Volume Title: Inventories and Business Cycles, with Special Reference to Manufacturers' Inventories

Volume Author/Editor: Moses Abramovitz

Volume Publisher: NBER

Volume ISBN: 0-870-14087-6

Volume URL: http://www.nber.org/books/abra50-1

Publication Date: 1950

Chapter Title: Timing and Conformity of Inventory Investment Cycles

Chapter Author: Moses Abramovitz

Chapter URL: http://www.nber.org/chapters/c9138

Chapter pages in book: (p. 332 - 344)

CHAPTER 14

Timing and Conformity of Inventory Investment Cycles

1 *Problems of Measurement*

The rate of investment by manufacturers in their commodity stocks may be estimated in two ways. If series showing the number of units of each commodity held in stock at the end of each period were available, we could value the change in the number of units of each commodity between the end of one period and the next either by its cost in the period in question, or if we wished to eliminate the influence of price changes, by its cost in some standard period. The aggregate value of the changes in stock for all commodities would be the figure needed.

Alternatively, if one has the values of the inventories held by manufacturers at the end of stated intervals, corrected to eliminate the effects of price changes, the difference between the corrected values held at the end of successive intervals gives the number of dollars spent by manufacturers to add goods to their stocks, the commodities so added being uniformly valued at their cost in some standard period. One may then revalue the investment in each interval to take account of changes in prices between the base period and each given period.

KUZNETS' ESTIMATES

The method we follow is dictated by the material. Estimates of the value of inventories held by manufacturers at the end of each year 1918-38, based on Kuznets' original work, were corrected for changes in the value of inventory units.[1] The difference in these values, corrected for price changes, is our fundamental measure of the rate of inventory investment. Since the corrected values of

[1] The construction of these estimates and the methods used in correcting for price changes are described in Chapter 4 and in greater detail in Appendix A.

inventory at the end of each year show the amount the stock would have cost if purchased in 1929, the change in value between year ends is the cost of the current investment in inventory when the goods added to stock are valued at their 1929 prices.

While the estimates in book values and their correction for changes in price have been described in other chapters, one matter deserves repetition. Some manufacturers value inventories at original cost, others at the lower of original cost or the cost of replacement. In correcting for changes in prices some assumption must be made about the prevalence of these practices. Since I believe that the 'cost or market' method is more common, my figures for inventory investment are based upon price corrections that assume that all manufacturers used this method. As a check against this extreme assumption, I used a second set of figures based upon another extreme assumption: that as much as half the total stock is valued at cost alone and never revalued when the market price is below cost (App. A, Sec. 2D). Except in the years of violent price disturbance 1919-22, they do not differ materially. Indeed, my observations about the tendency of the rate of inventory investment to move up and down with business in general would not be altered even if inventories were universally valued at original cost (see Chart 63). This was, to be sure, not the case in the years of large price movements following World War I. In that period, however, the assumption that inventories are always valued at cost yields implausible results. It suggests that there was a net liquidation of stocks during 1920, the peak year of the postwar boom, and a rapid accumulation during 1921 when businessmen were struggling to rid their shelves of goods. The data I use, therefore, are calculated on the assumption that all stocks are valued at the lower of cost or market price.

The difficulties inherent in correcting inventory values for changes in prices are, of course, magnified when we turn from the level of inventories in different years to the rate of growth and decline in stocks, for small errors in the value of stocks at the ends of successive years can produce a large error in the inventory change during the intervening period. Add to this the errors that arise from measuring cyclical behavior with annual data and it will readily be seen that the problems are formidable. It is especially

important, in using these data, to confine oneself to conclusions that apply to manufacturing as a whole based upon a clear consensus of the behavior of the various industry groups, and even then to avoid observations about details.

2 *Manufacturers' Inventory Investment*

Does inventory investment typically help to initiate the revivals and recessions of business? We can cast some light on this question if we know whether inventory investment reaches its peaks and troughs before or after business activity and whether it does so regularly. To discover this is the purpose of the timing and conformity measures presented in this section. Of course, the reference cycle turning dates are only benchmarks. But against these benchmarks, the timing relations of inventory investment to other crucial series may be judged.

Using the Kuznets estimates for ten large industry groups and for manufacturing as a whole, we compare the timing of the turns in inventory investment with those in business cycles and measure their conformity. To measure the timing of cyclical turns we use the National Bureau standard method for annual series. The midpoints of the years when the specific cycle turns in inventory investment occur are compared with the months in which the corresponding reference turns occur. The lead or lag is measured in months and averaged for all the turns at which comparisons can be made. Since the midpoint of the year in which a series reaches a specific cycle peak or trough is, of course, highly unlikely to be a good approximation to the actual date at which the series turns, any individual observation of relative timing will be in error by a larger or smaller number of months. The validity of the method, therefore, depends upon whether an average can eliminate a considerable part of this inaccuracy by offsetting the errors of single observations. As explained in Chapter 3, the method yields crude but useful results if based on many observations and confined to the broad features of the measures.

The timing measures do not provide a valid basis for supposing that inventory investment by manufacturers tends either to lead or to lag behind business cycle turns. The average lag for total manufacturing is only 0.2 months. An average based on all 86 timing

comparisons also yields a negligible lag. There are only 10 more lags than leads, an excess of only twelve percent. In only 4 of the 10 groups was the average lead or lag longer than 3 months. Of these, 2 were leads and 2 lags. I conclude that if inventory investment tends either to lead or to lag at business cycle turns, the average lead or lag is short, probably no longer than 3 months, an interval too short to be measured reliably by annual data.

A second observation is based on the number of timing comparisons in Table 61. Our data, running from 1919 to 1939 (except for miscellaneous manufacturing which ends in 1937), cover 11 business cycle turns. But since we do not have any way of knowing whether the rate of investment in 1919 was higher or lower than in 1918, comparisons are not made at the initial business cycle trough. For the ten industry groups 99 timing comparisons were possible, and of these, 86 comparisons could actually be made—evidence of the regularity with which the rate of inventory investment by manufacturers rises and falls with general business. For if a series skips a cycle, two possible comparisons are eliminated, and if it moves through an extra cycle, a comparison must often be discarded because of uncertainty in determining which of two spe-

TABLE 61

Investment in Manufacturers' Inventories, Constant Prices
Timing at Business Cycle Turns, 1919-1938

	NUMBER OF LEADS	NUMBER OF LAGS	AV. LEAD (−) OR LAG (+) MONTHS
(1)	(2)	(3)	(4)
Total manufacturing	4	6	+0.2
Food, beverages & tobacco	3	5	+3.9
Textiles & textile products*	2	5	−0.8
Leather & leather products	3	7	+2.6
Rubber & related products	4	4	−0.5
Lumber & wood products	2	7	+4.1
Paper, printing & publishing	3	7	+2.6
Chemicals & allied products	7	0	−7.6
Stone, clay & glass products	3	7	+1.4
Metals & metal products	3	6	+0.6
Miscellaneous	8	0	−8.1
Sum of 10 groups	38	48	
Av. of 10 groups weighted by no. of turns			+0.14

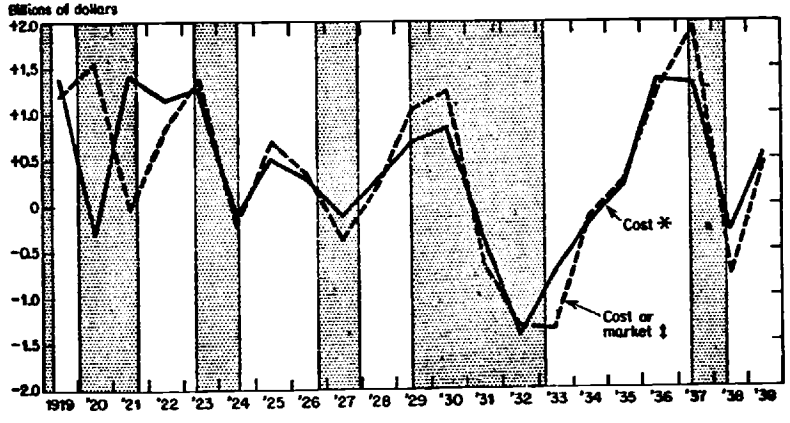
* One lead was excluded because it exceeded 24.5 months.

cific cycle turns should be matched with a given reference cycle turn. And the same sort of uncertainty arises in heightened degree if the series merely behaves irregularly. The large number of actual comparisons relative to the number possible provides a first indication of the conformity of inventory investment to business cycles. Moreover, it increases the reliance that can be put on our timing measures.

That inventory investment by manufacturers tends to conform positively to business cycles can be seen also from Chart 63. Two estimates of the rate of investment are shown: one based on the assumption that inventories are valued at the lower of cost or market price more nearly corresponds to reality; the other on the assumption that inventories are never marked down when prices fall. Under the first assumption, the rate of inventory investment by manufacturers was higher in every peak year of business than in adjacent trough years, and lower in every trough year than in adjacent peak years. In short, inventory investment rose during every expansion and declined during every contraction of business. Not only that, but its amplitude is roughly of the same size as that of business swings. The violent contraction of 1920-21 and the vigorous recovery of 1921-23 stand out plainly. The rate of investment dropped precipitously during the mild business contraction of

Chart 63

Total Manufacturers' Inventory Investment
Constant Prices



‡ Estimated on the assumption that inventories are valued at the lower of cost or market.
* Estimated on the assumption that inventories are always valued at cost.
Contractions (shaded) and expansions (unshaded) are marked off by the monthly reference chronology.

1923-24, but its movements were small during the mild cycle of 1924-27 and large again during the two violent business cycles that followed.

These intimations of systematic response to business cycles are fully confirmed by measures of conformity, made on the same plan as those used in Chapters 4 and 5 in connection with the level of stocks. There are, however, minor differences of procedure arising from the fact that our data are now calendar year, rather than end of year, series. Instead of comparing the movements of the investment data with a chronology based on the ends of years when business reached peaks and troughs, we use the National Bureau regular chronology of the calendar years when business was at peaks and troughs. This is our practice for series that move more or less synchronously. If a series has a pronounced lag, about six months, its movements are compared with the National Bureau fiscal year chronology. We say, in effect, that if an annual series tends to lag six months, it ought to rise and fall in conjunction with an annual chronology of business for years ending six months earlier. If a series leads by about six months, we still use the National Bureau fiscal year chronology, but predate it one year. Special business chronologies were prepared for series leading or lagging by three

TABLE 62

Investment in Manufacturers' Inventories, Constant Prices
Conformity to Business Cycles, 1918-1938

(1)	LEAD (−) OR LAG (+) ASSUMED[a] (MO.) (2)	NO. OF PHASES[b] (3)	INDEX OF CONFORMITY TO BUSINESS Exp. (4)	Contr. (5)	Cycle (6)
Total manufacturing	0	10	+100	+100	+100
Food, beverages & tobacco	+3	10	+20	+20	+11
Textiles & textile products	0	10	+20	+60	+56
Leather & leather products	+3	10	+100	+60	+56
Rubber & related products	0	10	+60	+100	+100
Lumber & wood products	+3	10	+60	+100	+100
Paper, printing & publishing	+3	10	+20	−60	−33
Chemicals & allied products	−9	9	+50	+100	+100
Stone, clay & glass products	0	10	+60	+100	+100
Metals & metal products	0	10	+60	+60	+56
Miscellaneous	−9	9	+50	+100	+100

[a] From Table 61, col. 4. Figures are rounded to the nearest 3-month interval.
[b] See Table 21, note b.

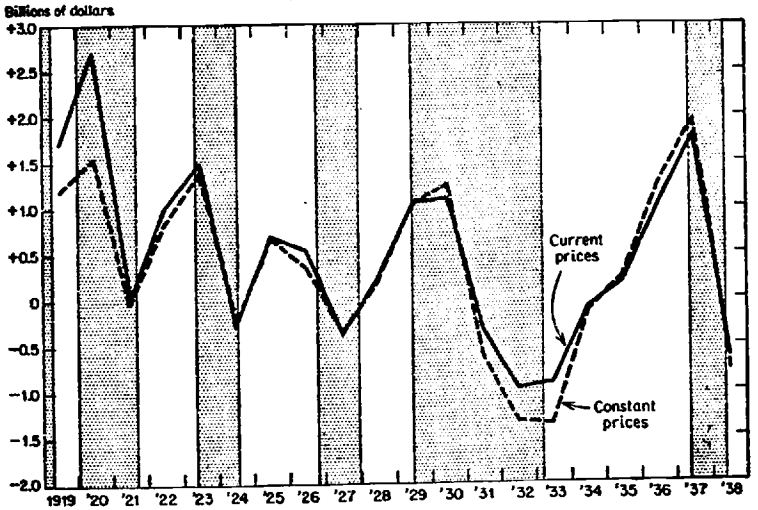
or nine months.[2] By following the average timing measures of Table 61, rounding the figures to the nearest 3-month interval, I distinguish between series that run synchronously with business cycles and those that tend to lead or lag. The measure itself is simple and has been fully explained in Chapters 3 and 4.

The movements of manufacturers' inventory investment coincide with the movements of business far more regularly than do stocks themselves (Table 62). The conformity of the total is perfect and five of the ten groups have full cycle indexes of +100. Only two fall below +50, and one of these is the only negative index in this column. We may conclude that inventory investment by manufacturers as a whole responds to business cycles in a highly systematic fashion, as far as the direction of its movement is concerned. When business gets better, the rate of investment rises; when the tide of business recedes, the rate of investment declines.

There is little difference between the behavior of manufacturers' inventory investment measured in constant prices and in current prices (Chart 64).

Chart 64

Total Manufacturers' Inventory Investment
Current and Constant Prices



Contractions (shaded) and expansions (unshaded) are marked off by the monthly reference chronology.

[2] See Ch. 3 for a fuller description of the Bureau's conformity measures and App. B for a description of the special business chronologies.

3 *Inventory Investment in Manufacturing and Other Industrial Divisions*

As in our study of stock levels, I digress at this point to compare the timing and conformity of manufacturers' inventory investments with those in mining, transportation and other public utilities, trade, and farming (Table 63 and Chart 65). Some 95 percent of all commercial stocks are held by these five groups.

TABLE 63

Total Inventory Investment and Its Major Components, Constant Prices
Timing and Conformity, 1919-1939

A TIMING AT BUSINESS CYCLE TURNS

	NUMBER OF Leads	Lags	AV. LEAD (−) OR LAG (+) MONTHS
Total[a]	5	5	−2.2
Total nonagricultural[a]	4	6	+0.2
Manufacturing	4	6	+0.2
Trade	5	5	−1.0
Transp. & other pub. ut.	1	6	+4.5
Mining & quarrying	0	6	+6.5
Mining & quarrying (inverted)[b]	8	2	−8.3
Agriculture	2	3	+1.1

B CONFORMITY TO BUSINESS CYCLES

	LEAD (−) OR LAG (+) ASSUMED (MO.)	INDEX OF CONFORMITY TO Exp.	Contr.	Cycle
Total[a]	−3	+100	+100	+100
Total nonagricultural[a]	0	+100	+100	+100
Manufacturing	0	+100	+100	+100
Trade	0	+100	+100	+100
Transp. & other pub. ut.[c]	+6	+100	+100	+100
Mining & quarrying	+6	+50	+100	+71
Mining & quarrying	−6[b]	−50	−50	−100
Agriculture	0	+60	+20	+11

[a] Includes construction, finance, and miscellaneous.

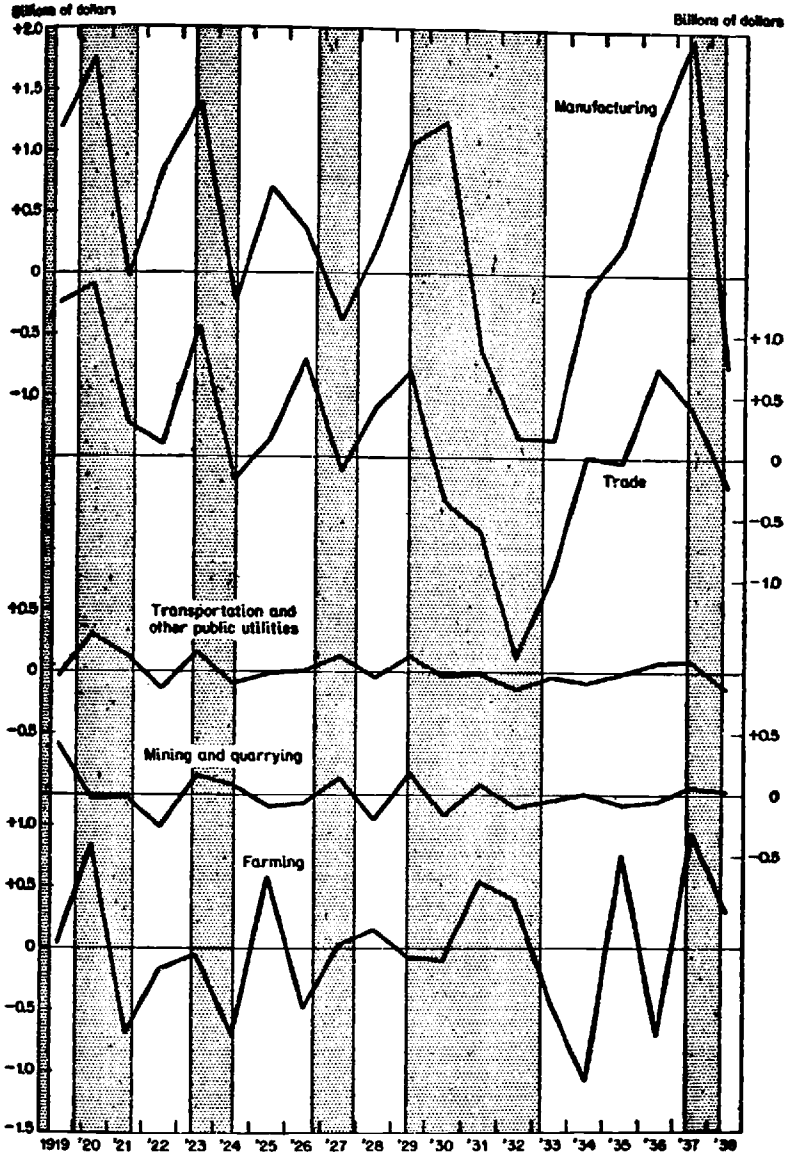
[b] Timing measured invertedly: specific cycle peaks are matched with reference troughs, troughs with reference peaks.

[c] The indexes would be the same if the lag assumed were 3 months.

Once again the resemblance between the manufacturing and trade divisions is marked. Both tend to move up and down with general business, and neither leads or lags consistently. At some turns in business, investment by manufacturers turns before invest-

Chart 65

Five Major Industrial Divisions
Inventory Investment during Business Cycles



Contractions (shaded) and expansions (unshaded) are marked off by the monthly reference chronology.

ment by distributors; at other turns the reverse is true. In both cases, however, the behavior of these annual data is consistent with the view that the monthly rate of investment turns near business cycle peaks and troughs. These observations are confirmed by Table 63 which indicates that inventory investment in trade led at five business cycle turns, lagged at the same number, and yielded an average lead that is not significant since it is based on annual figures. Assuming synchronous behavior, the conformity of this category of investment to business cycles is perfect.

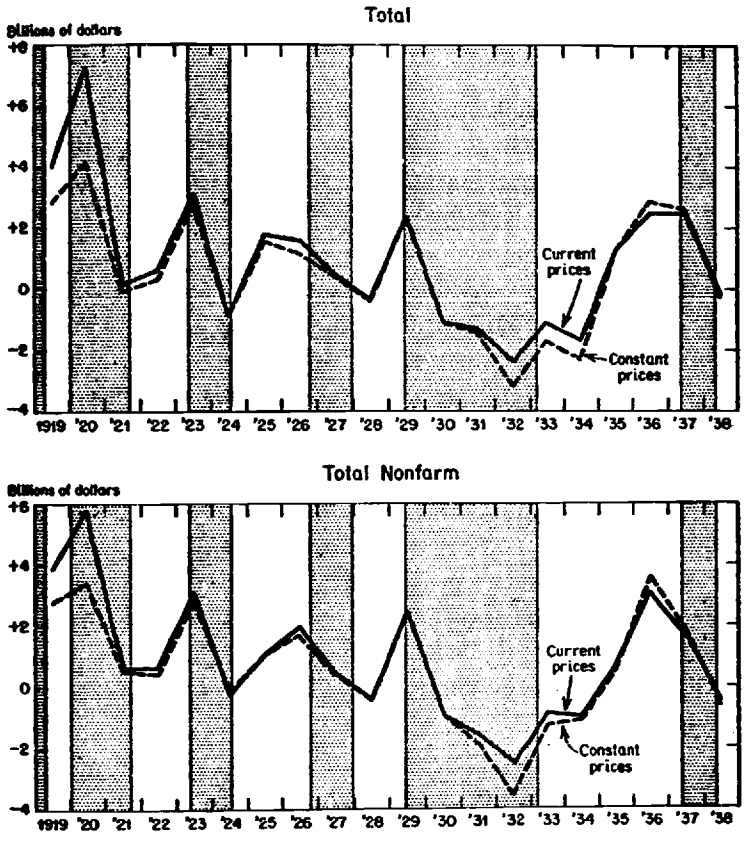
Inventory investment in transportation and public utilities, on the contrary, apparently lags behind business cycles. Lags predominate 6 to 1 over leads, and the average timing measures suggest a lag of 4.5 months. If we assume a lag of 6 months, the conformity measure indicates perfect agreement in direction of movement between business cycles and inventory investment.

The relation between business cycles and investment in the mining and quarrying industries may be described as inverted with a long lead about as well as positive with a long lag (Table 63). Thus if the peaks in inventory investment are compared with business cycle peaks, and troughs with troughs, six comparisons are possible, in all of which investment lags. If specific cycle troughs are matched with business cycle peaks, ten comparisons are possible: stocks lead in eight, lag in two. On the one basis, stocks appear to lag 6 months on the average; on the other, they appear to lead by 8 months. The larger number of comparisons that can be made when the series is analyzed invertedly suggest, as far as it goes, that this is the better basis. But the margin is not large and conformity measures on the two bases leave little to choose between them. However we express the relation, one thing is clear: when business turns down, inventory investment in this group, as in the public utility group, typically continues to rise for a considerable number of months. It begins to fall while contraction still has some months to run. It continues to fall after business has turned up but begins to rise well before the onset of recession.

Not unexpectedly, the rate of growth and liquidation of stocks in farming behaves irregularly during business cycles. Since short run supply is governed by harvests, it cannot be any surprise that farmers' stocks sometimes rise and sometimes fall in good years.

The behavior of total inventory investment, both including and excluding farm stocks, is dominated by the movements of manufacturing and trade. The totals, therefore, rise and fall with business and do not show any tendency to lead or lag that can be considered significant in view of the fact that the data are annual. And again, there is little difference, as far as timing and conformity go, between total investment measured in constant and in current prices (Chart 66).

Chart 66
Total Inventory Investment, Current and Constant Prices



Contractions (shaded) and expansions (unshaded) are marked off by the monthly reference chronology.

4 *Significance of the Timing of Inventory Investment Cycles*

This review of the data clearly establishes one facet of the role of inventory investment in business cycles. Increases in inventory in-

vestment regularly act to augment the forces of expansion from about the very beginning of the upward swing of business until approximately its very end. And declines in inventory investment augment the forces of contraction in the same way. The extent to which such investment intensifies the cyclical movements of the economy is, of course, another matter. This is a question of the magnitude of the fluctuations in inventory investment, studied in Chapter 21.

What the data leave obscure is the precise influence of inventory investment near the turning points of business cycles. Is it true that one reason for the turns in aggregate output is the desire of businessmen to increase the rate at which they are accumulating or liquidating stocks? The difficulty arises first because annual data are too coarse to establish the timing of cyclical turns except within a range of about six months. If we say, therefore, that annual data indicate that inventory investment tends to turn near reference turns, we do not exclude the possibility of a tendency to lead or lag behind the reference turns by as much as 3 months. Taking the data as they stand, therefore, we cannot say whether the beginnings of expansion and contraction in production are due in part to the turns in inventory investment or not.

For our purposes, however, we cannot accept the data as they stand. As already indicated (Ch. 4, Sec. 3) in adjusting the estimates of inventory investment for changes in prices, the indexes used fluctuate more violently than accurate indexes of inventory cost per unit would do. Consequently, the price-corrected value of inventories at the end of peak years, when prices have already begun to decline, probably tends to be somewhat higher than it should be compared with its value at the beginning of the year. Similarly at the end of trough years, the price-corrected value of stocks probably tends to be too low. The result is an overestimate of inventory investment in peak years of business and an underestimate in trough years. And this is the same as saying that the true turning points in inventory investment probably come a little earlier than our estimates indicate.

A final element of ambiguity is that the observed levels of inventory investment include some quantities of unplanned accumulation or liquidation of stocks. This is especially important at the

peaks and troughs of business. The analysis in Part Two has shown that the bulk of inventories (as distinct from inventory investment) tend to lag behind the turns of business by varying intervals. For the most part, the explanation appears to lie in a failure of businessmen to anticipate cyclical turns in demand far enough in advance to make sufficiently prompt and adequate adjustments in their purchases and production. In other words, immediately following a peak in business there occurs an unplanned accumulation of stocks, and immediately after a trough an unplanned liquidation. This, in turn, means that annual data on inventory investment in peak years of business are somewhat higher than they would be if they measured planned investment; in trough years they are lower. Planned investment in inventories probably turns somewhat earlier than actual investment, and actual investment a little earlier than our estimates indicate. On the basis of this analysis it seems reasonable to take the provisional position that the beginnings of recession and recovery in production are, as a rule, due in part to changes in planned inventory investment. But not until accurate monthly or quarterly data have been available for a considerable period can this provisional position be confirmed.