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cases the reasons for the differences in behavior of different series are apparent, though a thoroughgoing explanation may be lacking. In Section 4 we set forth the criteria so far adopted for selecting indicators, and in Section 5 describe the broad groups of series that appear to have useful indicator characteristics.

3) Series in all three timing groups (leaders, coinciders, and lagers), 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 (Sec. 2, 6, 7, and App. A). But this study also suggests that the interpretation of statistical indicators is subject to numerous difficulties and will often be attended by considerable uncertainty.

## 2

### 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 21 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.<sup>2</sup> In Chart 1 the asterisks identify the specific cycle peaks and troughs of the 21 indicators in 1932-39.

At an early stage of the National Bureau's business cycle

<sup>2</sup> See Arthur F. Burns and Wesley C. Mitchell, *Measuring Business Cycles* (National Bureau of Economic Research, 1946), pp. 56-66.

Chart 1  
Behavior of Twenty-one Statistical Indicators, 1932-1939

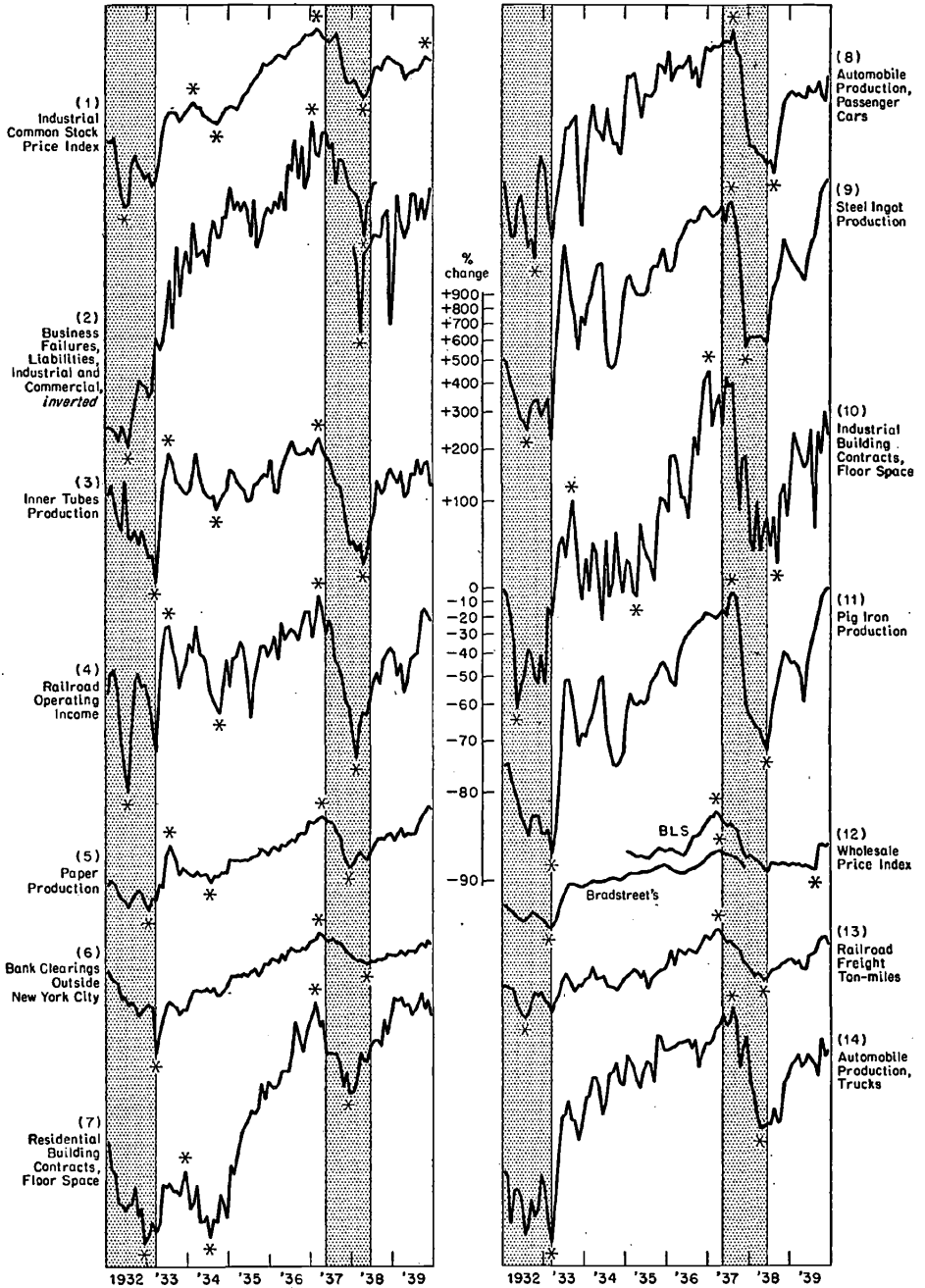
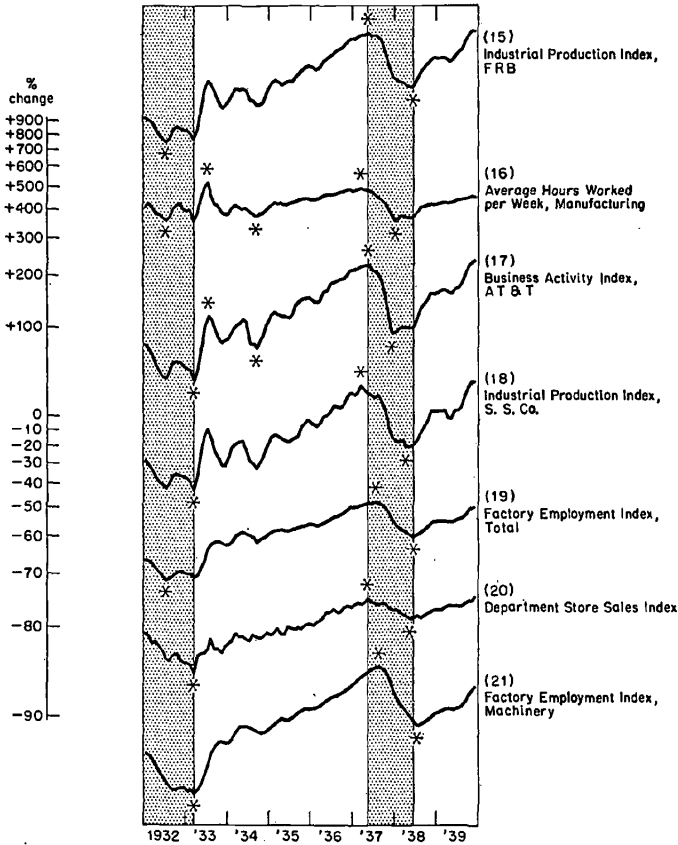


Chart 1 (concl.)



See note to Table 2. 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.

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.

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 (Table 1). The reference dates occurring in 1932-39 bound the shaded areas in Chart 1.

The number of months by which the specific cycle peaks and troughs of the 21 indicators lead or lag behind the 1937-38 reference dates are entered in Table 2, 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

TABLE 1  
Reference Dates and Durations of Business Cycles  
United States, 1854-1938

MONTHLY REFERENCE DATES		DURATION IN MONTHS			QUARTERLY REFERENCE DATES	
Peak	Trough	Expan- sion <sup>a</sup>	Contra- ction <sup>b</sup>	Full Cycle	Peak	Trough
June 1857	Dec. 1854					
	Dec. 1858	30	18	48	2Q 1857	4Q 1854
Oct. 1860	June 1861	22	8	30	3Q 1860	3Q 1861
Apr. 1865	Dec. 1867	46	32	78	1Q 1865	1Q 1868
June 1869	Dec. 1870	18	18	36	2Q 1869	4Q 1870
Oct. 1873	Mar. 1879	34	65	99	3Q 1873	1Q 1879
Mar. 1882	May 1885	36	38	74	1Q 1882	2Q 1885
Mar. 1887	Apr. 1888	22	13	35	2Q 1887	1Q 1888
July 1890	May 1891	27	10	37	3Q 1890	2Q 1891
Jan. 1893	June 1894	20	17	37	1Q 1893	2Q 1894
Dec. 1895	June 1897	18	18	36	4Q 1895	2Q 1897
June 1899	Dec. 1900	24	18	42	3Q 1899	4Q 1900
Sep. 1902	Aug. 1904	21	23	44	4Q 1902	3Q 1904
May 1907	June 1908	33	13	46	2Q 1907	2Q 1908
Jan. 1910	Jan. 1912	19	24	43	1Q 1910	4Q 1911
Jan. 1913	Dec. 1914	12	23	35	1Q 1913	4Q 1914
Aug. 1918	Apr. 1919	44	8	52	3Q 1918	2Q 1919
Jan. 1920	July 1921	9	18	27	1Q 1920	3Q 1921
May 1923	July 1924	22	14	36	2Q 1923	3Q 1924
Oct. 1926	Nov. 1927	27	13	40	3Q 1926	4Q 1927
June 1929	Mar. 1933	19	45	64	2Q 1929	1Q 1933
May 1937	June 1938	50	13	63	2Q 1937	2Q 1938

Source: Arthur F. Burns and Wesley C. Mitchell, *Measuring Business Cycles*, Table 16. Three of the trough dates have been revised: from September to July 1921, from December to November 1927, and from May to June 1938.

<sup>a</sup> From trough on preceding line to peak.

<sup>b</sup> From peak to trough on same line.

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

TABLE 2  
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., <sup>1</sup> 1882-1938 <sup>w</sup>	-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 <sup>w</sup>	-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 <sup>w</sup>	-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 <sup>w</sup>	-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	

S U M M A R Y

	NUMBER OF LEADS AND LAGS			
	19	14	13	12
Leads	19	14	13	12
Coincidences	..	3	2	3
Lags	2	4	6	6
M E A N S				
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
M E D I A N S				
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*, pp. 8-10. 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 Sec. 7).

<sup>1</sup> Inverted; see note 9.

<sup>w</sup> War cycle observations (timing comparisons at the 1918 peak, 1919 trough, and 1920 peak) are omitted.

business cycles. Eight of our 21, 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.

### 3

#### VARIETIES OF CYCLICAL BEHAVIOR AND THEIR CONSENSUS

Chart 1 and Table 2 demonstrate, in some degree, the varieties of cyclical behavior to be found in economic processes. The 21 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 exhibited in the table and chart. A more extensive view will be provided by the materials presented in subsequent sections of this report.<sup>3</sup> Meanwhile it may be helpful to examine a small sample of series selected for the diversity of their behavior. Chart 2 shows 'reference cycle patterns' of 7 monthly series during 5 successive business cycles, 1919-38, together with their average patterns for this period. Two of the 7, residential building contracts and the industrial production index, are from the 21 indicators of Chart 1; the rest are different.

<sup>3</sup> A still more comprehensive analysis of varieties of cyclical behavior will be presented in Wesley C. Mitchell's forth-coming volume, *What Happens during Business Cycles*.