

TABLE 5

Average Behavior of Various Time Series at Nine Successive Stages in the Reference Business Cycles which they respectively cover.

Average standings are computed from percentages of the average value of the variables in question during each reference cycle.

TITLE OF SERIES	No. of reference cycles covered	AVERAGE STANDING DURING								
		Three months centered on first revival	Expansion			Three months centered on recession	Contraction			Three months centered on next revival
			First third	Middle third	Last third		First third	Middle third	Last third	
Series Conforming Closely										
1. Pig Iron Output—U. S., 1885-1924	12	74	91	100	113	121	116	99	85	87
2. Bank Clearings—U.S., cities outside of N. Y., 1879-1924	13	83	89	97	108	111	110	105	101	104
3. Interest Rate, Prime Commercial Paper, N. Y. (Macaulay) 1859-1924	17	91	88	92	105	119	120	109	95	90
4. Actual Values of Shares Sold, New York Stock Exchange, 1885-1919	10	95	122	111	118	113	97	79	85	121
5. Wholesale Prices, U. S. Bureau of Labor Statistics, 1891-1924	10	94	95	99	105	108	108	104	100	100
6. Freight Receipts, Selected Railroads, Great Britain, 1879-1914	5	89	92	97	102	105	104	102	103	103
7. Unemployment Percentages, Trade Union Members, Great Britain, 1895-1921	5	188	105	69	65	52	71	126	200	200
*8. Private Bank Discount Rate, Germany, 1879-1914	7	69	82	96	119	136	122	103	85	68
Series Conforming Loosely										
9. Petroleum Wells Completed, U. S., 1871-1924	14	83	94	104	104	101	99	101	94	94
10. Hog Receipts, Chicago, 1861-1924	16	92	96	103	99	102	99	102	107	109
11. Stocks, Pig Iron, Cleveland District, Great Britain, 1879-1914	5	130	146	142	99	62	59	59	77	121
12. Municipal Pawnshops, Loans, France, 1872-1914	7 (a)	98	98	97	97	99	101	103	106	106
Series Conforming Slightly Or Not All										
13. Milk Receipts, New York City, 1897-1924	7	87	91	96	98	100	101	104	107	108
14. Post Office Receipts, France, 1879-1914	5	87	91	96	101	101	104	105	108	105

*Provisional

(a) 6 cycles for second half of reference cycle.

cycle were marked by one of the greatest stock-exchange booms on record—the boom which culminated in the Northern-Pacific “corner.” This episode is responsible for the exceptionally high standing of New York clearings in the first third of the expansion phase in the 1901-04 reference cycles, and in the corresponding phase of the presidential period. In the averages at the bottom of the table the wave pattern stands out more boldly in the reference cycles than in the presidential periods.

Chart 3 shows these two sets of averages, plotted side by side. The general resemblance of these curves to each other is scarcely less striking than the dissimilarity of the curves for 18 reference cycles and 16 presidential periods in Chart 2. Yet even here the tendency of New York bank clearings to move in cycles harmonizing with the cyclical fluctuations in business at large is far better shown by the observations based on our reference dates than by the observations based on the presidential election dates.

Of course no analysis confined to a single series can demonstrate the existence of a tendency among the economic activities of a business economy to move in cycles, or show in what activities this tendency manifests itself strongly and in what activities it counts for little in the complex of factors which shape the course of affairs. It is only by dealing with a wide variety of time series that these objectives can be attained. The National Bureau has not yet completed its analysis, and is not yet ready to formulate broad conclusions. But we may add a supplementary table giving specimen averages like those of Table 2 for three groups of series—series which conform closely to reference cycles, series which conform moderately well and series which show but slight traces of conformity. Slender as this exhibit is, it suffices to show that a high degree of conformity in cyclical behavior to the wave pattern marked out by the reference dates for revivals and recessions is a genuine, though by no means universal, phenomenon.

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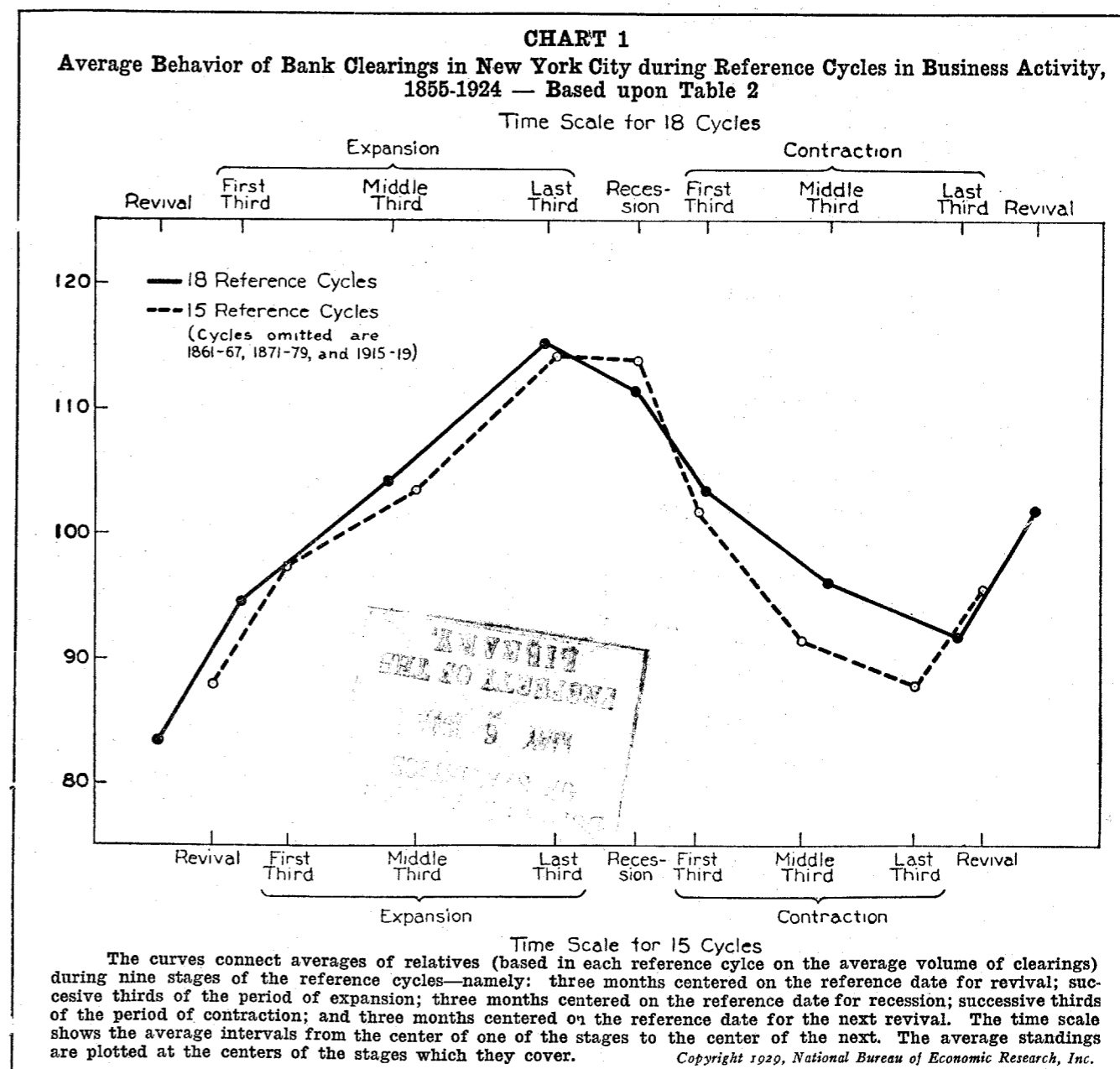
To Find Facts
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No. 31

474 West 24th Street, New York City

March 1, 1929

Testing Business Cycles¹



THE concept of business cycles is being put to a factual test in work now going on at the National Bureau in preparation for Dr. Wesley C. Mitchell's volume on *Business Cycles—The Rhythm of Business Activity*. All of the important time series

for the United States, England, France and Germany in the National Bureau's collection are being analyzed on a plan designed to show whether they undergo cyclical fluctuations corresponding in number, time and pattern to the fluctuations in the activity of general business.

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The chief steps in the analysis are as follows:

1. A set of "reference dates," based on the National Bureau's *Business Annals* supplemented by business indexes, is made for each country covered, to show the month and year when economic revivals and recessions occurred. These dates mark, as nearly as may be, the beginning, culmination and ending of successive cycles in business at large. The interval from one revival to the month preceding the next revival is called a "reference cycle."

2. Each series analyzed is broken into "reference-cycle segments" on the basis of this standard set of dates for the country from which the series comes.

3. The average value of the series is computed for each reference-cycle segment, and the original data for each segment are turned into percentages of the proper average. The use of percentages, or relatives, makes it easy to compare with each other the cyclical fluctuations of series different in form—for example, cement production in tons, imports in millions of dollars, unemployment percentages and index numbers of prices. Basing the relatives on average values during reference cycles systematizes comparisons between the cyclical fluctuations of the same series in different cycles and of different series in the same cycle. It also eliminates the greater part of the secular trends. But what may be called the "intra-cycle trend" is purposely left in the relatives to meet certain requirements of the investigation in its later stages.

4. The relatives are examined to see whether they show appreciable and regular seasonal fluctuations. If so, the seasonals are measured and eliminated from the relatives by methods which need not be described here. After this step has been taken, a series is in shape for critical study of its cyclical behavior.

5. This study begins with the cyclical fluctuations characteristic of the individual series—cycles which are no more likely to coincide precisely with the reference cycles in timing than the price fluctuations of a single commodity are likely to agree precisely in timing with the changes in an index number. A few series show no cycles at all; others show cycles which diverge widely from the standard pattern. These "non-conforming" cases are especially interesting theoretically. But most series "conform" more or less closely. Whatever cycles are found in a series are marked off. Their turning points are compared with the reference revivals and recessions, and the leads and lags are measured. Other measurements are made to show the duration of the phases of expansion and contraction, the percentages of rise and fall during these phases, and the percentages of change in the average values of the original data from one cycle to the next. All these measurements, to repeat, concern the cycles found in the series itself, though comparisons are made whenever possible with the corresponding characteristics of the reference cycles.

6. A second set of measurements concerns the behavior of the series during the cycles in business at large as marked off by the reference dates. Each reference cycle is treated as a unit. Whether long or short it is subdivided into eight segments to facilitate close examination of the cyclical behavior of different series on a uniform basis. The first point at which an observation is wanted is the reference date for revival. To minimize the influence of random variations, this observation is based on an average of the relatives in the three months centering upon this reference date. Then the period of expansion—the interval between revival and recession—is broken into three parts and observations are taken of the average standing of the relatives in the first, the middle and the last third. A fifth observation is taken at the reference date for recession—again a three-months' average centered on the date in question. The period of contraction—the interval between recession and the next revival—is treated like the period of expansion; that is, the contraction is broken into thirds and represented by three observations. That completes the eight observations; but a ninth is added to link each cycle into its successor—an average of relatives in the three months centering on the next revival date.

Every series covering a given reference cycle is spread out on this rigid framework and treated in the same way. When the nine observations of the average standing of the relatives can be made for a sufficient number of reference cycles, we obtain a fair picture of how a series behaves during revivals, expansions, recessions and contractions in business at large.

When applied to a large number of time series, this scheme provides a searching test of the notion that business cycles are a genuine species of economic phenomena. If these cycles were the figment of a stereotyping imagination, little similarity could be expected either in the behavior of any one series in different reference cycles, or in the behavior of different series in any one reference cycle.

Besides settling this issue concerning the reality of business cycles, the scheme makes it possible to determine what activities represented by time series do, and what do not, participate in the cyclical expansions and contractions of business at large; whether the cyclical responses of the conforming series are regular or intermittent, and whether they are mild or violent.

Presented in charts, the results show the "pattern" of the cyclical waves characteristic of different activities during reference cycles—provided, of course, that the series recording these activities cover enough cycles and show sufficient regularity of cyclical behavior to warrant confidence in the representative value of the averages. The patterns of different series have significant points of similarity and difference, which can often be connected with our non-statistical knowledge of the activities represented.

On the same proviso, the scheme also gives an approximate solution of the baffling problem how to segregate the cyclical fluctuations typical of an economic process from the random perturbations which are constantly affecting it.

In certain very long time series historical changes in cyclical behavior can be investigated. If the series runs back to the 1870's, it is possible to ascertain with considerable assurance how cyclical behavior is modified by a shift from a secular decline to a secular advance in the level of wholesale prices.

Further, the picture of the behavior of a series during reference cycles can be compared with the corresponding picture, taken at an earlier stage of the analysis, showing its behavior between its own low, high, low turning points. The differences between these two views are frequently striking, and always instructive.

Indeed, the uses of the device seem to be limited only by the time-span and quality of the original data. Of course, many series cover so brief a period that only the most tentative conclusions can be based upon any analysis of their cyclical behavior.

So far, Dr. Simon Kuznets, in charge of the statistical work, and his assistants have analyzed 265 American, English, German and French series in the manner described. To illustrate the pro-

cedure and the results, it is best to use the American series which covers the longest period in monthly form—bank clearings in New York City.

Table 1 gives the original data of this series—average daily clearings per month in millions of dollars—for one cycle, selected because it is short. The table also shows the relatives made from the original data, both before and after they were adjusted for seasonal variations. From the adjusted relatives, supplemented at each end by similar figures for another month or two (needed for the three-months averages centered on the reference dates for revivals), the nine observations called for by the scheme were made for the 1919-21 reference cycle.

TABLE 1
Bank Clearings in New York City by Months in one
Reference Business Cycle
MAY 1919 TO SEPTEMBER 1921

	Average Daily Clearings in Millions of Dollars	Percentages of Average Daily Clearings During the Cycle.	
		Before Adjustment For Seasonal Variations	After Adjustment For Seasonal Variations
1919			
May	609.1	97	95
June	658.5	105	98
July	705.6	112	113
August	629.9	100	111
September ..	653.7	104	108
October	765.0	122	114
November ..	752.9	120	117
December ...	773.5	123	121
1920			
January	748.7	119	112
February ...	625.7	99	106
March	720.4	115	120
April	726.7	116	115
May	636.8	101	99
June	683.6	109	102
July	639.8	102	103
August	577.0	92	103
September ..	620.1	99	103
October	666.5	106	99
November ...	647.8	103	100
December ...	676.8	108	106
1921			
January	599.1	95	89
February ...	518.9	82	88
March	538.1	86	90
April	517.9	82	81
May	511.2	81	79
June	561.6	89	83
July	495.3	79	80
August	469.5	75	84
September ..	502.6	80	83
Average for Cycle	628.7	100	100

Table 2 assembles observations of this character made from a series of tables like the sample given—one table for each cycle. By studying the full array, one can judge how regularly bank clearings in New York City have undergone cyclical expansions and contractions corresponding to the waves of rising and falling activity in American business.

The averages for the 18 reference cycles covered

TABLE 2

Bank Clearings in New York City at Nine Stages in Each Reference Business Cycle
JANUARY 1855 to JULY 1924

Average Standing in Percentages of the Average Volume of Clearings in Each Reference Cycle

REFERENCE BUSINESS CYCLES			AVERAGE STANDING DURING								
Revival	Recession	Revival	Three months centered on 1st revival	Expansion			Three months centered on recession	Contraction			Three months centered on next revival
				First third	Middle third	Last third		First third	Middle third	Last third	
1. Jan. 1855	July 1857	Jan. 1859	76	89	108	132	142	83	77	92	99
2. Jan. 1859	Nov. 1860	July 1861	94	96	103	115	111	91	86	78	70
*3. July 1861	May 1865	Jan. 1868	23	34	81	124	110	126	155	122	132
4. Jan. 1868	July 1869	Jan. 1871	89	92	108	119	124	106	87	87	84
*5. Jan. 1871	Nov. 1873	Apr. 1879	105	125	138	124	73	90	81	87	128
6. Apr. 1879	Apr. 1882	June 1885	83	88	110	126	114	114	97	69	66
7. June 1885	Apr. 1887	May 1888	78	98	100	106	107	105	98	90	97
8. May 1888	Aug. 1890	June 1891	90	92	103	106	112	108	91	94	92
9. June 1891	Feb. 1893	July 1894	100	108	117	109	124	107	76	74	75
10. July 1894	Jan. 1896	July 1897	85	88	100	110	107	102	101	100	127
11. July 1897	July 1899	Jan. 1901	72	81	81	118	120	119	104	105	142
12. Jan. 1901	Oct. 1902	Sept. 1904	100	124	98	111	119	98	90	83	106
13. Sept. 1904	June 1907	July 1908	82	100	110	111	96	101	68	76	91
14. July 1908	Feb. 1910	Feb. 1912	86	96	102	118	112	99	92	99	100
15. Feb. 1912	Feb. 1913	Jan. 1915	105	112	102	114	111	100	105	80	88
*16. Jan. 1915	Sept. 1918	May 1919	51	75	104	110	116	116	122	123	136
17. May 1919	Feb. 1920	Oct. 1921	95	106	111	117	113	107	98	83	82
18. Oct. 1921	June 1923	Aug. 1924	85	96	101	101	96	88	102	109	115
Averages											
All 18 cycles			83.2	94.4	104.3	115.1	111.5	103.3	96.1	91.7	101.7
Average deviations			13.1	12.9	8.0	6.3	9.0	8.7	13.0	12.2	19.4
All except the three starred cycles			88.0	97.7	103.6	114.2	113.9	101.9	91.5	87.9	95.6
Average deviations			7.6	8.2	5.7	6.1	7.9	7.1	8.7	9.8	15.6
Average intervals between stages, in months											
18 cycles				4.3	7.9	8.3	4.7	3.7	6.5	6.9	4.1
15 cycles				4.0	6.9	7.3	4.2	3.2	5.6	6.0	3.6
Average change per month											
18 cycles				+2.8	+1.0	+1.4	-0.6	-3.3	-1.5	-0.5	+2.4
15 cycles				+2.8	+0.7	+1.5	-0.1	-3.8	-2.0	-0.5	+2.1

by the record show a clear-cut cycle of the typical sort. The pattern of this cycle is presented to the eye by the unbroken line of Chart 1. From 83 at the initial revival, clearings mount through the period of expansion to 115 in its closing third; then they decline to 92 at the close of contraction, and bound up 10 points by the next revival. The amplitude of the wave is rather large—a 32-point rise and a 23-point fall. But the contraction is really a more violent movement, when allowance is made for its briefer duration, than the expansion. That fact is brought out by the figures at the bottom of the table showing average change per month. The culmination of the New York clearings cycle comes earlier than in most series—during the final third of expansion instead of in the three months centering on recession. Finally, there is a well-marked, rising intra-cycle trend. All of these characteristics conform to what we know from other sources about New York Clearings.

But is this average cycle representative? The

average deviations given at the bottom of the table are moderately reassuring. In comparison with other economic measures the present arrays cluster fairly well around their central tendencies. Yet a cycle-by-cycle scrutiny reveals three cycles which diverge materially from the pattern of the average; 1861-67, 1871-79 and 1915-19. In the 1861-67 cycle, New York clearings rose with only a trifling break at recession to the middle third of contraction. In the 1915-19 cycle they rose to the very end of contraction. Of course the exceptional character of these two cases is due to the price inflations of the Civil War and the World War. It is interesting to find how much alike was the behavior of New York clearings during war periods separated by half-a-century packed with change. The third divergent cycle is interesting for quite different reasons. A number of the series so far analyzed show occasional "extra cycles"—that is, now and then they pass through two complete cycles within the time covered by a single reference cycle. Extra cycles seem to be commonest in series which record

TABLE 3

Bank Clearings in New York City at Nine Stages in Each Presidential Period
NOVEMBER 1860 to OCTOBER 1924
Average Standing in Percentages of Average Volume of Clearings in Each Presidential Period

PRESIDENTIAL PERIODS	AVERAGE STANDING DURING									
	Three months centered on election	Successive Thirds of the First Two Years			Three months centered on mid-point of period	Successive Thirds of the Last Two Years			Three months centered on next election	
		First third	Middle third	Last third		First third	Middle third	Last third		
1. Nov. 1860 — Oct. 1864	56	43	41	64	88	111	157	191	210	
2. Nov. 1864 — Oct. 1868	99	93	94	112	133	92	98	109	128	
3. Nov. 1868 — Oct. 1872	114	114	101	86	82	95	97	108	125	
4. Nov. 1872 — Oct. 1876	166	142	96	92	97	98	88	80	83	
5. Nov. 1876 — Oct. 1880	77	80	86	79	82	90	134	139	174	
*6. Nov. 1880 — Oct. 1884	107	120	113	110	118	89	90	72	63	
*7. Nov. 1884 — Oct. 1888	85	76	104	103	116	112	101	102	102	
8. Nov. 1888 — Oct. 1892	90	98	102	108	99	90	102	99	96	
9. Nov. 1892 — Oct. 1896	119	128	88	84	86	98	106	98	100	
*10. Nov. 1896 — Oct. 1900	63	63	88	88	100	134	124	110	136	
*11. Nov. 1900 — Oct. 1904	87	119	100	112	107	98	86	91	128	
*12. Nov. 1904 — Oct. 1908	100	101	109	115	111	103	84	87	101	
*13. Nov. 1908 — Oct. 1912	93	99	114	97	90	92	96	102	107	
14. Nov. 1912 — Oct. 1916	98	90	87	75	62	84	93	81	121	
15. Nov. 1916 — Oct. 1920	63	87	85	88	91	98	125	117	113	
16. Nov. 1920 — Oct. 1924	108	95	90	103	98	103	96	114	134	
Averages										
All 16 periods	95.3	96.7	93.6	94.7	97.5	99.2	104.8	106.2	120.0	
Average Deviations	18.6	18.4	11.2	12.8	12.8	8.4	15.2	18.0	24.4	
Six Starred Periods corresponding roughly to reference cycles										
Average Deviations	10.8	17.9	7.3	8.2	8.0	12.2	10.4	10.7	17.5	
Average intervals between stages, in months										
		4.0	7.5	8.0	4.5	4.0	7.5	8.0	4.5	
Average change per month										
16 periods		+3.1	+0.4	-0.4	+0.1	+0.6	+0.4	+0.8	+0.2	
6 starred periods		+3.9	+1.8	+1.1	-0.05	+0.6	-0.6	-1.0	-0.4	

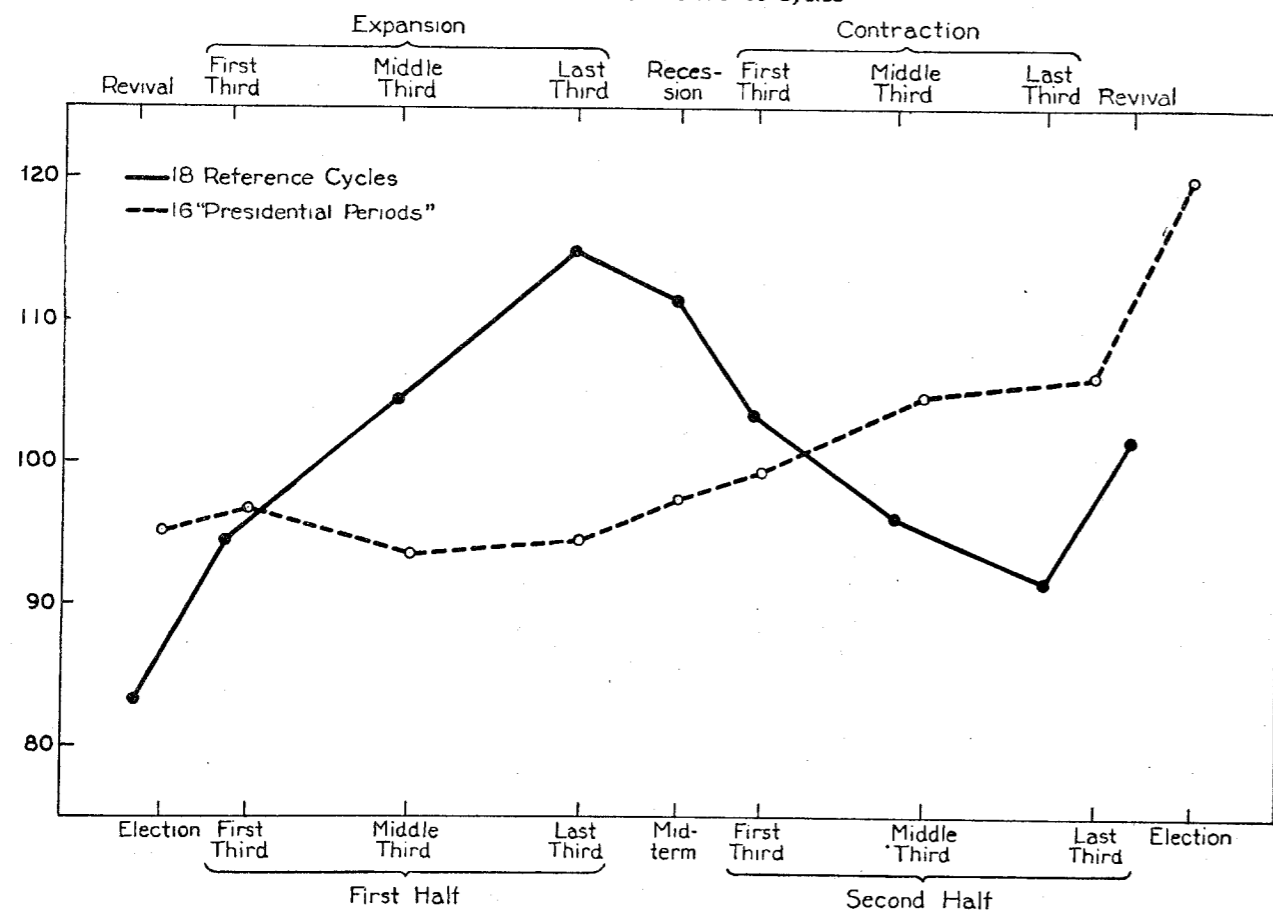
TABLE 4

Comparison of the Average Standing of New York Bank Clearings at Nine Stages of Six Reference Business Cycles and of Six Presidential Periods which Correspond Roughly to Each Other.

	AVERAGE STANDINGS AS GIVEN IN TABLES 2 AND 3									
	Revival or Election	Expansion or First Half			Recession or Mid-point	Contraction or Last Half			Revival or Election	
		First third	Middle third	Last third		First third	Middle third	Last third		
Cycle Apr. '79—May '85	83	88	110	126	114	114	97	69	66	
P. P. Nov. '80—Oct. '84	107	120	113	110	118	89	90	72	63	
Cycle June '85—Apr. '88	78	98	100	106	107	105	98	90	97	
P. P. Nov. '84—Oct. '88	85	76	104	103	116	112	101	102	102	
Cycle July '97—Dec. '00	72	81	81	118	120	119	104	105	142	
P. P. Nov. '96—Oct. '00	63	63	88	88	100	134	124	110	136	
Cycle Jan. '01—Aug. '04	100	124	88	111	119	98	90	83	106	
P. P. Nov. '00—Oct. '04	87	119	100	112	107	98	86	91	128	
Cycle Sept. '04—June '08	82	100	110	111	96	101	68	76	91	
P. P. Nov. '04—Oct. '08	100	101	109	115	111	103	84	87	101	
Cycle July '08—Jan. '12	86	96	102	118	112	99	92	99	100	
P. P. Nov. '08—Oct. '12	93	99	114	97	90	92	96	102	107	
Averages										
Reference Cycles	83.5	97.8	100.2	115.0	111.3	106.0	91.5	87.0	100.3	
Presidential periods	89.2	96.3	104.6	104.1	107.0	104.7	96.8	94.0	106.2	
Average deviations										
Reference Cycles	6.3	9.5	7.2	5.7	6.6	7.0	8.4	11.0	15.8	
Presidential periods	10.8	17.2	7.3	8.2	8.0	12.2	10.4	10.7	17.5	
Average intervals between stages in months										
Reference Cycles		4.4	8.2	8.6	4.7	3.7	6.7	7.0	4.1	
Presidential periods		4.0	7.5	8.0	4.5	4.0	7.5	8.0	4.5	
Average change per month										
Reference Cycles		+3.5	+0.02	+1.9	-0.6	-1.3	-2.7	-0.3	+4.1	
Presidential periods		+1.8	+1.1	-0.05	+0.6	-0.6	-1.0	-0.4	+3.9	

CHART 2

Average Behavior of Bank Clearings in New York City during 16 "Presidential Periods," 1860-1924 and during 18 Reference Cycles in Business Activity, 1855-1924. Based upon Tables 2 and 3
Time Scale for Reference Cycles



The curves connect averages of relatives which are based on the average volume of clearings during each presidential period and during each reference cycle respectively. Both presidential periods and reference cycles are sub-divided into nine stages, as indicated by the time scales at the top and bottom of the chart. The average standings are plotted at the centers of the stages which they cover. Copyright 1929, National Bureau of Economic Research, Inc.

financial operations. New York City clearings indulged in an extra cycle during the exceptionally long contraction in general business activity which followed the panic of 1873 and lasted from November of that year to March, 1879—a period of 77 months. Hence, when we stretch the New York relatives for these years over the reference cycle for 1871-79, we find two waves, a violent wave ending with the panic and a mild wave during the depression.

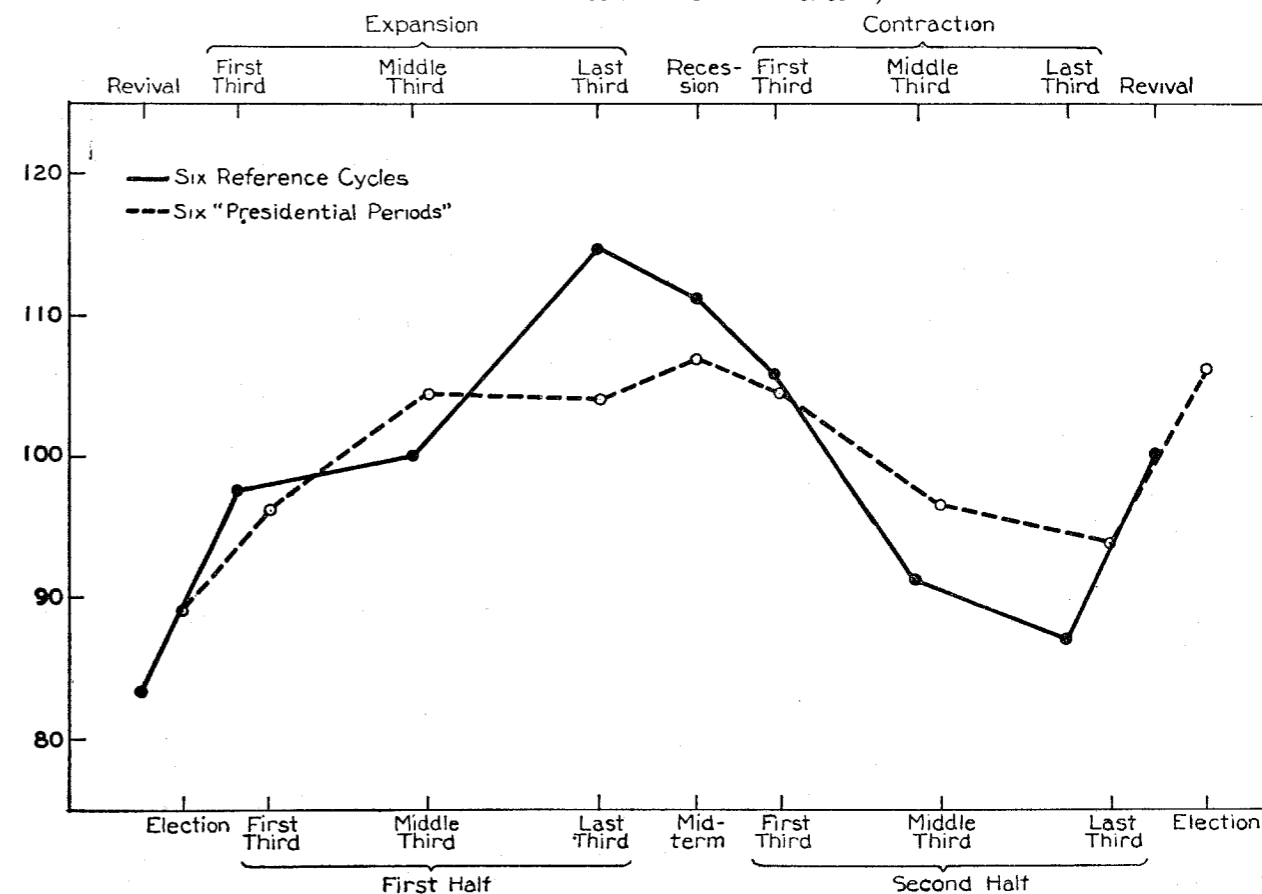
If one wishes to get from Table 2 a picture of the average cycle in New York clearings unaffected by great wars and extra-cycles (a rarer disturbing factor in this series than wars), it is best to omit the three reference cycles just discussed, and strike averages for the remaining 15. Such averages are given in the table. They show a more evenly balanced cycle with a flatter top, and a fall just equal to the rise—26 points, but once more the fall is a more violent readjustment in a briefer period. It is noteworthy that the average devia-

tions run on a lower level than in the first set of results. A glance at Chart 1, where the second averages are represented by a dotted line, shows how the omission of the three unusual cases modifies the pattern.

By way of illustrating what sort of results might be expected if our scheme of reference dates did not fit actual business fluctuations; or if the fluctuations of a given series did not agree approximately in time with our reference dates, we have experimented with another set of reference dates which are sometimes said to have great significance for the country's prosperity—namely, presidential elections. Relatives of New York City clearings have been worked out on the basis of average values during "presidential periods" running from one election to the next. These relatives have been averaged for the three months centering on election months, and for the three months centering on the middle months of the periods. Also the intervals

CHART 3

Average Behavior of New York Bank Clearings during Six Reference Cycles in Business Activity and during Six "Presidential Periods" which Corresponded roughly to Each Other. Based upon Table 4.
Time Scale for Six Reference Cycles



The curves connect averages of relatives which are based on the average volume of clearings during each presidential period and during each reference cycle, respectively. Both presidential periods and reference cycles are broken into nine stages, as indicated by the time scales at the top and bottom of the chart. The average standings are plotted at the centers of the stages they cover. Copyright 1929, National Bureau of Economic Research, Inc.

from an election to the middle month of a period, and from the middle month to the next election have been broken into thirds, and average standings computed for these segments. In short, the whole process followed in making Table 2 has been imitated in making Table 3. The times covered do not differ much. The average length of the 18 reference cycles is 46 months, as against the uniform 48-month duration of the 16 presidential periods.

The averages drawn from Table 3 show no wave motion. They decline slightly in the first half of the presidential periods and then rise decidedly. The average deviations are more than a third greater than in Table 2, and a period-by-period comparison shows a jumble of unlike movements quite different from the common pattern traceable with minor variations in all but three of the cycles in Table 2. The one significant feature of the averages in Table 3 is the intra-period trend. That comes out more clearly than in Table 2 just because

the cycles have been eliminated by averaging together periods which, as a group, have no economic characteristic in common except a prevailing tendency toward growth.

Chart 2 gives a graphic presentation of the averages for all 18 cycles covered by Table 2 and all 16 presidential periods covered by Table 3. The contrast between the two curves requires no comment.

Yet a period-by-period study of Table 3 discovers a more or less typical wave pattern in six of the presidential periods. These turn out to be presidential periods which corresponded roughly to reference cycles. Table 4 compares the fluctuations of New York clearings in these six pairs of cases. In five pairs out of the six, the wave pattern is decidedly clearer in the reference cycles than in the presidential periods. In the remaining pair—1900-01 to 1904—there is little to choose between the two sets of figures. The early months of this