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Volume Author/Editor: Moses Abramovitz

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Chapter Author: Moses Abramovitz

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CHAPTER 20

Summary Account of the Timing of Inventory Investment Cycles

We can now draw together the essential elements regarding the timing of turning points in inventory investment, its explanation, and interpretation.

The first question is how total inventory investment behaves. For an answer one has to depend upon the unsatisfactory indications of annual data. These tell as clear a story as such data can. In both current and constant prices total investment reached its peaks and troughs in the same years as general business at 7 of the 10 turns between the two world wars. Investment by manufacturers did the same, and investment by retailers and wholesalers did so at 8 out of 10 turns. The few investment turns that did not coincide with those in business were evenly divided between leads and lags.

As they stand these figures suggest that inventory investment tends neither to lead nor to lag behind the turning points of business cycles. The possibility that there is a regular tendency to lead or to lag by a short interval is not precluded. But our tests indicate that when annual data covering 5 cycles fail to indicate a lead or lag, the actual lead or lag, if any, will rarely be longer than, say, 3 months. If we take into consideration a certain bias due to the process of price correction on which the estimates are based, a short lead seems more likely than a short lag, but we cannot be sure.

This finding, though necessarily imprecise, is of great interest. It suggests that the common assumption that stocks are kept at a constant ratio to output and sales may be invalid. Were inventory-output and inventory-sales ratios constant, cycles in inventory in-

vestment would coincide with cycles in the rate of change in sales and output. It seems plausible to suppose, however, that the rate of change in output reaches its maxima and minima before the peaks and troughs of business. If, as it seems, inventory investment turns within a very short interval of the turns in business, it probably lags behind the rate of change in output.

This probability was confirmed by a study of rates of change in both aggregate and manufacturing output. The rate of growth or decline in aggregate output seems to have retarded markedly and regularly long before the peaks and troughs of business—often during the first half of expansions or contractions. These retardations have sometimes been followed by periods of renewed acceleration, but the subsequent peaks in the rate of growth or decline have rarely been as pronounced as the original. Inventory investment, in contrast, is near its trough when expansion begins and, at least in annual series, sweeps up smoothly to a peak near a business peak, then smoothly down to a trough near a business trough.

Further study of the rate of change in manufacturing production confirmed these general conclusions and added some interesting detail. During contractions output tends to decline at an increasingly rapid pace until about the middle of the phase, after which a period of retardation sets in. During expansions the rate of growth behaves less regularly. At the beginning of the phase output has usually been growing rapidly, then more slowly. Retardation has sometimes characterized the remainder of the phase but often it has been followed by a renewed spurt that sometimes brought the rate of growth in output to levels as high as or higher than those at the beginning of expansion.

These observations about the timing of inventory investment have an important bearing on the course and character of business cycles. If inventory-output ratios remained constant and inventory investment moved synchronously with, and in proportion to, the rate of change in output, inventory investment would rise more rapidly at the beginning of expansions and fall more rapidly at the beginning of contractions than it does. This would make the curves of output and income in the opening stages of cyclical recoveries and recessions more precipitous than they are. When the retardation of output growth sets in, inventory investment would

drop and tend to bring the business expansion to an end. Similarly, when the retardation of output decline sets in during contraction, inventory liquidation would drop and tend to bring on a revival of business. Continued growth in inventory investment during expansions and continued decline during contractions after output growth or decline begins to retard means that it acts to prolong the upward and downward swings of business. It may be said, therefore, that the lag of inventory investment behind the rate of change in output serves to moderate and to lengthen business expansions and contractions. These, of course, are tendencies. How influential the behavior of inventories is depends upon the magnitude of inventory investment changes compared with those in other categories of expenditure—the subject of Chapter 21.

Study of the behavior of total inventory investment and its major components leaves us with two solid findings: first, inventory investment turns near business cycle turns; secondly, it tends to lag behind the peaks and troughs in the rate of change in output. Several problems remain. One concerns the precise timing of investment. Is it actually synchronous with business cycle turns or does it tend to lead or to lag by a short interval? Secondly, does planned investment move in the same way as observed investment? A third problem arises with respect to the causes of fluctuations in investment. Why does it lag behind the rate of change in output and turn near the turns in business? To help answer these questions, we examine the evidence on the movements of investment in manufacturers' stocks.

From the viewpoint of cyclical behavior, inventories held by manufacturers are not homogeneous. The study of inventory cycles in Part Two indicated the necessity for distinguishing four major classes: goods in process, raw materials, finished goods made to order, and finished goods sold from stock. Their behavior differs because the motives that control inventory policy vary. Within two, raw materials and finished goods sold from stock, still further distinctions are required. These stem from the fact that among manufacturers of different types of commodity the ability to control the rate at which materials are received or produced varies. Moreover, not all commodities can be stored in the same degree. These differences are reflected in the cyclical behavior of stocks.

They led us to distinguish raw materials purchased from other domestic manufacturers or dealers from agricultural products purchased from producers or any type of imports that must be purchased long before they are to be used. Manufacturers' receipts of goods in the former class can be rapidly adjusted to changes in current requirements. Their receipts in the latter class cannot be adjusted promptly. Again, among finished goods sold from stock we have to distinguish goods made from agricultural materials that cannot well be stored in crude form from goods made from other materials. Fabrication of the former is heavily influenced, if not controlled, by haphazard changes in supply, which in turn affects stocks of finished goods. Production of goods made from other materials follows changes in demand. Finally, there is a distinction to be made between finished durables and nondurables. The first may be stored for long periods; and the inventory-sales ratio may be allowed to vary widely. The second must be sold promptly; and the inventory-sales ratio must be kept fairly stable.

These distinctions are as essential to an understanding of inventory investment cycles as they are for inventory cycles. As we have seen, the cyclical behavior of inventory investment differs significantly from class to class. However, the characteristic features of investment in each class were more difficult to establish than were those of inventory cycles because cycles in the rate of change in inventories are more variable. This, of course, was only to be expected. The first differences in any series that does not move continuously are bound to follow a less steady course than their cumulative counterpart. To illustrate: small fluctuations in the amount by which, say, receipts exceed the consumption of a raw material cause the rate of inventory investment to turn although inventories continue upward. This additional element of volatility aggravates the difficulties of using small samples of series covering short periods. The significant tendencies in the data, which would doubtless be revealed if the records were comprehensive, are often masked by random movements in the few commodities for which we have records. Generalization has, therefore, been more difficult with respect to cycles in investment than in inventories. I shall, however, summarize the main suggestions I believe the study yields. For this purpose, I neglect certain minor groups of stocks which appear to

behave irregularly during business cycles, and confine attention to classes whose action seems to shape the regular pattern of manufacturers' total investment.

1 *Goods in Process and Finished Goods Made to Order*

These two groups, which together account for 25 to 30 percent of manufacturers' stocks, may conveniently be considered together. For neither is any useful amount of data available. But both are closely tied to manufacturing production. If more goods are to be produced, more must flow through the fabricating process. And when goods are made to order, they are generally delivered promptly. They remain in stock during the time required for packing and to arrange transportation and, if delivery is to the purchaser's location, during the time required for shipment. If we ignore seasonal factors and changes in the composition of output, the inventory-output ratio should remain approximately constant. If it does, the absolute changes in inventories should be approximately proportional to those in production. As explained in Chapter 15, investment in goods in process should tend to lead the rate of change in output. By the same token, investment in goods made to order should tend to lag behind the rate of change in output. In both instances, however, the differences in timing between changes in investment and in output, at least on the average for all manufacturing, are so small that they may safely be neglected for present purposes.

With the information now available, we can best judge the movements of inventory investment in these categories from the cyclical pattern of the rate of change in output. From the viewpoint of cyclical timing, the problem was to determine the behavior of the rate of change in output, and one purpose of the detailed study of rates of change in manufacturing was to ascertain the cyclical pattern of investment in stocks of goods in process and in finished goods made to order.

Translated into terms of inventory investment, our observations about the cyclical pattern of changes in output imply that investment in goods in process and in finished goods made to order usually reach peaks and troughs long before business activity. Not infrequently, however, inventory investment in these categories turns

up again just before the peak of business. Before business troughs, a reversal of this sort is not characteristic of investment.

2 *Raw Materials*

For reasons explained in Chapters 9, 10, and 16, manufacturers try to maintain a fairly constant ratio between their stocks of raw materials and the rate at which they are consumed in production. If we could assume that they are completely successful, we could use the rate of change in output as an indicator of investment, just as we did in the case of goods in process and finished goods made to order. But such an assumption is obviously invalid. Because a period, more or less long, elapses between an order for supplies and delivery, manufacturers must foresee their requirements for raw materials some time ahead. The order-delivery interval is indeed short for most raw materials. Even so, errors are inevitable. And whether the errors of manufacturers offset one another is uncertain. Much depends upon the size of the individual errors and, even more, on whether all or most manufacturers make errors of the same sort at the same time. Such points can hardly be settled by general reasoning. It appeared, therefore, that in the absence of direct observation, no useful statement could be made about the relation between output and inventory investment.

In this situation, it is especially unfortunate that records on stocks of raw materials are so scarce. The results they yield are badly in need of more empirical support. But as far as they go, they suggest the following conclusions.

1) For commodities supplied under conditions allowing manufacturers quickly to adjust receipts to requirements, the rate of change in stocks of raw materials is positively correlated with the rate of change in output in the industry using the materials. Despite errors that presumably affect the individual firm's decisions about purchases, this relation emerged clearly from comparisons between the stocks and rates of fabrication of three raw materials of this character—cotton, silk, and hides. Since about 75 percent of the raw materials used by manufacturers are procured under conditions similar to those that characterize our small sample, it is arguable that inventory investment in raw materials is positively correlated with the rate of change in output in most American in-

dustry. Indeed, among manufacturers as a whole, this tendency should stand forth all the more sharply. The chance errors of prediction by individual manufacturers are more likely to offset one another. And the forces making for manufacturers' errors are less likely to operate in the same direction in different industries than in a single industry.

A positive relation between investment and the rate of change in output for this major fraction of raw materials is not the same as a synchronous relation between investment and the rate of change in output for all raw materials. It is, indeed, two steps removed. First, inventory investment probably lags behind the rate of change in output even in the case of materials for which manufacturers can quickly adjust receipts to requirements. This is plausible if we assume that manufacturers judge their future requirements by recent experience. An upturn in the rate of increase in output would not then be matched immediately by an upturn in the rate of increase in receipts of materials, and inventories would not immediately grow proportionately. But manufacturers would attempt to eliminate the discrepancy in subsequent periods. Such a tendency for investment to lag was apparent in the case of silk stocks, though not in those of cotton and hides. As pointed out in Chapter 17, however, lags might well have been discovered even for cotton and hides were we in a position to make timing measurements on a finer scale. Moreover, since our three materials are all procured from dealers who hold stocks ready for delivery, the interval between order and receipt is especially short. It would be longer and the tendency to lag presumably more marked if we had data for materials purchased from other manufacturers, particularly from manufacturers whose goods are usually made to order rather than sold from stock.

There is reason, therefore, to expect investment to lag behind the rate of change in output even when materials are procured under conditions that permit a fairly rapid adjustment of receipts to requirements. As pointed out above, however, not all materials are obtained under such favorable conditions. Examples of materials whose supply cannot promptly be adjusted to requirements indicate that the lag of investment behind the rate of change in output in the industries using the materials is very long. Peak rates of

accumulation, indeed, usually lag behind the peak in output itself as well as in the rate of change in output. They come, that is, during contractions in output. Peak rates of inventory liquidation generally follow revivals of output. For such materials, therefore, inventory investment tends to be rising in the period just before output reaches its peak and to be falling just before output reaches its low point. Such behavior by this minor fraction of raw materials reinforces the shorter lag in the major fraction.

All this leaves us uncertain, within a considerable range, about the timing of investment in raw materials relative to the turns in general business. If investment kept pace with the change in output, it would tend to lead business turns by a long interval, perhaps as much as half a phase on the average. In the past a lead of this length has been a fairly regular characteristic of the rate of change in output relative to business cycle troughs. In expansions the rate of increase in output has usually reached a maximum long before the business peak, but it has sometimes gone to a second peak in the last quarter of expansion. As stated, however, investment in stocks of raw materials probably tends to lag behind the rate of change in output. To this degree, of course, the lead of investment in raw materials relative to business turns must be shorter than the lead of the rate of change in output. How much shorter it is impossible now to estimate and almost futile to guess. Meanwhile, let us recall that a lead of half a phase, that is, two 'stages' in National Bureau terminology, amounts to about 13 months in the average expansion and about 10 months in the average contraction. A lag of investment in raw materials behind the rate of change in output of even 6 months would still leave this class of investment leading business turns by several months. This, of course, is presumably subject to considerable irregularity, especially near business peaks, corresponding to the irregularity in the timing of turns in the rate of change in output.

3 *Finished Goods*

Of the 40 percent of all manufacturers' finished goods stocks, between an eighth and a quarter are made to order. Investment in them, as we have seen, fluctuates like that in goods in process.

Another small class are finished goods sold from stock whose

production cycles are influenced mainly from the side of supply. The chief cyclical characteristic of investment in this class is its irregularity. It cannot be important in explaining the typical cyclical pattern of aggregate investment in manufacturers' stocks.

Still a third small category consists of goods sold from stock whose production cycles are governed principally by changes in demand but which, for one reason or another, are perishable. Evidence about the behavior of this group is almost wholly lacking, but general reasoning suggests that since the goods are perishable they must be disposed of promptly; wide variations in the inventory-sales ratio could not be long tolerated. If so, the rate of change in output is again a good guide to the cyclical behavior of investment. But once more it seems plausible that manufacturers will not be able to predict sales accurately enough to modify their holdings of stocks simultaneously with changes in sales. On the contrary, changes in the rate of increase in sales will probably be followed by changes in the rate of increase in output only after an interval, and appropriate changes in stocks will occur somewhat later still. Thus it seems reasonable to think that investment in this class of finished goods lags behind the rate of change in output by a short period, much in the same way as in the case of investment in raw materials.

Whatever the value of this suggestion, it applies to only a small class of stocks—in all likelihood less than 5 percent of all manufacturers' inventories. Because of the nature of the goods, only small stocks can be kept relative to sales. And to reduce still further the risk of inventory losses, many perishable goods industries produce to order rather than to stock.

There remains a last important class of finished goods sold from stock—durable staples whose production cycles are governed by changes in demand—constituting between 20 and 25 percent of manufacturers' stocks. According to the rather good sample of such goods for which records are available, it appears that when shipments turn down after the peak of business, investment leaps up sharply. (I am writing here in the relative sense in which a decline in the rate of liquidation is equivalent to an increase in accumulation.) Manufacturers, presumably caught off guard by an unexpected cyclical decline in sales, were unable to reduce their

rate of fabrication soon enough. During at least the early months of most contractions, the rate of accumulation of stocks increases, then levels off. A point in doubt is whether a downturn in investment begins before the trough in business. The marked indications of such a downturn in long contractions, those of three years or longer, are consistent with the finding that in long contractions the peak in stocks of this type is reached well before the upturn in business (Ch. 11). There are good reasons, moreover, for expecting such a downturn in the last part of shorter phases. The stocks that continue to accumulate during contraction, first because the downturn of shipments is not expected, later because manufacturers choose to keep their production from falling as far and fast as their sales, must become an increasing burden on the companies holding them. The motive to reduce the rate at which stocks pile up, if not to begin liquidation, must become stronger and stronger. Finally, there is evidence that toward the end of a business contraction but before the trough, the number of industries whose production is falling diminishes, the number whose production is rising increases. This undoubtedly reflects an increase in the sales of some industries. And when sales increase, the rate of accumulation of finished goods drops sharply. The fact that the number of industries in which this may be presumed to occur grows in the last stage of contraction bolsters the presumption that during this period the aggregate rate of accumulation of these stocks by manufacturers tends to fall.

There are then good reasons for expecting such a decline. But however good the argument, the fact is that our sample does not clearly support such an hypothesis. As far as contractions of short and moderate length are concerned, the matter remains in doubt.

All these observations may be repeated for business expansions. The upturn is accompanied by a sharp reduction in inventory investment. The downward movement continues for some months, then levels off. In long expansions the rate of liquidation falls before the peak in business, then accumulation begins. But in short or moderately long expansions, the evidence that investment turns up before the peak of business is passed is doubtful.

4 *Pattern of Total Investment*

We are now in a position to offer a partial explanation of the cyclical behavior of manufacturers' inventory investment—its tendency to lag behind the rate of change in output and reach turning points in the neighborhood of the turning points of business cycles. For we can see, at least roughly, the diverse behavior of the major components of total investment, establish their approximate size, and identify the motives and technical conditions that account for their cyclical movement. There are serious gaps, but the account takes us a considerable distance. I shall attempt a highly summarized statement in terms of movements during a business contraction. With some exceptions the account for expansions would follow the same lines except that the direction of inventory movement would be reversed.

1) In the opening stage of a contraction, investment in goods in process and in finished goods made to order, together accounting for 25-30 percent of all manufacturers' holdings, falls rapidly. This rapid drop is a simple concomitant of the sharp reduction in output to which stocks are technically bound.

Investment in raw materials, about 40 percent of the total, falls less rapidly. Manufacturers in general would like to decrease their stocks of raw materials in rough proportion to the decline in the volume of business, but for many reasons cannot. A cyclical downturn in sales seems to catch businessmen unawares. Even if they begin to reduce their orders for supplies immediately, a period of varying length intervenes between order and delivery. The interval may vary from a few days to many months depending upon the distance a manufacturer is from his source of supplies, on the mode of transportation, and on the speed with which suppliers fill orders. In addition, manufacturers are likely to hesitate at first about altering the volume of their purchases, since they are uncertain, at the moment of recession, about the course of business. Some manufacturers, finally, are bound by long term commitments made when the outlook was brighter. These will be canceled if possible, but often they will prevent a reduction in receipts of materials for a long time. As a result, stocks of raw materials continue to rise during the first 3 or 4 months of contraction, though at a declining rate, and then are reduced only gradually.

Offsetting these declines in investment in the first stage of contraction is a rapid increase in investment in finished durables sold from stock. Most such goods are produced in industries in which output is governed principally by changes in demand. (Finished goods of this sort are perhaps 20-25 percent of manufacturers' total stocks.) Again, a decline in business finds manufacturers unprepared. Their sales and shipments drop before they can reduce their output. And when they do reduce it, they do so less rapidly than shipments are falling. Manufacturers apparently prefer to see their stocks of finished goods, which have been largely liquidated in the preceding expansion, pile up rather than curtail their operations more drastically. As the goods in question are durable staples, an accumulation of stocks for the sake of cushioning production somewhat from the impact of declining sales can be tolerated.

The movement of these four categories of investment presumably causes a relatively small decline in total investment. I say presumably because it is a weakness of this account that, with respect to one important matter, it necessarily proceeds in qualitative terms. It is impossible, on the basis of the sample data now available, to measure precisely the relative rates of change in the different categories of stocks. One can say that 25-30 percent of the total fall rapidly, that 40 percent fall slowly, and that another 20-25 percent rise rapidly. I presume that this means a relatively slow rise in total stocks. And this is consistent with the general showing of the comprehensive annual data. But we cannot be certain until adequate monthly data are available for all the significant inventory classes. This is an unavoidable difficulty which qualifies the account of the early part of contraction and restricts equally the significance of the remainder of this hypothesis.

2) Liquidation of goods in process and of finished goods made to order usually increases until about the middle of contraction. Judging by the rate of decline in output, the trough in these categories of investment sometimes precedes, sometimes follows the midpoint, but the rate has usually been higher in the second quarter than in the first and sometimes even higher in the third quarter.

At the same time, the liquidation of raw materials, which lagged in the early months of contraction, begins to proceed more rapidly.

The accumulation or slow liquidation in the first quarter gives rise to redundant inventories relative to the smaller volume of business, and manufacturers are driven to curtail their orders more drastically. Finally, the rate of accumulation of finished goods, if it does not fall off, at least does not continue to increase much. There is, consequently, clear indication that the pace of inventory liquidation accelerates in the middle quarters of contraction, at least until output begins to decline less rapidly.

- 3) At some point in the last half of contraction output begins to fall at a slower pace. This may sometimes happen even before the midpoint, but, in any event, rarely later than the end of the third or the beginning of the fourth quarter. When it occurs, liquidation of goods in process and of finished goods made to order also begins to fall. Investment in these goods, in the relative sense in which we use the term, rises, but is countered by investment in the other two major groups. Because manufacturers do not foresee changes in the pace of business far enough in advance, investment in raw materials, the largest single group, probably continues to fall for a few months after the rate of decline in output begins to moderate. And because the stocks of finished goods, which have been piling up since the beginning of the phase, become increasingly heavy, manufacturers at least check the increase in their rate of accumulation. If the phase is long enough and prior accumulations heavy enough, liquidation may even start. Thus for a few months after the rate of decline in output begins to diminish, inventory investment in the aggregate probably continues to fall.
- 4) The preceding analysis explains in brief why inventory investment declines from the beginning of contraction until near the end; also why it tends to lag behind the rate of change in output. But it fails to settle a final question. Does aggregate investment turn up shortly before the revival of business and so help account for the upturn? Annual estimates cannot provide the answer and when we turn to monthly data, we are left equally uncertain. Investment in goods in process and in finished goods made to order certainly tends to rise in the later months of contraction because the peak in the rate of decline in output is usually passed still earlier. More doubtful is the case of raw materials. Since investment in raw materials probably lags behind the rate of change

in output, it may still be declining at the end of contraction. This is the more likely the later the rate of change in output turns up. It is less likely if the rate of change in output turns up early in contraction, as it sometimes does. But even if investment in raw materials begins to rise, the behavior of investment in finished goods is open to question. In long contractions stocks finally become so heavy that either liquidation begins or the rate of accumulation falls before the end of the phase. The same may be true of the somewhat shorter contractions than the 3-year phases I have been calling 'long'. These declines in investment, when they occur, act to offset the increases in the other categories.

I conclude, therefore, that the behavior of investment toward the very end of contraction is highly uncertain. It is determined partly by the lead in the rate of change in output, which varies from cycle to cycle, and partly by the movement of investment in finished goods, which depends upon the length of the phase.

5) The above analysis assumes implicitly that aggregate investment falls in a smooth curve to its trough, then rises. This assumption cannot be confirmed by annual data, and, if it is invalid, another hypothesis is open to us. Let us suppose that the tendency, such as it is, for investment in finished goods to fall before business reaches a trough is not sufficient to offset the increase in investment (decline in the rate of liquidation) in stocks of goods in process, finished goods made to order, and raw materials. Aggregate investment in inventories would then begin to rise before business reached a trough. This tendency may nevertheless be concealed in annual data by events immediately following the business trough. When sales start to rise, there is always a sharp drop in the rate of accumulation of finished goods and a beginning of rapid liquidation. It seems likely also that stocks of raw materials drop rapidly for a short time. In both cases, the reduction in investment may be due to the failure of manufacturers to foresee the rise in sales and to prepare for it by increasing production of finished goods and purchases of raw materials. The result is that aggregate inventory investment in the year of the business cycle trough is reduced by involuntary disinvestment after the (monthly) trough has passed, though it may have been rising due to a planned decline in liquidation before the trough. If this pos-

sibility should be confirmed, and it is not inconsistent with the present evidence, planned inventory investment may be one cause of cyclical revival, though the process is concealed in annual data. 6) During expansions there is a further element of uncertainty. Although the rate of change in output usually reaches a high point in the early part of the phase, then recedes, it has sometimes tended to rise again in the last quarter of expansion. Other things being equal, this should reduce the occasions when investment in manufacturers' inventories leads a downturn compared with the occasions on which it leads upturns.

Despite its many gaps and inadequacies, this account helps to establish and explain two significant aspects of the dynamics of business cycles: the approximate synchronism between business cycles and inventory investment and the lag of inventory investment behind the rate of change in output. For the latter, two general factors are responsible: One is the varying interval required for decision, for liquidation of past commitments, and for purchase, production, and transportation before a change in the rate of output and sales is reflected in the volume of investment in raw materials inventories. The other is the attempt of manufacturers to cushion the impact of changes in sales on production by tolerating large counter-cyclical changes in the stock of finished goods. With more adequate data, these qualitative conclusions may be given more precision, and the moot question settled whether inventory investment regularly operates to initiate revivals and recessions of business at large.