Volume Title: What Happens During Business Cycles: A Progress Report

Volume Author/Editor: Wesley Clair Mitchell

Volume Publisher: NBER

Volume ISBN: 0-870-14088-4

Volume URL: http://www.nber.org/books/mitc51-1

Publication Date: 1951

Chapter Title: Our Methods of Measuring Cyclical Behavior

Chapter Author: Wesley Clair Mitchell

Chapter URL: http://www.nber.org/chapters/c3166

Chapter pages in book: (p. 9 - 26)

CHAPTER 3

Our Methods of Measuring Cyclical Behavior

How to prepare these raw materials for use was the next problem. Again we built upon preceding work. But the methods of time-series analysis devised by others were not perfectly suited to our needs, so that we had to make numerous adaptations and some innovations. The basic features of our technique were sketched at the end of *Business Cycles: The Problem and Its Setting.* Its development was supervised by Simon Kuznets for a time; then by Arthur F. Burns, who introduced many improvements and subjected the evolving scheme to numerous tests. Its latest form is set forth at length in *Measuring Business Cycles,* published in 1946. To make what follows intelligible, I must describe briefly parts of the procedure. Readers who wish a fuller account should consult our formidable monograph.

I Specific Cycles

Determining whether a series undergoes seasonal variations, measuring and removing such as appear are the first operations. Next, the seasonally-adjusted data are charted and examined to see whether 'specific cycles' are present. This is our name for wave movements in a time series corresponding in duration to our working concept of business cycles; that is, waves lasting from over one year to ten or twelve years when measured from crest to crest or trough to trough. Such cycles appear plainly in a large majority of the series we have analyzed, but not in all. Examples of the exceptional cases are 'sticky' prices that remain unchanged for long stretches, then suddenly jump to a different level; net gold movements between the United States and the United Kingdom, which fluctuate so choppily

that cycles can hardly be seen; and transit rides in New York City, which shrink appreciably only under the pressure of exceedingly hard times. Presumably a statistician who resorted to smoothing devices or fitted trend lines to the series we classify as noncyclical could show wavelike movements in most of them. Even without such practices we find that more than 95 percent of some 830 monthly or quarterly series from the United States undergo specific cycles.

We identify the specific cycles in a series by the dates of their troughs and peaks. Usually we take the cycles as units that begin and end with a trough. But approximately an eighth of our American series move inversely to the cyclical tides; for example, bankruptcies, idle freight cars, numerous inventories, and bank reserve ratios. In such series, we treat the specific cycles as units beginning and ending with peaks.

II Relation of Specific to Business Cycles

One clause in our basic definition can be restated in this form: business cycles are due to the predominance of agreement in timing among specific cycles. If that is true, the peaks of positive and the troughs of inverted specific cycles in a representative collection of time series must occur in clusters, and so also must the troughs of positive and the peaks of inverted specific cycles. Thus our concept of business cycles can be subjected to one crucial test as soon as the specific-cycle turning dates in a diversified sample of time series have been determined.

III Reference Dates

In designing this test we started with the contributions of financial journalists, business annalists, and statisticians who have identified successive business cycles in our four countries. Their dates and even their lists of cycles differ; nevertheless, they give rough indications of the periods within which clusters of specific-cycle peaks are likely to occur, and of other periods in which clusters of troughs may be expected. Arranging our findings to see whether they confirm earlier conclu-

sions, to resolve a few conflicts of opinion, and to make sure that notable clusters have not been overlooked is a laborious task, and one that cannot be regarded as finished until all the evidence has been carefully weighed. When we find a definite cluster of specific-cycle turning dates, we accept it as marking the culmination of a business-cycle expansion or contraction, and seek to determine the month within the clustering zone when economic activity reached its largest or smallest volume. These months constitute a tentative set of 'reference dates', which purport to show the troughs and peaks of successive business cycles within a country during the period we can cover statistically.

Table 1 presents the monthly and annual reference dates for the United States since 1854 that underlie the cyclical measures exhibited in later chapters. The word 'tentative' in the title of the table is to be taken seriously. These dates were developed at a time when our collection of series, our methods of analysis, and our knowledge concerning the cyclical behavior of different activities were poorer than they have since become. A systematic review of the dates, begun in 1940, was interrupted by the war. When we are able to resume it, we shall presumably make numerous minor and perhaps a few major changes, especially in the earlier decades for which statistical records are scanty. Meanwhile we work with the approximations in hand. Chapter 4 of *Measuring Business Cycles* demonstrates that they agree well with the findings of earlier investigators, and the sequel will show that they yield significant results when used as the time scale for analyzing the movements of several hundred series.

It would be far easier to base a chronology of business cycles upon the cyclical turning dates in some single aggregate such as national income or employment, and these dates would have a more definite meaning than can be attached to culminations of cyclical expansions and contractions in 'general business activity'. But we could find no series from any of the four nations we were studying that summarizes the cyclical fluctuations of its economy in a way we could trust over the

Table 1

Tentative Reference Dates of Business Cycles in the United States[a]

BY MONTHS

Initial Trough	Peak	Terminal Trough	Expansion (*mos.*)	Contraction (*mos.*)	Total (*mos.*)
December 1854	June 1857	December 1858	30	18	48
December 1858	October 1860	June 1861	22	8	30
June 1861	April 1865	December 1867	46	32	78
December 1867	June 1869	December 1870	18	18	36
December 1870	October 1873	March 1879	34	65	99
March 1879	March 1882	May 1885	36	38	74
May 1885	March 1887	April 1888	22	13	35
April 1888	July 1890	May 1891	27	10	37
May 1891	January 1893	June 1894	20	17	37
June 1894	December 1895	June 1897	18	18	36
June 1897	June 1899	December 1900	24	18	42
December 1900	September 1902	August 1904	21	23	44
August 1904	May 1907	June 1908	33	13	46
June 1908	January 1910	January 1912	19	24	43
January 1912	January 1913	December 1914	12	23	35
December 1914	August 1918	April 1919	44	8	52
April 1919	January 1920	September 1921	9	20	29
September 1921	May 1923	July 1924	20	14	34
July 1924	October 1926	December 1927	27	14	41
December 1927	June 1929	March 1933	18	45	63
March 1933	May 1937	May 1938	50	12	62

BY CALENDAR YEARS

Trough	Peak	Trough	Peak	Trough	Peak
1855	1856	1888	1890	1914	1918
1858	1860	1891	1892	1919	1920
1861	1864	1894	1895	1921	1923
1867	1869	1896	1899	1924	1926
1870	1873	1900	1903	1927	1929
1878	1882	1904	1907	1932	1937
1885	1887	1908	1910	1938	
		1911	1913		

[a] The reference dates since 1919 have recently been revised as follows: July instead of September 1921, November instead of December 1927, June instead of May 1938.

periods we wished to cover. While the concept of general business activity is fuzzy, it has the advantage of adaptability to differences in the composition of national economies and to changes in composition that occur within each of them from decade to decade. About the several senses in which the term can be taken and their statistical counterparts, more will be said in Part III, The Consensus of Cyclical Behavior.

IV Reference-Cycle Bases and Relatives

A chronology of our sort is tested in the process of use. We break every series from a country into 'reference-cycle segments' on the basis of the reference dates in order to observe its behavior during successive business cycles. But before we can compare our observations upon different series we must put into similar form the data expressed in tons, cubic feet, gallons, dozens, dollars, hours, percentages, passenger miles, or other units. That we do by turning the seasonally-adjusted data for each reference cycle into percentages of their average value. This average value we call a 'cycle base'; percentages of it are 'cycle relatives'. For example, the figures of a series during the latest peacetime business cycle covered by Table 1 are percentages of the average monthly value of its seasonally-adjusted data for the 62 months from March 1933 to May 1938. This base in New York City bank debits is $15.3 billion; in trading on the New York Stock Exchange it is 37.8 million shares; in call money rates, 0.908 percent.

V Treatment of Secular Movements

The conversion of data into cycle relatives renders comparable the early and late cycles in the same series, however different the levels on which they run. That is, it eliminates in stepwise fashion 'intercycle' trends. But it does not eliminate 'intracycle' trends. When output is growing rapidly, our cycle relatives have an upward tilt reflecting whatever secular change occurs within the limits of each cycle. In a declining industry the cycle relatives tilt downward. Thus we do not separate cyclical from secular movements in the usual fashion by fitting trend lines and treating wavelike deviations from them as cyclical fluctuations.

The inclusion of intracycle trends in cycle relatives helps to reveal and to explain what happens during business cycles. Rapidly growing industries affect business cycles otherwise than do industries barely holding their own or shrinking. The role played by railroad purchasing and financing in American

business cycles changed notably when the great era of construction came to a close. To understand the country's fortunes after 1910, we should take account of the spectacular rise in motor car production. As in these familiar instances, so in many others a radical elimination of all changes persisting over periods longer than business cycles would erase differentiating factors of great practical and theoretical significance.

Of course, we could add to our knowledge by making two sets of cycle relatives for each time series, one as free as possible from trend factors, the other including intracycle trends. But double analyses would be so expensive as to reduce greatly the number of series we could cover. For reasons that will appear presently, restricting the economic scope of the investigation would seriously detract from its value.

VI Reference-Cycle Patterns

Next we prepare 'cyclical patterns' from the cycle relatives. For that purpose we divide each reference cycle into nine stages. Stage I includes three months centered on the initial trough, stage V three months centered on the peak, and stage IX three months centered on the terminal trough. The phase of expansion between stages I and V is divided into thirds, which constitute stages II, III, and IV. The contraction phase is similarly divided into stages VI, VII, and VIII. Patterns of successive cycles overlap, in that stage I of a cycle includes the same months as stage IX of its predecessor, and its stage IX includes the same months as stage I of its successor. Then we compute an average of the cycle relatives of all months covered by each stage, thereby reducing the influence of erratic movements on the patterns. By observing how a series behaves as it passes through the nine stages of successive reference cycles, we obtain a sufficiently detailed picture of its response to, and a basis for judging its reaction upon, individual business cycles. Finally, to determine what behavior is 'characteristic' of the series—a venturesome step to be discussed presently—we average the measures of individual cycles and record their average deviation.

VII Average Rates of Rise or Fall per Month

In deriving the cyclical patterns we disregard for the moment differences in the duration of business cycles. To us one such cycle in one country is a unit of experience to be assembled with other units in an array, from which we hope to learn the features characteristic of the species. But the relation of our units to calendar time is one of the features we wish to analyze. A simple transformation of the cyclical patterns serves this purpose. Starting with the average standings of the cycle relatives as shown by the cyclical pattern, we determine the differences between the standings in successive stages, divide each difference by the corresponding number of months between the midpoints of the stages, and so get the average rates of change per month from stage to stage. As the sequel will show, we rely heavily upon these measures of the changing pace at which expansions and contractions run their course in different series.

VIII Indexes of Conformity

When charted, our average reference-cycle patterns show vividly how different series conform to business cycles, but we need explicit measures of this trait. For that purpose, we find by how much a series rises (or falls) from the trough to the peak of each reference-cycle expansion, and by how much it falls (or rises) from the peak to the trough of each contraction. The *amplitudes* of these responses are measured in reference-cycle relatives; that is, percentages of reference-cycle bases. The *regularity* of the responses from cycle to cycle is measured by an 'index of conformity'. Thus a rise from stage I to stage V is marked +100, a fall is marked −100, and no change, 0. The algebraic sum of these marks divided by their number yields an index of conformity to reference expansions. It ranges from +100 (indicating positive conformity in every expansion), through 0 (indicating no change in any expansion, or an equal number of positive and inverted responses), to −100 (indicating inverse movement in every expansion). The

index of conformity to reference contractions is made in the same way except that the signs are reversed, for a fall in stages V–IX now constitutes positive conformity and a rise constitutes inverted conformity.

Some series with intracycle trends sloping steeply upward continue to rise throughout reference contractions, yielding indexes of +100 in expansion and −100 in contraction. But if the rise in contractions is uniformly slower than the rise in the preceding and following expansions, the series plainly conforms after a fashion to business cycles. Rapidly falling trends sometimes have the opposite effect. Even moderate trends may produce lapses from conformity to mild reference contractions when tilted upward, and lapses in mild expansions when tilted downward. To measure the regularity of these relations, we compare the rate of change in a series during each contraction with its rate of change during the preceding and also during the subsequent expansion, recording what we find in a third index–that is, an index of 'conformity to business cycles'. Here +100 signifies a rise in every expansion and a fall in contraction, or a rise in expansion and no change in contraction, or no change in expansion and a fall in contraction, or a rise in both phases but at a slower pace in contraction, or a fall in both phases but at a faster pace in contraction. Opposite behavior of any of these types yields an index of conformity to business cycles of −100.

Thus, for every series we compute three indexes of conformity, one for reference expansion, a second for reference contraction, and a third comparing the movements in the two phases. But while these indexes are useful in all instances, and adequate for series that follow the standard timing scheme closely or depart from it in a random fashion, they do not present clearly the behavior of series that usually lead or lag behind the cyclical procession. For these numerous and highly interesting series we make a second set of conformity indexes based upon whatever group of reference stages represents their typical cyclical timing. When a series shows no regular timing relation to business cycles, we content ourselves with the first

Table 2

Specimen Indexes of Conformity

	Series[a]	No. of Reference Cycles Covered	Stages Covered by *Expansion*	Stages Covered by *Contraction*	Timing Characteristics	Stages Used in Making Index of Conformity to *Reference expansion*	Stages Used in Making Index of Conformity to *Reference contraction*	Index of Conformity to *Reference expansion*	Index of Conformity to *Reference contraction*	Index of Conformity to *Business cycles*
1	Index of industrial production	5	I–V	V–IX	Positive, no lead or lag	I–V	V–IX	+100	+100	+100
2	Bank clearings, N.Y. City	18	VIII–IV	IV–VIII	Positive, lead at both turns	VIII–IV	IV–VIII	+100	+78	+88
3	Commercial paper rates, N.Y. City	20	II–VI	VI–II	Positive, lag at both turns	II–VI	VI–II	+80	+71	+95
4	Contracts, commercial buildings, value	5	VIII–V	V–VIII	Positive, lead at trough	VIII–V	V–VIII	+100	+60	+100
5	Yields of high grade corp. & munic. bonds	10	III–VII	VII–III	Neutral	III–VII	VII–III	+40	+40	+68
6	Plans for new buildings, Manhattan, N.Y.	15	VII–III	III–VII	Neutral	VII–III	III–VII	+73	+62	+87
7	Gum rosin stocks	5	VI–IX	I–VI	Inverted, lag at peak	I–VI	VI–IX	−67	−67	−82
8	Visible supply of wheat	16	...	...	Irregular	I–V	V–IX	0	−12	−10

[a] See Appendix B for sources of data.

set of indexes on the standard basis of expansion in stages I–V and contraction in V–IX.

The examples of our indexes in Table 2 illustrate the varieties of cyclical timing and degrees of conformity. The Federal Reserve Board's index of industrial production is treated on a I–V basis because it conforms closely to the cyclical tides in every instance. The visible supply of wheat, which undergoes highly irregular fluctuations from one business cycle to the next, is treated in the same way. Bank clearings and commercial paper rates in New York City respond positively to business cycles, but the first usually leads and the second usually lags at reference troughs and peaks. Bond yields usually turn up in midexpansion and turn down in midcontraction, while building plans in Manhattan usually turn up in midcontraction and down in midexpansion. We call both of these opposite types of timing 'neutral'. Obviously, the expansion stages on which the indexes are based require close attention.

The numerical values of our conformity indexes differ from ordinary percentages. The indexes show, not the percentage of business cycles covered by a series in which its movements conform to the cyclical tides, but the percentage of conforming minus contrary movements. A lapse in any cycle will make our index lower than the corresponding percentage as usually computed, and the fewer the cycles covered by a series the larger will be the difference caused by a single lapse. For example, if a series spans 3 reference cycles, conforms positively to 2 and inversely to the third, the percentage of positive conformity is 67; but our index is +33. If we ignore instances of no change, an index of +50 means positive conformity in 3 cycles out of 4, an index of −60 means inverse conformity in 4 out of 5, +80 means positive conformity in 9 out of 10, and +90 in 19 out of 20.

IX Our Use of Averages

A complete history of business cycles would describe not only the characteristics common to all members of the species but also the characteristics that make each cycle unique. A com-

plete theory would explain not only how business cycles come about but also how each cycle comes to differ from the others. Our observations upon individual time series should provide data for pursuing both of these ideals. They should cover arrays of cycles as wide as the data allow. In each array, they should record both the typical features of cyclical behavior and the cycle-by-cycle idiosyncrasies.

The usual method of observing statistical arrays is to describe their 'central tendency' by an average of some sort, and their variability by some measure of dispersion. We wished to adapt this standard procedure to the study of cyclical behavior. But for that step we had no precedents. On the contrary, some earlier investigators had reached conclusions that, if valid, would impose narrow restrictions upon averaging of the sort we planned, or bar it altogether. Before we could proceed, we had to examine these views.

Chapter 10 of *Measuring Business Cycles* tests several variants of the hypothesis that cyclical behavior is subject to secular or discontinuous changes. If the alleged secular changes are large, they may dominate our measures of individual cycles and vitiate the averages—a risk to which our findings seem especially exposed, for, though we exclude intercycle, we retain intracycle trends. Will not reference-cycle relatives containing a progressively changing element of trend show different types of response to the early and to the late cycles in our arrays? Then what meaning can we attach to averages including all the cycles? On the other hand, if cyclical behavior changes discontinuously in the course of a nation's development, averaging may be permissible, but only within the limits of each historical phase. A third group of hypotheses is examined in Chapter 11—several forms of the view that cyclical behavior undergoes cyclical changes. If there are 'cycles of cycles', the relatively short waves in which our interest centers should be classified according to the positions they occupy in a longer sequence, and any averaging done should be confined to waves in a similar position. Thus, our desire to work with the widest arrays of cycles covered by

statistical records is open to at least three sets of forcibly presented objections.

In general, our tests of the hypotheses so baldly summarized here yielded negative results. We found no convincing evidence that secular, discontinuous, or cyclical changes in cyclical behavior were so marked and pervasive as to debar us in principle from treating the cycles covered by a series as a single array. However, the tests show some instances, and detailed work with our full sample of series adds others, in which division of reference cycles into groups is necessary.[1] To cite examples: the output of beehive coke changed its behavior drastically when byproduct furnaces became the chief producers; the establishment of the Federal Reserve System was followed by significant changes in the behavior of numerous series on banking and interest rates; long waves in indexes of prices lead us at times to segregate the cycles occurring during the phases of progressive increases and progressive declines in reference-cycle bases. Thus, when occasion requires, we take account of secular, discontinuous, and cyclical changes in the behavior we are trying to measure. But such instances are not numerous. Usually we make a single set of averages including all the reference cycles covered by a series.

No tests are necessary to prove that the behavior of virtually every series is subject to a fourth set of changes—the irregular movements that are so troublesome to all time-series analysts. The standard device for mitigating their disturbing effects upon cyclical measures of individual series is averaging of some sort. Our use of nine 'stages', usually covering three months or more, in making reference-cycle patterns affords some protection; for even three-month averages are freer from erratic perturbations than monthly data. We take a further and more effective step when we average the stage-by-stage measures of several cycles. In such averages, whatever features are peculiar to single cycles tend to offset one another, while whatever features are common to most cycles tend to stand out more clearly. Desire to protect our measures as much as we can

[1] See Chart 1 below, Figures 8, 13–14, 32, and 35.

against random movements is one of our strongest reasons for observing as many cycles as the data allow. We have more confidence in the representative value of averages derived from long than from short series, and more confidence when we can treat long series as wholes than when we are forced to break them into segments. As a rule, the more cycles we can cover the better.

But this rule does not apply when the movements in a few cycles are exceptionally violent. For example, indexes of commodity prices behave sedately most of the time, but they ran wild during and immediately after the Civil War and World War I. Our averages would give a distorted picture of the way in which these prices typically react to business cycles if the war episodes were not excluded.[2] They are excluded also from the averages of most series representing the dollar values of goods produced or exchanged. More rarely, we exclude cycles dominated by wartime demands or great labor disputes from averages of series expressed in physical units.

After finishing the analysis of a series we cannot tell precisely what mixture of movements our averages and average deviations represent. Probably all of these measures include a residue of irregular movements, which often seems disturbingly large. They may include also many vestiges of secular or discontinuous changes or of long cycles. They are warped further by whatever errors we committed in identifying business cycles and dating their peaks and troughs. Often more disturbing still are doubts about the trustworthiness or adequacy of the original data and of our adjustments for seasonal variations. Certainly the majority of series cover periods so brief that averaging has a poor chance of performing the wonders we ask of it.

All that can be expected from the simple and rough methods we apply to imperfect records are tolerable approximations. Refining and elaborating our statistical technique might lessen doubts, but we have not thought the gains would offset the limitations a more time-consuming treatment would impose

[2] See Chart 1, Figure 17.

upon the scope of the investigation. There is another and we believe a more effective way of determining the economic significance of our statistical findings.

X Tests of Consilience

What one series tells us about the cyclical behavior of some activity can often be checked by what other series tell. By examining several fallible witnesses, noting the points of agreement and conflict in their testimony, we can usually get a well buttressed story of the salient points. The opportunities for testing of this sort are wider than one not well acquainted with statistical records may suppose.

Many of the factors that concern a student of business cycles are nowadays recorded by two or more agencies. Certain activities have several branches so closely allied that conclusions concerning the cyclical characteristics of each can be checked by comparisons with the others. When an industry flourishes in several countries, international comparisons are helpful. The same factor may be reported in physical units for one purpose, in monetary units for others, and the two recordings may be supplemented by price quotations. Of the making of index numbers there is no end; seldom if ever do two indexes of commodity prices, security prices, cost of living, production, retail sales, employment, payrolls, business activity, or what not, agree precisely; but the divergencies may tell as much as the agreements, provided the compilers have given adequate descriptions of their data and methods. Often an index can be compared also with several of its own components. Nor is the testing of series by one another confined to comparing records of the same or of closely related factors; it can often be extended to comparisons of factors one expects to differ in specifiable ways. As the last clause implies, designing these tests involves more than the mechanical assembling of measures derived from several sources. What practical experience and theoretical analysis have taught about the interrelations among economic activities guides us in selecting series to be compared and in interpreting the similarities and differences of their behavior.

Early in the investigation we found that we could best determine the cyclical characteristics of agricultural production by focusing attention upon traits common to the records of several crops in the same country, and the records of the same crop in several countries. As our experience grew, we relied increasingly upon such tests of consilience. Many of the doubts we harbored when trying to extract meanings from individual series were dissipated when we examined groups. Desire for this type of evidence led us to collect many more time series than we originally thought necessary. The detailed conclusions presented in later chapters rest for the most part on studies of group behavior, while the broader conclusions rest on the consilience among the group studies when interpreted in the light of what we know about the relations of one activity to another, and of each activity to the economy as a whole.

XI Our Sample of Time Series

To match our working definition of business cycles, our statistical observations should extend over all economic activities, whether organized in business enterprises or not. Ideally, the time series used should cover many cycles in strictly comparable fashion. In practice we are forced to work with records that are far from complete and uniform. Even now in the United States satisfactory data cannot be had upon numerous matters of importance, and the supply dwindles rapidly as we delve into the past or go abroad. Yet on some heads the record is so voluminous that we have not been able to collect and analyze all the series in form for use, not to speak of those which might be compiled from original sources.

Table 3 indicates how far we had carried our analysis of American data by months or quarters when the basic compilations for this report were drawn up. In addition, we then had some 160 annual series from the United States as well as some 300 British, French, and German series upon which I could draw at need. While I was studying the American sample of monthly or quarterly series, our computing unit was seeking to remedy its most glaring deficiencies. So far, we have added

Table 3

BASIC SAMPLE OF 794 MONTHLY OR QUARTERLY SERIES FOR THE UNITED STATES USED IN LATER TABLES

Group	Total No. of Series	Classified by Number of Reference Cycles Covered by Averages				
		Under 4	*4–5*	*6–10*	*11–15*	*16–21*
Retail & wholesale trade	27	14	10	3	..	..
Foreign commerce	20	..	..	11	1	8
Orders from manufacturers	18	6	4	4	1	3
Contracts & permits for construction	58	1	43	13	..	1
Inventories	62	15	35	7	1	4
Production	188	34	101	39	6	8
Transportation & communication	31	..	13	11	6	1
Employment & hours of work	46	2	40	4	..	..
Wage rates & average earnings	15	..	15	..	..	..
Payrolls & total incomes	30	..	29	1	..	..
Prices of commodities	147	..	61	20	57	9
Banking & money	69	..	10	52	6	1
Interest rates & bond yields	23	..	10	8	2	3
Stock exchange transactions & prices	10	..	2	2	2	4
Security issues & savings	15	..	10	4	1	..
Business profits	5	..	4	..	1	..
Business failures	11	3	..	2	4	2
Bank clearings & debits	8	..	3	1	2	2
Indexes of business activity	11	..	1	2	3	5
Summary [a]						
Flow of commodities, services, or incomes	478	72	272	94	14	26
Prices of commodities or services	168	..	80	20	59	9
Financial activities or prices	135	3	37	68	16	11
General business activity	13	..	2	2	4	5
All series	794	75	391	184	93	51
% of all series	100.0	9.4	49.2	23.2	11.7	6.4

[a] Based on a more detailed classification than is provided above.

more than 30 monthly and more than 90 annual series, of which use is made in the text, though they have been incorporated into few of the tables.

The grouping of series in Table 3 is an adaptation of the familiar headings under which statistical data are compiled for practical uses. It serves some of our needs, but has to be supplemented by other arrangements based upon analytic criteria. For example, in studying investment, we assemble series selected from the groups 'security issues and savings', 'interest rates and

bond yields', 'stock exchange transactions and prices', 'orders from manufacturers', 'contracts and permits for construction', 'inventories', 'production', 'employment and hours of work', 'prices of commodities', and 'banking and money'.

The number of series in the 19 groups of the table reflects partly the unevenness of our progress in different segments of the field and partly the relative abundance of suitable data. To give examples of both factors: we have exploited the series on construction rather fully, but have confined our work on security prices to a few indexes, neglecting so far the readily available quotations of individual stocks and bonds; foreign commerce has long been recorded in considerable detail, while data on the far larger volume of domestic trade are relatively recent and unsystematic. The gravest inadequacies of the sample appear in personal incomes other than factory wages, and the profits or losses of business enterprises. Despite the special attention given to these groups in the supplementary work mentioned above, the evidence remains sketchy and largely in annual form.

Another disturbing feature of our sample is that in only 41 percent of our series are more than 5 reference cycles covered by the averages. Can we trust measures based on so few cycles? To find out, we experimented with 7 series representing widely different activities during the 15 reference cycles of 1879–1933. Each series was broken into 3 segments of 5 cycles. The results presented at length in Chapter 12 of *Measuring Business Cycles* show differences among the 3 group averages of each series; but these differences are notably smaller than the differences among the individual cycles within each group. Further, the differences among the averages of groups belonging to the same series are significantly smaller than the differences among the averages of groups belonging to different series. These experiments are reassuring as far as the broad features of cyclical behavior are concerned; but they warn us against taking seriously small differences among our averages. For example, it would be naive to trust the decimals of our reference-cycle patterns: only when the amplitudes of these patterns are small

are the first integers likely to be good approximations; when the amplitudes are large only the tens, or even hundreds are significant. What merits attention is the ranges within which the measures of different activities fall—not the exact figures.

If averages are broadly similar whether based upon the 5 reference cycles of 1879–97, 1897–1914, or 1914–33, as these tests indicate, we seem warranted in comparing measures of series covering unlike periods, provided always that we have taken the precautions described in an earlier section against marked changes in the cyclical movements we average. We should be delighted to maintain strict uniformity of time coverage if we could do so by lengthening short series; but to attain it by shortening long ones would be to sacrifice more than we should gain. However, in detailed comparisons of cyclical behavior, we often make special averages of the longer series to match the periods covered by shorter ones; for the briefer the time span of comparisons, the more are our averages influenced by the idiosyncrasies of individual cycles. Now and then the reader will find us cutting down 5-cycle series to match a 4-cycle group, or performing some equally repugnant amputation. He will find also that the shorter the statistical records of an economic activity, the more series we seek to use and the more heavily we lean upon tests of consilience.

Descriptions of methods and raw materials acquire livelier meaning when one examines the results they help to produce. To that task we now turn. But, while pressing onward, we shall have to recur ever and again to methodological problems concerning the adequacy of our data, the logical implications of our technique, and the economic significance of our measures.