has great advantages over rigid mechanical procedures. Obviously, however, the necessity to rely on specialized experts and the consequent irreproducibility of the selections also has its disadvantages which critics have not failed to mention.

The large accumulation of knowledge about business cycles gained during many years of cycle dating and the possibility of using computer programs to simulate, in part at least, the traditional procedures have led Bry and Boschan of the NBER to experiment with a programed selection of indicator turns.[7] The results are most encouraging in the sense that the dates selected formerly by the NBER analysts are, in general, reproduced by the programed procedures.

The Bry-Boschan turning point program is basic to the present study, which carries the experiment further, to the dating of reference cycles. Reference cycle turns are defined as turns in composite indexes and diffusion indexes, and these indexes are derived by combining selected indicator series. As will be explained in detail in later sections, the composite index is an average of modified and standardized indicators, while the diffusion index is based on a count of the number of indicators rising and falling during a given month.

These methods are tested by applying them first to the dating of classical business cycles. They are successful beyond expectations. Each of the eight handpicked turns, 1948-61, can be exactly reproduced in this fashion.[8] This suggests that in growth cycles, too, the dates of our programed turns are those that would have been selected by traditional methods.

[7]Gerhard Bry and Charlotte Boschan, *Cyclical Analysis of Time Series: Selected Procedures and Computer Programs*, New York, NBER, 1971.

[8]With the indicator list used in this paper, one of the eight handpicked turns differs from its computerized counterpart. With the improved list that will be used in the final version of the study even this discrepancy disappears.

2. THE GROWTH CYCLE CONCEPT OF THIS STUDY AND ALTERNATIVE CONCEPTS

The Definition of Growth Cycles Used in This Study

From the point of view of this study, the outstanding merit of the growth cycle concept chosen is its close resemblance to the Burns-Mitchell definition of business cycles which underlies the NBER business cycle analysis. This is important because it enables us to compare the insights gained in using the new chronology to the body of knowledge based on the traditional chronology.

The growth cycle definition given in the preceding section differs from the traditional one only in replacing the words "expansion" and "contraction" by "period of relatively high growth rates" and "period of relatively low growth rates."

Alternatively the Burns-Mitchell definition could be revised by inserting the words "adjusted for their long-run trends" after "economic activities." This version brings out the identity between classical cycles and growth cycles when long-run trends are horizontal. Establishment of growth cycle analysis means that Burns and Mitchell's old ideal——to have two sets of measures, "one as free as possible from trend factors, the other including intracycle trends"——will at long last have been attained. The realization of this ideal was prevented by the expensiveness of double analysis before the advent of the computer.[9]

One important implication of the use of the Burns-Mitchell definition is the rejection of the definition of reference cycles as cycles in a single comprehensive aggregate and retention of the idea of reference cycles as fluctuations occurring at about the same time in a broad variety of economic activities comprising inputs and outputs in physical and dollar units, measures of financial markets, prices, wages, interest rates, etc.

Concerning the duration of phases and cycles I adopt the rules used in the Bry-Boschan computer program: the minimum duration of a cycle phase is five months; of a full cycle, fifteen months. By comparison, the NBER rules used in the handpicking of turns are that a full business cycle must have a minimum duration of more than a year. (The shortest business cycle observed historically in the United States lasted seventeen months.) In specific series, cycles as short as fifteen months are recognized. No minimum length for a business cycle phase has been laid down in traditional cycle dating, but in practice no phase shorter than six months has been recognized.

[9] See Burns and Michell, *Measuring Business Cycles* p. 41; and Wesley C. Mitchell, *What Happens During Business Cycles*, New York, NBER, 1951, p. 14.

It may be noted that the relative length of the two phases of the classical cycle will differ from those of the growth cycle. In a growing economy high-rate phases must always coincide with expansions of classical cycles, while low-rate phases may coincide with either classical cycle phase. Conversely, classical expansions may be times of high or of low rates in growth cycles. Classical recessions, on the other hand, must be low-rate phases since negative rates of change are necessarily below the normal rising ones. High-rate phases thus will tend to be shorter than expansions, and low-rate phases longer than recessions. Or, downturns will tend to lead peaks and upturns will tend to lag troughs.

Regarding amplitudes and diffusion no specific requirements have been set up in the traditional NBER procedure, although the general requirement is imposed that cycles should be widely diffused and not be divisible into shorter cycles of similar character with amplitudes approximating their own.

Neither the Bry-Boschan program nor the method of this study specifies amplitude minima since such a criterion is very difficult to introduce. The degree of diffusion, on the contrary, is decisive in the computerized determination of reference cycles which relies on diffusion indexes and composite indexes.

Where the definition of growth cycles must differ from that of classical ones is in the criterion by which the two cycle phases are distinguished. In classical cycles this consists simply of the direction of change in economic activities. In growth cycles the criterion is the relation of a given rate of change in economic activities to a corresponding "average" or "normal" rate.

In this study, because of its exploratory character, two different definitions of a "normal" rate are used, each underlying a different statistical technique. In one concept the normal rate is the rate of a trend line fitted to the data. Growth cycles are here defined as deviations from the trends (deviation cycles), and are treated in the same fashion as are data unadjusted for trend in the analysis of classical cycles. This concept is as close as can be to the traditional one. It is, of course, open to the objection that the cycles depend on the selection of the trend.

Therefore the results are checked by those obtained with the second concept, which requires no trend fitting but deals directly with the rate of change rather than with the series proper. The "normal" rate is here the average rate in a full cycle. The cycle must comprise two parts: in one the average rate of change must be significantly higher than the cycle average and in the other it must be significantly lower. These alternations of periods of high growth rates with periods of low growth rates are termed step cycles.[10]

[10] I owe the idea and the name of step cycles to Milton Friedman and Anna J. Schwartz. Both cycle concepts will be explained in detail in a later section.

The reasons for defining growth cycles in terms of high and low rates as distinct from rising and falling rates will be explained in the chapter on step cycles.

Alternative Growth Cycle Concepts

Several alternative growth cycle concepts have been proposed in the literature or are being used in empirical work.

There is, first, the old idea of defining business cycles simply as cycles in a single comprehensive aggregate such as GNP. Correspondingly, growth cycles can be defined as cycles in the trend-adjusted GNP. This definition has been rejected by the NBER for classical cycles and is rejected in the present study because thorough investigations have shown how uncertainties in the measurement of GNP and the necessarily very frequent revisions, which often reach back a number of years, would increase the likelihood of selecting the wrong turns.[11] Moreover, GNP data are not available monthly, whereas a monthly reference chronology is required.

Rejection of the concept of reference cycles as cycles in the GNP implies a fortiori rejection of a definition which at first glance appears most appealing: a cycle in capacity utilization or in the gap between actual and potential output. The importance of the degree of capacity utilization makes this concept meaningful and hence attractive. However, the likelihood of error is even greater with this definition than when growth cycles are defined as cycles in the GNP. Potential output must be estimated with the help of estimates of potential inputs and of productivity. Clearly these estimates leave much room for the analyst's judgment. Thus the reference dates will be affected not only by the uncertainties of the basic GNP data but also by erroneous assumptions about the movements in potential GNP.[12]

[11] For an excellent study of the effects of dating reference cycles by GNP cycles, see two articles by Victor Zarnowitz, "On the Dating of Business Cycles," *Journal of Business of the University of Chicago*, April 1963, and "Cloos on Reference Dates and Leading Indicators: A Comment," *ibid.*, October 1963.

For a striking example of repeated back-and-forth shifts of a trough through GNP revisions, see Rendigs Fels and C. Elton Hinshaw, *Forecasting and Recognizing Business Cycle Turning Points*, New York, NBER, 1968, p. 29.

For general arguments against reliance upon a single measure, see Mitchell, *What Happens During Business Cycles*, p. 11, and Geoffrey H. Moore, "What Is a Recession?" *American Statistician*, October 1967.

For a contrary view, see George W. Cloos, "How Good Are the National Bureau's Reference Dates?" *Journal of Business*, January 1963.

[12] For an example of the application of this concept to the analysis of instability in twelve countries, see Lundberg, *Instability*. Lundberg comments (p. 102): "Obviously the suggested method involves a considerable degree of arbitrariness and subjective judgment."

Output gaps, it may be noted, can be regarded as deviations from a particularly meaningful trend line. They thus resemble the deviations from the trend-adjusted GNP which are among our indicators.

Another possible concept of growth cycles, which is being used in some countries as a basis for empirical research, should be considered. Its salient feature is that the direction of change is decisive, as in classical cycles. But, in contrast to the classical cycle concept, absolute declines observed in certain selected activities suffice for recognizing recessions. Indicators of especially high cyclical sensitivity may show absolute declines despite rising trends. Other indicators fail to participate in the general trend of the economy. Declines in indicators of this type constitute a recession by this definition, the continued growth in aggregate activity notwithstanding.

The switch from a widely diffused decline in aggregate activity to a decline in selected activities involves a more radical change in concept than may at first appear. The revised concept can be defended only on one of two assumptions: Either the activities selected for their absolute declines are more significant than those not declining; or else the absolute decline in selected activities coincides with reduced growth in the rest of the economy and is significant for this reason. Even if this last assumption should be warranted, preference for the use of absolute declines in selected activities would mean that such declines are deemed to be a better measure of retarded growth in aggregate activity than are growth rates in the majority of activities which show no absolute decline.

The concept of the business cycle described above has not been explicitly stated and advocated, as far as I know. Nor have the underlying assumptions been spelled out and investigated. Yet empirical business cycle research in some countries is based on it. The reason is probably that it retains the classical direction-of-change criterion, and, in contrast to our modified concept, requires no revision of statistical methods. However, this simplicity is more apparent than real in view of the crucial unanswered questions mentioned above.[13]

Another possible revision of the business cycle concept which deserves very serious consideration has recently been proposed by Solomon Fabricant.[14] Fabricant argues that "as everybody knows, the general price level has been rising more sharply in recent years than at any other time since the outbreak of the Korean War. Statistical series measuring economic

[13]It may be noted that in the United States at least, the series with absolute decline in periods of low growth in aggregate activity are mostly leading indicators rather than coincident ones. The former are, of course, not suited to the determination of a cycle chronology.

[14]See Fabricant's paper in this volume.

activity in terms of current-price values will be affected by these price changes to a greater degree now than in most earlier periods." He concludes that under today's conditions only indicators measured in real terms should be used in identifying business cycles. The customary pecuniary indicators should be replaced by their deflated counterparts.

Fabricant realizes, of course, that the concept of a deflated cycle is very different from the traditional business cycle concept. Changes in price-cost relationships and fluctuations in the rate of change of the general price level constitute major elements in the process by which a business expansion attains momentum and gradually develops the restrictive forces that tend to bring it to an end. Similarly, prices and costs play a part in the process by which recessions breed revivals. We cannot adequately describe what happens during business cycles, or adequately explain what happens, without referring to price changes. But this basic change is acceptable, Fabricant thinks, when we are concerned merely with identifying cycles and not with describing or explaning them.

To me this distinction appears questionable, since the only purpose of identifying cycles is to provide the framework for description and analysis. But be that as it may, the main question is whether the fundamentally changed concept is a significantly improved tool of cycle analysis.

There are various possible definitions of deflated cycles, and the chronology obtained depends on which one is chosen. One concept, which might be termed the deflated classical business cycle, differs from the traditional business cycle concept only in relying exclusively on indicators in physical units or in constant dollars. A recession is then an absolute fall in deflated indicators. A chronology based on this definition would add at most (we cannot tell yet in August 1970), one recession, in 1969-70, to those identified with the traditional definition. The 1961-69 expansion would remain unbroken.

Otherwise "the indicators based on pecuniary values, and the measurements free of price change, usually tell much the same story."[15] Some of the turning dates of earlier cycles would be shifted, however. Thus, the later part of expansions has typically been a period of rising prices and costs accompanied by relatively little or no growth in physical output. Hence, in deflated cycles, the last stage of some traditional expansions will be shifted into the contraction phase. Amplitudes also differ between real and pecuniary cycles, and the amplitude ranking of historical cycles is likely to change with the new concept.

Altogether then the use of the concept of deflated classical cycles means accepting a basic change in the definition of business cycles and a change in

[15] See Fabricant's paper in this volume, p. 99.

the traditional chronology in order (possibly) to reclassify the latest low growth period. Although it would be interesting to see how the deflated cycles differ from traditional ones, the benefits of this revision seem insufficient to justify it.

A second definition of deflated cycles, and the one Fabricant has in mind, refers to fluctuations in the deviations of the deflated series from their long-run trends. One might speak of deflated growth cycles. Again only physical unit or constant-dollar indicators are to be used. These indicators are to be fitted with trends, and the highs and lows of the deviations from these trends are the turning points.

This definition is quite similar to that of our deviation cycles. The main difference is the technicality that for deflated growth cycles pecuniary series are trend-adjusted in two steps (first for the price trend, then for the remaining trend), while for deviation cycles the adjustment is made in one step. A second possible difference between the two cycle concepts arises if not only the trend but also the cyclical movement of prices is eliminated in deflated growth cycles. If, however, deflation is defined as referring only to the price trend and not to the entire price movement——a possibility considered by Fabricant——then the results with deflated growth cycles should be essentially the same as those with deviation cycles.

Finally, an earlier method of analyzing mild economic fluctuations is to be mentioned here. In her work on cycles in consumption Ruth Mack identified minor waves occurring within business expansions or contractions of the interwar period.[16] Subcycles, as she called them, are shorter (their minimum duration is five months), and flatter (their minimum phase amplitude is zero), than regular business cycles. The subcycle concept proved a useful tool for the analysis of the interwar period. It was not designed, of course, for situations in which the predominance of negative rates of change is a rare exception.

3. CRITERIA FOR THE SELECTION OF INDICATORS

Does the change in the type of cycle to be dated affect the problem of selecting the indicators to be used? The answer for the present study is "no" and for the simple reason that without benchmarks for growth cycles there is no precise information on the behavior of individual indicators in these cycles. The general impression, confirmed by the study of German growth cycles, is that the timing of individual indicators in growth cycles tends to be similar to that in classical cycles. This rule may have important exceptions however. For instance, indicators with strong trends which for this reason are

[16] Ruth Mack, *Consumption and Business Fluctuations*, New York, NBER, 1956.

not useful in dating classical cycles may score high in the dating of growth cycles. Conversely, other indicators may fail to reflect the more subtle growth cycles although their sensitivity suffices for classical ones. Whatever such differences may emerge in the future, however, our best working hypothesis at present is to assume similarity in an indicator's relation to the two types of cycles. Thus we expect series which coincide with classical cycles to coincide also with growth cycles, and so on.

On this assumption we can accept the classification of indicators which underlies the NBER dating of classical cycles and choose indicators from the large collection of series whose cyclical properties have been thoroughly analyzed and evaluated at the NBER, especially by Geoffrey H. Moore and Julius Shiskin.[17]

It is not the new cycle concept but the new method of dating which creates a difficult problem in the selection of indicators. Because of the mechanical procedures it must be decided how many series to include, which ones to select, what weights to apply.

These questions did not arise when the traditional method was applied. Its flexibility enabled the analyst to vary the implied weight of a series as the situation required. He was free to disregard an otherwise reliable indicator if there was reason to believe that its movements in a particular case were due to special, noncyclical forces, as happens occasionally.[18]

In the mechanical determination of reference turns, on the contrary——and this is its greatest disadvantage——a fixed list of indicators must be used, at least at the present state of the experiment. Making up such a fixed list involves problems not heretofore encountered in cycle dating, but similar to problems met before in selecting so-called short lists of indicators. Actually these short lists can be regarded (and the latest ones are so regarded), as precursors of the fixed list.[19]

It is only by experimenting that the effect of the various choices to be made can be detected. Therefore the list on which most of the present study is based——and which is the fourth one tested——is still preliminary. We know

[17] See, e.g., Geoffrey H. Moore and Julius Shiskin, *Indicators of Business Expansions and Contractions*, New York, NBER, 1967, Occasional Paper 103, and Geoffrey H. Moore (ed.), *Business Cycle Indicators*, New York, NBER, 1961.

[18] "Indeed, one of the greatest hazards in forecasting is that a statistical series which is generally highly reliable may suddenly and without warning prove quite unreliable" (Alec Cairncross, "Economic Forecasting," *Economic Journal*, December 1969, p. 803).

[19] The "short list" is a "list of 25 series, drawn from the full 1966 list of 88 series. All . . . series on the short list have high scores and involve little duplication." A short list of indicators "is a step toward a summary, from which one may wish to go farther . . . " (Moore and Shiskin, *Indicators*, pp. 4 and 32).

that certain changes in it are desirable but have postponed them in the expectation that further ones will suggest themselves. Making all changes at one time saves the cost of repeated analysis.

The following are some of the required difficult choices: How many indicators should be included? Taking a small group has the advantage that the selection can be limited to the highest-scoring coincident indicators. But even the best indicators are imperfect, and this argues for a longer list which will reduce the effect of the vagaries of an individual series on the results. We have experimented with lists of 7, 12, and 19 indicators and settled tentatively on a 17-indicator list. The selections are described in section 4 and the series are shown in Table 3 (section 5).

The next question is whether to include only roughly coincident indicators or also leading and lagging ones.[20] Although the former are naturally the most important for cycle dating, leading and lagging series can also be helpful when they represent important aspects of the economy not represented by the coincident ones. In cases of double peaks and troughs, for instance, leading and lagging indicators may contribute to the decision.

Moreover, it would be wrong to assume that turns in averages of indicators classified as "roughly coincident" coincide exactly with the handpicked, classical reference turns. The truth is that the roughly coincident series lead far more often than they lag. This reflects the NBER principle of late dating, of which more below. If such series are used exclusively the combined index has a tendency to lead at reference dates. To compensate for this some lagging series must be included.

Further, the NBER timing classification is based on the record of a series during the full period for which it is available. In some instances this may differ from its record after 1947. An unclassified series may thus, in the period under review, coincide as regularly as a classified one. For these reasons the 17-indicator list includes, in addition to 12 coincident series, one leading, three lagging, and one unclassified series.

A third issue concerns the inclusion of quarterly series, which may be deemed inappropriate for determining monthly reference turns.[21] However, "it would not do . . . to neglect quarterly series entirely. GNP, plant and equipment expenditures, new capital appropriations, changes in business inventories, and corporate profits, all of which are quarterly, are far too

[20] Rough coincidences include exact coincidences and leads and lags of three months or less.

[21] See e.g., Norman Trueblood, "The Dating of Postwar Business Cycles," American Statistical Association, *Proceedings of the Business and Economic Statistics Section*, 1961, p. 17.

important."[22] These series are helpful in deciding the existence of a cycle in doubtful cases and in determining the neighborhood of turns. Therefore, four quarterly series are included in the 17-indicator list.

However, the assumption that quarterly series turn in the center month of the quarter may impart a bias toward center-month turns to the reference dates. This can be avoided by constructing two alternative indexes in which turns are assumed to occur in the first and last months of the quarters respectively. Rules can be set up to decide the——relatively few——cases in which the reference turn varies among the three sets of indexes.[23]

How should one choose among all the possible indicator lists that would fit the aforementioned general considerations? Our main criterion in evaluating a list is its performance in dating classical business cycles. The chronology obtained when our mechanical methods are applied to the list in question should be as similar as possible to the generally accepted NBER chronology obtained by traditional subjective methods. The idea is that a list which yields the "right" classical turns will also yield the "right" growth cycle turns. This may certainly be questioned but, at present, it is the best working hypothesis. Moreover, use of such a list warrants the assumption that the relations found between classical and growth cycles are not attributable to the choice of indicators.

Should the currently used classical cycle chronology be the target to be duplicated or should we aim at slightly revised dates? The latter seems the preferable choice. The main reason is that some of the time series on which the chronology is based were revised substantially *after* the determination of the presently used dates. Since these revisions can, in some instances, affect the selection of a reference date, it is sensible to take them into account and to set up a slightly revised version of the customary NBER chronology as our target. The discussion of these revisions will be found in section 4.

The task is, then, to put together a list of indicators on the basis of which our mechanical methods reproduce the revised classical NBER cycle chronology. Outsiders may think that this is easy, that any combination of high-rated indicators will fill the bill. But this is not so. Due to the indicators' imperfections, the turns of indicator averages vary with the indicator mix. Considerable experimentation is thus needed to discover a list with which the computer program reproduces exactly each of the eight classical cycle turns, 1948-61. Our tentative 17-series list is still not perfect by this standard. On its basis the diffusion index misses one of the target turns and the composite index misses two.

[22] Moore and Shiskin, *Indicators*, p. 33.

[23] This procedure has been applied in Mintz, *Dating Postwar Business Cycles*, p. 21. In the present paper it has been used for one diffusion index without causing any change in turns. It will be applied to all indexes in the final version of the study.

Another criterion by which the quality of indicators should be judged has not been used so far, but will be used in the final version. It concerns the agreement between deviation cycles and step cycles. The higher the agreement between turns in the deviations of a series from its trend and turns in its rate of growth, the more suitable it is for the dating of growth cycles.

There are considerable discrepancies between deviation cycles and step cycles of some of our present indicators, as will be seen in later sections. These discrepancies are reflected in the resulting reference chronologies. In order to reduce the consequent uncertainty about growth cycle dates, indicators with large discrepancies will be eliminated from the final list as far as possible.

In the next section the classical reference dates obtained with different indicator lists will be discussed.

4. CLASSICAL BUSINESS CYCLES DATED BY COMPUTER METHODS

The Statistical Procedures

The procedures used in this study in adjusting and combining indicators are as follows:

Modification of Indicators. All indicators, except a few which show no seasonal fluctuations, are published in seasonally adjusted form in *Business Conditions Digest (BCD).*[24] The adjustment is made either at the data source or at the Bureau of the Census by the X-11 seasonal adjustment program. We do not use the series in their published form, however, but in the modified version which is also produced by the X-11 program and is designed to eliminate extremes from the irregular component of the series.[25] Modification could be dispensed with in the analysis of classical cycles, but in the analysis of rates of change large erratic movements are so disturbing that this adjustment was found to be necessary. It is not to be denied that modification like seasonal adjustment may shift turns in undesirable ways at times, but this disadvantage is minor in comparison to some quite unacceptable results obtained with unmodified series in the analysis of growth cycles.

[24] *Business Conditions Digest* (formerly *Business Cycle Developments*), published monthly by the Bureau of the Census, U.S. Department of Commerce.

[25] The modification consists in replacing the extreme values of the series with the corresponding values of a smoothed version (a Henderson curve) of it. The method is described in Julius Shiskin, Allan H. Young, and John C. Musgrave, *The X-11 Variant of the Census Method II Seasonal Adjustment Program*, Bureau of the Census, Technical Paper No. 15, February 1967.

Turning Points in Indicators. The turning points of the adjusted and modified series are selected by the aforementioned Bry–Boschan computerized method.[26] This method consists, essentially, in first identifying major cyclical swings, then delineating the neighborhoods of their maxima and minima, and finally narrowing the search for turning points to specific calendar dates. All procedures are performed on the seasonally adjusted modified data.

This stepwise approach to the selection of turns is necessary because most time series are much too choppy for direct mechanical selection of cyclical maxima and minima. Such a procedure would, instead, give a large number of highs and lows most of which would indicate only a brief fluttering of the data rather than a cyclical turn. For this reason the existence of cycles must first be determined in a smoothed form of the series before the precise date can be selected in the unsmoothed data.

The first curve from which turning points are determined is a twelve-month moving average of the seasonally adjusted, modified data. This is a convenient means for eliminating fluctuations of subcyclical duration or of very shallow amplitudes. The rule for selecting turning points is: any month whose value is higher than those of the five preceding months and the five following months is regarded as the date of a tentative peak; analogously, the month whose value is lower than the five values on either side is regarded as the date of a tentative trough. These tentative turns are tested for compliance with a set of constraint rules concerning alternation of phases and duration of phases and cycles.

The next step in the process is the determination of tentative cyclical turns on the Spencer curve of the seasonally adjusted, modified data. The Spencer curve is selected as the next intermediary curve because its turns tend to be closer to those of the unsmoothed data than are those of the twelve-month moving average.[27]

In principle, the program searches, in the neighborhood (defined as plus or minus five months) of the turns established on the twelve-month moving average, for like turns on the Spencer curve. That is, in the neighborhood of peaks, it searches for the highest of the eleven points on the Spencer curve; in the neighborhood of troughs, for the lowest. The Spencer curve turns thus located are then subjected to several tests.

[26] Bry and Boschan, *Cyclical Analysis.*

[27] The Spencer curve is a complex fifteen-month graduation formula, a weighted moving average with the highest weights in the center and negative weights at either end. This ensures that the curve follows the data closely. It has approximately the flexibility of a five-month moving average but is much smoother.

They are rejected when they are (1) less than six months from either end of the series; (2) like turns and less than fifteen months apart; and (3) like turns without an intervening opposite turn.

The accepted turns in the Spencer curve provide the basis for the next step in the search for turns in the unsmoothed data. In this step the series is smoothed by a three- to six-month moving average. The exact number of months depends on the time it takes for the cyclical component to exceed the irregular component in the particular series analyzed.

The method of deriving turning points in this moving average is practically the same as that for the Spencer curve. The highest peaks on the moving average curve within a span of five months from the dates of the peaks on the Spencer curve are selected and, correspondingly, so are the troughs.

The last step of the procedure is to find the peak and trough values in the unsmoothed, seasonally adjusted, modified data which correspond to the short-term moving average turns previously established. This search is again analogous to the previous ones. The program establishes the highest values in the unsmoothed data within a span of plus or minus five months from the peak in the short-term moving average curve; correspondingly, the lowest value of the unsmoothed data in the neighborhood of moving average troughs is established.[28]

Having again eliminated any turns not complying to the rules, the remaining ones are the final programed turning points of the series.

It should be noted that the computer program does not utilize directly any information on the amplitude of cycles. The only way in which amplitude plays a role is that the moving averages, especially the initial twelve-month moving average, tend to iron out minor swings (though only if they are also brief). The program's disregard for amplitudes makes the good agreement between traditional and programed specific cycles even more remarkable.

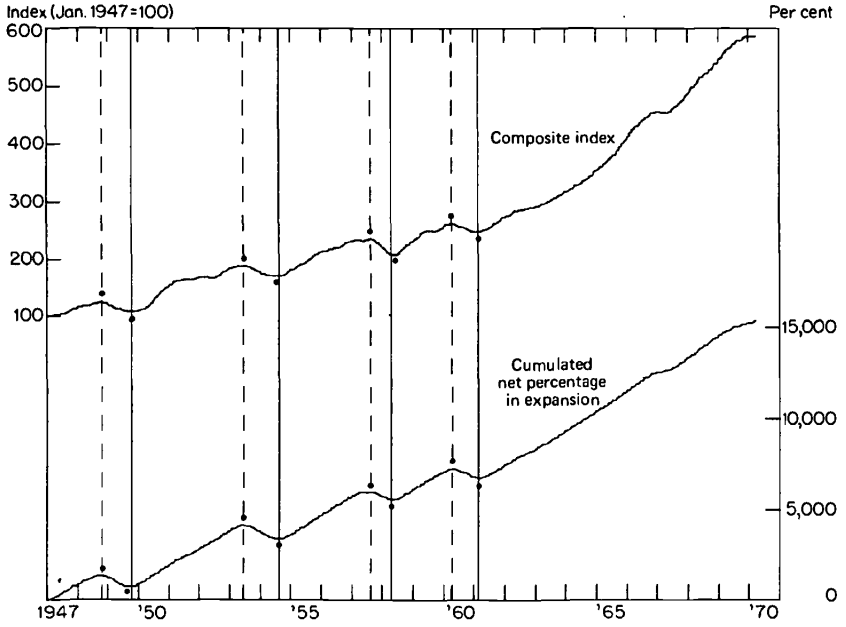
Out of the 162 turns of nineteen indicators in classical business cycles, 1948-61, all but three have been accepted in this study. The three corrections are due to a minor shortcoming of the program.

Turning Points in Reference Cycles. One method of identifying reference cycle turns utilizes the indicator turns in the construction of a diffusion index. This index is constructed by counting, in each month covered, the number of indicators in their high-rate phase. The phase may be a classical expansion or a growth cycle phase. An indicator is classified as in high-rate phase during the months between its upturn and its downturn, exclusive of the upturn month and inclusive of the downturn month. (The low-rate phase is defined correspondingly.) The excess of the number of indicators in

[28]To be more precise, the span varies between four and six months, depending on the term of the moving average.

high-rate phase over the number in low-rate phase is expressed as a percentage of the total number of indicators covered. This percentage is termed the "historical diffusion index." A downturn in this index—the reference cycle downturn—is located in the month in which the number of indicators in the high phase exceeds the number in the low phase and which precedes a month in which indicators in the low phase outnumber those in the high phase. The index thus crosses the zero line between the downturn and the following

Chart 1
Classical U.S. Business Cycles, 1947–70
Seventeen Indicators



Net per cent in expansion: excess of percentage undergoing cyclical expansion over percentage undergoing contraction.

Composite index: average of amplitude – adjusted rates of change of 17 indicators. The average rate for January 1947 is set equal to 100.

Solid vertical lines indicate business cycle troughs, broken vertical lines, business cycle peaks based on the revised reference cycle chronology (see text).

month. The upturn is determined in corresponding fashion. In order to show cycle turns, as customary, at the highest and lowest points of cycle curves, rather than at the crossing of the zero line, the index is usually shown in cumulated form (Chart 1).[29]

[29] Some of the diffusion indexes in Table 1 and 2 are not "historical" indexes but "current" ones. The method of construction is the same in both. However, in the current index an indicator in a given month is defined as in upswing or downswing according to its change over a fixed span of months, instead of by its cyclical phase.

The second method of identifying reference cycle turns does not require identification of indicator turns. It uses composite indexes which are constructed as follows: First, the month-to-month percentage changes in each indicator are obtained, using as base the average of the two months rather than the initial month (to assure symmetrical treatment of increases and decreases). Second, these percentage changes are standardized so that their average, without regard to sign, is equal to unity (1.0 per cent per month) for each indicator, January 1947-March 1970. Third, the adjusted percentages for a given month are averaged over the several indicators, which are given equal weights. Fourth, these averages are adjusted so that they too will equal 1.0 per cent per month, January 1947-March 1970. Finally, the adjusted average percentage changes are cumulated into a monthly index.[30]

Turning points in composite indexes are selected by the same method by which turning points in individual indicators are determined.

Opinions will differ regarding the acceptance or rejection by the program of borderline cases, i.e., relatively mild cycles. Since drawing the line here is a matter of subjective judgment and since the turns selected by the program seem sensible to us, we have not attempted any modifications.

Comparison of Handpicked and Programed Chronologies of U.S. Classical Business Cycles

Chronologies Related to Traditional NBER Reference Cycle Turns. A number of diffusion indexes and composite indexes based on various lists of indicators have been constructed for the present study. The purpose was to find an index turning in the months previously selected as classical business cycle turns. The timing of turns in these indexes is shown in the lower part of Table 1.[31]

The smallest number of indicators is used in the composite index in line 9 and is based on the seven coincident indicators making up the NBER 1966 short list, which represents a well-rounded group of roughly coincident high-scoring series.

For the indexes in lines 10, 14, and 15 we have added five indicators to the original seven. Of the additions one is a leader and one a lagger, both from the short list; three are coincident but not on the short list.

The third group comprises seventeen indicators, of which six are coincident series from the short list, six are coincident series not from the short list, one is a leader and three are laggers from the short list, and one is an unclassified series (lines 11 and 16).

[30] Julius Shiskin and Geoffrey H. Moore, "Leading Indicator Indexes: Construction, Performance, and Uses" (mimeo), p. 9.

[31] The individual series covered are listed in Table A–1.

The fourth group differs from the third by including one more leader and one more lagger, both from the short list (lines 12, 13, and 17).

In addition to the indexes constructed for this study the table also shows indexes made up by others for various purposes other than the determination of business cycle turns (lines 4 to 8). Furthermore, the table includes for comparison the reference chronologies of Cloos and Trueblood, which are not based on mechanical methods but on judgment similar to that applied to the traditional NBER turning points (lines 2 and 3; see source note to table).

All indicators are monthly except for one quarterly series in the group of seven and three more quarterly series in the larger groups.

TABLE 1

Leads and Lags of Turns in 16 Chronologies of U.S. Classical Business Cycles at NBER Reference Turns, 1948–61

(CI = composite index; DI = diffusion index)

Line No.	Type of Index	No. of Indicators	Lead (−) or Lag (+) in Months at the Following Peaks (P) and Troughs (T) in U.S. Business Cycles (Year and Month):								Total Discrepancies		Author (See notes for full references.)
			P '48	T '49	P '53	T '54	P '57	T '58	P '60	T '61	No.	No. of Months	
1			11	10	7	8	7	4	5	2			
2	No index used		−1	−3	0	−3	+1	0	0	0	4	8	Trueblood
3	Median	4	−1	−3	−1	−3	+1	0	0 or +2	0	5 or 6	9 or 11	Cloos
4	CI	5	−1	0	0	0	+1	0	−3	0	3	5	Shiskin-Moore
5	CI	6	−1	0	0	−3	+1	0	0	0	3	5	Shiskin
6	DI	8	−1	0	−2	−1	0	0	−1	0	4	5	Shiskin
7	DI	8	−2	+1	0	−4	+1	−1	0	0	5	9	Shiskin
8	DI	15	−2	0	−1	−2	−4	0	−1	0	5	10	Bry-Boschan
9	CI	7	−1	0	−2	−3	+1	0	−1	0	5	8	Mintz
10	CI	12	−1	0	−2	−3	−5	0	−1	0	5	12	Mintz
11	CI	17	−1	0	−1	−1	+1	+1	−1	0	6	6	Mintz
12	CI	19	−1	0	−2	−1	+1	+1	−1	0	6	7	Mintz
13	CI	19	−1	0	−1	0	+1	+1	−1	0	5	5	Mintz
14	DI	12	−2	0	−2	0	−4	−1	−1	0	5	10	Mintz
15	DI	12	−2	−2	−1	−3	−3	0	0	0	5	11	Mintz
16	DI	17	−1	−2	−1	0	+1	0	−1	0	5	6	Mintz
17	DI	19	−2	−2	−1	0	0	0	−1	0	4	6	Mintz

Notes to Table 1

P = peak.

T = trough.

Note: For a listing of the individual series included in each index, see Table A-1.

Line 1. The standard NBER business cycle chronology.

2. Source: Norman C. Trueblood, "The Dating of Postwar Business Cycles," *American Statistical Association, Proceedings of the Business and Economic Statistics Section*, 1961, pp. 17–19.

3. Source: George W. Cloos, "How Good are the National Bureau's Reference Dates?" *Journal of Business*, January 1963, pp. 14–32. Coverage: Roughly coincident indicators.

4. Source: Julius Shiskin and Geoffrey H. Moore, "Leading Indicator Indexes," draft prepared for a meeting of the International Statistical Institute, London, September 1969, p. 7. Also charted in U.S. Department of Commerce, Bureau of the Census, *Business Conditions Digest*, Monthly. Coverage: Roughly coincident indicators from the NBER 1966 Short List.

5. Source: Julius Shiskin, *Signals of Recession and Recovery*, New York, NBER, Occasional Paper, 66, 1961, p. 180. Coverage: Roughly coincident indicators from the NBER 1960 Short List.

6. Source: *ibid.*, p. 185. Coverage: Roughly coincident indicators from the NBER 1960 Short List. Diffusion index is current for one-month span.

7. Source and coverage same as for line 6. Diffusion index is current for three-month span.

8. Source: Gerhard Bry and Charlotte Boschan, *Cyclical Analysis of Time Series: Selected Procedures and Computer Programs*, New York, NBER, 1971. Coverage: Roughly coincident indicators from NBER 1966 Short List and Full List. Diffusion index is historical.

Lines 9 to 17. Indexes were constructed for this study.

9. Coverage: All roughly coincident indicators from the NBER 1966 Short List. Nonmodified series.

10. Coverage: Same indicators as in line 9, plus one leader and one lagger from the same list, plus three roughly coincident indicators from NBER 1966 Full List. Nonmodified series.

11. Coverage: From the NBER 1966 Short List: 6 roughly coincident indicators, 1 leader, 3 laggers. From the NBER 1966 Full List: 6 roughly coincident indicators and 1 unclassified series. Modified series.

12. Coverage: Same as in line 11, except that one leader and one lagger are added. Modified series.

13. Same as line 12, except that index is rounded.

Lines 14 to 17. All diffusion indexes are historical.

14. Coverage: Same as line 10. Nonmodified series.

15. Coverage: Same as line 10. Modified series.

16. Coverage: Same as line 11. Modified series.

17. Coverage: Same as line 12. Modified series.

The most striking feature of Table 1 is the stability of the dates. In not one instance do the measures suggest omission of a turn.[32]

But the table also reveals that all chronologies differ at some points from the traditional NBER dates. As indicated in the last columns such differences occur at from three to six of the eight turns covered and involve leads and lags adding up to from five to twelve months. Except for lags at the 1957 peak, almost all discrepancies are due to leads of the chronologies relative to the traditional NBER dates. We shall discuss this aspect presently.

The BCD composite index of five coincident indicators (line 4) differs "only" three times from the traditional chronology, but in one case (1960) the discrepancy amounts to as much as three months. The older composite index (line 5) agrees in 1960 but leads by three months in 1954. Even less agreement is shown by the diffusion indexes (lines 6, 7, 8).

Among indexes constructed for this study, the composite index based on the short list's seven coincident series (line 9) leads at 4 out of 8 traditional turns. This reflects the fact that more than half of the timing relationships of the individual indicators are leads and the average timing of every one of the seven is leading (measured by the median timing at the 8 turns).

There is no change in timing when the composite index is based on twelve indicators instead of on seven (line 10). The exception is the 1957 peak which is shifted from the end to the start of a flat ceiling by the addition of series with early downturns. This composite index thus leads at 5 out of 8 turns. Diffusion indexes derived from the same twelve indicators (lines 14, 15), also lead at the majority of turns and the leads are on the average longer than those of the composite indexes. Expanding the base of the indexes to seventeen or nineteen indicators reduces at least the average duration of the discrepancies if not their number (lines 11, 12, 13, 16, 17).

The evidence of Table 1 suggests that no otherwise satisfactory list of indicators will yield the exact dates constituting the traditional NBER chronology. This, of course, is not surprising. Quite the contrary, one must be impressed by the closeness of the programed turns based on the latest version of the indicators and the traditional turns based on earlier, yet unrevised versions.

Revision of Traditional NBER Reference Cycle Turns. However, the discrepancies are an argument for adjusting the traditional chronology. Not the only argument, of course. For years it has been recognized at the NBER

[32] There are also no additional turns in any of the indexes.

that the chronology should be reviewed in the light of the latest information.[33] This we have done and the revised chronology is shown at the top of Table 2.

The proposed adjustments shift three out of the four peaks covered to the month preceding the traditional peak and the fourth to the month following the traditional peak. The four troughs remain unchanged. The average shift is thus only half a month. (This may be compared to an average shift by 0.6 months for the cycles 1919-38.[34]

The adjustments reflect the long-recognized tendency of reference turns to lag relative to indicator turns.[35] Before World War II it occurred mainly at troughs, but afterward it became characteristic of the peaks. One cause of the lags is obvious: observance of the rule to place reference turns toward the end of flat turning zones. As troughs since 1948 have been far more sharply drawn than peaks, the late-dating rule affects only the latter.[36]

Another explanation of lateness of turns has been suggested, namely, that there is a systematic downward bias in unrevised data.[37] It is not clear why this should be the case. However, it would at any rate explain only lateness at troughs and have the contrary effect at peaks.

It has also been surmised that in the interwar period symptoms of economic upturns had to be viewed most cautiously, while in more recent cycles it is the downturn which is relatively unlikely. It is not impossible that considerations of this type affected the decisions of NBER analysts, but it appears much more likely to me that these decisions reflected simply the facts of each given situation: the concentrated sharp upturns of indicators at troughs, the scattered gradual decline of indicators at peaks.

The reasons for revising the traditional chronology will now be reviewed date by date, drawing on the views found in the literature and on the evidence shown in Table 1.

[33] "There is need for a review of the recent (postwar) business-cycle reference dates in the light of revised and new data now available. This has been clearly acknowledged by the National Bureau" (Zarnowitz, "Dating of Business Cycles," p. 189). Work in progress for this purpose was interrupted by the untimely death of Alexander Pitts.

[34] Geoffrey H. Moore, "Discussion," American Statistical Association, *Proceedings of the Business and Economic Statistics Section*, 1961, pp. 34–35.

[35] Moore (ed.), *Business Cycle Indicators*, p. 218.

[36] For discussion of the rule, see Zarnowitz, "Dating of Business Cycles," p. 194.

[37] Trueblood, "Dating of Postwar Business Cycles," p. 17.

The 1948 peak has been shifted from November to October. The two months were close rivals to begin with according to Moore ("Discussion," p. 34) and Fels (p. 25)[38] Trueblood is "persuaded that October is preferable to November as the cycle peak month" (p. 17) because revisions had lowered GNP, personal income, and industrial production in the very end months of 1948 relative to the autumn months.

The argument in favor of the earlier date is strongly supported by the evidence in Table 1, where all indexes without exception turn in September or October, rather than November.

The 1949 trough remains unchanged in October. In this case the NBER was faced with "a close decision because the trough was double-bottomed" (Fels, p. 5). This is confirmed by Moore who refers to uncertainty between October or "some earlier month" ("Discussion," p.34). Trueblood argues at length in favor of July as the correct date which, he maintains, was obscured by unrevised data and by the effects of major strikes (pp. 17, 18). Similarly Cloos finds that "July is a rather good reference month, and October is much too late" (p. 28). Zarnowitz discusses the difficulty of setting a reference date in a period of major strikes. He seems to be leaning more toward the later date (p. 187).

The evidence in Table 1 is mixed. The diffusion indexes give the earlier, the composite indexes the later, date. This means that while the majority of indicators rose in September and October, the amplitude of rises was on the average smaller than that of declines.

For this reason the case for August seems to me slightly stronger than that for October.

The 1953 peak has been shifted from July to June. This shift has not been suggested by others. Yet, most of the indexes suggest June, or even May, as the turning month. I conclude, therefore, that June is preferable to July.

The 1954 trough remains unchanged in August. Trueblood argues for a shift to May because the revised data show a "quite small" rise from May to August. But he also notes: "The question whether the period from the spring to late summer 1954 should be treated as a protracted 'bottoming out' period and part of the recession, or as the beginning of cyclical recovery, thus balances on a fairly narrow statistical margin" (p. 18). Zarnowitz does not make a choice but notes that "the uncertainty attaching to an earlier choice would have been considerably greater" (p. 198).

[38]Sources referred to in the discussion of individual turning points are as follows (figures in parentheses refer to footnote in which the full citation appears): Cloos, "National Bureau's Reference Dates" (11); Fels and Hinshaw, *Business Cycle Turning Points* (11); Moore (ed.), *Business Cycle Indicators* (17); Moore, "Discussion" (34); Trueblood, "Dating of Postwar Business Cycles" (21); and Zarnowitz, "Dating of Business Cycles" (11).

The timing of the indexes in Table 1 reflects the dilemma very well. Many turn before August, but those which we regard as the best ones do not and this is the basis for our decision.

The 1957 peak has been shifted from July to August. Moore found in 1958 that it was "difficult to say whether July or August should be considered the zenith" (*Indicators*, p. 146). Fels terms July "a close choice over August" (p. 30). Trueblood thinks that "a better case can be made for August than for July" (footnote 11).

The indexes in Table 1 show a mixed picture. But it is mixed between August and a much earlier month, April or even March, rather than between August and July. It is a clear case of a double peak with the later peak occurring definitely in August rather than in July.

The 1958 trough remains unchanged in April. According to Trueblood this is "the clearest monthly trough indicated for any of the recessions covered" (p. 19). Fels notes that no alternative has been suggested (p. 6).

Most of the indexes in Table 1 turn in April. There is thus no reason for an adjustment.

The 1960 peak has been shifted from May to April. This conflicts with the view of Trueblood that "May seems to be a reasonable choice for peak month although it does represent a compromise in a rather ambiguous period" (p. 19). It also conflicts with Cloos who regards July, if anything, as an alternative rather than April (p. 29).

Our decision is based on the evidence of the indexes which almost uniformly point to April as the peak date. The *BCD* composite index would select an even earlier month (February).

The 1961 trough remains unchanged in February. There is general agreement on this date and it is supported by every one of the indexes in Table 1.

Table 2 is the same as Table 1 except that the timing is now related to the revised reference turns. It may be noted that the revision reduces the discrepancies between the NBER dates, on the one hand, and the turns selected by Cloos, the Shiskin-Moore index, the Bry-Boschan index, and one of the Shiskin indexes, on the other. The revised dates are not closer, however, to the Trueblood dates, nor to two of the Shiskin indexes.

The indexes prepared for this study turn closer to the revised than to the standard dates, of course, since they have influenced the revision decision. Based on the 17-indicator list, the composite index and the diffusion index agree better with the reference dates than any chronology in Table 1. The composite index (line 11) coincides at six turns and differs by one month at each of two troughs. The diffusion index coincides at these same troughs, but leads by two months at the 1949 trough.

TABLE 2

Leads and Lags of Turns in 17 Chronologies of U.S. Classical Business Cycles at Revised Reference Turns, 1948–61

(*CI = composite index; DI = diffusion index*)

Line No.	Type of Index	No. of Indicators	Lead (−) or Lag (+) in Months at the Following Revised Peaks (P) and Troughs (T) in U.S. Business Cycles (Year and Month):								Total Discrepancies: No. of	No. Months	Author (See notes for full references.)
			P '48 10	T '49 10	P '53 6	T '54 8	P '57 8	T '58 4	P '60 4	T '61 2			
1	No index used		+1	0	+1	0	−1	0	+1	0	4	4	NBER
2	No index used		0	−3	+1	−3	0	0	+1	0	4	8	Trueblood
3	Median	4	0	−3	0	−3	0	0	+1 or +3	0	3	7 or 9	Cloos
4	CI	5	0	0	+1	0	0	0	−2	0	2	3	Shiskin-Moore
5	CI	6	0	0	+1	−3	0	0	+1	0	3	5	Shiskin
6	DI	8	0	0	−1	−1	−1	0	0	0	3	3	Shiskin
7	DI	8	−1	+1	+1	−4	0	−1	+1	0	6	9	Shiskin
8	DI	15	−1	0	0	−2	−5	0	0	0	3	8	Bry-Boschan
9	CI	7	0	0	−1	−3	0	0	0	0	2	4	Mintz
10	CI	12	0	0	−1	−3	−6	0	0	0	3	10	Mintz
11	CI	17	0	0	0	−1	0	+1	0	0	2	2	Mintz
12	CI	19	0	0	−1	−1	0	+1	0	0	3	3	Mintz
13	CI	19	0	0	0	0	0	+1	0	0	1	1	Mintz
14	DI	12	−1	0	−1	0	−5	−1	0	0	4	8	Mintz
15	DI	12	−1	−2	0	−3	−4	0	+1	0	5	11	Mintz
16	DI	17	0	−2	0	0	0	0	0	0	1	2	Mintz
17	DI	19	−1	−2	0	0	−1	0	0	0	3	4	Mintz

P = peak.
T = trough.

Note: For explanation of the revised reference turns, see text. For explanation of the indexes, see the notes to Table 1. Line 1 of Table 2 gives the lead (−) or lag (+) of the traditional NBER chronology shown on line 1 of Table 1.

The planned final revision of the 17-indicator list should remove even these small discrepancies. In the meantime the 17-indicator list is used in the remainder of this study as the currently best approximation to the desired one.

A further point to be noted in favor of the 17-indicator list is the extraordinary smoothness of the indexes based on it (see Chart 1). This

greatly reduces the uncertainty of turning dates. The month-to-month percentage change of the irregular component of the composite index is only 0.26 as compared to 0.43 for the Moore-Shiskin index. The ratio of the irregular to the cyclical change is 0.27 for the 17-indicator index, compared to 0.57 for the Moore-Shiskin index.[39]

5. DEVIATION CYCLES AND STEP CYCLES IN INDIVIDUAL INDICATORS

Procedures for Deviation Cycles

The first of our two growth cycle definitions is: Growth cycles are cycles in a series' deviations from its long-run trend. The identification of deviation cycles and the dating of their turning points depends, of course, crucially on the selection of the trend curve. The unavoidable arbitrariness of this selection is a serious and valid objection to reliance on trend-adjusted data. It is the main reason for our use of a second growth cycle definition which is entirely independent of the choice of trends and thus provides a check on the deviation cycles.

It is also worth noting that the reference growth cycle is based on a composite of a number of indicators, each adjusted by its own trend. There is thus a chance for some offsetting of errors and the method is less dangerous than when an entire analysis relies on a single trend curve fitted to the GNP or to potential output.

As a check we have also recomputed several composite indexes by using indicators not adjusted for trend and, instead, adjusting the finished composite index. In most instances, the turns in deviations of this composite index from the 75-month moving average coincide with the turns in the corresponding composite index based on trend-adjusted indicators. But with most indicator lists one or two of the fourteen turns in each of two corresponding indexes differ by a month or two.

In order to reduce the arbitrariness of the trend adjustment as far as possible, we applied the same formula to all seventeen indicators. This could not have been done with fitted trends because of the diversity of long-run movements among indicators. In some instances the movements of a series have shifted over time, and two or more trends would have had to be fitted to a single indicator. Since it is inadvisable to fit several trends to a period of only twenty-three years and even more inadvisable to adjust different

[39]Measures for the Shiskin-Moore index are from *Business Conditions Digest*, June 1970, p. 101. For explanation of the measures and further examples, see Julius Shiskin, *Signals of Recession and Recovery*, New York, NBER, Occasional Paper 77, 1961, pp. 48, 49.

indicators in different ways, we decided on using a long-term moving average flexible enough to cope with the diversity of trends. In order to iron out cyclical swings a term of six to seven years is required. We chose a seventy-five-month moving average as a convenient figure that fits the requirement. The missing thirty-seven months at either end of the moving average are supplied with the help of its average rate of change during the first two years and last two years for which it is available. This method of extrapolation implies that the series proper is assumed to repeat, in the period not covered by the data, its pattern during the first and last years which are covered by the data. For two series the trends through March 1970 are shown in the top panels of Charts A-1 and A-2, in the appendix, below.

The percentage deviations of the series from their moving average trends represent the deviation cycles of the indicators (the second panels on Charts A-1 and A-2).[40] The turning points are selected by the computer program described in the preceding section.

Findings on Deviation Cycles

The analysis covers the period from November 1947 to March 1970. In this period the program identifies 15 turns in each of eight indicators; 13 turns in six more indicators; 12 turns in one and only 10 turns in the two remaining series. Of the 14 growth cycle phases delimited by these turns, 7 correspond to classical business cycle phases; 2 occur about 1951-53, the Korean war cycle; and 5 are phases of the 1960's. The phases skipped by those indicators which have fewer than 15 turns are most often those of the Korean cycle (seven indicators). The 1961-63 cycle is skipped by only one series, despite its mildness. Through March 1970, two series had not turned up since 1966 and two others had not turned down since 1967.[41]

Inspection of the charts shows that most trend-adjusted indicators move in clear-cut cyclical swings with unmistakable turning points.[42] (In the final version of the study charts like A-1 and A-2 will be provided for all indicators.) Sharply defined cycles of large amplitude are found in corporate profits, expenditures on plant and equipment, job openings, and imports. Cycles of smaller amplitude but of outstanding smoothness are characteristic

[40]The unemployment rate and the number of unfilled jobs show no rising trend. For some other indicators trends are debatable, at least for part of the period. However, for uniformity, all series have been expressed as deviations from the moving average.

[41]Of the 230 turning points recognized by the program I have changed three and omitted three. I have also added three turns not recognized by the program.

[42]In the final version of the study measures of amplitude and smoothness will be supplied.

of GNP in 1958 dollars, wages and salaries, the number of employees, and inventories. Deviation cycles are less clear, on the other hand, in series whose large erratic movements obscure to some extent the cyclical ones. This holds mainly for labor costs and interest rates. Prices have been stable over some periods so that the dating of their turning points is sometimes difficult.

In all series the amplitudes of deviation cycles which correspond to classical business cycles are much larger than the others. This implies that the amplitudes are smaller in the 1960's than in the 1950's. The flattest movements occur in most instances during the peak-to-peak cycle of 1951-53, and during the trough-to-trough cycle of 1961-63.

In these borderline cases existence of a deviation cycle may well be questioned. However, omitting flat cycles would require specificiation of amplitude minima. The thorny problems involved in setting amplitude standards have prevented their use in both the traditional NBER method and in the Bry-Boschan computer method. One main aspect of the problem is that amplitudes change over time; consequently, standards derived from an earlier period may be entirely inappropriate in a later one. For this and other reasons we have not attempted to introduce an amplitude constraint into the turning point program.[43]

Even the flattest cycle, however, represents a prolonged movement in one direction. And most importantly, there was remarkable consilience among indicators even in marginal cycles. This last point will be the topic of the following chapter.

Procedures for Step Cycles

Our second definition——growth cycles are alternations between periods with relatively high rates of change and periods with relatively low rates of change——has the advantage of focusing on that aspect of economic change which today attracts the greatest interest. Moreover, it is independent of subjective trend selections. However, the disadvantage of the approach, for our purposes, is that growth rates have to be analyzed by a technique different from the one applied to the original series.

The crucial point is that in the case of rates of change cycle phases cannot be defined by rises and falls but must be defined by high and low levels. This was found by Milton Friedman and Anna Schwartz in their work on money, and they termed the alternations of high and low rates "step cycles."[44] To avoid misunderstandings it should be noted that the special treatment of rates

[43]For a fuller explanation see Bry and Boschan, *Cyclical Analysis*, pp. 11–15, 16.

[44]Milton Friedman and Anna Schwartz, "Money and Business Cycles," *Review of Economics and Statistics: Supplement*, February 1963.

of change is not based on their exhibiting step patterns. The reason for the step cycle concept is, rather, that the timing of rises and falls in growth rates differs from their timing in the underlying series. Growth tends to be most rapid when it starts from a low base, i.e., shortly after the end of a period of low growth or decline. Conversely, rates tend to be lowest shortly after the termination of rapid-growth period and thus at the beginning rather than at the end of a low-growth period. This behavior of rates of change means that large parts of business expansions are characterized by falling rates and large parts of business contractions by rising ones, rather than the other way around.

This growth rate pattern is illustrated by the third curve on Charts A-1 and A-2, and there is ample evidence for it in the literature. For instance, the rate of increase of U.S. gross national product in constant dollars was 60 per cent higher, on the average, in the first halves of the seven expansions (1921-38, 1949-61) than in their second halves. The rate of fall in the corresponding seven contractions was twice as large in the earlier part than in the later one.

Furthermore, the average monthly rate of change of thirty-four comprehensive American series before 1938 was more than twice as high between business cycle troughs and the first third of expansions than in later expansion stages. The average rate of decline was largest in the first half of contractions.[45]

Thus, if cycle phases were defined by growth rate peaks and troughs, they would tend to lead business cycles by a half to nearly a full phase. Expansions, for instance, would usually include only the beginning of a high-growth period, while most of this period would be included in the contraction phase. Since this would run counter to generally accepted ideas on business cycles, peaks and troughs in growth rates cannot serve to delimit cycle phases. Instead, the downturn must be defined as the end of a period of relatively high growth and the upturn as the end of a period of relatively low growth.

Growth rates are classified as "high" or "low" by comparisons of average rates in each of three successive cycle phases. The average rate during a high step must exceed the average rates during the preceding and succeeding low steps. The main difference between deviation cycles and step cycles thus is in the definition of the "normal" growth rate which serves as standard for distinguishing high and low rates. In deviation cycles the normal rates are given by the long-run trend. In step cycles the normal rate in each cycle is the average rate for that cycle. For each cycle phase the average rate is measured

[45] See Mitchell, *What Happens During Business Cycles*, p. 299. For similar results regarding the rate of change of the money supply, see Phillip Cagan, *Determinants and Effects of Changes in the Stock of Money, 1875–1960*, New York, NBER, 1965, p. 271.

against two normal rates: the average rate of the cycle beginning with that phase and the average rate of the cycle ending with that phase.

Due to the basic similarity of both cycle concepts, the timing of step cycles is, in most instances, the same, or very close to, that of the trend-adjusted series proper. This will be shown below and agrees with the Friedman and Schwartz findings.

Analysis of rates of change also presents another problem, especially in monthly series. Month-to-month percentage changes are often highly jagged series with a sawtooth appearance and, at the first glance, reveal neither cycles nor cyclical turns. The rate of change of industrial production in Chart A-1 is a good illustration.[46] To deal with this problem, we first find the approximate dates when a period of high growth ended and low growth began, and vice versa, on a chart showing the twelve-month moving average of the rates of change. It is noteworthy how clearly the underlying cyclical movements stand out in the smoothed rates of change on curve *4* in Charts A-1 and A-2 even for rates as choppy as those for industrial production. Selecting the zone where a step turn occurred is thus not difficult in most instances. The exact month of the step turn is then tentatively identified by inspection of the chart of the unsmoothed rates.

At this point the computer program takes over.[47] Each tentative cycle, i.e., each period between two like tentative step turns is broken into two parts at every intervening month. For each of these possible breaking points the variance between the average rates of change in the two parts (the step means) is computed. The breaking point that yields the largest variance is selected as the turning point. For instance, if a tentative cycle had a duration of twenty-four months, the program would test the variance between the mean rates of change for partitions into six and eighteen months, seven and seventeen months, eight and sixteen months, etc.

One reason for maximizing the variance rather than the simple difference between alternative step means is that the latter neglects the influence of the step length. Doubtful months would be assigned to the longer step, because this would increase the difference between step means even if the standing of the series in the month in question were much closer to the average rate of the short step than to that of the long one.

If the computed turning point differs from the tentatively selected one, every analysis which used the latter must be repeated with the former. This

[46] One reason is that independent errors of measurement in the original series introduce a negative serial correlation into rates of change.

[47] The method used is essentially a computerized version of the Friedman and Schwartz method. Friedman and Schwartz decided by inspection, in most instances, and relied on calculation without use of computers in difficult cases.

procedure is continued until each upturn has been confirmed as the correct partition between the adjacent downturns and each downturn as the correct partition between the adjacent upturns. Each turn thus has to be confirmed by three computations. It must be valid (1) as the end of one cycle, (2) as the beginning of the next cycle, and (3) as the correct partition between two adjacent turns of the opposite type.[48]

All the step turns in the seventeen indicators have been confirmed in this manner. In the case of some quarterly indicators all tentative turns were validated at the first trial. For some very erratic series, on the other hand, up to fifty periods had to be partitioned before some twelve steps meeting the requirements could be identified.

It should be noted that this objective validation procedure eliminates most of the subjective element which adheres to the initial selection of the tentative turns. The only decision the computer program cannot handle is whether to treat a given period as part of a step phase or as a separate step cycle. In such borderline cases subjective judgment must be used.

[48]To illustrate: assume, first, that December 1955 has been confirmed, in the manner described below, as the date of a downturn and that January 1961 has been tentatively selected as the date of the next downturn. The computer program then finds the date of the upturn between these two downturns. For this purpose it divides the tentative cycle at each intervening month into two phases, the first, one of low growth and the second, one of high growth. For each of these partitions the variance is computed. Assume it is found that partition in April 1959 yields the largest variance between the two steps. (Partitions at points less than five months from the tentative turns are excluded by requiring a five-month minimum phase duration.)

Next, the computer-determined upturn in April 1959 is used together with the next tentative upturn in February 1963 in order to check whether the downturn in January 1961 (used previously for the selection of the upturn of April 1959) is the correct partition between April 1959 and February 1963. If the downturn in January 1961 is confirmed, we proceed to the checking of the following turn. If the downturn in January 1961 is rejected, however, and replaced by, say, March 1961, the analysis which used January 1961 as the cycle end, must be repeated with the new date, March 1961. This means that the period from December 1955 to March 1961 will be partitioned in the manner described above. This either may confirm the previously found upturn in April 1959 or may result in a different date, say, May 1959. In the latter case the April 1959–February 1963 analysis has to be replaced by one for the period May 1959–February 1963. And so on.

The first turns at either end of a series obviously cannot be confirmed in this fashion. All that can be done in order to identify the best possible turns at the ends is to experiment with several alternative dates. For each such date the maximum variance between the two following, or the two preceding, steps is computed. The alternative turn that yields the highest maximum variance is the one chosen.

Findings on Step Cycles

The timing of the step cycles agrees with that of the deviation cycles in the sense that nearly every turn in one type of cycle matches a turn in the other type (Table 3). (The steps are indicated in Charts A-1 and A-2 by horizontal lines drawn at the average level of the step.) Out of 230 deviation cycle turns, November 1947-March 1970, only 6 have no counterpart in step cycles, and 11 out of 241 step cycle turns do not match a turn in deviation cycles. Most of the nonmatching turns occur in the mild cycle 1951-53.[49]

Of the matching turns one-half coincide exactly and three-quarters coincide roughly. This correspondence is impressive when one considers the difference in methods used, the large erratic component of the movements analyzed, and the numerous borderline cases.

However, it must also be stressed that 58, or 26 per cent, of the turns in the two types of cycles occur more than three months apart. There are a number of reasons for these discrepancies. One is the occurrence of flat bottoms and ceilings or of double turns. In such instances it can easily happen that the two methods pick different dates. The 1951 downturn in industrial production provides a good illustration (Chart A-1). The downturn in the deviation cycle is the later, the step cycle downturn the earlier, of a pair of double peaks.

Other discrepancies reflect differences between the trend on which the deviation cycle is based and the trend implicit in the average growth rates on which the step cycles are based. The main case in point are the downturns 1955-57. In these years the 75-month moving average rises steeply enough in many series to produce early downturns while the rate of change remains——for nearly two years, in some instances——distinctly higher than in the low-rate phase of 1954 and 1958. Since this type of discrepancy is systematic it is reflected in the reference turns; the problem it creates will be taken up in the next chapter.

Another factor causing discrepancies between the two types of cycles are the deficiencies of some indicators. Agreement between deviation turns and step turns of some indicators is much better than that between turns of others. While 93 per cent of the turns in wages and salaries and 90 per cent of those in retail sales coincide roughly, only 46 per cent of the turns in the unemployment rate do so. In terms of exact coincidences the range is between 87 per cent of turns in wages and salaries and 23 per cent in (again) the unemployment rate.

[49] In 1951–53 a step cycle but no deviation cycle is identified in four indicators, while a deviation cycle but no step cycle is found in one indicator.

TABLE 3

Comparison of Turning Points in Deviation Cycles (DC) and Step Cycles (SC), Seventeen U.S. Indicators, November 1947–March 1970

Ident No.[a]	*Indicator Title:*	Number of Turns: Covered DC	Covered SC	Matching	Coinciding Exactly	Coinciding Roughly	Differing 4 Months or More	Per Cent of Turns: Coinciding Exactly	Coinciding Roughly	Differing 4 Months or More
Summary:	**17 Indicators**	**230**	**241**	**224**	**109**	**166**	**58**	**49**	**74**	**26**
16	Corporate profits after taxes	13	13	11	7	7	4	64	64	36
41	Number of employees on nonagricultural payrolls, establishment survey	15	15	15	5	12	3	33	80	20
43	Unemployment rate, total	13	13	13	3	6	7	23	46	54
47	Index of industrial production	15	15	15	6	10	5	40	67	33
48	Man-hours in nonagricultural establishments	15	15	15	5	10	5	33	67	33
49	Nonagricultural job openings unfilled	10	13	9	5	6	3	56	67	33
52	Personal income	13	15	13	7	9	4	54	69	31
53	Wage and salary income in mining, manufacturing, and construction	15	15	15	13	14	1	87	93	7
54	Sales of retail stores	15	15	15	10	13	2	67	87	13
55	Index of wholesale prices, industrial commodities	10	12	10	4	8	2	40	80	20
61	Business expenditures for new plant and equipment, total	12	15	12	9	9	3	75	75	25
62	Index of labor cost per unit of output, total manufacturing	13	15	13	6	10	3	46	77	23
71	Manufacturing and trade inventories, total book value	15	15	15	6	12	3	40	80	20
114	Discount rate on new issues of 91-day Treasury bills	13	10	10	5	9	1	50	90	10
200	Gross national product in current dollars	15	15	15	5	11	4	33	73	27
205	Gross national product in 1958 dollars	15	15	15	5	9	6	33	60	40
512	General imports, total	13	15	13	8	11	2	62	85	15

[a]The series identification numbers used in the *Business Conditions Digest*.

A large irregular component may be one of the factors in an indicator's poor performance in this respect. That the unemployment rate has the largest irregular movement among our indicators seems to support this view.[50] But the evidence is mixed. Some series which are nearly as irregular as unemployment, e.g., the Treasury bill rate and imports, show good agreement between deviation and step turns.

Agreement between the step and deviation turns also is much better at certain dates than at others for most indicators. There are strong turns and weak turns, as will be brought out further in the discussion of the reference cycles. The greatest uncertainty surrounds the turns at either end of the period covered. The deviation cycles are here based on extrapolated trends which may differ widely from actual ones. Similarly the growth rate step averages cannot be compared to preceding ones at the beginning of the period or to following ones at the end. Hence turns close to the beginning or end of the series should be considered highly tentative.

As mentioned previously, we plan to replace indicators which are deficient for our purposes because of large disagreements between dates of turns in the two types of growth cycles by more satisfactory ones.

6. A CHRONOLOGY OF U.S. GROWTH CYCLES

Growth cycles in the general economy are determined on the basis of the growth cycles in the indicators. For this purpose the indicators are combined into two types of indexes: composite indexes and diffusion indexes.[51] Each

[50] The measure of irregularity referred to is the average month-to-month percentage change in the irregular component of the series. The irregular component is obtained by dividing a smooth, flexible moving average of the seasonally adjusted series, which represents the cyclical component, into the seasonally adjusted series.

[51] The indexes are constructed in the same fashion as those for classical cycles, described in Section 4, except as follows:

The *composite index for deviation cycles* uses the trend-adjusted indicators where the index for classical cycles uses non-trend-adjusted ones. The composite index for deviation cycles equalizes the month-to-month differences in the standing of the indicators, whereas the index for classical cycles equalizes month-to-month percentage changes. The latter are not used for deviation cycles because the trend-adjusted series are expressed as percentage ratios to the trend.

In addition to the main composite index for deviation cycles, described in the preceding paragraph, we constructed a short-cut composite index for deviation cycles. Instead of adjusting each indicator for its trend and then combining them into the composite index, we took the composite index for classical cycles and adjusted that for its trend as represented by the 75-month moving average. The turns in the short-cut composite index coincide with those in the main index except for slight differences in two instances.

The chronology in Table 4 is based on the main composite index which, however, has not been extended beyond June 1969. Therefore, the last downturn, April 1969, is taken temporarily from the short-cut index, which is also shown in Chart 3.

type of index is constructed for deviation cycles and for step cycles; consequently, with a given list of indicators, four reference chronologies are obtained.[52]

The basic features of the four sets of reference dates derived from the 17-indicator list are the same (Table 4). Each set consists of fifteen turning points, eight downturns and seven upturns, 1948-69. Eight of these turns correspond to classical peaks and troughs, 1948-61. Two turns mark the Korean war cycle, four the two growth cycles, 1961-67. We cannot tell at this writing (August 1970) whether the last downturn, in 1969, will or will not match a classical peak. Most observers would probably have expected the number and location of growth cycle turns to be approximately as we find them.

The seven cycles stand out as clearly as one might wish in the two diffusion indexes on Chart 2. The amplitudes of the cycles on this chart, it should be remembered, do not indicate amplitudes of indicator movements, but reflect the duration and degree of diffusion of these movements.

The seven cycles are clearly drawn also in the composite index based on deviation cycles, although this index is less smooth than the diffusion indexes and has a long, nearly horizontal stretch in 1963-64 (Chart 3). In the composite index based on rates of change the reference cycles are represented by the horizontal step lines (Chart 3, curve *B*). The cycle turns are at the ends of the steps, i.e., at the ends of periods of high or low rates.

Although the occurrence of the seven growth cycles is confirmed by each of the four chronologies: the exact turning dates differ in many instances. Hence, the choice among the four indexes is important and difficult. The choice is necessary because we aim at presenting a single growth cycle

The main *composite index for step cycles* is derived by using the month-to-month percentage changes of the indicators in the same fashion as the original series are used in the classical composite index. The amplitude adjustment is applied to month-to-month differences between rates of change instead of to month-to-month percentage changes. Step cycle turning points are obtained by partitioning the composite index by the same method by which individual indicators are partitioned.

Also, a short-cut composite index has been constructed for step cycles, analogous to the short-cut composite index for deviation cycles. A series of month-to-month percentage changes is derived from the composite index for classical cycles. This series is partitioned into step cycles. As in the case of deviation cycles, the turning dates are identical in the main and in the short-cut index, with two exceptions.

Because the main composite index for step cycles has not been updated, the chronology in Table 4 and the curve in Chart 3 are based on the short-cut index.

[52]The number of chronologies actually obtained in preparing this paper has been much greater, since we have experimented with several indicator lists.

TABLE 4

Leads and Lags of Upturns (*U*) and Downturns (*D*) in Classical Reference Cycles, in Three Growth Cycle Indexes, and in Leading Indicators at Growth Cycle Reference Turns, 17 U.S. Indicators, 1948–69

Date of Growth Cycle Reference Turns		Leads and Lags in Months of Turns in:									
		Classical Cycles Composite Index[a]		Deviation Cycles Diffusion Index		Step Cycles Composite Index		Step Cycles Diffusion Index		Leading Indicators Composite Index[b]	
Upturns	Downturns	U	D	U	D	U	D	U	D	U	D
	Aug. 1948		+2		−2		+2		+1		−7
Nov. 1949		−1		0		0		0		−5	
	May 1951				+3		−1		−1		−4
July 1952				−1		0		−1		0	
	Dec. 1952		+6		+2		+3		+3		+1
Sept. 1954		−1		0		−2		−1		−6	
	Feb. 1957		+6		0		+6		+6		−14
May 1958		−1		0		0		−1		−1	
	Feb. 1960		+2		0		−9		−2		−10
Apr. 1961		−2		0		0		−2		−4	
	May 1962				0		−1		−3		−1
June 1964				−7		+3		+3		−20	
	Sept. 1966				−3		+1		+1		−6
Oct. 1967				0		−5		−4		−7	
	April 1969				+1		+4		+4		0

[a]Revised data; see Table 2.
[b]From *Business Conditions Digest*, March 1970, p. 102.

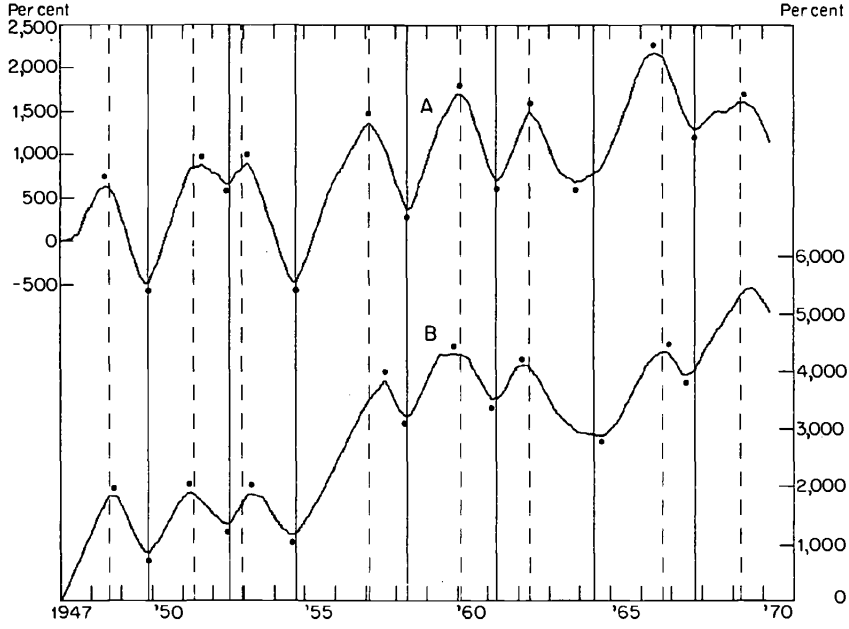
chronology. To work with two sets of dates, however similar to each other, would obviously be awkward and confining.[53]

Two Deviation Cycle Indexes Compared

Examination of agreements and disagreements among the four chronologies discloses, first, that turns in each pair of indexes for a given cycle type are very similar. Thus eight out of fifteen turns in the diffusion index and in the composite index based on deviation cycles coincide exactly, and all but one coincide at least roughly. The exception is the upturn occurring in November 1963 in the diffusion index and in June 1964 in the

[53]The NBER has always selected a single month as turning point even when the evidence did not point clearly to a single month. Otherwise it would be necessary to work with alternative turns or with turning zones, which would greatly reduce the usefulness of the chronology.

Chart 2
U.S. Growth Cycles, 1947–70
Diffusion Indexes, Seventeen Indicators



A: Based on cycles in indicators' deviations from their trends.

B: Based on high and low steps in growth rates of indicators.

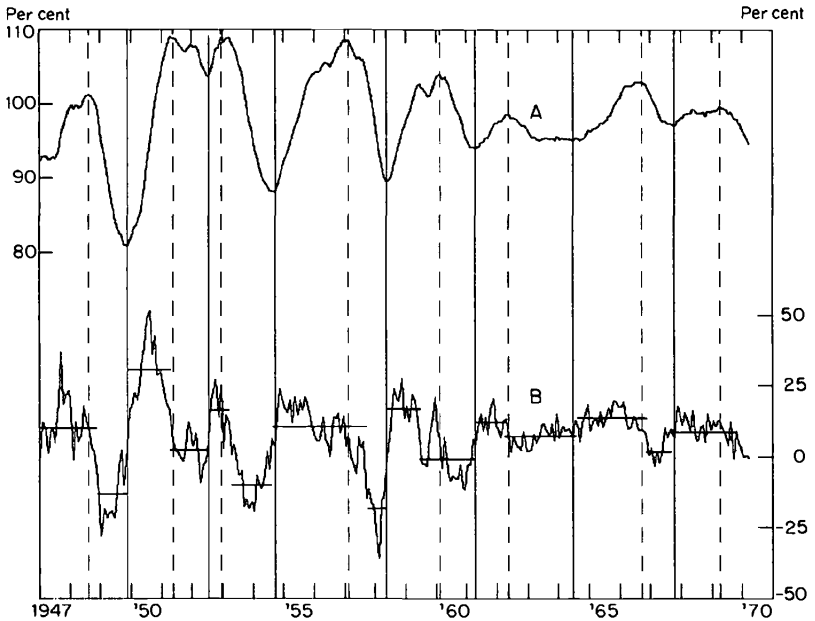
Diffusion indexes are constructed by cumulating the excess of the percentage of indicators undergoing a cyclical speedup over the percentage undergoing a slowdown.

Solid vertical lines indicate growth cycle upturns, broken vertical lines, growth cycle downturns, based on Chart 3, Series A.

composite index. This upturn is the most difficult one to date because the economy grew over many months at a nearly constant rate.

In the center of the period, it should be noted, there is a sequence of six turns which coincide exactly in the two indexes. As mentioned previously, the turns in the center of the period covered are more reliable and thus should agree better than those at the ends. A further noteworthy point is that those turns which correspond to classical peaks and troughs agree much better than the others. Of the former, 75 per cent coincide exactly, against 30 per cent of the latter. Another noteworthy feature is that upturns agree better in the two indexes than downturns. Similarly, in classical cycles, since World War II, troughs are much more sharply drawn than peaks.

Chart 3
U.S. Growth Cycles, 1947–70
Composite Indexes, Seventeen Indicators



Both composite indexes are derived from the composite index for classical business cycles shown in the upper curve of Chart 1.

A: Classical composite index adjusted for trend (per cent deviations from trend).

B: Month to month per cent change in classical composite index (annual rates).

Solid vertical lines indicate growth cycle upturns, broken vertical lines, growth cycle downturns, based on Series A.

Two-Step Cycle Indexes Compared

The corresponding comparison between diffusion and composite indexes for step cycles shows similar results. Of the fifteen turns, seven coincide exactly, and all but one coincide roughly. The exception here is the 1959-60 downturn, which comes seven months earlier in the composite index than in the diffusion index.

Deviation Cycles and Step Cycles Compared

The differences between the dates of deviation cycle turns and step cycle turns are much greater than those between the two indexes for each type of cycle. Turns in the two composite indexes and the two diffusion indexes fail to coincide even roughly in four and five out of the fifteen instances. Exact

coincidences are the exception (two in the diffusion indexes and four in the composite indexes). The median discrepancy is three months between the diffusion indexes and two and a half months between the composite indexes.

Most of the larger discrepancies are due to relatively flat movements of the indexes which make selection between two or more alternative dates depend on tiny differences between standings. For instance, the two diffusion indexes identify different turns in the flat bottom 1963-64 and at the rounded downturns in 1951 and 1966. The composite indexes disagree for the same reason at the double peak of 1960 and at the upturn in 1967. With an improved indicator list some or most of these discrepancies should be removed.

The 1957 downturn is a different case. Both diffusion indexes trace a sharp triangle here, and the six-month discrepancy reflects the difference in the two trend curves. The flatter trend implicit in the step cycles gives a later downturn. Since this lag occurs in nine of our indicators, including the most important ones, it will not be eliminated by a change in the indicator mix.

The difficult choice for the final growth cycle chronology is, thus, between deviation cycles and step cycles. The latter have the great advantage that they are independent of the subjective selection of a trend curve. The advantage of the deviation cycles, on the other hand, is that they are easily understood and quite similar in concept to classical business cycles.[54]

Other criteria to be considered in choosing among the indexes are their amplitude and smoothness. Judged by the smoothness of the composite indexes deviation cycles are far superior to step cycles, of course, since rates of change are always more erratic than the series from which they are drawn. The ratio of the irregular to the cyclical components of the indexes is nearly four times as large in the step cycle index as in the deviation cycle one.[55] The amplitudes of the composite indexes are not comparable because of the different definitions of the two types of cycles.[56]

[54]Chronologies based on German deviation cycles and German step cycles were quite similar, consequently, it made little difference which one was selected. I preferred the diffusion index for deviation cycles for its somewhat greater smoothness and amplitude. Composite indexes were not used for German growth cycles (see Mintz, *Dating Postwar Business Cycles*).

[55]This refers to the measure explained in footnote 50. The ratio of the irregular to the cyclical component is 0.4 for the deviation cycle index and 1.5 for the step cycle index.

[56]Measured by month-to-month change in the cyclical component, amplitudes of composite indexes always equal 1 by definition. Measuring amplitudes by differences in standings at turning points does not fit the step cycle concept. Step cycle amplitudes must be measured by differences between the levels of steps; these differences are not comparable to the amplitudes of deviation cycles.

The diffusion indexes hardly differ in either amplitude or smoothness (Chart 2). There is practically no countercyclical movement in either one. Although there are large differences in amplitudes of individual cycle phases, the average amplitude of the two indexes for the entire period is nearly the same. In both deviation and step cycles at least 15 out of the 17 indicators move in the same direction during some months. The exception is the 1951-53 downturn-to-downturn cycle in which this high degree of diffusion is not reached.

My tentative decision is to use the deviation cycles. Given this decision it does not make much difference whether the diffusion index or the composite index is used. I have tentatively chosen the composite index because it takes account of amplitudes of changes in the indicators, while the diffusion index registers only their direction.

From here on the comments and measurements refer to the composite index based on deviation cycles.

Description of U.S. Growth Cycles

The seven cycles vary greatly in amplitude as measured by the differences in index standings at turning points.[57] The largest cycle (1948-51, downturn to downturn) is more than five times as large as the two smallest ones (1966-69, downturn to downturn, and 1961-64, upturn to upturn). As expected, large amplitudes characterize cycles which match classical business cycles. On the average the swings of such growth cycles are twice as large as the swings of the others. This implies that the cycles of the 1950's are on the average larger than those of the 1960's.

Amplitudes of downturn-to-downturn cycles vary more than amplitudes of upturn-to-upturn cycles. This reflects the positive correlation of high rates and subsequent low rates and the absence of such correlation between high rates and preceding low rates.

As to phase amplitudes, a comparison of the seven high-rate phases shows that the 1958-60 amplitude was about average. Significantly, this phase matches the smallest of the classical expansions covered. The two large high-rate phases, 1949-51 and 1954-57, were very roughly twice the average. Among the four high-rate phases which were below average the largest, reaching two-thirds of the average, was in 1964-66, while 1967-69 was the

[57] The amplitudes referred to in the text are those of the short-cut composite index (see footnote 51). They are based on the ratios of the classical composite index to its trend and represent the differences between the standings of these ratios at turning points. The numerical values of the amplitudes are, therefore, not meaningful; that is why they are discussed in terms of their relative magnitudes only.

smallest, with only one-fourth of the average amplitude and one-ninth of the largest amplitude.

Amplitudes of low-rate phases vary much less than those of high-rate phases. Again the amplitude of the 1960-61 low-rate phase, which matches the smallest classical recession covered, is near average for the seven low-rate phases. The three phases 1948-49, 1952-54, and 1957-58 were about twice as large as the average, and the three phases 1951-52, 1962-64, and 1966-67 about half the average.

The latest low-rate phase can, at this writing, be measured only from April 1969 to March 1970, the last month covered. Within this period, its amplitude was somewhat smaller than the 1966-67 one and somewhat larger than the 1962-64 one.

Regarding acceptance of the proposed seven growth cycles, opinions may differ, of course. Does the flattest of the cycles deserve that name? Should not a minimum amplitude be stipulated in some fashion? The reasons for not setting such a rule are the same mentioned earlier with regard to cycles in the indicators: mainly the difficulty of setting standards suitable for a future different from the past. With the declining trend of amplitudes a lower limit set today may easily be obsolete tomorrow.

There are also other good arguments for acceptance of the seven cycles. One is their high degree of diffusion among the 17 indicators. At 11 of the 15 reference turns each of the indicators, with negligible exceptions, has a matching turn. One of the remaining four reference turns is the 1969 downturn, which is too recent for all indicator downturns to be identified as yet. (In fact, as of August 1970 downturns have been dated in 13 of the 17 series.) This leaves three turns at which diffusion is not high and which do mark a cycle whose elimination deserves serious consideration, namely, the one from the downturn in 1951 to the downturn in 1952. The deviation cycles of seven indicators skipped the 1952 upturn and either the 1951 downturn or the 1952 one. Diffusion was higher in terms of step cycles. A corresponding cycle was not identified in only four of the indicators.

Another objection to the 1951-52 cycle is its short duration. It lasted only 19 months as compared to 27 months (1960-62, downturn to downturn) for the next shortest cycle. The longest of the growth cycles lasted 52 months (1962-66) and their average length was three years.

But if the 1951-52 growth cycle is the shortest and the least diffused, there are also arguments in favor of its recognition. First, its amplitude ranks above that of the 1966-69 cycle. Second, it appears in each of the four growth cycle indexes and equally in every experimental index based on different indicator lists. Third, if this reference cycle were rejected, the majority of indicators would show a cycle not matched by a reference cycle.

Such "extra" cycles otherwise are rare exceptions. Last, but not least, the behavior of the leading indicators confirms the cycle. On balance, therefore, we deem it preferable to recognize the weakest of our cycles.

Relations of Growth Cycles to Classical Business Cycles

One important aspect of the growth cycles is their relation to classical cycles (Table 4). We expect classical troughs to lead growth cycle upturns and classical peaks to lag growth cycle downturns, and this is confirmed by the signs of the timing relation at all eight turns covered. The leads at the lower turning points are remarkably regular and also very short. Upturns were too sharp for the removal of the trend to have much effect. At the upper turning points there are two short (two months) lags in 1948 and 1960 and two long (six months) lags in 1953 and 1957. In the two latter instances the step cycle turns, too, lag behind the reference turns, reflecting the effect of a relatively steep trend curve on the latter.

The timing relations imply that high-rate phases are shorter than classical expansions and low-rate phases longer than contractions. In fact, the average duration of the two growth cycle phases is similar, 19 months for highs and 17 months for lows. The near-equal length is in accord with the definition of the phases as periods of above- and below-average growth. Also as expected, the average duration of growth cycles is much shorter——three years——than the average duration of classical business cycles, which was 46 months for the three peak-to-peak cycles, 1948-60, and would be much longer if an expansion, 1961-69, were included.

Assuming past timing relationships to continue into the future, one may conclude that once a growth cycle downturn has occurred, a classical peak should follow within six months at most or there will be no classical peak at all to match that particular downturn. This has an interesting implication for the current (July 1970) situation. If the date of the growth cycle downturn, April 1969, is correct, the classical peak should have followed by October 1969 at the latest, if at all. We find that no classical peak occurred through March 1970. Hence, on the basis of historical experience, such a peak should not be expected any longer which means there neither has been nor will be a classical recession matching the present slowdown.

If this conclusion should be wrong, if a classical peak should have occurred after March, this could signify either that the growth cycle downturn of April 1969 was placed much too early (which is quite possible in view of its tentative character), or that the lag of the peak behind the downturn was much longer this time than ever before.

Relations of Leading Indicators to Growth Cycles

How useful the growth cycle chronology can be in clarifying cyclical relationships is illustrated by its effect on the evaluation of the leading indicators. What we find is that the fifteen growth cycle turns match the turns in the composite index of the classical leading indicators one to one (Table 4).[58] This is important because one of the main objections to the usefulness of the leading indicators is that they give "false signals." It does not help us much, so the argument goes, that the leaders predict classical business cycle turns correctly, since they also predict turns which never occur. This argument is no longer valid when growth cycles are recognized and false signals become right signals.

The length of lead of the leaders differs, of course, between growth cycles and classical cycles. At upper turning points they are shorter, at lower ones they are longer, at growth cycle turns compared to classical turns.[59]

To cite just one more example of the uses of growth cycles we refer to the analysis of fluctuations in the quantity of money. From 1949 to 1970 cycles in the rate of change of the money supply match growth cycles one to one. And with one exception, where the two downturns coincide, the turns in money lead the growth cycle turns.[60]

Many other cyclical relationships may be expected to be clarified with the help of the growth cycle chronology.

7. CONCLUSION

This study demonstrates, first, that the traditional NBER business cycle chronology, 1948-61, can be reproduced exactly by computerized methods. One interesting implication of this finding is that the traditional NBER methods have all along been far more objective than one might have thought.

[58] The comparison refers to the Composite Index of 12 Leaders, Original Trend, published in *Business Conditions Digest*, March 1970, p. 102.

It should be noted that the leaders and the growth cycles have only one series in common, therefore, their agreement cannot be explained by an overlap of coverage.

[59] The variability of the lengths of leads is not smaller relative to growth cycles than to classical cycles. But this statement refers to the composite index of leaders without trend adjustment. In a later version our usual trend adjustment will be applied to this index, and this may reduce the variability of the leads. Julius Shiskin found a great reduction in variability of leads when he adjusted the composite index of the leaders to move along the same trend as the index representing classical cycles with which the leaders' index was being compared.

[60] This is based on step cycles in the rate of change of money as analyzed by Anna Schwartz.

The finding further suggests that after some more testing of the new methods they will be able to replace subjective cycle dating.

The second major result of the study is to give precision to a revised cycle concept, namely, growth cycles or cycles defined as alternating periods of above-and below-average economic growth. Growth cycles, it is found, can be identified as clearly and confidently as the traditional business cycles.

All our measurements lead to the recognition of seven growth cycles in the United States, 1948-69. These cycles were widely diffused. With very few exceptions, turns in every one of the seventeen indicators used match the growth cycle turns. The seven cycles vary greatly in amplitude and duration. Amplitudes of those growth cycles which match classical business cycles are, according to preliminary measures, about twice as large on the average as amplitudes of other growth cycles. Durations vary between 19 and 55 months. The average length of growth cycles was three years.

Turning now to the description of growth cycle phases, it is found that four low-rate phases match classical recessions but are three to seven months longer than the latter. Of the three remaining low-rate phases, one occurred after the Korean War, one from May 1962 to June 1964, and the third from September 1966 to October 1967. The amplitude of the largest low-rate phase was roughly four times that of the smallest one.

The low-rate phase which started in 1969 is not included above because its end cannot be ascertained on the basis of data through August 1970. At that date it had already lasted 17 months, which is longer than all but two of the preceding low-rate phases. The amplitude of the latest low-rate phase was, to August 1970, smaller than amplitudes of phases matching classical recessions but larger than amplitudes of the other three low-rate phases.

High-rate phases are, of course, much shorter than classical expansions. In the 1960's three such phases occurred within a single expansion and there were two high-rate phases during the 1949-53 expansion. The two high-rate phases which each correspond to a single classical expansion, viz., 1954-57 and 1958-60, are still seven months and three months shorter than their classical counterparts.

The range of amplitudes of high-rate phases is far greater than that of low-rate phases. The amplitude of the largest high-rate phase is about nine times as great as that of the smallest one (1967-69).

One example of the usefulness of the growth cycle chronology is the light it throws on the leading indicators. Turns in the composite of these indicators match the fifteen growth cycle turns one to one. It has always been regarded as the main weakness of the leading indicators that, while correctly predicting classical business cycle turns, they also falsely predict turns which never occur. However, these false signals become true ones once the existence of

growth cycles is recognized and it is understood that the predictions of the indicators may be taken to refer not only to the classical cycles but to growth cycles as well.

POSTSCRIPT

The extension of the coverage through August 1970 has not changed the previous findings. The tentative downturn date of the growth cycle remains April 1969. The rise of the trend-adjusted composite index to this date and the subsequent fall stand out more sharply in the extended and revised data than in the previous ones.

In the composite index without trend adjustment, which represents the classical business cycle, no peak can be determined in the period covered. Although the index stands no higher in May 1970 than in December 1969 and thus identifies a period of stagnation, this does not suffice for classifying the period as a recession by traditional standards. The corresponding diffusion index also failed to cross the zero line through August 1970, since there was a majority of rising indicators in each month.

That the indexes which clearly identify each of the preceding recessions do not signalize a recession in the first half of 1970 is not surprising, since the behavior of the economy in the latter period was very different from that in the preceding four recessions. The contrast is fully described and discussed in Fabricant's essay in this volume (pp. 000-000 and Table 1).

I mention only a few of the striking differences Fabricant finds between classical recessions and the first half of 1970. First, in the latter period, but not in the former, most current-dollar indicators kept rising. But that is not all. When attention is restricted to deflated and physical volume series, the contrast persists. Thus the value of deflated retail sales kept rising in the first half of 1970, deflated personal income and the number of employees rose during the first quarter, and real GNP rose during the second quarter.

Where declines did take place in nonpecuniary indicators their mildness is again in contrast to those of previous recessions. In the first half of 1970 most declines amounted to no more than one-third to one-seventh of the corresponding ones in the recession of 1960-61 which itself is considered a borderline case because of its mildness. The unemployment rate is an exception because it rose almost as much in the first half of 1970 as in 1960-61. But even its rise was only half as much or less than those occurring in the three preceding recessions.

The foregoing comments, it should be noted, refer exclusively to the first half of 1970 and have no bearing on the possibility of a recession in the second half of the year.

APPENDIX

General Notes to Appendix Charts

Solid vertical lines indicate growth cycle upturns; broken vertical lines, growth cycle downturns.

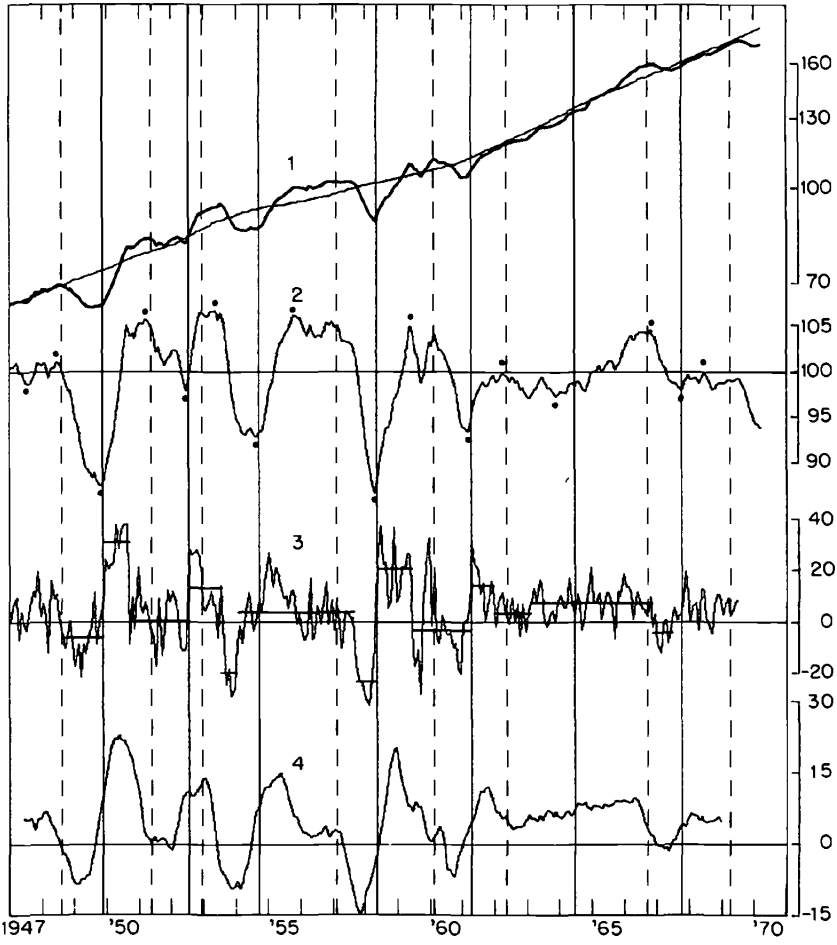
Dots on curve 2 identify deviation cycle turning points.

Horizontal lines drawn through curve 3 indicate average rates of change during step phases. The last point of these lines is the step turn.

The slight oscillations of some curves in the charts occur because the computer plotting equipment plots a sloping line in small horizontal and vertical steps.

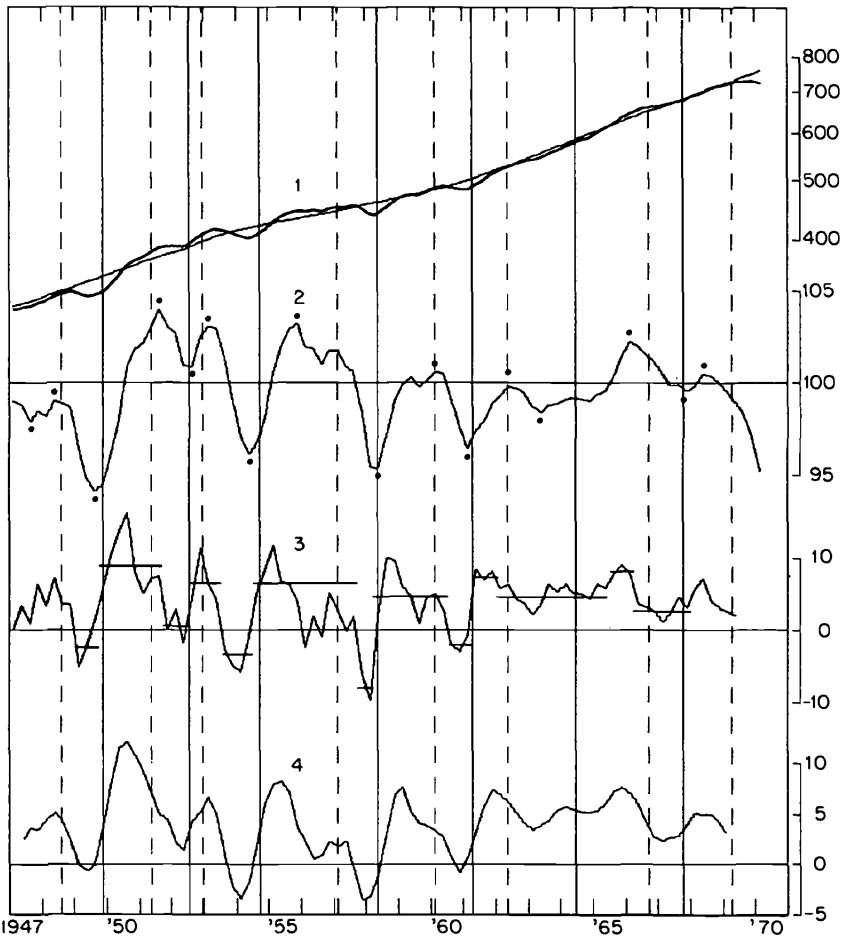
In the final version of this study there will be one chart for each indicator. In the August 1970 version there are only two charts for purposes of illustration. In these two charts curves 1 and 2 end in March 1970, but curves 3 and 4 are not extended beyond June 1969.

Chart A-1
Index of Industrial Production
(1957-59=100)



1: Seasonally adjusted data and seventy-five month moving average.
2: Deviations from seventy-five month moving average, per cent.
3: Change from month to month, per cent, annual rate.
4: Centered twelve-month moving average of line 3, per cent.

Chart A-2
Gross National Product in 1958 Dollars
(Annual rate, billion dollars)



1: Seasonally adjusted data and twenty-five quarter moving average.
2: Deviations from twenty-five quarter moving average, per cent.
3: Change from quarter to quarter, per cent, annual rate.
4: Centered four-quarter moving average of line 3, per cent.

TABLE A–1
Listing of Indicators Used In Tables 1 and 2
(asterisk signifies that indicator was used)

Indicator No.	Line Numbers in Tables 1 and 2														
	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
16								*	*	*	*	*	*	*	*
19										*	*				*
40						*									
41	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
42						*									
43		*	*	*	*	*	*	*	*	*	*	*	*	*	*
45						*									
46						*									
47	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
48								*	*	*	*	*	*	*	*
49								*	*	*	*	*	*	*	*
51			*	*	*										
52	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
53						*			*	*	*			*	*
54			*	*	*	*	*	*	*	*	*	*	*	*	*
55				*	*	*			*	*	*			*	*
56		*					*	*				*	*		
57	*					*									
61								*	*	*	*	*	*	*	*
62									*	*	*			*	*
71									*	*	*			*	*
72										*	*				*
114									*	*	*			*	*
200				*	*	*		*	*	*	*	*	*	*	*
205						*	*	*	*	*	*	*	*	*	*
512									*	*	*			*	*

Source: See Notes to Table 1. For indicator titles, see Table 3.