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## How Inventory Movements Contribute to Instability

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In observing the behavior of manufacturers' inventories, it has been assumed that fluctuations in general business activity are caused by forces unrelated to inventory movements, and that the latter may be regarded as dependent fluctuations, superimposed upon the business cycle.

It has been shown, however, that inventory investment movements are among the major variables in the economy. The demonstrated cyclical sensitivity of this important component of the national product raises two fundamental questions: In what manner do changes in inventory investment contribute to the cumulative forces of expansion and contraction? Is it possible that movements in inventory investment may spark the upswing and bring about the downturn, thereby constituting an underlying cause as well as an aggravating force?

### METZLER'S INVENTORY CYCLE THEORY

To answer these questions it is useful to examine Lloyd Metzler's theory of the inventory cycle.<sup>1</sup> Metzler presents his study, not as a theory of the business cycle, but as a contribution to the understanding of its nature. In the American Economic Review article in which he summarizes his theory and explains its significance, Metzler reviews several of the earlier cycle theories and points to what he considers their common property: each conceives of expansion and contraction as highly cumulative in nature and capable of being terminated only through certain limiting forces which are operative only toward the end of each phase. These older theories hold "that the economy is essentially unstable."<sup>2</sup>

In Metzler's alternative explanation, business cycles may be regarded as recurrent deviations from equilibrium levels of income, deviations which come about as a result of the structure of the economic system. In this view the economy is essentially stable, but any increase in demand (through, say, a change to a permanently higher level of autonomous investment) will set up oscillations around a new equilibrium.

The inventory cycle is offered as an example of such a structural cycle. It comes about as a result of the attempts of businessmen to bring inventories into a desired relationship with sales. Initially, efforts to replace or increase depleted inventories increase income and consumption, thereby pulling down the level of stocks further and causing additional increases in inventory demand, income, and con-

<sup>1</sup> Metzler's elaboration of the nature and significance of inventory cycles is set forth in three articles: "The Nature and Stability of Inventory Cycles," *Review of Economic Statistics*, August 1941, pp. 113-129; "Factors Governing the Length of Inventory Cycles," *ibid.*, February 1947, pp. 1-15; "Business Cycles and the Modern Theory of Employment," *American Economic Review*, June 1946, pp. 278-291.

<sup>2</sup> Metzler, "Business Cycles and the Modern Theory of Employment," p. 280.

sumption. Ultimately, however, efforts to adjust stocks become more successful in spite of the derived increases in consumption, and at some point the rate of inventory accumulation reaches a peak and begins to decline. This brings a corresponding decline in income and consumption, resulting in unwanted stocks. Efforts of businessmen to reduce stocks cause further declines in income and consumption, again defeating inventory objectives. But once again inventory adjustment ultimately begins to be achieved. Disinvestment reaches its maximum and begins to diminish (i.e., there is an increase in the inventory investment series), bringing an increase in aggregate demand, and a new cycle follows.

It is essential to the argument that the interaction of the multiplier and accelerator causes the rate of change in sales to decline after a time during expansion (and rise after a time during contractions). The accelerator is defined below. The multiplier is simply the reciprocal of the marginal propensity to save. This reversal in direction of movement in the rate of change in sales brings in its wake a reversal of inventory investment and of income.<sup>3</sup>

In his two articles dealing with the properties of inventory cycle models, Metzler varies assumptions regarding the size of the marginal propensity to consume, the nature of expectations, and the inventory accelerator.<sup>4</sup> In all the models the marginal propensity to consume is equal to the average propensity to consume, and consumption is not lagged (i.e., all consumption expenditures are made from current income). On the other hand, production is lagged, in the sense that production in a given period is guided by the sales of the preceding period. In the simplest models, production for sales in period  $t$  is equal to sales in  $t-1$ , and businessmen attempt to maintain a constant level of stocks. But in the more complex models, the coefficient of expectations and the inventory accelerator are introduced. The coefficient of expectations is a percentage figure, applied to the change

<sup>3</sup> The argument may be stated in terms of a relatively simple model in which sales in period  $t$  are expected to be those observed in period  $t-1$  and desired inventories are a constant proportion of sales:

(1) Output ( $Y_t$ ) = autonomous investment ( $A$ ) plus output for sale, i.e., sales of last period ( $S_{t-1}$ ), plus planned inventory investment ( $I_t$ )

$$Y_t = A + S_{t-1} + I_t$$

(2) Planned inventory investment is the sum of:

(a) Unplanned inventory disinvestment of last period ( $I'_t$ ) which is the difference between expected and actual sales last period. Since the expected sales last period are  $S_{t-1}$ , and the actual sales are  $S_{t-1}$ ,

$$I'_t = S_{t-1} - S_{t-1}$$

(b) The increase in required stocks made necessary by the increase in sales ( $I''_t$ ). Stocks required in period  $t$  equal expected sales in  $t$  times the inventory sales ratio ( $a$ ). Stocks required in period  $t-1$  equal expected sales in  $t-1$  times  $a$ . Since  $I'_t$  would only bring stocks into line with sales in  $t-2$ ,  $I''_t$  must bring stocks into line with  $S_{t-1}$  (expected  $S_t$ ). Therefore,

$$(c) \quad \begin{aligned} I''_t &= a(S_{t-1} - S_{t-2}) \\ I_t &= I'_t + I''_t = (S_{t-1} - S_{t-2}) + a(S_{t-1} - S_{t-2}) \\ I_t &= (1+a)(S_{t-1} - S_{t-2}) \end{aligned}$$

(3) Total output, therefore, is:

$$Y_t = A + S_{t-1} + (1+a)(S_{t-1} - S_{t-2})$$

(4) From the above, the conditions under which the movement of output is revised may be noted. In period  $t$  the change in output from the previous period is  $Y_t - Y_{t-1}$

where

$$Y_t = A + S_{t-1} + (1+a)(S_{t-1} - S_{t-2}) \quad \text{and} \\ Y_{t-1} = A + S_{t-2} + (1+a)(S_{t-2} - S_{t-3})$$

As long as sales are rising at an increasing rate  $Y$  must rise, and at an increasing rate. But if the rate of change in sales begins to decline,  $Y_t - Y_{t-1}$  will remain positive only so long as  $S_{t-1}$  exceeds  $S_{t-2}$  by more than  $(1+a)$  times the difference between the rates of change in sales. If the rate of change in sales is declining,  $S_{t-1} - S_{t-2}$  is becoming a smaller positive quantity while  $(S_{t-1} - S_{t-2}) - (S_{t-2} - S_{t-3})$  is becoming a larger negative quantity. Given a decline in the rate of increase in sales, the sign of  $Y_t - Y_{t-1}$  must, therefore, eventually become negative.

<sup>4</sup> Metzler, "The Nature and Stability of Inventory Cycles"; "Factors Governing the Length of Inventory Cycles." See note 1.

in sales in the current period ( $S_t - S_{t-1}$ ), to give the expected change in the next period. The inventory accelerator is expressed as a percentage figure which, when applied to expected sales, gives the inventory objective for the next period.

Metzler concludes that the propensity to consume is a more important factor governing the length of the cycle than are the inventory accelerator and the coefficient of expectations. Expansion and contraction phases of the cycle are shown to be more prolonged the larger the propensity to consume or the larger the inventory accelerator, but less prolonged with larger values of the coefficient of expectations. The cycle can only occur for certain values of the marginal propensity to consume and the accelerator. At values below the critical limits, a disturbance merely leads to a new position of equilibrium; above the critical limits, the cycle is unstable, aggregate output moving continuously upward with wavelike fluctuations in the rate of increase.

#### OBSERVATIONS ON THE VALIDITY OF METZLER'S THEORY

That it is rarely possible to submit an economic theory to a conclusive empirical test is an all too familiar observation. Useful theory requires a high level of abstraction and the generous use of *ceteris paribus* assumptions. When the theorist makes use of the rigorous language of mathematics these difficulties may be multiplied, for special assumptions must be kept at a minimum, and the language permits of few ambiguities. In short, theory attempts to cut through to essential and recurrent processes, but empirical tests must be conducted in a complex and changing world, in which parameters change and essential processes are fused with accidental or irregular ones.

If Metzler's theory were to be tested it is expected that the following specific problems would be encountered:

(1) There is no means available of determining either the size or the degree of stability of the accelerator or the expectations coefficient. Moreover, only *ex post facto* observations can be made of the relationships between income and consumption, thus making it impossible to compute in advance the value of the marginal propensity to consume. An additional complication involving parameters is that there is no means of determining the duration of lags between the receipt and the spending of a given income dollar and, consequently, no means of determining directly the duration of a "period" as Metzler visualizes it in his model.

(2) The problem is rendered especially difficult by the fact that Metzler is concerned with inventory, rather than business cycles; his theory is directed toward understanding the process by which an economy seeks a new equilibrium. He recognizes that the business cycle is a complex phenomenon and that the establishment of a single causal relationship for any given cycle is unlikely.<sup>6</sup> Yet the data needed to establish or to disprove the Metzler theory bear the stamp of the additional forces present in the business cycle itself.

(3) Associated with this difficulty is the fact that Metzler does not elaborate a theory of durable-goods investment. He makes only brief reference to it, stating that his models may be readily abridged to remedy the omission by combining the induced demand for invest-

<sup>6</sup> Metzler, "Business Cycles and the Modern Theory of Employment," p. 282.

ment goods with the demand for consumers goods in a general "propensity to spend."

There are, however, at least three grounds for suspecting that the relationship is more complex than Metzler implies:

(a) Evidence indicates that the lag between the decision to invest and the investment expenditure is longer than that which he hypothesizes for the decision to consume (derived immediately from income) and consumption expenditure.<sup>6</sup>

(b) Inventory requirements arising out of changes in durables investment are likely to be smaller than those in consumption expenditures. An examination of institutional arrangements supports this view: In the marketing of producers investment goods, the channels from manufacturer to ultimate purchaser are largely direct, with no middlemen's stocks held. Moreover, it is well established that such investment goods as heavy machinery are produced principally to order, and that manufacturers' finished-goods requirements for such products are small.

(c) It is unlikely that durable-goods investment is derived merely from changes in income. Very likely it is influenced importantly by a number of other factors, including the existing stock of equipment, changes in technology, changes in population, changes in costs of production, and changes in availability of funds.

(4) Metzler makes simplifying assumptions regarding price movements and supply conditions. He assumes that prices remain unchanged and that supply is perfectly expansible. In fact, most prices have a degree of cyclical sensitivity, and it is reasonable to suppose that price movements influence businessmen's anticipations and inventory objectives. Moreover, supply conditions deteriorate during certain stages of the business cycle and improve during others, and these changes influence inventory objectives and the purchasing process.

Although it appears unlikely that conclusive tests of Metzler's theory can be devised, it stands as an hypothesis of major importance: (a) It suggests that attempts to adjust inventories may, because of income feedback, be partially self-defeating, thereby providing a cumulative force in expansion and in contraction; (b) it suggests a way in which movements in inventory investment may be reversed prior to reversals in aggregate demand.

Is there, then, any evidence which will permit at least a tentative judgment as to the validity of the Metzler thesis in explaining the nature of forces at work in the cyclical process? Some such evidence may be found in the behavior of consumption and saving, and in timing comparisons of turns in inventory investment with turns in rates of change in final purchases.

#### BEHAVIOR OF CONSUMPTION AND SAVING

During the postwar years a number of studies have been undertaken to determine the relations of consumption or saving to income and other

<sup>6</sup> Victor Zarnowitz has compiled series which portray both aggregate fixed investment commitments (equipment orders placed and industrial construction contracts let) and aggregate fixed investment expenditures. During the period covered by these series (1949-58) timing comparisons reveal a systematic lag between orders and expenditures ranging between 6 and 12 months, with the exception of a lag of 30 months associated with the unusual demand and supply conditions arising out of the Korean war. Victor Zarnowitz, "The Timing of Manufacturers' Orders During Business Cycles," *Business Cycle Indicators*, New York, Princeton for NBER, pp. 476-477.

variables, and to measure the stability of such relationships.<sup>7</sup> While, to a considerable extent the conclusions drawn from these studies remain controversial, there seems to be general agreement on at least the following:

1. The relationship between consumption and income is markedly less stable for short periods than for long.

2. Consumption is significantly related to a number of variables other than current income. These variables include liquid asset position, past income (or some concept of permanent income), and expectations regarding future income and prices.

In the years since the war consumer spending has been maintained at high levels for a number of months after each decline in aggregate activity.<sup>8</sup> Moreover, there is evidence that on occasions such stability existed before the war. Unpublished quarterly estimates prepared for the National Bureau of Economic Research by Harold Barger indicate that consumption increased during the recession of 1923-24 and remained virtually unchanged during the recession of 1926-27.

What are the implications of these findings? Certainly it can be held that the behavior of consumption during minor business cycle recessions (the sort which have characterized the postwar period) is distinctly different from that described by Metzler. If the marginal propensity to consume is very low (i.e., if the response of consumption to a decline in aggregate income is very small), the feedback process which is the essential element of Metzler's theory will be broken or become relatively unimportant. The expansion would terminate at the point at which inventories are brought into the desired relationship with sales. A decline in inventory investment, and thus in output, would follow; but an equilibrium adjustment of aggregate income would be readily attained, since the decline in investment would not set off a downward movement in sales.

Under such circumstances, the full extent of the observed declines in both inventory investment and inventories proper would not be explainable in terms of the Metzler process. Such declines might be due to a correction of earlier speculative overcommitment in stocks and to the downward revision of inventory objectives (i.e., a reduction in the desired inventory-to-sales ratio) arising out of changes in supply conditions. They might be due also to the adjustment of stocks to an independently determined decline in the production of durable capital goods. This latter cause would appear to be a partial explanation at best, for marked inventory disinvestment during recession is characteristic of all sectors of industry, and of wholesaling and retailing as well.

In regard to expansion periods, the findings which show consumption to be influenced by factors other than current income, and which

<sup>7</sup> Cf. Franco Modigliani, "Fluctuations in the Savings Income Ratio: A Problem in Economic Forecasting," Conference on Research in Income and Wealth, New York, NBER, 1949, vol. II, p. 379ff. Robert Rosa, "Use of the Consumption Function in Short Run Forecasting," *Review of Economics and Statistics*, May 1948, pp. 100-102. Robert Ferber, "A Study of Aggregate Consumption Functions," New York, NBER, Technical Paper 8, 1953, and "Accuracy of Aggregate Savings Function in Postwar Years," *Review of Economics and Statistics*, May 1953, pp. 144-146. Arnold Zellner, "Short Run Consumption Function," *Econometrica*, vol. 25, 1957, p. 565. Milton Friedman, "A Theory of the Consumption Function," Princeton for NBER, General Series 63, 1957. M. J. Fanell, "The New Theories of the Consumption Function," *Economic Journal*, December 1959, pp. 678-696. J. S. Duesenberry, Otto Eckstein, and Gary Fromm, "A Simulation of the U.S. Economy in Recession," *Econometrica*, October 1960, pp. 749-809.

<sup>8</sup> A. F. Burns, "Progress Toward Economic Stability," *American Economic Review*, March 1960, pp. 9-10. In speaking of postwar consumption behavior, Dr. Burns concludes that "this new role of the consumer reflects some of the developments of the postwar period \* \* \*, particularly the greatly enhanced stability in the flow of personal income, the steady expansion in the number of income recipients, and the relative increase in the number of steady jobs. It reflects also the improvements of financial organization and other structural change which have strengthened the confidence of people \* \* \*. Whatever may have been true of the past, it can no longer be held that consumers are passive creatures who lack the power or the habit of initiating changes in economic life." *Ibid.*, p. 10.

demonstrate a very considerable degree of short-run instability in the consumption function, argue that Metzler's thesis is an abstraction which neglects significant relationships and provides, at best, a very imperfect description of the forces at work.

This is not to say, however, that the income effect is of no importance during expansions. The marginal propensity to consume may be unstable, but aggregate consumption usually does rise with rising incomes. Moreover, business spending also rises. Under such conditions it is to be expected that efforts to increase inventories will be self-frustrating to a degree, and the process of inventory investment may, in some measure, feed upon itself. If all planned inventory investment is not realized, then investment demand has contributed more significantly to the cumulative forces of expansion than the data show. This does not mean that these expansions could have been sustained by a Metzler-type process alone. But it is a suggestion that the demand arising out of attempted investment is probably well in excess of that which can be measured from the (realized) inventory investment data.

#### TIMING OF INVENTORY INVESTMENT AND RATES OF CHANGE IN FINAL PURCHASES

In Metzler's theory, not only must final purchases respond to changes in aggregate output and income, but the response must be large enough to defeat inventory objectives significantly. During the expansion phase increased final purchases, along with such inventory investment as may be realized, bear aggregate activity upward. The peak in the rate of inventory accumulation cannot be attained until the rate of increase in final purchases has begun to subside. Similarly, it is the unanticipated decline in final purchases during the contraction phase, along with realized inventory disinvestment, that carries aggregate activity downward. The highest rate of inventory liquidation cannot be attained until the rate of decrease in final purchases has begun to subside, for only then may adjustment of stocks reach a maximum.<sup>9</sup>

We have already had occasion (ch. 4) to observe the timing relationship between movements in rates of change in manufacturing activity and in purchased-materials investment. A similar relationship exists: (1) between rates of change in manufacturing activity (either output or sales) and investment in manufacturers' total stocks, and (2) between rates of change in activity (sales) and inventory investment for both retailers and wholesalers (chart 17, table 36). In the manufacturing series, inventory investment lags behind rates of change in activity at every comparison. In the retailing and wholesaling series, the same lag occurs in 7 out of 10, and 6 out of 8 comparisons, respectively.

<sup>9</sup> The point may be demonstrated by reference to equation 2c (see note 4), which shows that planned inventory investment is dependent on the rate of change in sales with a one-period lag. Thus total inventory investment would show a one-period lag if it depended only on planned inventory investment. Actually it also includes unplanned investment ( $U_t$ ).

$$U_t = S_{t-1} - S_t = -(S_t - S_{t-1}) \quad (4)$$

and total inventory investment is:

$$I_t + U_t = (1+a)(S_{t-1} - S_{t-2}) - (S_t - S_{t-1}) \quad (5)$$

Since the second term ( $S_t - S_{t-1}$ ) is increasing as long as the rate of growth of sales is increasing, total inventory investment is prevented from rising as fast as the rate of increase in sales during the period of acceleration. Thereafter, the offsetting effect of unplanned investment diminishes. Accordingly, the lag of investment behind the turning points in the rate of increase would, in general, be more than one period.

TABLE 36.—Timing of selected inventory investment series to related purchase or sales series  
[Current dollars]

|  | Peak      | Trough    | Peak      | Trough    | Peak      | Trough    | Peak      | Trough    | Peak      | Trough    | Peak      | Trough    |
|--|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| Quarter-to-quarter change final purchases (less services)..... | Aug. 1946 | Feb. 1949 | Aug. 1950 | Aug. 1952 | Nov. 1952 | Feb. 1954 | Aug. 1955 | Feb. 1956 | Feb. 1957 | Feb. 1958 | Feb. 1958 | Feb. 1958 |
| Nominal inventory investment.....                              | -3        | +9        | +9        | -3        | 0         | -3        | +3        | (1)       | (1)       | 0         | 0         | 0         |
| Quarter-to-quarter change, manufacturing output (F.R.B.).....  | May 1946  | Feb. 1949 | Aug. 1950 | Aug. 1951 | Nov. 1952 | Nov. 1953 | May 1955  | Feb. 1956 | Nov. 1956 | Feb. 1958 | Feb. 1958 | Feb. 1958 |
| Manufacturers' inventory investment (book value).....          | +3        | +6        | +3        | +9        | +6        | +9        | +12       | (1)       | (1)       | +3        | +3        | +3        |
| Quarter-to-quarter change, retail sales.....                   | Aug. 1946 | Feb. 1949 | Feb. 1951 | May 1951  | Nov. 1952 | Aug. 1953 | May 1955  | Feb. 1956 | Aug. 1957 | Feb. 1958 | Feb. 1958 | Feb. 1958 |
| Retailers' inventory investment (book value).....              | +3        | +9        | 0         | +12       | +9        | +15       | +6        | +6        | -9        | 0         | 0         | 0         |
| Quarter-to-quarter change, wholesale sales.....                | Aug. 1946 | May 1949  | Aug. 1950 | May 1951  | Aug. 1952 | Nov. 1953 | Nov. 1955 | (2)       | (2)       | Feb. 1958 | Feb. 1958 | Feb. 1958 |
| Wholesalers' inventory investment (book value).....            | +3        | 0         | -3        | +6        | +3        | +9        | +3        | (2)       | (2)       | +3        | +3        | +3        |

<sup>1</sup>No matching turn.

<sup>2</sup>No turn.

Source: Based on material from Department of Commerce.



CHART 17

QUARTER-TO-QUARTER CHANGE IN FINAL PURCHASES AND SALES, AND INVENTORY INVESTMENT, SELECTED SERIES, 1946-58

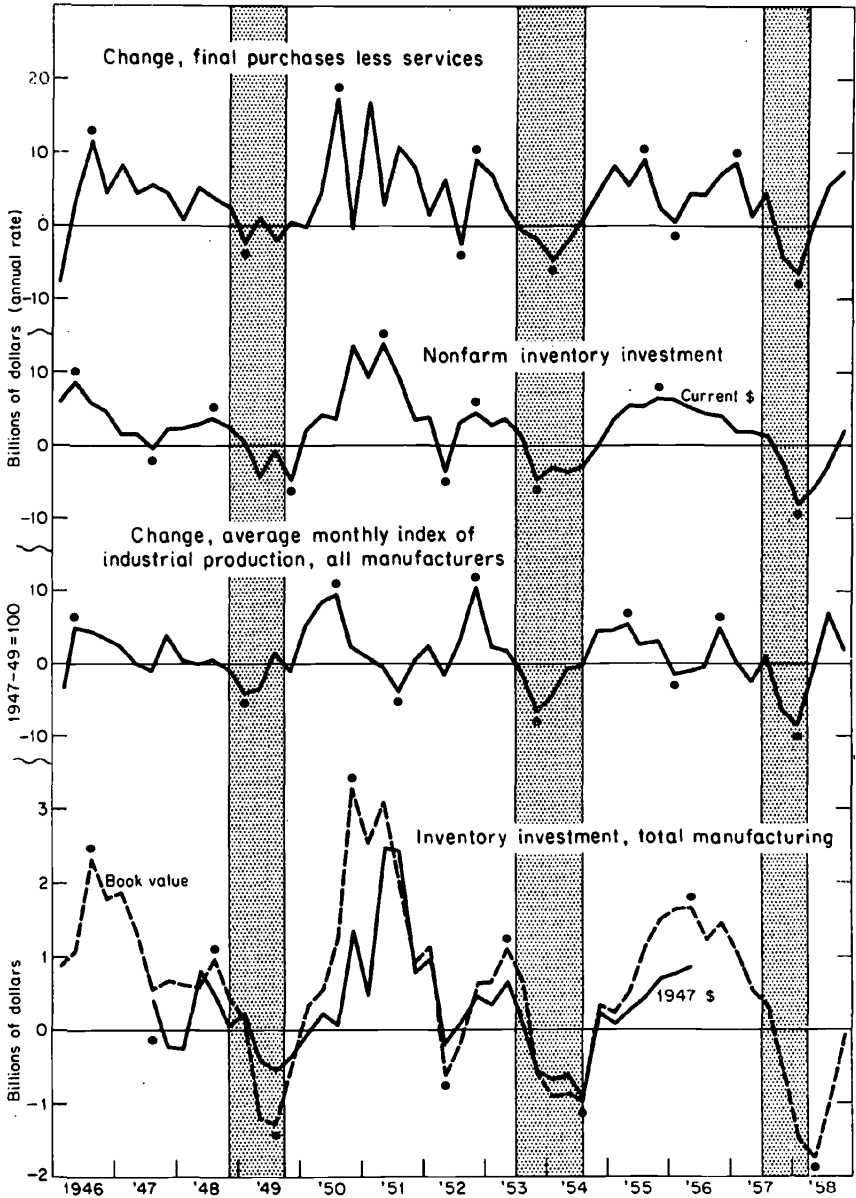
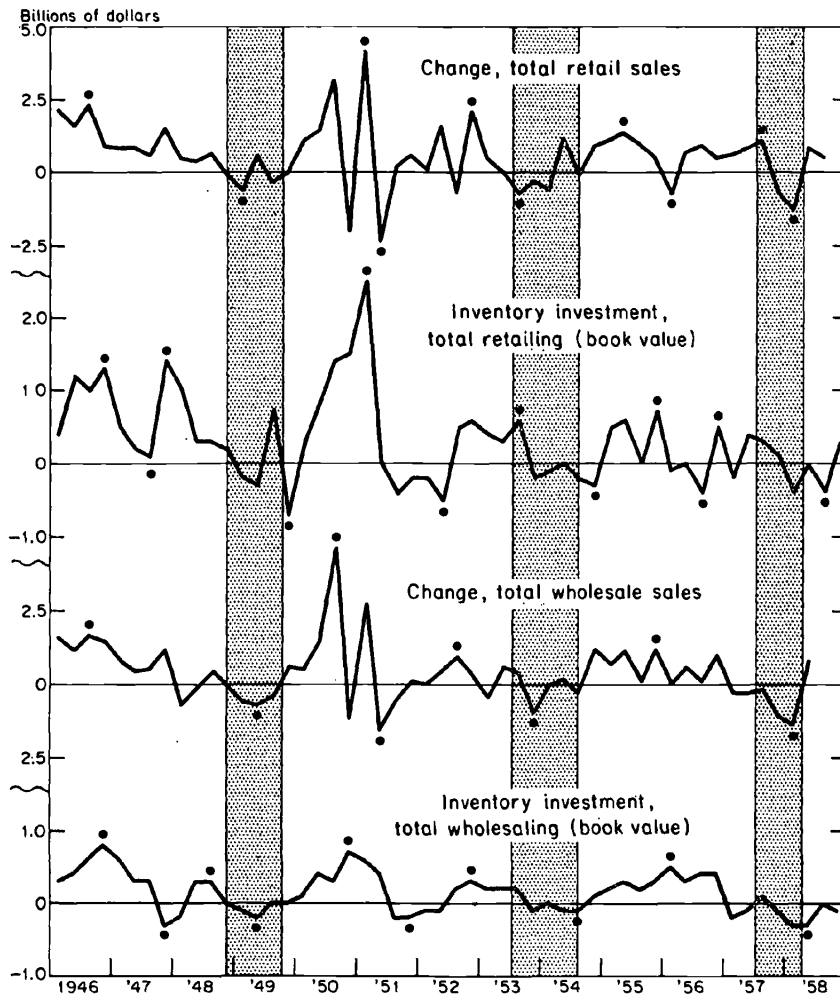


CHART 17—Continued



Shaded areas represent business contractions; unshaded areas, expansions.  
Dots identify peaks and troughs of specific cycles.

Source: All series except change in average index of manufacturers' output were compiled from Department of Commerce data. Manufacturers' output series from Federal Reserve Board.

It should be noted, however, that there is not a completely consistent relationship between movements in the two types of series. Looking once again at the total manufacturers, total wholesalers, and total retailers data, it will be observed that there are two instances of this lack of correspondence. The first occurs early in the postwar period, when each inventory investment series shows a second cycle following a trough in the third or fourth quarter of 1947. There is no full-fledged corresponding cycle to be found in any of the series representing rates of change in activity, although each of these series do turn up for a single quarter at the end of 1947. In the second instance, the manufacturing and retailing activity series trace out an

"extra" cycle after forming a trough in the first quarter of 1956. The manufacturers' inventory investment series, however, moves downward from second quarter 1956 to first quarter 1958. The retailing investment series shows only a poorly defined and somewhat erratic cyclical movement beginning in the third quarter of 1956 and ending in the first quarter of 1958.

In the nonfarm inventory investment series, movements are found which conform in most instances to the pattern of quarter-to-quarter change in final purchases, in a manner similar to that observed between inventory investment and rates of change in activity for manufacturing, retailing and wholesaling (chart 17).<sup>10</sup> During the first business cycle, inventory investment shows two distinct cycles. The first peak occurs within 3 months of the peak in the final purchases series, but the trough and peak which follow have no counterpart in the latter series. In the second business cycle there are once again two well-established cycles in inventory investment, but in this instance both conform to roughly similar movements in the final purchases series. In the third business cycle, inventory investment moves in conformity to changes in final purchases during approximately the first half of the expansion. Following the first quarter of 1956, a second cycle is noted in the final purchases series, but inventory investment moves steadily downward.

In contrast to the behavior of the manufacturing, wholesaling, and retailing series, nonfarm inventory investment does not show a well-defined tendency to lag behind rates of change in its corresponding purchases series. Turns in the nonfarm investment series coincided with final purchase turns in two of the eight comparisons, led by one quarter in three comparisons, and lagged by one to three quarters in the remaining three comparisons.

There is no present method to reconcile statistically the consistent lagging relationship of inventory investment to rates of change in activity in the manufacturing, wholesaling, and retailing series, with the irregular timing of total nonfarm inventory investment relative to rates of change in final purchases. It should be recognized, however, that the manufacturing and wholesaling activity series are not closely comparable to final purchases. The former series reflect, in part, variations in inventory investment of their customers as well as production or sale of goods destined for end use, whereas the final purchases data are free of inventory investment changes. Whatever may be the explanation of the differences, the aggregative data conform more closely to the concepts envisioned in the theory and must be given great weight.

Although these findings are inconclusive as regards the relevance of Metzler's theory, they provide the basis for a general conclusion of some importance: in spite of the lack of a well-established timing characteristic, movements in aggregate nonfarm inventory investment appear to be significantly related to movements in the rate of change in activity. There have been two postwar instances in which this has not been true, but the overall consistency of the relationship, despite its looseness, is impressive. There are no observations of timing

<sup>10</sup> The final-purchases series used in this analysis excludes consumer purchases of services. It covers only spending for commodities, construction and Government (Government spending on services is included). It should be noted, however, that some inventory investment occurs in the service industries or in response to spending on services.

differences in nonfarm inventory investment and final purchases which are greater than 9 months.

The question arises, however, whether or not this observed conformity necessarily implies that the acceleration principle is at work. Bert G. Hickman takes the position that it does not.<sup>11</sup> In an analysis of the role of the acceleration principle in business cycles he shows that most of the retardation in manufacturing production and sales and in retail sales (observed above) appears to be accounted for by diffusion, i.e., by actual expansions or contractions in individual industries or retail store classifications. Such a finding leads him to conclude that "acceleration-induced inventory investment may be a comparatively unimportant initiating (as contrasted with amplifying) factor in business contractions."<sup>12</sup>

It is important to note that the emphasis here is on the words, "acceleration induced." His evidence does not rule out other models in which inventory investment is an initiating factor (one such model is presented later in this chapter). Moreover, until he examines the data for individual industries, his evidence against even acceleration-induced investment is indirect.

#### BEHAVIOR OF INVENTORY INVESTMENT UNDER CONDITIONS OF CHANGING INVENTORY OBJECTIVES

One major gap in Metzler's theory has not been examined: its failure to treat the influence of supply conditions and the ordering process on the determination of inventory behavior. In the economic world of Metzler's models there is only one stage of economic activity, and it is assumed implicitly that all sales are made for immediate delivery. Firms have no suppliers; there are no purchase orders and no backlogs of unfilled orders. The entrepreneur's output plans are guided by his anticipated sales to consumers and by his inventory objectives. The latter (except in the model in which stock objectives are held constant) are based entirely upon the level of sales anticipated in the subsequent period.

In practice, however, inventory objectives are influenced by other factors. In chapter 4 it was shown that order backlogs vary cyclically, especially in the important durables group, and that sellers' willingness to hold purchased-materials stocks is thereby affected. Moreover, these fluctuations in order backlogs are indicative of changing supply conditions which alter buyers' desired inventory target levels. Such changes in supply conditions have a well-defined cyclical pattern.<sup>13</sup>

Thus we find that forces operating through supply conditions act upon individual manufacturers in their roles as both buyers and sellers, causing them to attempt to adjust their stocks. These changes in inventory demand are superimposed upon cyclical changes in final demand. Moreover, they are likely to both set up price movements and to be accentuated by them. In a sense the result is a sort of

<sup>11</sup> Bert G. Hickman, "Diffusion, Acceleration, and Business Cycles," *American Economic Review*, September 1959, pp. 551-558.

<sup>12</sup> *Ibid.*, p. 588.

<sup>13</sup> As indicated earlier the pattern was outlined as follows:

1. Availability of materials reaches its maximum at approximately the trough of the business cycle and begins to deteriorate with the beginning of recovery, or very shortly thereafter. Supply conditions deteriorate at an accelerating rate during early expansion and then at a diminishing rate.

2. By midexpansion, supply conditions begin to improve, although high levels of unfilled orders attest to substantial delays. Improvement may proceed at varying rates, but it is continuous throughout the latter half of the expansion.

3. In the final months of expansion and during early recession, availability improves at an accelerating rate. The maximum rate of improvement is attained by midrecession.

accelerator, but the process is quite different from that visualized in Metzler's theory.

#### THE OCCURRENCE OF "EXTRA" INVESTMENT CYCLES

It will be recalled that during the 1945-48 and 1949-53 expansions there were additional upward movements in inventory investment not matched by a movement in rates of change in final purchases, but that in the 1954-57 expansion there was not. Is it possible that differences in the availability of materials may provide a key to explaining inventory investment behavior on these occasions? Such evidence as does exist is indirect, but it points to supply conditions as a significant factor in determining the response of inventory investment movements to changes in final purchases during the latter half of expansion periods. In the 1945-48 expansion, the durable-goods sector adjusted quickly to immediate postwar demand. Durables unfilled orders began to decline after October 1946. The ratio of unfilled orders to sales reached a peak of 5.99 in the first quarter of 1946; by the second quarter of 1947 it had fallen to a level of 4.10, and continued to fall thereafter (see chart 7).<sup>14</sup> Under these conditions, there was no significant upward movement in purchased-materials investment after mid-1947. In fact, the deflated data show continuous disinvestment.

This behavior is in complete contrast to that of the nondurables sector during the same period. For the latter, the immediate postwar period was one of continued strong demand and limited capacity. Unfilled orders rose to near-peak levels in early 1947, and remained virtually unchanged throughout the remainder of the year. Unfilled-orders-to-sales ratios are not available prior to 1948 but in the first quarter of that year the ratio stood at 1.78, a level which was subsequently exceeded only in first quarter 1951. It was under these conditions of sustained high demand and short supply that nondurable purchased-materials inventory investment moved upward in a second expansion during the second half of 1947.

In the 1949-53 expansion, it was the nondurables sector that adjusted quickly to demand conditions. A flood of orders immediately followed the outbreak of the Korean war, and the unfilled-orders-to-sales series attained a peak level of 1.91 in first quarter 1951. But unfilled orders began to decline following the peak in March 1951, and by the fourth quarter of 1952 the ratio had fallen to 1.10. Thus, the initial upsurge in purchased-materials investment was short lived. Investment reached its peak in fourth quarter 1950, and there was no upward movement thereafter.

In the durables sector, demand outstripped supply during almost the entire expansion period. Unfilled orders rose until September 1952 and remained at a high level until mid-1953. The unfilled-orders-to-sales ratio reached a maximum of 7.02 in August 1952. In contrast to the nondurables, durables purchased-materials investment moved upward during the latter half of 1952 and first half of 1953.

In the 1954-57 expansion, neither durables nor nondurables showed a record rise in unfilled order backlogs. The nondurables unfilled-

<sup>14</sup> Absolute levels of unfilled orders to sales differ substantially between the durables and nondurables categories, the former being much higher, due to longer periods of production and a much larger percentage of business done on order. In the postwar period durables ratios have ranged between 6.8 and 2.41, nondurables between 1.8 and 0.85. It is the relative movements in these ratios, not their absolute levels, which are significant.

orders-to-sales ratio reached a peak at 1.11 in the fourth quarter of 1955 and fell continuously thereafter. Unfilled orders rose for a longer period in the durables sector, but the levels of order backlogs never reached the peak of the preceding expansion. In third quarter 1956, the peak ratio of 4.43 was attained.

In the same period, total manufacturers' purchased-materials investment failed to respond to the sharp upward movement in rates of change in final purchases. Unfortunately, there are no deflated data subsequent to mid-1956, and the behavior of the durable and nondurable categories cannot be ascertained with certainty. In the undeflated data the peak in durables purchased-materials investment was reached in third quarter 1955, and there was no second cycle thereafter. The nondurables undeflated series shows a gentle rise to a peak in second quarter 1957. The inventory investment movement had but little amplitude, however, and it is possible that deflated data would show no significant movement.

To summarize: the first two postwar expansion periods were characterized by double cycles in total manufacturers' purchased-materials inventory investment. In contrast, there was no second movement in the 1954-57 expansion, in spite of the well-defined upturn in rates of change of final purchases in 1956. The two "extra" cycles were not generalized throughout the manufacturing sector, but are traceable to the nondurables group in the first instance and to the durables group in the second. These movements occurred only under conditions of relatively high levels of unfilled orders.

There is evidence here that general availability of materials influences the behavior of inventory investment in the later stages of expansion, when the upward movement in final purchases continues because certain types of final expenditures still rise; under conditions of "tight" supply, there may be a resurgence of inventory investment, whereas under conditions of ready availability there will not.

This is by no means a solid finding. I am not able to establish the precise relationship between supply and inventory investment. Moreover, I generalize from the behavior of purchased materials to that of total nonfarm inventory investment. Nevertheless, the observed behavior is interesting. It suggests the hypothesis that after the initial surge in inventory investment, the relative availability of materials will determine whether or not it may once again become a source of strength during the expansion.

#### THE RELATIVE IMPORTANCE OF CHANGES IN INVESTMENT DURING RECESSION

In chapter 2, it was pointed out that movements in inventory investment were greater, relative to changes in national product, during early than during later expansion, and were greatest during recession. These observations may readily be interpreted in the light of observed supply conditions. Shifts in the vendor-performance and purchasing-policy series are most abrupt during the first half of expansion phases and during contractions (chart 9). Inspection of these data indicates that changes in supply conditions affect the initial stages of expansion and contraction about equally, but the expansions having been much longer, the effect is weakened during the latter part of these phases. In addition, inventory movements are larger relative

to change in national product during recession because final purchases, particularly consumption, remain relatively stable in this phase but rise during expansion. The interesting point is that inventory investment can show such sharp declines during recessions under conditions of relatively stable consumption.

It would appear that these declines are due in part to the abrupt shifts in purchasing policy already noted. When purchase based on requirements extending well into the future is changing abruptly to purchase based on immediate needs, it seems likely that firms are cutting inventory objectives drastically and attempting to trim stocks. The observed behavior of vendor-performance and purchasing-policy series provide evidence to support this thesis. Thus, in Metzler's terminology, there occurs a sharp increase in the accelerator (i.e., an increase in the amount of inventories to be liquidated for a given decline in sales or output) resulting in a sharper inventory disinvestment than would otherwise occur under conditions of relatively slight declines in final purchases.

#### FACTORS CONTRIBUTING TO TURNING POINTS

The present section is concerned with the manner in which inventory investment may contribute to business cycle turning points.

In early expansion, as sales rise, purchase orders also rise sharply. Two reasons for this rise in orders have already been discussed: (a) The firm places orders to meet rising sales requirements; and (b) the firm places orders to increase the volume of stocks on hand. A third reason may be added: (c) The firm may place orders simply to increase its order commitments on the supplier's books. At a time when delivery periods are being extended, the purchaser will realize that his order may be desirable, not only to build up his stocks, but also to provide him with additional protection against the possibility of price increases or against being "uncovered" at some future date. Thus the purchasing firm looks not only to its stock on hand or in transit from supplier in assessing the degree to which it is protected; it looks also to its "goods on order." It is this "total ownership position" along with sales requirements which guides purchasing policy.<sup>15</sup>

Throughout the buying movement, firms increasingly place orders in excess of their requirements in order to provide themselves with this kind of protection. At some point the ownership position approaches a "satisfactory" condition (given existing anticipations as to sales, prices, and vendor performance) and orders tend to recede toward a level which covers sales alone. It is highly likely that such a decline will contribute to the termination of the expansion.

It is conceivable, of course, that sales will continue to increase; additional purchase orders to cover sales requirements and, perhaps, to keep the ratio of stocks and orders to sales at a satisfactory level, may be enough to keep total orders rising. But the increase in demand would need to be quite sharp; presumably it would stem from some vigorous new source, such as a shift in the propensity to consume or a sharp increase in investment spending.

On the other hand, if something were to cause delivery periods to shorten, or anticipations of vendor performance to improve, the in-

<sup>15</sup> I am indebted to Ruth Mack for introducing me to this concept and stressing its importance. See Ruth P. Mack and Victor Zernowitz, "Cause and Consequence of Change in Retailers' Buying," *American Economic Review*, March 1958, pp. 27ff.

ventory objective and the desired ratio of ownership to sales would be reduced. Under these conditions, it would be highly probable that orders would fall. Such changes are easily visualized: delivery conditions might improve as a result of expansion of capacity as cyclical expansion goes on. Or, as has already been suggested, a decline in the current rate of deterioration of vendor performance may affect anticipations favorably.

Given the initial downturn in orders and sales, the decline in purchasing orders proceeds during recession under the combined impetus of forces paralleling those noted during expansion: (a) there is a decline in sales requirements, (b) the firm reduces orders in order to reduce the volume of stocks, and (c) the improvement in vendor performance leads to a reduction in the desired ratio of outstanding orders to sales. As recession deepens, purchasing policy shifts very sharply, and within a relatively short period of time a majority of firms are purchasing on a short-range basis. When this occurs, inventory policy is no longer influenced significantly by considerations of delays in delivery. The target level for stocks is then related principally to anticipated sales requirements.

At this point it is to be expected that forces (b) and (c) are no longer operative and that inventory objectives will no longer decline. Orders must turn up unless the decline in final sales alone is sufficient to decrease them further. If the only reason for the decline in total sales and output has been the attempt to achieve the goals mentioned under (b) and (c) (that is, if final sales were constant), then the level of orders and of activity may be expected to rise. This seems to approximate what has occurred during postwar recessions. Consumption expenditures have been relatively insensitive to declines in national income, and Government expenditures have tended to be stable or to rise. As a result, the postwar recessions have been characterized by an early upturn in inventory investment. Of course, if final purchases were sensitive to declines in income, in the manner assumed by Metzler, the decline in inventory investment would set up a cumulative process and the trough would be reached under conditions described at the beginning of this chapter.

This discussion of the impact of changing supply conditions has been stated in terms of manufacturers' purchased-materials inventory policy alone. Chapter 6 indicates that the analysis can probably be extended to certain types of goods in process, since these stocks, when held between stages, behave similarly to purchased materials (see chart 16). The behavior of finished goods must be explained in somewhat different terms, but we have seen that investment in these stocks does not lag behind that of purchased materials and goods in process by many months (ch. 7, table 33, chart 16). No confident statement regarding retailers' and wholesalers' stocks can be made, since this study has dealt with them only in passing. On an a priori basis, however, the analysis would appear to be applicable, for distributors, to the extent that they purchase from manufacturers, have as much reason to respond to changing supply conditions as do manufacturers' purchasing agents.



## CONCLUSIONS

It is now possible to bring together certain observations made in this chapter and to draw conclusions regarding their usefulness in explaining cyclical fluctuations. For this task it is convenient to arrange the various points according to the light they shed upon the two questions posed previously. How do changes in inventory investment contribute to the cumulative forces of business cycle expansion and contraction? Do movements in inventory investment spark the upswing and bring about the downturn, thereby constituting an underlying cause of business cycles as well as an aggravating force?

There is no doubt that inventory fluctuations contribute to the cumulative movements which constitute business cycles. Both the prewar and postwar data show clearly that changes in the rate of realized inventory accumulation are an important source of increase in demand during the greater part of expansions, and are a principal source of decline in demand during contractions. (See ch. 2.) Moreover, it is probable that the contribution is greater than may be observed in these data, since they show only realized inventory investment. One of the great contributions made by Metzler is his conclusion that adjustments in inventory contribute more to instability than may be observed, because they set up increases or decreases in final purchases which, in part, defeat the attempted adjustments. It would appear, however, that this income effect has been more important in expansions than contractions.

Another source of instability has been traced to the interaction between availability of materials and purchasing policy. An important reason for the cumulative force developed by buying movements is that purchasing policy alters with any increase in activity: The volume of orders rises not only to provide for sales, but to provide for inventories and to increase the time-range of advance purchasing. Increased demand gives rise to a deterioration of supply conditions which in turn, causes firms to raise their inventory objectives and their commitment to suppliers. The process occurs in reverse during the contraction phase.

This interaction alone could not long sustain a buying movement or a curtailment phase, but coupled to an income effect, speculative tendencies, or effect on plant and equipment investment (particularly through expectations) the result is a mechanism capable of generating very powerful cumulative forces. It is fortunate that the process has within it the means of its own termination within a relatively short period of time, and that the income feedback effect is limited during recession. Otherwise, business cycles would be much more severe than we have known them to be in recent times.

Turning points in planned inventory investment must be regarded as reversals in demand. *Ceteris paribus*, when firms cease to attempt to accumulate stocks at as high a rate as previously, their purchases from suppliers decline; when firms cease to attempt to reduce stocks at as fast a rate as previously, their purchases increase.

According to Metzler, the explanation of turning points in the business cycle lies in this process.<sup>16</sup> Turns in inventory investment

<sup>16</sup> For the purposes of his analysis, Metzler treats the business cycle as an inventory cycle. He fully realizes, of course, the complexity of business cycle relationships.

occur after rates of change in activity have reached a peak or trough, thereby permitting accumulation or liquidation of stocks to proceed at a rate more closely approximating the desired level.

Timing comparisons of turns in nonfarm inventory investment and final purchases show that, on a number of occasions, investment has turned earlier than would be expected in Metzler's theory. Under existing institutional arrangements, however, there is another way in which inventory investment turns can come about. Management considers not only stocks on hand when examining its inventory position, but also its outstanding purchase orders. As expansion proceeds, the quantity of goods on hand and on order increases. Ultimately, management must consider itself sufficiently protected and, other things being equal, the volume of orders which it places with suppliers will decline.

The observation that inventory investment has led all three post-war business cycle peaks and two of the three business cycle troughs lends support to the argument that turns in inventory investment play a role in sparking the upturn from recession and in halting the process of expansion. During expansion, continued increases in fixed investment and consumption expenditures seem characteristic of the modern business cycle, but the inventory requirements traceable to such expenditures are not likely to be large.

It is my conclusion that these observations are useful in explaining both the cumulative forces of expansion and contraction and the processes by which these phases may be terminated. This is not to deny the complexity of the forces which are combined in the business cycle. Evidence abounds that there are other contributory processes at work, some of which are also capable of causing cyclical reversals. But this, in turn, does not detract from the proposition that the processes which surround the accumulation and liquidation of inventories also contribute significantly to an explanation of cyclical fluctuations.

In a period such as the years since the war, when the underlying forces of growth have been strong and the recessions interrupting the general rise in national output have been only a year or less in duration, the inventory investment mechanism, as modified above, appears as a highly likely candidate for explaining turning points and, in part, the cumulative character of the business cycle.