Volume Title: Measuring Business Cycles

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Volume Publisher: NBER

Volume ISBN: 0-870-14085-X

Volume URL: http://www.nber.org/books/burn46-1

Publication Date: 1946

Chapter Title: Stable and Irregular Features of Cyclical Behavior

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Chapter URL: http://www.nber.org/chapters/c2991

Chapter pages in book: (p. 472 - 514)

CHAPTER 12

# Stable and Irregular Features of Cyclical Behavior

THE TWO preceding chapters suggest that irregular changes in cyclical behavior are far larger in scope than secular or cyclical changes. This tentative finding will not be questioned by students who believe that it is vain to strive after a general theory of crises, or depressions, or business cycles. Their argument is that each of these episodes must be explained by the peculiar combination of conditions prevailing at the time, and that these combinations differ endlessly from one another. Students starting from this theoretical position may see little value in statistical averages of the sort we use to describe cyclical behavior. If the episodic features of historical business cycles are the thing of real importance, averages that conceal the episodic movements are futile if not mischievous constructions—as futile and mischievous as general theories of business cycles. In this chapter we attempt to indicate to what extent averages are justifiably subject to such criticisms.

## I Individual Features of Successive Cycles

Every realistic investigator recognizes that business activity at any time is influenced by countless 'random' factors. Some arise from the processes of nature, some from agreements or quarrels among men, some from changes in governmental policy, some from discoveries or inventions—the list of sources is indefinitely long. Some random factors influence directly only a single enterprise; e.g., a new method of keeping accounts, a fire, or the loss of a key employee. Others impinge directly on a whole industry or locality; e.g., unionization of employees, a change in fashion, a new building code, or tariff, or tax on real estate. Still others influence all or most business enterprises of a country, such as a change in the currency system, a war, a general strike. Some 'disturbances' pass quickly, others linger for several years; some exercise a slight and some a potent influence; some affect agents that 'respond' quickly, others affect agents that 'respond' slowly; some tend to stimulate, others to depress business activity, while many are stimulating in certain directions and depressing in others. A cyclical expansion in general business may be curtailed by 'unfavorable' random factors potent enough to overcome the cyclical forces making for further expansion —such as the respending of incomes that are themselves increasing, the accumulation of stocks necessitated by a growing volume of business, new investments in plant fostered by expanding markets and general optimism. But a cyclical expansion may be curtailed also by 'favorable' random factors that intensify business activity and so accelerate the development of whatever stresses bring on a recession.

Each specific and business cycle is therefore an individual differing in countless ways from every other. But what features of a business or specific cycle are 'peculiar', and the ways in which they are 'peculiar', cannot be determined without reference to some 'norm'. Those who accept an episodic theory of business cycles cannot escape having notions of what is 'usual' and what is 'unusual' about any given cycle. By striking averages

TABLE 176
Cyclical Measures of Pig Iron Production and Prices
United States, 1879–1933

| Dates of reference cycles | Number of months lead (−) or lag (+) of specific-cycle turns in | | | | Corresponding specific cycles in iron production | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Iron production at reference | | Iron prices[a] at reference | | Duration in months | | | Amplitude[b] of | | | Per month amplitude[b] of | | |
| Upturn–Peak–Trough | P[c] | T[c] | P[c] | T[c] | Expansion | Contraction | Full cycle | Rise | Fall | Rise & fall | Rise | Fall | Rise & fall |
| Mar.79 | | −2 | | | | | | | | | | | |
| Apr. 79–Mar.82–May 85 | +11 | −4 | ... | ... | 49 | 23 | 72 | 64.0 | 24.6 | 88.6 | 1.3 | 1.1 | 1.2 |
| June85–Mar.87–Apr. 88 | +7 | −1 | ... | ... | 33 | 5 | 38 | 64.8 | 25.5 | 90.3 | 2.0 | 5.1 | 2.4 |
| May88–July 90–May 91 | −2 | −1 | ... | ... | 26 | 11 | 37 | 50.2 | 47.4 | 97.6 | 1.9 | 4.3 | 2.6 |
| June91–Jan. 93–June 94 | −11 | −8 | ... | +9 | 10 | 20 | 30 | 45.4 | 63.7 | 109.1 | 4.5 | 3.2 | 3.6 |
| July 94–Dec. 95–June 97 | −1 | −8 | −2 | 0 | 25 | 11 | 36 | 87.2 | 60.8 | 148.0 | 3.5 | 5.5 | 4.1 |
| July 97–June 99–Dec. 00 | +6 | −2 | +6 | −2 | 38 | 10 | 48 | 76.0 | 30.5 | 106.5 | 2.0 | 3.0 | 2.2 |
| Jan. 01–Sep. 02–Aug. 04 | +9 | −8 | +2 | −1 | 32 | 6 | 38 | 49.0 | 50.0 | 99.0 | 1.5 | 8.3 | 2.6 |
| Sep. 04–May 07–June 08 | +2 | −5 | −4 | +11 | 43 | 6 | 49 | 73.6 | 62.7 | 136.3 | 1.7 | 10.4 | 2.8 |
| July 08–Jan. 10–Jan. 12 | 0 | −13 | −2 | +1 | 24 | 11 | 35 | 78.6 | 41.7 | 120.3 | 3.3 | 3.8 | 3.4 |
| Feb. 12–Jan. 13–Dec. 14 | 0 | 0 | 0 | +4 | 25 | 23 | 48 | 45.0 | 56.8 | 101.8 | 1.8 | 2.5 | 2.1 |
| Jan. 15–Aug. 18–Apr. 19 | +1 | +1 | −13 | +3 | 45 | 8 | 53 | 61.9 | 40.3 | 102.2 | 1.4 | 5.0 | 1.9 |
| May19–Jan. 20–Sep. 21 | +8 | −2 | +8 | +6 | 16 | 10 | 26 | 40.7 | 91.1 | 131.8 | 2.5 | 9.1 | 5.1 |
| Oct. 21–May 23–July 24 | 0 | 0 | −8 | +13 | 22 | 14 | 36 | 108.3 | 58.6 | 166.9 | 4.9 | 4.2 | 4.6 |
| Aug.24–Oct. 26–Dec. 27 | −3 | −1 | −7 | +7 | 24 | 16 | 40 | 36.5 | 18.7 | 55.2 | 1.5 | 1.2 | 1.4 |
| Jan. 28–June 29–Mar.33 | +1 | 0 | 0 | 0 | 20 | 44 | 64 | 50.0 | 148.9 | 198.9 | 2.5 | 3.4 | 3.1 |
| Average | +2 | −3 | −2 | +4 | 29 | 15 | 43 | 62.1 | 54.8 | 116.8 | 2.4[d] | 4.7[d] | 2.9[d] |

[a] Weighted average of the prices of four leading grades of pig iron, derived from publications of the Bureau of Labor Statistics (*Bulletin* through 1931, *Wholesale Prices* thereafter).

[b] In specific-cycle relatives.

[c] P stands for peaks, T for troughs.

[d] Unweighted average.

of cyclical behavior we make such notions more definite. Averages provide standards for judging individual cycles and thus can be no less useful to the episodic theorist than to students who believe that business cycles have enough common features to admit of a general explanation.

How averages help to identify the peculiarities of successive cycles is simply illustrated by the cyclical measures for the American iron industry in Table 176. The cyclical contraction in iron output during 1907–08 was short but violent, the rate of decline exceeding any other contraction in the period covered. The expansion during the War cycle of 1914–19 was exceptionally long but of average amplitude; hence the rate of rise was well below average. The rise in 1924–26 was unusually small for this volatile activity; it was accompanied by one of the briefest rises in pig iron prices on record, and was followed by a cyclical decline in output much milder than usual but about average in duration. The contraction of 1929–33 was the longest and largest on record, but the rate of decline was below average. The upturn in 1933 coincided with upturns in iron prices and general business, in contrast to past cycles when it usually led the former by substantial and the latter by somewhat shorter intervals.

Chart 73 presents a more elaborate illustration. It shows the reference cycles of the seven series discussed in preceding chapters, cycle by cycle, against a background of averages for the fifteen cycles from 1879 to 1933. The average patterns are so plotted in relation to the patterns for single cycles that the standings of the two at the reference peak are vertically aligned. Of course, the chart contains too few series to convey an adequate notion of the special characteristics of successive business cycles. Nevertheless, it illustrates vividly how averages help to spot idiosyncrasies. For example, we see that the rise of the business cycle of 1879–85 was exceptionally long; apparently it was also of larger amplitude than usual and was marked by irregularly declining interest rates; it culminated in a peak level maintained for some months, was followed by a very long contraction, and experienced a money market panic towards the close of the contraction.[1] By contrast the cycle of 1900–04 seems 'normal', but it too has numerous distinctive features. The stock exchange panic of May 1901, associated with the 'corner' in Northern Pacific stock, is reflected in the patterns of both call money rates and share trading. The amplitude of this cycle was milder than average in series relating to the physical volume of business, but larger than average in call money and share trading. Further, contraction seems to have lasted slightly longer than expansion, whereas the opposite relation is the rule. Dozens of peculiarities of other cycles stand out in the chart: the long expansion of 1914–18,

[1] The panic came in May 1884. On the chart it appears merely as a faint rise between stages VII and VIII in call money rates. The standings at these stages are averages based on numerous months, and nearly iron out this violent financial episode. This limitation of the cyclical patterns must be borne in mind; they are an efficient tool for extracting meaning from the raw data, but neither they nor anything else can serve as a substitute for study of the raw data (see Chart 31).

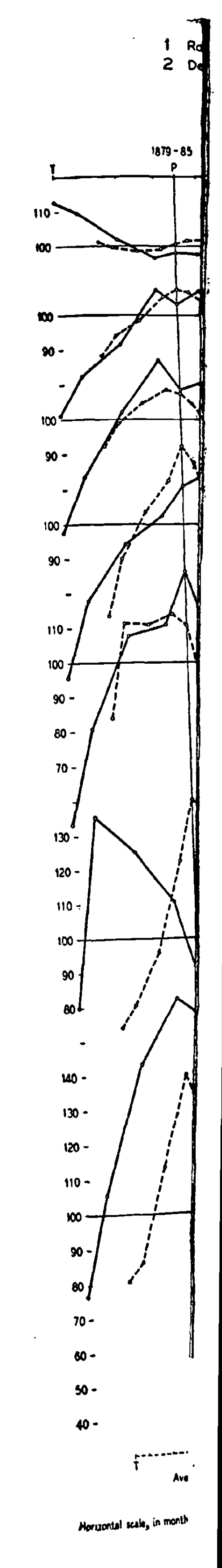
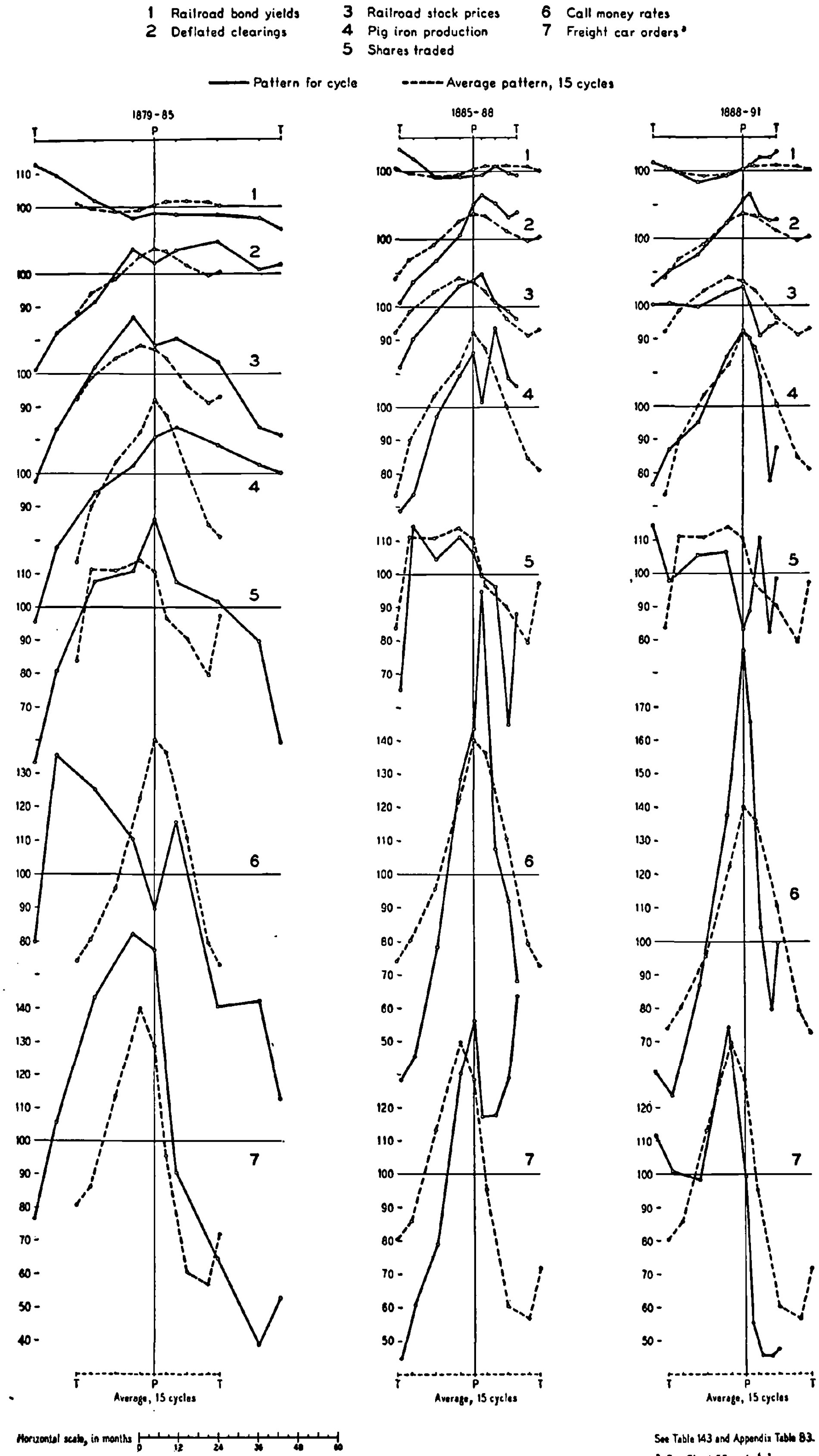


CHART 73

**Patterns of Successive Reference Cycles Compared with Their Average Pattern, 1879–1933**

**Seven American Series**




See Table 143 and Appendix Table B3.

* See Chart 58, note 'a'

CHART 73 (CONT.)

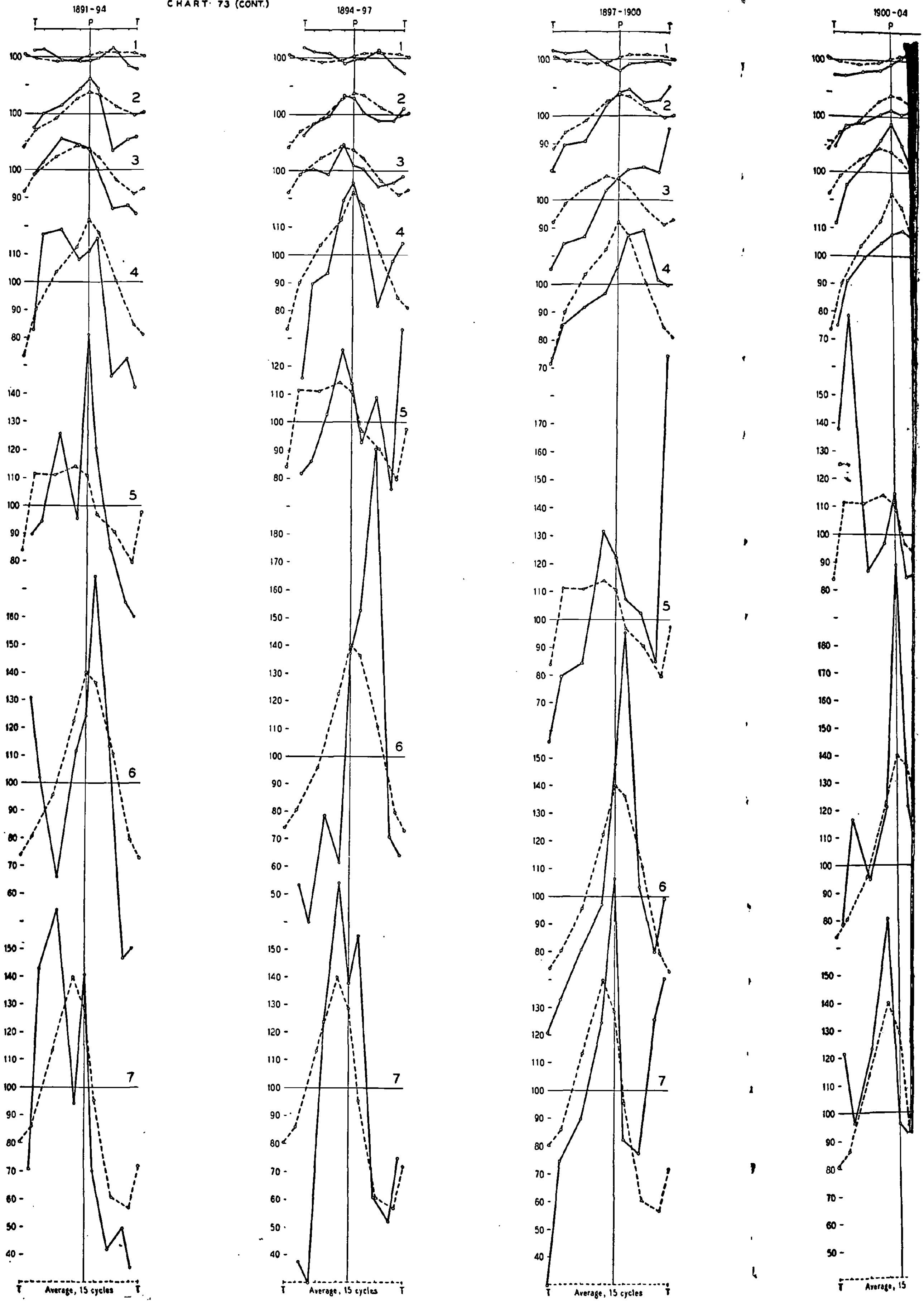


CHART 73 (CONT.)

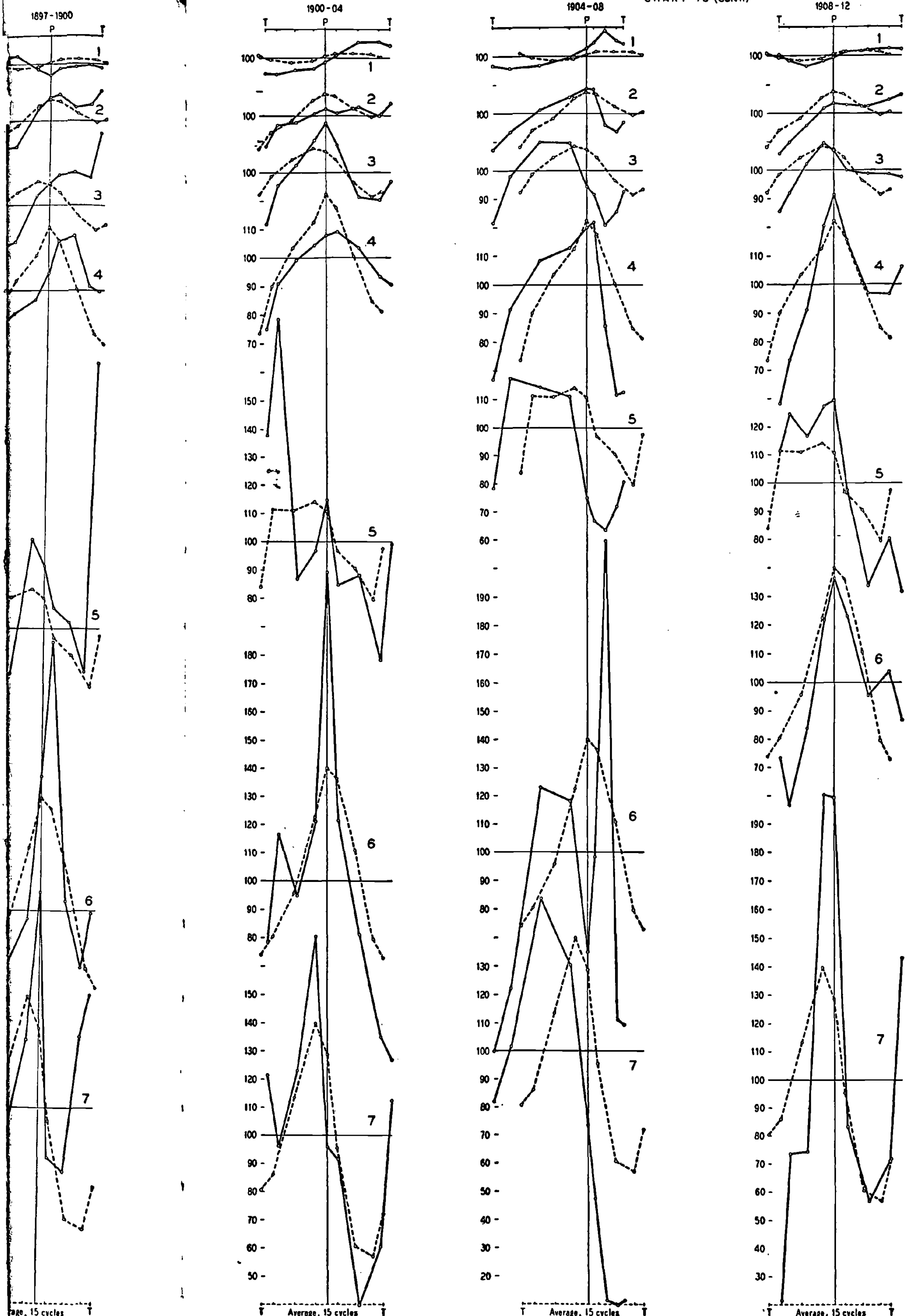


CHART 73 (CONT.)

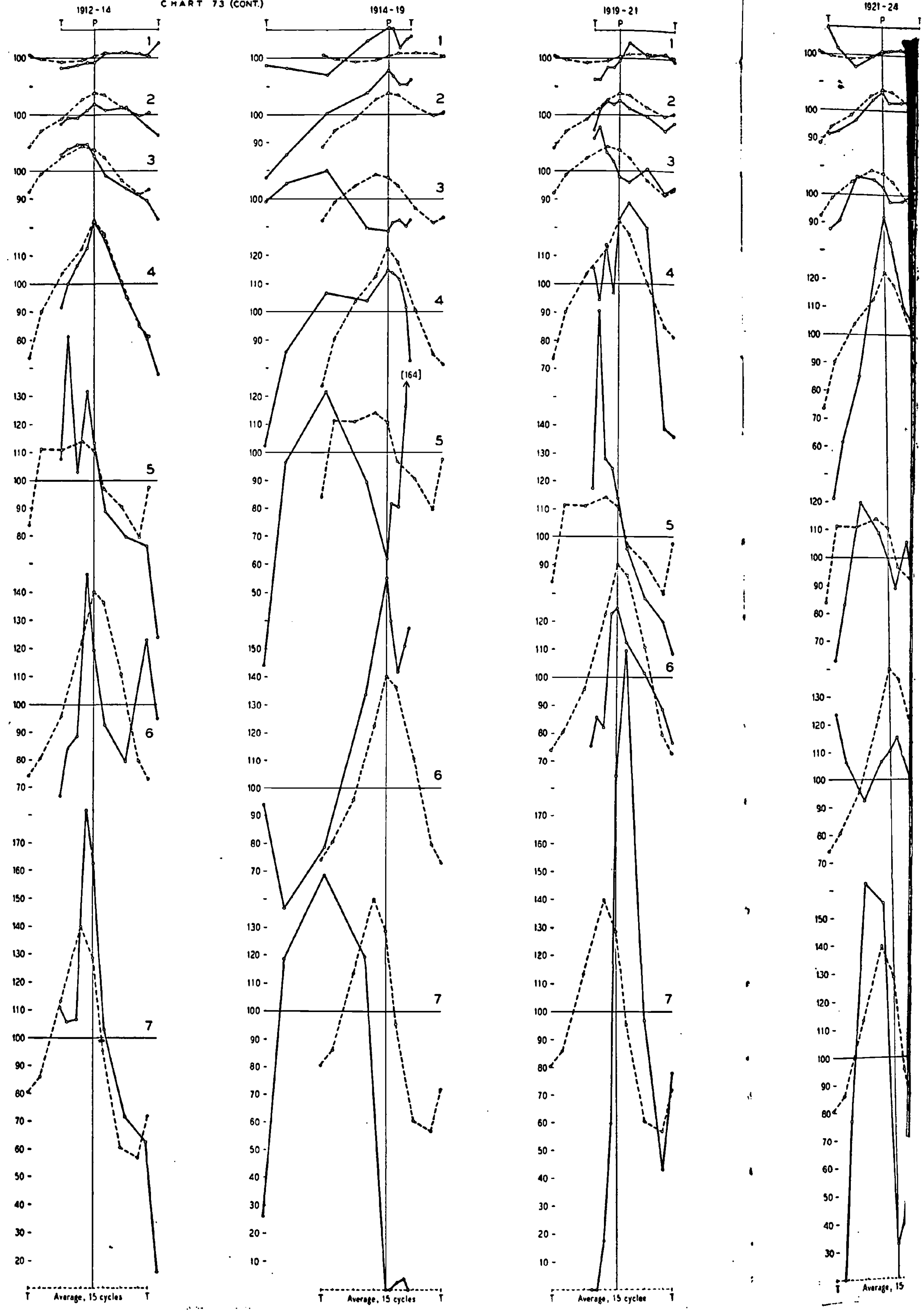
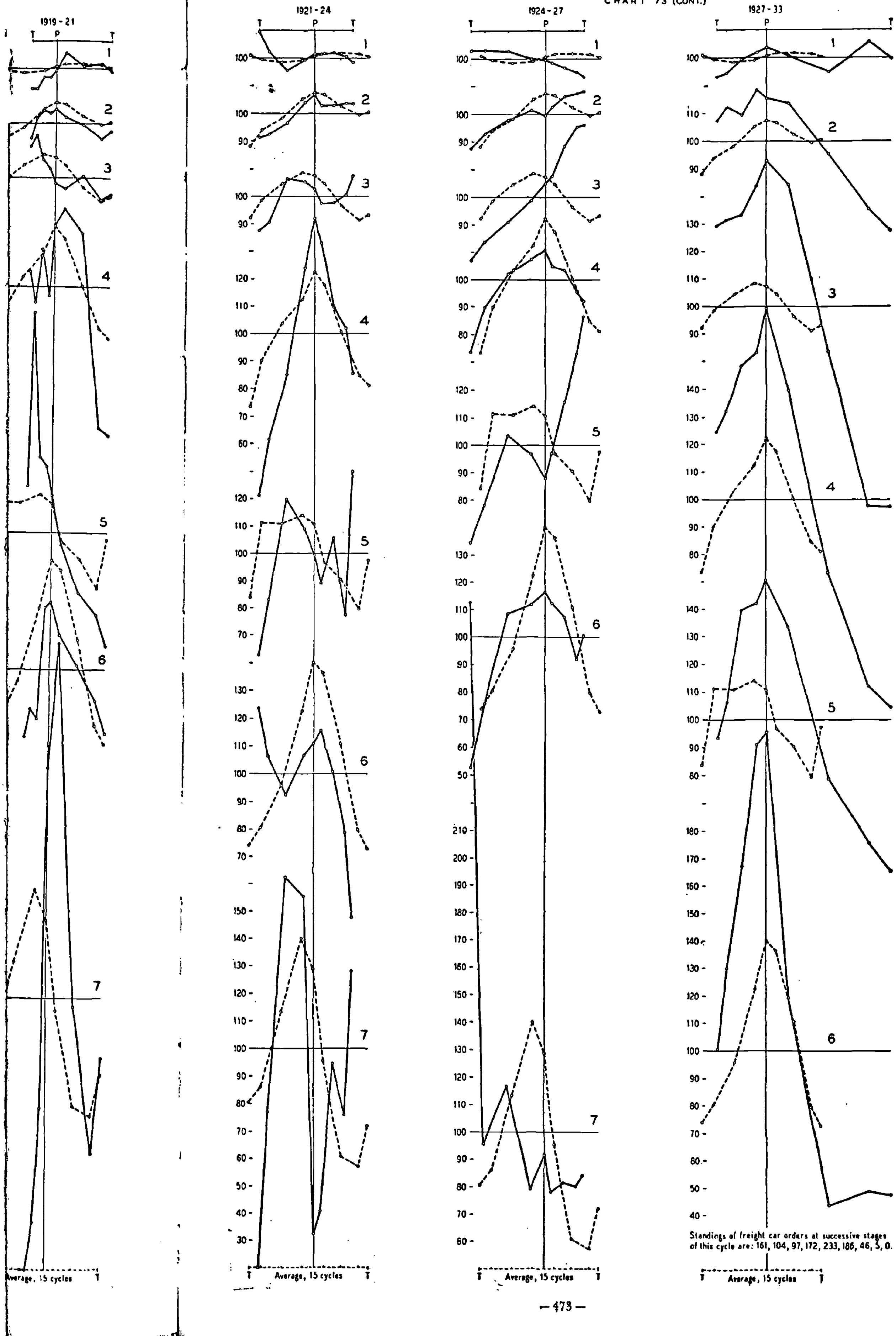


CHART 73 (CONT.)

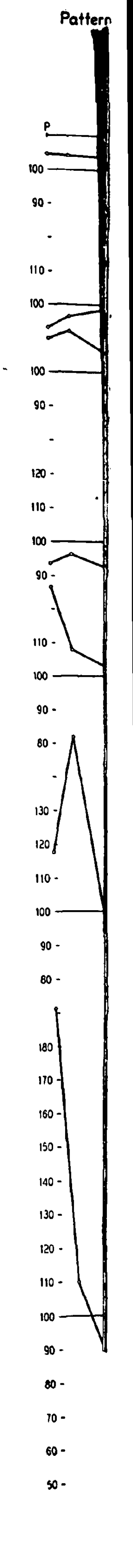


the brief and moderate decline of 1918–19, the long and violent decline of 1929–33, the concerted downturn of different activities in 1929, the widely scattered downturns at the reference peak in 1918, the accentuated decline in the last stage of the 1913–14 contraction, the money market panic in 1914, the insensitivity of security markets to the contraction of 1926–27, and so on.

We come closer to the continuum of business activity by analyzing reference cycles marked off by peaks as well as by troughs.[2] Chart 74 illustrates the point: it is made like Chart 73 except that the average patterns, which are now based on fourteen cycles instead of fifteen, are plotted so that their standings and those of individual cycle patterns at the reference trough are vertically aligned.[3] By coupling contractions with the following instead of the preceding expansions, the recovery phase of business cycles becomes clearer. Several characteristics of the cyclical movements are also made more prominent. In particular the cycle of 1918–20 appears below average in amplitude, and certainly as the shortest we have recognized. Because the contraction and expansion are so short,[4] share trading and railroad stock prices, which usually and also in this cycle lead in revivals and recessions by substantial intervals, appear as 'positive' movements during this peak-to-peak cycle.[5]

## II Stable Features of Successive Cycles

Averages not only provide benchmarks for judging individual cycles; they also indicate roughly what cyclical behavior is characteristic of different activities, and that is their chief value. Of course, a blind use of averages may lead to worthless conclusions. For example, if two related



[2] As yet our standard measurements include only the latter (see pp. 162-3). But the patterns of the present sample of seven series are shown on both a positive and inverted basis, cycle by cycle, in Appendix Tables B3-B4.

[3] It is well to note the dependence of the reference-cycle standings on the base. The reference-cycle standings of single cycles in Chart 74 differ from corresponding standings in Chart 73 because they are computed on different bases; the average patterns differ for this reason and also because Chart 73 includes one more cycle than Chart 74. Of course, a rise between adjacent standings computed on one base will appear as a rise on any other base, and so will a fall. But a rise between adjacent *average* standings computed on one set of bases may appear as a fall when the average standings are computed on another set of bases. Thus the average pattern of call money rates reaches a peak at the same time as the reference peak in Chart 73 but during the first third of contraction in Chart 74. This difference could arise either from the additional cycle covered by Chart 73 or from the different bases employed in the two charts. The former happens to be responsible; when the additional cycle is eliminated from the averages in Chart 73, the fall from the peak to the first third of contraction is replaced by a rise.

Still another factor affects one discrepancy between the patterns of freight car orders in the two charts. The reference expansion in 1924–26 is based in Chart 73 on figures from the *Iron Trade Review* and in Chart 74 on Partington's compilations. See Ch. 9, note 2.

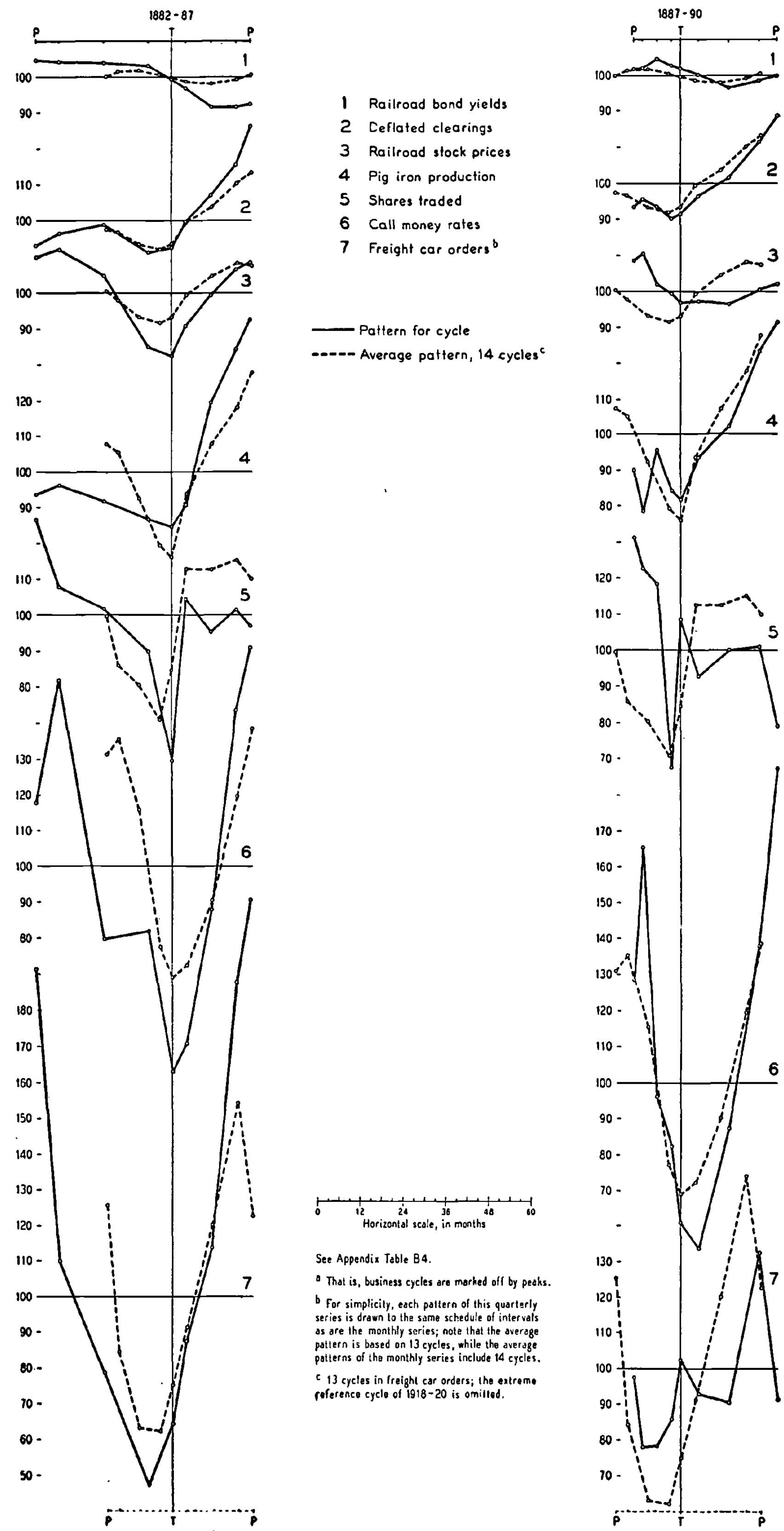
[4] See, however, p. 194.

[5] For a case worked out in detail by the methods illustrated in this section, see our *Bulletin 61*, in which fluctuations in the production of numerous industries during the American business cycle of 1927–33 are compared with averages of preceding cycles.

CHART 74

**Patterns of Successive Reference Cycles Compared with Their Average Pattern, 1882–1929**
**Seven American Series**

(Patterns made on inverted basis[a])

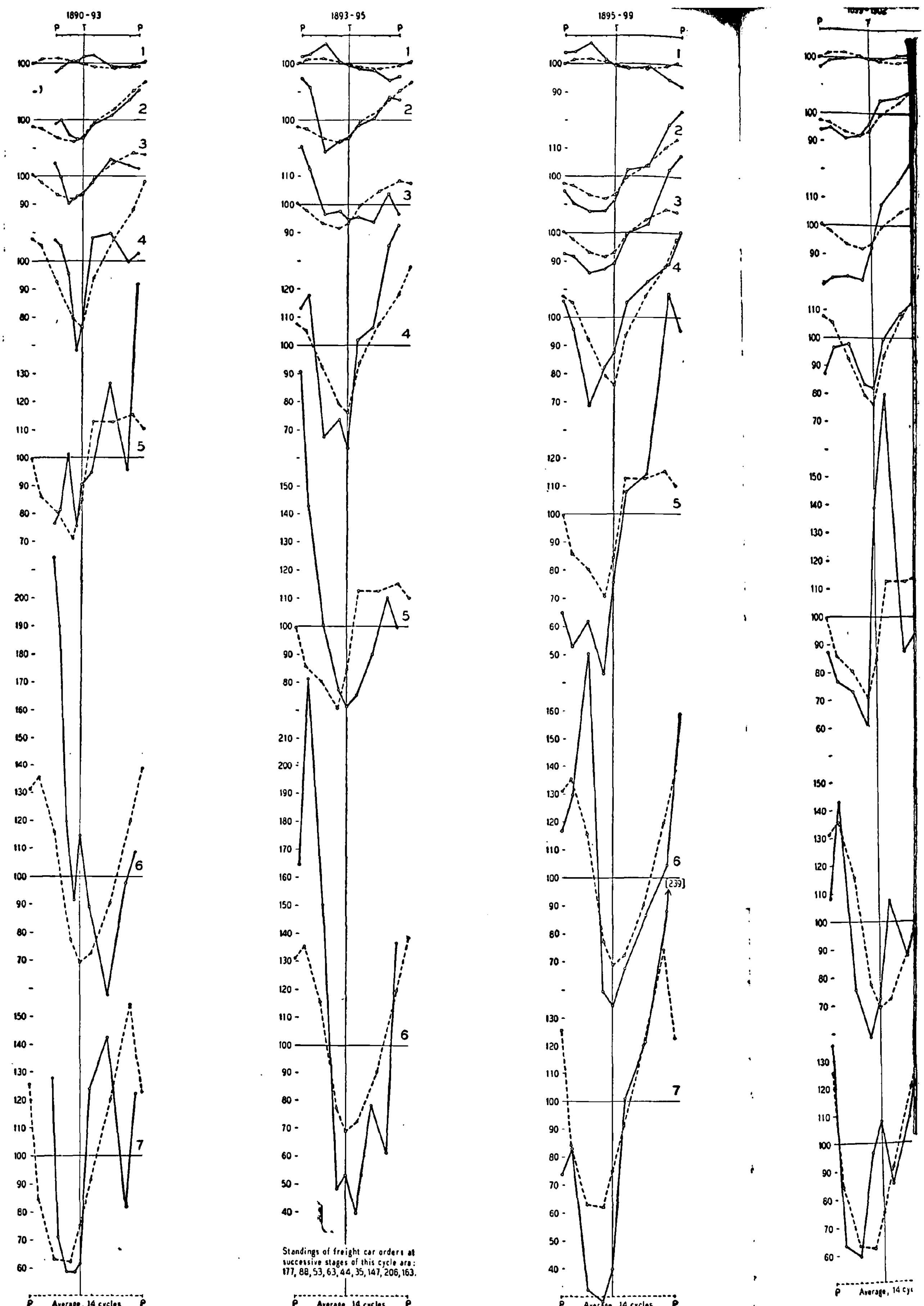


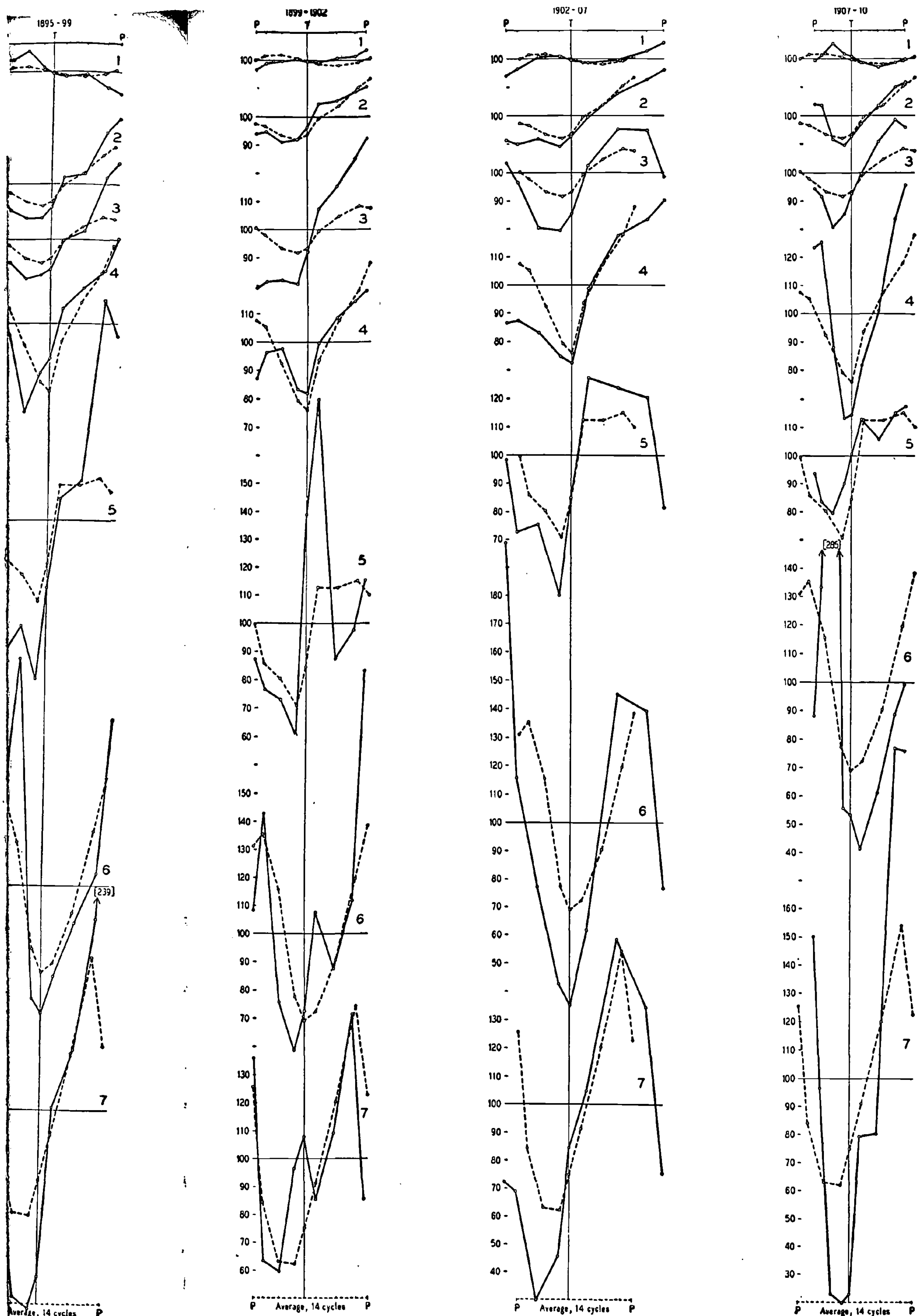

See Appendix Table B4.

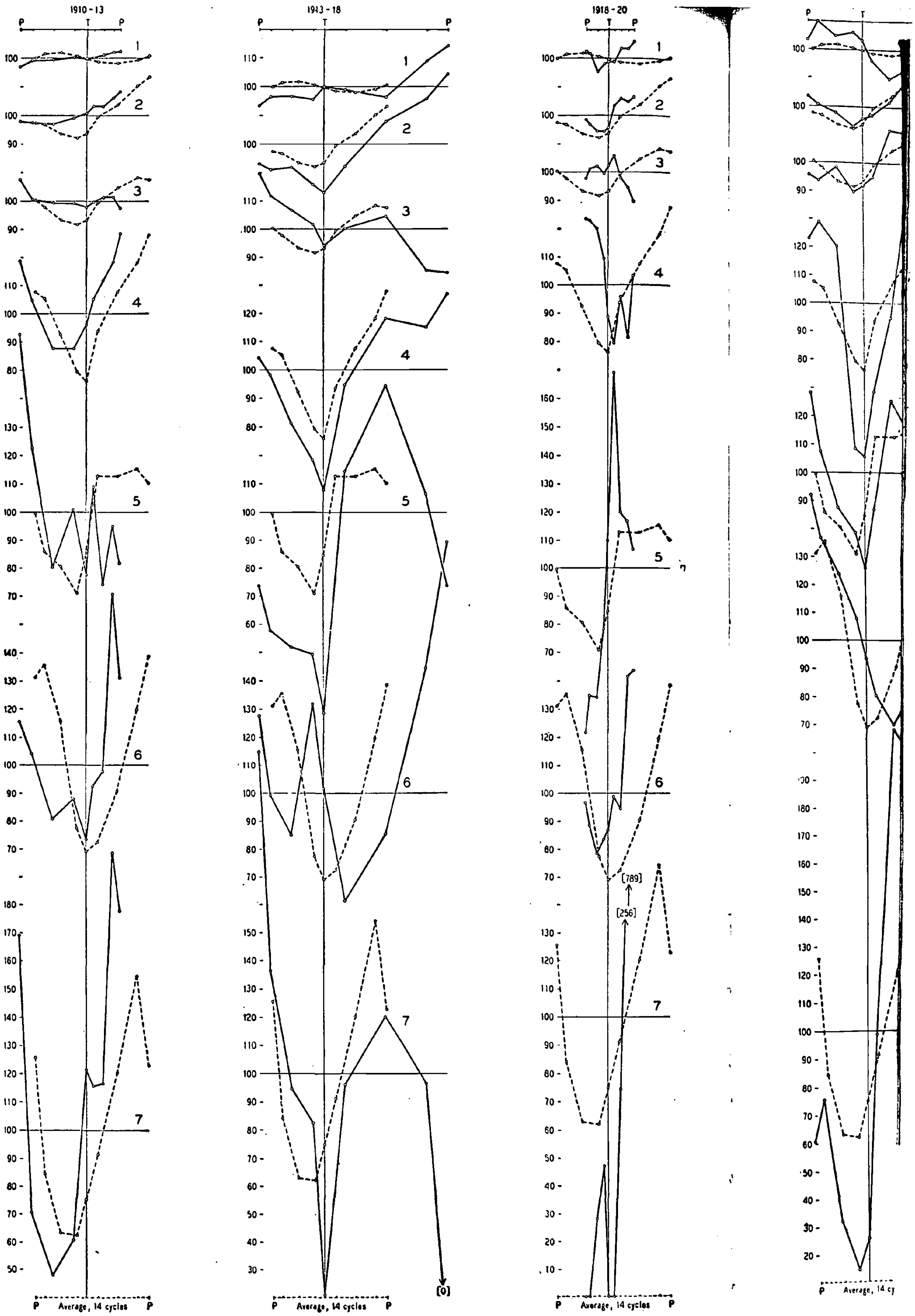
[a] That is, business cycles are marked off by peaks.

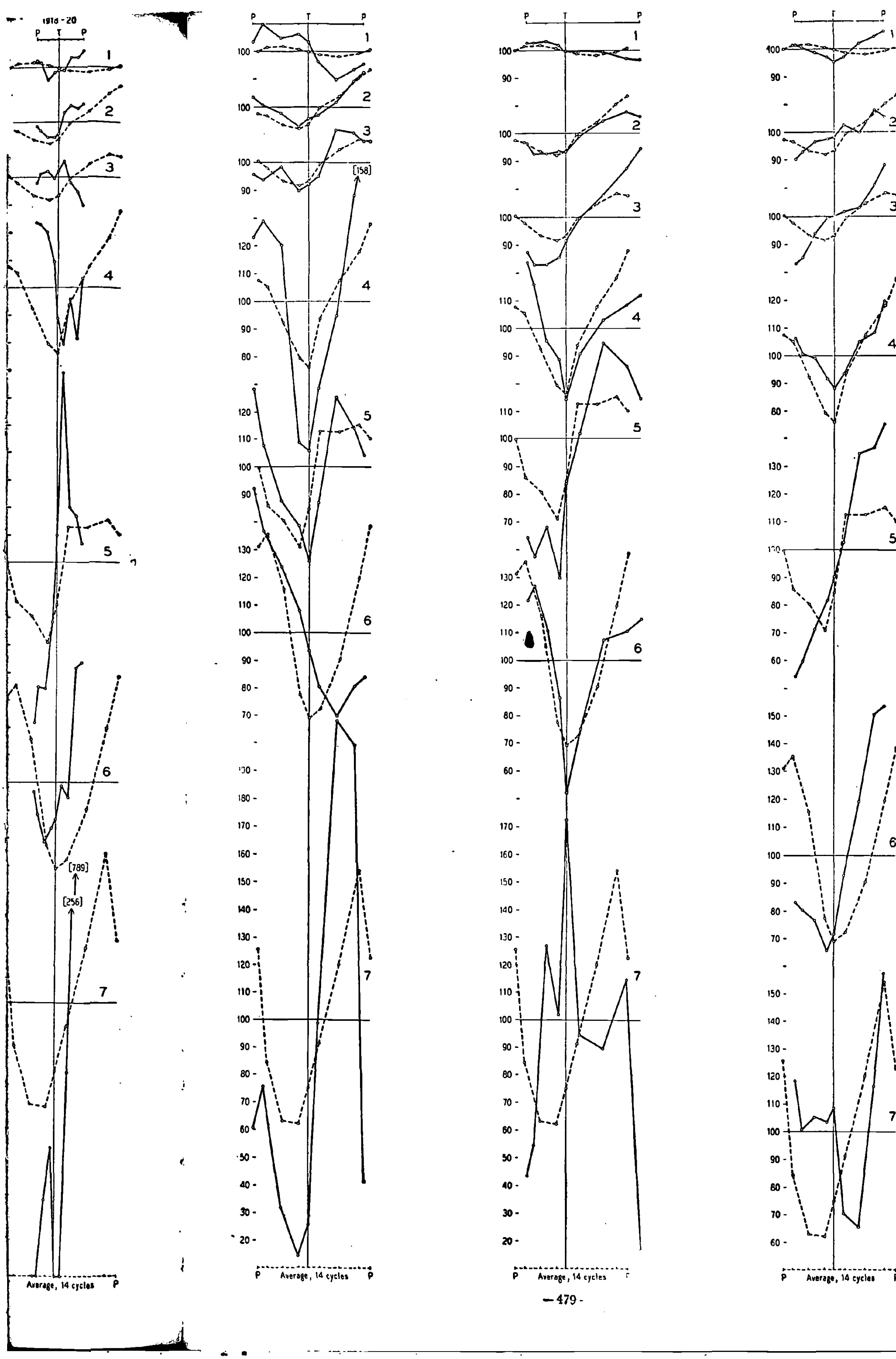
[b] For simplicity, each pattern of this quarterly series is drawn to the same schedule of intervals as are the monthly series; note that the average pattern is based on 13 cycles, while the average patterns of the monthly series include 14 cycles.

[c] 13 cycles in freight car orders; the extreme reference cycle of 1918–20 is omitted.


1890-93
1893-95
1895-99
P T P
Standings of freight car orders at successive stages of this cycle are: 177, 88, 53, 63, 44, 35, 147, 206, 163.
[239]
P Average, 14 cycles P


1895 - 99
1899 - 1902
1902 - 07
1907 - 10
P
T
P
Average, 14 cycles
[239]
[285]


1910 - 13
1913 - 18
1918 - 20
P
T
1
2
3
4
5
6
7
[789]
[256]
[0]
Average, 14 cycles
Average, 14 cycles
Average, 14 cycles


1918-20
P T P
1
2
3
4
5
6
7
[789]
[256]
Average, 14 cycles P
P Average, 14 cycles P
[158]
P Average, 14 cycles P
P Average, 14 cycles P

activities have identical amplitudes in nineteen business cycles and widely different amplitudes in one business cycle, averages covering all twenty cycles would be misleading, as would also deviations of individual cycles from the averages. Again, an investigator who finds that the average timing of two series is approximately the same might infer that their characteristic cyclical timing is really the same, in disregard of a persistent lag of one series during all but one or two freakish cycles. Clearly, averages alone may cause an investigator to declare at times that a persistent difference exists in cyclical behavior when none exists in fact, and to declare at other times that no difference exists when ones does exist in fact.

These dangers are real and it is important to stress them. But it is even more important to recognize that averages, if used judiciously, enable us to describe what cyclical behavior has been characteristic 'in the long run' of different factors in our business economy. Our studies in Chapters 10 and 11 have yielded little evidence that secular, structural, or cyclical changes have impressed their influence strongly on the cyclical behavior of single activities or business as a whole. On the other hand, a great deal of evidence exists that random factors constantly influence business activities. Now and then we find secular, or discontinuous, or cyclical changes in the cyclical behavior of single series; but when that happens we restrict averages to periods or groups of cycles that seem homogeneous. Hence we provisionally regard our averages as rough representatives of the cyclical movements characteristic of individual activities and the average deviations as rough representatives of the variability of cyclical measures around fairly stationary means. So far as certain features are peculiar to the individual cycles of a series, they tend to fade out in averages; that is, the averages tend to emphasize the effects common to most cycles in the group.

Charts 73 and 74 teach more than that the behavior of each series differs considerably from cycle to cycle. Another and no less important lesson is that despite these variations the reference cycles of the same series bear a family resemblance, while the reference cycles of different series vary in characteristic ways. What happens upon striking averages for groups of specific or reference cycles is indicated simply by the charts in Chapters 10 and 11. The story is almost always the same: the idiosyncrasies of individual cycles tend to vanish, the average patterns of the same series look much alike in different samples of cycles, the patterns of different series become sharply differentiated, and the relations among the series persist with great regularity from one sample of cycles to the next. This tendency of individual series to behave similarly in regard to one another in successive business cycles would not be found if the forces that produce business cycles had slight regularity.

Table 177 shows how stable are the relations among the amplitudes of

TABLE 177

Amplitude of Successive Reference Cycles
Seven American Series, 1879–1933

| Business cycle[a] | Railroad bond yields (III-VI) | Deflated clearings (VIII-V) | Railroad stock prices (VIII-IV) | Shares traded (VIII-IV) | Pig iron production (I-V) | Call money rates (I-V) | Freight car orders (VIII-IV) |
|---|---|---|---|---|---|---|---|
| | | | Rise & fall in reference-cycle relatives | | | | |
| 1879–1885 | +7.5 | +39.1 | +90.6 | +86.4 | +66.3 | +66.8 | +247.6 |
| 1885–1888 | +6.2 | +34.4 | +29.1 | +68.9 | +57.4 | +180.6 | +98.7 |
| 1888–1891 | +4.5 | +33.3 | +11.1 | +59.3 | +81.2 | +213.3 | +149.7 |
| 1891–1894 | +6.1 | +39.4 | +33.5 | +50.6 | +76.8 | +78.0 | +71.5 |
| 1894–1897 | +3.0 | +21.9 | +19.7 | +87.1 | +91.5 | +157.2 | +243.1 |
| 1897–1900 | −6.3 | +33.7 | +23.1 | +146.3 | +41.1 | +146.0 | +102.6 |
| 1900–1904 | +1.6 | +19.6 | +60.5 | +75.3 | +50.4 | +302.7 | +172.1 |
| 1904–1908 | +12.2 | +40.4 | +58.4 | +103.9 | +110.4 | +60.8 | +207.1 |
| 1908–1912 | +3.0 | +19.3 | +41.7 | +75.1 | +98.3 | +112.1 | +310.8 |
| 1912–1914 | +4.4 | +16.9 | +22.5 | +47.4 | +85.0 | +76.6 | +245.4 |
| 1914–1919 | +14.5 | +40.6 | −18.1 | +20.9 | +94.5 | +98.7 | +132.5 |
| 1919–1921 | +27.9 | +22.6 | +5.9 | +95.4 | +94.1 | +97.1 | +75.5 |
| 1921–1924 | +8.7 | +21.7 | +24.4 | +65.5 | +157.4 | +50.8 | +223.9 |
| 1924–1927 | −5.5 | +3.9 | +0.2 | +22.3 | +55.8 | +79.4 | +7.3 |
| 1927–1933 | +20.4 | +48.5 | +131.1 | +143.0 | +189.5 | +282.8 | +186.5 |
| | | | Rank of rise & fall | | | | |
| 1879–1885 | 1 | 2 | 6 | 5 | 3 | 4 | 7 |
| 1885–1888 | 1 | 3 | 2 | 5 | 4 | 7 | 6 |
| 1888–1891 | 1 | 3 | 2 | 4 | 5 | 7 | 6 |
| 1891–1894 | 1 | 3 | 2 | 4 | 6 | 7 | 5 |
| 1894–1897 | 1 | 3 | 2 | 4 | 5 | 6 | 7 |
| 1897–1900 | 1 | 3 | 2 | 7 | 4 | 6 | 5 |
| 1900–1904 | 1 | 2 | 4 | 5 | 3 | 7 | 6 |
| 1904–1908 | 1 | 2 | 3 | 5 | 6 | 4 | 7 |
| 1908–1912 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 1912–1914 | 1 | 2 | 3 | 4 | 6 | 5 | 7 |
| 1914–1919 | 2 | 4 | 1 | 3 | 5 | 6 | 7 |
| 1919–1921 | 3 | 2 | 1 | 6 | 5 | 7 | 4 |
| 1921–1924 | 1 | 2 | 3 | 5 | 6 | 4 | 7 |
| 1924–1927 | 1 | 3 | 2 | 5 | 6 | 7 | 4 |
| 1927–1933 | 1 | 2 | 3 | 4 | 6 | 7 | 5 |
| Average for | | | | | | | |
| 1879–1933 | 1.2 | 2.5 | 2.6 | 4.7 | 5.0 | 6.0 | 6.0 |
| 1885–1914 | 1.0 | 2.6 | 2.6 | 4.7 | 4.9 | 6.1 | 6.2 |

Roman numerals after the titles indicate what stages of the reference cycles are matched with reference expansion, the remaining stages being matched with reference contraction. Concerning the meaning of the signs, see note 7.

[a] Years of the initial and terminal troughs of the monthly reference cycles (Table 16).

our seven series during the business cycles from 1879 to 1933. The amplitudes are computed from reference-cycle standings in the terminal stages assigned to expansion and contraction, as given in our standard Table R4.[6] For example, in call money rates we match stages I-V with reference expansions and stages V-IX with reference contractions; hence the amplitude of the joint rise and fall of a given reference cycle is the excess of the standing in stage V over the standing in I plus the excess of the standing in

[6] See p. 174 and Table 47.

stage V over the standing in IX.[7] Once the reference-cycle amplitudes of the several series have been computed, we rank them in each cycle by assigning a value of 1 to the smallest and 7 to the largest. Now, if the rankings were purely fortuitous, the mean ranks of the individual series would tend towards equality; but it is plain that the rankings of the series tend to persist from cycle to cycle. By applying a mathematical test devised by Friedman for ranked two-way distributions, we find that the probability that the mean ranks of our series would differ on account of chance factors by more than the observed amount is less than one in a million.[8]

These results are corroborated by specific-cycle measures. The reference-cycle measures in Table 177 have the advantage that they can be computed for every business cycle covered; but they fail to take account of departures from that timing which we consider usual in the series, and thus understate by varying margins the full amplitudes of the specific cycles. The amplitude measures supplied by our standard Table S2 have opposite advantages and disadvantages: they show the full amplitudes of the specific cycles but these cycles do not correspond invariably to business cycles. The latter disadvantage is minimized in Table 178 which is restricted to 1885–1914, a period when the specific cycles of all series except railroad bond yields bear one-to-one correspondence to business cycles. The rankings of the specific-cycle amplitudes of the several series turn out to be even more stable from one business cycle to another than do the rankings of the reference-cycle amplitudes. It is also notable that the ranks of the two sets of amplitudes match fairly well. The principal discrepancies are the lower rank of iron production and the higher rank of call money rates in the specific-cycle than in the reference-cycle measures.

In Table 179 we contrast cyclical amplitudes and cyclical durations. The table arrays averages based on four samples of specific cycles in each of our seven series. The arrays make it possible to perform an experiment. Our concern is, let us say, with the amplitudes of full specific cycles. We select at random any one of the four averages for bank clearings, then do the same for iron production and the other series. It is plain that no matter what seven averages are drawn, bond yields will occupy the first

[7] It will be noticed that a few entries are negative. A negative entry usually means inverse conformity and a plus entry positive conformity to full business cycles, as defined in Ch. 5, Sec. IX-X. But this inference may prove false when the reference-cycle 'rise' and 'fall', as recorded in col. (2) and (5) respectively of our standard Table R4, are both plus or both minus; for while the 'rise & fall' shown in Table 177 is computed directly from the 'rise' and 'fall', our conformity measure is derived from the 'per month' figures.

[8] See Milton Friedman, The Use of Ranks to Avoid the Assumption of Normality Implicit in the Analysis of Variance, *Journal of the American Statistical Association*, Dec. 1937. Friedman's method involves the computation of a statistic that tends to be distributed as 'chi-square' with $(p-1)$ degrees of freedom, where $p$ is the number of ranks. This statistic comes out 68.8 for the ranks in Table 177. For six degrees of freedom the probability of a value of 'chi-square' greater than 68.8 is .000000.

TABLE 178

Amplitude of Specific Cycles Corresponding to Successive Business Cycles
Seven American Series, 1885–1914

| Business cycle[a] | Railroad bond yields | Deflated clearings | Railroad stock prices | Pig iron production | Shares traded | Freight car orders | Call money rates |
|---|---|---|---|---|---|---|---|
| | | | Rise & fall in specific-cycle relatives | | | | |
| 1885–1888 | 14.4 | 43.1 | 45.0 | 90.3 | 145.0 | 209.0 | 329.2 |
| 1888–1891 | 16.3 | 36.5 | 23.2 | 97.6 | 88.9 | 228.6 | 284.9 |
| 1891–1894 | 23.8 | 42.9 | 48.0 | 109.1 | 209.9 | 283.7 | 351.6 |
| 1894–1897 | 21.9 | 31.7 | 31.3 | 148.0 | 129.3 | 223.0 | 369.8 |
| 1897–1900 | 18.7[b] | 41.8 | 50.5 | 106.5 | 237.2 | 295.0 | 280.1 |
| 1900–1904 | | 27.1 | 76.6 | 99.0 | 358.6 | 290.8 | 322.0 |
| 1904–1908 | 24.4 | 51.8 | 82.0 | 136.3 | 197.4 | 402.6 | 421.9 |
| 1908–1912 | 15.2[c] | 34.3 | 53.0 | 120.3 | 123.3 | 334.5 | 148.7 |
| 1912–1914 | | 23.0 | 33.4 | 101.8 | 181.2 | 369.2 | 185.3 |
| | | | Rank of rise & fall | | | | |
| 1885–1888 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 1888–1891 | 1 | 3 | 2 | 5 | 4 | 6 | 7 |
| 1891–1894 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 1894–1897 | 1 | 3 | 2 | 5 | 4 | 6 | 7 |
| 1897–1900 | 1[d] | 2 | 3 | 4 | 5 | 7 | 6 |
| 1900–1904 | 1[d] | 2 | 3 | 4 | 7 | 5 | 6 |
| 1904–1908 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 1908–1912 | 1[d] | 2 | 3 | 4 | 5 | 7 | 6 |
| 1912–1914 | 1[d] | 2 | 3 | 4 | 5 | 7 | 6 |
| Average.... | 1.0 | 2.2 | 2.8 | 4.2 | 5.0 | 6.2 | 6.6 |

The turning points of the specific cycles are given in Appendix Table B1.

[a] Years of the initial and terminal troughs of the monthly reference cycles (Table 16).

[b] Amplitude of the cycle from June 1899 to Feb. 1905.

[c] Amplitude of the cycle from Feb. 1909 to June 1914.

[d] The amplitude of a specific cycle that corresponds approximately to two business cycles is repeated in deriving ranks.

place, clearings the second place, stock prices the third, iron production the fourth, share trading and call money rates the fifth or sixth, and freight car orders the seventh. Of course, an increase in the number of samples would blur the picture. For example, the average amplitude is larger in call money rates than in freight car orders in the sample of cycles covered by Table 178. Again, the rankings of the per month amplitudes of Table 179 are less stable than the total amplitudes. This tendency of the rankings of different series to shade into one another would become more pronounced if we compared seventy instead of seven series. Hence in dealing with numerous series we must think more often of differences among groups of activities than of differences among single series, and we must think more in terms of orders of magnitude than in terms of exact differentials. Subject to this reservation, average amplitudes are indicators of real differences in the cyclical behavior of economic activities.

Let us now perform a similar experiment on the cyclical durations. Again we select any one of the four averages for bond yields, and do the

TABLE 179

Arrays of Average Durations and Amplitudes of Specific Cycles
Based on Four Samples from Seven American Series

| Average duration of full cycles in months | | AVERAGE AMPLITUDE IN SPECIFIC-CYCLE RELATIVES: Rise & fall | | AVERAGE AMPLITUDE IN SPECIFIC-CYCLE RELATIVES: Per month rise & fall[a] | |
|---|---|---|---|---|---|
| Car orders | 32 | Bond yields | 20 | Bond yields | 0.4 |
| Bond yields | 32 | Bond yields | 23 | Bond yields | 0.6 |
| Call rates | 36 | Bond yields | 24 | Bond yields | 0.6 |
| Clearings | 37 | Bond yields | 27 | Clearings | 0.8 |
| Stock prices | 37 | Clearings | 37 | Bond yields | 0.9 |
| Call rates | 38 | Clearings | 40 | Clearings | 0.9 |
| Call rates | 38 | Clearings | 41 | Clearings | 0.9 |
| Car orders | 39 | Clearings | 42 | Clearings | 1.1 |
| Car orders | 40 | Stock prices | 52 | Stock prices | 1.4 |
| Call rates | 40 | Stock prices | 67 | Stock prices | 1.4 |
| Clearings | 41 | Stock prices | 74 | Stock prices | 1.4 |
| Shares traded | 42 | Stock prices | 76 | Stock prices | 1.5 |
| Bond yields | 42 | Iron output | 107 | Iron output | 2.6 |
| Iron output | 43 | Iron output | 113 | Iron output | 2.8 |
| Iron output | 43 | Iron output | 117 | Iron output | 2.9 |
| Iron output | 44 | Iron output | 131 | Iron output | 3.2 |
| Iron output | 44 | Shares traded | 148 | Shares traded | 3.6 |
| Shares traded | 44 | Call rates | 187 | Call rates | 4.5 |
| Clearings | 44 | Shares traded | 190 | Shares traded | 4.6 |
| Shares traded | 44 | Shares traded | 204 | Shares traded | 4.9 |
| Bond yields | 45 | Call rates | 218 | Shares traded | 5.2 |
| Shares traded | 46 | Shares traded | 220 | Call rates | 5.9 |
| Car orders | 48 | Call rates | 232 | Call rates | 6.3 |
| Bond yields | 49 | Call rates | 289 | Car orders | 8.3 |
| Stock prices | 49 | Car orders | 319 | Call rates | 8.4 |
| Stock prices | 50 | Car orders | 421 | Car orders | 9.7 |
| Clearings | 54 | Car orders | 425 | Car orders | 13.2 |
| Stock prices | 63 | Car orders | 518 | Car orders | 20.4 |

Derived from Table 140, which gives averages for all cycles in each series, and from Table 145, which gives averages for three subgroups containing an equal or approximately equal number of cycles. The order of the items is based on averages carried to more places than shown here.

[a] Unweighted average.

same for bank clearings and the other series. Suppose that the following averages are drawn: freight car orders 32, railroad bond yields 32, call money rates 36, deflated clearings 37, shares traded 42, pig iron production 43, railroad stock prices 63. From this sample we might conceivably jump to the conclusion that the specific cycles of bond yields and car orders are shorter and the cycles of stock prices longer than those of the other series. But we might have made another drawing of averages: railroad stock prices 37, call money rates 40, pig iron production 43, shares traded 44, deflated clearings 44, railroad bond yields 45, and freight car orders 48. These averages practically reverse the showing of the first set. Careful inspection of Table 179 will demonstrate that by changing the samples we may get almost any result for cyclical durations.

In view of this remarkable contrast between the durations and amplitudes of specific cycles, we make in Tables 180-182 a more comprehensive test of the business-cycle behavior of our seven series. From 1879 to 1933 fifteen business cycles occurred in the United States according to our reference dates. We divide these cycles into groups of five: the first from 1879 to 1897, the second from 1897 to 1914, the third from 1914 to 1933. Table 180 shows averages of the duration, amplitude, and several other characteristics of cyclical behavior for each of these periods, series by series. In no instance are the averages for the three periods identical. But whereas the average durations of full specific cycles of the seven series in one period seem uncorrelated with those in another period, the averages of other cyclical measures tend to repeat the same order. This tendency toward repetition is measured by coefficients of rank correlation in Table 181. The correlation between the ranks of the average durations of specific cycles in the first and second periods is negative; the correlation coefficients between the first and third periods and between the second and third, while positive, are of negligible size and much the smallest in the table. For every other cyclical measure the coefficients are invariably positive. They are remarkably high for specific-cycle amplitudes, also for rates of change during reference cycles and for timing measures at reference peaks. The tendency toward repetition is smaller in other cyclical measures, but it is present also in the timing at reference troughs and even in the durations of expansions and contractions of specific cycles. Variance analysis confirms these results. Whether we include all the cycles in each series or restrict analysis to 1879–1933, which is covered by all seven series, Table 182 shows that the differences among series are 'significantly' larger than the differences within series for every measure except the duration of full specific cycles.[9]

These statistical findings are in harmony with theoretical expectations. The sequence of changes is less uniform in revivals than in recessions, since revivals lack the compulsion that attends business recessions. The durations of expansions and contractions differ significantly among individual activities, since some tend to lead at revivals and lag at recessions, others show opposite relations,[10] while still others usually lead or usually lag at both turns. In general, we should expect that average measures of cyclical timing, amplitude, and rate of movement during reference cycles will differ significantly among major economic processes, while average durations of full specific cycles will not. For the periods of business cycles come to be impressed on the components of the economic

[9] The results are similar when the analysis is confined to briefer periods, that is, 1879–97, 1897–1914, 1914–33; though the picture for the last period is somewhat blurred. This detailed evidence is omitted.

The variance ratios in Table 182 cannot be interpreted unambiguously, not only for the reasons adduced earlier (pp. 392, 397-8, 400-1), but also because the variances of most cyclical measures differ from series to series. It does not seem, however, that the latter factor can seriously limit interpretation; first, because most of the variance ratios are very high, second, because the ratios meet in detail expectations based both on theoretical reasoning and on analysis of the cycle-by-cycle measures.

[10] See pig iron prices (Table 176) for an example; none of our seven series behave in this fashion.

TABLE 180

Average Cyclical Measures Covering Successive Periods of Five Business Cycles and All Fifteen Cycles from 1879 to 1933

Seven American Series

| Measure and period[a] | Deflated clearings | Pig iron production | Freight car orders | Railroad stock prices | Shares traded | Call money rates | Railroad bond yields |
|---|---|---|---|---|---|---|---|
| AVERAGE DURATION OF SPECIFIC CYCLES[b] | | | | | | | |
| Expansion | | | | | | | |
| 1879–1897 | 28 | 29 | 22 | 21 | 15 | 15 | 19 |
| 1897–1914 | 33 | 32 | 25 | 30 | 15 | 24 | 47 |
| 1914–1933 | 39 | 25 | 12 | 31 | 24 | 19 | 17 |
| 1879–1933 | 33 | 29 | 19 | 27 | 18 | 19 | 25 |
| Contraction | | | | | | | |
| 1879–1897 | 9 | 14 | 23 | 25 | 31 | 17 | 25 |
| 1897–1914 | 10 | 11 | 18 | 15 | 28 | 20 | 13 |
| 1914–1933 | 16 | 18 | 19 | 21 | 20 | 19 | 23 |
| 1879–1933 | 11 | 15 | 20 | 20 | 26 | 18 | 21 |
| Full cycle | | | | | | | |
| 1879–1897 | 37 | 43 | 46 | 46 | 46 | 32 | 43 |
| 1897–1914 | 44 | 44 | 43 | 44 | 42 | 44 | 60 |
| 1914–1933 | 55 | 44 | 32 | 52 | 44 | 37 | 41 |
| 1879–1933 | 44 | 43 | 39 | 47 | 44 | 37 | 46 |
| AVERAGE AMPLITUDE OF SPECIFIC CYCLES[c] | | | | | | | |
| Rise | | | | | | | |
| 1879–1897 | 28 | 62 | 151 | 29 | 74 | 131 | 7 |
| 1897–1914 | 25 | 64 | 171 | 36 | 108 | 136 | 14 |
| 1914–1933 | 27 | 59 | 254 | 36 | 112 | 77 | 13 |
| 1879–1933 | 27 | 62 | 199 | 34 | 98 | 117 | 11 |
| Fall | | | | | | | |
| 1879–1897 | 12 | 44 | 144 | 25 | 73 | 137 | 12 |
| 1897–1914 | 10 | 48 | 167 | 23 | 112 | 135 | 5 |
| 1914–1933 | 19 | 72 | 264 | 52 | 93 | 71 | 13 |
| 1879–1933 | 13 | 55 | 200 | 32 | 92 | 117 | 11 |
| Rise & fall | | | | | | | |
| 1879–1897 | 40 | 107 | 295 | 54 | 148 | 269 | 19 |
| 1897–1914 | 36 | 113 | 338 | 59 | 220 | 272 | 19 |
| 1914–1933 | 46 | 131 | 518 | 89 | 204 | 148 | 25 |
| 1879–1933 | 40 | 117 | 400 | 66 | 190 | 234 | 22 |
| Rise per month[d] | | | | | | | |
| 1879–1897 | 0.9 | 2.6 | 9.8 | 1.4 | 7.7 | 11.5 | 0.4 |
| 1897–1914 | 0.8 | 2.1 | 7.2 | 1.3 | 9.8 | 5.7 | 0.3 |
| 1914–1933 | 0.8 | 2.6 | 41.3 | 1.2 | 5.3 | 4.2 | 0.7 |
| 1879–1933 | 0.8 | 2.4 | 22.0 | 1.3 | 7.6 | 7.6 | 0.5 |
| Fall per month[d] | | | | | | | |
| 1879–1897 | 1.6 | 3.8 | 6.5 | 1.2 | 2.5 | 9.2 | 0.5 |
| 1897–1914 | 2.9 | 5.6 | 11.3 | 1.7 | 4.2 | 8.4 | 0.4 |
| 1914–1933 | 1.2 | 4.6 | 15.9 | 2.2 | 5.6 | 4.6 | 1.2 |
| 1879–1933 | 1.9 | 4.7 | 11.8 | 1.6 | 4.1 | 7.6 | 0.8 |
| Rise & fall per month[d] | | | | | | | |
| 1879–1897 | 1.1 | 2.8 | 7.1 | 1.2 | 3.6 | 8.6 | 0.4 |
| 1897–1914 | 0.8 | 2.6 | 8.1 | 1.4 | 5.2 | 6.1 | 0.3 |
| 1914–1933 | 0.8 | 3.2 | 20.4 | 1.5 | 4.9 | 3.9 | 0.7 |
| 1879–1933 | 0.9 | 2.9 | 12.9 | 1.4 | 4.6 | 6.5 | 0.5 |

TABLE 180—*Continued*

Average Cyclical Measures Covering Successive Periods of Five Business Cycles and All Fifteen Cycles from 1879 to 1933

Seven American Series

| Measure and period[a] | Deflated clearings | Pig iron production | Freight car orders | Railroad stock prices | Shares traded | Call money rates | Railroad bond yields |
|---|---|---|---|---|---|---|---|
| AVERAGE LEAD (−) OR LAG (+)[b] | | | | | | | |
| At reference peaks | | | | | | | |
| 1879–1897 | +3.8 | +0.8 | −4.4 | −4.4 | −11.4 | +1.2 | +10.6 |
| 1897–1914 | +4.2 | +3.4 | −6.0 | −1.6 | −12.0 | +2.4 | +9.7 |
| 1914–1933 | +1.2 | +1.4 | −3.4 | −8.5 | −7.8 | −2.0 | +3.2 |
| 1879–1933 | +3.2 | +1.9 | −4.6 | −4.6 | −10.4 | +0.5 | +7.9 |
| At reference troughs | | | | | | | |
| 1879–1897[e] | −6.2 | −3.2 | −2.0 | −0.8 | −2.2 | +2.2 | +16.6 |
| 1897–1914[f] | −7.4 | −7.2 | −9.4 | −9.6 | −4.8 | 0.0 | +12.7 |
| 1914–1933 | −3.8 | −0.3 | +1.2 | −7.0 | −6.5 | +3.0 | +0.2 |
| 1879–1933 | −5.8 | −3.4 | −3.1 | −5.8 | −4.6 | +1.7 | +10.2 |
| AVERAGE CHANGE PER MONTH DURING[g] REFERENCE CYCLES | | | | | | | |
| Expansion | | | | | | | |
| 1879–1897 | +0.9 | +2.1 | +3.5 | +0.7 | +1.4 | +2.8 | 0.0 |
| 1897–1914 | +0.8 | +2.2 | +5.3 | +1.2 | +1.8 | +3.8 | +0.2 |
| 1914–1933 | +0.7 | +2.4 | +3.1 | +0.4 | +2.7 | +3.1 | +0.4 |
| 1879–1933 | +0.8 | +2.3 | +4.0 | +0.8 | +2.0 | +3.2 | +0.2 |
| Contraction | | | | | | | |
| 1879–1897 | −0.7 | −1.7 | −4.1 | −0.8 | −2.2 | −5.0 | −0.2 |
| 1897–1914 | −0.4 | −1.8 | −5.1 | −0.7 | −2.2 | −3.1 | 0.0 |
| 1914–1933 | −0.4 | −3.3 | −3.5 | −0.4 | −0.6 | −2.8 | −0.2 |
| 1879–1933 | −0.5 | −2.3 | −4.2 | −0.6 | −1.7 | −3.6 | −0.1 |
| Difference[h] | | | | | | | |
| 1879–1897 | −1.5 | −3.9 | −7.6 | −1.5 | −3.5 | −7.8 | −0.2 |
| 1897–1914 | −1.2 | −4.0 | −10.4 | −1.9 | −4.1 | −6.9 | −0.2 |
| 1914–1933 | −1.1 | −5.7 | −6.5 | −0.8 | −3.3 | −5.9 | −0.6 |
| 1879–1933 | −1.3 | −4.5 | −8.2 | −1.4 | −3.6 | −6.9 | −0.3 |

[a] The periods refer to business cycles, as marked off by the monthly reference dates in Table 16. The specific cycles are fitted as closely as possible into these periods; for full details, see Appendix Table B9.

[b] In months.

[c] In specific-cycle relatives.

[d] Unweighted average.

[e] Excludes timing at reference trough of June 1897.

[f] Excludes timing at reference trough of Dec. 1914.

[g] That is, during stages matched with reference expansions and contractions (see Table 177), in units of reference-cycle relatives.

[h] That is, average difference between reference contractions and expansions (see Table 47, col. 8).

TABLE 181

Coefficients of Rank Correlation between Average Cyclical Measures of Seven American Series in Different Periods

| Measure[a] | Rank correlation between averages of seven series in | | |
|---|---|---|---|
| | 1879–1897 and 1897–1914 | 1897–1914 and 1914–1933 | 1879–1897 and 1914–1933 |
| DURATION OF SPECIFIC CYCLES | | | |
| Expansion | +.56 | +.21 | +.38 |
| Contraction | +.68 | +.39 | +.86 |
| Full cycle | −.32 | +.11 | +.07 |
| AMPLITUDE OF SPECIFIC CYCLES | | | |
| Rise | +1.00 | +.96 | +.96 |
| Fall | +.96 | +.89 | +.86 |
| Rise & fall | +1.00 | +.96 | +.96 |
| Rise per month | +.86 | +.96 | +.89 |
| Fall per month | +.96 | +.79 | +.71 |
| Rise & fall per month | +.96 | +.96 | +.89 |
| LEAD OR LAG | | | |
| At reference peaks | +.95 | +.86 | +.83 |
| At reference troughs | +.43 | +.46 | +.39 |
| CHANGE DURING REFERENCE CYCLES | | | |
| Expansion | +.96 | +.82 | +.89 |
| Contraction | +.96 | +.89 | +.82 |
| Difference | +.89 | +.93 | +.96 |

Based on the averages in Table 180, carried to an additional place.

[a] See the fuller stubs in Table 180, and the appended notes.

system, while the very propagation of business cycles seems causally connected with differences in the timing and amplitude of cyclical movements in different parts of the economy. Tables 183-184 present frequency distributions of the timing and amplitude measures of our seven series. It will be noticed that the distributions of the individual series tend to occupy different portions of the scale. In contrast, the durations of specific cycles, as may be seen from Table 185, cluster in about the same intervals as do the durations of business cycles. Of course, if the lower limit of the duration of movements that we recognize as specific cycles were reduced, we might find greater differences among the cyclical durations of our series. But we define specific cycles, as indeed we must, in a manner consistent with our working definition of business cycles, and we deem it a significant fact that our series tend to show cyclical movements that correspond to that definition.

Two conclusions emerge from this analysis. In the first place our tests, so far as they go, bear out the concept of business cycles as units of roughly concurrent fluctuations in many activities.[11] In the second place, they demonstrate that although cyclical measures of individual series usually vary greatly from one cycle to the next, there is a pronounced tendency towards repetition in the relations among the movements of different

[11] For a demonstration based on a larger sample, see Ch. 4, Sec. VI.

TABLE 182

Tests of the Statistical Significance of Differences among Average Cyclical Measures of Seven American Series

| Measure[a] | Ratio of variance among seven series to variance within series based on: All cycles in each series | Cycles from 1879 to 1933 |
|---|---|---|
| DURATION OF SPECIFIC CYCLES | | |
| Expansion | 3.30♪ | 3.03♪ |
| Contraction | 2.79♩ | 2.96♩ |
| Full cycle | 0.77 | 0.69 |
| AMPLITUDE OF SPECIFIC CYCLES | | |
| Rise | 28.49♫ | 23.83♫ |
| Fall | 25.17♫ | 21.52♫ |
| Rise & fall | 28.45♫ | 24.39♫ |
| Rise per month | 4.01♪ | 2.83♩ |
| Fall per month | 15.49♫ | 12.84♫ |
| Rise & fall per month | 12.22♫ | 9.00♫ |
| LEAD OR LAG | | |
| At reference peaks | 14.73♫ | 12.97♫ |
| At reference troughs | 12.06♫ | 8.66♫ |
| CHANGE DURING REFERENCE CYCLES | | |
| Expansion | 11.44♫ | 11.35♫ |
| Contraction | 12.34♫ | 13.14♫ |
| Difference | 18.38♫ | 21.03♫ |

For periods covered by each series and averages based on all cycles, see Table 140. Averages for 1879–1933 are given in Table 180.

[a] See the fuller stubs in Table 180, and the appended notes.

♩ Larger than the value that would be exceeded once in twenty times by chance. This value ranges from 2.18 to 2.20 for the different measures.

♪ Larger than the value that would be exceeded once in a hundred times by chance. This value ranges from 2.96 to 3.01 for the different measures.

♫ Larger than the value that would be exceeded once in a thousand times by chance. This value ranges from 4.05 to 4.19 for the different measures.

TABLE 183

Frequency Distribution of Amplitudes of Specific Cycles Seven American Series

| Rise & fall in specific-cycle relatives[a] | Number of cycles in: Deflated clearings | Pig iron production | Freight car orders | Railroad stock prices | Shares traded | Call money rates | Railroad bond yields |
|---|---|---|---|---|---|---|---|
| Under 20.0 | 1 | .. | .. | .. | .. | .. | 8 |
| 20.0– 29.9 | 4 | .. | .. | 1 | .. | .. | 9 |
| 30.0– 44.9 | 7 | .. | .. | 6 | .. | .. | 3 |
| 45.0– 67.4 | 1 | 1 | .. | 5 | .. | .. | .. |
| 67.5–101.1 | 2 | 4 | .. | 3 | 1 | 4 | .. |
| 101.2–151.8 | .. | 8 | .. | 2 | 4 | 4 | .. |
| 151.9–227.7 | .. | 2 | 2 | .. | 6 | 5 | .. |
| 227.8–341.6 | .. | .. | 8 | 1 | 3 | 6 | .. |
| 341.7–512.5 | .. | .. | 4 | .. | 1 | 3 | .. |
| 512.6–768.8 | .. | .. | 3 | .. | .. | 1 | .. |
| Over 768.8 | .. | .. | 2 | .. | .. | .. | .. |
| Total | 15 | 15 | 19 | 18 | 15 | 23 | 20 |

For the cycle-by-cycle measures and periods covered, see Appendix Table B1.

[a] Except for the open-end class at the start, the lower limits of successive classes are in geometric progression.

TABLE 184

Frequency Distribution of Leads or Lags of Specific Cycles
Seven American Series

| Lead (−) or lag (+) at reference turn (mos.) | Number of specific-cycle turns in | | | | | | |
|---|---|---|---|---|---|---|---|
| | Deflated clearings | Pig iron production | Freight car orders | Railroad stock prices | Shares traded | Call money rates | Railroad bond yields |
| | Timing at reference peaks | | | | | | |
| −24 to −18 | .. | .. | 2 | 2 | 1 | .. | .. |
| −17 to −11 | .. | 1 | 3 | 1 | 7 | 1 | .. |
| −10 to −4 | .. | .. | 5 | 7 | 5 | 2 | .. |
| −3 to +3 | 10 | 9 | 3 | 6 | 1 | 11 | 3 |
| +4 to +10 | 3 | 4 | 2 | 1 | 1 | 5 | 7 |
| +11 to +17 | 1 | 1 | 1 | .. | .. | .. | 5 |
| +18 to +24 | .. | .. | .. | .. | .. | .. | 1 |
| Total....... | 14 | 15 | 16 | 17 | 15 | 19 | 16 |
| | Timing at reference troughs | | | | | | |
| −38 to −32 | .. | .. | .. | 1 | .. | .. | .. |
| −31 to −25 | .. | .. | .. | .. | .. | .. | .. |
| −24 to −18 | .. | .. | .. | 2 | 1 | .. | .. |
| −17 to −11 | 2 | 1 | 2 | 2 | 2 | 1 | .. |
| −10 to −4 | 7 | 5 | 6 | 6 | 4 | 3 | 2 |
| −3 to +3 | 6 | 10 | 5 | 5 | 8 | 8 | 1 |
| +4 to +10 | .. | .. | 4 | 1 | 1 | 4 | 3 |
| +11 to +17 | .. | .. | .. | 1 | .. | 3 | 5 |
| +18 to +24 | .. | .. | .. | .. | .. | .. | 4 |
| +25 to +31 | .. | .. | .. | .. | .. | .. | 1 |
| Total....... | 15 | 16 | 17 | 18 | 16 | 19 | 16 |

For the cycle-by-cycle measures and periods covered, see Appendix Table B3.

TABLE 185

Frequency Distribution of Durations of American Business Cycles
and Specific Cycles in Seven Series

| Duration of cycles (mos.) | Number of cycles in | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | General business activity | Deflated clearings | Pig iron production | Freight car orders | Railroad stock prices | Shares traded | Call money rates | Railroad bond yields |
| 11 – 20 | .. | .. | .. | 1 | 3 | .. | 2 | 2 |
| 21 – 30 | 2 | 3 | 2 | 6 | 2 | 2 | 4 | 3 |
| 31 – 40 | 7 | 5 | 7 | 4 | 3 | 5 | 6 | 4 |
| 41 – 50 | 6 | 6 | 3 | 3 | 5 | 6 | 9 | 6 |
| 51 – 60 | 1 | .. | 1 | 4 | 2 | .. | 2 | 1 |
| 61 – 70 | 1 | .. | 1 | .. | .. | .. | .. | 4 |
| 71 – 80 | 2 | .. | 1 | .. | .. | .. | .. | .. |
| 81 – 90 | .. | .. | .. | 1 | .. | 2 | .. | .. |
| 91 – 100 | 1 | .. | .. | .. | 1 | .. | .. | .. |
| 101 – 110 | .. | .. | .. | .. | 1 | .. | .. | .. |
| Over 110 | .. | 1 | .. | .. | 1 | .. | .. | .. |
| Total..... | 20 | 15 | 15 | 19 | 18 | 15 | 23 | 20 |

The durations of cycles in general business activity are derived from the monthly reference troughs of business cycles, 1854–1933, in Table 16. See Appendix Table B1 for the periods covered by the specific cycles and their successive durations.

activities in successive business cycles. Our analysis of hundreds of time series is sufficiently advanced to give us full confidence in these conclusions. Later monographs will demonstrate in detail that the processes involved in business cycles behave far less regularly than theorists have been prone to assume; but they will demonstrate also that business-cycle phenomena are far more regular than many historically-minded students believe.

These facts have a vital bearing on the value of averages as a tool of theoretical analysis. If business cycles had few if any repetitive features other than the cyclical movement in 'total output' or 'total employment' itself, averages of cyclical measures would have little value. Whether or not a general theory of business cycles would be possible in such a case, average measures of cyclical behavior could be of no aid in the development of a general theory. But so far as business cycles have repetitive features, averages help to expose these features. By showing what cyclical behavior is characteristic of different activities, they put observational records in a form that both reveals concretely what is to be explained and helps in finding explanations. When used competently, average measures of cyclical movements in different economic processes go far toward accounting for one another.

Our theoretical work leans heavily on cyclical averages, such as are described in this book, and we hope that others will find them helpful. Instead of setting out from the dreamland of equilibrium, or from a few simple assumptions that common sense suggests about the condition of business in late 'prosperity' or 'depression', as is the usual procedure of business-cycle theorists, we start our theoretical analysis with cyclical averages; in other words, our 'assumptions' are derived from concrete, systematic observations of economic life. Not only that, but we can test our reasonings as we journey through successive stages of the cycle by referring ever and again to the arrays of averages. This program is essayed in a volume now in preparation, which seeks to explain how business cycles come about and why they differ from one another.[12]

## III Influence of Extreme Items on Averages

It follows from the preceding analysis that the tendency of averages to conceal the episodic features of successive cycles is from our viewpoint a virtue rather than a defect. We consider averages faulty not so much because they conceal episodic movements as because they do not do so sufficiently. The larger the variability of cyclical measures, the fewer the cycles covered, the narrower the geographic area or the economic scope represented by a series, the rougher must averages be as gauges of cyclical

[12] For the program as a whole, see Ch. 1, Sec. VIII.

behavior. Some of the differences between averages for the same series in Table 180 are considerable. A few reflect structural or secular changes in cyclical behavior: for example, the recent decline in the amplitude of specific cycles in call money rates, and the shortening of the lead of iron production at reference troughs. But we believe that random factors are chiefly responsible for the wide variations sometimes found in averages based on different groups of cycles.

One outstanding example may be cited. After the entry of the United States into World War I, the railroads curtailed purchases of equipment drastically, anticipating that the government would take over their business. On December 28, 1917 the government actually took control and set up the Railroad Administration. No freight cars were purchased for several months. When designs for standard equipment were finally worked out, the Administration entered the market on May 1, 1918 with orders for 99,500 cars. On a quarterly basis the figures of car orders during 1918 and 1919, in thousands of cars, run as follows: 1, 100, 0, 0, 1, 0, 0, 3.[13] We recognize a specific cycle with a trough in the first quarter of 1918, a peak in the second quarter of 1918, and a terminal trough in the third quarter of 1919. The legitimacy of treating the rise between the first and second quarters in 1918 as a specific-cycle expansion instead of a random movement may be questioned. This 'cycle' is certainly one of the most peculiar on record: zero values predominate, the duration is only six quarters, the total amplitude is nearly 1,200 points, the rise per month is 195 points. But we believe that in view of the attendant circumstances this movement is best regarded as a specific cycle dominated by random disturbances. It illustrates how cyclical fluctuations may sometimes be twisted out of their ordinary course by government, which can concentrate its purchases on a single day or month, while there is bound to be some dispersion over time when numerous units act independently. The extraordinary specific cycle of 1918–19 in freight car orders accounts for some of the most striking differences between the averages of subgroups in Table 180.

As explained in Chapter 9, Section II, we attempt to minimize such distortions by excluding from the averages cycles dominated by random factors. We do this freely when we are reasonably sure that certain cycles of a series are dominated by random influences, as in the case of most price and value series during serious monetary disturbances.[14] We sometimes follow this practice even when we lack definite knowledge of random perturbations associated with a given 'extreme' cycle. But our exclusions of cycles on account of size alone are few in comparison with the number

[13] John E. Partington, *op. cit.*, pp. 156-7, 225.

[14] We make no exclusions in many series on interest rates and security prices, since they often escape the extreme fluctuations characteristic of price series during periods of monetary disturbance. Three of the seven series we use for illustrative purposes—railroad bond yields, call money rates, and railroad stock prices—are cases in point.

TABLE 186
Influence of the Highest and Lowest Values on the Average Duration, Timing and Amplitude of Specific Cycles
Seven American Series

| Measure and basis of average[a] | Deflated clearings | Pig iron production | Freight car orders | Railroad stock prices | Shares traded | Call money rates | Railroad bond yields |
|---|---|---|---|---|---|---|---|
| AVERAGE DURATION OF SPECIFIC CYCLES | | | | | | | |
| Expansion | | | | | | | |
| N | 32.6 | 28.8 | 18.3 | 28.8 | 17.9 | 19.9 | 21.0 |
| N−L | 34.0 | 30.1 | 19.2 | 30.2 | 18.9 | 20.6 | 21.7 |
| N−H | 29.6 | 27.4 | 17.0 | 25.5 | 16.2 | 19.0 | 19.1 |
| Contraction | | | | | | | |
| N | 11.4 | 14.5 | 21.2 | 21.0 | 26.2 | 18.0 | 21.4 |
| N−L | 12.1 | 15.2 | 22.0 | 21.9 | 27.6 | 18.6 | 22.4 |
| N−H | 9.4 | 12.4 | 20.0 | 18.6 | 24.7 | 17.2 | 19.9 |
| Full cycle | | | | | | | |
| N | 44.0 | 43.3 | 39.5 | 49.8 | 44.1 | 37.9 | 42.4 |
| N−L | 45.1 | 44.6 | 40.7 | 51.7 | 45.5 | 38.7 | 43.8 |
| N−H | 39.0 | 41.3 | 37.0 | 44.1 | 41.1 | 37.2 | 41.1 |
| AV. LEAD (−) OR LAG (+) | | | | | | | |
| At reference peaks | | | | | | | |
| N | +3.2 | +1.9 | −5.8 | −5.6 | −10.4 | −0.1 | +7.8 |
| N−L | +3.6 | +2.8 | −4.6 | −4.6 | −9.5 | +0.6 | +8.3 |
| N−H | +2.3 | +1.2 | −6.9 | −6.6 | −11.4 | −0.7 | +7.1 |
| At reference troughs | | | | | | | |
| N | −5.8 | −3.4 | −3.0 | −7.4 | −4.6 | +1.5 | +11.8 |
| N−L | −5.1 | −2.7 | −2.1 | −6.0 | −3.7 | +2.4 | +12.9 |
| N−H | −6.2 | −3.7 | −3.8 | −8.6 | −5.4 | +0.7 | +10.7 |
| AVERAGE AMPLITUDE OF SPECIFIC CYCLES | | | | | | | |
| Rise | | | | | | | |
| N | 26.9 | 62.1 | 213.0 | 35.6 | 98.1 | 115.9 | 10.8 |
| N−L | 28.3 | 63.9 | 218.9 | 37.3 | 101.9 | 119.7 | 11.2 |
| N−H | 24.5 | 58.8 | 192.3 | 32.4 | 92.0 | 106.9 | 9.5 |
| Fall | | | | | | | |
| N | 13.4 | 54.8 | 211.6 | 31.8 | 92.4 | 116.1 | 12.5 |
| N−L | 14.1 | 57.3 | 219.6 | 33.3 | 96.3 | 120.1 | 13.1 |
| N−H | 10.4 | 48.0 | 190.5 | 25.3 | 86.4 | 106.0 | 11.5 |
| Rise & fall | | | | | | | |
| N | 40.2 | 116.8 | 424.5 | 67.3 | 190.5 | 232.0 | 23.3 |
| N−L | 41.8 | 121.2 | 436.5 | 69.9 | 197.7 | 238.8 | 24.3 |
| N−H | 36.6 | 111.0 | 382.8 | 57.6 | 178.4 | 212.9 | 22.3 |
| Rise per month[b] | | | | | | | |
| N | 0.83 | 2.42 | 22.56 | 1.43 | 7.63 | 6.88 | 0.57 |
| N−L | 0.86 | 2.50 | 23.61 | 1.49 | 8.00 | 7.10 | 0.59 |
| N−H | 0.79 | 2.24 | 12.98 | 1.30 | 6.72 | 6.08 | 0.51 |
| Fall per month[b] | | | | | | | |
| N | 1.93 | 4.67 | 11.74 | 1.69 | 4.09 | 7.63 | 0.86 |
| N−L | 2.03 | 4.93 | 12.12 | 1.75 | 4.29 | 7.91 | 0.89 |
| N−H | 1.17 | 4.26 | 10.21 | 1.54 | 3.69 | 7.01 | 0.68 |
| Rise & fall per month[b] | | | | | | | |
| N | 0.94 | 2.87 | 13.20 | 1.44 | 4.56 | 6.28 | 0.63 |
| N−L | 0.97 | 2.99 | 13.71 | 1.49 | 4.75 | 6.49 | 0.65 |
| N−H | 0.90 | 2.71 | 10.31 | 1.38 | 4.31 | 5.92 | 0.58 |

In order to bring out variations in detail, we use decimals freely in this and the following table. All durations are expressed in months, amplitudes in specific-cycle relatives.

[a] N stands for the full number of cyclical observations on the series, as shown in Tables 140 and 141. 'N−L' excludes the single lowest value in the array, 'N−H' excludes the single highest value. For cycle-by-cycle measures other than the per month amplitudes, see Appendix Tables B1 and B3.

[b] Unweighted average.

TABLE 187

Several Positional Arithmetic Means
Duration, Timing and Amplitude of Specific Cycles
Seven American Series

| Measure and no. of items averaged[a] | Deflated clearings | Pig iron production | Freight car orders | Railroad stock prices | Shares traded | Call money rates | Railroad bond yields |
|---|---|---|---|---|---|---|---|
| AVERAGE DURATION OF SPECIFIC CYCLES | | | | | | | |
| Expansion | | | | | | | |
| N | 32.6 | 28.8 | 18.3 | 28.8 | 17.9 | 19.9 | 21.0 |
| N−2 | 30.9 | 28.7 | 17.8 | 26.8 | 17.2 | 19.7 | 19.7 |
| N−4 | 30.9 | 28.4 | 17.2 | 25.1 | 16.3 | 19.8 | 18.3 |
| 3 or 4 | 29.7 | 25.3 | 14.0 | 22.0 | 17.0 | 19.3 | 16.5 |
| 1 or 2 | 30.0 | 25.0 | 12.0 | 22.0 | 16.0 | 18.0 | 16.5 |
| Contraction | | | | | | | |
| N | 11.4 | 14.5 | 21.2 | 21.0 | 26.2 | 18.0 | 21.4 |
| N−2 | 9.9 | 13.0 | 20.8 | 19.4 | 26.2 | 17.9 | 20.9 |
| N−4 | 9.5 | 12.7 | 20.2 | 18.3 | 26.5 | 17.7 | 20.0 |
| 3 or 4 | 8.7 | 11.0 | 17.0 | 13.8 | 24.3 | 17.0 | 18.2 |
| 1 or 2 | 9.0 | 11.0 | 18.0 | 14.0 | 24.0 | 17.0 | 18.5 |
| Full cycle | | | | | | | |
| N | 44.0 | 43.3 | 39.5 | 49.8 | 44.1 | 37.9 | 42.4 |
| N−2 | 39.8 | 42.5 | 38.1 | 45.8 | 42.4 | 38.0 | 42.4 |
| N−4 | 40.0 | 41.6 | 37.8 | 43.6 | 40.1 | 38.3 | 42.5 |
| 3 or 4 | 39.7 | 38.7 | 38.0 | 43.0 | 41.0 | 39.0 | 42.5 |
| 1 or 2 | 40.0 | 38.0 | 39.0 | 44.0 | 41.0 | 38.0 | 43.5 |
| AV. LEAD (−) OR LAG (+) | | | | | | | |
| At reference peaks | | | | | | | |
| N | +3.2 | +1.9 | −5.8 | −5.6 | −10.4 | −0.1 | +7.8 |
| N−2 | +2.7 | +2.2 | −5.7 | −5.5 | −10.5 | +0.1 | +7.6 |
| N−4 | +2.2 | +2.0 | −5.3 | −5.2 | −10.7 | +0.3 | +7.7 |
| 3 or 4 | +2.0 | +0.7 | −5.2 | −5.7 | −10.7 | 0.0 | +7.0 |
| 1 or 2 | +2.0 | +1.0 | −5.0 | −5.0 | −11.0 | 0.0 | +7.0 |
| At reference troughs | | | | | | | |
| N | −5.8 | −3.4 | −3.0 | −7.4 | −4.6 | +1.5 | +11.8 |
| N−2 | −5.5 | −3.0 | −2.9 | −7.1 | −4.4 | +1.6 | +11.9 |
| N−4 | −5.4 | −2.8 | −2.7 | −7.3 | −4.2 | +1.4 | +12.3 |
| 3 or 4 | −4.7 | −1.8 | −2.7 | −7.5 | −2.8 | +0.7 | +13.5 |
| 1 or 2 | −4.0 | −2.0 | −3.0 | −8.0 | −2.5 | +1.0 | +14.0 |
| AVERAGE AMPLITUDE OF SPECIFIC CYCLES | | | | | | | |
| Rise | | | | | | | |
| N | 26.9 | 62.1 | 213.0 | 35.6 | 98.1 | 115.9 | 10.8 |
| N−2 | 25.9 | 60.5 | 197.4 | 34.0 | 95.7 | 110.4 | 9.9 |
| N−4 | 26.0 | 59.9 | 190.1 | 32.2 | 95.3 | 108.6 | 9.7 |
| 3 or 4 | 25.8 | 58.7 | 177.5 | 29.1 | 99.8 | 95.9 | 9.3 |
| 1 or 2 | 26.8 | 61.9 | 177.3 | 27.4 | 101.6 | 98.0 | 9.4 |
| Fall | | | | | | | |
| N | 13.4 | 54.8 | 211.6 | 31.8 | 92.4 | 116.1 | 12.5 |
| N−2 | 11.0 | 50.3 | 197.7 | 26.6 | 90.2 | 109.8 | 12.0 |
| N−4 | 10.2 | 48.9 | 190.9 | 25.5 | 89.6 | 108.6 | 11.7 |
| 3 or 4 | 9.3 | 51.4 | 175.9 | 25.4 | 83.9 | 106.7 | 10.9 |
| 1 or 2 | 9.7 | 50.0 | 169.3 | 25.0 | 83.8 | 101.6 | 10.8 |
| Rise & fall | | | | | | | |
| N | 40.2 | 116.8 | 424.5 | 67.3 | 190.5 | 232.0 | 23.3 |
| N−2 | 38.0 | 115.3 | 393.0 | 59.8 | 185.3 | 219.1 | 23.2 |
| N−4 | 36.5 | 113.0 | 378.4 | 57.4 | 183.8 | 215.1 | 22.6 |
| 3 or 4 | 37.5 | 105.9 | 341.9 | 47.3 | 181.1 | 187.8 | 22.4 |
| 1 or 2 | 36.5 | 106.5 | 334.5 | 46.8 | 181.2 | 187.4 | 22.6 |

TABLE 187—*Continued*

Several Positional Arithmetic Means
Duration, Timing and Amplitude of Specific Cycles
Seven American Series

| Measure and no. of items averaged[a] | Deflated clearings | Pig iron production | Freight car orders | Railroad stock prices | Shares traded | Call money rates | Railroad bond yields |
|---|---|---|---|---|---|---|---|
| AVERAGE AMPLITUDE OF SPECIFIC CYCLES—*Continued* | | | | | | | |
| Rise per month[b] | | | | | | | |
| N | 0.83 | 2.42 | 22.56 | 1.43 | 7.63 | 6.88 | 0.57 |
| N−2 | 0.82 | 2.32 | 13.53 | 1.36 | 7.05 | 6.28 | 0.52 |
| N−4 | 0.82 | 2.20 | 12.89 | 1.35 | 6.70 | 6.03 | 0.51 |
| 3 or 4 | 0.83 | 1.97 | 10.83 | 1.32 | 6.10 | 5.63 | 0.45 |
| 1 or 2 | 0.80 | 2.00 | 10.80 | 1.30 | 6.20 | 5.60 | 0.45 |
| Fall per month[b] | | | | | | | |
| N | 1.93 | 4.67 | 11.74 | 1.69 | 4.09 | 7.63 | 0.86 |
| N−2 | 1.22 | 4.51 | 10.51 | 1.59 | 3.88 | 7.29 | 0.71 |
| N−4 | 1.01 | 4.39 | 10.30 | 1.56 | 3.90 | 6.98 | 0.65 |
| 3 or 4 | 0.97 | 4.10 | 9.10 | 1.30 | 3.63 | 6.40 | 0.52 |
| 1 or 2 | 1.00 | 4.20 | 9.10 | 1.30 | 3.60 | 6.50 | 0.50 |
| Rise & fall per month[b] | | | | | | | |
| N | 0.94 | 2.87 | 13.20 | 1.44 | 4.56 | 6.28 | 0.63 |
| N−2 | 0.93 | 2.83 | 10.67 | 1.42 | 4.50 | 6.12 | 0.61 |
| N−4 | 0.92 | 2.80 | 10.23 | 1.42 | 4.50 | 6.05 | 0.58 |
| 3 or 4 | 0.90 | 2.67 | 9.57 | 1.42 | 4.57 | 5.97 | 0.48 |
| 1 or 2 | 0.90 | 2.60 | 9.50 | 1.40 | 4.60 | 6.00 | 0.50 |

All durations are expressed in months, amplitudes in specific-cycle relatives.

[a] That is, number of central items in array that are averaged. N stands for the full number of cyclical observations on the series, as shown in Tables 140 and 141. See text for full explanation of symbols. For cycle-by-cycle measures other than the per month amplitudes, see Appendix Tables B1 and B3.

[b] Unweighted average.

of averages we take. We deem it a better general rule to use fully the comparatively few cyclical observations available for a series than to conjecture that an item that looks extreme would continue to appear in the same light if the series covered two or three times as many cycles.

Table 186 measures the influence exercised on some of our cyclical averages by the highest and lowest items found in the different arrays. This influence is disconcerting at times. For example, the average rise per month during expansions of freight car orders is 22.6 points for the nineteen specific cycles from 1870 to 1933; the average falls to 13.0 when the peculiar expansion lasting one quarter in 1918 is left out. Again, the average fall per month in deflated clearings is 1.9 points for the fifteen specific cycles from 1878 to 1933, but is only 1.2 points when the brief and violent contraction of 1907 is excluded. It is plain that 'extreme' values sometimes dominate the averages, and that they frequently make their influence felt. Nevertheless, the relations among the averages of the seven series in our sample are much the same whether the averages include all items or exclude on a uniform plan the highest or lowest values. Of course, these results would be blurred if the experiment were based on shorter series, if seventy series were compared instead of seven, or if the highest value or two were excluded in some instances and the lowest value or two in others—which we might well do if we knew enough about the play of 'random forces' on the cyclical behavior of different series.

Sometimes statisticians employ positional means as a device for eliminating or reducing the influences of extreme values, and we ourselves have used this device in making seasonal indexes.[15] But it seems sounder practice to proceed cautiously and discriminatingly in each instance than to exclude throughout some fixed number of values at both ends of arrays.[16] Not infrequently these values are extreme only in the sense that they occupy the inescapable first and last places of a variable series, or they are truly extreme at one end but not at the other. To lop off values at both ends of an array by mechanical rule is to discard information indiscriminately.

It is of some interest, however, to compare our standard results with those yielded by positional means. The averages in Table 187 are made from arrays, that is, from cyclical measures arranged in order of size. They show the average duration, timing and amplitude of the specific cycles in the seven series we have been using for experimental purposes. One average is based on $N$ items; that is, it includes all observations on the series. A second includes the middle $(N-2)$ items; that is, the lowest and highest values are excluded. A third includes the middle $(N-4)$; that is, the lowest and highest two values are excluded. The fourth includes the middle three or four items according as the number of cyclical observations is odd or even. The fifth is the median; it includes solely the middle item when the number of observations is odd and the middle two items when the number is even.[17]

If we may judge from Table 187, the exclusion of the single highest and lowest values usually has a slight effect on cyclical averages. The effect is somewhat larger when the highest and lowest two values are omitted, but even these exclusions do not affect materially the relations among the averages. Our samples indicate that if we omitted the extremes at both ends of arrays, average measures of cyclical duration and amplitude, though not of timing, would be far more often below than above the averages we actually make, but the relations among the averages for different series would be substantially the same. Even average durations of full specific cycles, which do not differ significantly among our series, repeat much the same order in the positional as in the full means. Of

15 In this operation a judgment factor still enters; that is, in deciding what number of central values are to be averaged. See p. 46.

16 To be sure, mechanical rules have some advantage when work must move speedily, or when expert assistance is not available.

17 These several averages may be regarded as members of a family of positional arithmetic means, of which the arithmetic mean of ordinary usage includes the maximum number and the median the minimum number of central values in an array. It may be noted parenthetically that this statement defines the median unambiguously.

course, when only one or two central items are included in positional means, greater differences appear. But medians are not formidable rivals of arithmetic means when arrays are short and the gaps between successive values erratic, which is the typical occurrence in our tables of cyclical measures. Despite their greater roughness, the medians rarely differ in order of magnitude from the arithmetic means. Further, the rankings of the medians and the arithmetic means are very similar.

Tables 188-189 and Charts 75-76 illustrate the effects of different methods of averaging on our cyclical patterns. Once again, the shapes of the patterns are substantially the same whether we use all items in making averages or drop one to two values at the ends of the arrays.[18] Even the median patterns of the specific cycles rarely differ radically from the mean patterns.[19] They move in the same directions throughout. Now and then, one pattern shows acceleration and the other retardation; in such instances the cycle-by-cycle measures usually confirm the mean pattern. The median reference-cycle pattern of some series diverges sharply from the mean pattern, especially at the turns. But once again, when the two move in different directions or when one pattern shows acceleration and the other retardation, the cycle-by-cycle measures usually confirm the mean pattern.[20] We conclude that, on the whole, the mean patterns are more faithful representatives of cyclical behavior than the median patterns.

The preceding tests are based upon samples that include a larger number of cycles than most series in our collection. For this reason we make similar tests for smaller groups of cycles in Table 190. Of course, the omission of one or two values at the extremes of an array can make a greater difference when there are six cycles than when there are three times as many. To exclude the highest and lowest two values in a series of five or six items is to convert means into medians. Few of the results for small groups are modified drastically by changing the form of the average; yet the table demonstrates vividly the instability of small samples.

We have already noted that the means of cyclical durations and amplitudes tend to decline as the number of central items included diminishes.

18 Such results may, of course, be expected even for reference cycles of random series.

19 As noted on the chart we use the mean (arithmetic average) intervals between cycle stages in plotting the median as well as the mean patterns. The reason medians of the intervals are not used is that they bear no determinate relation to the median duration of full cycles. This difficulty is shared by positional means generally and is a serious inconvenience in handling measures that bear additive relations to one another, such as durations of cyclical phases, durations of intervals between cycle stages, and amplitudes of cycle phases.

The charts also show average deviations of the patterns about their means. When the average deviation is small, the mean and median must be close together. When the average deviation is large, we cannot tell whether exclusion of items at the ends of arrays will affect the results much or little; but large average deviations are always a warning that the full mean may misrepresent the central tendency of the observations.

20 We omit the detailed evidence supplied by our standard Tables S5 and R2 and first differences of the entries in those tables.

TABLE 188

Several Positional Arithmetic Means of Specific-cycle Patterns

Seven American Series

| Series and no. of items averaged[a] | Average in specific-cycle relatives at stage | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | I | II | III | IV | V | VI | VII | VIII | IX |
| | Initial trough (3 mos.) | Expansion | | | Peak (3 mos.) | Contraction | | | Terminal trough (3 mos.) |
| | | First third | Middle third | Last third | | First third | Middle third | Last third | |
| **Deflated clearings** | | | | | | | | | |
| 15...... | 85.7 | 90.5 | 99.2 | 106.7 | 112.6 | 108.7 | 106.0 | 101.9 | 99.2 |
| 13...... | 85.8 | 90.9 | 99.1 | 106.4 | 111.8 | 108.2 | 105.4 | 102.2 | 99.9 |
| 11...... | 85.9 | 91.2 | 99.0 | 106.4 | 111.3 | 108.2 | 105.4 | 102.5 | 100.3 |
| 3...... | 85.7 | 91.9 | 98.6 | 106.6 | 110.1 | 107.8 | 104.5 | 103.7 | 101.6 |
| 1...... | 85.5 | 91.7 | 98.5 | 106.8 | 110.0 | 108.0 | 104.4 | 103.8 | 100.5 |
| **Pig iron production** | | | | | | | | | |
| 15...... | 67.3 | 82.5 | 103.7 | 116.5 | 129.3 | 122.6 | 108.2 | 88.4 | 74.6 |
| 13...... | 65.1 | 81.1 | 101.8 | 114.5 | 127.5 | 122.8 | 109.8 | 91.2 | 76.0 |
| 11...... | 64.1 | 81.3 | 101.6 | 114.5 | 127.0 | 122.7 | 111.3 | 93.9 | 77.3 |
| 3...... | 64.8 | 82.6 | 100.4 | 113.4 | 126.9 | 121.7 | 113.3 | 91.4 | 76.3 |
| 1...... | 67.0 | 83.5 | 101.2 | 113.1 | 127.7 | 122.2 | 113.5 | 90.2 | 76.8 |
| **Freight car orders** | | | | | | | | | |
| 19...... | 29.5 | 66.3 | 104.5 | 136.8 | 242.5 | 112.6 | 100.2 | 72.2 | 30.9 |
| 17...... | 27.6 | 64.1 | 97.0 | 126.1 | 227.9 | 115.3 | 100.9 | 70.9 | 29.4 |
| 15...... | 26.1 | 63.7 | 95.2 | 123.4 | 221.4 | 117.6 | 102.4 | 71.3 | 27.6 |
| 3...... | 19.8 | 53.7 | 95.2 | 122.2 | 201.9 | 123.5 | 98.7 | 64.5 | 26.8 |
| 1...... | 19.4 | 54.5 | 97.2 | 123.0 | 202.4 | 123.1 | 94.6 | 62.4 | 26.1 |
| **Railroad stock prices** | | | | | | | | | |
| 18...... | 82.8 | 88.0 | 98.8 | 110.8 | 118.3 | 112.4 | 103.2 | 94.0 | 86.6 |
| 16...... | 83.2 | 88.6 | 99.3 | 110.1 | 116.7 | 111.4 | 102.3 | 95.6 | 89.1 |
| 14...... | 84.0 | 89.5 | 99.9 | 109.5 | 115.6 | 110.5 | 101.9 | 94.8 | 89.4 |
| 4...... | 84.3 | 90.1 | 100.7 | 108.2 | 114.4 | 109.6 | 100.7 | 94.4 | 89.5 |
| 2...... | 84.8 | 90.5 | 100.9 | 108.0 | 114.7 | 109.4 | 100.8 | 94.8 | 89.6 |
| **Shares traded** | | | | | | | | | |
| 15...... | 55.4 | 79.7 | 106.5 | 119.0 | 153.4 | 119.7 | 100.4 | 81.6 | 61.0 |
| 13...... | 55.8 | 79.4 | 106.3 | 116.4 | 151.0 | 119.5 | 100.6 | 81.1 | 60.7 |
| 11...... | 56.0 | 78.9 | 107.2 | 114.6 | 148.8 | 119.4 | 100.8 | 80.6 | 60.6 |
| 3...... | 57.0 | 76.3 | 108.0 | 111.7 | 149.5 | 119.6 | 100.5 | 79.1 | 61.7 |
| 1...... | 57.2 | 76.3 | 109.3 | 110.2 | 151.0 | 120.0 | 100.3 | 78.7 | 60.2 |
| **Call money rates** | | | | | | | | | |
| 23...... | 62.1 | 80.3 | 104.7 | 123.2 | 178.0 | 120.4 | 89.9 | 71.8 | 61.9 |
| 21...... | 61.5 | 79.5 | 104.1 | 123.8 | 171.8 | 120.0 | 89.7 | 70.7 | 60.1 |
| 19...... | 61.4 | 79.7 | 103.6 | 123.8 | 170.9 | 119.5 | 90.8 | 70.8 | 60.1 |
| 3...... | 63.4 | 79.1 | 105.5 | 122.3 | 164.1 | 116.4 | 99.3 | 71.0 | 60.7 |
| 1...... | 63.2 | 79.7 | 106.4 | 121.5 | 163.8 | 115.5 | 99.2 | 69.4 | 59.7 |
| **Railroad bond yields** | | | | | | | | | |
| 20...... | 96.1 | 98.4 | 101.5 | 104.0 | 106.9 | 103.7 | 100.6 | 96.9 | 94.3 |
| 18...... | 96.6 | 98.8 | 101.5 | 103.9 | 106.9 | 103.6 | 100.5 | 97.1 | 94.7 |
| 16...... | 96.6 | 98.6 | 101.4 | 103.8 | 106.8 | 103.6 | 100.4 | 97.0 | 94.8 |
| 4...... | 96.7 | 98.6 | 101.2 | 103.6 | 106.7 | 103.4 | 99.8 | 97.0 | 94.4 |
| 2...... | 97.0 | 98.8 | 101.3 | 103.6 | 106.5 | 103.5 | 99.8 | 97.1 | 94.4 |

[a] That is, number of central items in array that are averaged. The average on the first line for each series includes all cycles in the series. For the periods covered, see Chart 75; for the cycle-by-cycle patterns, Appendix Table B1.

atterns

| VIII | IX |
|---|---|
| Last third | Terminal trough (3 mos.) |
| 101.9 | 99.2 |
| 102.2 | 99.9 |
| 102.5 | 100.3 |
| 103.7 | 101.6 |
| 103.8 | 100.5 |
| 88.4 | 74.6 |
| 91.2 | 76.0 |
| 93.9 | 77.3 |
| 91.4 | 76.3 |
| 90.2 | 76.8 |
| 72.2 | 30.9 |
| 70.9 | 29.4 |
| 71.3 | 27.6 |
| 64.5 | 26.8 |
| 62.4 | 26.1 |
| 94.0 | 86.6 |
| 95.6 | 89.1 |
| 94.8 | 89.4 |
| 94.4 | 89.5 |
| 94.8 | 89.6 |
| 81.6 | 61.0 |
| 81.1 | 60.7 |
| 80.6 | 60.6 |
| 79.1 | 61.7 |
| 78.7 | 60.2 |
| 71.8 | 61.9 |
| 70.7 | 60.1 |
| 70.8 | 60.1 |
| 71.0 | 60.7 |
| 69.4 | 59.7 |
| 96.9 | 94.3 |
| 97.1 | 94.7 |
| 97.0 | 94.8 |
| 97.0 | 94.4 |
| 97.1 | 94.4 |

ach series includes
ppendix Table B1.



TABLE 189

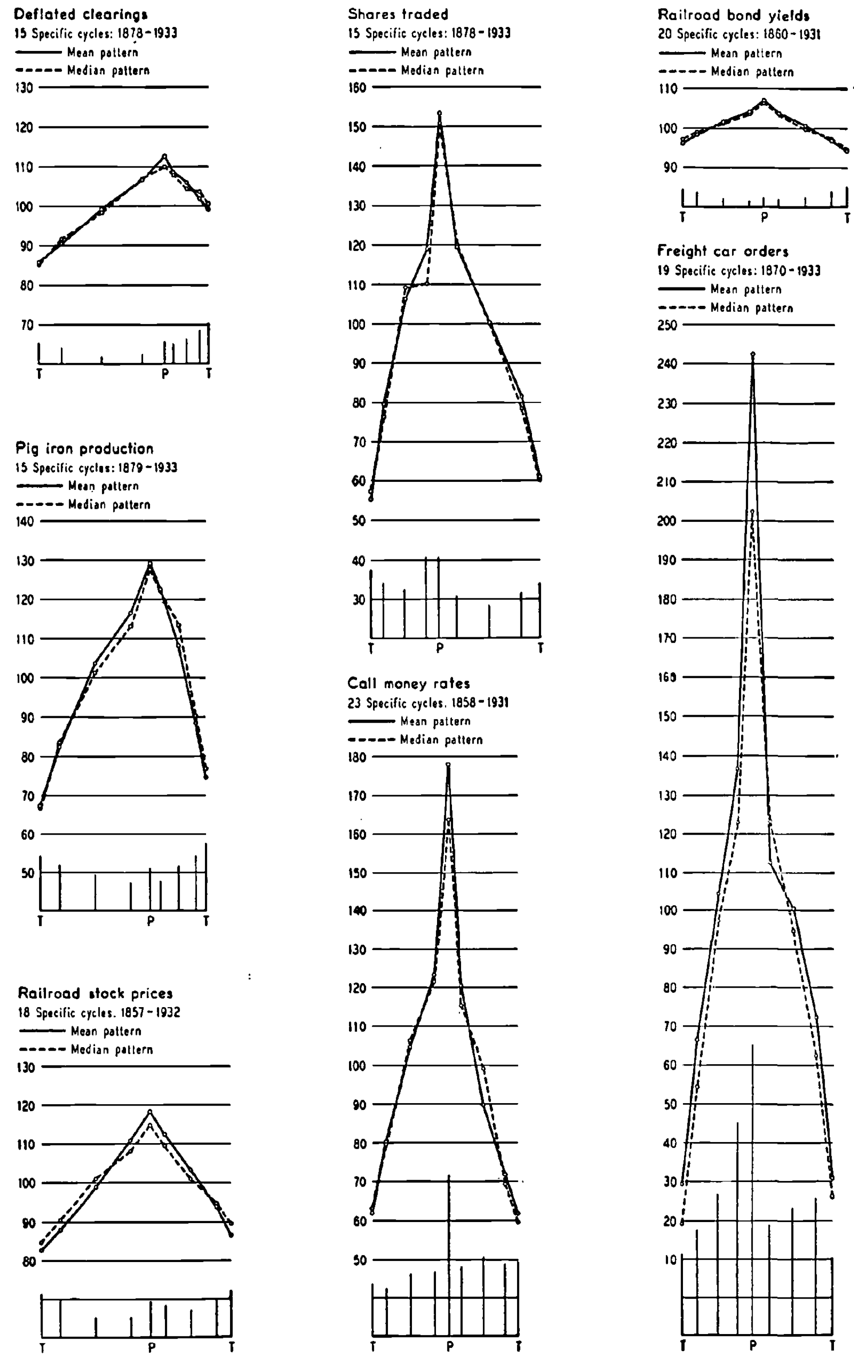
Several Positional Arithmetic Means of Reference-cycle Patterns
Seven American Series

| Series and no. of items averaged[a] | Average in reference-cycle relatives at stage | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | I | II | III | IV | V | VI | VII | VIII | IX |
| | Initial trough (3 mos.) | Expansion | | | Peak (3 mos.) | Contraction | | | Terminal trough (3 mos.) |
| | | First third | Middle third | Last third | | First third | Middle third | Last third | |
| Deflated clearings | | | | | | | | | |
| 15...... | 88.1 | 94.0 | 98.4 | 105.2 | 107.5 | 106.7 | 102.3 | 99.5 | 100.6 |
| 13...... | 88.0 | 93.5 | 98.1 | 104.5 | 107.5 | 106.6 | 102.8 | 100.5 | 102.3 |
| 11...... | 88.2 | 93.5 | 98.1 | 104.4 | 107.2 | 106.5 | 102.8 | 100.7 | 102.5 |
| 3...... | 88.0 | 92.9 | 98.2 | 104.1 | 106.9 | 106.2 | 102.8 | 101.6 | 103.5 |
| 1...... | 87.6 | 92.9 | 97.9 | 103.9 | 106.9 | 107.1 | 102.9 | 101.2 | 103.6 |
| Pig iron production | | | | | | | | | |
| 15...... | 73.3 | 90.0 | 103.5 | 112.5 | 122.2 | 117.6 | 100.4 | 84.8 | 81.1 |
| 13...... | 71.8 | 89.0 | 101.4 | 110.6 | 119.8 | 117.2 | 101.3 | 87.0 | 83.6 |
| 11...... | 70.5 | 87.8 | 100.8 | 110.6 | 118.9 | 116.9 | 102.1 | 89.1 | 85.0 |
| 3...... | 71.3 | 88.8 | 99.5 | 110.0 | 119.4 | 115.5 | 105.3 | 95.3 | 87.8 |
| 1...... | 71.3 | 89.7 | 99.2 | 109.4 | 120.0 | 115.7 | 103.7 | 95.7 | 87.4 |
| Freight car orders | | | | | | | | | |
| 16...... | 76.0 | 82.1 | 112.9 | 136.8 | 122.3 | 93.8 | 62.0 | 64.1 | 89.2 |
| 14...... | 65.9 | 83.6 | 116.1 | 137.8 | 123.2 | 90.8 | 62.3 | 60.6 | 76.9 |
| 12...... | 62.7 | 85.5 | 115.7 | 139.0 | 124.8 | 87.1 | 63.7 | 59.5 | 76.9 |
| 4...... | 57.4 | 92.4 | 113.7 | 140.0 | 131.0 | 83.5 | 63.4 | 56.2 | 72.4 |
| 2...... | 57.8 | 96.0 | 112.6 | 137.4 | 139.3 | 82.8 | 62.7 | 56.3 | 76.3 |
| Railroad stock prices | | | | | | | | | |
| 19...... | 91.0 | 96.9 | 104.0 | 109.4 | 106.9 | 104.3 | 97.7 | 92.5 | 94.7 |
| 17...... | 91.0 | 97.0 | 103.3 | 108.5 | 105.2 | 102.7 | 97.5 | 94.4 | 96.8 |
| 15...... | 91.2 | 96.7 | 103.1 | 108.2 | 105.2 | 102.9 | 97.5 | 94.4 | 95.9 |
| 3...... | 91.1 | 96.0 | 102.3 | 108.7 | 105.8 | 101.2 | 96.9 | 93.8 | 95.0 |
| 1...... | 87.6 | 95.4 | 102.2 | 109.0 | 105.6 | 100.7 | 97.7 | 93.9 | 94.8 |
| Shares traded | | | | | | | | | |
| 15...... | 83.8 | 111.2 | 110.9 | 114.0 | 110.6 | 96.8 | 90.5 | 79.5 | 97.5 |
| 13...... | 84.2 | 108.5 | 110.7 | 113.7 | 110.5 | 96.2 | 90.6 | 77.3 | 94.2 |
| 11...... | 84.0 | 104.7 | 111.3 | 113.7 | 110.1 | 95.3 | 91.3 | 75.7 | 92.3 |
| 3...... | 83.1 | 100.1 | 109.1 | 111.0 | 113.7 | 95.1 | 89.7 | 76.5 | 89.1 |
| 1...... | 81.2 | 97.7 | 107.8 | 111.0 | 113.7 | 95.6 | 88.1 | 76.3 | 88.1 |
| Call money rates | | | | | | | | | |
| 19...... | 77.5 | 82.4 | 98.4 | 128.2 | 159.5 | 128.5 | 103.9 | 81.1 | 76.2 |
| 17...... | 77.2 | 81.8 | 96.3 | 123.9 | 143.6 | 128.4 | 101.1 | 79.6 | 74.0 |
| 15...... | 76.7 | 81.0 | 95.0 | 119.9 | 142.4 | 127.0 | 96.7 | 79.3 | 74.2 |
| 3...... | 74.5 | 85.6 | 92.0 | 118.3 | 132.7 | 118.4 | 99.3 | 79.5 | 77.2 |
| 1...... | 74.6 | 85.7 | 92.4 | 118.2 | 136.2 | 119.3 | 100.9 | 79.8 | 76.7 |
| Railroad bond yields | | | | | | | | | |
| 19...... | 102.0 | 100.5 | 98.3 | 98.9 | 101.0 | 102.0 | 101.5 | 101.1 | 100.2 |
| 17...... | 101.9 | 100.3 | 98.5 | 99.0 | 100.6 | 101.8 | 101.4 | 101.2 | 100.4 |
| 15...... | 101.8 | 100.0 | 98.5 | 98.6 | 100.2 | 101.5 | 101.4 | 101.2 | 100.4 |
| 3...... | 101.6 | 101.1 | 97.8 | 98.4 | 99.4 | 101.5 | 101.7 | 101.0 | 99.8 |
| 1...... | 102.3 | 100.7 | 97.8 | 98.3 | 99.4 | 101.4 | 101.8 | 100.8 | 99.8 |

[a] That is, number of central items in array that are averaged. The average on the first line for each series includes all cycles in the series. For the periods covered, see Chart 76; for the cycle-by-cycle patterns, Appendix Table B3.

CHART 75

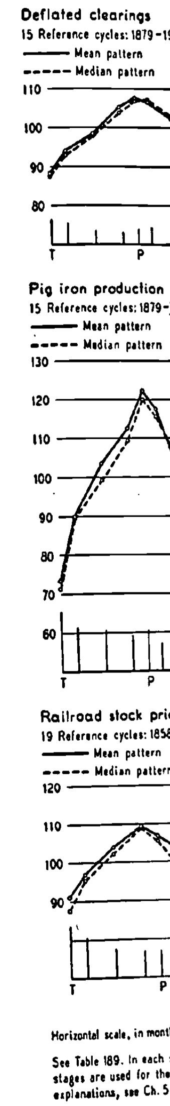
## Mean and Median Specific-cycle Patterns
### Seven American Series




Horizontal scale, in months 0 12 24 36 48 60

See Table 188. In each series the mean (arithmetic average) intervals between cycle stages are used for the median pattern as well as for the mean pattern. For other explanations, see Ch. 5, Sec. VI.





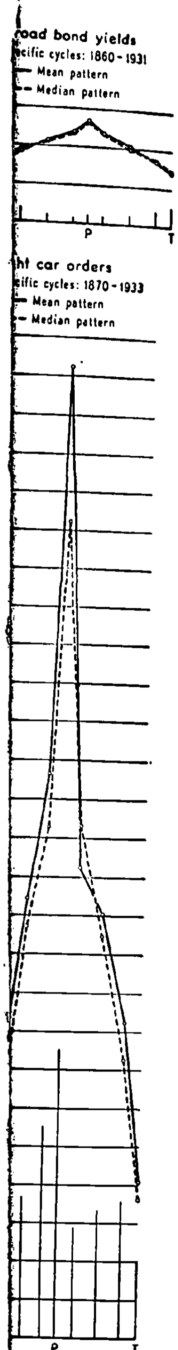
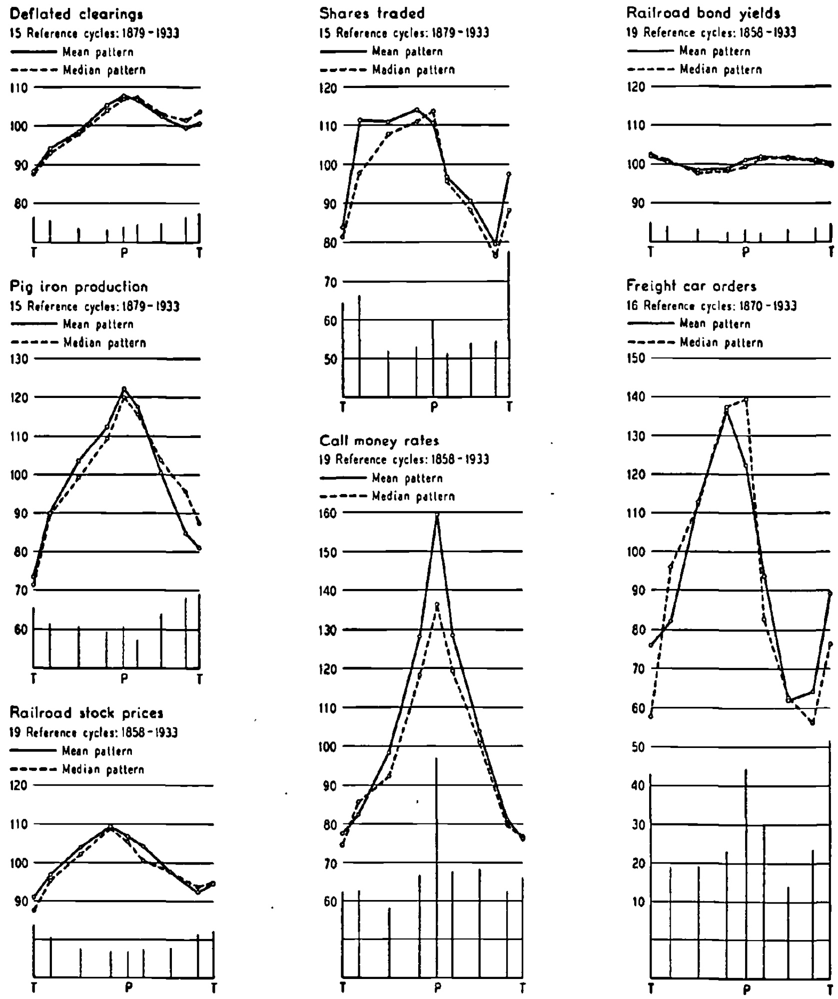



CHART 76

Mean and Median Reference-cycle Patterns
Seven American Series




Horizontal scale, in months 0 12 24 36 48 60

See Table 189. In each series the mean (arithmetic average) intervals between cycle stages are used for the median pattern as well as for the mean pattern. For other explanations, see Ch. 5, Sec. VII.

TABLE 190

Several Positional Arithmetic Means
Duration and Amplitude of Small Groups of Specific Cycles
Seven American Series

| Series and period covered | No. of specific cycles (N) | Average duration of full cycles in months | | | Average amplitude in specific-cycle relatives | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Rise & fall | | | Per month rise & fall[a] | | |
| | | N items | Middle (N−2) items | Middle (N−4) items | N items | Middle (N−2) items | Middle (N−4) items | N items | Middle (N−2) items | Middle (N−4) items |
| Deflated clearings | | | | | | | | | | |
| 1878–1893 | 5 | 37 | 37 | 36 | 42 | 41 | 43 | 1.1 | 1.2 | 1.1 |
| 1893–1910 | 5 | 41 | 41 | 43 | 37 | 36 | 34 | 0.9 | 0.9 | 0.9 |
| 1910–1933 | 5 | 54 | 42 | 49 | 41 | 31 | 25 | 0.8 | 0.8 | 0.8 |
| Pig iron production | | | | | | | | | | |
| 1879–1896 | 5 | 43 | 37 | 37 | 107 | 99 | 98 | 2.8 | 2.9 | 2.6 |
| 1896–1914 | 5 | 44 | 45 | 48 | 113 | 110 | 106 | 2.6 | 2.5 | 2.6 |
| 1914–1933 | 5 | 44 | 43 | 40 | 131 | 134 | 132 | 3.2 | 3.2 | 3.1 |
| Freight car orders | | | | | | | | | | |
| 1870–1894 | 6 | 48 | 45 | 46 | 421 | 383 | 386 | 9.7 | 8.1 | 7.9 |
| 1894–1914 | 6 | 40 | 41 | 42 | 319 | 322 | 315 | 8.3 | 8.0 | 7.8 |
| 1914–1933 | 7 | 32 | 29 | 28 | 518 | 436 | 438 | 20.4 | 14.0 | 12.9 |
| Railroad stock prices | | | | | | | | | | |
| 1857–1889 | 6 | 63 | 53 | 46 | 76 | 76 | 71 | 1.5 | 1.4 | 1.4 |
| 1889–1907 | 6 | 37 | 39 | 43 | 52 | 52 | 49 | 1.4 | 1.4 | 1.4 |
| 1907–1932 | 6 | 49 | 41 | 38 | 74 | 44 | 43 | 1.4 | 1.4 | 1.4 |
| Shares traded | | | | | | | | | | |
| 1878–1897 | 5 | 46 | 39 | 37 | 148 | 146 | 145 | 3.6 | 3.8 | 4.3 |
| 1897–1914 | 5 | 42 | 42 | 42 | 220 | 205 | 197 | 5.2 | 5.0 | 4.7 |
| 1914–1933 | 5 | 44 | 38 | 40 | 204 | 211 | 213 | 4.9 | 5.0 | 5.1 |
| Call money rates | | | | | | | | | | |
| 1858–1880 | 7 | 38 | 38 | 40 | 218 | 158 | 140 | 5.9 | 5.0 | 5.5 |
| 1880–1904 | 8 | 36 | 37 | 36 | 289 | 293 | 304 | 8.4 | 8.3 | 8.0 |
| 1904–1931 | 8 | 40 | 40 | 40 | 187 | 163 | 156 | 4.5 | 4.2 | 4.0 |
| Railroad bond yields | | | | | | | | | | |
| 1860–1876 | 6 | 32 | 32 | 29 | 27 | 28 | 26 | 0.9 | 0.9 | 1.0 |
| 1876–1905 | 7 | 49 | 48 | 47 | 20 | 20 | 20 | 0.4 | 0.4 | 0.4 |
| 1905–1931 | 7 | 45 | 46 | 45 | 24 | 22 | 23 | 0.6 | 0.5 | 0.5 |

Averages are derived from arrays: the average based on the middle (N−2) items excludes the single highest and lowest items, and so on.

[a] Unweighted average.

This tendency indicates a 'skew' towards the higher values.[21] The distributions of durations of business cycles resemble those of specific cycles, in that both are skewed positively.[22] In part these results flow from our method of marking off business and specific cycles; that is, we have a rigid

[21] When the highest single value of an array deviates from the mean by more than the lowest single value, the mean with these extremes omitted must be smaller than the full mean; the decline in the average is indicative of a skew towards the higher values. Similarly, when the mean of the values above the median deviates from the mean of the full array by more than the mean of the values below the median, the median must be lower than the full mean; the fact that it is lower is again indicative, though more definitely since the base is broader, of a skew towards the upper ranges.

[22] See above, Tables 168 and 185; also Mitchell, *Business Cycles: The Problem and Its Setting*, pp. 416-24.

lower limit b
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limit formall
tremely large
limitations o
positive skew
statements m
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terns, we sho
dreds, rather
least at this s
cise figures;
former. Som
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23 There is a sli
and a strong te
joint rise and fa

24 Cf. Ch. 5, Sec

lower limit but no rigid upper limit to the duration of movements that we recognize as cycles. In the case of cyclical amplitudes we fix no lower limit formally, but our technique is inherently more sensitive to extremely large than to extremely small amplitudes.[23] When there are no limitations of this character, as happens in the timing measures, we find positive skewness no more frequently than negative skewness. But these statements merely scratch the surface of the problem raised by the asymmetries, and we must postpone full analysis. The one point we wish to stress now is that when we find skewness in distributions of cyclical measures, it is rarely so marked as to destroy the usefulness of arithmetic means as rough measures of central tendency.

At the same time we recognize that the samples of cycles covered by our collection of time series are often unstable to a disconcerting degree. In dealing with the amplitudes of specific cycles and with cyclical patterns, we should often count by tens and in extreme instances by hundreds, rather than by integers or decimals. The significant matters—at least at this stage of our work—are, usually, orders of magnitude, not precise figures; the latter often have little value except as guides to the former. Sometimes we regard only the average deviations showing the variability from cycle to cycle as significant, while the averages serve merely as a base from which to measure deviations. To show that the movements of a given factor with respect to business cycles vary within wide limits is an important result, and one that can often be established from a relatively slender sample.

## IV Causal Interpretation of Averages

If the analysis of this and the two preceding chapters is valid, our averages may, with the exercise of due caution, be treated as representatives of the cyclical movements that characterize different activities, and the average deviations as representatives of the variability of cyclical measures around fairly stationary means. It is tempting to pass from this statement to another, namely, that averages represent roughly the effects of cyclical forces and that average deviations represent the effects of random forces. Such statements do no harm if carefully interpreted, but they are easily misconstrued and therefore best avoided.[24]

For example, Chart 77 shows clear-cut specific-cycle patterns in crop production in the United States and Great Britain. But the reference-cycle patterns in both countries are nearly straight lines, their slopes reflecting mainly the upward trend of the American series and the down-

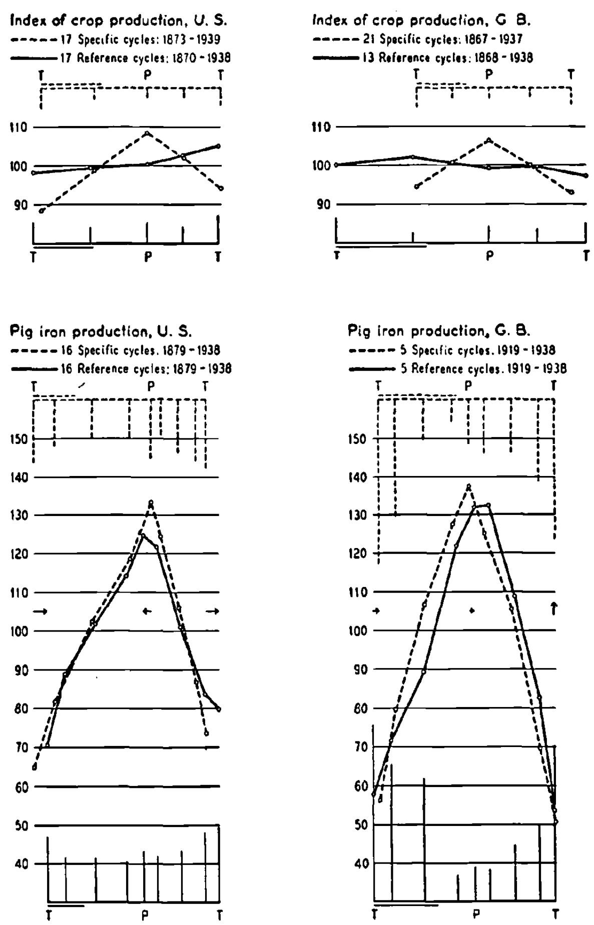
23 There is a slight tendency for the standings of specific cycles to be skewed negatively at troughs and a strong tendency for the standings to be skewed positively at peaks; while the rise, fall, and joint rise and fall of the specific cycles tend to be skewed positively (Tables 187-188).

24 Cf. Ch. 5, Sec. VII.

ward trend of the British. The relation between the specific- and reference-cycle patterns indicates that in each country the specific cycles of crop output have been virtually independent in time of business cycles. It is clear therefore that we cannot regard the specific-cycle averages as measuring the effects of business-cycle forces. We might say that they measure the effects of specific-cycle forces. In that case we should have to include variations in growing conditions (the vagaries of the weather,

CHART 77

Average Cyclical Patterns of Crop and Pig Iron Production
United States and Great Britain




Horizontal scale, in months 0 12 24 36 48 60

→ Indicates lead at reference peaks, or troughs; ← lag at reference peaks; ↑ rough coincidence at reference troughs.

The two crop series are annual; hence the five-point patterns. For sources of data, see Appendix C; for explanation of chart, Ch. 5, Sec. VIII and XI.

plant diseases, insects, and so on) as well as variations in the activities of farmers among specific-cycle forces. But variations in growing conditions are usually classed as random perturbations; if we treat them as such we should have to say that random factors enter substantially into the specific-cycle averages, whether or not rhythmic tendencies characterize the activities of farmers.

As another example, let us take the cyclical behavior of pig iron production in the United States and Great Britain (Chart 77). Now we find that the reference-cycle pattern resembles the specific-cycle pattern very closely in each country. But if we interpret the average reference-cycle pattern as representing business-cycle influences, that precludes an identical interpretation of the specific-cycle pattern. For if the first interpretation is valid, the specific-cycle pattern must contain a random component measured roughly by the difference between the two patterns. We might say that the specific-cycle averages represent specific-cycle forces, but that statement of itself adds nothing to knowledge. We might say instead that business-cycle forces dominate while random forces have little influence on the specific cycles of pig iron production. Even this statement involves many assumptions; among others, (1) that random factors have slight influence upon the timing of business cycles, (2) that variations in the timing of iron production at business-cycle turns do not arise from variations in business-cycle forces, (3) that the timing of random perturbations affecting iron production is uncorrelated with the timing of business cycles, (4) that random perturbations influence the amplitude and pattern of specific cycles as little as they influence their timing in regard to business cycles. Although assumptions of this type may be an intellectual convenience at certain stages of an argument, it is well to recognize that they bury important problems.

In general, when business-cycle influences dominate the movements of a series and random influences count for little, the average specific- and reference-cycle patterns should be closely similar. But we must not lose sight of the fact that similarity might also be produced by factors peculiar to a series, if their influence happens to correspond closely in timing with the cyclical tides of general business. Similarity may also be produced by random influences that affect the same way both the cyclical tides of general business and the specific cycles of the series. On the other hand, wide differences between the two cyclical patterns need not mean that random influences are dominant. For such differences might have been produced by rhythmic specific-cycle influences that are independent of business cycles rather than by random influences. Sometimes the two patterns may appear rather different at first sight though a series is dominated by business cycles, as when it participates in business cycles by rising in the late stages of reference contractions and the early stages of reference expansions, and falling in the late stages of reference expansions and the early stages of reference contractions. However, when the relation is of this type the amplitude of the reference-cycle pattern should approach that of the specific-cycle pattern.

These remarks indicate a few of the difficulties in interpreting averages and average deviations in causal terms. Averages and average deviations provide materials for studying the effects of business-cycle and random forces; they do not solve this problem. Nor can we work with a simple dichotomy of causal factors, unless we assume that secular factors can never express themselves independently of cyclical factors, and treat as random all factors, other than business cycles, that 'produce' specific cycles. From the point of view of a business-cycle theory that puts the subject in a box by itself, these assumptions may be legitimate; but if one wishes to understand the business cycles of actual experience, it is desirable to get as much insight as possible into the miscellaneous and dim category of factors that seem independent of business cycles, whether their influence is cumulative, haphazard or rhythmic. We shall learn more by discriminating among different influences than by lumping as many as possible under one heading.

If, therefore, we sometimes speak of the differences among successive business cycles as 'random', we merely use a vague shorthand expression. It is conceivable that even wars and variations in rainfall, which we regard as two of the most powerful 'random' disturbances of economic life, have sufficient regularity to be predictable. As we press analysis of the variations among business cycles, we may find many significant differences between cycles that come in times of war and those that come in times of peace, between cycles occurring in times of agricultural prosperity and in times of agricultural depression, between cycles characterized by vigorous revivals in investment and lags in consumption and those characterized by vigorous revivals in consumption and lags in investment, between short and long business cycles, mild and violent cycles, and so on.[25] These alluring investigations must stand over until we have attained a tolerably accurate working knowledge of what cyclical fluctuations are typical in different business processes and their broad interrelations.

## V Test of Consilience among the Results

As stated many times in this book, such knowledge is not easy to attain. The more we have studied business cycles the more we have become convinced of both the importance and the difficulty of determining reliably what cyclical behavior has been characteristic of different economic activities. Theorists sometimes wrangle about questions of fact as if they were problems in metaphysics. Whether and how wage rates conform to busi-

[25] Unfortunately, the small number of cyclical observations places severe limits upon analysis.

ness cycles is a question of fact; so also with building construction, savings, interest rates, and other economic factors. No speculative solution can have any meaning, except as a hypothesis to be tested. To settle these questions of fact, statistics must be marshaled with scientific care, they must be analyzed with the aid of expert knowledge of business processes, and they must be tested for consistency with other leading facts.

Not a few of our time series are rough compilations. Most of them we feel are much too brief for our needs. Our statistical analysis is imperfect: at times the seasonal movements are refractory, now and then the specific cycles are elusive, and there are the many other difficulties on which we have expatiated in preceding chapters. To break through the mist that envelops the facts of cyclical experience, whenever possible we work with several series representing the same process or closely related processes. When results for related series are set side by side, the insufficiencies of our data and methods can to a large extent be overcome. By checking varied bits of evidence against one another, it is usually possible to establish with confidence what cyclical movements are characteristic of different business factors and the relations in time between these movements and business cycles. Where we would be reluctant to generalize on the basis of a single set of fallible observations, the consilience of several sets of observations gives us courage to push forward toward our goal of determining what business cycles are, how they typically run their course, and what tendencies they show toward variation.

Ordinarily we can find several series that represent the behavior of the same economic process in different areas or periods, or of similar economic processes in the same area and period. For example, we have analyzed so far nine series on residential building in the United States. Three show contracts for total residential building in different units—dollar value, square feet of floor space, and number of structures. Another three show separately the value of contracts for one and two family dwellings, apartment houses, and hotels. These six records of contracts by months are supplemented by much longer series of permits for residential building issued annually in Manhattan, Philadelphia and St. Louis. And the American materials are compared with numerous foreign series, some of which measure the volume of residential building completed and thus enable us to observe the stage when construction products are installed. Our analysis of many other business factors is equally detailed. So far we have analyzed eleven series showing purchases or production of railroad equipment, sixteen series on bank clearings or debits, twenty-four on the output of iron and steel, thirteen on stock prices, numerous wholesale price indexes, employment and wage disbursements in upwards of a score of industries, the volume of business estimated in various ways, and so on. Never do two or more samples yield identical results. But when there is marked agreement among the results yielded by several samples, we feel justified in regarding those features of cyclical behavior that characterize the entire group as reliably established. This presumption of reliability is strengthened when the results accord well with *a priori* expectations based upon broader but less exact knowledge, or when they accord well with considerations that come to mind after the statistical analysis is finished, especially when the latter type of confirmation is itself tested by a fresh appeal to facts.

Of course, the test of consistency among different sets of statistical results, or between statistical results and other knowledge, is not limited to cases of agreement. For example, we do not expect exports to have the same relation to domestic cycles in the United States as in Great Britain; we expect new construction and repair work to bear different relations to business cycles; we expect interest rates on 4-6 month loans to behave differently from bond yields; we expect bank clearings in New York City to differ from 'outside' clearings in ways we can define in advance. So too, we expect a combination of similarities and differences to appear when we have series showing physical output, prices, employment, and wage disbursements for a given industry. Our idea of what similarities and differences to expect may be vague when we first make such comparisons; but if we have data of these four types for several industries we can form more definite expectations to test. In a still broader fashion we can tell whether our inclusive measures of production, transportation, employment, prices, inventories, sales, and monetary circulation are consistent with one another.

In the last resort, judgment concerning the significance of our measurements must depend upon the fashion in which they fit together. Whether the conclusions about the cyclical behavior of the processes treated in any one monograph are sound or not can seldom be settled by looking merely at the evidence there presented; almost always the evidence concerning processes treated in other monographs must be considered. A more rigorous test will be supplied by the final volume, where we shall try to weave the many lines of evidence presented in the monographic studies into a systematic account of how business cycles run their course.