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Chapter Author: Geoffrey H. Moore

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CHAPTER 7

Statistical Indicators of Cyclical Revivals and Recessions

Geoffrey H. Moore

I. Aim of the Study and Summary of Findings

In December 1937, in response to a request by a public agency, the National Bureau undertook a brief study, based upon materials already at hand, of statistical indicators of cyclical revivals. At that time the economy was experiencing a sharp business contraction. For many years the Bureau had been analyzing time series—monthly, quarterly, and annual—on a wide variety of economic processes, in order to achieve a better understanding of how business cycles come about. Consequently, a considerable fund of information was available to answer the question, what statistical series are most likely to give some sign of the approaching end of a business contraction?

Wesley C. Mitchell and Arthur F. Burns proceeded to apply certain objective criteria to approximately 500 monthly or quarterly series, and selected seventy-one that on the basis of performance promised to be fairly reliable indicators of revival. A closer screening of the seventy-one yielded twenty-one series that were deemed the most trustworthy. In May 1938 the series were listed in *Statistical Indicators of Cyclical Revivals* (Bulletin 69), together with an explanation of the criteria of selection and a record of the cyclical behavior of each series [reprinted here, Chapter 6].

The measures of behavior upon which the selection was based were for different periods, depending upon when the particular series became available. The longest series went back to 1854 and covered twenty-one revivals; many began in 1919 and covered only five revivals. The measures ended with 1933, the last revival before the study was made. The National Bureau has since added many series to its collection, revised the measures of cyclical behavior, and extended them through the business cycle of 1933–38.[1] Because many series cover only a few cycles, the addition of even a single cycle materially increases our information on cyclical behavior. Also, the numerous political and economic changes after 1933 make it important that the experience of this period be considered. Hence

NOTE: Reprinted from Occasional Paper 31, New York, NBER, 1950. Appendix A of the original paper is reprinted here as Chapter 20, and Appendix B as the appendix at the end of this chapter.

[1] We have not as yet [1950] determined the turning points of any business cycle since 1938; see, however, section VII of this paper. [For a chronology of turning points through 1958, see Appendix A.]

it seems desirable now to revise the list of indicators of revivals and to extend the analysis to recessions. That is the immediate aim of this study.

We have also a broader objective: to exhibit some of the differences among economic processes in respect of their role in business cycles. While we cannot undertake to account for the differences here, we can demonstrate their existence and indicate their nature. To know what are the leading and the lagging processes, and to have some measures of their performance in successive cycles, is fundamental to an understanding of business cycles.

This report is preliminary. We have not applied as many objective criteria to the selection of indicators as we plan to, and further work on problems connected with the use and interpretation of indicators is in progress. Nevertheless, the investigation points to certain general conclusions, with which we may acquaint the reader at the outset. These conclusions, and the sections of the report in which they are developed, are:

1. Economic processes, as represented by monthly and quarterly time series, differ widely in the timing of their fluctuations during business cycles. While there is a strong tendency for many processes to expand and contract at about the same time, in every cycle the cyclical turning points of different series are rather widely dispersed. For example, of 400 series especially selected for the regularity of their behavior during business cycles seldom more than 80 per cent were undergoing cyclical expansion (or contraction) at any time between 1885 and 1940. Their peaks and troughs clustered around peaks and troughs in aggregate economic activity, but each cluster was spread over a year or two or three. Indeed, by the time the last few series in a cluster reached peaks, the first troughs in the next cluster had usually begun to appear. For examples and evidence see sections II and III.

2. By the application of objective criteria it is possible to select series whose timing in successive business cycles has been relatively systematic, and which therefore may be of value as indicators of revivals and recessions. That is, one can identify a group of series whose turning points have typically preceded the cyclical turns in aggregate economic activity; another group whose turns have typically coincided (roughly) with the turns in aggregate economic activity; and still another whose turns have typically followed those in aggregate economic activity. In many cases the reasons for the differences in behavior of different series are apparent, though a thoroughgoing explanation may be lacking. In section IV we set forth the criteria so far adopted for selecting indicators, and in section V describe the broad groups of series that appear to have useful indicator characteristics.

3. Series in all three timing groups (leaders, coinciders, and laggers),

when interpreted in the light of their past behavior and economic significance, may prove useful in anticipating and identifying cyclical revivals and recessions. The evidence each type of series supplies serves to confirm or qualify that supplied by the others, and together they may be expected to provide helpful signs of an approaching recession or revival, and especially to facilitate prompt recognition of such a development once it occurs. These expectations are based upon study of the behavior of various groups of series in successive business cycles since 1885 (sections II, VI, and VII). But this study also suggests that the interpretation of statistical indicators is subject to numerous difficulties and will often be attended by considerable uncertainty.

II. An Experiment with Indicators

Our comprehension of, not to say interest in, the problem of selecting and using indicators can be advanced by performing a little experiment with the twenty-one indicators listed in Bulletin 69. As stated above, they were chosen on the basis of their behavior at revivals, the last revival considered being that of 1933. How did they behave at the next revival, in 1938? At the recession in 1937? Here we have a test of the validity of the selection.

One of the first steps in our analysis of a time series, once its seasonal variations have been removed, is to mark off what we call specific cycles. In a chart on which the entire series is plotted we look for broad swings in the data, of a duration (from peak to peak or trough to trough) roughly similar to that of business cycles, that is, two to ten or twelve years. Once we have identified the swings we date their turning points, aided in both processes by certain rules laid down in advance and applied uniformly to all series.[2] In Chart 7.1 the asterisks identify the specific cycle peaks and troughs of the twenty-one indicators in 1932–39.

At an early stage of the National Bureau's business cycle studies a need developed for a set of "reference dates," or dates of peaks and troughs of business cycles—not merely to identify the object to be studied but more particularly to facilitate investigation of the interrelations among numerous time series. For example, rather than compare the dates of specific cycle peaks in each series of a group with those in every other series, it is ordinarily much simpler to compare each series' peaks with a standard set of dates, then compare the results for the different series. Also, the data for the period between any two successive reference troughs (or peaks) may be used to compute a cyclical pattern showing the movement of a given series, and since the period is the same for all series the patterns may be directly compared.

[2] See Arthur F. Burns and Wesley C. Mitchell, *Measuring Business Cycles*, New York, NBER, 1946, pp. 56–66.

Consequently, after examining the movements of numerous economic time series and studying the contemporary reports of observers of the business scene, a set of reference dates was chosen which fairly represented the dates when expansions and contractions in general business activity culminated (Appendix A). The reference dates occurring in 1932–39 bound the shaded areas in Chart 7.1.

The number of months by which the specific cycle peaks and troughs of the twenty-one indicators lead or lag behind the 1937–38 reference dates are entered in Table 7.1, together with the averages of similar entries for prior reference dates. Whether the results are considered favorable or unfavorable depends, of course, on one's expectations. Each of the indicators reached a peak that could be compared with the May 1937 reference peak and a trough that could be compared with the June 1938 reference trough. Series often fail in this respect, either by not having any corresponding cyclical movement or by having more than one in the same vicinity, though failures are less likely when the general contraction is sharp, as in 1937–38. Relatively few series, that is, exhibit one-to-one correspondence between their cycles and business cycles. Eight of our twenty-one, indeed, had an "extra" contraction in 1933–35, as the chart reveals.

At the 1938 revival the turning points are fairly closely bunched a few months in advance of the reference trough; the leads are less numerous at the 1937 peak, but that is what one would expect from the averages. The sequences that might be inferred from the average timing at preceding peaks or troughs were, however, only roughly followed at the 1937 peak and the 1938 trough, and the fallibility of single series as indicators is evident. As will be shown more fully below, at every cyclical turn some of the series that typically lead are likely to lag. Moreover, while on the whole the series confirm one another in indicating a recession about May 1937 and a revival about June 1938, the chart exhibits many little puzzles that would have plagued, and no doubt did plague, contemporary observers of month-by-month developments.

III. Varieties of Cyclical Behavior and Their Consensus

Chart 7.1 and Table 7.1 demonstrate, in some degree, the varieties of cyclical behavior to be found in economic processes. The twenty-one series differ in their amplitude of cyclical fluctuation, in their smoothness or freedom from erratic movements, in the general pattern of their movement during 1932–39, in the timing of their fluctuations relative to business cycles. The problem of selecting statistical indicators of business cycles is essentially to systematize this variety, so that it may be put to use.

The variety that actually exists in statistical records far exceeds that

CHART 7.1

Behavior of Twenty-one Statistical Indicators, 1932–39

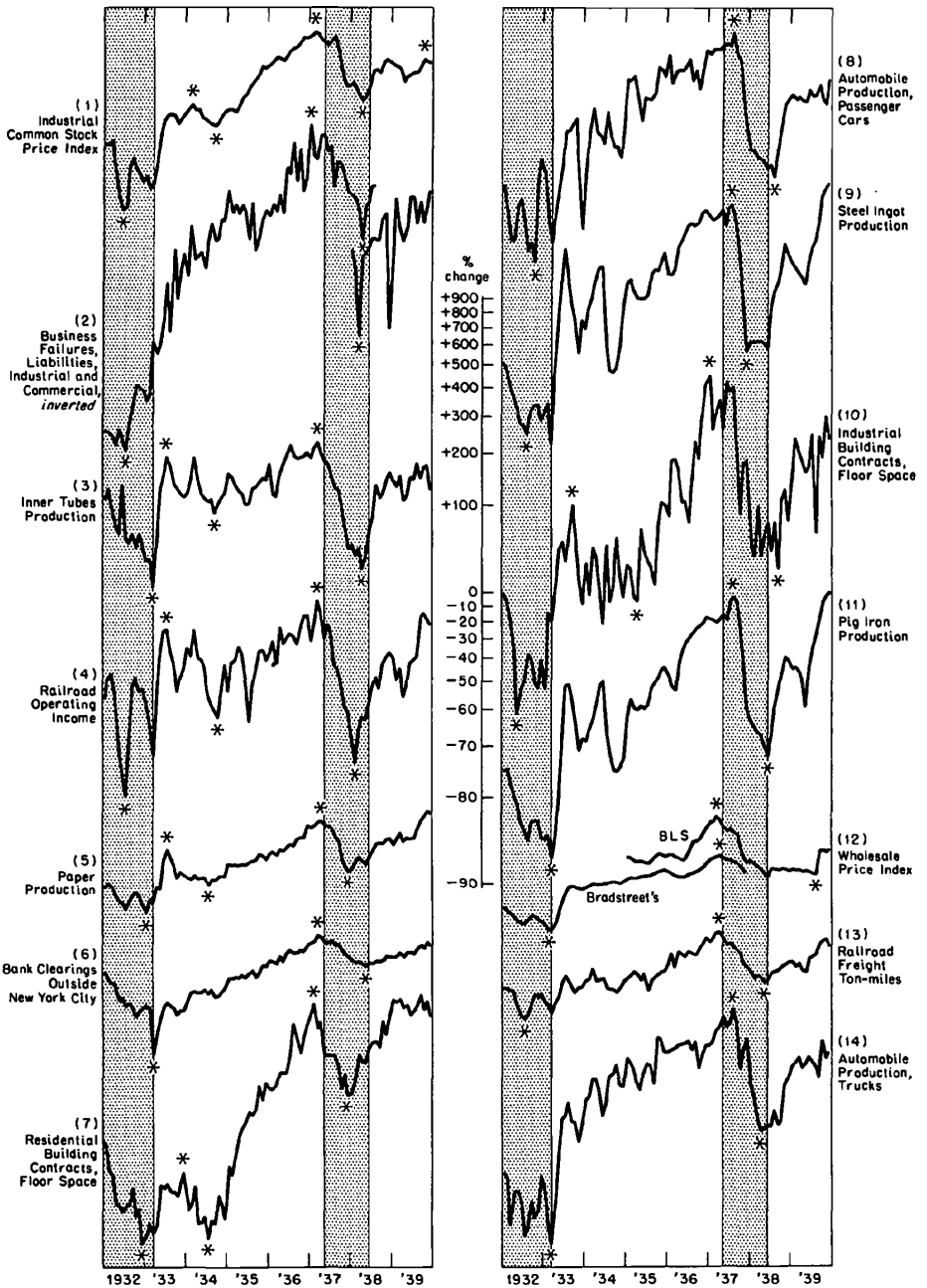
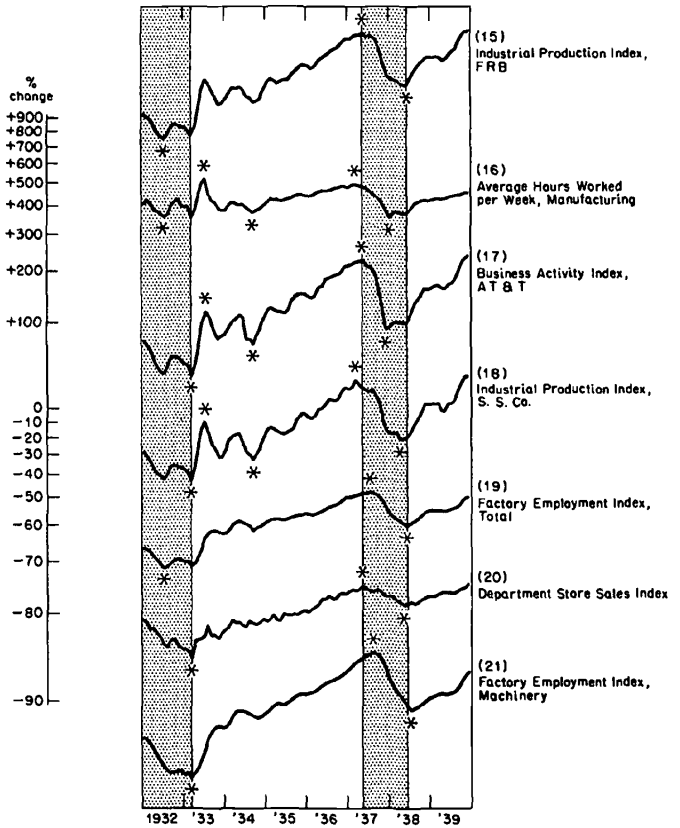


CHART 7.1 (concluded)



See note to Table 7.1.
All series, except (1) and (12), are adjusted for seasonal variations.
Shaded areas represent reference contractions; white areas, reference expansions.
Asterisks identify peaks and troughs of specific cycles.

exhibited in the table and chart. A more extensive view will be provided by the materials presented in subsequent sections of this report.[3] Meanwhile it may be helpful to examine a small sample of series selected for the diversity of their behavior. Chart 7.2 shows "reference cycle patterns" of seven monthly series during five successive business cycles, 1919–38, together with their average patterns for this period. Two of the seven, residential building contracts and the industrial production index, are from the twenty-one indicators of Chart 7.1; the rest are different.

[3] A still more comprehensive analysis of varieties of cyclical behavior is presented in Wesley C. Mitchell's *What Happens during Business Cycles*, New York, NBER, 1951.

TABLE 7.1

Cyclical Timing of Twenty-one Statistical Indicators

Series and Reference Period Covered	LEAD (−) OR LAG (+) IN MONTHS, AT BUSINESS CYCLE TURNS					
	Troughs Before 1938		June 1938	*Peaks Before 1937*		May 1937
	Range	Av.	Trough	Range	Av.	Peak
1. Indus. stock price index, 1899–1938	−18 to +1	−8	−2	−21 to +3	−6	−3
2. Indus. & comm. failures, liab.,[1] 1882–1938[w]	−12 to +6	−7	−2	−23 to +2	−8	−4
3. Inner tube production, 1921–38	−12 to 0	−5	−2	−15 to −2	−9	−2
4. Railroad operating income, 1907–38[w]	−11 to +1	−5	−4	−7 to 0	−3	−2
5. Paper production, 1918–38	−10 to 0	−5	−6	−7 to 0	−3	−1
6. Bank clearings outside NYC, 1879–1938[w]	−10 to +6	−5	−1	−13 to +10	+1	−2
7. Resid. bldg. contracts, fl. space, 1919–38	−7 to 0	−4	−6	−16 to +8	−7	−3
8. Auto. production, passenger cars, 1914–38	−6 to 0	−4	+2	−10 to +7	−3	+3
9. Steel ingot production, 1899–1938	−13 to +1	−4	−6	−10 to +9	+1	+3
10. Indus. bldg. contracts, fl. space, 1919–38	−10 to 0	−3	+3	−4 to 0	−2	−4
11. Pig iron production, 1879–1938	−13 to +1	−3	0	−11 to +11	+2	+3
12. Wholesale price index, 1893–1938[w]	−11.5 to +5	−3	+14	−18 to +8	−3	−1
13. Railroad freight ton-miles, 1908–38	−10 to +1	−2	−1	−4 to +3	0	−1
14. Auto. production, trucks, 1913–38	−6 to 0	−2	−2	−13 to +8	−1	+3
15. Indus. production index, FRB, 1919–38	−8 to 0	−2	0	0 to +2	+1	0
16. Av. hours worked per week, mfg., 1921–38	−8 to +5	−2	−5	−11 to +4	−4	−2
17. Bus. activity index, AT & T, 1879–1938	−8 to +1	−2	−6	−15 to +9	−1	0
18. Indus. prod. index, S.S. Co., 1919–38	−4 to +1	−1	−2	−1 to +1	0	−2
19. Factory emp. index, total, 1914–38	−8 to +2	−1	0	−19 to +2	−5	+2
20. Department store sales index, 1919–38	0 to +5	+2	−1	+3 to +9	+5	0
21. Factory emp. index, machinery, 1919–38	0 to +3	+2	+1	0 to +2	+2	+3

	Number of Leads and Lags			
Leads	19	14	13	12
Coincidences		3	2	3
Lags	2	4	6	6
	Means			
Series 1– 7	−6	−3	−5	−2
Series 8–14	−3	+1	−1	+1
Series 15–21	−1	−2	0	0
Series 1–21	−3	−1	−2	0
	Medians			
Series 1– 7	−5	−2	−6	−2
Series 8–14	−3	0	−1	+3
Series 15–21	−1	−1	0	0
Series 1–21	−3	−2	−2	−1

For sources and brief descriptions of the behavior of these series see Bulletin 69 [reprinted here, Chapter 6]. The measures in this table, based on our latest analyses, differ slightly from those given in the bulletin. Series 2 (Bradstreet's) was discontinued in January 1933; the similar compilation by Dun is used thereafter. Series 12 (Bradstreet's index) was discontinued in November 1937; the BLS index of wholesale prices of 28 basic commodities, which begins in 1935, is used here to determine the 1938 trough (see section VII).

[i] Inverted; see note 9.

[w] War cycle observations (timing comparisons at the 1918 peak, 1919 trough, and 1920 peak) are omitted.

CHART 7.2

Reference Cycle Patterns of Seven Series, 1919–38

1 Residential Building Contracts, Floor Space
2 Industrial Production Index, FRB
3 Railroad Locomotive Shipments
4 Business Failures, Liabilities, Manufacturing Companies
5 Refined Copper Stocks
6 Bond Sales, New York Stock Exchange
7 Agricultural Marketings Index

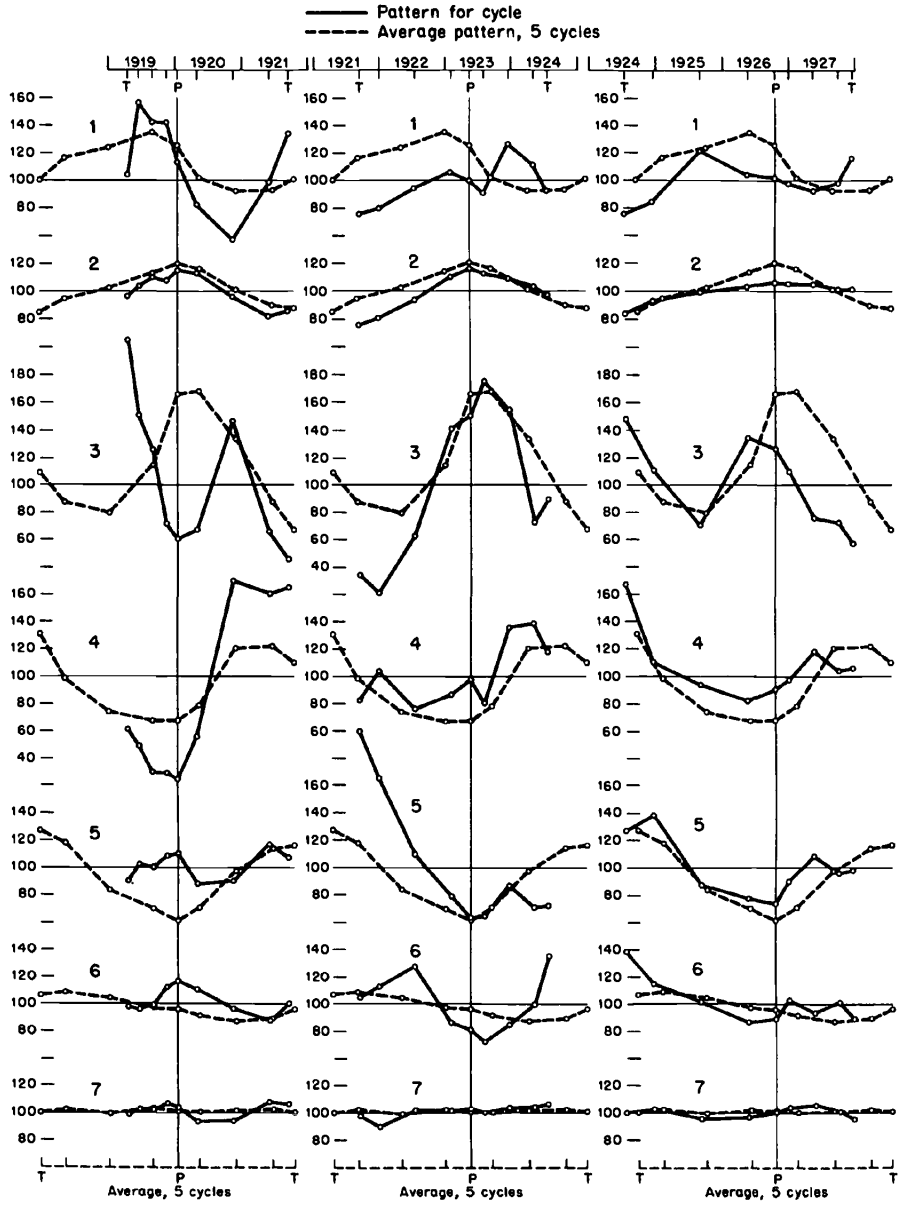
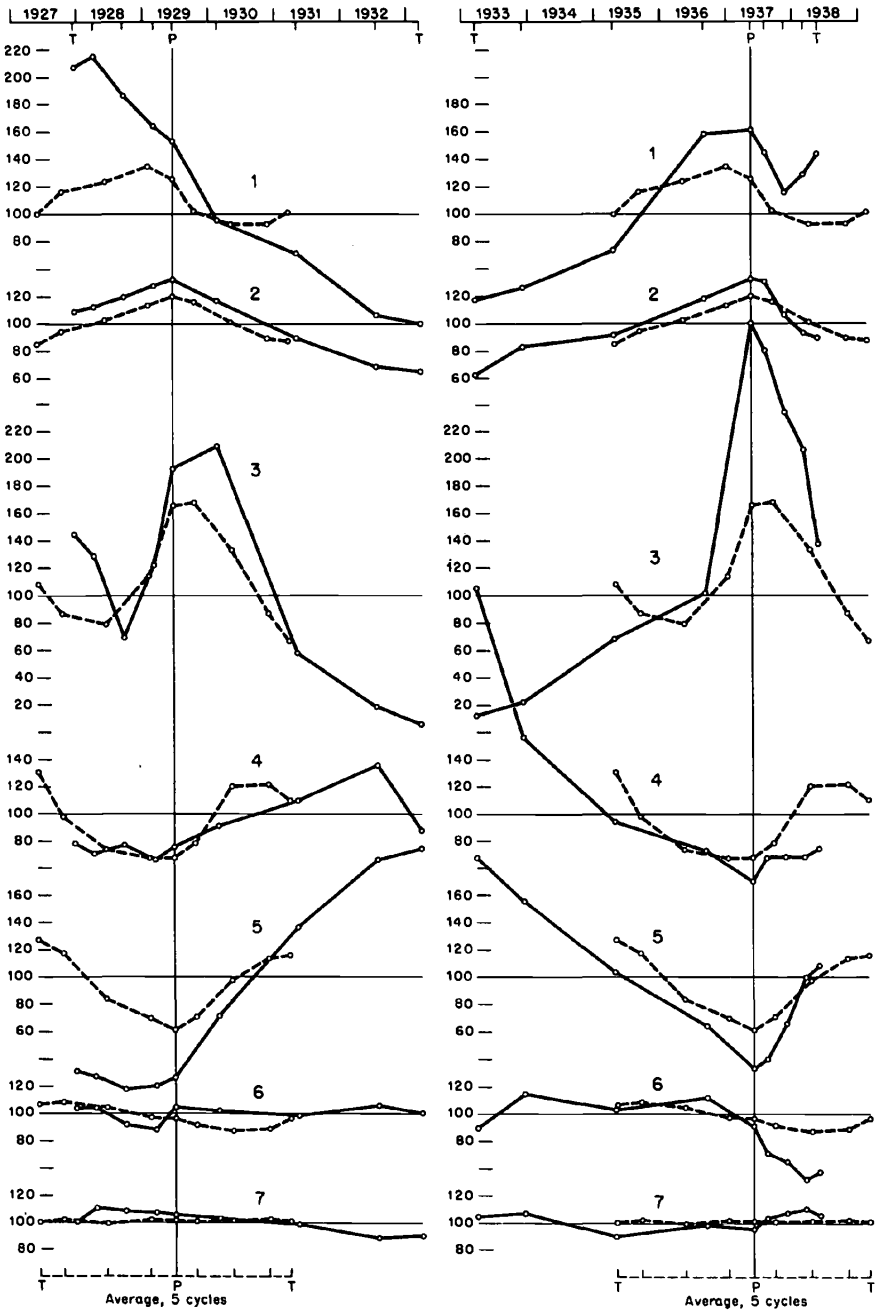


CHART 7.2 (concluded)



Since we shall have occasion later to use measures based upon reference cycle patterns, an understanding of how they are computed is essential. First, the monthly seasonally adjusted series is divided into so-called reference cycle segments—the intervals between successive reference troughs. Next we compute the average standing of the series during each segment, and express the monthly figures as percentages of this base. These percentages are called "reference cycle relatives." This step reduces the original data for every series to a common unit, so that series expressed in diverse units may be compared. The third step is to compute a nine-point pattern for each reference cycle segment by breaking the segment into nine stages and computing the average of the relatives for each stage. Stage I covers the three months centered on the initial trough, stage V the three months centered on the peak, and stage IX the three months centered on the terminal trough. Stages II, III, and IV cover successive thirds of the length of the expansion, and stages VI, VII, and VIII successive thirds of the contraction. By averaging the reference cycle relatives for the months included in each stage we get the reference cycle patterns plotted in Chart 7.2.[4] Finally, the nine-point patterns for a series may be averaged over as many cycles as the series covers, or any subset. The averages in Chart 7.2 are confined to the five cycles of 1919–38, though some series cover earlier cycles.

Let us examine first these average patterns. The pattern for residential building contracts declines before the expansion in general business activity ends and rises in the later stages of the general contraction. The index of industrial production moves roughly synchronously with the ebb and flow of general business. Deliveries of railroad locomotives fluctuate widely and lag at both peaks and troughs. Failures of manufacturing enterprises, measured by their liabilities, decline as prosperity advances and rise in depression, but tend to lead. Their average pattern is almost an inverted replica of that of residential building contracts. Stocks of refined copper also are "inverted," declining steadily as business expands and rising when it contracts, neither leading nor lagging perceptibly. Bond sales in the financial markets begin to decline early in expansion and continue to decline until the business contraction is well advanced, when they begin to rise. Their timing is but one step removed from that of residential building contracts. The average pattern for marketings of agricultural products deviates little from a horizontal line.

[4] The effect of this process may be visualized by comparing the patterns in Chart 7.2 for residential building contracts and the industrial production index, 1933–38, with the corresponding monthly data for these series in Chart 7.1. The reference patterns and conformity measures used in this report are based on reference dates as they stood *before* the revisions noted in Appendix A; but the measures of timing of specific cycles are based on the revised dates [except that the unrevised dates April 1919 and June 1929 were used since these revisions were made subsequent to this analysis].

Now if the average patterns were strictly representative of the individual cycle patterns, the variety of behavior depicted would be considerable. But clearly they understate the variety that actually exists. The set of patterns for each individual cycle differs from the average set in countless ways. Sometimes, as in 1919–20, the expansion is much shorter than average; sometimes, as in 1933–37, much longer. In the 1926–27 contraction the movements of most series were smaller than their average movement in contractions; in the 1937–38 contraction most of the movements were larger than average. In four contractions the upturn in residential building contracts preceded that in the index of industrial production, as it did on the average; but this did not happen in the 1929–33 contraction.

The averages are far more representative for some series than for others. There is so little repetition in the behavior of the index of agricultural marketings in successive business cycles that the fluctuations largely cancel themselves out in the average; hence the latter approximates a straight line. At the opposite extreme is the index of industrial production, which matches almost perfectly the successive phases marked out by the reference dates. The behavior of the other series is moderately consistent in successive cycles; but the distinctive timing of their average patterns is not repeated in every cycle.

Chart 7.2 makes it plain that no two business cycles are exactly alike—amplitudes, durations, and timing sequences differ. Cycle forecasting is not simple. However, the sample of series in this chart is too small to represent well what happens during business cycles. Timing sequences there are, and they are a vital feature of every business cycle. But there is also a consensus: ". . . a cycle consists of expansions occurring at about the same time in many economic activities, followed by similarly general recessions, contractions, and revivals which merge into the expansion phase of the next cycle. . . ."[5] What Chart 7.2 fails to demonstrate is that most economic activities, on any reasonable definition, expand and contract roughly in unison.

This consensus can be demonstrated in various ways. One can examine the reference cycle patterns of various series of broad scope, such as production indexes, total employment, national income, bank debits, retail sales, railway traffic, price indexes. Or one can summate, in one way or another, the reference cycle patterns of the 800-odd individual monthly or quarterly series we have analyzed for the United States. The use of reference cycle patterns, of course, presupposes that the reference dates are at least roughly accurate; if no consensus were revealed, it might be due to inaccuracy in the dates. On the other hand, one can examine the concentration in time of specific cycle turning dates, either

[5] *Measuring Business Cycles*, p. 3.

in the broad aggregates or in the mass of lesser series. These are determined independently of the reference dates and independently in the different series.[6]

We need not pursue this matter far, for it is treated at length, especially by use of reference cycle materials, in Mitchell's *What Happens during Business Cycles* (see note 3). Besides, here we are primarily interested in timing sequences. However, one product of this study is a chronology of specific cycle peaks and troughs in a large number of series, and this chronology is worth examining for the light it throws not only on the consensus of cyclical behavior but also on the nature of revivals and recessions.

From our full collection of more than 800 series we selected, by a process described in sections IV and V, the 404 series whose fluctuations conformed most consistently to business cycles over the period each series covers, after allowance for systematic differences in timing. The number reaching a peak or a trough in a given month, taken as a percentage of the total number of series available in that month, is recorded in Chart 7.3.[7] The number available does not remain the same over the whole period, as the accompanying figures taken in January at ten-year intervals show.

	1890	*1900*	*1910*	*1920*	*1930*	*1940*
No. of series	83	140	175	326	356	330

New series are incorporated whenever they begin (or rather, in order to simplify the procedure, they are treated as if they began one month before their initial specific cycle turning point), and some drop out, so that the total included at any one time never reaches 404. Since the number of series available is much smaller in earlier years, we begin the chart in 1885, though it could be extended back to 1854.

The sample, therefore, varies in size and content. Also it is biased by the way it was selected. Nevertheless it covers a large proportion of our full collection and a broad array of economic processes (see section V). The inclusion of similar information for the other 400-odd series would only reduce, not eliminate, the relative concentration of peaks and troughs around particular dates that appears in Chart 7.3. [Cf. Chapter 2, Chart 2.1.]

It is illuminating to record the data also in terms of the percentage of series undergoing specific cycle expansion in each month. If in a given month 20 out of 100 series are contracting, including, say, 10 series that reach troughs in that month, while 80 are expanding, including 20 that reach peaks, then the number expanding the next month will be 80 +

[6] Exceptions in both respects are occasionally made; see *ibid.*, pp. 58 and 138–139.

[7] In series that are considered to be inverted in relation to business cycles, troughs are counted as peaks and vice versa; see note 9.

10 — 20 = 70. The number expanding in each succeeding month can be determined simply by adding the difference between the number reaching troughs and the number reaching peaks each month. The wavelike line in Chart 7.3 shows the result of this operation, when changes in the number of series available are allowed for by reducing the figures to percentages of that number.

Whereas the white and black bars in the chart reveal the concentrations of specific peaks in the vicinity of reference peaks, and of specific troughs in the vicinity of reference troughs, the continuous curve shows that the proportion of series expanding has invariably reached its highest point some time before the reference peak and its lowest point some time before the reference trough. The curve is, as stated above, mathematically related to the turning point distribution; but what they both show is not a mere piece of statistical arithmetic. The percentage of series expanding begins to decline when the percentage of series reaching peaks begins to exceed the percentage reaching troughs, and continues to decline until the percentage reaching troughs exceeds that reaching peaks. Its cyclical course has been fairly continuous because the first condition (peaks more prevalent than troughs) has persisted for a fairly long interval, and has gradually given way to a period in which the second condition is dominant, and so on.

Thus Chart 7.3 demonstrates a consensus: "expansions occurring at about the same time in many economic activities, followed by similarly general recessions, contractions, and revivals which merge into the expansion phase of the next cycle." The reference dates identify these general cycles with tolerable accuracy. No additional cycles of similar generality seem to appear, nor could any that are identified as reference cycles have well been omitted.[8]

But from Chart 7.3 we can draw a more complete picture of a business cycle. To be specific, let us trace the developments in 1921–24, a fairly typical cycle. The reference trough, July 1921, is roughly in the center of a period in which many series reached troughs, few reached peaks. Troughs apparently associated with this zone began to appear as early as June 1920, even while other series were reaching peaks apparently associated with the preceding peak zone. By July 1921 the percentage

[8] In 1933–35 there is some concentration of peaks and troughs, but the percentage of series expanding never falls below 63, whereas in every other reference contraction it falls well below 50. See the discussion of this period in *Measuring Business Cycles*, pp. 87–90, and the analysis of the dependability of the reference dates, *ibid.*, pp. 94–114. Although in Chart 7.3 reference dates often coincide with the month of highest concentration of peaks or troughs, this does not necessarily indicate their accuracy, or their failure to do so their inaccuracy. For one thing, Chart 7.3 does not take into account differences in the economic significance of the series; for another, it does not allow for differences in their typical behavior during business cycles. These considerations and others underlie the concept and procedures used in selecting reference dates (cf. *ibid.*, pp. 71–81.)

CHART 7.3

Percentage of Series Reaching Specific Cycle Peaks and Troughs and Percentage Expanding, All Series with "Acceptable" Conformity

(solid vertical lines indicate reference troughs; broken vertical lines, reference peaks)

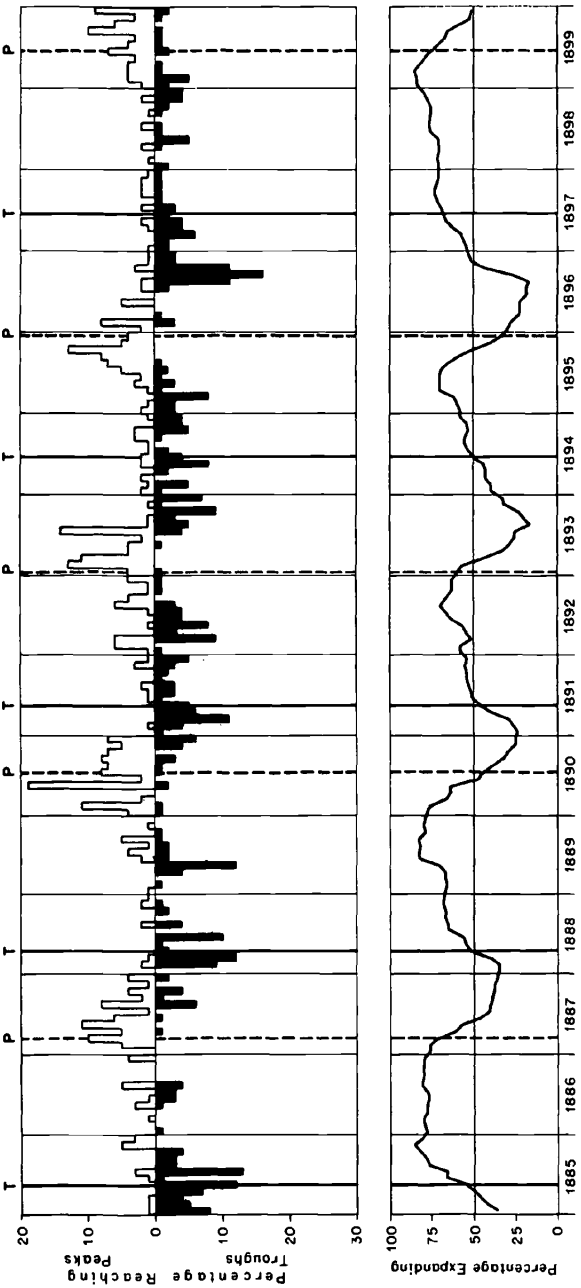
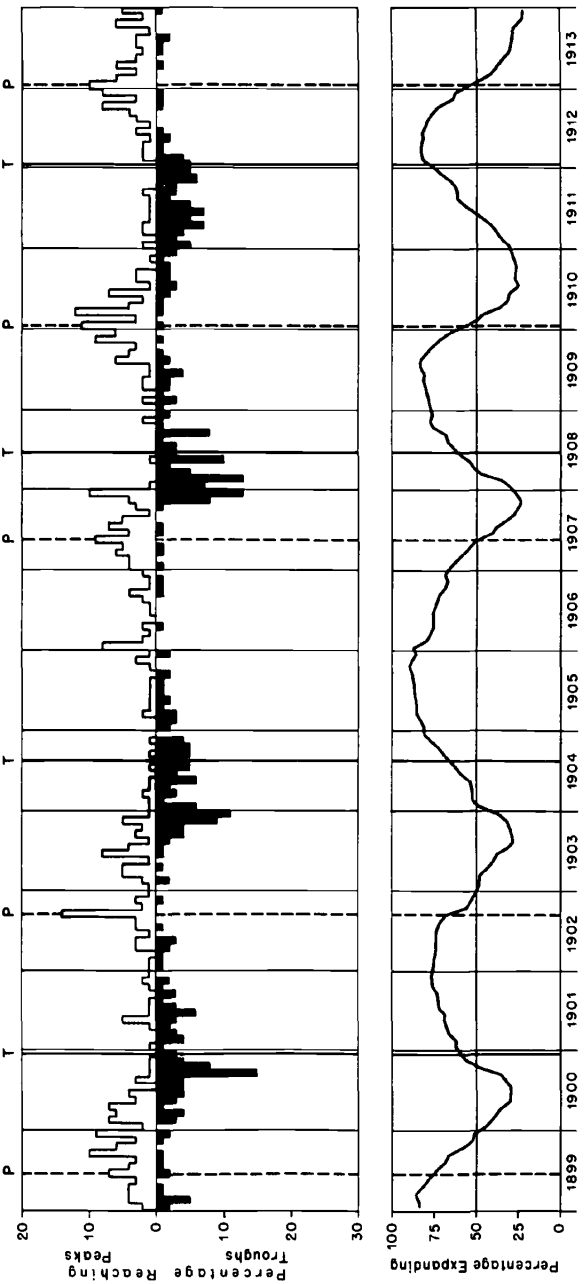


CHART 7.3 (continued)



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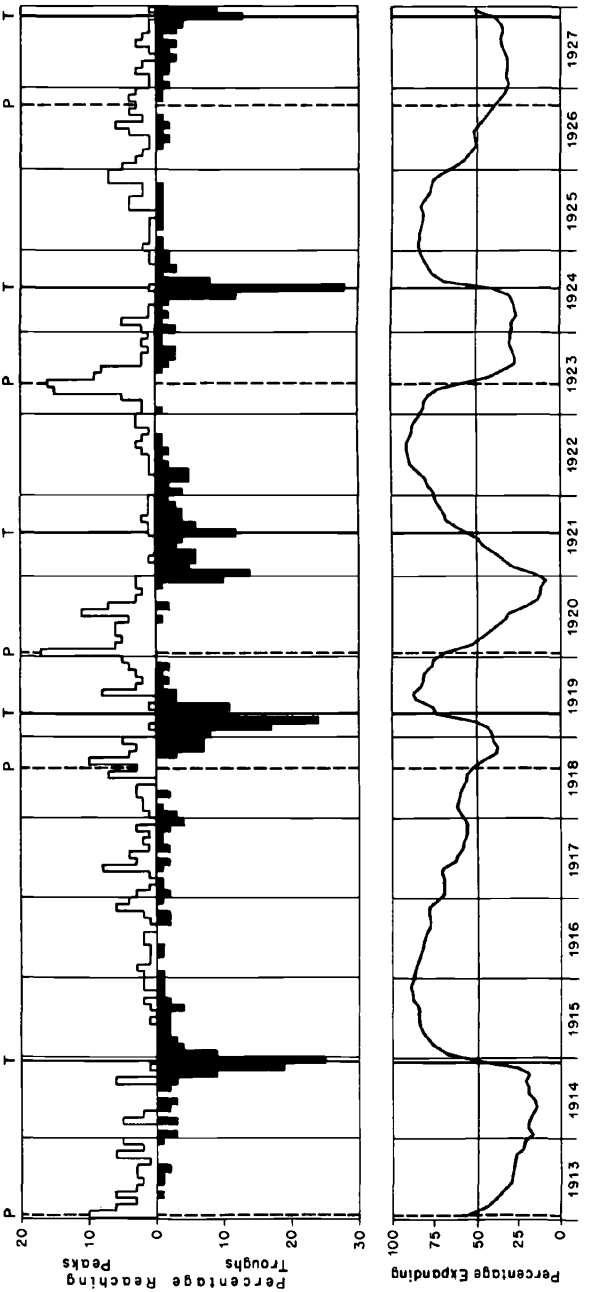
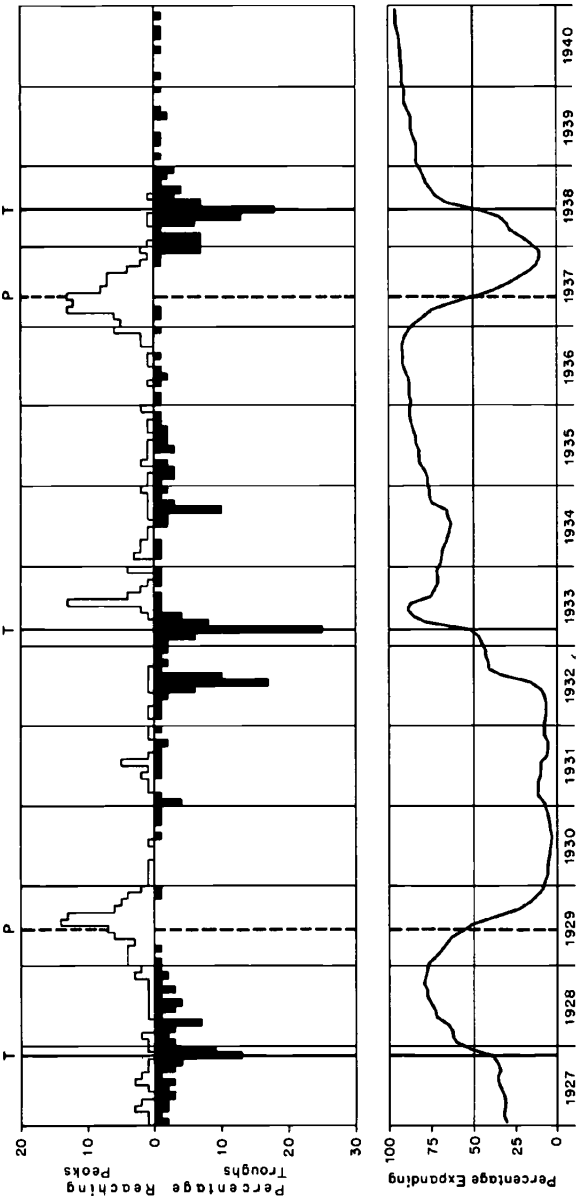


CHART 7.3 (concluded)



of series expanding had already been rising for seven months, and had reached approximately 50. It continued to grow until July 1922, when it was 90 per cent. By this time most of the series had already reached troughs, and a few peaks were beginning to appear. A concentration of peaks occurred in the first half of 1923, neatly grouped around the May reference peak. The percentage of series expanding had by then receded from 90 to 60, while the percentage contracting had grown, of course, from 10 to 40. The contraction continued to spread until the autumn of 1923, when the percentage contracting reached 75, where it remained until the middle of 1924. During that interval approximately as many series were reaching troughs as were reaching peaks. In July 1924, the reference trough, nearly 30 per cent of the sample reached troughs, and the percentage expanding shot up rapidly. While the concentration of troughs in June, July, and August 1924 was much denser than in the corresponding months of 1921, the zone of troughs apparently associated with the 1924 revival extended from the middle of 1923 until late in 1925. By that time the next expansion was well under way.

Thus even the series in this sample, selected for the regularity with which they conform to business cycles, show wide differences in the timing of their cyclical fluctuations. The percentage of series expanding rarely exceeded 80 or fell below 20 in any month between 1885 and 1940. The zones in which the peaks (or troughs) concentrate extend over a year or two or three, and the peak zones often overlap the trough zones. In the words of Mitchell and Burns (Bulletin 69), a business cycle revival or recession "is not an event that happens in a single month, but a complicated series of changes that occur cumulatively in various economic processes during a period that may last a year or more." This very fact spells some hope for the user of statistical indicators.

IV. Criteria for Selecting Indicators

Bulletin 69 described an ideal statistical indicator of cyclical revivals and recessions in the following terms:

1. It would cover half a century or longer, thus showing its relation to business cycles under a variety of conditions.
2. It would lead the month around which cyclical revival centers by an invariable interval—say three months, or better, six months. It would also lead the central month of every cyclical recession by an invariable interval, which might differ from the lead at revival.
3. It would show no erratic movements; that is, it would sweep smoothly up from each cyclical trough to the next cyclical peak and then sweep smoothly down to the next trough, so that every change in its direction would herald the coming of a revival or recession in general business.
4. Its cyclical movements would be pronounced enough to be readily

recognized, and give some indication of the relative amplitude of the coming change.

5. It would be so related to general business activity as to establish as much confidence as the nature of such things allows that its future behavior in regard to business cycles will be like its past behavior.

As is, of course, obvious from Table 7.1 and Chart 7.1, no series possessing all these characteristics was found. Nor have we had better success in this investigation. The synthetic curve plotted in Chart 7.3 (the percentage of series expanding) comes perhaps as close as any to meeting the specifications, but even it does not lead the central months of cyclical revivals and recessions by an invariable interval nor is it free from erratic movements. Its merits will be discussed more fully in section VI.

Realizing that the ideal indicator was not to be found in their collection, the authors of Bulletin 69 looked for series that most nearly approached the ideal. The criterion for their initial selection of seventy-one indicators was what may be called the "two-thirds rule." That is, a series was considered an acceptable indicator of revivals if its specific cycle troughs led the corresponding reference troughs at two-thirds or more of the reference troughs it covered; or if it was "roughly coincident" (turned within three months of the reference trough) at two-thirds or more of the troughs; or even if it lagged at two-thirds or more of the troughs.[9] Of course, if an ideal leading indicator could be found, the other types would be superfluous. As it is, both the roughly coincident and lagging series yield useful information on the course of a business cycle.

For the further screening given the seventy-one indicators selected by the two-thirds rule (which was relaxed slightly in a few cases), the five general criteria quoted above were spelled out into eleven specific characteristics. Other things being equal, a series was considered more useful as an early indicator of revivals:

1. The longer its average lead at past revivals.
2. The more uniform are these leads in occurrence and length.
3. The closer its specific cycles come to having a one-to-one correspondence with business cycles.
4. The more clearly defined its specific cycles.
5. The less intense its erratic movements in comparison with the amplitude of its specific cycles.

[9] The peaks of a series taken to be inverted with respect to business cycles, such as business failures, are compared with reference troughs. Usually it is easy to decide whether a series should be treated positively or invertedly; but it is difficult when the series leads or lags by long intervals. Throughout this report we adhere to the objective rule we follow in our standard analyses (cf. *Measuring Business Cycles*, pp. 115–117, 188–189). For example, the series on bond sales (Chart 7.2) is treated invertedly under our rule; hence most of the timing observations are lags. If it were treated positively it would lead. Adherence to the rule does not, of course, necessarily lead to the most useful or sensible treatment.

6. The fewer the changes in the direction of its month-to-month movements.
7. The smaller and more regular the seasonal variations that have to be "eliminated" before the specific cycles can be studied.
8. The larger the number of past revivals covered by the series.
9. The farther back in time any irregularities in conformity to business cycle revivals occurred.
10. The broader the range of activities represented by the series.
11. The more stable the economic significance of the process represented.

A sifting of the seventy-one series on the basis of these criteria gave the twenty-one listed in Table 7.1.

Clearly, many considerations enter into the selection of a series as an indicator of revival or recession. Some that have nothing to do with the behavior of the series might be added to the eleven noted. For example, a lag in the publication of a series is often sufficient to justify its rejection as a useful indicator. Again, whether or not the series is published in seasonally adjusted form is a consideration, for seasonal elimination is expensive and time-consuming.

In this study we have not yet carried the application of selective criteria as far as in Bulletin 69, though we plan to continue work along these lines. What we have done is to design and apply a method for rating series on the basis of two criteria: the consistency with which their movements have conformed to business cycles, and the consistency with which their turning points have led, lagged, or roughly coincided with the reference dates. A series' rating is based upon estimates of the probability that, for specified measures of its past performance, a result as good as or better than the one observed would occur in random sampling.

These measures of performance may be based on all the cycles covered by a series; then the computed probability takes into account differences in the lengths of series, i.e. differences in the amount of information on cyclical behavior available for each series. The two-thirds rule did not do this. On the other hand, to avoid ambiguities due to differences in time coverage and to possible changes in behavior, it is desirable to have measurements based upon a fixed and recent period for all series. Consequently, two sets of measures have been used: one based on all cycles covered by the series, the other on 1919–38, a period covered by most of the series.

The first criterion, conformity, is designed to spot series whose movements have paralleled business cycles consistently. If a series consistently expands during business expansions and contracts during business contractions, it has at least one of the qualities of a good indicator. However, allowance should be made for the fact that some series typically contract during business expansions and expand during contractions, and that

others show characteristic differences in timing in relation to business cycles.

These differences are revealed, at least crudely, by the reference cycle patterns computed for each series (cf. Chart 7.2). Consequently, we examine the patterns to determine the set of "stages," or interval, during which the series typically expands, and those during which it typically contracts.[10] For example, the expansion intervals for the first six series in Chart 7.2, taking into consideration all the cycles covered by each series, are: residential building contracts, VII-IV; industrial production index, I-V; locomotive shipments, III-VI; liabilities of business failures, IV-VII; refined copper stocks, V-IX; bond sales, VII-II. The seventh series in Chart 7.2, agricultural marketings, behaves so irregularly in successive reference cycles that a division into typical expansion and contraction intervals is not justified.

The expansion interval usually corresponds rather closely to the interval during which the average reference pattern rises, and the contraction interval to the interval during which the average pattern declines, as the reader can verify from Chart 7.2. The intervals, of course, imply a certain kind of timing. Thus the expansion interval, VII-IV, for residential building contracts implies that the series typically leads by one stage at business peaks and by two stages at business troughs. The typical sequences among the series can be traced by the arrangement that follows, which utilizes the expansion and contraction intervals.

	TYPICAL DIRECTION OF CHANGE BETWEEN STAGES							
	I–II	II–III	III–IV	IV–V	V–VI	VI–VII	VII–VIII	VIII–IX
		Business Expansion				*Business Contraction*		
	Trough to First Third	First to Middle Third	Middle to Last Third	Last Third to Peak	Peak to First Third	First to Middle Third	Middle to Last Third	Last Third to Trough
Resid. bldg. contracts	+	+	+	−	−	−	+	+
Indus. prod. index	+	+	+	+	−	−	−	−
Locomotive ship.	−	−	+	+	+	−	−	−
Failures, liab., mfg.	−	−	−	+	+	+	−	−
Ref. copper stocks	−	−	−	−	+	+	+	+
Bond sales, N.Y. S. E.	+	−	−	−	−	−	+	+

Once the expansion and contraction intervals have been fixed, one can measure the consistency of performance in successive cycles by counting the number of cycles in which the series rises between the initial and terminal expansion stages and the number in which it falls; likewise

[10] For an account of how this is done, the reader is referred to *Measuring Business Cycles*, pp. 185–197.

one can count the number of cycles in which there is a decline and the number in which there is a rise between the initial and terminal contraction stages.

In Chart 7.2 the industrial production index has a perfect conformity score: it rises during its expansion interval in each of the five cycles (that is, the standing at stage V is higher than at stage I in five cycles); and it declines between V and IX in each cycle. Refined copper stocks rise in four out of five cycles during their expansion interval, V-IX, and decline in four cycles out of five during their contraction interval. Bond sales rise three times out of five during their expansion interval, VII-II,[11] and decline four times out of five during their contraction interval.

The expansion and contraction conformity scores, when combined, measure the parallelism between the movements of the series and business cycles. For this purpose, the number of rises in the series' typical expansion interval and declines in its contraction interval can be taken as a proportion of the total number of expansions and contractions covered. This measure would be $\frac{10}{10}$ or unity for the index of industrial production, $\frac{8}{10}$ for copper stocks, $\frac{7}{10}$ for bond sales. It could not exceed unity, nor could it fall much below one-half if the expansion interval was at all typical.

However, this simple measure is the same for a series lapsing once from perfectly consistent conformity in five phases as for a series lapsing twice out of ten. Should one not have more confidence in the excellence of the series in the second case than in the first? If some simplifying assumptions are made, it is easy to compute the probability that as few as, say, two lapses in conformity out of ten will occur by chance, and this may be compared with the probability of obtaining as good a result as one lapse out of five by chance. Our method, then, is simply to compute these probabilities for each series' expansion and contraction scores, and to combine the expansion and contraction probabilities for a given series by multiplying them: the smallest product probabilities indicate the best series so far as conformity is concerned.[12]

A small product probability may, however, result from a strong secular

[11] In this case, to compare stage VII of one cycle with stage II of the next, the standing at stage II is recomputed on the base of the preceding cycle.

[12] The underlying assumptions are that the probability that a series will rise (or fall) during its expansion interval in a given business cycle is one-half, and that the results in successive cycles are independent. Then the probability that no lapses will occur in, say, 5 phases is $(\frac{1}{2})^5 = .03125$; that 1 lapse will occur, $5(\frac{1}{2})^5 = .15625$; 2 lapses, $10(\frac{1}{2})^5 = .3125$; and so on according to the binomial expansion. Cumulating, one obtains the probability for as good a result as no lapses, .03125; one lapse, .1875; two lapses, .5; etc. Both underlying assumptions are open to question, and the computed probabilities cannot be interpreted in any strict sense. Several other procedures were tried but the above seemed adequate for rating series roughly, which is all that is possible since the conformity scores themselves contain a rather limited amount of information about the series' behavior. When a series does not change in its expansion (or contraction) interval in a given cycle the observation is counted as one-half rise, one-half fall.

trend in the series. An upward trend can help to produce a high expansion score, and the corresponding expansion probability may be so low as to offset a relatively high contraction probability and yield a relatively low product. Two procedures help to avoid this. First, we require that there be both an excess of rises over declines in expansion intervals *and* an excess of declines over rises in contraction intervals. This eliminates series in which the effect of trend is so strong as to produce more rises than declines in both phases (or vice versa). Such series cannot be said to parallel business cycles. Although they may reflect the influence of business cycles by alternately rising faster and slower, and hence not be entirely valueless as indicators, they may well be set aside at the start.

The second and more important procedure is to subject the expansion and contraction probabilities to a maximum acceptance level, .188. When either probability is above this level (or rather, above the nearest possible approximation to it in the given case), the series is rejected. The .188 level is the probability that one or fewer lapses in conformity will occur in five phases. Series that would get a low product probability merely because of an exceptionally low expansion (or contraction) probability are thereby eliminated. Reasonably good conformity to both expansions and contractions is an essential characteristic of a good indicator, whether revivals or recessions are of chief interest.

The general effect of the procedure, as the accompanying figures illustrate, is that for the same proportion of lapses in conformity, the longer the series, the lower the probability; and the longer the series, the higher the maximum acceptable proportion of lapses in conformity. When the

Phases covered by series (no.)	5	10	15	20
Lapses in conformity (no.)	1	2	3	4
Probability	.188	.055	.018	.0058
Maximum acceptable no. of lapses	1	3	$5\frac{1}{2}$	$7\frac{1}{2}$
Probability	.188	.172	.214	.182

conformity probability criterion is applied to the full periods covered by the seven series of Chart 7.2, two series are rejected (Table 7.2).

Series with acceptable conformity are then subjected to the timing criterion. Timing is measured by comparing the dates of a series' specific cycle peaks and troughs with the reference dates, and the intervals, in months, are classified as leads, lags, or rough coincidences.[13] A consistent

[13] For purposes of the probability criterion described below, an exact coincidence was counted as a half lead and a half lag. Rough coincidences include exact coincidences and leads or lags of one, two, or three months. Any timing comparison must be in one of the three timing groups, and some may be in two (leads and rough coincidences, or lags and rough coincidences). But at some reference turns there may not be any timing comparison, either because no specific cycle turn occurs in the vicinity or because several turns compete. Cf. *Measuring Business Cycles*, pp. 116–128.

TABLE 7.2

Conformity Measures, Seven Series

Series and Reference Period Covered by Conformity Measures	Expansion Interval	NO. OF CYCLES IN WHICH THE SERIES DURING ITS *Expansion Interval* Rises	*Expansion Interval* Falls	*Contraction Interval* Rises	*Contraction Interval* Falls	*Conformity Probability* Expansion	*Conformity Probability* Contraction	*Conformity Probability* Product	Series Accepted or Rejected
Resid. bldg. contracts, fl. space, 1919–38	VII–IV	4	1	1	4	.188	.188	.035	Accepted
Indus. production index, FRB, 1919–38	I–V	5	0	0	5	.031	.031	.0010	Accepted
Railroad locomotive shipments, 1918–37	III–VI	4	1	1	4	.188	.188	.035	Accepted
Bus. failures, liab., mfg., 1894–1938[w]	IV–VII	9	1	1	9	.011	.011	.00012	Accepted
Refined copper stocks, 1910–38[a]	V–IX	5	2	2	4	.227	.344	.078	Rejected
Bond sales, NY Stock Exchange, 1888–1938	VII–II	12	2	3	11	.0065	.029	.00019	Accepted
Agricultural marketings index, 1919–38	[b]	4	1	3	2	[b]	[b]	[b]	Rejected

[a] Data are not available for the 1914–19 cycle.

[b] Timing is irregular; stages I–V are used as the expansion interval but series is rejected (see text).

[w] War cycle observations (1914–21) are omitted.

leader at peaks, then, is a series that leads at a large proportion of the reference peaks covered. What is a large proportion and what a small is determined by computing the probability that, when a series covers a certain number of reference peaks (or troughs), a specified number of timing comparisons of a given type will be equaled or exceeded by chance.[14] As with conformity, a maximum acceptance level is adopted, corresponding as nearly as may be to the probability (.223) that four or more timing comparisons will appear in a given group when the series covers six reference turns. The accompanying figures illustrate how the timing probabilities vary with the length of the series. A series leading at two-thirds of the reference peaks covered is assigned a much lower probability if it achieves this record in twenty-one cycles than in six.

No. of ref. peaks (or troughs) covered by series	6	12	18	21
Timing comparisons of one type (no.)	4	8	12	14
Probability	.223	.087	.037	.025
Timing comparisons of one type, min. accept. no.	4	7	10	11
Probability	.223	.216	.210	.257

A record of leads at eleven peaks in twenty-one cycles is roughly equivalent, on a probability basis, to a record of four in six cycles.[15] Table 7.3 shows the timing probabilities for the five series of Chart 7.2 that have acceptable conformity.

Since the conformity and timing probabilities just described are based on a series' behavior during all the business cycles it covers,[16] they do not

[14] Since a tabulation of the total number of leads, lags, and rough coincidences for all series having acceptable conformity revealed that the number in each class was roughly the same—about 43 per cent of the number of reference turns covered by the series, .43 was adopted as the probability that a series will produce a timing comparison of a given type at a reference turn.

[15] A series that leads at 11 peaks out of 21 has not, it is true, achieved a good record as a leader if it lags at the other 10. Our method, in effect, gives some weight to the possibility that the series will not reach a corresponding peak at all 21 reference peaks. The difficulty could be avoided by computing two probabilities, one based on the number of corresponding turns relative to the number of reference turns, the other on the number of leads relative to the number of corresponding turns.

A simpler expedient would be to adopt a higher acceptance level. The probability (.057) corresponding to 5 leads out of 6 reference turns covered would be fairly satisfactory, since it would require a minimum of 13 leads in 21 turns ($P = .064$). The classification of series in sections V and VI is based, however, on the procedure described in the text. A saving feature is that a well-conforming series with, say, 11 leads and 10 lags is likely to have at least as many rough coincidences, in which case it will be classified also as a "coincider."

[16] An exception is made in price and certain value series, observations during war cycles being omitted.

TABLE 7.3

Timing Measures, Five Series

Series, Reference Period Covered, and Reference Turn	No. of Ref. Turns Covered	*No. of Timing Observations That Are*				Av. Lead(−) or Lag(+) (months)	*Timing Probability*[a]		
		Leads	Exact Coin.	Lags	Rough Coin.		Leads	Lags	Rough Coin.
Resid. bldg. contracts, fl. sp., 1919–38									
Reference peaks	5	4		1	1	−6.2	.112		
Reference troughs	6	5	1		2	−4.5	.019		
Industrial production index, FRB, 1919–38									
Reference peaks	5		3	2	5	+0.6		.204	.015
Reference troughs	6	4	2		5	−2.2	.057		.057
Railroad locomotive shipments, 1918–38									
Reference peaks	6	1	1	3	2	+1.4			
Reference troughs	6			6	1	+10.0		.0063	
Business failures, liab., mfg.,[1] 1895–1938[w]									
Reference peaks	10	8	2		4	−6.5	.0031		
Reference troughs	11	8	1	2	2	−6.3	.022		
Bond sales, NY Stock Exchange,[1] 1890–1937									
Reference peaks	14	3		10	2	+5.8		.030	
Reference troughs	13	2		11	2	+7.2		.0027	

[a] Only the accepted timing probabilities are recorded; see text.

[1] Inverted; see note 9.

[w] War cycle observations (1918–20) are omitted.

take account of possible secular changes in cyclical behavior. For example, a series whose conformity has improved may get a lower rating than its recent performance would justify. Or a series may be classed as a leader at peaks, when recently it has lagged. While significant shifts of this sort do not appear to be widespread, our measures may be misleading when they do occur.

A few illustrations will suffice to reveal the nature of the problem. A series on railroad freight ton-miles is rejected on the basis of its conformity during all cycles covered (1867–1938), because in nearly half the reference contraction intervals it does not decline. But its failure is confined to its early years; since 1907 it has declined in every contraction except one, that of 1910–12, a rather mild depression. This shift in behavior is due to the declining secular rate of growth of railroad freight traffic (the rate of growth in the early years being so rapid as to offset depressions) and perhaps also, in some degree, to the declining relative volume of agricultural traffic.

Shifts in conformity are often related to shifts in timing. An improved conformity may mean a more consistent timing relationship, i.e. the proportion of reference turns for which there are no corresponding specific turns may be smaller, and noncorresponding, or extra, specific turns may be less frequent. For example, in 1867–1919 total exports conformed irregularly, rising in ten and falling in three expansions and rising in nine and falling in four contractions; since 1919 exports have increased in each expansion and declined in each contraction. The pre-1919 period yields only eleven timing comparisons; fifteen reference turns are skipped and there are twenty-four extra specific turns. After 1919 there are seven comparisons; only four turns are skipped and there are only five "extras."

Besides shifts in the degree of correspondence between specific and business cycles, shifts may occur in the kind of timing. Prior to 1913 railroad ton-miles lagged at each of the eight reference peaks with which a specific peak could be matched, often by substantial intervals. Since then it has led at four peaks, and lagged only twice; none of these intervals exceeded four months. Orders for railway equipment illustrate another type of shift in timing. In the early years they led business revivals by much longer intervals than in recent cycles. Burns and Mitchell (*Measuring Business Cycles*, pp. 414–416) attribute this to a shift of the railroad industry from a dominant to a subordinate position as an object of investment.

The method we have chosen to meet the problem of shifts in conformity and timing is to rate all series on the basis of their performance after 1919, provided they cover at least the four cycles 1921–38. Comparison with results based on all cycles covered will bring to light changes in behavior. Furthermore, by rating all series on the basis of performance in 1919–38 we can test the performance of identical groups of series in earlier cycles;

in other words, test whether secular or other changes in behavior have been so general as to make it impossible to discover stable behavior characteristics. Looking backward in time, we can make the same sort of test that was made in Table 7.1 looking forward. Another advantage of fixing the period (approximately) is that the arbitrary method of equating different historical periods by a probability scheme is avoided. In particular, since the dates of reference troughs seem to have a small bias in the early years, long series are in fact not treated on precisely the same basis as short, in respect of their behavior at troughs. The reference dates in 1919–38 are more firmly established and in any event fixing the period eliminates the difficulty.

The conformity and timing probabilities (for the full period covered by the series and for 1919–38) are the measures so far developed and applied in this study. Both types of measure contribute useful information about the quality of a series as an indicator. While they are not strictly independent in a statistical sense, they utilize the data in quite different ways, and the two together contribute more information than either alone. Nevertheless, by themselves they will not yield a wholly satisfactory set of indicators. For one thing, the acceptance levels we have set are met by very many series, and a long list of indicators is practically a serious inconvenience. But we did not wish to set the levels much higher (see, however, note 15), for that would mean giving disproportionate weight to what are, in and of themselves, rather rough measures of behavior. We plan, instead, to apply additional criteria to achieve a finer selection. Some consideration, for example, should be given to the length of the average lead or lag; this is done only indirectly and crudely by the timing probabilities (see section V). Again, a series may get a low conformity and a low timing probability, yet have such large erratic movements as to be of little value as an indicator. Moreover, account has not been taken directly of how closely the movements of a series match the variations in amplitude of successive business cycles. [See *Measuring Recessions*, reprinted here, Chapter 5, for tests of this sort.] Consequently, the classifications of series based upon the probability measures, which we present and utilize in sections V and VI, must be taken as provisional and subject to elaboration and revision.

V. Classification of Series According to Conformity and Timing

The 801 monthly and quarterly time series for the United States analyzed in connection with the National Bureau's general investigation of business cycles are the foundation of this study.[17] Assembled over a period of years for a variety of purposes, they cover a wide range of

[17] Included are 57 series on the status of national banks at 5 irregularly spaced "call dates" within the year; 61 "short" series are excluded (see text).

economic activities. The measures of cyclical behavior computed for each series on a standard plan have been subjected to the techniques described in the preceding section. We now show how groups of series on different economic processes are classified by these techniques.

As our monthly and quarterly reference dates cover 1854–1938, the cyclical measures for an individual series do not go beyond these dates. Most series, of course, begin much later than 1854 and some end before 1938. Since the behavior of discontinued series may provide clues to useful series that are or might become currently available, we have included them in our tabulations. We have excluded, for the time being, some sixty-one series that cover less than four business cycle expansions and four contractions, on the ground that our simple procedures, devised to achieve a rough grading of the great mass of series, are inadequate to assess the value of very short series. These, together with other series that have come into being since 1938, should be considered as candidates in a final selection of indicators, and some attention is given them in section VII.

In general, the highly uneven distribution of series according to the type of economic activity represented (Table 7.4, cols. 2 and 3) is the result of variations in both the availability of data and the degree of intensity with which certain parts of the National Bureau's business cycles research program have been pursued. These exigencies, of course, affect the selection of indicators, for we cannot select indicators from types of activity for which we do not have any series. Some of these deficiencies, fortunately, can be made up from data that have become available in recent years and cover only a brief period.

Eighty-two of the 576 "rejected" series (col. 2), or about 10 per cent of the collection, conform so irregularly to business cycles that no expansion or contraction interval seems typical, e.g. contracts for public construction, production of foodstuffs, railroad rates and fares, and certain classes of inventories. These series are not without significance for business cycle analysis, for processes that fluctuate more or less independently of business cycles are part of the economic environment and may exert sufficient force to alter substantially the course of a business cycle. Nevertheless, it is important to separate them from the more reliable indicators.

An additional 315 series in column 2 fail to meet our minimum standard for conformity, although they conform better than the eighty-two series just mentioned. All told 397, or nearly half, of the 801 series are rejected on grounds of irregular conformity, while 404 have "acceptable" conformity when behavior during the entire period of the series is considered. Applying the test for consistency in timing to these 404 series we reject 179 series. That is, 179 series fail to meet the timing test.

TABLE 7.4

Classification of All Series Examined for Acceptability as Indicators

Group (1)	*Number of Series* Rejected (2)	*Number of Series* Accepted (3)	% Accepted (4)	*Number of Series*[a] *Accepted for* Leads Only (5)	Leads & Rough Coin. (6)	Rough Coin. Only (7)	Lags & Rough Coin. (8)	Lags Only (9)
Retail sales	9	3	25	...	...	1	...	2
				...	...	2	...	1
Wholesale sales	6	...	0	...	...	...	...	...
				...	...	...	...	...
Imports	10	3	23	...	1	1	...	1
				...	...	2	...	1
Exports	7	...	0	...	...	...	...	...
				...	...	...	...	...
New orders	8	7	47	7	...	...	...	...
				6	1	...	...	...
Const. contracts & permits								
Public & private	7	7	50	7	...	...	...	...
				7	...	...	...	...
Private	12	15	56	12	1	1	...	1
				10	2	3	...	...
Public	16	...	0	...	...	...	...	...
				...	...	...	...	...
Inventories	54	2	4	1	...	...	...	1
				1	...	...	...	1
Production								
General indexes	7	16	70	3	3	3	5	2
				2	6	8	...	...
Foodstuffs	45	...	0	...	...	...	...	...
				...	...	...	...	...
Other perishables	21	5	19	1	...	1	...	3
				2	2	1	...	...
Semidurables	20	5	20	1	...	3	...	1
				5	...	...	...	...
Durables	29	15	34	5	1	3	3	3
				7	4	4	...	...
Trans. & commun.								
Traffic	10	1	9	...	...	1	...	...
				...	1	...	...	...
Rates & fares	7	1	12	1	...	...	...	...
				...	...	...	...	1
Other series	15	6	29	...	6	...	...	...
				1	5	...	...	...
Employment								
General indexes	...	5	100	...	1	1	2	1
				3	...	1	1	...
Perish. goods indust.	8	2	20	...	...	...	1	1
				...	...	1	1	...
Semidur. goods indust.	9	6	40	1	...	3	1	1
				6	...	...	...	...
Dur. goods indust.	5	6	55	1	...	2	3	...
				...	1	3	2	...
Av. hours worked per week	3	6	67	4	...	1	1	...
				5	...	1	...	...
Earnings per employee	18	1	5	...	...	...	...	1
				...	1	...	...	...

TABLE 7.4 (concluded)

Group (1)	Number of Series Rejected (2)	Number of Series Accepted (3)	% Accepted (4)	Number of Series[a] Accepted for: Leads Only (5)	Leads & Rough Coin. (6)	Rough Coin. Only (7)	Lags & Rough Coin. (8)	Lags Only (9)
Payrolls & other income payments								
General indexes	1	2	67	...	...	...	2	...
				...	...	1	1	...
Perish. goods indust.	5	4	44	...	...	...	...	4
				...	...	1	2	1
Semidur. goods indust.	8	6	43	...	...	1	4	1
				5	...	1	...	...
Dur. goods indust.	3	5	62	...	...	...	2	3
				1	...	1	3	...
Prices of commodities								
General indexes	9	3	25	1	2	...	...	...
				1	1	1	...	...
Farm products & foods	51	...	0	...	...	...	...	...
				...	...	...	...	...
Other perishables	19	2	10	1	...	...	...	1
				1	...	...	...	1
Semidurables	14	4	22	...	...	2	...	2
				1	...	...	...	3
Durables	34	10	23	4	2	2	1	1
				2	1	1	2	4
Banking & money								
National Bank series	37	21	36	6	...	1	...	14
				10	1	2	...	8
Fed. Reserve member bank series	16	...	0	...	...	...	...	...
				...	...	...	...	...
Fed. Reserve Bank series	9	...	0	...	...	...	...	...
				...	...	...	...	...
Other monetary series	3	1	25	...	...	...	...	1
				...	...	...	...	1
Interest rates & bond yields	15	8	35	...	...	1	...	7
				...	...	...	...	8
Stock exchange transactions	...	3	100	2	...	...	...	1
				2	...	...	...	1
Stock prices	...	6	100	6	...	...	...	...
				6	...	...	...	...
Security issues, corporate	10	4	29	3	...	...	...	1
				3	...	...	...	1
Business profits	4	7	64	1	3	3	...	...
				5	1	...	1	...
Business failures	6	8	57	8	...	...	...	...
				8	...	...	...	...
Bank clearings & debits	...	5	100	...	2	...	3	...
				4	1	...	...	...
Bus. activity indexes	...	12	100	1	2	5	4	...
				2	10	...	...	...
Unclassified	6	2	25	1	...	...	...	1
				1	...	...	...	1
All series	576	225	28	78	24	36	32	55
				107	38	34	13	33

[a] First line is the distribution of series according to their behavior at peaks; second line, the distribution at troughs.

The classification of series by type of activity was designed by Wesley C. Mitchell and used in *What Happens during Business Cycles*. The term "accepted" means accepted for conformity and for timing at both peaks and troughs (see text).

TABLE 7.5

Percentage of Series with Acceptable Conformity and Timing, by Economic Groups

Group	No. of Series in Group	% Accepted
Employment, general indexes	5	100
Stock exchange transactions	3	100
Stock prices	6	100
Bank clearings & debits	5	100
Business activity indexes	12	100
Production, general indexes	23	70
Average hours worked per week	9	67
Payrolls, general indexes	3	67
Business profits	11	64
Payrolls, durable goods industries	8	62
Business failures	14	57
Private construction contracts & permits	27	56
Employment, durable goods industries	11	55
Public & private construction contracts & permits	14	50
New orders	15	47
Payrolls, perishable goods industries	9	44
Payrolls, semidurable goods industries	14	43
Employment, semidurable goods industries	15	40
National bank series	58	36
Interest rates & bond yields	23	35
Production, durables	44	34
Transportation & communication, other series	21	29
Security issues, corporate	14	29
Retail sales	12	25
Commodity prices, general indexes	12	25
Other monetary series	4	25
Unclassified series	8	25
Imports	13	23
Commodity prices, durables	44	23
Commodity prices, semidurables	18	22
Production, semidurables	25	20
Employment, perishable goods industries	10	20
Production, other perishables	26	19
Transportation & communication, rates & fares	8	12
Commodity prices, other perishables	21	10
Transportation & communication, traffic	11	9
Earnings per employee	19	5
Inventories	56	4
Wholesale sales	6	0
Exports	7	0
Public construction contracts	16	0
Production, foodstuffs	45	0
Prices, farm products & foods	51	0
Federal Reserve member bank series	16	0
Federal Reserve Bank series	9	0
All series	801	28

SOURCE: Table 7.4.

at either reference peaks or troughs or both. These, added to the 397 series rejected for conformity, make up the 576 series in column 2. The remaining 225 series (col. 3) show acceptable, but not necessarily similar, timing at both turns.

The application of the conformity and timing criteria eliminates all the wholesale sales series, exports, contracts for public construction, production of foods, prices of farm products and foods, and Federal Reserve Bank and member bank series. In general, the percentage of acceptable indicators varies strikingly among different types of economic process (Table 7.4, col. 4, and Tables 7.5 and 7.6). This percentage is useful in pointing to areas in which a search for indicators is likely to be rewarding. But it is merely a guide. In the great majority of groups some series are "acceptable" and others are not. The individual series must be examined to find out which is which. Moreover, the position of a group in the array is affected by the particular types of series that get into it. The timing and conformity of the wholesale sales group would undoubtedly be better were the series available for a longer period; most of the series in this group are too short to get included in the table, and the others are not representative of wholesale sales in general. The better showing of the national bank than of the member bank series must be interpreted in the light of the fact that all except one of our national bank series end in 1914, while our sample of member bank series not only covers a later period and a different banking system but also a narrower range of banking processes. The larger percentages of acceptable employment and payroll series than of production series (see Table 7.6) are probably partly accounted for by the wider coverage of the individual employment and payroll series. The percentages, therefore, require careful interpretation, but they are at least suggestive.

The various types of economic process distinguished in Table 7.4 differ not only in potency as sources of acceptable indicators but also in the kind of timing the acceptable series exhibit (col. 5–9). By separating series that have an acceptable number of both leads and rough coincidences from those that have an acceptable number of leads only, we can get a crude indication of the size of the lead: series of the latter type are likely to lead by longer intervals. Hence the five timing groups in Table 7.4 indicate roughly series whose timing is characterized by "long leads," "short leads," "short leads or lags," "short lags," and "long lags."

Before we consider the differences among the economic groups we must note one peculiarity of the over-all totals—the rough symmetry in the distribution of series at peaks and the decided asymmetry at troughs. That is, while at peaks the leaders somewhat outnumber the laggards, at troughs nearly three times as many series lead as lag. It is evidently easier to find advance indicators of revivals than of recessions.

TABLE 7.6

Percentage of Series with Acceptable Conformity and Timing, Prices, Production, Employment, and Payrolls

Group	Commodity Prices	Production	Employment	Payrolls
Foodstuffs*	0	0	20	44
Other perishables	10	19		
Semidurables	22	20	40	43
Durables	23	34	55	62
General indexes	25	70	100	67

SOURCE: Table 7.4.

* In the case of commodity prices, this group includes farm products.

Why this should be we are not entirely sure. Several reference troughs may have been postdated a few months, whereas it seems that errors in reference peaks are more evenly distributed (cf. section VI). But these errors occur before 1919; since then the reference dates are determined from better statistical materials, have been reviewed more carefully, and seem substantially correct. Yet the results of classifying series according to their timing in 1919–38 (see Table 7.7) are similar to those in Table 7.4, which utilize the entire period covered by the series. When the timing comparisons of all series with acceptable conformity are put together, leads outnumber lags at only three of the five reference peaks in 1919–38 but at five of the six troughs (the exception is November 1927). This difference between peaks and troughs seems to be characteristic, however, only of the series whose timing is acceptable. Among the rejected series leads outnumber lags at three of the five reference peaks and at three of the six reference troughs. The roughly symmetrical behavior of the rejected series seems to dispose of the question of a bias in the reference dates in this period (though not, of course, of errors in individual dates).

A plausible hypothesis is that our sample is biased, containing an undue proportion of series that turn up early in revival for economic reasons.[18] This can hardly be due to a concentration in the sample of a

[18] In the accepted group the preponderance of leads at both peaks and troughs is greater than in the rejected group, as the accompanying figures show. No doubt the explanation is that leading series tend to be more sensitive to business cycles than lagging series, hence larger proportions qualify under our tests. The number of timing comparisons for 1919–38 is given below:

	Leads	*Exact Coin.*	*Lags*	*Total*	*Ratio: Leads to Lags*
			At Five Reference Peaks		
Rejected group	314	68	319	701	.98
Accepted group	420	124	364	908	1.15
			At Six Reference Troughs		
Rejected group	374	105	328	807	1.14
Accepted group	521	256	297	1074	1.75

TABLE 7.7

Distribution of Acceptable Series by Timing Classifications Based on Full Period Covered and on 1919–38

	Number of Series Accepted for					
	Leads Only	Leads & Rough Coin.	Rough Coin. Only	Lags & Rough Coin.	Lags Only	Total No. of Series
ALL SERIES						
Full period class. of timing at						
Peaks	78	24	36	32	55	225
Troughs	107	38	34	13	33	225
1919–38 class. of timing at						
Peaks	42	16	30	26	29	143
Troughs	57	26	36	16	8	143
SERIES THAT DO NOT COVER 1919–38						
Full period class. of timing at						
Peaks	21	3	2	3	15	44
Troughs	27	5	3	...	9	44
SERIES THAT COVER 1919–38 ONLY						
Full period & 1919–38 class. of timing at						
Peaks	27	9	16	19	18	89
Troughs	38	18	20	10	3	89
SERIES THAT COVER MORE THAN 1919–38						
Accepted both full period and 1919–38						
Full period class. of timing at						
Peaks	11	7	10	6	9	43
Troughs	20	9	8	3	3	43
1919–38 class. of timing at						
Peaks	11	6	9	7	10	43
Troughs	16	6	14	4	3	43
Accepted full period, rejected 1919–38						
Full period class. of timing at						
Peaks	19	5	8	4	13	49
Troughs	22	6	3	...	18	49
Rejected full period, accepted 1919–38						
1919–38 class. of timing at						
Peaks	4	1	5	...	1	11
Troughs	3	2	2	2	2	11

NOTE: Only series accepted for conformity and for timing at peaks and troughs are included. The 1919–38 classifications are based on cyclical measures ending with 1938 and beginning 1919, 1920, or 1921, depending upon when the series starts and whether the first cycle following World War I is omitted.

particular type of economic process, however, since the distribution of many groups of series at troughs in Table 7.4 is biased toward leads as compared with their distribution at peaks. The effect is noticeable in production, employment, payrolls, money and banking series, profits, bank clearings and debits, and business indexes. The only sizable group that tends in the opposite direction is commodity prices.

Strong upward trends might produce such a widespread effect. But it must be remembered, first, that the reference dates also are influenced by trends—they are not determined from trend-adjusted data. Second, if upward trends produced leads at troughs they might well, though not necessarily, produce lags at peaks.[19] This, however, is not what we find. Upward trends, coupled with a tendency toward sharp cyclical declines after peaks and gradual declines before troughs, would have the required asymmetrical effect. Whether investigation will show this type of specific cycle pattern to be prevalent we do not know.

Whatever the explanation, there can be no doubt that the distribution of turning points in many types of economic process in this country is on the average different for troughs and peaks. At revivals, the upturn in aggregate economic activity is typically preceded by upturns in a substantial majority of these processes. At recessions, on the other hand, there is no such rule.

Two other features of Table 7.4 are fundamental. First, the series within a given economic group frequently tend to have similar timing at peaks and at troughs. In some groups this is obvious from the entries in the table, even though the individual series are not identified. For example, six of the seven accepted series in the new orders group are classified "leads only" at both peaks and troughs, while one is classified "leads only" at peaks and "leads and rough coincidences" at troughs. For some other groups the situation is much less clear. In a cross tabulation of all 225 acceptable series, however, 113 series are classified in precisely the same timing group at peaks and at troughs: sixty-four are "leads only," nine "leads and rough coincidences," eight "rough coincidences only," six "lags and rough coincidences," and twenty-six "lags only."[20] The result is similar in a simpler cross tabulation, involving only three classes (leads, lags, and rough coincidences) instead of five. Classifying each of the 225 acceptable series by its most common type of timing,[21] at peaks and

[19] See *Measuring Business Cycles*, pp. 276–278.

[20] If it were equally likely that a series would be in any one of the 5 classes and the results at peaks and troughs were independent, we would expect only 45 series to be classified identically at peaks and troughs. Allowing for the actually observed unequal distributions of series at peaks and at troughs raises the expected figure to 57. Both are far below the observed number, 113.

[21] When the number of leads and rough coincidences is the same, a series is classified as a leader; when the number of lags and rough coincidences is the same, a lagger.

troughs separately, we find that seventy-five series lead at peaks and at troughs, twenty-nine roughly coincide, and thirty lag. On this basis 60 per cent of the acceptable series have similar timing at revivals and recessions. Other things being equal, indicators of this sort have distinct advantages since one can use the same series continuously, instead of shifting from one set to another. We shall have occasion to examine these three groups of series in sections VI and VII; the individual series are listed in the appendix.

The second fundamental fact revealed by Table 7.4 is that economic processes differ strikingly in timing. The differences among groups are more distinct at peaks than at troughs, because of the bias toward leads at troughs. Nevertheless, combining the classifications at the two turns, we can say that the acceptable series in the following groups tend to be classified mainly as leaders (col. 5): new orders, private construction contracts and permits, hours of work per week, stock exchange transactions and prices, security issues, and business failures. Groups in which the series are classified largely as leaders or rough coinciders (cols. 5, 6, and 7) are: transportation, business profits, bank clearings and debits, and indexes of business activity. In only one group do laggers (col. 9) plainly predominate: interest rates and bond yields. But payrolls are classified mainly as laggers or rough coinciders (cols. 7, 8, 9), and retail sales might be put tentatively in this category, too. The production series do not concentrate heavily in any timing group, though leaders outnumber laggers. Employment and commodity price series also are fairly evenly scattered, while the national bank series tend either to lead or to lag by long intervals.

So much for a general view of the results obtained by applying our standards of conformity and timing to the full record of each series. Now let us consider briefly the results of applying these standards to 1919–38 alone.

Since a large proportion of our series begin in 1919 or shortly before, we should not expect these results, in the aggregate, to differ greatly from the previous ones. In 1919–38, 143 series have acceptable conformity and timing at peaks and troughs and of these eighty-nine cover 1919–38 only (Table 7.7). As in the full period analysis leaders preponderate, and more at troughs than at peaks. However, the proportion of series that lead or lag by long intervals ("leads only" or "lags only") is considerably smaller in 1919–38. This is clearly due to the prevalence of long leaders and laggers in two groups of series: the forty-four acceptable series that do not cover 1919–38 and the forty-nine series that are accepted on the basis of the full period but rejected in 1919–38. In the other groups long leaders or laggers do not predominate so much.

The timing characteristics of the forty-four series that end some time

before 1938 are intriguing, but they must be reserved for later investigation. Nearly half are national bank series, which we have not compiled beyond 1914. On the other hand, the timing classification of the forty-nine series that are accepted for the full period but rejected for 1919–38 poses a question we cannot ignore. Did this substantial group of series behave in a significantly different way after 1919?

Table 7.8 is designed to answer the question. Section A shows the timing of this group before and after 1919. For comparative purposes section B shows the timing before and after 1919 of the fifty-four series that were accepted in1919–38 and extend back of 1919 (including eleven series rejected on the basis of their full period behavior). Since the latter series are classified solely on the basis of their timing in 1919–38, the pre-1919 data are strictly independent of the data used to classify the series.

The forty-nine series of section A plainly deteriorated somewhat in quality as indicators after 1919. Whereas before 1919 there was a corresponding specific turn at 95 per cent of all the reference peaks covered by the entire group of series, after 1919 the percentage was only 87; similarly, the percentage at troughs declined from 96 to 86. Indeed, every timing group has fewer timing observations relative to the number of reference turns covered after 1919 than before. In other words, the cycles in these series did not match the reference cycles as well after 1919 as before. Moreover, the proportion of leads shown by the leading series and of lags by the lagging series declined considerably, though not sufficiently to obscure the broad differences in the timing of the different groups. The leaders tended to lead and the laggers to lag after as well as before 1919.

We may conclude, first, that classification of the forty-nine series on the basis of their full period behavior is not wholly misleading with respect to their recent behavior; second, that while our technique has identified series that have in general deteriorated in quality or altered their timing, we would do well to examine each series more closely before deciding that its behavior has altered significantly.[22] On the average, the forty-nine series covered nearly twice as many reference turns before 1919 as after, so that the full period test was based on about three times as much information as the 1919–38 test. As the table demonstrates, the pre-1919 information was definitely useful in determining the nature of the timing relationships among these series. Ignoring that information may make for errors in classification. By the same token, it would seem

[22] Of the 329 series that cover more than 1919–38 only 54, or 16 per cent, are accepted on the basis of their behavior during 1919–38, whereas 92, or 28 per cent, are accepted on the basis of their full period behavior. In itself, this does not necessarily mean that the series deteriorated after 1919. Even if each series behaved in exactly the same way after 1919 as before we should expect the percentage accepted for 1919–38 to be smaller than for the full period because the levels of acceptable conformity and timing are higher the shorter the period (see section IV).

TABLE 7.8

Timing Observations Before and After 1919, Two Groups of Series

A. SERIES ACCEPTED FOR FULL PERIOD, BUT REJECTED FOR 1919–38[a]

Timing Classification, Full Period

	Leads Only	Leads & Rough Coin.	Rough Coin. Only	Lags & Rough Coin.	Lags Only
TIMING AT PEAKS BEFORE 1919					
Number of series	19	4[b]	8	4	13
Total ref. turns covered	168	30	73	34	111
Total timing observations	161	30	70	34	101
Number of					
Leads exceeding 3 months	93	10	11	1	4
Leads of 3 months or less	31	11	16	4	2
Exact coincidences	8	4	10	3	2
Lags of 3 months or less	13	4	21	17	21
Lags exceeding 3 months	16	1	12	9	72
Av. lead (−) or lag (+), mos.	−6.7	−2.8	−0.1	+2.8	+6.7
TIMING AT PEAKS, 1919–38					
Number of series	19	4[b]	8	4	13
Total ref. turns covered	88	16	37	18	61
Total timing observations	79	15	33	16	48
Number of					
Leads exceeding 3 months	41	4	8	...	6
Leads of 3 months or less	15	6	12	5	6
Exact coincidences	4	2	2	3	1
Lags of 3 months or less	6	1	6	4	8
Lags exceeding 3 months	13	2	5	4	27
Av. lead (−) or lag (+), mos.	−4.7	−3.2	−1.5	+1.1	+3.1
TIMING AT TROUGHS BEFORE 1919					
Number of series	22	6	3	...	17[c]
Total ref. turns covered	199	50	12	...	152
Total timing observations	192	50	12	...	141
Number of					
Leads exceeding 3 months	124	22	4	...	13
Leads of 3 months or less	42	26	3	...	10
Exact coincidences	10	2	1	...	7
Lags of 3 months or less	6	...	3	...	18
Lags exceeding 3 months	10	...	1	...	93
Av. lead (−) or lag (+), mos.	−6.6	−3.9	−1.7	...	+8.2
TIMING AT TROUGHS, 1919–38					
Number of series	22	6	3	...	17[c]
Total ref. turns covered	124	33	16	...	89
Total timing observations	108	32	14	...	72
Number of					
Leads exceeding 3 months	55	2	...	...	13
Leads of 3 months or less	16	8	3	...	5
Exact coincidences	7	16	2	...	8
Lags of 3 months or less	12	5	5	...	13
Lags exceeding 3 months	18	1	4	...	33
Av. lead (−) or lag (+), mos.	−2.7	−0.5	+2.3	...	+5.8

TABLE 7.8 (concluded)

B. SERIES ACCEPTED FOR 1919–38[a]

	Timing Classification, 1919–38				
	Leads Only	Leads & Rough Coin.	Rough Coin. Only	Lags & Rough Coin.	Lags Only
TIMING AT PEAKS BEFORE 1919					
Number of series	15	7	13[b]	7	10[b]
Total ref. turns covered	69	51	62	45	52
Total timing observations	52	43	53	42	49
Number of					
Leads exceeding 3 months	17	11	12	11	10
Leads of 3 months or less	15	11	8	6	7
Exact coincidences	4	4	7	8	5
Lags of 3 months or less	5	9	15	7	6
Lags exceeding 3 months	11	8	11	10	21
Av. lead (−) or lag (+), mos.	−4.2	−1.2	−0.2	−0.4	+0.9
TIMING AT PEAKS, 1919–38					
Number of series	15	7	13[b]	7	10[b]
Total ref. turns covered	69	30	64	35	50
Total timing observations	66	30	63	35	50
Number of					
Leads exceeding 3 months	39	7	6	1	5
Leads of 3 months or less	19	18	18	2	1
Exact coincidences	3	3	16	11	5
Lags of 3 months or less	2	2	18	17	22
Lags exceeding 3 months	3	...	5	4	17
Av. lead (−) or lag (+), mos.	−5.4	−3.9	−0.6	+1.2	+2.8
TIMING AT TROUGHS BEFORE 1919					
Number of series	14[d]	7[c]	15[c]	5[c]	5
Total ref. turns covered	49	64	73	35	44
Total timing observations	46	56	64	25	42
Number of					
Leads exceeding 3 months	23	20	25	12	6
Leads of 3 months or less	9	19	15	6	10
Exact coincidences	9	8	12	3	1
Lags of 3 months or less	3	7	4	2	8
Lags exceeding 3 months	2	2	8	2	17
Av. lead (−) or lag (+), mos.	−3.6	−3.7	−1.5	−1.9	+1.9
TIMING AT TROUGHS, 1919–38					
Number of series	14[d]	7[c]	15[c]	5[c]	5
Total ref. turns covered	79	41	86	28	28
Total timing observations	76	41	86	27	28
Number of					
Leads exceeding 3 months	48	9	10	2	4
Leads of 3 months or less	13	14	14	3	1
Exact coincidences	5	15	35	1	3
Lags of 3 months or less	4	3	22	16	8
Lags exceeding 3 months	6	...	5	5	12
Av. lead (−) or lag (+), mos.	−4.4	−1.6	−0.2	+1.7	+4.8

[a] "Accepted" means accepted for conformity and for timing at peaks and troughs. Only series that cover reference turns before 1919 and through 1938 are included. War cycle observations are omitted in certain series.

[b] One series beginning 1914 is omitted here since the war cycle (1918) peak is omitted; the series is included in the distributions for troughs.

[c] One series beginning 1918 is omitted here but included in the distributions for peaks.

[d] Five series beginning 1918 are omitted here but included in the distribution for peaks.

particularly desirable in the case of short series to supplement our simple measures of conformity and timing by more information about the same series or by information about related series.

Even when the information utilized in classifying series is confined to 1919–38, however, the results are not without utility outside of this period. The pre-1919 behavior of the fifty-four series classified in section B of Table 7.8 resembles their behavior during 1919–38, though the differences among the groups are less sharp. The timing relationships among economic processes evidently have some degree of stability.

VI. Behavior of Selected Groups of Indicators, 1885–1940

We have not found any single series that bears an invariant relation to business cycles as defined by our reference dates. The series classified in the timing group "rough coincidences" have the smallest variations in timing. But even here variations do occur, and some series have extra cycles or "skip" reference turns. Moreover, the more interesting indicators of revivals and recessions are the leaders or (as we shall see) the laggers, and for them the variations in timing are larger. Few long series that tend to lead have a perfect record of leads without lags, and none leads by a constant interval.

Evidently it would be unwise to place sole reliance upon a single indicator of revivals or recessions. Special circumstances can always arise that will cause it to fail. But what of the alternative—using several indicators? To answer this question let us examine the behavior in successive business cycles of the groups of series obtained by applying our conformity and timing criteria.

We have already presented in Chart 7.3 the percentage of the 404 series with "acceptable" conformity reaching a specific cycle peak or trough in each month, 1885–1940, together with the derived percentage expanding. And we have noted the clustering of specific cycle peaks around reference peaks and of specific troughs around reference troughs. No reference peaks or troughs are skipped by these concentrations, nor do appreciable concentrations appear outside the vicinity of the reference dates, except possibly in 1933–35 (cf. note 8). This is to be expected, of course, if the reference dates are accurate. The really noteworthy feature of Chart 7.3 is that these clusters are spread over a considerable period, usually a year or more, and in phases of moderate length the clusters of peaks begin at about the time the clusters of troughs end, and vice versa. Hence the intriguing possibility presents itself that we may be able to recognize the clusters well before the peak or trough in aggregate economic activity.[23]

[23] Some interesting experiments along this line were reported by C. Ashley Wright in a paper in *Conference on Business Cycles*, New York, NBER, 1951.

TABLE 7.9

Timing of Percentage of Series Expanding and Contracting in Successive Business Cycles, 1879–1938: Two Groups of Series

A. BUSINESS EXPANSIONS

HIGHEST PERCENTAGE OF SERIES EXPANDING

Monthly Reference Dates		*All Series with Acceptable Conformity*[a]				*Series That Lead at Peaks and Troughs*[b]			
			No. of Months				No. of Months		
Trough	Peak	Date[c]	After Ref. Trough	Before Ref. Peak	%	Date[c]	After Ref. Trough	Before Ref. Peak	%
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
3/79	3/82	1/80	10	26	85.7	2/80	11	25	100.0
5/85	3/87	11/85	6	16	85.9	7/85	2	20	100.0
4/88	7/90	9/89	17	10	82.9	6/89	14	13	82.6
5/91	1/93	8/92	15	5	70.0	11/91	6	14	92.0
6/94	12/95	6/95	12	6	70.1	5/95	11	7	64.5
6/97	6/99	3/99	21	3	85.8	7/97	1	23	97.1
12/00	9/02	12/01	12	9	76.0	4/01	4	17	83.3
8/04	5/07	10/05	14	19	89.8	11/04	3	30	100.0
6/08	1/10	8/09	14	5	83.1	11/08	5	14	100.0
1/12	1/13	3/12	2	10	83.1	2/12	1	11	83.3
12/14	8/18	11/15	11	33	90.4	6/15	6	38	100.0
4/19	1/20	7/19	3	6	87.9	5/19	1	8	90.0
7/21	5/23	8/22	13	9	90.7	4/22	9	13	100.0
7/24	10/26	1/25	6	21	84.2	7/25	12	15	96.7
11/27	6/29	10/28	11	8	79.7	1/28	2	17	91.7
3/33	5/37	9/36	42	8	92.0	11/36	44	6	94.5
Average	1879–1918		12.2	12.9			5.8	19.3	
Av. Dev.	1879–1918		3.7	7.7			3.4	7.2	
Average	1919–37		15.0	10.4			13.6	11.8	
Av. Dev.	1919–37		10.8	4.2			12.2	3.8	
Average	1879–1937		13.1	12.1			8.2	16.9	
Av. Dev.	1879–1937		5.6	6.8			6.4	6.4	

The curve representing the percentage of series expanding, based on the same data, suggests this possibility even more strongly. Its cycles are extraordinarily well defined, are in one-to-one correspondence with business cycles, and reach their maxima and minima long before the corresponding reference peaks and troughs. On the average in 1879–1938 the percentage of series expanding reached its highest level about a year after the expansion in general activity began and about a year before it ended (Table 7.9, A, cols. 4 and 5). Similarly, the percentage expanding reached its lowest level (the percentage contracting its highest level) in midcontraction, on the average (Table 7.9, B, cols. 4 and 5). But the intervals between the peaks and troughs in the curve and the preceding

TABLE 7.9 (concluded)

B. BUSINESS CONTRACTIONS
HIGHEST PERCENTAGE OF SERIES CONTRACTING

Monthly Reference Dates Peak (1)	Trough (2)	*All Series with Acceptable Conformity*[a] Date[c] (3)	No. of Months After Ref. Peak (4)	Before Ref. Trough (5)	% (6)	*Series That Lead at Peaks and Troughs*[b] Date[c] (7)	No. of Months After Ref. Peak (8)	Before Ref. Trough (9)	% (10)
3/82	5/85	5/84	26	12	88.7	5/84	26	12	95.2
3/87	4/88	2/88	11	2	65.0	8/87	5	8	73.9
7/90	5/91	1/91	6	4	76.3	11/90	4	6	82.6
1/93	6/94	8/93	7	10	83.9	7/93	6	11	96.3
12/95	6/97	8/96	8	10	83.3	2/96	2	16	90.9
6/99	12/00	7/00	13	5	71.4	11/99	5	13	86.1
9/02	8/04	8/03	11	12	72.4	6/03	9	14	89.7
5/07	6/08	11/07	6	7	76.5	10/07	5	8	90.0
1/10	1/12	7/10	6	18	75.0	3/10	2	22	95.7
1/13	12/14	5/14	16	7	85.2	3/13	2	21	93.9
8/18	4/19	11/18	3	5	63.1	6/17	−14[d]	22	72.7
1/20	7/21	12/20	11	7	90.6	8/20	7	11	91.8
5/23	7/24	3/24	10	4	74.2	8/23	3	11	78.3
10/26	11/27	1/27	3	10	69.4	11/26	1	12	81.7
6/29	3/33	8/30	14	31	96.3	10/31	28	17	100.0
5/37	6/38	11/37	6	7	90.1	11/37	6	7	92.6
Average	1882–1919		10.3	8.4			4.7	13.9	
Av. Dev.	1882–1919		4.7	3.7			5.0	4.6	
Average	1920–38		8.8	11.8			9.0	11.6	
Av. Dev.	1920–38		3.4	7.7			7.6	2.3	
Average	1882–1938		9.8	9.4			6.1	13.2	
Av. Dev.	1882–1938		4.2	4.6			5.7	4.1	

[a] 404 series; see section V.
[b] 75 series; see section V and the appendix.
[c] Dates are determined in accordance with rules for marking specific cycle turns. See *Measuring Business Cycles*, pp. 56–66.
[d] Highest percentage contracting precedes reference peak by 14 months.

or following reference dates varied greatly from one cycle to another, ranging from two or three months to more than three years.

Two other characteristics of the curve in Chart 7.3 should be noted. First, particularly in recent cycles, the curve reaches the 50 per cent level at or about the time of the reference peak or trough. Some of the discrepancies in earlier cycles (e.g. 1899) may be due to misdated reference turns. This feature of the curve, of course, enhances its value as an indicator, assuming it could be made available on something like a current basis (see Chapter 20).

Second, the maximum or minimum levels reached during a business cycle expansion or contraction are fairly closely associated with the amplitude of the phase. The lowest level reached during the relatively mild business contraction of 1926–27 (31 per cent) was relatively high compared, say, with the lowest level reached during the Great Depression (4 per cent, in 1930). In other words, in no month during the 1926–27 contraction were more than 69 per cent of the series contracting, whereas in 1929–33 the figure reached 96 per cent.

The fact is, as Burns and Mitchell have observed, that the diffusion of business cycle movements among economic processes is related to the amplitude of the cyclical phase.[24] Severe contractions are widely diffused, mild contractions moderately diffused. Similarly, expansions that attain large amplitudes are usually spread over many sectors of the economy, while mild expansions tend to be confined to fewer sectors. The Chart 7.3 curve is interesting, therefore, because it confirms Burns' and Mitchell's finding; it utilizes a much larger sample of series and it measures diffusion in a different way.[25] Again, this property of the curve enhances its potential value as an indicator.

Chart 7.3 is based upon all series with acceptable conformity, regardless of what kind of timing they exhibit. The general shape of the distributions of specific cycle turning points in Chart 7.3 might lead one to suspect that some sort of random process was at work: that the turning points in different series tend to cluster around certain points in time but that the position of an individual series in this cluster is a matter of chance.[26] No doubt there is a random element or "error" in the selection of specific cycle turns in individual series, since these are determined from the original data adjusted only for seasonal variations. But the series are not independent of one another. In the first place, there is a considerable amount of statistical duplication—we include not only indexes of total production but also many component series, etc. Secondly, the series are interrelated economically. One result is that sequences in the turning dates of individual series and groups of series tend to be repeated in cycle after cycle, a fact demonstrated in Chart 7.4.

[24] *Measuring Business Cycles*, p. 106.

[25] They used a sample of 46 long series (a smaller number before 1890) and measured diffusion by the number of series rising or falling during a given reference phase (i.e. using conformity measures). In five mild expansions during 1879–1933 they found (p. 106) the average percentage of series that rose, when allowance is made for systematic leads and lags, was 81; in five moderate expansions, 90; in five vigorous expansions, 94. The average percentage of series that declined in five mild contractions was 75; in five moderate contractions, 82; in five severe contractions, 98. The corresponding average percentages based on the entries through 1933 in our Table 7.9, col. 6, are, for expansions: 78, 84, and 87; and for contractions: 71, 76, and 87.

[26] The smaller size of the "sample" in the early years contributes to the greater irregularity of the percentage distributions in those years.

As described in section V, the three groups of series in Chart 7.4 are obtained by applying our conformity and timing criteria to the full period covered by each series and selecting the series that have similar timing at business cycle peaks and troughs. The appendix lists the seventy-five series in the leading group, the twenty-nine in the roughly coincident group, and the thirty in the lagging group. Not all are available at any one time, however; the numbers in January every tenth year are:

	1890	*1900*	*1910*	*1920*	*1930*
Leading group	23	36	47	61	60
Roughly coincident group	1	1	5	22	29
Lagging group	12	18	21	20	22

The significance of the chart may be grasped more easily if we trace the events recorded by it in the 1921–24 cycle, as we did in connection with Chart 7.3. Starting in the middle of the chart with the distribution of troughs in the leading group (which comprises such series as new orders for goods, construction contracts, hours of work per week, stock market activity), we see that some of these series began to turn up in the second half of 1920, (point *a* in the chart) and that more than half had reached bottom by the end of the first quarter in 1921 (*b*).[27] By that time a few series in the roughly coincident group (which includes several indexes of production, employment, railroad traffic, etc.) had begun to reverse their downward movement, but most of the upturns in this group occurred in the third quarter of 1921 (*c*), where the reference trough is placed (July). Nearly all the troughs in the lagging series (payrolls, certain price series, interest rates, etc.) came after the reference trough, their turns being scattered through the second half of 1921 and the first three quarters of 1922 (*d*). Thus more than a year elapsed between the median upturn in the leading group and that in the lagging group.

The second and third quarters of 1922 not only saw the last of the upturns in the lagging group but also the first of the downturns in the leading group (*e*, top of chart). By the beginning of 1923 half of the leading series had reached peaks, and in the second quarter most of the roughly coincident series began to decline. In May 1923 the reference expansion that began in July 1921 ended. The lagging group registered peaks throughout the ensuing contraction. Hardly had the contraction begun, however, when upturns in the leading series began to appear. They

[27] For clarity the distributions in Chart 7.4 are plotted by quarters instead of by months; nearly all the individual series, however, are monthly. The medians (shown by arrows) are computed and plotted on a monthly basis. They are derived, not from all the specific cycle turns recorded in the chart, but from the "corresponding" turns, i.e. those that in the analysis of the individual series are compared with reference turns. This procedure defines the clusters of turns for which the medians are computed. Roughly 95 per cent of the turns in these groups of series are "corresponding."

CHART 7.4

Number of Series Reaching Specific Cycle Peaks and Troughs, Three Groups of Series

(arrows indicate medians; solid vertical lines, reference troughs; broken vertical lines, reference peaks)

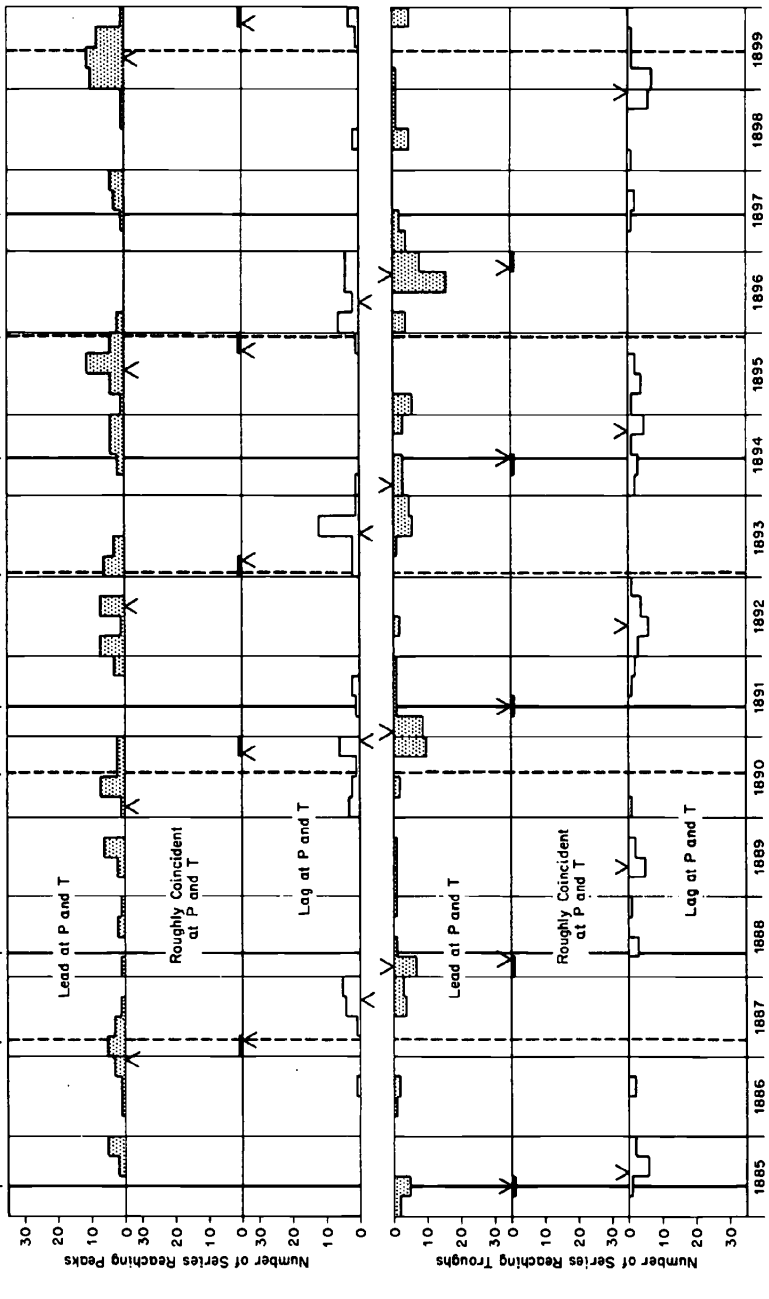


CHART 7.4 (continued)

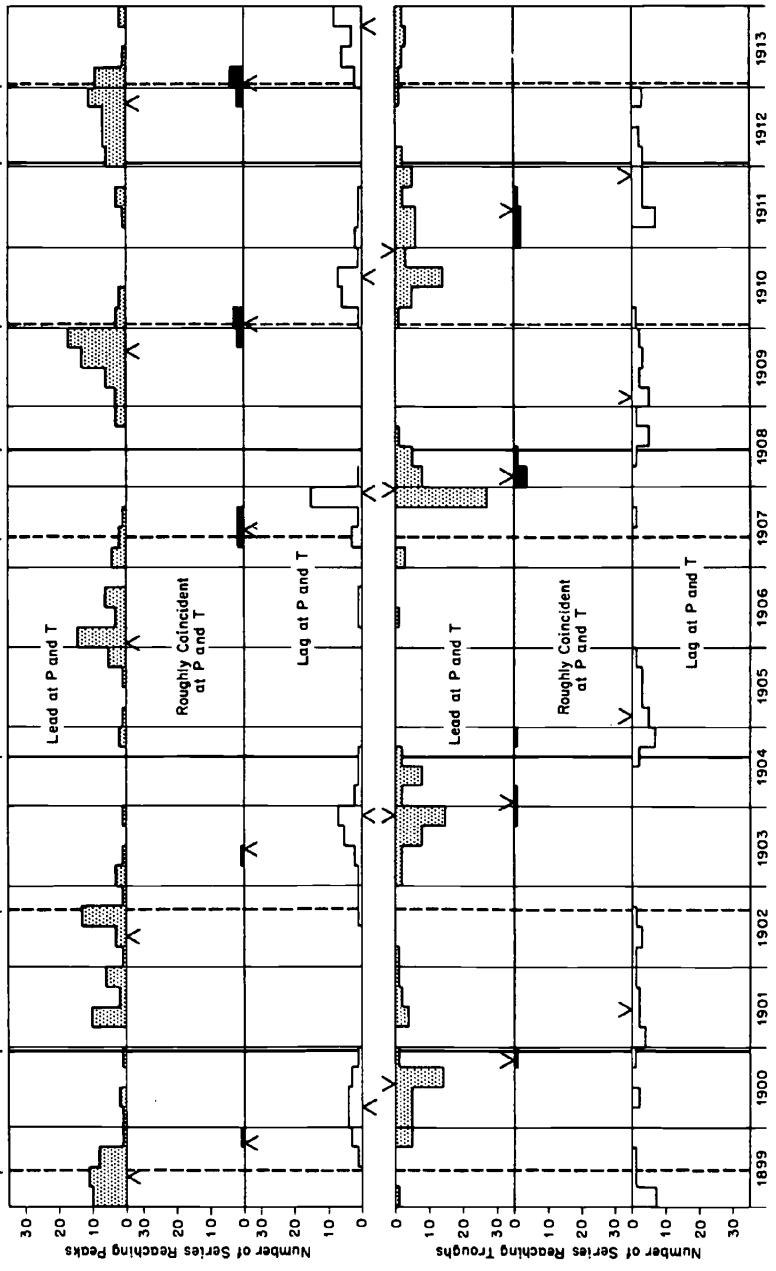
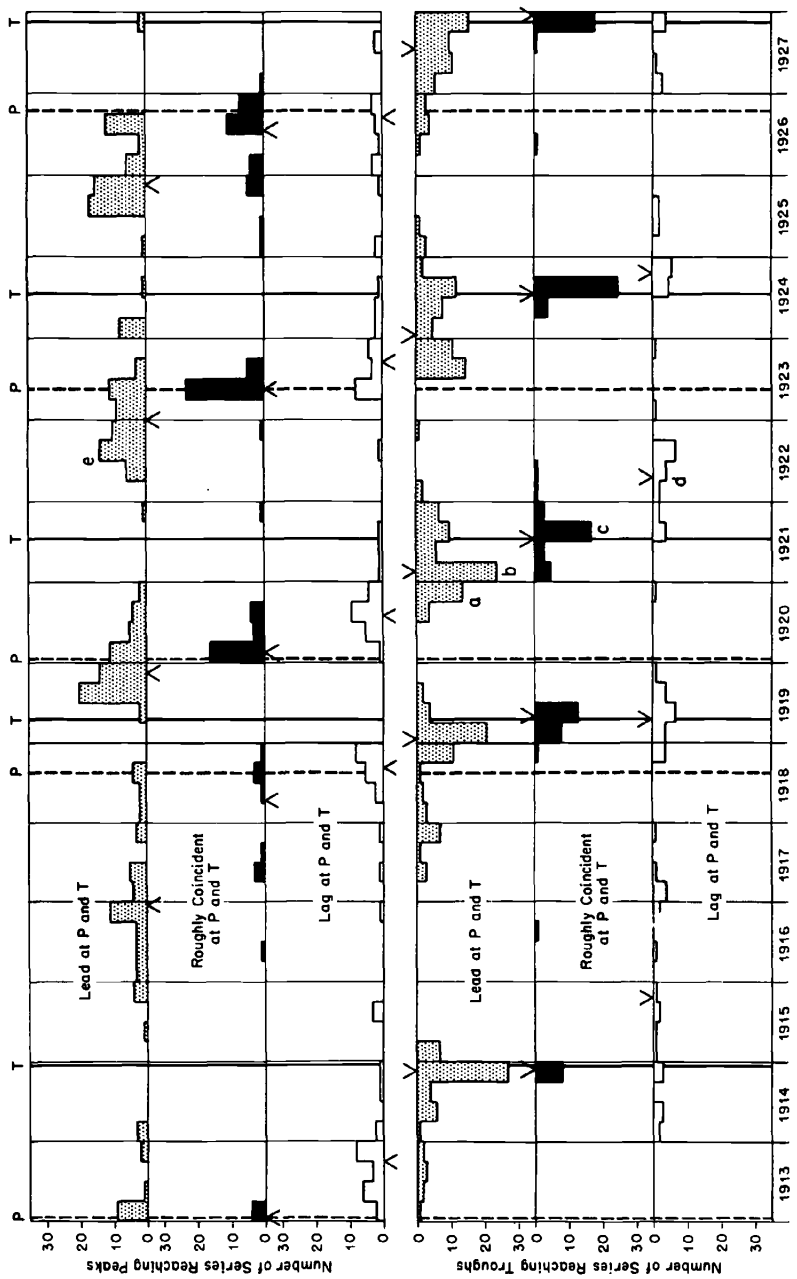
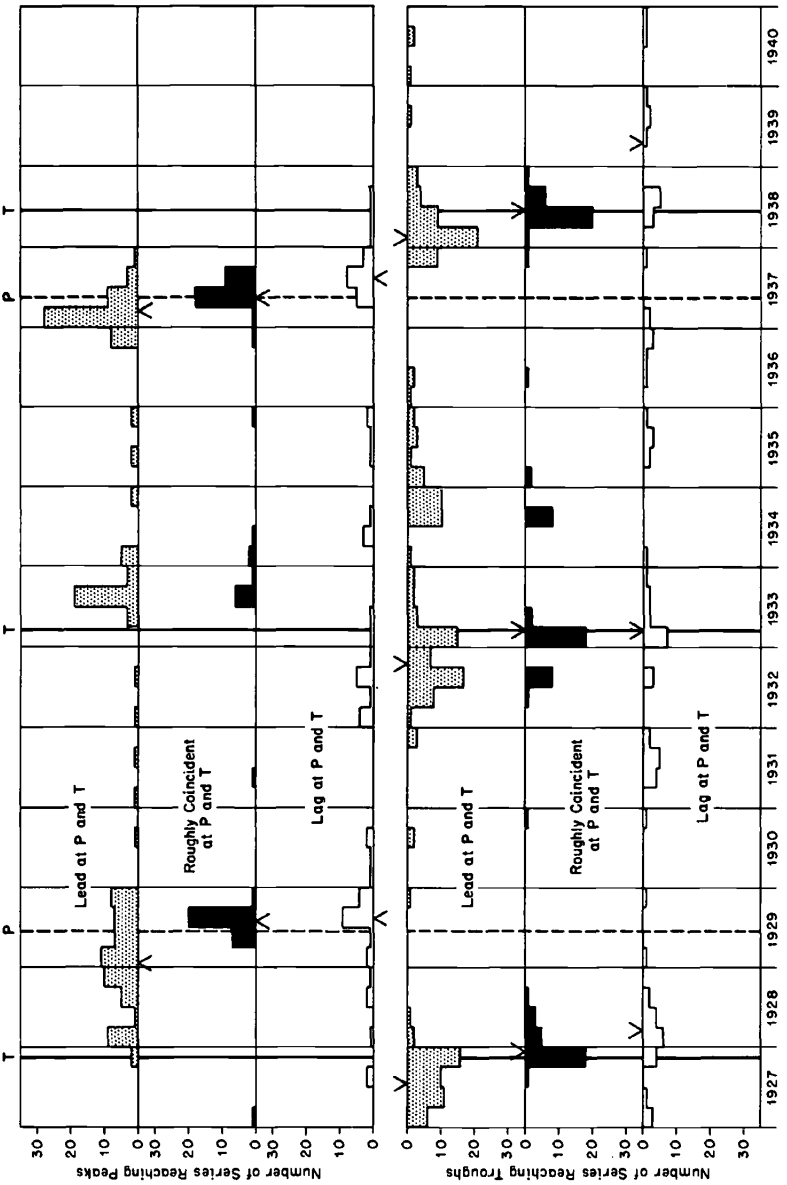


CHART 7.4 (continued)



a, b, c, d, e – See text.

CHART 7.4 (concluded)



occurred in two waves: in the second half of 1923 and in mid-1924. Troughs in the roughly coincident series were concentrated in mid-1924, when the next reference expansion started. In the third and fourth quarters of 1924 many of the lagging series joined in this expansion.

By following the chart up and down in this manner one gets a lively impression of the continuity and the sequence of events in successive business cycles. It should be borne in mind that the sample of series in each of the three groups remains substantially the same from cycle to cycle, varying only because a series is discontinued or a new one becomes available. We would, of course, expect to find a difference in the timing of the three groups when results for the period as a whole are considered, for the series were selected on the basis of their timing during the period they covered. But what emerges from Chart 7.4 is that the expected sequence among the groups, as reflected, say, in the medians, appears at every single business cycle peak and at all except two troughs (1919 and 1933). Moreover, between peaks and troughs the sequence is highly consistent too. The median trough of the lagging group invariably precedes the median peak of the leading group; and with only one exception, 1903, the median peak of the lagging group precedes the median trough of the leading group (Table 7.10).

Not only is there a notable degree of consistency in the timing of the medians, but the average leads and lags are fairly long. In fact, the medians for the leading and lagging groups tend to be almost uniformly distributed over the cycle, as the average intervals in the accompanying tabulation show. Even the average deviations of the intervals do not differ greatly, whether based on like or unlike turns.[28]

Intervals Between Median Turns in Leading and Lagging Groups, 1887–1938
(months)

	Interval			Average Interval, 15 Observations	Average Deviation	Range	Range of Middle 13 Observations
A.	Peak, leading	to	Peak, lagging	11.6	3.6	17.5(5 to 22.5)	14(7 to 21)
B.	Peak, lagging	to	Trough, leading	7.1	5.3	38(0 to 38)	13(0.5 to 13.5)
C.	Trough, leading	to	Trough, lagging	12.1	4.1	24(3 to 27)	11(5 to 16)
D.	Trough, lagging	to	Peak, leading	12.2	5.7	45(3 to 48)	12(5 to 17)

[28] The larger average deviations in intervals B and D are caused by the extreme intervals that occurred in the 1929–37 cycle; excluding these, the average deviations would actually be smaller than in intervals A and C. But rough uniformity in variability is suggested by the ranges of the middle 13 items.

TABLE 7.10

Timing of Medians of Corresponding Specific Cycle Turns, 1885–1938: Three Groups of Series[a]

	Reference Peak	LEAD (−) OR LAG (+) AT REFERENCE PEAKS: Median Trough, Lagging Group	Median Peak In: Leading Group	Median Peak In: Roughly Coin. Group	Median Trough, Leading Group	Reference Trough	LEAD (−) OR LAG (+) AT REFERENCE TROUGHS: Median Peak, Lagging Group	Median Trough In: Leading Group	Median Trough In: Roughly Coin. Group	Median Trough In: Lagging Group	Median Peak, Leading Group
				(months)					(months)		
	Mar. 1887	−20	−3	0[b]	+6	+11	May 1885		−6	0[b]	+2	+19
	July 1890	−14	−5	+3[b]	+5	+6	Apr. 1888	−7	−2	−1[b]	+13	+22
	Jan. 1893	−8	−5	+2[b]	+6	+13	May 1891	−5	−4	0[b]	+12	+15
	Dec. 1895	−14	−5	−2[b]	+5	+9	June 1894	−11	−4	0[b]	+4	+13
	June 1899	−6	−1	+4[b]	+9.5	+13	June 1897	−13	−9	−8[b]	+18	+23
	Sep. 1902	−15	−4	+9[b]	+14	+14	Dec. 1900	−8.5	−5	−2[b]	+6	+17
	May 1907	−27	−16	+1	+6.5	+7	Aug. 1904	−9	−9	−7	+6	+17
	Jan. 1910	−11	−4	0	+7	+11	June 1908	−6.5	−6	−4	+8	+15
	Jan. 1913	−14	−3	0	+8.5	+22	Jan. 1912	−17	−13	−7	−2	+9
	Aug. 1918	−34	−20	−4	+1	+5	Dec. 1914	−14.5	−1	−0.5	+10	+24
	Jan. 1920	−9	−2	+1	+6.5	+13	Apr. 1919	−7	−3	+0.5	0	+7
	May 1923	−13	−4.5	0	+4	+8	July 1921	−11.5	−5	0	+9	+17.5
	Oct. 1926	−24	−11	−3	−1	+9	July 1924	−10	−6	0	+3	+16
	June 1929	−15	−5	+1	+2	+40	Nov. 1927	−14	−4	+1	+4	+14
	May 1937	−50	−2	0	+3	+9	Mar. 1933	−43	−5	0	0	+48
							June 1938	−10	−4	0	+10	
Average	1885–1918	−16.3	−6.6	+1.3	+6.8	+11.1		−9.8	−5.9	−3.0	+7.7	+16.5
Av. dev.	1885–1918	6.4	4.6	2.6	2.3	3.5		3.2	2.7	2.8	4.5	4.2
Average	1919–38	−22.2	−4.9	−0.1	+2.9	+15.8		−17.7	−4.5	+0.2	+4.3	+23.9
Av. dev.	1919–38	11.8	2.5	1.2	1.9	9.7		10.1	0.8	0.3	3.4	12.1
Average	1885–1938	−18.3	−6.0	+0.8	+5.5	+12.7		−12.5	−5.4	−1.8	+6.4	+18.4
Av. dev.	1885–1938	8.5	3.8	2.1	2.6	5.2		5.2	2.1	2.4	4.4	5.8

[a] For list of series in each group see the appendix.

[b] Based on one series only.

Chart 7.5 demonstrates the extraordinarily long leads of the leading series when their movements are expressed in terms of the percentage of series expanding (see also Table 7.9, col. 9), and confirms the striking differences in timing of all three groups. The maxima of the curve for the lagging group coincide roughly with the reference peaks, as indeed they must since the downturns in these series are usually clustered in the period immediately following the reference peak. Likewise the minima approximately coincide with the reference troughs since the upturns in the lagging series tend to come just after the reference trough. Much of the time this curve is moving in precisely the opposite direction to the curve for the leading group.[29]

The sequences exhibited in cycle after cycle by the groups of series in Charts 7.4 and 7.5 are not mere statistical effects produced by our method of classification. First, as suggested above, the application of the method would not, by itself, be expected to produce similar sequences cycle by cycle. Secondly, and this is the clue to the real explanation, the processes that tend to lead and lag are not the same, as section V makes clear. It is beyond the scope of this report to explain why certain processes lead and others lag, though the reasons are, in many cases, fairly obvious. New orders for goods and contracts for construction would be expected to lead the output of the products to which they give rise. Changes in hours of work would be expected to take precedence over changes in the work force (employment) when the work load shifts. But many significant timing differences are more subtle (e.g. the lead in liabilities of business failures, inverted; the lag in long-term interest rates, or their lead when taken invertedly; the lag in bond sales, inverted), and to develop a thoroughgoing explanation is one of the principal tasks of business cycle theory. In this connection the possibility of a causal connection between the turns in lagging series and the subsequent opposite turns in leading series should not be overlooked.

No doubt the charts idealize the situation somewhat. If the processes that lead and lag had been picked in advance (on the basis of experience) and tested over subsequent cycles, the sequences would likely have been blurred to some extent—though not entirely. Of that we have evidence in the experiment with twenty-one indicators reported in section II, and further evidence will emerge in section VII. Moreover, the pre- and post-1919 tests in Table 7.8 also indicated a fairly high degree of continuity in

[29] The curve for the leading group also tends to lead the curve in Chart 7.3, based on series undifferentiated as to timing. The leading curve crosses the 50 per cent line before the reference peak or trough in nearly every instance, and it almost invariably reaches a maximum level before the curve in Chart 7.3. Like the latter, the level reached by the leading curve during a reference phase tends to be correlated with the amplitude of the phase. The average percentages corresponding to those in note 25, computed from Table 7.9, col. 10, are, for expansions: 87, 90, 99; and for contractions: 85, 84, 95.

timing relationships. Burns and Mitchell reached a similar conclusion in a series of tests on a small sample of series for several successive periods.[30]

Our brief examination of the cyclical behavior of groups of series is pertinent not only to the selection and use of indicators but also to an understanding of the nature of business cycles. Business cycles consist of "expansions occurring at about the same time in many economic activities, followed by similarly general recessions, contractions, and revivals. . . ."[31] But the sequence of change in economic processes also plays a role. Leading and lagging processes, symptomatic of the influence of current changes on subsequent events, doubtless have a part in generating business cycles.[32]

From Chart 7.4 one might draw the following schematic picture of business cycles. A few months after a business cycle trough, the series that typically lag begin to rise; shortly after most of the laggards have started to rise the series that typically lead begin to fall; then the group that typically turns near business cycle peaks declines; once the decline has become fairly general, the laggards begin to fall; on their heels come the processes that lead, which begin to rise; they in turn are soon followed by the group whose turns tend to coincide with business troughs; then the laggards begin to show their heads again and the round of events is repeated.[33] This description is not very meaningful, of course, unless the groups of series are specified. One specification is provided in the appendix. However, as we remarked above, significant processes whose timing is not recorded in Chart 7.4 participate in the cyclical procession. They too differ in their timing characteristics, though their behavior is less consistent from cycle to cycle.

The degree of continuity suggested by Charts 7.4 and 7.5, viewed in conjunction with Chart 7.3, is the more remarkable when one considers that only the dates of cyclical turns are recorded. Even this minimum of (discontinuous) information gives the impression that the transformation of one business cycle phase into the next is a gradual, not an abrupt process. If this impression is correct, it is a useful point of departure for current appraisals of the business situation; for it means that we have a better chance of recognizing at what stage of the cycle the economy is likely to be a few months hence than if the transition were abrupt. Thus if Charts 7.4 and 7.5 or their equivalents were kept reasonably up to date, they could be helpful in interpreting the current business situation and its prospects. The importance of differentiating processes with different timing characteristics is apparent. The movements of roughly coincident series provide a check on one's interpretation of the movements of leading

[30] *Measuring Business Cycles*, pp. 393–400, 485–490.
[31] *Ibid.*, p. 3.
[32] Cf. *ibid.*, p. 488.
[33] Cf. *ibid.*, p. 70.

CHART 7.5

Percentage of Series Expanding, Three Groups of Series

(solid vertical lines indicate reference troughs; broken vertical lines, reference peaks)

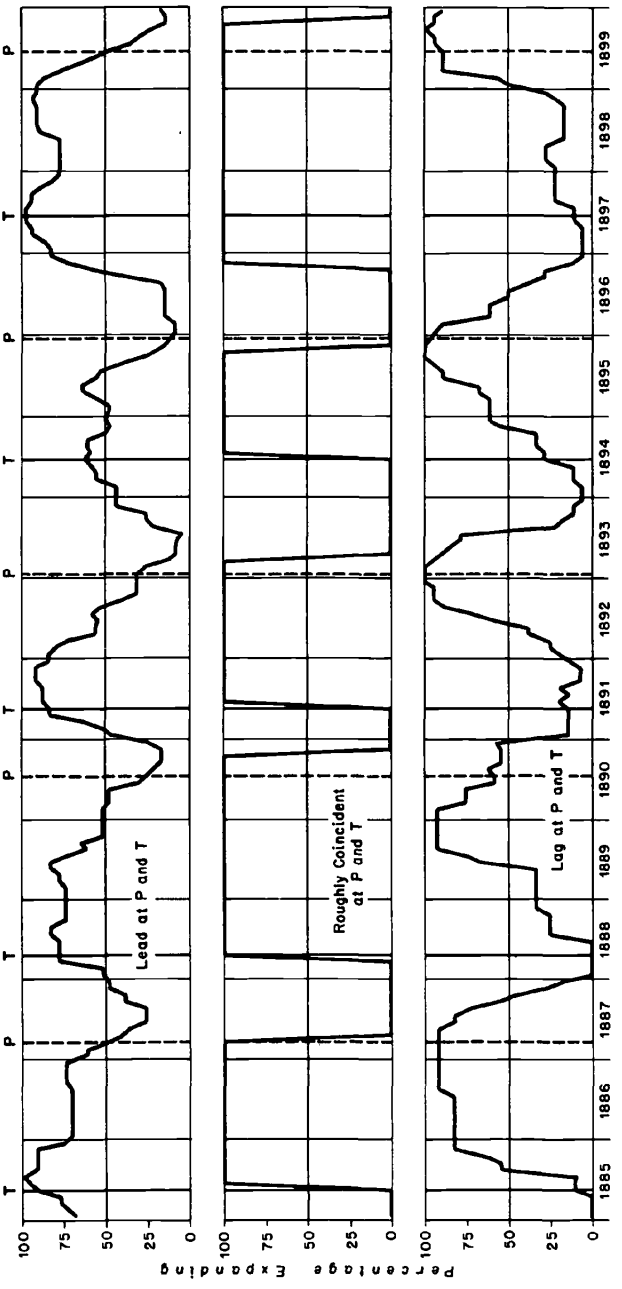


CHART 7.5 (continued)

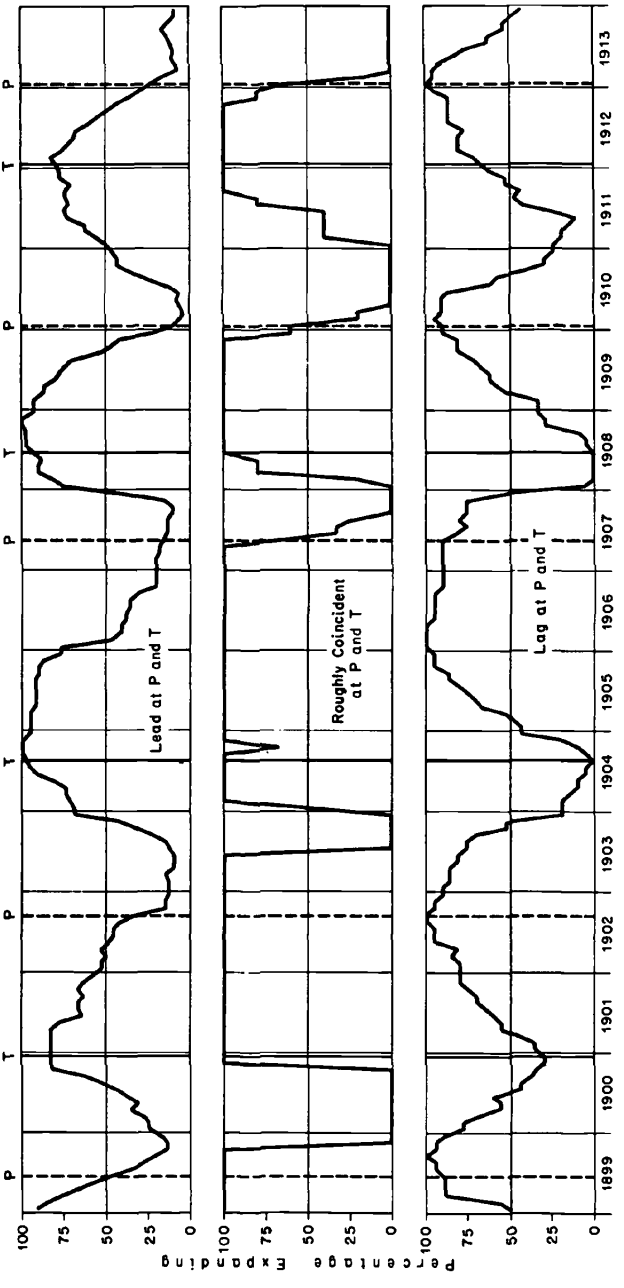


CHART 7.5 (continued)

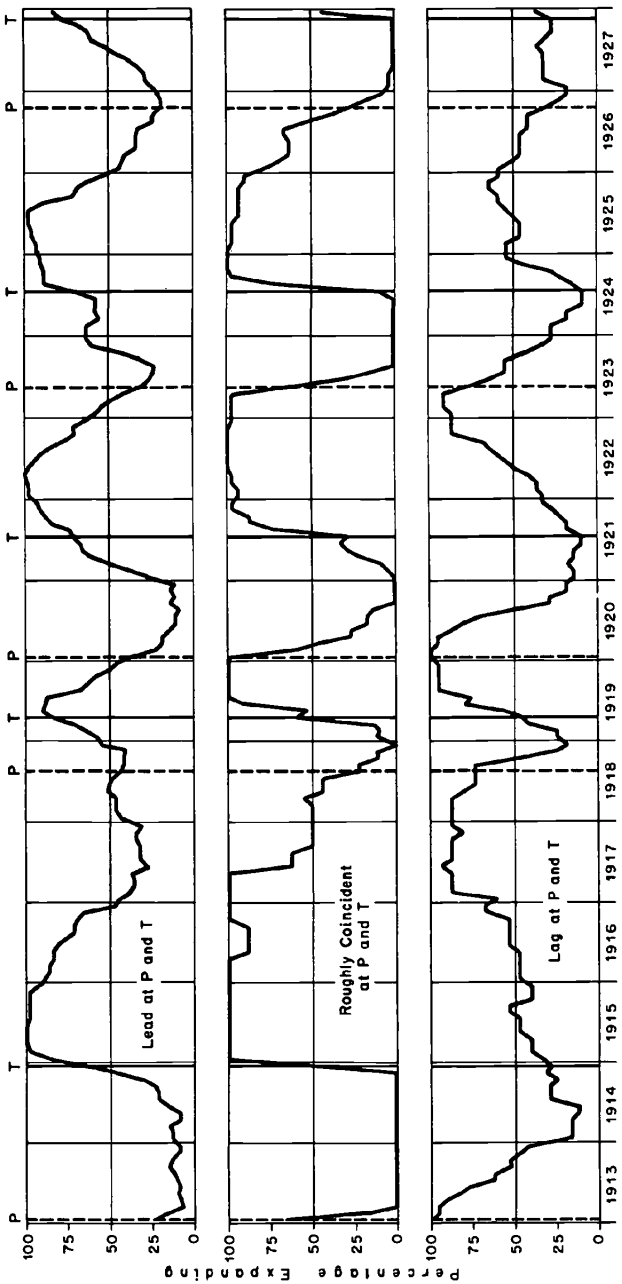
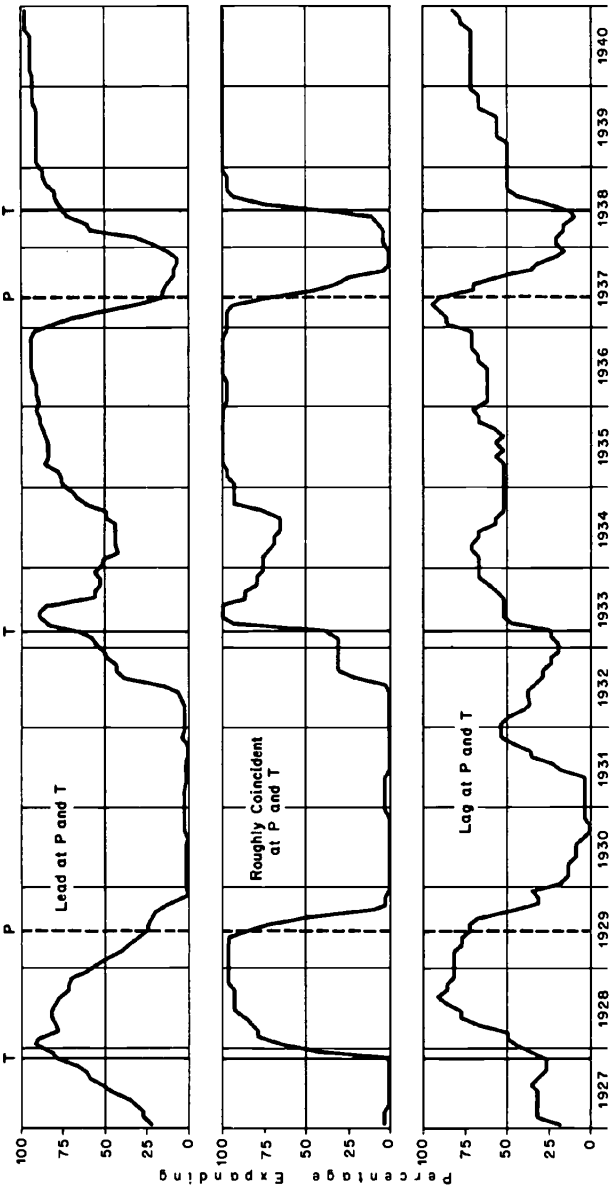


CHART 7.5 (concluded)



series and vice versa. Also, it seems desirable to keep track of the lagging processes, if the advantages of a continuous moving picture of the changing business scene are to be obtained.

VII. A Tentative List of Current Indicators

One goal of this investigation is a brief list of current statistical indicators, systematically selected and properly annotated. We have not reached this goal. But we have gone a considerable distance toward it, and it may be helpful to take a jump ahead and set forth the best brief list we can devise at present. No doubt it will be revised as the investigation proceeds, and criteria besides timing and conformity are systematically applied to the National Bureau's collection of series. The list we offer (Table 7.11 and Chart 7.6) is not based on any such systematic weeding; hence it is highly tentative. In making it we have not held strictly to the historical series actually analyzed in the investigation, even when they are currently available, but whenever possible have substituted essentially similar series of broader coverage.

Our best guides to a selection are the broad indications of Table 7.4, and the detailed list of series in the appendix. Since our list is short, we confine it to series with similar timing at peaks and troughs, classifying them in three groups: leading, roughly coincident, and lagging. The series are arranged in Table 7.11 and Chart 7.6, however, according to the average timing they (or their nearest equivalents) exhibited at both peaks and troughs up to 1938. The averages present a more or less continuous array from long leads to long lags, rather than three sharply defined groups.

For leaders, Table 7.4 points to new orders, private construction contracts and permits, average hours worked per week, stock exchange transactions and prices, security issues, and business failures. That is to say, since in each of these groups leading series predominate, the chances are good that any particular series we select will have the indirect support of related series. Representatives of each of these groups as well as of others are in the leading group in the appendix.

New orders are represented in our short list by the current Department of Commerce series on the value of new orders for durable goods placed with manufacturers. This compilation begins in 1939, but the similar series by the National Industrial Conference Board beginning 1929, and several series on the physical volume of orders for certain types of durable goods, available for a longer period, give some indication of how it might have behaved earlier.[34] Two series on building contracts are included (residential, and commercial and industrial), each in terms of

[34] The NICB series leads the reference turns in 1937 and 1938 (see Chart 7.6), is coincident at the 1933 trough. Its timing at the 1929 peak is uncertain.

floor space rather than value since the physical dimension is of greater interest and more relevant to the physical volume of industrial activity such contracts call forth. For hours of work we use the Bureau of Labor Statistics series for manufacturing, which begins in 1932. Its prior behavior presumably resembled that of the similar compilation by the National Industrial Conference Board, which was discontinued after July 1948. We omit stock exchange transactions and security issues, because the erratic movements in such series make it difficult to judge their cyclical course currently. Stock prices are somewhat less erratic, and we include a stock price index. Liabilities of business failures, taken, of course, on an inverted basis, completes the list of leaders suggested by the timing classification of Table 7.4. We add two other series: number of new incorporations (see the appendix) and the BLS index of wholesale prices of twenty-eight basic commodities. The latter, which begins in 1935, seems to be roughly equivalent, in terms of composition and effective weighting, to Bradstreet's index (see the appendix), which had an extraordinarily consistent cyclical record before it was discontinued in 1937.[35]

For roughly coincident series Table 7.4 defines four areas in which most of the series display roughly coincident timing with a tendency to lead (transportation, profits, bank clearings and debits, and indexes of business activity); three without marked leading or lagging tendency (production, employment, and commodity prices); and two in which the series display both roughly coincident and lagging tendencies (payrolls and retail sales), which we shall consider in connection with our lagging group. Our selections for transportation and profits are freight carloadings and total corporate profits, both being listed in the Roughly Coincident section of the appendix. Bank debits outside New York City, our third selection, is not listed in the appendix, though both New York City and total clearings and debits are. The reason is that the outside clearings and debits series is classed as a lagger at peaks and a leader at troughs. But in recent cycles this difference has practically disappeared, and in 1919–38 outside debits is classed as a rough coincider at both turns while neither the New York City component nor the total meet our acceptance levels for conformity and timing.

In the roughly coincident group we include gross national product, the most comprehensive value of output aggregate available on a quarterly basis since 1939, and the Federal Reserve Board index of industrial production. The timing of the former is probably fairly close to that of clearings and debits outside New York City. Employment is represented by the BLS series for nonagricultural establishments, which begins in 1935 and is seasonally adjusted by the Federal Reserve Board. The

[35] Nevertheless, the two indexes are very differently constructed, Bradstreet's being the aggregate price per pound of some 96 commodities, the BLS' an unweighted geometric mean of relatives for 28 products.

TABLE 7.11

Record of Timing of Selected Statistical Indicators at Business Cycle Turns

Selected Indicator[a]	Series Used for Record of Timing	Ref. Period Covered	Number of Ref. Turns Covered[b]	*Number of* Exact Leads	Exact Coin.	Exact Lags	Rough Coin.	Average Lead (−) or Lag (+) (months[b])
	A. LEADING GROUP							
1. Bus. failures, liab., indus. & comm., Dun's[i]	Same as prec. col.	1879–1938[w]	14	11	1	1	2	−10.5
			16	14		1	1	−7.5
2. Indus. common stock price index, Dow-Jones	Same as prec. col.	1899–1938	11	8		2	6	−6.0
			11	8	1	1	4	−7.2
3. New orders, dur. goods indus., value, D. of C.	5 series, physical vol.[c]	1919–38	25	21	1	2	9	−6.9
			30	24	1	4	10	−4.7
4. Resid. bldg. contracts, fl. space, Dodge	Same as prec. col.	1919–38	5	4		1	1	−6.2
			6	5	1		2	−4.5
5. Comm. & indus. bldg. contracts, fl. space, Dodge	Same as prec. col.	1919–38	5	4		1	2	−5.2
			6	4	1	1	4	−1.7
6. Av. hours worked per week, mfg., BLS	Av. hours worked per week, mfg., NICB	1921–38	4	3		1	1	−3.8
			5	3	1	1	1	−2.6
7. New incorporations, no., Dun's	New incorp., no., Evans	1860–1938	20	12	1	4	8	−2.5
			20	15	1	3	4	−3.5
8. Whol. price index, 28 basic commod., BLS	Whol. price index, Bradstreet's	1893–1937[w]	11	7		2	5	−2.6
			11	8	1	1	5	−3.2
	B. ROUGHLY COINCIDENT GROUP							
9. Employ. in nonagric. establishments, BLS	Factory employ. index, Jerome (to 1914), BLS	1890–1938	14	3	1	8	7	−0.2
			14	7	4	1	7	−3.3
10. Unemployment, D. of C.[i]	See text							
11. Corporate profits after taxes, quarterly, D. of C.	Corp. profits after taxes, quarterly, Barger	1920–38[w]	4	2	1	1	3	−1.5
			5	3	1	1	4	−1.8
12. Bank debits outside NYC, FRB	Clearings outside NYC, C & FC (to 1919); debits outside NYC, FRB	1879–1938[w]	14	3	1	9	9	+2.0
			16	13	1	1	9	−4.3
13. Freight carloadings, AAR	Same as prec. col.	1918–38	6	1	3	2	5	−0.3
			6	2	4		5	−1.3
14. Industrial production index, FRB	Same as prec. col.	1919–38	5		3	2	5	+0.6
			6	4	2		5	−2.2
15. Gross national product, quarterly, D. of C.	See text							
16. Whol. price index, excl. farm products & foods, BLS	Same as prec. col.	1914–38[w]	4	3			2	−3.5
			6	1	1	3	3	+3.7

	C. LAGGING GROUP							
17. Personal income, D. of C.	Income payments, Barger (to 1929), D. of C.	1921–38	4			3	2	+4.0
			5	1	2	1	4	−0.2
18. Sales by retail stores, D. of C.	Department store sales index, FRB	1919–38	5		1	4	3	+3.8
			6	1	1	3	4	+1.8
19. Consumer instalment debt, FRB	Same as prec. col.	1929–38	2			2		+5.0
			2			2	1	+3.5
20. Bank rates on bus. loans, quarterly, FRB	Same as prec. col.	1919–38	5		1	3	1	+5.5
			6			5	3	+4.8
21. Mfrs'. inventories, in current prices, D. of C.	Mfrs'. inventories, in current prices, NICB	1929–38	2			2		+6.5
			2			2	1	+7.5

[a] Numbers and titles identify the series plotted in Chart 7.6, except as follows: The initial segments (in Chart 7.6) of series 3, 10, and 21 are compilations of the National Industrial Conference Board. The initial segment of series 7 (4 states) is compiled by the Corporation Trust Co. For series 11 the Department of Commerce series (beginnng 1939) was extended back to 1936 by the use of data for 242 corporations compiled by Thor Hultgren. All series except 2, 8, 16, 20 are adjusted for seasonal variations. Series 1, 4, 5, 6, 7, 10, 12, 13, 19 were adjusted by the National Bureau.

[b] Entry on first line is for reference peaks, second line for reference troughs.

[c] The five series are new orders for southern pine lumber, oak flooring, architectural terra cotta, fabricated structural steel, and machine tools & forging machinery. The timing entries are totals for the 5 series; the averages are simple averages of the average timing of each series. See also note 34.

[i] Inverted; see note 9.

[w] War cycle observations are omitted.

AAR: Association of American Railroads

Barger: Harold Barger, *Outlay and Income in the United States, 1921–38* (NBER, 1942)

BLS: U.S. Bureau of Labor Statistics

Bradstreet's: The Bradstreet Co. (after 1933, Dun & Bradstreet, Inc.)

C & FC: *Commercial and Financial Chronicle* (1879–83, *The Public*)

D. of C.: U.S. Department of Commerce

Dodge: F. W. Dodge Corporation

Dow-Jones: Dow-Jones & Co., Inc.

Dun's: R. G. Dun & Co. (after 1933, Dun & Bradstreet, Inc.)

Evans: G. Heberton Evans, Jr., *Business Incorporations in the United States, 1800–1943* (NBER, 1948)

FRB: Board of Governors of the Federal Reserve System

Jerome: Harry Jerome, *Migration and Business Cycles* (NBER, 1926)

NICB: National Industrial Conference Board

CHART 7.6

Behavior of Selected Statistical Indicators, 1936–58

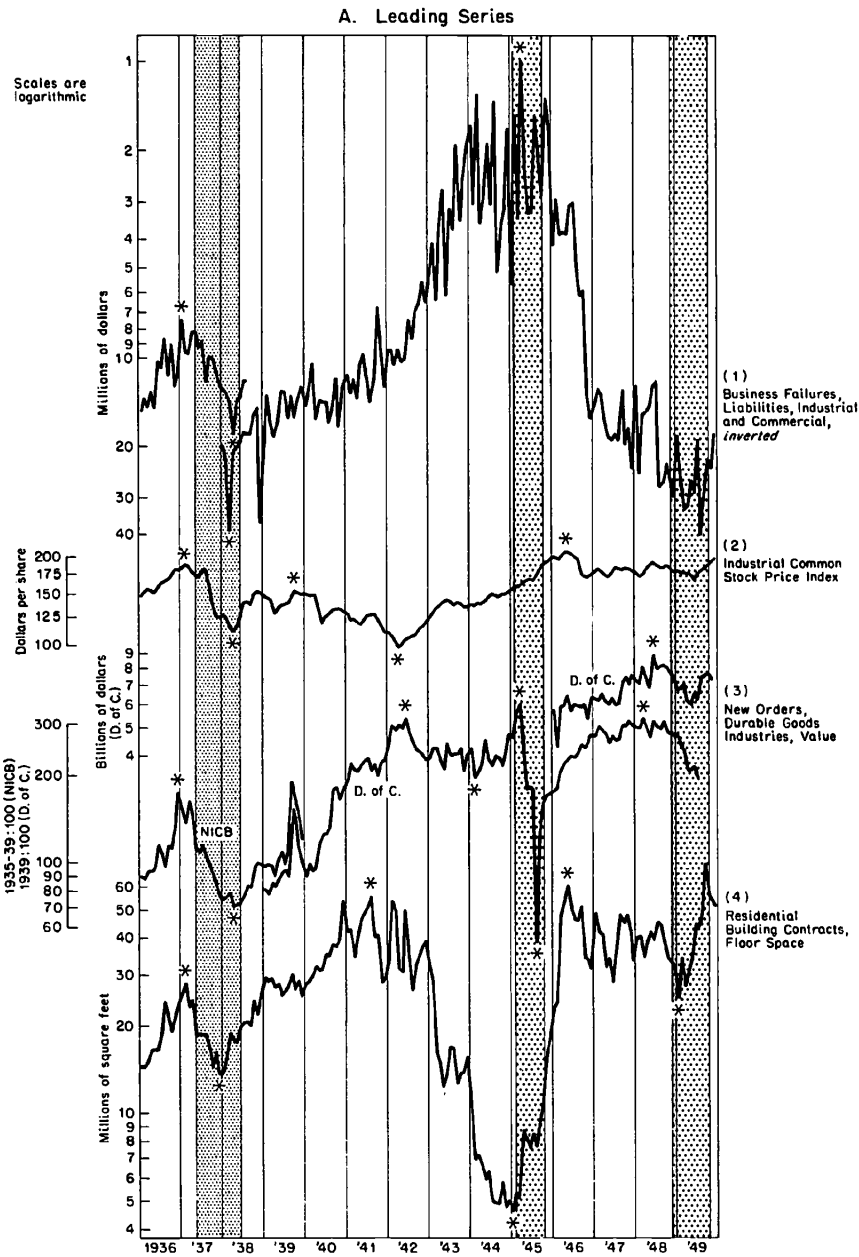


CHART 7.6 (continued)

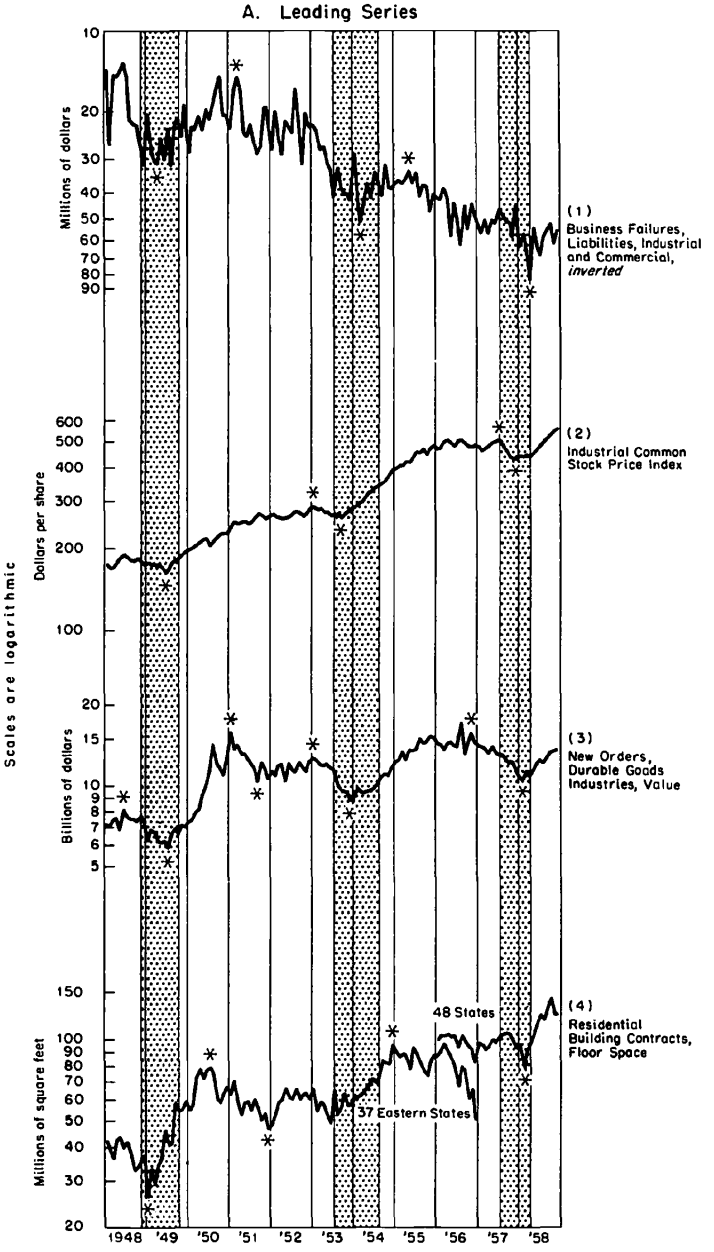


CHART 7.6 (continued)

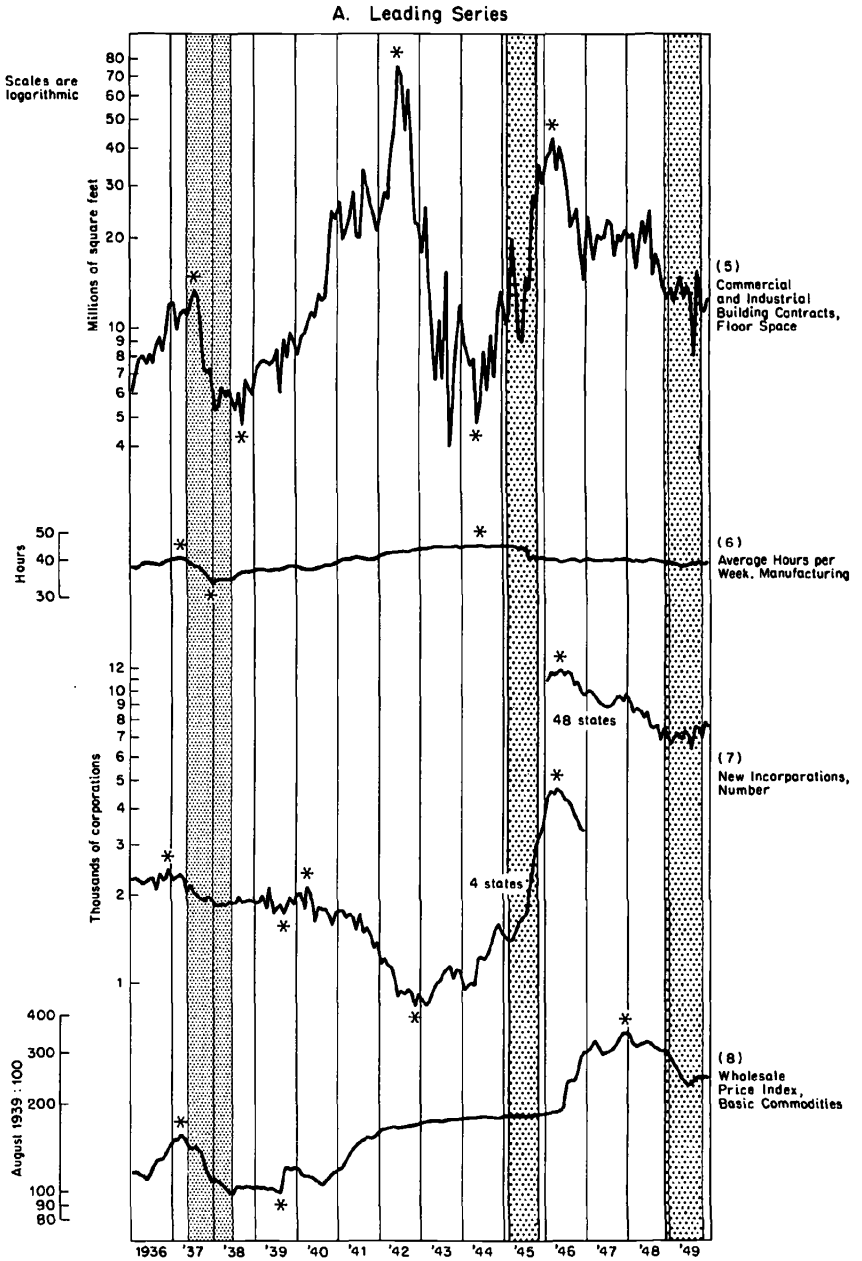


CHART 7.6 (continued)

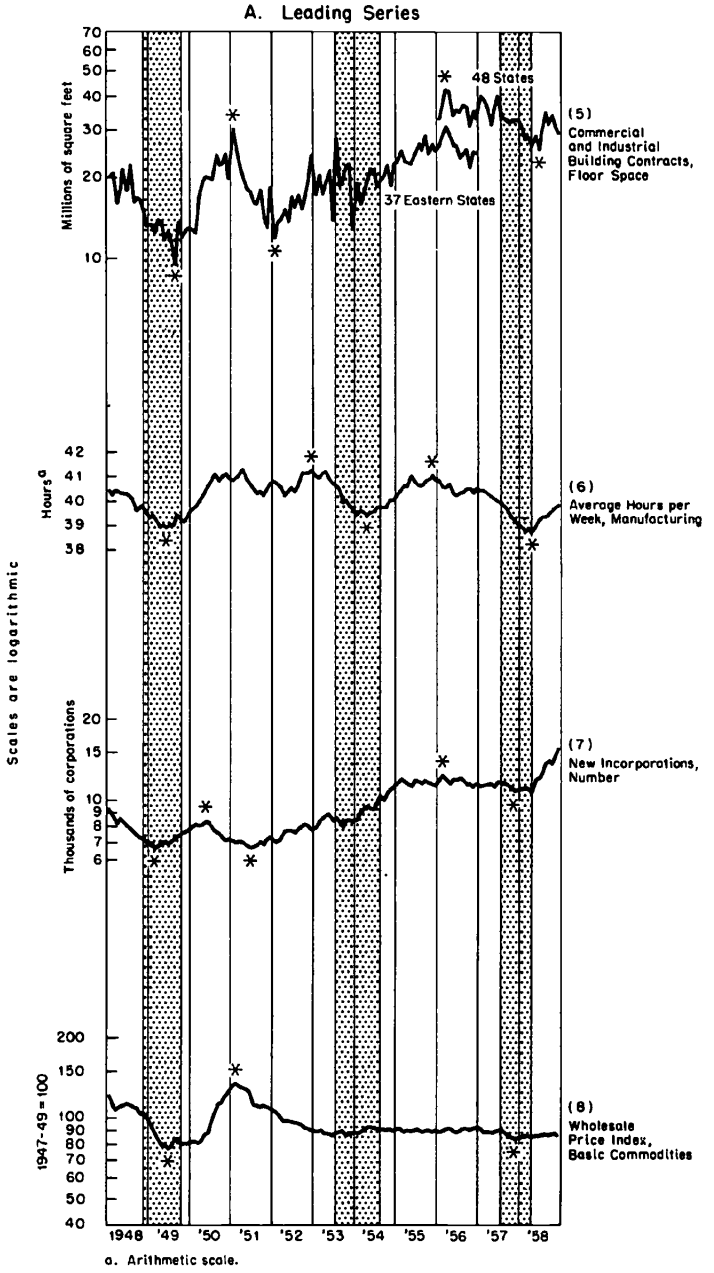
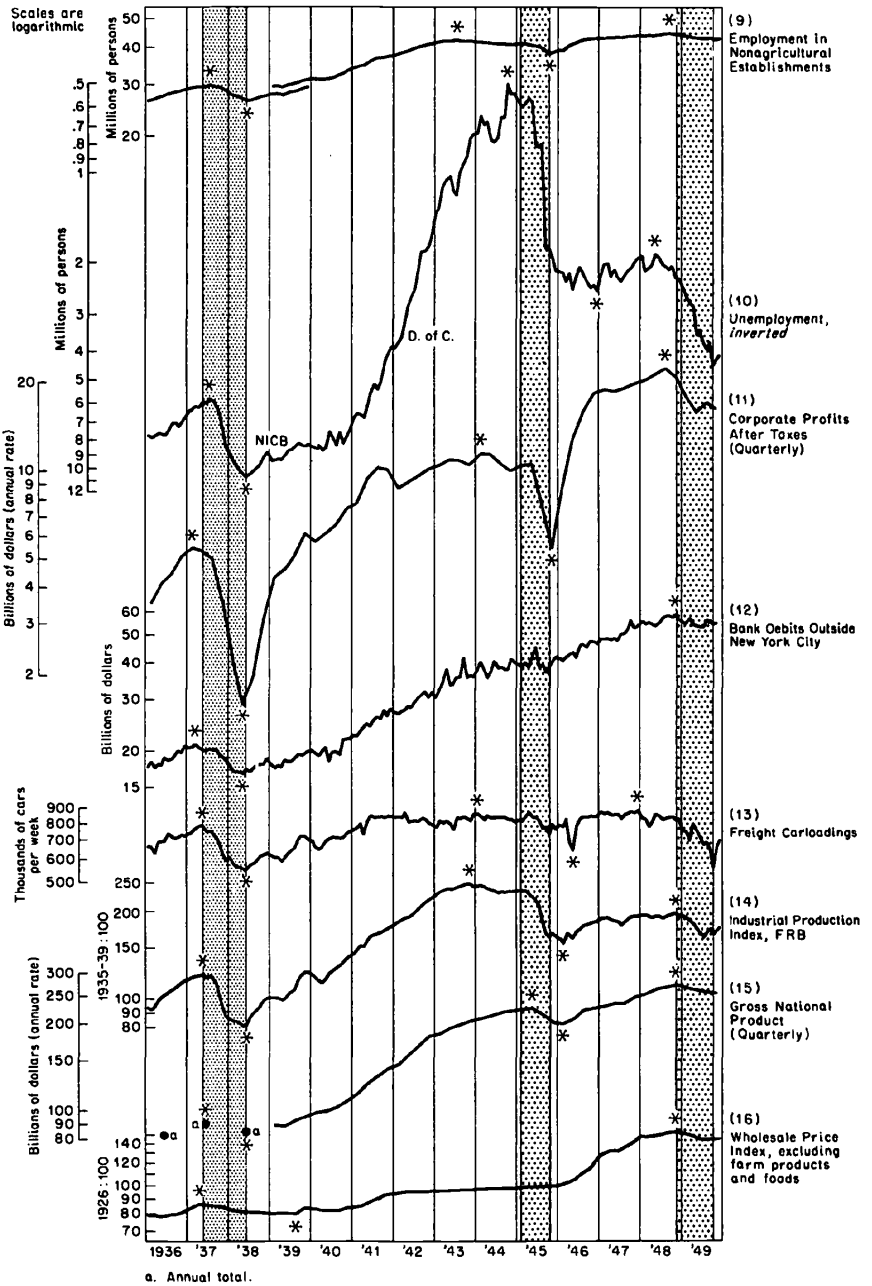


CHART 7.6 (continued)

B. Roughly Coincident Series



a. Annual total.

CHART 7.6 (continued)

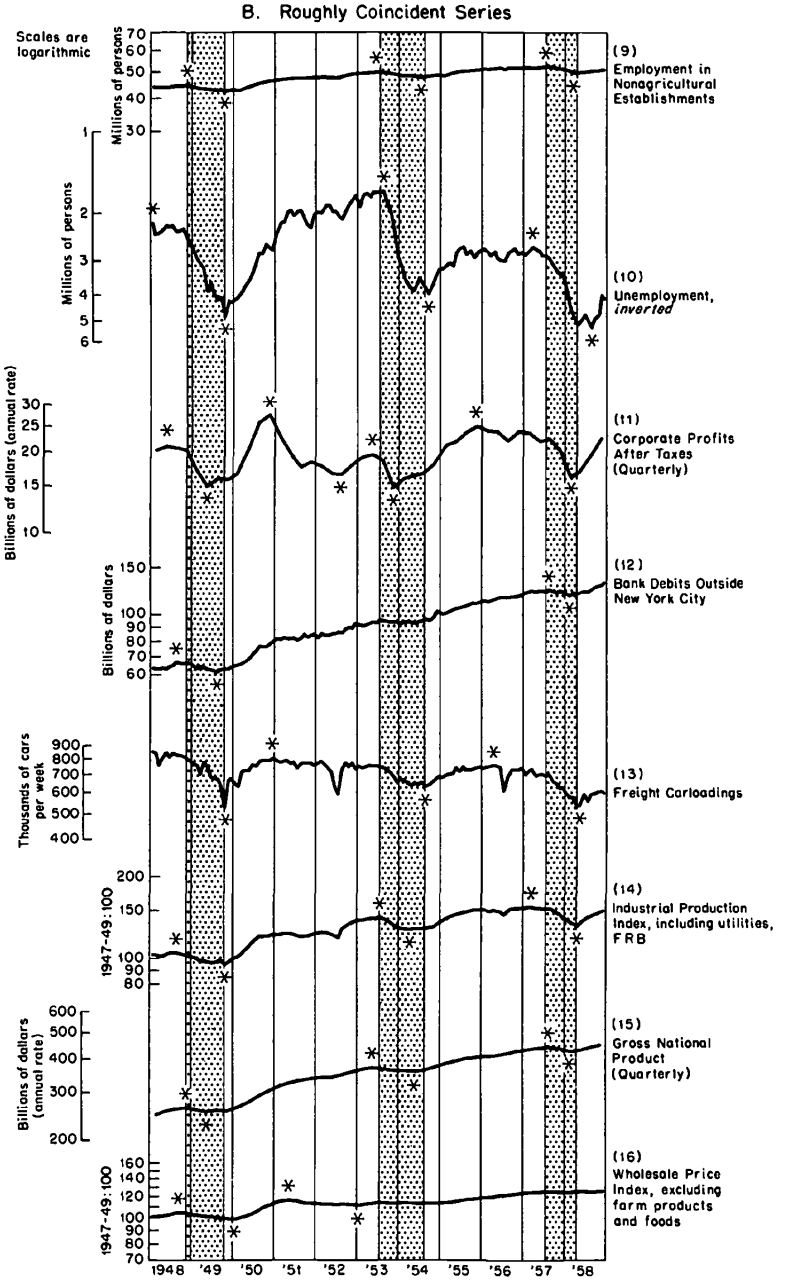


CHART 7.6 (continued)

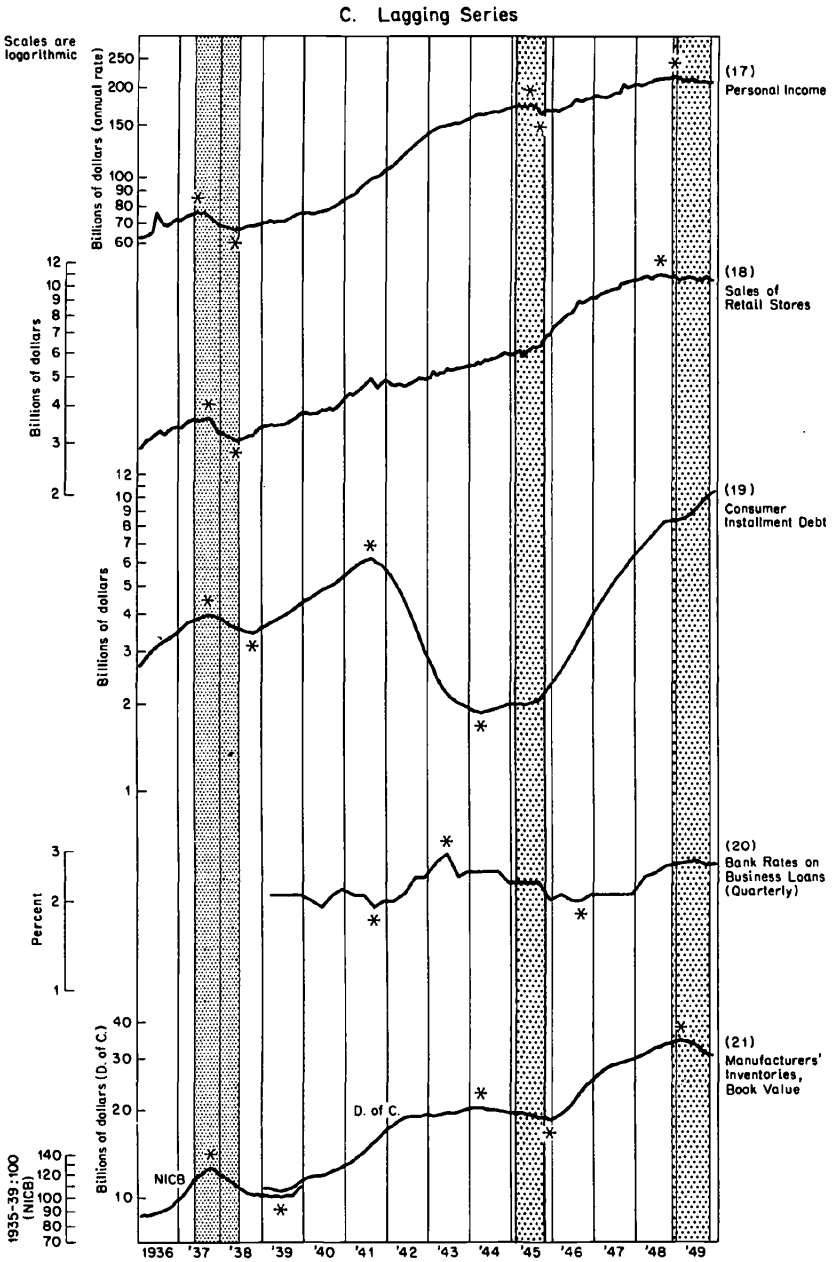
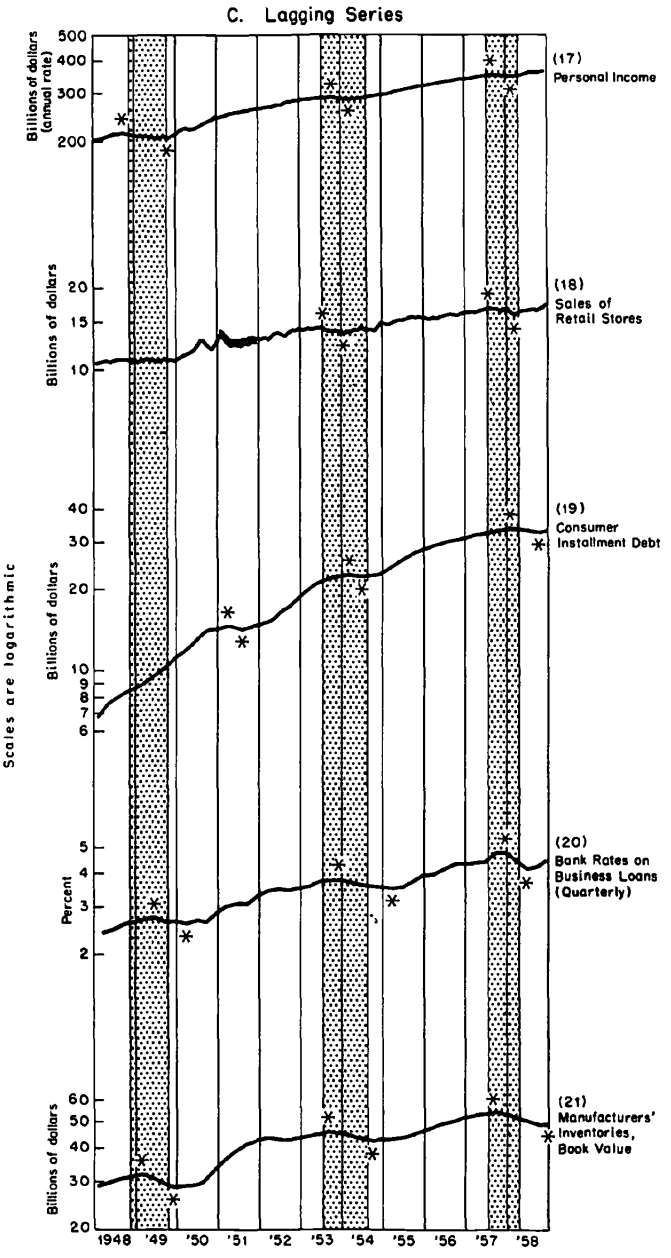


CHART 7.6 (concluded)



Bureau of the Census publishes the monthly unemployment estimates, beginning 1940, which we have adjusted for seasonal variations. The timing of both the employment and the unemployment series can be only roughly judged from factory employment, the most comprehensive historical employment series in monthly form, but there is no reason to doubt that they both belong in the roughly coincident category. The commodity price series that appears to be most suitable for this group is the BLS index of wholesale prices of all commodities other than farm products and foods.

As laggers, interest rates and bond yields, payrolls, and retail sales are the most promising groups, according to Table 7.4. In recent years both short- and long-term interest rates have conformed to business cycles less well than they did formerly; nevertheless, we include bank rates on business loans. This series did not quite meet our minimum standard of conformity in 1919–38, hence it is not listed in the appendix; yet its timing was fairly consistent, as Table 7.11 reveals. Instead of an index of factory payrolls we use the more comprehensive, albeit less sensitive, Department of Commerce series on personal income. Wages are, of course, a large element in the latter, and many of the other components, such as salaries, rent, dividends, and interest payments may be expected to lag. For retail sales we select the comprehensive retail stores series which begins in 1935.

The two other lagging series in Table 7.11 were selected on the basis of other information than that in Table 7.4 or the appendix. The tendency for manufacturers' total inventories to lag is demonstrated and analyzed in Abramovitz' study, *Inventories and Business Cycles*.[36] Consumer instalment debt series are not covered in Table 7.4 because they are too short; nevertheless, their lagging tendency seems to be well established.[37]

Our tentative list of indicators (Table 7.11), then, consists of eight leaders, eight rough coinciders, and five laggers, twenty-one in all. Fourteen cover the processes represented by the twenty-one selected indicators of revivals in Bulletin 69 (cf. Table 7.1). The other seven (new

[36] See also Moses Abramovitz, *The Role of Inventories in Business Cycles*, Occasional Paper 26, New York, NBER, 1948. Note, however, that this essay deals solely with the physical volume of inventories, whereas our monthly series is in terms of book value.

[37] See Gottfried Haberler, *Consumer Instalment Credit and Economic Fluctuations*, New York, NBER, 1942, pp. 54–69.

(Notes to Chart 7.6)

NOTE: The section of the chart for 1936–49 is from Occasional Paper 31, except that shaded areas for 1945 and 1948–49 have been added; the 1948–58 section is new.

All series are adjusted for seasonal variations except: (2) and (3) for 1936–39; (8), (16), and (20) for 1939–49; and (2), (8), (16), and (20) for 1948–58.

Shaded areas represent business contractions; unshaded areas, expansions.

Asterisks identify peaks and troughs of specific cycles.

SOURCE: Volume II.

orders, incorporations, unemployment, incomes, inventories, bank rates, and instalment debt) are not represented in the earlier list, a circumstance that in part reflects the growth in the statistical material at our disposal in the last decade.

Obviously many other series compete for the analyst's attention, and it would have been easy to expand our list. In interpreting the behavior of the comprehensive series listed it will often be helpful to examine series of narrower scope. The recent study of manufacturers' inventories by Abramovitz, cited above, illustrates how enlightening this may be. On the other hand, more comprehensive aggregates than some of those we have selected have a bearing on the course of business, e.g. total construction contracts, or total consumer debt outstanding. Where value aggregates are listed the analyst may wish to compile physical volume series, and vice versa. Moreover, series that are similar in coverage may be needed for certain comparisons. For example, many of the series in our list that differ in coverage can be restricted to manufacturing industries alone. Finally, considerable interest attaches to series that are, at least to an approximation, first differences of the series on our list. Examples are the gross and net labor accession rate, inventory investment, and gross and net changes in consumer debt. [For a revision of the list of indicators given in Table 7.11, see Chapter 3. A complete and revised record of the leads and lags of each indicator at each business cycle turn through 1958 is provided in Appendix B.]

What sort of picture do our twenty-one indicators draw of business conditions in recent years? In Chart 7.6 we attempt to identify specific cycle peaks and troughs in each series since 1936, comparing each new possible specific cycle expansion or contraction with earlier phases in the same or equivalent series, following the procedure laid down in *Measuring Business Cycles* (pp. 56–66). [Chart 7.6, which originally stopped in 1949, has been carried through 1958.] Since the most recent phases are nearly always incomplete, this may result in an undercount of recent specific cycle turns, which must be allowed for in interpreting the series as a group.

In the 1937–38 contraction the three groups of series behaved in rather characteristic fashion. The leading group tended to lead, both at the May 1937 reference peak and the June 1938 trough. The turns in the roughly coincident group are distributed within a narrow range on both sides of the reference dates. The lagging group tended to lag. With the advent of war, however, the fairly orderly sequence was violently disturbed. There is no need here to describe the course of events or to analyze the various factors that influenced the movement of each series. It is more important to consider whether, since the war, the prewar pattern of relationships has been restored.

We think the behavior of the series in the vicinity of the business

TABLE 7.12

Chronology of Postwar Peaks in Selected Statistical Indicators

		Leading Group[a]	Roughly Coincident Group	Lagging Group[b]
Mar.	1946	Comm. & indus. bldg. contracts		
May	1946	Resid. bldg. contracts New incorporations Industrial stock prices		
Dec.	1947	Basic commodity price index	Freight carloadings	
May	1948		Unemployment (*inv.*)	
June	1948	New orders, durables		
Aug.	1948		Corp. profits (quart.)	Retail Sales
Sep.	1948		Nonagric. employ.	
Nov.	1948		Indus. prod. index Gross nat. prod. (quart.) Debits outside NYC Wh. price index excl. farm & food prod.	
Dec.	1948			Pers. income
Feb.	1949			Mfrs'. invent.

[a] Average hours worked per week and liabilities of business failures (inverted) reached peaks in June 1944 and April 1945, respectively.

[b] Consumer instalment debt had not reached a peak by December 1949. Bank interest rates in September and December 1949 were only slightly below the peak figure reached in June 1949.

contraction that began in the autumn of 1948 indicates there has been a substantial restoration. Considering first the roughly coincident group we find that most of these series expanded rather rapidly in 1946, made smaller gains in 1947, and reached peaks in 1948 (Table 7.12). The declines recorded during 1948–49, according to Chart 7.6, were not so large as in 1937–38, but the recent declines exceed those in some of the milder business contractions of the past.[38]

All the series in the leading group were contracting by June 1948. In sharp contrast to the concentration of peaks in this group in 1936 and 1937, the postwar peaks are scattered over several years, owing partly to special circumstances connected with the war. Business failures began to increase even before the postwar business expansion got under way, but leveled off in 1947. Stock prices, residential building contracts, new

[38] The percentage decline in the FRB industrial production index between 3-month averages centered on November 1948 and July 1949 was 14. In 1937–38 the percentage decline from peak to trough was 32; in 1929–33, 53; in 1926–27, 5; in 1923–24, 16; and in 1920–21, 32. A similar comparison based on the average relative change in three indexes of business activity (AT&T, Barron's, and Cleveland Trust Co.) that cover 16 business cycle contractions, 1882–1938, shows that 6 of the contractions were smaller, 10 larger, than the 1948–49 decline.

incorporations, and commercial and industrial building contracts began to decline early in 1946, fluctuated narrowly about a horizontal level through 1947 and part of 1948, then declined further. Average hours worked per week in manufacturing, after declining sharply from the wartime peak, did not rise sufficiently in 1946–47 for the movement to be considered a specific cycle expansion, but the high point was reached in December 1947.[39] The basic commodity price index began to fall in January 1948, and new orders for durable goods followed in June. There is hardly any question, then, that the prewar tendency for declines in the leading group of series to precede those in the roughly coincident group has reasserted itself.

Like the roughly coincident series, all the lagging series rose in 1946–48, some continuing an expansion that, by 1948, had lasted ten years with hardly an interruption. The peak in retail sales came in August 1948, personal income in December, and manufacturers' inventories in February 1949. Bank interest rates declined slightly after the second quarter of 1949, but consumer instalment debt continued to rise throughout the year. Thus the behavior of this group of series is somewhat mixed, but the lagging tendency clearly prevails.

In concluding this examination of the recent behavior of our tentatively selected list of indicators, it is well to underline some limitations on their use. It is perhaps unnecessary to point out that all of our analysis has been directed toward revivals and recessions in general business activity. This is not always the matter of chief interest; cyclical developments in a particular industry, line of activity, or region may properly claim the analyst's attention. Although he may find that some of our results can be adapted to such ends, obviously each such question requires careful examination and a fresh approach.

In attempting to judge the course of cyclical movements in the economy as a whole, the user of statistical indicators will not find his task easy. The cautions Mitchell and Burns voiced in 1938 in *Statistical Indicators of Cyclical Revivals* [reprinted here, Chapter 6] bear repeating. Most of them are as applicable to recessions as to revivals.

While this study has, we hope, contributed something to render guesses about the future course of business less hazardous, we find little to justify more optimism than Mitchell and Burns expressed. Our impression is that forecasts of revivals and recessions by means of the materials and approaches described in this paper will be subject to all the difficulties they mentioned. Nevertheless, there is some ground for confidence that objective use of these methods will at least reduce the

[39] The series compiled by the National Industrial Conference Board on average hours in 25 manufacturing industries, discontinued after July 1948, shows a specific cycle expansion from February 1946 (39.0 hours) to December 1947 (41.2 hours).

usual lag in recognizing revivals or recessions *that have already begun.*[40] If, after an expansion in a group of roughly coincident series, several begin to decline, careful study of the recent behavior of a group of leading series may yield convincing evidence that the decline is or is not cyclical, and that a recession is or is not under way. True, this is forecasting of a sort. But it is forecasting with a highly important element of confirmation, which works in two directions. The behavior of the roughly coincident series confirms or fails to confirm that of the leading series, and vice versa. Some clue to the prospect that the emerging expansion or contraction will be comparable in magnitude to previous cyclical movements may be given by the extent to which it is already diffused among the processes being examined. Perhaps other aids to interpretation, such as those we describe in Chapter 20, can be developed. In any case, if errors are to be minimized, painstaking study of the current and past behavior of the individual series, intelligent analysis of the factors that underlie their interrelationships, and judgment of the changing political and economic environment will be required.

Appendix: List of Series with Acceptable Conformity and Timing, in Three Timing Groups

For an explanation of the criteria met by series in this list, the types of series that did not qualify, and the timing classification, see sections IV and V. No attempt has been made to identify series completely, since the list itself can serve only as a rough guide to a choice of useful indicators. Series that in our analysis do not extend as far as the 1938 reference trough are marked with an asterisk. The parenthetic figure following the group title is the number of series in the group.

SERIES THAT LEAD AT PEAKS AND TROUGHS (75)

New Orders (6): Locomotives; freight cars; railroad passenger cars; rails;* steel sheets;* oak flooring.

Public and Private Construction Contracts and Permits (7): Total contracts, value; total contracts, adjusted for changes in cost; total contracts, New England, value;* total building contracts, value; same, floor space; total building permits, value; building plans, Manhattan, value.

Private Construction Contracts (10): Total private, value; total residential,

[40] Though difficult to measure, this lag is clearly not negligible. If the user of statistical indicators could do no better than recognize contemporaneously the turns in general economic activity denoted by our reference dates, he would have a better record than most of his fellows. For example, the reference peaks preceding the severe contractions of 1920–21, 1929–33, and 1937–38 come in January 1920, June 1929, and May 1937, respectively. But it was not until autumn in each of those years that economic difficulties received general notice. The contraction of 1948–49 began in the autumn of 1948; but it was not until the spring of 1949 that most observers were convinced that a recession was under way.

value; same, floor space; 1- and 2-family dwellings, value; commercial and industrial building, value; same, floor space; commercial building, number of projects; industrial building, value; same, floor space; food factories, value.

Inventories (*1*): Tin, visible supply.

Production (*6*): Paper; inner tubes; southern pine lumber; oak flooring (shipments); steel sheets; lead ore (shipments).

Transportation and Communication (*2*): Operating revenues of railroads, freight; railroad operating expense per traffic unit (inverted).

Employment (*2*): Percentage employed, all trade union members, Massachusetts;* same, textile industry.*

Average Hours Worked per Week, Manufacturing (*4*): All wage earners; all male; male skilled and semiskilled; male unskilled.

Prices, Wholesale (*4*): Bradstreet's index;* inedible tallow; common bricks; slab zinc.

National Bank Series (*6*): Individual deposits, New York City;* same, central reserve cities;* bank deposits, New York City;* same, central reserve cities;* ratio, loans and discounts to individual deposits, country districts (inverted);* ratio, loans and discounts to net deposits, country districts (inverted).*

Stock Exchange Transactions (*2*): Shares sold, New York Stock Exchange, number; same, value.*

Stock Price Indexes (*6*): Common stocks, Cowles, S. & P.; same, Frickey;* preferred stocks, Frickey;* industrial stocks, Dow-Jones; transportation stocks, Mitchell;* railroad stocks, Macaulay.*

Security Issues, Corporate (*3*): Cash obtained thru new issues, Ayres;* stocks, all corporations; stocks, American and Canadian corporations.

Business Profits (*4*): Railroad operating income; net railroad operating income; net revenue from railroad operations; same, per traffic unit.

Business Failures, Number, Inverted (*2*): Large manufacturing companies; suspended banks.*

Business Failures, Liabilities, Inverted (*6*): Total;* industrial and commercial; all manufacturing companies; large manufacturing companies; trading companies; suspended banks.*

Bank Clearings and Debits (*2*): Clearings (to 1919) and debits, total; same, New York City.

Business Activity Indexes (*1*): Deposits activity, adjusted for trend.

Unclassified (*1*): New incorporations, number.

SERIES THAT ARE ROUGHLY COINCIDENT AT PEAKS AND TROUGHS (29)

Retail Sales (*1*): Sales, 2 mail order houses, adjusted for trend and changes in prices.

Imports (*1*): Semimanufactures, value.

Production, General Indexes (6): Physical volume of business activity, Babson; industrial production, S. & P.; manufactures, FRB; producer goods, Leong; durable goods, FRBNY; producer durable goods, FRBNY.

Production, Other (2): Coke; merchant pig iron.

Transportation and Communication (5): Freight carloadings; ton-miles per freight car on line; ton-miles per serviceable freight car; ton-miles per freight locomotive; ton-miles per serviceable freight locomotive.

Employment, Factory (5): Total, New York state; durable goods; cement, clay, and glass; iron and steel products; machinery.

Average Hours Worked Per Week (1): Class I railroad employees, unskilled.

Payrolls, Factory (3): Boots and shoes; lumber and products; iron and steel products.

Prices, Wholesale (1): Douglas fir lumber.

Business Profits (2): All corporations; mining corporations.

Business Activity Indexes (2): Annalist; AT&T, adjusted for trend.

SERIES THAT LAG AT PEAKS AND TROUGHS (30)

Retail Sales (1): Sales per store, 3 restaurant chains.

Imports (1): Coffee (inverted).

Inventories (1): Cotton, at mills.

Payrolls, Factory (4): Total; food products; baking; glass.

Prices, Wholesale (4): Fuel and lighting; bleached muslin; ginghams; building materials.

National Bank Series (8): Lawful money holdings, central reserve cities (inverted);* ratio, loans and discounts to individual deposits, total;* same, New York City;* same, reserve cities other than central;* ratio, loans and discounts to net deposits, total;* same, New York City;* same, central reserve cities;* same, reserve cities other than central.*

Other Monetary Series (1): Currency in public circulation.

Interest Rates and Bond Yields (7): Ninety-day time money rates; commercial paper rates; bond yields, 60 high-grade; same, 15 industrial; same, 15 public utility; same, railroad; same, municipal.

Stock Exchange Transactions (1): Bond sales, New York Stock Exchange (inverted).

Security Issues, Corporate (1): Short-term bonds and notes, American and Canadian corporations.

Unclassified (1): Magazine advertising, linage.