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Volume Title: Statistical Indicators of Cyclical Revivals and Recessions

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Volume Publisher: UMI

Volume ISBN: 0-87014-346-8

Volume URL: <http://www.nber.org/books/moor50-1>

Publication Date: 1950

Chapter Title: BEHAVIOR OF SELECTED GROUPS OF INDICATORS, 1885-1940

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Chapter URL: <http://www.nber.org/chapters/c3233>

Chapter pages in book: (p. 45 - 62)

1919-38, though the differences among the groups are less sharp. The timing relationships among economic processes evidently have some degree of stability.

6

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 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 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.²⁸

²⁸ Some interesting experiments along this line were reported by C. Ashley Wright in a paper presented at the Conference on Business Cycles Research, National Bureau of Economic Research, November 25-27, 1949.

TABLE 10

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 No. of Months After Before				Series That Lead at Peaks and Troughs ^b No. of Months After Before			
Trough (1)	Peak (2)	Date ^c (3)	ref. trough (4)	ref. peak (5)	% (6)	Date ^c (7)	ref. trough (8)	ref. peak (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 10, A, col. 4 and 5). Similarly, the percentage expanding reached its lowest level (the percentage contracting its highest level) in mid-contraction, on the average (Table 10, B, col. 4 and 5). But the intervals between the peaks and troughs in the

TABLE 10 (CONCL.)

B Business Contractions

HIGHEST PERCENTAGE OF SERIES CONTRACTING

Monthly Reference Dates		All Series with Acceptable Conformity ^a				Series That Lead at Peaks and Troughs ^b			
Peak (1)	Trough (2)	Date ^c (3)	No. of Months After ref. peak (4)	No. of Months Before ref. trough (5)	% (6)	Date ^c (7)	No. of Months After ref. peak (8)	No. of Months 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	9	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 Sec. 5.

^b 75 series; see Sec. 5 and App. B.

^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.

curve and the preceding 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 3 should be noted. First, particularly in recent cycles, the curve reaches the 50 percent 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 App. A).

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 percent) was relatively high compared, say, with the lowest level reached during the Great Depression (4 percent, in 1930). In other words, in no month during the 1926-27 contraction were more than 69 percent of the series contracting, whereas in 1929-33 the figure reached 96 percent.

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 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 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 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

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 in a given reference phase (i.e., using conformity measures). In five mild expansions during 1879-1933 they found (Table 26, 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 10, column 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.

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 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 4.

As described in Section 5, the three groups of series in Chart 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. Appendix B lists the 75 series in the leading group, the 29 in the roughly coincident group, and the 30 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 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*),

²⁷ For clarity the distributions in Chart 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 percent of the turns in these groups of series are 'corresponding'.

Chart 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)

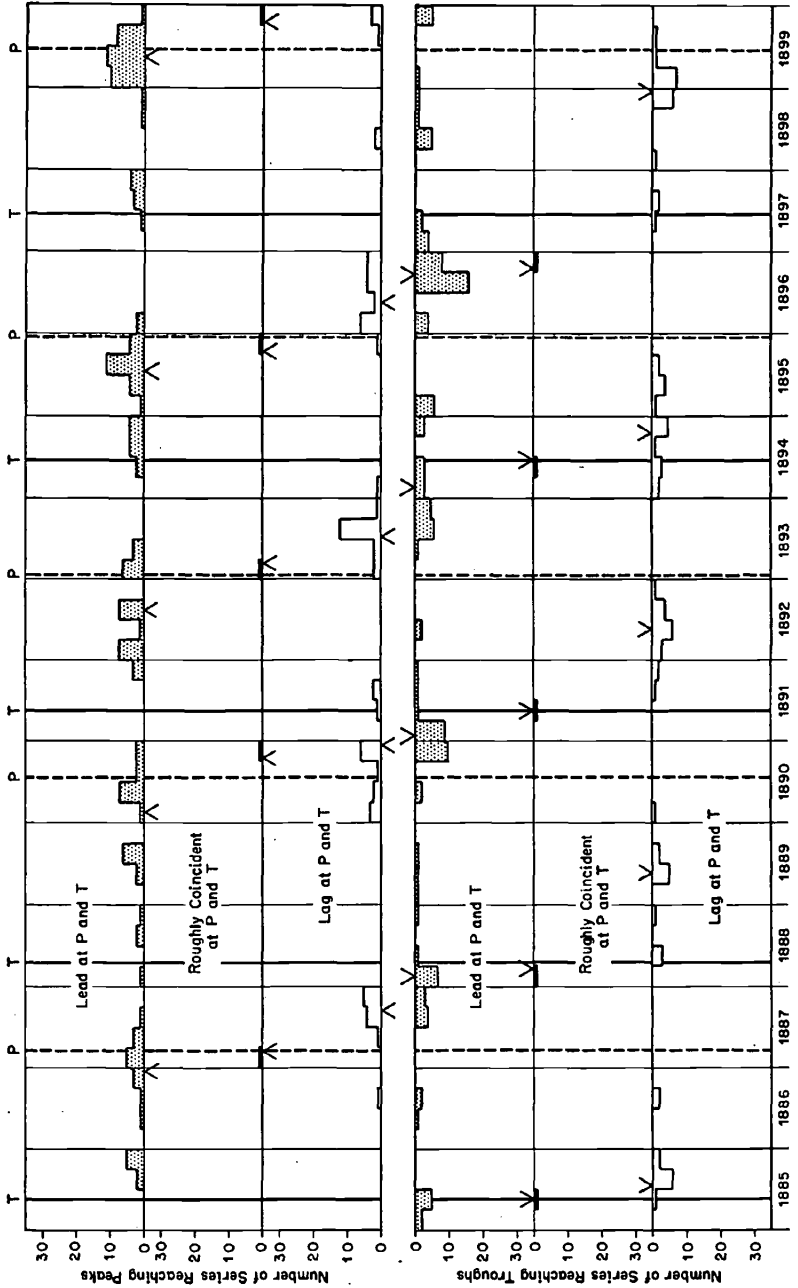


Chart 4 (cont.)

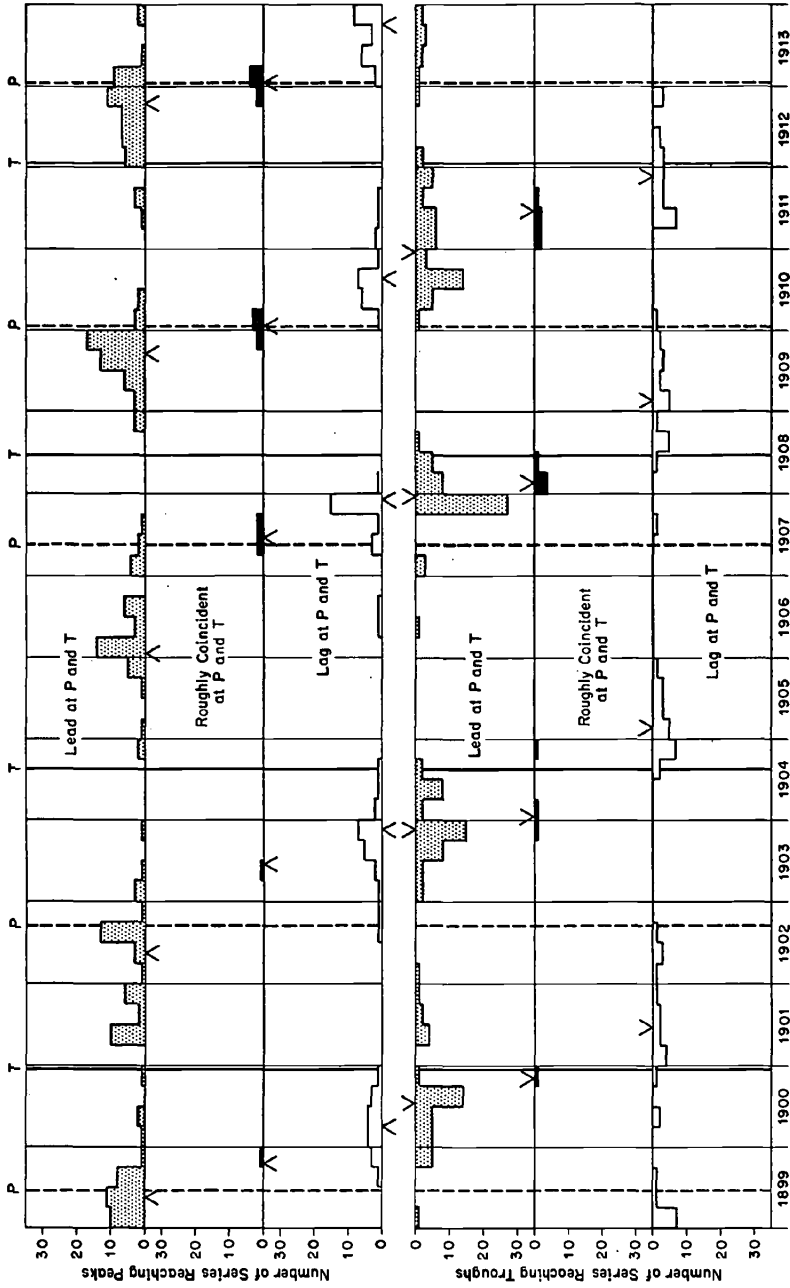
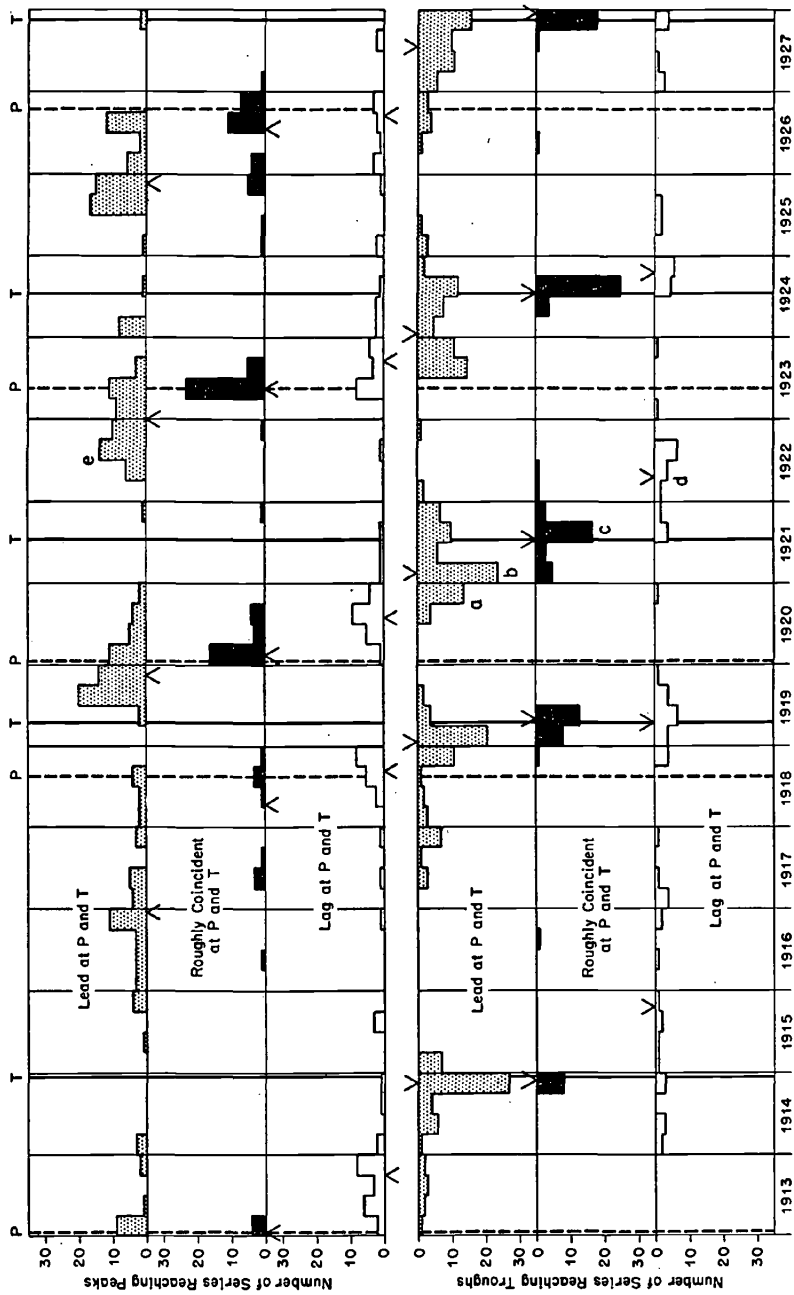
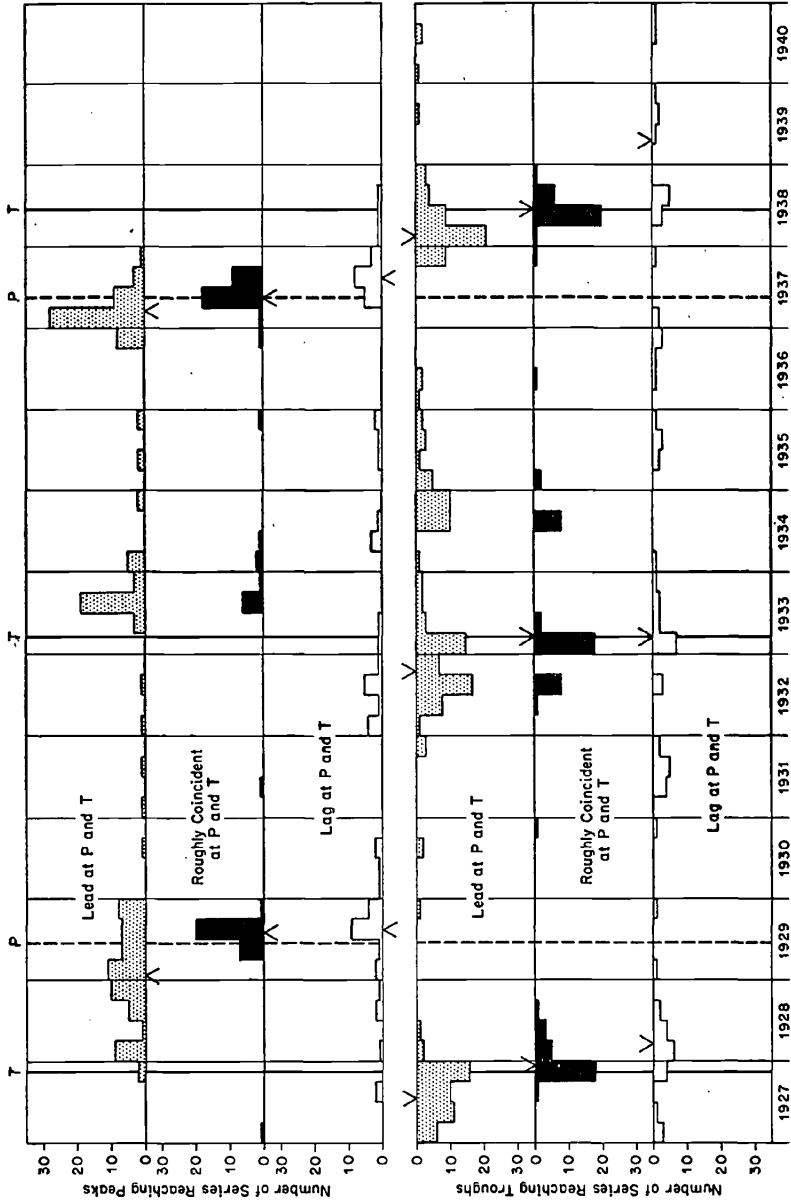


Chart 4 (cont.)



a, b, c, d, e - See text.

Chart 4 (concl.)



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 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 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 11).

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

TABLE 11

Timing of Medians of Corresponding Specific Cycle Turns, 1885-1938
Three Groups of Series^a

Reference Peak	LEAD (-) OR LAG (+) AT REFERENCE PEAKS			Reference Trough	LEAD (-) OR LAG (+) AT REFERENCE TROUGHS		
	M E D I A N P E A K I N				M E D I A N T R O U G H I N		
	Median lagging group	Lead-ing group	Roughly coin. group		Median lagging group	Lead-ing group	Roughly coin. group
Mar. 1887	-20	-3	0 ^b	May 1885	-6	0 ^b	+2
July 1890	-14	-5	+3 ^b	Apr. 1888	-7	-2	+13
Jan. 1893	-8	-5	+2 ^b	May 1891	-5	-4	+12
Dec. 1895	-14	-5	-2 ^b	June 1894	-11	0 ^b	+13
June 1899	-6	-1	+4 ^b	June 1897	-13	-9	+18
Sep. 1902	-15	-4	+9 ^b	Dec. 1900	-8.5	-5	+17
May 1907	-27	-16	+1	Aug. 1904	-9	-7	+6
Jan. 1910	-11	-4	0	June 1908	-6.5	-4	+8
Jan. 1913	-14	-3	0	Jan. 1912	-17	-7	+2
Aug. 1918	-34	-20	-4	Dec. 1914	-14.5	-1	+10
Jan. 1920	-9	-2	+1	Apr. 1919	-7	+0.5	0
May 1923	-13	-4.5	0	July 1921	-11.5	-5	+9
Oct. 1926	-24	-11	-3	July 1924	-10	0	+3
June 1929	-15	-5	+1	Nov. 1927	-14	-4	+4
May 1937	-50	-2	0	Mar. 1933	-43	0	0
Average 1885-1918	-16.3	-6.6	+1.3	June 1938	-10	-4	+10
Av. dev. 1885-1918	6.4	4.6	2.6		-9.8	-5.9	+7.7
Average 1919-38	-22.2	-4.9	-0.1		3.2	2.7	2.8
Av. dev. 1919-38	11.8	2.5	1.2		4.5	4.5	4.5
Average 1885-1938	-18.3	-6.0	+0.8		-17.7	-4.5	+4.3
Av. dev. 1885-1938	8.5	3.8	2.1		10.1	0.8	3.4
					-12.5	-5.4	+6.4
					5.2	2.1	2.4
							4.4

^a For list of series in each group see App. B. ^b Based on one series only.

be almost uniformly distributed over the cycle, as the average intervals in the accompanying tabulation show. Even the average

Intervals between Median Turns
in Leading and Lagging Groups, 1887-1938

Interval		Average interval, 15 observations	Average Deviation	Range (m o n t h s)	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)

deviations of the intervals do not differ greatly, whether based on like or unlike turns.²⁸

Chart 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 10, 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

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.

²⁹ The curve for the leading group also tends to lead the curve in Chart 3, based on series undifferentiated as to timing. The leading curve crosses the 50 percent line before the reference peak or trough in nearly every instance, and it almost invariably reaches a maximum level before the curve in Chart 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 10, col. 10, are, for expansions: 87, 90, 99; and for contractions: 85, 84, 95.

The sequences exhibited in cycle after cycle by the groups of series in Charts 4 and 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 5 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 21 indicators reported in Section 2, and further evidence will emerge in Section 7. Moreover, the pre- and post-1919 tests in Table 9 also indicated a fairly high degree of continuity in 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

³⁰ *Measuring Business Cycles*, pp. 393-400, 485-90.

³¹ *Ibid.*, p. 3.

Chart 5
Percentage of Series Expanding, Three Groups of Series
 (solid vertical lines indicate reference troughs; broken vertical lines, reference peaks)

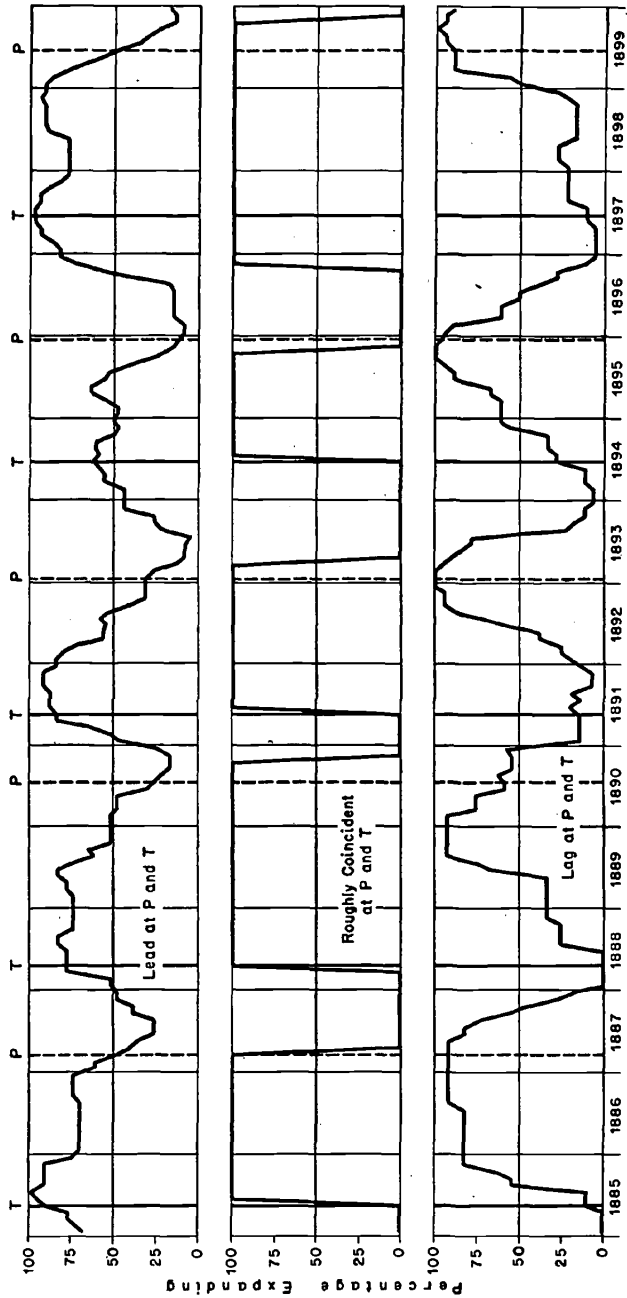


Chart 5(cont.)

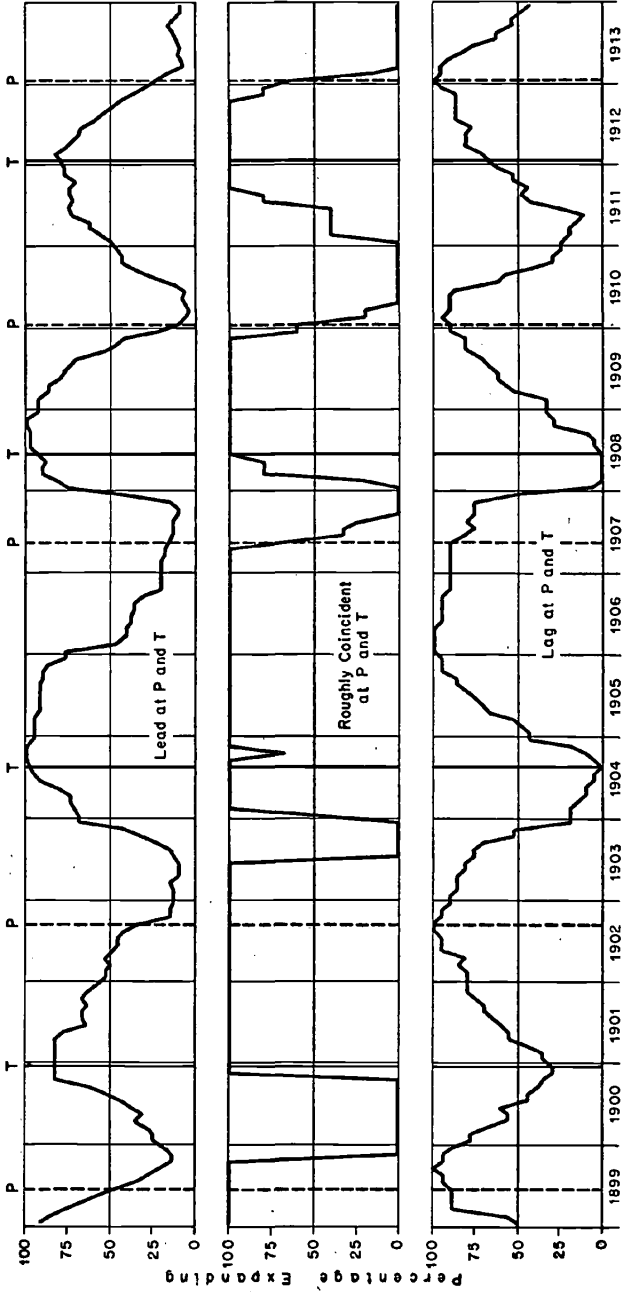


Chart 5 (cont.)

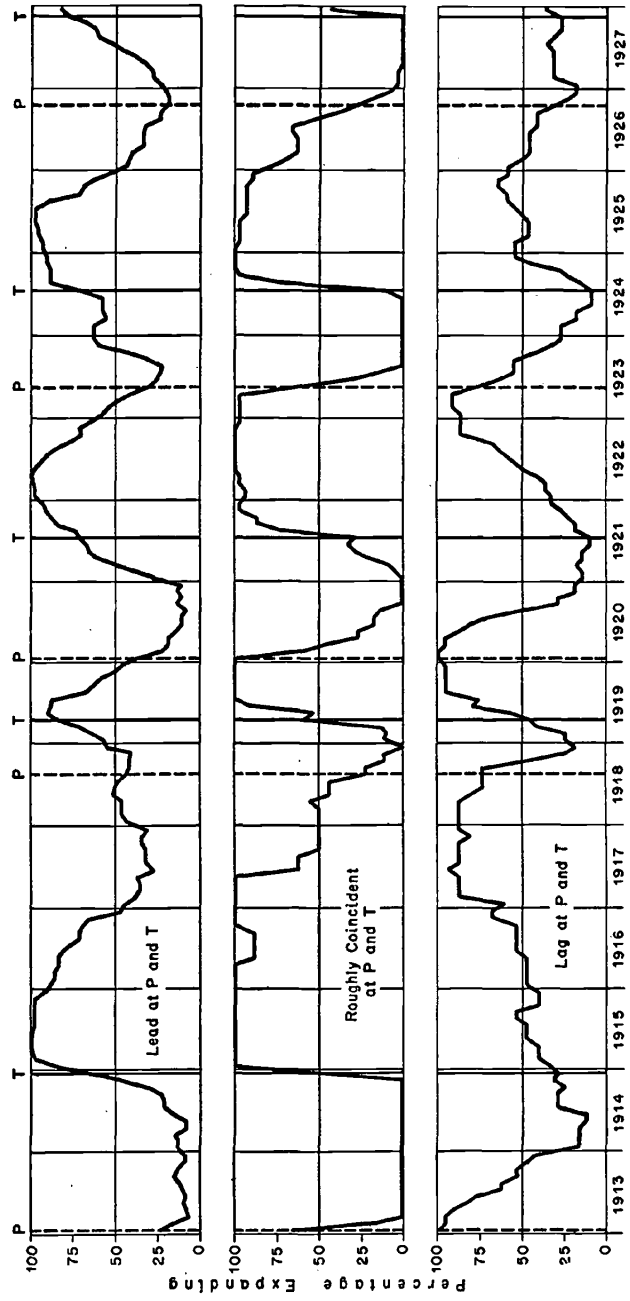
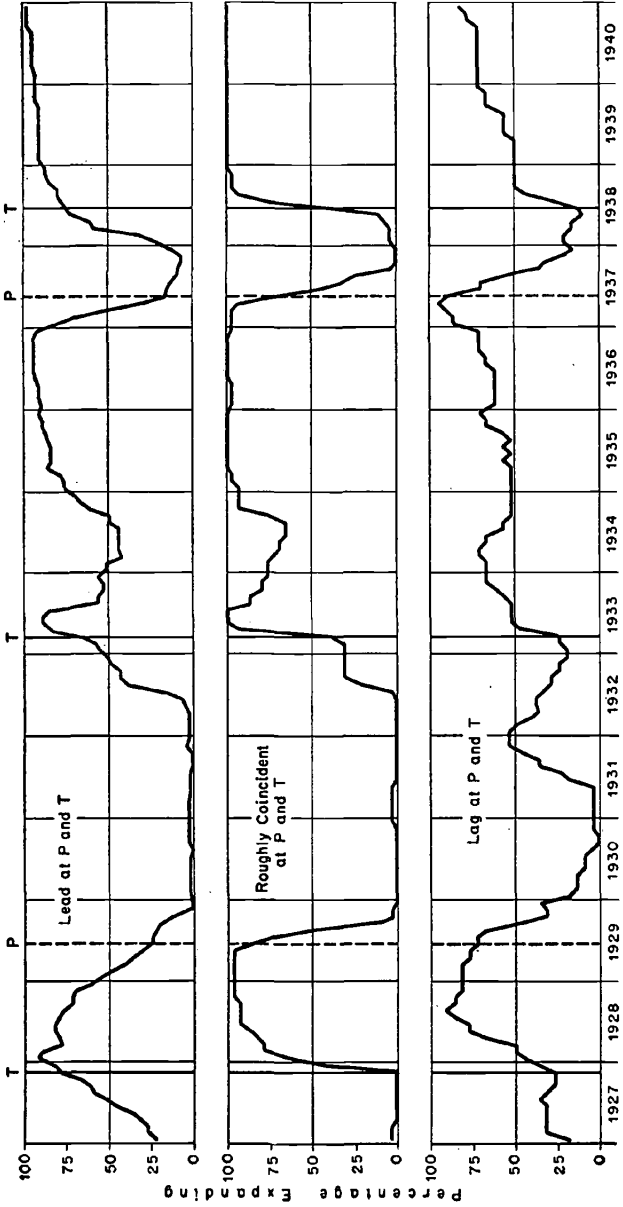


Chart 5 (concl.)



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 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 Appendix B. However, as we remarked above, significant processes whose timing is not recorded in Chart 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 4 and 5, viewed in conjunction with Chart 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 4 and 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 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.

³² Cf. *ibid.*, p. 488.

³³ Cf. *ibid.*, p. 70.