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## CHAPTER 15

### Inventory Investment and Rates of Change in Output

#### 1 *Significance of the Relation*

It is a common theory that businessmen attempt to maintain their inventories in a certain ratio to sales (or, in the case of manufacturers' raw materials and goods in process, in a certain ratio to production). If this were true without qualification and if the attempt were wholly successful, inventories would rise and fall synchronously with sales (or production) and inventory investment would vary synchronously and proportionately with changes in sales and production. This idea is the basis for the simplest and most mechanical application of the acceleration principle to inventory investment (see Ch. 1).

As we have seen in Part Two, however, inventories tend to lag 6-12 months behind sales and output. And Chapter 14 showed that inventory investment tends to reach its peaks and troughs at approximately the peak and trough dates of business cycles, which are also the turning points of sales and output. This suggests that inventory investment lags behind changes in output and sales. For it is plausible that the rate of growth and decline in a series of data should reach its turning points before the data themselves do. This, however, is not inevitable. Output may grow most rapidly just before it begins to decline and decline most rapidly just before it begins to rise. The cyclical pattern of the rates of change in output and sales needs to be established.

If inventory investment does tend to lag behind the rates of change in output and sales, this does not mean that businessmen do not attempt to maintain an approximately constant relation between sales and inventories, nor that the acceleration principle is not part of a valid theory of fluctuations in inventory investment. J. M. Clark, in his formulation of the acceleration principle, ex-

pected a lag and allowed for it. If inventory investment is found to lag behind changes in output, we should try to establish the length of the lag, consider its significance, and determine its causes.

The data presented in Sections 2 and 3, below, lead to the conclusion that the rate of increase in output is usually at a maximum long before the peak in business, often before half the expansion has run its course. Similarly, the rate of decline in output is usually at a maximum long before the trough in business. Occasionally—often in expansions, less often in contractions—the rate of change in output has picked up after the peak rate has been passed and retardation in growth, or decline, has begun. But typically the later peaks in the rate of growth or decline do not reach levels as high as the earlier ones.

These intra-phase (i.e., intra-expansion or intra-contraction) oscillations in the rate of change in output may themselves at times be associated with similar intra-phase fluctuations in inventory investment. It is quite possible, for example, that after an initial rise in inventory investment at the beginning of an expansion, there is a decline. This, in turn, causes the rate of growth in output to fall. Later, inventory investment picks up again and causes a renewed spurt in output.<sup>1</sup> Such intra-phase fluctuations in inventory investment cannot be excluded, although they do not appear in the annual data reviewed in Chapter 14. What we can say confidently on the basis of the annual data is that if there is more than one peak in inventory investment during expansions, the highest comes at the end of the phase. Similarly, the lowest of the troughs, if there is more than one, comes at the end of contraction. Typically, therefore, there is a long interval between the highest rate of increase in output and the highest level of inventory investment and between the highest rate of decline in output and the lowest level of inventory investment. The lag of inventory investment behind the

<sup>1</sup> An important fact that does not seem consistent with this notion is that in the initial stages of expansion, inventory investment is still negative (inventories continue to decline after output revives), though not as low as at the trough in output. In addition, inventory-sales and inventory-output ratios are declining rapidly (Ch. 6). There seems little reason to expect a widespread attempt at inventory liquidation in the first stages of expansion. Similarly, at the beginning of contraction, inventory investment is still very high—though falling—and inventory-sales ratios are rising rapidly. There seems little reason to expect inventory accumulation to become larger.

rate of change in output can be seen in another way. At the beginning of expansions the rate of increase in output is usually very high, but inventory investment is still negative. In contractions, the reverse is true: the rate of decline in output is very high, but inventories are still increasing, though at a slower pace than at the peak in business.

The lag of inventory investment affects the character of business cycles significantly, for if inventory investment leaped promptly at the beginning of business expansions and collapsed promptly at the beginning of contractions, the changes in output at these stages would be even larger than those we observe. The changes in inventory investment would then augment the changes in output due to other causes. And if inventory investment tended to fall off after the peak rates of growth in output had been reached—instead of rising to still higher levels—the peaks of output and of business cycles would occur sooner than has been true in the cycles of experience. The decline in inventory investment would tend to bring on a decline in business at large, instead of sustaining a further increase. Similarly in contractions: if inventory investment rose with the rate of decline in output after the latter had reached its lowest point, business would tend to recover sooner than it actually has. In other words, in comparison with a situation in which inventory investment varied synchronously with the rate of change in output, the lag of inventory investment tends to moderate the pace and extend the length of expansions and contractions.

This argument has anticipated the results of our study of rates of change in output, to which we now turn. Section 2 is concerned with the cyclical behavior of the rates of change in aggregate output and business activity. Section 3 is a more detailed study of rates of change in manufacturing production.

## 2 *Rates of Change in Total Output*

We use four indexes in examining the behavior of rates of change in total output or business activity: Barger's quarterly estimates of income and outlay 1921-38, the series of bank clearings outside New York City 1919-38, and the FRB index of industrial production 1919-38. Barger's estimates are indexes of total output in current prices. The bank clearings measure the volume of business

transactions, also in current prices.<sup>2</sup> The index of industrial production measures the physical volume of production in mining and manufacturing industries.

From the viewpoint of this study, each series suffers from certain defects. Barger's series were derived by making quarterly interpolations of Kuznets' well known annual estimates of national income and output. In many sectors, however, the interpolators are of dubious accuracy, and in some sections, Barger had to resort to formal mathematical graduations.<sup>3</sup> The latter practice is of special significance for our problem since it necessarily produces a rounded contour at the turning points of the original data. This, in turn, makes for retardation in the rates of growth or decline of the series in the immediate neighborhood of their peaks and troughs.

The bank clearings series has two significant defects. Although it excludes New York clearings, it reflects financial as well as commercial and industrial transactions. In addition, it records transactions, not at the time when the sales took place, but later when payments were actually made. The index of industrial production, finally, is faulty in that it does not reflect activity in the extractive industries (other than mining), or in distribution, services, or government. Despite these defects, the four indexes taken together constitute a fairly satisfactory basis for judging changes in total output, if conclusions are confined to broad features of their behavior.

The quarter to quarter or month to month changes in the series are plotted in Chart 67. Five-month moving averages of the changes in the monthly data are also shown in order to help the reader follow the trend of these choppy series. Asterisks at peaks mark the dates during business cycle expansions when, in the writer's judgment, serious retardation in the rate of change begins. Asterisks at troughs mark similar dates in contractions.

<sup>2</sup> This series is available also in deflated form, but its rate of change fluctuates within so narrow a range that to separate cyclical movements from irregular oscillations is difficult. Whether this is due to imperfections in the price indexes used to adjust the series is not clear. As far as cyclical movements can be identified, they do not differ substantially in timing from those in the un-deflated data.

<sup>3</sup> Including depreciation in both series, about 25 percent of outlay in 1929 was subject to graduation, about 40 percent of income. Prior to 1929 a somewhat larger fraction of both series, but especially of income, was subject to graduation. See *Outlay and Income in the United States, 1921-1938*, pp. 213-4.

Chart 67  
**Total Output and Business Activity, Quarterly or Monthly Changes**

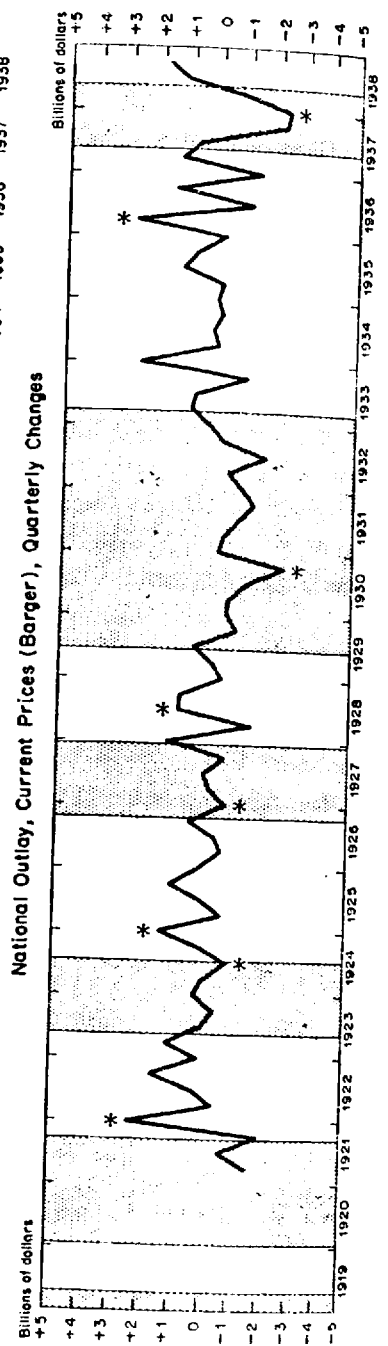
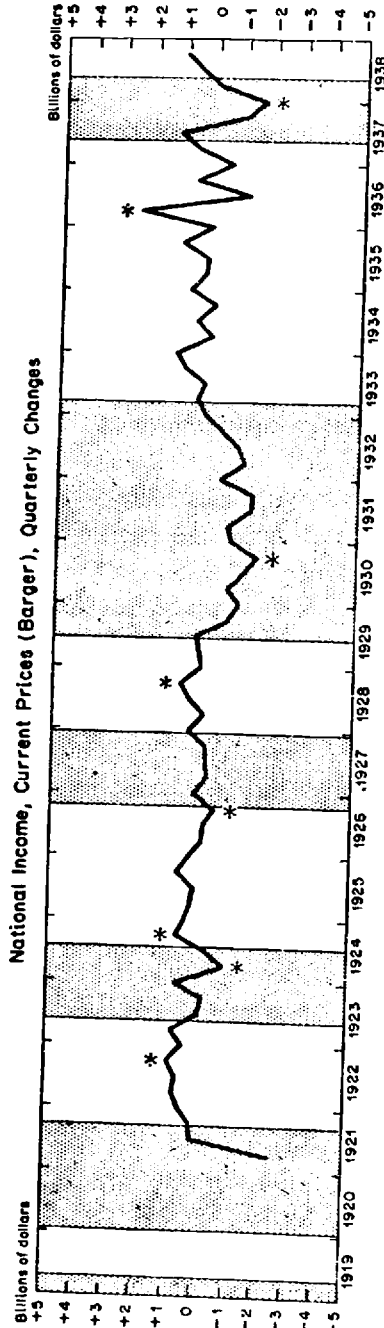
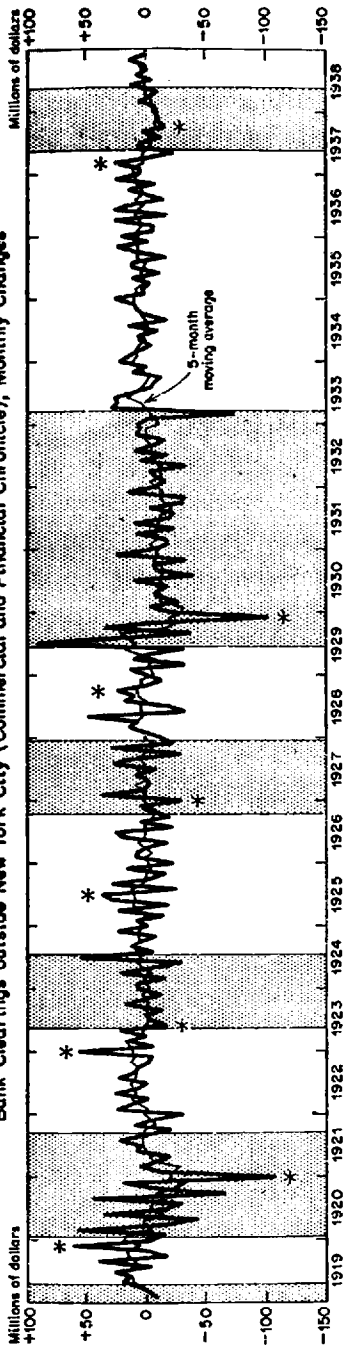
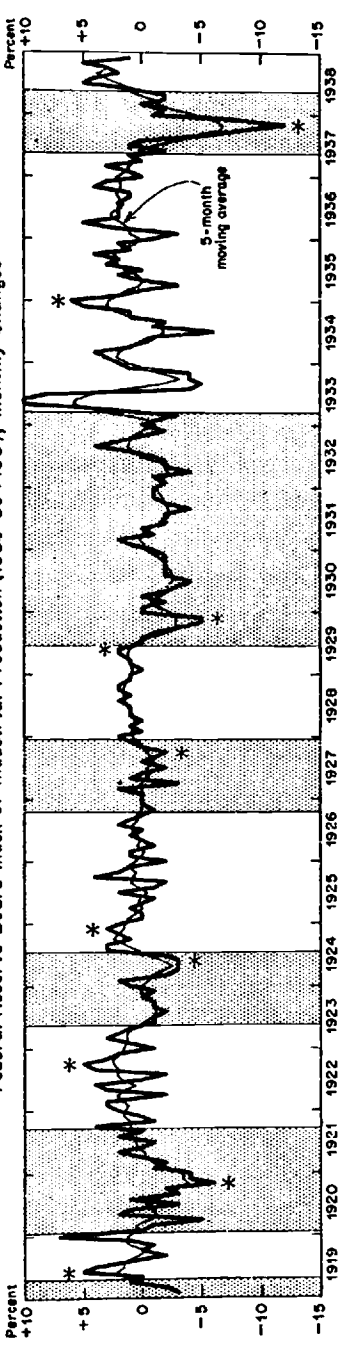


Chart 67 (concl.)  
 Bank Clearings outside New York City (Commercial and Financial Chronicle), Monthly Changes



Federal Reserve Board Index of Industrial Production (1935-39 : 100), Monthly Changes



\* Peaks and troughs of cycles in quarterly or monthly changes.  
 Contractions (shaded) and expansions (unshaded) are marked off by the monthly reference chronology in the four panels.

The marked peaks and troughs in the rates of growth invariably lead the turning points of business cycles, usually by many months. As already said, in many expansions and in some contractions there are one or more periods of accelerated change later in the phase; but seldom do these later peaks or troughs in the rate of growth reach such high (or low) points as those marked.

The reader should notice also that I have not marked the beginning of the first serious retardation during the expansion of 1933-37 since that seemed to be associated with the speculative boom and decline of 1933. Such intense speculative movements were not typical of the period although, of course, of great importance in 1919-21. Had the 1933 episode been taken into account, the interval between the first important peak in the rate of change and the peak in business would appear to be longer. The intervals between the turning points of the rates of growth or decline and those of business cycles are shown in Table 64. While there is some disagreement among the four series in individual cycles, the rate of change in total output clearly tends to begin to retard a considerable number of months before the end of a phase. In expansions 3 of the 4 series yield average leads of 13 months or more. In contractions, all 4 series show average leads longer than

TABLE 64  
Rates of Change in Total Output and Business Activity  
Timing at Business Cycle Turns, 1920-1938

Reference date	Nat. income	Nat. outlay	Bank clearings	Industrial production	Average of 2 or 4 series
LEAD AT BUSINESS CYCLE PEAKS (MONTHS)					
Jan. 1920	n.a.	n.a.	1.5	7.5	4.5
May 1923	7.5	16.5	4.5	7.5	9.0
Oct. 1926	24.5	21.5	15.5	22.5	21.0
June 1929	8.5	11.5	8.5	0.5	7.2
May 1937	13.5	13.5	2.5	28.5	14.5
Av. 4 or 5 cycles	13.5	15.8	6.5	13.3	
LEAD AT BUSINESS CYCLE TROUGHS (MONTHS)					
Sept. 1921	n.a.	n.a.	8.5	10.5	9.5
July 1924	3.5	0.5	13.5	1.5	4.8
Dec. 1927	14.5	11.5	11.5	2.5	10.0
March 1933	29.5	29.5	39.5	39.5	34.5
May 1938	4.5	4.5	7.5	6.5	5.8
Av. 4 or 5 cycles	13.0	11.5	16.1	12.1	



12 months. In expansions at least two-thirds of all the comparisons were leads longer than 7 months; one-half were longer than 11 months. In contractions the comparable figures were 6 and 11.

There is considerable variation among cycles in the length of the leads. In terms of the average for all series, the leads ranged from 4.5 to 21 months in expansions, from 4.8 to 34.5 months in contractions. The variability, however, is far less pronounced when the leads are expressed as percentages of the length of expansion and contraction. The average leads are then all long, ranging between 29 and 78 percent of expansions and between 33 and 69 percent of contractions. It seems valid to conclude that total output and business activity tend to begin a period of serious retardation in growth or decline before the turning point in business. The interval is usually many months before the end of the phase and is always a considerable fraction of the phase.

### 3 *Rates of Change in Manufacturing Output*

The rest of this chapter has the twofold objective of testing the conclusions of the preceding section by studying many commodities and establishing the cyclical patterns of the rates of change in manufacturing. The latter aim is especially important because, as will appear in Chapter 16, the cyclical movements of investment in stocks of goods in process can be gauged from those in the rate of change in output.

#### OUTPUT SERIES SAMPLE

For the special purpose of gauging the changes in stocks of goods in process from output data it would be desirable to construct indexes in which series representing the output of individual industries or commodities are weighted according to the relative values of the goods in process normally held to support such output. Unfortunately no estimates of the value of goods in process by industry or commodity I could now make would be sufficiently accurate to justify the construction of specially weighted indexes. We must, therefore, remain content with the standard indexes of output weighted by value added in manufacturing. To measure the output of manufacturing as a whole and of the major industry groups I used the standard FRB indexes, supplemented by indexes compiled by Y. S. Leong and by the Federal Reserve Bank of New

York. The metals series was computed by the National Bureau from several appropriate FRB output indexes; measures for two other industry groups, printing and transportation equipment, are averages of measures of several Bureau series, the original data for which are mainly in physical units. For petroleum and rubber, consumption series in physical units, compiled by the Bureau, are used.

To help overcome the difficulties that may arise from value-added weights I compiled also measures of the rates of change in a large sample of individual production series, 57 in number, distributed throughout the main groups of manufacturing industries. A study of the cyclical patterns of numerous individual series serves a twofold purpose. It tests the consistency with which the patterns that appear to characterize the multi-industry aggregates are repeated in the individual indexes. And incidentally it indicates whether a change in the weighting scheme might make a significant difference in the behavior of the aggregates.

In selecting, from the National Bureau's much larger collection, the series to be included in the sample of individual commodities and industries, I was guided by several criteria. I sought, first, to include series for the main kinds of product or the main branches of an industry at a level of detail immediately above that represented by the major industry groups distinguished by the Federal Reserve Board. For example, I included series of cattle hide leather production and of shoe production to represent the main branches of the leather and leather products industry, but not the production of men's and women's shoes separately. I included an index of the number of animals slaughtered under federal inspection to represent activity in the meat packing branch of the foods and beverages industry, but not series representing the slaughter of cattle, hogs, or sheep separately. I gave preference, secondly, to series representing the actual output of commodities or the rate of consumption of the raw materials from which they are made and admitted series based on manhours or employment only when reliable output figures were unavailable. Finally, I included only monthly or quarterly series, since annual data are plainly too coarse to reveal the changing rates of growth and decline in output during business cycles.

## MEASURE OF THE RATE OF CHANGE

Because numerous commodities are studied, it was impractical to compute month to month changes in output for this special purpose and to study the cyclical patterns of these changes directly. Instead, we use the National Bureau standard measure of the rate of change per month from stage to stage of reference cycles. The construction of this measure was described and illustrated in Chapter 3. A short restatement may, nevertheless, be useful here.

First, the seasonally corrected data of a series are divided into segments bounded by the successive troughs of business cycles as identified by the monthly chronology of business cycle turning points. The average level of the data within a given business (reference) cycle is calculated and the monthly values of the series converted to percentages of this base. These percentages are called 'reference cycle relatives'. The average standing of the relatives is then computed at each of the 9 stages into which each business cycle is divided. Stage I covers the 3 months centered on the initial trough, stage V, the 3 months centered on the peak, and stage IX, the 3 months centered on the terminal trough. The averages at stages II-IV are averages of data falling within successive thirds of the expansion; the averages at stages VI-VIII give the mean standings of the data for periods representing successive thirds of the contraction.

The rates of change in output from stage to stage of a business cycle are calculated from these figures. The rate of change between stages I and II is the difference in reference cycle relatives between the average levels of output in these stages, divided by the number of months between the midpoint of stage I and of stage II. This procedure applied to stages II and III yields the rate of change in output per month between these stages, and so on. The end result is a cyclical pattern of the rate of change in output per month from stage to stage of a single reference cycle. These rates of change between stages are averaged for as many cycles as a series covers to yield an average reference cycle pattern of the rate of change in output.

It is important to inspect one feature to establish its relevance to the present problem. Inventory investment consists of the absolute change in stocks during a period. As far as investment is con-

nected with changes in output, the connection is presumably with such changes measured in absolute terms. We should notice, therefore, that the National Bureau measure of the rate of change per month from stage to stage of a cycle is, in fact, a measure of the absolute rate of change in a series. Within any individual cycle, differences between the level of a series at various stages measured in reference cycle relatives are exactly proportionate to the absolute differences in the original data. Thus the rate of change in reference cycle relatives validly depicts the absolute rate of change. In comparisons between cycles, the transformation of the original data into reference cycle relatives is an advantage in that the pattern of change during cycles when the level of output was relatively high is not given any more weight in our averages than the pattern of change during cycles when the level of output was relatively low.

#### CYCLICAL PATTERNS IN THE RATE OF CHANGE IN MANUFACTURING OUTPUT

The need to test the consistency with which the patterns in the average behavior of multi-industry indexes are repeated in the reported activity of individual industries and commodities as well as in successive business cycles makes the presentation of the evidence awkward. It is complicated the more by the striking and significant fact that, with respect to the rate of change in output, contractions and expansions are not symmetrical.

To focus attention certain broad conclusions may be stated at the outset. First, during the early part of contractions manufacturing output tends to decline at an increasing rate; it reaches a maximum about the middle of contraction, then slackens. This simple, sine-curve-like pattern does not appear without exception. There are numerous defections, but it does appear sufficiently often to justify its identification as a tendency. Not only that: even when the balanced picture of increase, then decrease, in the rate of decline in output does not appear, the rate of decline in output almost always retards toward the end of contraction. In short, the maximum rate of decline in output is reached considerably before the trough of business cycles, and is generally falling in the latter part of contractions.

No such simple observations can be made about expansions. In-

deed the most striking feature of the behavior of the rate of growth of output during expansions is its variability. The pattern of growth of total output has differed from cycle to cycle, and within any given cycle it has varied markedly from industry to industry. Business expansions are, in this respect, heterogeneous, and it will require additional work to reveal the regularities that presumably underlie the observed differences. Meanwhile, it is important to remember that, since a large part of the dynamics of business expansion—the role of investment in inventories, among other things—depends upon the pattern of the rate of output growth, explanations of these phenomena must grapple with the fact that the pattern shows little tendency to repeat itself. Our notions of how business expansions cumulate, breed obstacles, and finally destroy themselves must include several variants corresponding to the ways in which the rate of change of output behaves.

As quite different generalizations seem appropriate to contractions and expansions it is convenient to review the evidence for these phases separately. I shall begin with the more regular patterns of contractions.

#### RATE OF DECLINE IN OUTPUT DURING BUSINESS CONTRACTIONS

As measured by the FRB index (Table 65 and Chart 68), the rate of decline in total manufacturing production increases, reaches a maximum between stages VI and VII, then falls. The pattern characteristic of the total is repeated for durable and nondurable manufactures except that the maximum rate of decline for durables appeared to come between stages VII and VIII instead of between VI and VII.

The FRB does not divide its series into producer and consumer goods,<sup>4</sup> but somewhat less satisfactory indexes have been calculated by Y. S. Leong and by the Federal Reserve Bank of New York. Since their coverage and methods of computation differ, both are presented. The similarity of the measures they yield bolsters confidence in them. The two indexes of total output of producer goods have patterns similar to that for all manufacturing,

<sup>4</sup> Consumer goods consist of finished goods of types used principally by consumers. Producer goods include finished goods used by business as well as all goods requiring further fabrication whether destined finally for consumers or producers.

TABLE 65

General Indexes of Manufacturing Production: Average Patterns of Rates of Change per Month, 5 Business Contractions, 1920-1938

PRODUCTION INDEXES	AV. CHANGE PER MO. IN REF. CYCLE RELATIVES BETWEEN STAGES			
	V-VI	VI-VII	VII-VIII	VIII-IX
Total manufacturing, FRB	-1.1	-2.8	-1.9	-0.5
Durables, FRB	-0.9	-3.8	-4.0	-1.1
Nondurables, FRB	-1.2	-1.9	-0.2	-0.1
Producer goods, Leong	-1.5	-3.7	-2.8	-0.7
Producer goods, FRB of N.Y.	-0.9	-1.7	-2.1	-1.0
Durable, FRB of N.Y.	-0.7	-4.3	-3.7	-1.1
Nondurable, FRB of N.Y.	-1.1	-2.1	-0.6	-0.9
Consumer goods, Leong	-1.9	-0.3	-1.2	-0.2
Consumer goods, FRB of N.Y.	-1.7	-0.8	-1.0	-0.4
Durable, FRB of N.Y.	-3.2	-3.1	-3.4	-0.7
Nondurable, FRB of N.Y.	-1.3	-0.2	-0.5	-0.3

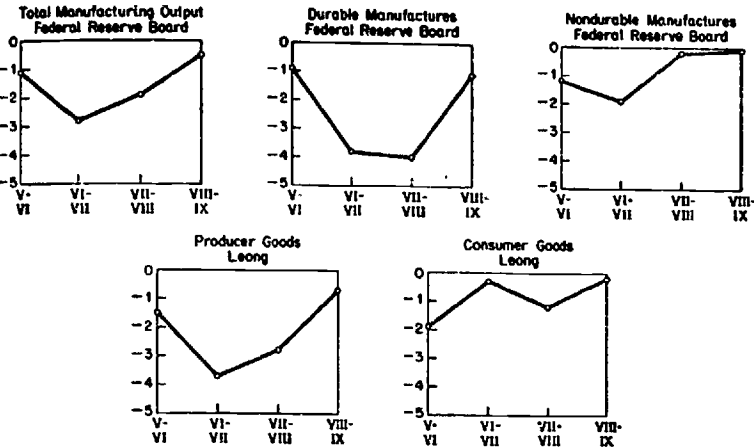
The sources and character of the indexes are described in App. G.

again with the difference that the maximum rate of decline in Leong's index comes between stages VI and VII, that in the Bank's index between stages VII and VIII. And the Bank's index of durables repeats this pattern. The first apparent departure is in the Bank's index of producer nondurable goods which attains a maximum rate of decline between stages VI and VII, begins to fall much more slowly, then picks up speed slightly toward the end of the phase, between stages VIII and IX.

A more serious departure from the regular pattern first discerned in the total is found in the various consumer goods indexes. These resemble the total and the other groups in that the rate of decline in output falls toward the end of the phase. Both Leong's and the Bank's indexes of total output of consumer goods, however, place the maximum rate of decline in the first part of contraction, followed by more moderate drops, then by a more rapid decline before the pace of contraction moderates at the end of the phase. The Bank's index of consumer nondurables behaves similarly, but the average pattern of its index of consumer durables more nearly resembles that of total manufacturing output.

These average patterns suggest that the most general attribute of output during contractions is that its rate of decline falls off toward the end of the phase. Somewhat less strong is a tendency for

Chart 68  
 General Indexes of Manufacturing Production  
 Average Patterns of Rates of Change per Month from Stage to Stage  
 of 5 Business Contractions, 1920-1938



Vertical scale in cycle relatives.

the rate of decline to pick up speed in the first part of contraction and to reach a maximum about the middle. This pattern appears in all except the consumer goods segment and even there it is repeated, at least roughly, in the consumer durables category.

How consistently do these characteristics appear in measures for smaller subdivisions of manufacturing and for individual cycles? I begin with average patterns for 14 industry groups. Table 66 lends strong support to the notion that output tends to decline most rapidly about the middle of contraction and less rapidly toward the end. In these average patterns the rate of decline is regularly highest in either the interstage interval VI-VII or VII-VIII. In only one group, petroleum products, is it at its maximum in the last interstage interval of contraction; and only in leather and leather products is there an indication that the pace of contraction accelerates at the end of the phase after having moderated earlier.

The impressive uniformity of these measures is not fully maintained by the calculations made on the sample of 57 series representing individual industries and commodities some of which begin before 1919, the earliest year covered by the industry indexes. Actual measures of average rates of change are shown in Table 67.

TABLE 66  
 Fourteen Industry Groups: Average Patterns of Rates of Change  
 per Month in Production during Business Contractions

	NO. OF CONTR.	AV. CHANGE PER MO. IN REF. CYCLE RELATIVES BETWEEN STAGES			
		V-VI	VI-VII	VII-VIII	VIII-IX
DURABLE GOODS INDUSTRIES					
Lumber, 1919-38	5	-1.1	-3.3	-0.9	-0.9
Furniture, 1924-38	3	-1.6	-3.2	-2.7	-0.9
Stone, clay & glass, 1919-38	5	-1.4	-1.9	-1.3	+0.9
Metals, 1919-24, 1924-38	5	-0.9	-5.8	-4.6	-1.1
Transp. equipment, 1919-38	5	-2.7	-2.9	-5.7	-2.0
Machinery, 1924-38	3	-0.6	-3.3	-4.2	-1.5
NONDURABLE GOODS INDUSTRIES					
Food, 1919-38	5	-0.02	-0.3	-0.3	+0.2
Textiles, 1919-38	5	-3.0	-3.4	-0.1	0
Leather, 1919-38	5	-1.5	-3.1	+0.8	-0.2
Paper & pulp, 1919-38	5	-0.7	-2.5	-0.8	+0.2
Printing, 1919-33	4	-0.2	-0.9	-0.4	-0.2
Rubber, 1924-38	3	-2.3	-2.8	-1.9	+0.6
Petroleum, 1919-38	5	+0.9	+0.4	-0.2	-0.3
Chemicals, 1924-38	3	+0.1	-1.1	-1.4	-0.5

Source: App. G. The industrial classification used here and in Table 72 follows that of the FRB. It shows data separately for 5 industries which are usually combined with larger groups in the classification used elsewhere in this study. The additional industries here distinguished are petroleum (otherwise included in chemicals and allied products), furniture (lumber and wood products), printing (paper, printing and publishing), machinery and transportation equipment (metals and metal products).

The series are combined indexes of the physical output of commodities in each industry group except that rubber and petroleum are consumption series in physical units. The rates of change for printing are a simple average of such measures for book paper production and newsprint paper consumption. The rates of change for transportation equipment are a weighted average of the rates of change for 7 series representing the output or shipments of transportation equipment items.

Table 68 shows how many and what percentage of the series had rates of change which, on the average, rose, fell, or remained constant between the interstage intervals of contraction. The rate of change is said to rise if, when the series is rising, its rate of rise accelerates or, when the series is falling, its rate of decline retards or the series begins to rise. Its rate of change is said to fall if, when the series is rising, its rate of rise retards, it reverses direction or, when the series is falling, its rate of decline accelerates.

Table 68 suggests that the only solid tendency of manufacturing output during contraction is for its rate of decline to retard between stages VIII and IX, the last interstage interval of the phase. The average rates of decline rose and fell in about the same num-



ber of series between stages VI and VII as between V and VI. And the same is true when one compares the rates of decline between stages VII and VIII with those between VI and VII. Between stages VIII and IX, however, the number of series with rates of decline lower than between stages VII and VIII exceeded those with higher rates more than 2 to 1. Thus an unweighted count of the 57 output series suggests that the rate of decline in total manufacturing remains approximately constant until near the end of contraction, then retards. The series in the important metal and metal products group do tend to decline most rapidly around the middle of contraction and their amplitude of fluctuation is wider than that of series in the other groups.<sup>5</sup>

But this is not the whole story. The average rates of decline in 23 series—slightly over 40 percent of the total—conform to a sine-curve-like pattern, accelerating in the first part of contraction, then retarding (Table 67). Though the sine-curve pattern does not characterize a majority of the series, it is the most common type. Seventeen other series declined most rapidly in the first interstage interval of contraction, V-VI, less rapidly thereafter. The average rates of decline in 40 of the 57 series, about 70 percent, reached maxima well before the trough of business, that is, between stages VII and VIII or earlier.

These results are based upon averages covering all the business cycles over which each individual series extends. Additional information may be had by considering measures for individual cycles. Measures made on the index of total output (Table 69 and Chart 69) show that the average pattern, in which the rate of decline first increases, then decreases, appears clearly in only two of the five individual cycles: the first and last contractions of the period, the violent downswings of 1920-21 and 1937-38. In the 1926-27 contraction the maximum rate of decline also came about the middle of the phase—between stages VII and VIII—but between stages VI and VII output increased. During the great depression of 1929-32 the rate of decline reached a maximum early, then fell at an

<sup>5</sup> These facts are especially relevant to the analysis of goods in process in Chapter 6. The share of the metals and metal products industries as holders of goods in process is larger than their relative contribution to value added in manufacturing.

TABLE 67  
Fifty-seven Production Series: Average Patterns of Rates of Change  
per Month during Business Contractions

	NO. OF CONTR.	AV. CHANGE PER MO. IN REP. CYCLE RELATIVES BETWEEN STAGES			
		V-VI	VI-VII	VII-VIII	VIII-IX
FOOD, BEVERAGES AND TOBACCO					
Animals slaughtered, 1908-38	8	-0.3	+0.3	-1.2	+0.5
Milk used in factory prod., 1919-38	5	+0.1	+0.3	+0.4	+1.9
Wheat flour, 1914-24, 1924-38	6	-0.9	0	+0.8	+2.7
Sugar meltings, 1891-21, 1921-38	13	-1.1	+0.7	+0.02	+2.4
Shortening, 1924-38	3	+2.1	+0.4	+1.3	-6.4
Tob. consumption in cigarettes, 1914-38	6	-1.8	+1.0	+1.3	-1.4
TEXTILES AND TEXTILE PRODUCTS					
Cotton consumption, 1914-38	6	-2.6	-2.1	-2.0	+0.1
Wool consumption, 1919-38	5	-5.4	-4.5	-0.04	-0.9
Raw silk deliveries, 1921-38	4	-2.9	-1.6	+0.4	+1.5
Rayon deliveries, 1924-38	3	-1.1	-1.9	-0.1	+3.0
Fabrics, factory employment, 1919-38	5	-0.7	-2.0	-0.4	-0.3
Wearing apparel, factory emp., 1919-38	5	-0.2	-1.3	-0.3	-0.3
LEATHER AND LEATHER PRODUCTS					
Cattle hide & kip leather, 1921-38	4	-2.2	-2.0	-1.2	-0.4
Shoes, 1924-38	3	-1.8	-2.4	+1.2	+0.3
RUBBER AND RELATED PRODUCTS					
Auto. inner tubes, 1921-38	4	-6.2	-0.8	-2.2	+0.8
Auto. pneumatic casings, 1921-38	4	-6.2	-0.4	-2.0	+0.05
LUMBER AND WOOD PRODUCTS					
Douglas fir lumber, 1919-33	4	-1.2	-1.4	-1.2	-0.4
Southern pine lumber, 1919-38	5	-1.1	-2.0	+0.1	-0.5
Oak flooring, 1912-38	7	-4.1	-1.3	+2.8	+1.4
Furniture, 1924-38	3	-1.6	-3.2	-2.7	-0.9
PAPER, PRINTING AND PUBLISHING					
Fine paper, 1919-33, 1933-38	5	-0.9	-2.5	-1.0	+0.6
Wrapping paper, 1924-38	3	-0.6	-4.4	-0.4	+1.1
Newsprint shipments, 1919-38	5	0	-0.7	-2.4	+0.3
Book paper, 1919-33	4	+0.1	-1.7	-0.8	-0.5
Paper boxes, factory emp., 1919-38	5	+0.04	-0.9	-1.1	-0.4
Newsprint consumption, 1919-38	5	-0.5	-0.3	-0.5	-0.2

TABLE 67 (Concl.)

	NO. OF CONTR.	AV. CHANGE PER MO. IN REF. CYCLE RELATIVES BETWEEN STAGES			
		V-VI	VI-VII	VII-VIII	VIII-IX
<b>CHEMICALS AND ALLIED PRODUCTS</b>					
<i>Chemical products</i>					
Ethyl alcohol, 1921-38	4	-3.3	+1.1	-2.1	-1.5
Fertilizer consumption, 1924-38	3	-2.5	-1.7	+1.1	-0.6
Inedible tallow, 1919-38	5	-0.4	+0.7	+1.4	+0.3
Explosives shipments, 1921-38	4	-3.5	-1.3	-1.4	-0.5
Linseed oil, 1919-38	5	-4.5	-3.5	+0.5	-3.0
Refined cottonseed oil, 1919-38	5	+1.3	+1.7	+1.8	-2.5
<i>Petroleum products</i>					
Gasoline, 1919-38	5	+1.6	+0.8	+0.2	-0.02
Lubricants, 1919-38	5	+0.1	+0.1	-1.6	-1.4
<b>STONE, CLAY AND GLASS PRODUCTS</b>					
Portland cement, 1912-38	7	-1.5	+0.1	+0.1	-1.0
Polished plate glass, 1924-38	3	-3.8	-3.8	-9.0	+0.7
Face brick, 1919-24, 1924-33	4	-1.5	-3.3	-0.4	+0.2
Prepared roofing shipments, 1919-27, 1927-33, 1933-38	5	-4.5	+0.9	+0.8	+0.2
Asphalt, 1919-38	5	+0.4	+0.3	-0.7	+2.3
<b>METALS AND METAL PRODUCTS</b>					
<i>Metals</i>					
Pig iron, 1879-1938	16	-0.6	-3.8	-3.5	-1.6
Steel ingots, 1900-38	10	-0.9	-4.6	-4.3	-1.7
Refined copper, N. & S. Am., 1919-38	5	-0.6	-0.6	-2.9	-1.9
Steel sheets, 1919-33, 1933-38	5	-4.7	-4.8	-5.2	+1.4
Lead ore shipments, 1897-1924, 1924-38	11	-3.5	-1.4	-1.2	+1.9
Slab zinc, 1921-38	4	-1.9	-1.5	-1.8	-1.7
Tin & ternc plate, 1924-33, 1933-38	3	+1.5	-3.9	-5.7	-1.2
Enameled sanitary ware ship., 1919-27	3	-0.6	+2.0	-0.6	-0.7
<i>Transportation equipment</i>					
Passenger auto., 1914-38	6	-6.3	-0.4	-1.6	-0.03
Trucks, 1914-38	6	-5.6	-2.9	-3.4	-1.8
Auto. parts & accessories ship., 1927-38	2	-3.3	-5.0	-6.4	-0.9
Vessels under construction, 1919-38	5	+2.9	-0.5	-5.0	-6.3
Freight car shipments, 1919-38	5	+0.7	-6.7	-16.0	-1.7
R.R. passenger car. ship., 1919-38	5	+19.0	-12.4	+6.1	-20.3
R.R. locomotive ship., 1919-38	5	-0.1	-4.7	-8.4	-6.9
<i>Machinery shipments, value</i>					
Machine tool, 1927-33	1	-6.9	-6.2	-2.1	-1.4
Industrial pumps, 1919-33	4	+0.02	-2.7	-3.6	-3.2
Woodworking mach., 1919-38	5	-4.7	-4.0	-3.9	-2.7

Unless otherwise specified, each series represents the physical output of a commodity or is an index of the physical output of a group of commodities. Full titles and brief descriptions of the sources and character of these series are given in App. G.

ever slower pace. All these four contractions share the single characteristic that the decline in output began to fall off some time before the last part of the phase, between stages VII and VIII or earlier. Only in the mild contraction of 1923-24 did output decline most rapidly between stages VIII and IX, the last part of the phase.<sup>6</sup>

TABLE 68  
Fifty-seven Production Series: Direction of Movement of Average Rates of Change per Month between Interstage Intervals of Business Contractions

Interstage Intervals	Rising	Constant	Falling
	NUMBER		
V-VI & VI-VII	28	3	26
VI-VII & VII-VIII	30	1	26
VII-VIII & VIII-IX	39	2	16
	PERCENTAGE		
V-VI & VI-VII	49.1	5.3	45.6
VI-VII & VII-VIII	52.6	1.8	45.6
VII-VIII & VIII-IX	68.4	3.5	28.1

By and large the measures made on the industry groups and individual industries confirm these results (Table 70). At the beginning of all three major contractions of the period (1920-21, 1929-32, and 1937-38), a majority of the industry groups declined at an accelerating rate and at the end a majority fell at a diminishing rate. In the two minor contractions of the mid-'twenties the reverse was true. In one, however, the indicated acceleration of the pace of the decline at the end of the phase is fairly weak. As in the measures of total output, in the 1923-24 contraction alone is there a clear indication that output was falling at an accelerating pace during the last part of the phase.

I conclude from these numerous observations that the rate of decline in output tends markedly to diminish well before the end of cyclical contractions. It tends to accelerate in the early part of contractions, but this tendency is weaker and its validity less assured.

<sup>6</sup> This agrees with the showing of the aggregate indexes in Section 2. The interval between the upturn in the rate of change of these indexes and the business cycle trough in July 1924 was shorter than at other troughs of business.

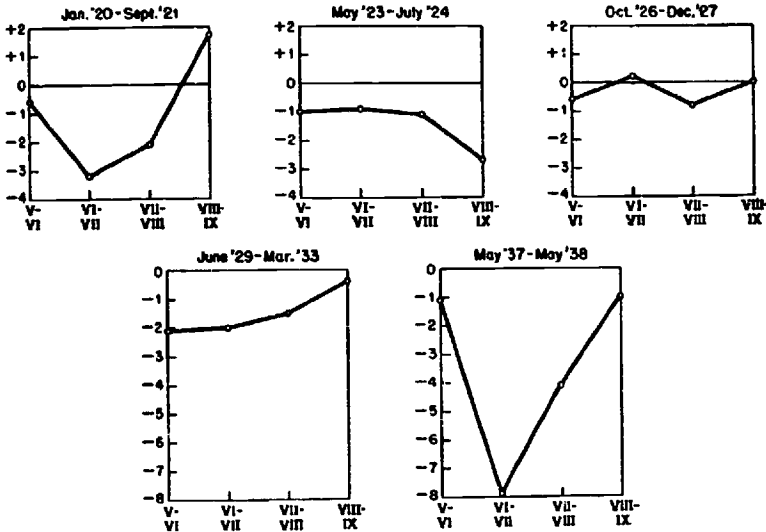
TABLE 69

Federal Reserve Board Index of Manufacturing Production  
 Patterns of Rates of Change per Month, 5 Business Contractions  
 1920-1938

BUSINESS CONTRACTION	CHANGE PER MO. IN REF. CYCLE RELATIVES BETWEEN STAGES			
	V-VI	VI-VII	VII-VIII	VIII-IX
Jan. 1920 - Sept. 1921	-0.6	-3.2	-2.1	+1.7
May 1923 - July 1924	-1.0	-0.9	-1.1	-2.7
Oct. 1926 - Dec. 1927	-0.6	+0.2	-0.8	0
June 1929 - March 1933	-2.1	-2.0	-1.5	-0.4
May 1937 - May 1938	-1.1	-7.9	-4.1	-1.0

Chart 69

Federal Reserve Board Index of Manufacturing Production  
 Patterns of Rates of Change per Month from Stage to Stage  
 of 5 Business Contractions



Vertical scale in cycle relatives.

RATE OF GROWTH IN OUTPUT DURING BUSINESS EXPANSIONS

To define the tendencies of the rate of change in output during expansions is far more difficult. The average patterns of the general indexes of production do indeed suggest some interesting conclusions. But these are supported only in part by the average behavior of the subgroups or of the aggregate in individual cycles.

The average pattern of the index for all manufacturing during

TABLE 70

Manufacturing Production: Direction of Movement of Rates of Change per Month between Interstage Intervals, 5 Business Contractions, 1920-1938

BUSINESS CONTRACTION	NO. OF SERIES WITH INDICATED MOVEMENT BETWEEN INTERSTAGE INTERVALS								
	V-VI to VI-VII			VI-VII to VII-VIII			VII-VIII to VIII-IX		
	+	o	-	+	o	-	+	o	-
	FOURTEEN INDUSTRY GROUP INDEXES								
1/1920- 9/1921	2		8	6		4	8		2
5/1923- 6/1924	7		3	5		5	2		8
10/1926-12/1927	10		4	5		9	6		8
6/1929- 3/1933	5		9	9	1	4	13		1
5/1937- 5/1938			13	9		4	11		2
	FIFTY-SEVEN PRODUCTION SERIES								
1/1920- 9/1921	19		21	21		19	29		11
5/1923- 6/1924	34		13	21		26	16		31
10/1926-12/1927	40		15	22	3	30	28	1	26
6/1929- 3/1933	29	3	24	31	2	23	47	1	8
5/1937- 5/1938	15		36	32		19	31		20

expansions (Table 71 and Chart 70) is an interesting contrast to its pattern during contractions. The rate of growth is at first relatively rapid, then retards, and picks up speed again as the phase draws to a close. This behavior, however, has not been generally characteristic of manufacturing output. While the pattern marked out by the index of total output is repeated by the index of durable goods, it is not shared by the index of nondurables. The latter, like the total, first falls, then rises, but the rate of growth of nondurable output is lower toward the end of expansion, that is, between stages IV and V, than between stages III and IV.

The true dichotomy, however, is apparently not one between durables and nondurables, but rather between producer and consumer goods. Whether we look at Leong's index or the Federal Reserve Bank's, the output of producer and durable goods seems to act similarly, rising toward the end of expansion. The rate of growth of consumer goods is like that of nondurables, declining toward the end of the phase. So much is only to be expected from the degree to which these classifications overlap. With the Federal Reserve Bank indexes (Table 71) we can be more discriminating, for they divide both producer and consumer goods into durables

TABLE 71

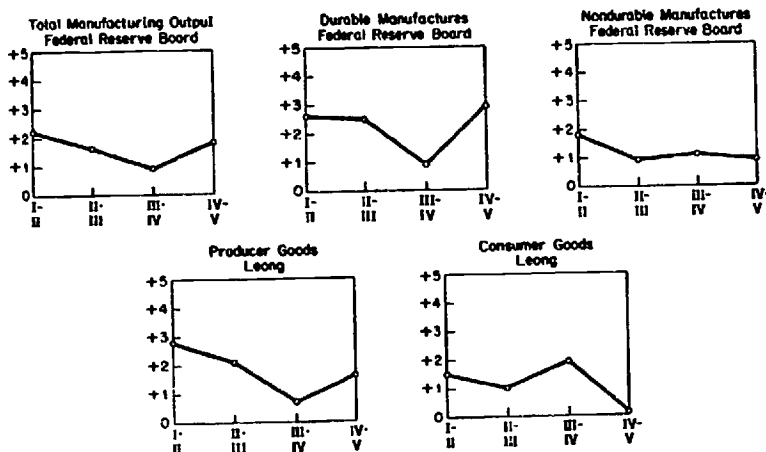
General Indexes of Manufacturing Production: Average Patterns of Rates of Change per Month, 5 Business Expansions, 1919-1937

PRODUCTION INDEXES	AV. CHANGE PER MO. IN REF. CYCLE RELATIVES BETWEEN STAGES			
	I-II	II-III	III-IV	IV-V
Total mfg., FRB	+2.2	+1.6	+0.9	+1.8
Durables, FRB	+2.6	+2.5	+0.9	+2.9
Nondurables, FRB	+1.8	+0.9	+1.1	+0.9
Producer goods, Leong	+2.8	+2.1	+0.7	+1.6
Producer goods, FRB of N.Y.	+2.3	+1.4	+0.4	+1.4
Durable, FRB of N.Y.	+2.5	+2.5	+0.7	+2.1
Nondurable, FRB of N.Y.	+2.4	+0.4	+0.1	+0.7
Consumer goods, Leong	+1.5	+1.0	+1.9	+0.1
Consumer goods, FRB of N.Y.	+1.0	+0.9	+1.2	-0.5
Durable, FRB of N.Y.	+3.5	+3.9	+2.7	-1.7
Nondurable, FRB of N.Y.	+0.4	+0.1	+0.8	-0.2

See Table 65.

Chart 70

General Indexes of Manufacturing Production  
Average Patterns of Rates of Change per Month from Stage to Stage  
of 5 Business Expansions, 1919-1937



Vertical scale in cycle relatives.

and nondurables. Producer goods, whether durable or nondurable, grew more rapidly in the last interstage interval of expansion than in the third interval. Consumer goods, durable and nondurable, on the contrary, grew less rapidly in the last interval than in the third.

The tendency, if there is one, for the pace of output to accelerate toward the end of expansion is confined to producer goods. Producer goods, however, do not cover merely items of finished equipment to be sold to business. They include also goods requiring further fabrication whatever their ultimate destination. They therefore cover a much larger volume of commodities than do consumer goods which are limited to commodities ready for sale to ultimate consumers.

One final aspect of Table 71 deserves notice. Whatever the differences among the various categories of manufacturing with respect to the rate of increase in output at the end of expansion, there is virtually unanimous agreement about events during the first half of the phase. As far as these averages may be trusted, it appears to have been characteristic of manufacturing that the rate of expansion, after starting at a relatively rapid pace between stages I and II, retarded between stages II and III. This is the showing of the total and of all the component indexes except two. The rate of growth of the Federal Reserve Bank index of producer durables does not change between these two intervals; its index of consumer durables rises.

TABLE 72  
Fourteen Industry Groups: Average Patterns of Rates of Change per Month in Production during Business Expansions

	NO. OF EXP.	AV. CHANGE PER MO. IN REF. CYCLE RELATIVES BETWEEN STAGES			
		I-II	II-III	III-IV	IV-V
DURABLE GOODS INDUSTRIES					
Lumber, 1919-38	5	+1.6	+0.8	+1.1	+0.8
Furniture, 1924-38	3	+0.8	+1.1	+1.2	+1.5
Stone, clay & glass, 1919-38	5	+2.0	+2.3	+0.5	+2.2
Metals, 1919-24, 1924-38	5	+3.6	+3.0	+0.6	+4.1
Transp. equipment, 1919-38	5	+0.8	+4.8	+2.3	+1.9
Machinery, 1924-38	3	+1.9	+1.6	+2.1	+2.1
NONDURABLE GOODS INDUSTRIES					
Food, 1919-38	5	+0.1	+0.3	+0.7	+0.5
Textiles, 1919-38	5	+2.6	+0.6	+1.5	+0.9
Leather, 1919-38	5	+0.9	+0.3	+0.7	+1.0
Paper & pulp, 1919-38	5	+2.2	+1.2	+1.3	+1.6
Printing, 1919-33	4	+1.7	+1.0	+0.9	+1.5
Rubber, 1924-38	3	+3.1	+2.0	+0.2	-0.1
Petroleum, 1919-38	5	+1.2	+1.0	+0.9	+0.8
Chemicals, 1924-38	3	+1.0	+1.0	+1.0	+1.1

See Table 66, notes.



How consistent are these behavior traits in series representing industry groups and individual commodities (Table 72)? The 14 industry groups cannot be divided between consumer and producer goods, but the industries have been grouped according to the durability of their products. The tendencies that appeared in the general indexes are no longer visible. Half the durable goods industries grow at a higher rate between stages II and III than between stages I and II; half at a lower rate. Virtually the same even division appears in later intervals. The latter point is true also for the nondurable goods industries, but in this category most industries advanced less rapidly in the second interval than in the first.<sup>7</sup>

This apparently constant rate of growth of aggregate manufacturing output during expansions is belied by the measures for individual industries and commodities. These suggest again that the aggregate conceals differences in its components. The average cycle measures in Tables 73 and 74 are strikingly similar to the results suggested by the general indexes (Table 71) in certain interesting and important respects.<sup>8</sup> The average rates of growth of a considerable majority of the 57 series declined from interstage interval I-II to II-III. Again the sole exception was consumer durables. Another striking similarity is the apparent change between the third and last intervals of expansion. Again the rate of growth of the output of producer goods apparently rose toward the end of expansion and that of consumer goods declined.

If these observations were true for all cycles, they would be of great significance. But cycle by cycle examination confirms the suggestions of the averages only in part. I confine the presentation

<sup>7</sup> The character of the durable goods index in Table 71 seems to have been determined chiefly by the weight assigned to the metals group; the character of the nondurable goods index is attributable to the weights assigned to the foods and textiles groups.

<sup>8</sup> In some respects the two bodies of data yield different results. For example, the rate of growth of the index of all manufacturing was lower between stages III and IV than between II and III; the growth of the Reserve Bank index of producer goods was also slower, but that of the Bank index of consumer goods was higher. A small majority of all 57 series, on the contrary, rose at a more rapid rate between stages III and IV, most of the producer goods rose at a less rapid rate and most of the consumer goods at a more rapid rate.

**TABLE 73**  
**Fifty-seven Production Series: Average Patterns of Rates of Change**  
**per Month during Business Expansions**

(1)	NO. OF EXP.	TYPE OF GOODS*	AV. CHANGE PER MO. IN REF. CYCLE RELATIVES BETWEEN STAGES			
			(4)	(5)	(6)	(7)
<b>FOOD, BEVERAGES AND TOBACCO</b>						
Animals slaughtered, 1908-38	8	CN	+0.6	-0.6	+0.7	-0.2
Milk used in factory prod., 1919-38	5	CN	-0.3	+0.3	+0.2	-0.4
Wheat flour, 1914-24, 1924-38	6	CN	-2.3	+0.8	+0.2	+0.1
Sugar meltings, 1891-21, 1921-38	13	CN	-0.1	+0.1	+0.2	-0.1
Shortening, 1924-38	3	CN	+2.7	+1.8	-0.1	-0.5
Tob. consumption in cigarettes, 1914-38	6	CN	-0.3	+2.5	+3.2	+0.3
<b>TEXTILES AND TEXTILE PRODUCTS</b>						
Cotton consumption, 1914-38	6	PN	+1.7	+0.4	+1.5	+0.9
Wool consumption, 1919-38	5	PN	+5.2	-0.7	+1.9	+2.2
Raw silk deliveries, 1921-38	4	PN	+0.2	+1.2	+0.5	+0.4
Rayon deliveries, 1924-38	3	PN	+1.8	+0.9	+1.2	+2.8
Fabrics, factory emp., 1919-38	5	PN	+1.6	+0.4	+0.5	+0.7
Wearing apparel, factory emp., 1919-38	5	CN	+0.8	+0.7	+0.9	+0.2
<b>LEATHER AND LEATHER PRODUCTS</b>						
Cattle hide & kip leather, 1921-38	4	PN	+1.8	-0.2	+0.2	+1.3
Shoes, 1924-38	3	CN	+1.2	0	+0.4	+1.1
<b>RUBBER AND RELATED PRODUCTS</b>						
Auto. inner tubes, 1921-38	4	CN	+1.6	+1.5	+0.6	-1.4
Auto. pneumatic casings, 1921-38	4	CN	+2.5	+2.2	+0.4	-0.8
<b>LUMBER AND WOOD PRODUCTS</b>						
Douglas fir lumber, 1919-33	4	PD	+1.6	-1.2	-0.6	+1.0
Southern pine lumber, 1919-38	5	PD	+1.2	+0.4	+0.3	-0.7
Oak flooring, 1912-38	7	PD	+4.1	+3.0	+0.7	+1.4
Furniture, 1924-38	3	CD	+0.8	+1.1	+1.2	+1.5
<b>PAPER, PRINTING AND PUBLISHING</b>						
Fine paper, 1919-33, 1933-38	5	CN	+3.4	+2.2	+0.9	+0.5
Wrapping paper, 1924-38	3	PN	+1.8	+0.5	+0.7	+1.1
Newsprint shipments, 1919-38	5	PN	+1.1	+1.5	+0.9	+0.5
Book paper, 1919-33	4	PN	+2.2	+1.0	+1.2	+2.8
Paper boxes, factory emp., 1919-38	5	PN	+0.6	-0.1	+0.9	+1.0
Newsprint consumption, 1919-38	5	CN	+1.2	+1.0	+0.6	+0.3
<b>CHEMICALS AND ALLIED PRODUCTS</b>						
<i>Chemical products</i>						
Ethyl alcohol, 1921-38	4	PN	+2.3	+2.1	+1.8	0
Fertilizer consumption, 1924-38	3	PN	+0.8	+0.1	+0.5	+1.2
Inedible tallow, 1919-38	5	PN	+2.0	-0.1	+0.7	+0.1
Explosives shipments, 1921-38	4	PN	+1.1	+0.2	+2.0	+0.8
Linseed oil, 1919-38	5	PN	+3.0	-2.1	+1.5	+4.0
Refined cottonseed oil, 1919-38	5	PN	+0.4	-2.0	+1.5	-1.5

TABLE 73 (Concl.)

(1)	NO. OF EXP.	TYPE OF GOODS*	AV. CHANGE PER MO. IN REF. CYCLE RELATIVES BETWEEN STAGES			
			(4)	(5)	(6)	(7)
<i>Petroleum products</i>						
Gasoline, 1919-38	5	CN	+1.0	+0.9	+1.5	+0.5
Lubricants, 1919-38	5	PN	+1.5	+0.8	+0.9	+0.9
STONE, CLAY AND GLASS PRODUCTS						
Portland cement, 1912-38	7	PD	+1.1	+1.2	+0.5	+1.3
Polished plate glass, 1924-38	3	PD	+3.3	+2.0	+1.7	+1.7
Face brick, 1919-24, 1924-33	4	PD	+3.4	+2.9	+0.02	+3.0
Prepared roofing shipments, 1919-27, 1927-33, 1933-38	5	PD	+0.9	-0.6	+3.2	+1.5
Asphalt, 1919-38	5	PD	+1.4	+1.5	+3.2	+0.9
METALS AND METAL PRODUCTS						
<i>Metals</i>						
Pig iron, 1879-1938	16	PD	+3.8	+2.0	+1.3	+2.9
Steel ingot, 1900-38	10	PD	+4.2	+2.4	+1.1	+3.3
Refined copper, N. & S. Am., 1919-38	5	PD	+0.3	+2.4	+0.9	+2.0
Steel sheets, 1919-33, 1933-38	5	PD	+4.6	+2.8	+1.3	+4.5
Lead ore shipments, 1897-1924, 1924-38	11	PD	+1.3	+0.9	+0.3	+1.4
Slab zinc, 1921-38	4	PD	+2.2	+1.6	+1.6	+2.5
Tin & terne plate, 1924-33, 1933-38	3	PD	+3.5	+1.5	+0.6	+0.6
Enameled sanitary ware ship., 1919-27	3	CD	+8.3	+2.1	+1.2	-2.8
<i>Transportation equipment</i>						
Passenger automobiles, 1914-38	6	CD	+3.7	+4.1	+3.2	-0.7
Trucks, 1914-38	6	PD	+2.9	+3.8	+3.9	+6.8
Auto. parts & accessories ship., 1927-38	2	CD	+3.2	+3.4	+0.8	+0.1
Vessels under construction, 1919-38	5	PD	-12.6	-2.8	+0.4	+3.0
Freight car shipments, 1919-38	5	PD	-1.1	+28.0	-13.7	+0.1
R.R. passenger car. ship., 1919-38	5	PD	-11.5	+3.9	+6.7	-9.3
R.R. locomotive ship., 1919-38	5	PD	-8.3	-3.3	+1.9	+7.8
<i>Machinery shipments, value</i>						
Machine tool, 1927-33	1	PD	+4.7	+4.2	+8.0	+2.7
Industrial pumps, 1919-33	4	PD	+2.3	+2.0	+4.0	+3.7
Woodworking mach., 1919-38	5	PD	+4.1	+2.8	+2.9	+2.4

See Table 67, note.

\* The symbols in col. 3 indicate the classification of the industry or commodity according to durability and user, the basis for the calculations of Table 74, as follows:

CD	Consumer durables	PD	Producer durables
CN	Consumer nondurables	PN	Producer nondurables

**TABLE 74**  
**Fifty-seven Production Series Classified by User and Durability**  
**Direction of Movement of Average Rates of Change per Month**  
**between Interstage Intervals of Business Expansions**

	DIRECTION OF MOVEMENT BETWEEN INTERSTAGE INTERVALS								
	I-II to II-III			II-III to III-IV			III-IV to IV-V		
	+	0	-	+	0	-	+	0	-
	NUMBER OF SERIES								
Consumer goods	7	10		7	10		2		15
Durable	3	1		1	3		1		3
Nondurable	4	9		6	7		1		12
Producer goods	9	31		24	1	15	23	3	14
Durable	8	15		10	1	12	14	2	7
Nondurable	1	16		14		3	9	1	7
Total durable	11	16		11	1	15	15	2	10
Total nondurable	5	25		20		10	10	1	19
All series	16	41		31	1	25	25	3	29
	PERCENTAGE OF SERIES								
Consumer goods	41	59		41		59	12		88
Durable	75	25		25		75	25		75
Nondurable	31	69		46		54	8		92
Producer goods	22	78		60	2	38	57	8	35
Durable	35	65		43	4	53	61	9	30
Nondurable	6	94		82		18	53	6	41
Total durable	41	59		41	4	55	56	7	37
Total nondurable	17	83		67		33	33	3	64
All series	28	72		54	2	44	44	5	51

See Table 73, col. 3, for industries included in each class.

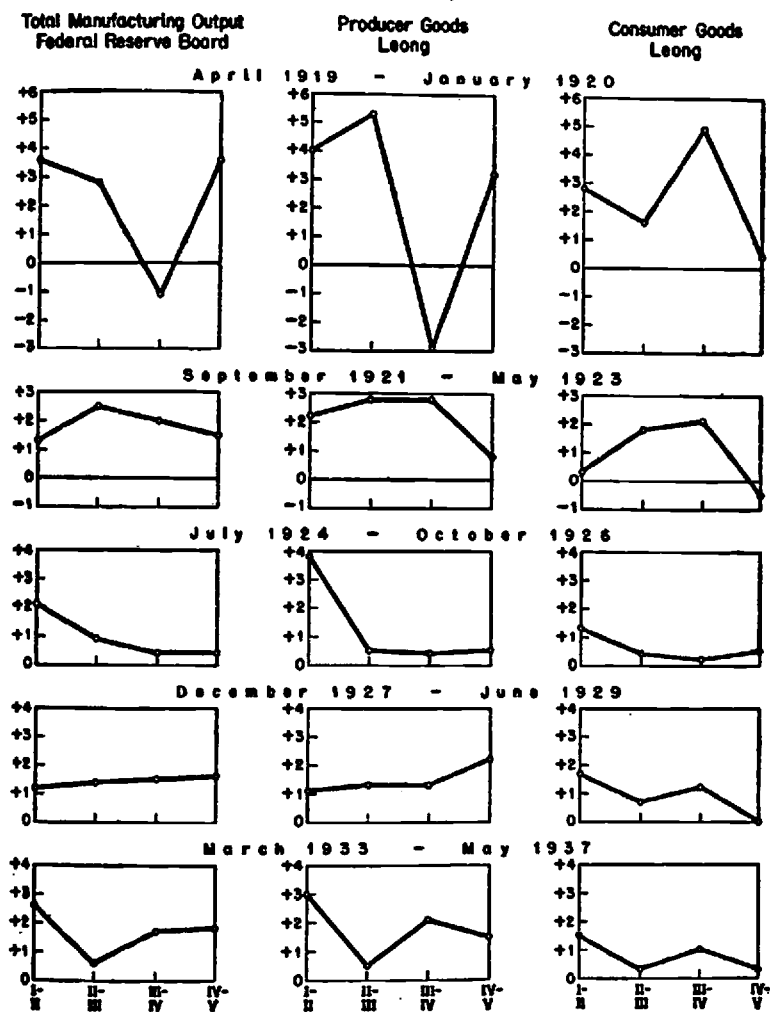
of data to the general indexes and individual commodities grouped into producer and consumer goods categories. Chart 71 depicts the patterns of the rate of growth of total manufacturing output, as measured by the FRB index, and of the output of producer and consumer goods, as measured by Leong's indexes.<sup>9</sup> Table 75 shows, cycle by cycle, the number and percentage of all individual commodity series whose rate of growth rises or falls between interstage intervals. This information is furnished for all the series for which

<sup>9</sup> Leong's indexes are presented in preference to those of the Federal Reserve Bank of New York because the latter are adjusted for trend and contain some indexes of output in industries other than manufacturing. They are, therefore, less easily compared with the FRB index of total manufacturing production.

data are available in a given cycle and for these series grouped into producer and consumer goods categories.

Within the consumer goods group, certain tendencies may be identified, at least tentatively. According to the measures made from Leong's index (Chart 71), the advance in the first part of expan-

Chart 71  
 General Indexes of Manufacturing Production  
 Patterns of Rates of Change per Month from Stage to Stage  
 of 5 Business Expansions



Vertical scale in cycle relative.

sion was relatively rapid in 4 out of 5 cycles. In the second interstage interval, the pace moderated—again in 4 out of 5 cycles. In the third interval, the advance quickened, then slackened decisively in the fourth. The summary of the movements of individual series (Table 75) confirms the behavior of the index, at least as far as the deceleration at the end of the phase is concerned. And it does not contradict the behavior of the index in earlier intervals.<sup>10</sup>

TABLE 75  
Fifty-seven Production Series Classified by User  
Direction of Movement of Rates of Change per Month  
between Interstage Intervals, 5 Business Expansions, 1919-1937

BUSINESS EXPANSION	DIRECTION OF MOVEMENT BETWEEN INTERSTAGE INTERVALS								
	I-II to II-III		II-III to III-IV			III-IV to IV-V			
	+	0	+	0	-	+	0	-	
	NUMBER OF SERIES								
Consumer goods									
4/1919- 1/1920	5		6	6		5	2		9
9/1921- 5/1923	10		3	6	1	6	3	1	9
7/1924-10/1926	5	2	9	4	1	11	8	3	5
12/1927- 6/1929	9	1	6	7		9	6	1	9
3/1933- 5/1937	4		12	12		4	5	1	10
Producer goods									
4/1919- 1/1920	14	1	14	12		17	19	2	8
9/1921- 5/1923	19		15	21	1	12	11	1	22
7/1924-10/1926	8		31	16		20	20	1	18
12/1927- 6/1929	24	1	15	25		15	15	1	24
3/1933- 5/1937	4		31	28		7	20		15
	PERCENTAGE OF SERIES								
Consumer goods									
4/1919- 1/1920	45		55	55		45	18		82
9/1921- 5/1923	77		23	46	8	46	23	8	69
7/1924-10/1926	31	12	57	25	6	69	50	19	31
12/1927- 6/1929	56	6	38	44		56	38	6	56
3/1933- 5/1937	25		75	75		25	31	6	63
Producer goods									
4/1919- 1/1920	49	3	48	41		59	65	7	28
9/1921- 5/1923	56		44	62	3	35	32	3	65
7/1924-10/1926	21		79	41	8	51	51	3	46
12/1927- 6/1929	60	2	38	62		38	38	2	60
3/1933- 5/1937	11		89	80		20	57		43

<sup>10</sup> A majority of the series grow less rapidly in the interval II-III than in the interval I-II in 3 out of 5 cycles. A majority grow more rapidly in the interval III-IV than in the interval II-III in 2 out of 5 cycles, and the series are evenly divided in one more cycle.

There is little regularity, however, in the rate of growth of producer goods industries from one cycle to the next. According to Leong's index, the pace was faster in the interval II-III than in the interval I-II in three cycles, slower in two. Between intervals II-III and III-IV it was constant in two cycles, almost unchanged in a third, faster in a fourth, and slower in a fifth. Between intervals III-IV and IV-V it accelerated in two cycles, declined in two, and remained almost constant in a fifth. Summaries of the movements of individual series indicate similar irregularity. With the exception of one cycle in Leong's data, however, there is evidence of a decisive retardation in growth in some interval before expansion ends. In this respect the measures made on manufacturing output confirm those made on the indexes of aggregate output.

As explained above, the producer goods category, which covers the output not only of finished capital goods but also of unfinished goods destined to be used by both business and consumers, is much more important than the consumer goods category. As a result, aggregate manufacturing output followed the varying pattern of producer goods production rather than the relatively stable pattern of consumer goods production.

#### CONCLUSION

For the readers' convenience, I shall here state categorically the chief conclusions to which I think the measures examined above lead.

- 1) During contractions manufacturing production tends to decline at its most rapid rate well before the trough of business is reached. There is some indication that it tends to reach its maximum rate about the middle of the phase, but it has sometimes achieved its maximum near the very beginning. In any event, the rate of decline has usually been decelerating near the trough of business. These observations are consistent with the general trend of the data, but many industries have not acted in this way in every cycle observed, and in one cycle the rule did not hold at all.
- 2) During expansions the rate of growth in consumer goods production appears to have shared one important characteristic of all manufacturing output in contraction: the maximum rate has usually occurred well before the peak of business. But while the rate of growth in this category has typically been much lower near the

end of expansion than earlier, no clear rule emerges about the stage when it tends to be at a maximum.

3) The pattern of the rate of growth of producer goods has been highly variable from cycle to cycle. The rate of growth near the end of expansion has sometimes been relatively high, sometimes relatively low. The same may be said for the earlier stages of expansion, except the first when it has usually been fairly high. Almost always, however, a period of serious retardation has been experienced before the end of expansion.

4) The behavior of producer goods has generally overshadowed that of consumer goods, and the rate of growth of total manufacturing output during expansions has usually been dominated by the irregular behavior of the rate of growth of producer goods output.

These detailed characteristics of the pattern of the rate of change in manufacturing production are significant for the analysis of investment in goods in process set forth in the next chapter. Here we revert to the broad finding confirmed by the indexes of both aggregate output and manufacturing production. The rate of growth in output reaches a high point considerably before the end of expansion, a trough considerably before the end of contraction. The turning points occur sometimes at the very beginning of a phase, often during its first half. A period of retarded change follows, which may last throughout the remainder of a phase or, especially in expansions, may be succeeded by a period of accelerated movement. In the latter case, the succeeding peaks in the rate of change in output are usually lower than the initial peak, and the same with the troughs.

The movements of inventory investment are quite different. The rate of accumulation of inventories is typically low—usually negative—at the beginning of expansion. And whatever oscillations it may experience during the course of the phase—annual data do not give any indication of serious intra-phase fluctuations—it normally reaches its peak near the peak of the business cycle. Similarly in contractions: the phase opens with inventories still growing; liquidation begins gradually and is normally most rapid near the trough of the business cycle.



The significance of this behavior has already been described. The lag of inventory investment behind the rate of change in output acts to moderate the pace and extend the duration of expansions and contractions. We must now try to understand the causes of the lag. The next four chapters attempt to provide an explanation as far as manufacturers' inventories are concerned. As in Part Two, we find that there are significant differences between the behavior of investment in goods in process, raw materials, and finished goods. An explanation of the behavior of total inventory investment by manufacturers must be sought in the forces that control investment in the several categories.