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LETTER OF TRANSMITTAL

JULY 3, 1962.

Hon. WRIGHT PATMAN,
Chairman, Joint Economic Committee,
House of Representatives, Washington, D.C.

DEAR MR. CHAIRMAN: Transmitted herewith is a report entitled "The Role of Inventories During Expansions and Contractions," which has been submitted by the task force appointed by me for this purpose.

The purpose of the participants in this report has been to summarize existing knowledge of the part played by changes in business inventories in accentuating postwar business recessions and recoveries, once turning points in business cycles have been reached.

Two additional task force reports will deal with other aspects of inventory changes. One of these will summarize existing knowledge of the part played by inventory changes in influencing turning points in the business cycle. The other will deal with influences of inventory fluctuations on price levels and rates of business capacity utilization. Members of the task force who have participated in the present report are as follows:

Prof. James S. Duesenberry, Harvard University
Mr. Robert J. Eggert, director of marketing research, Ford Division of Ford Motor Co.
Mrs. Ruth P. Mack, National Bureau of Economic Research
Mr. Sanford S. Parker, chief economist, Fortune magazine
Mr. Murray Weidenbaum, economist, the Boeing Co.
Mr. Nat. Weinberg, director, special projects and economic analysis, United Auto Workers, AFL-CIO
Prof. Thomas M. Stanback, Jr., New York University and National Bureau of Economic Research

All of these individuals have given their time and knowledge voluntarily, without compensation. Particular thanks are due to Prof. Thomas M. Stanback, Jr., New York University and the National Bureau of Economic Research, for preparing the first draft of the report and, thereafter, revising the draft to incorporate the suggestions and recommendations of other members of the task force. Because of the shortness of the time available for the preparation of the report, it was not possible to try to obtain the agreement of all members of the task force participating in the report on each and every suggestion, recommendation, or reservation, in which case such suggestions or reservations are noted in footnotes at appropriate places in the text.

While a principal purpose of the task force reports has been to obtain an authoritative statement of what can be said with confidence concerning the role of inventories in economic fluctuations, another objective has been to obtain such statements in nontechnical language,

to the extent possible, so that the available information on the subject will be readily accessible to the general public.

To a very large extent this report draws on the 13 technical papers prepared for the subcommittee under the general title, "Inventory Fluctuations and Economic Stabilization," and published during December of last year and June of this year; but the report also reflects the published findings of other research as well as the rich experience of individual members of the task force.

Prof. James S. Duesenberry, Harvard University, has served as general chairman of the task force. Prof. Paul G. Darling, on loan to the subcommittee from Bowdoin College, has had major staff responsibility for assisting the members of the task force during the period of preparation of this report.

Sincerely yours,

HENRY S. REUSS,
Acting Chairman,
Subcommittee on Economic Stabilization,
Automation, and Energy Resources.

THE ROLE OF INVENTORY CHANGES DURING EXPANSION AND CONTRACTION

(References appearing in brackets, [ ], are to lettered items in the bibliography appearing at end of paper)

The objective of this paper is to set forth a brief, simplified description of the role of inventory changes during expansion and contraction based upon findings contained in the various study papers prepared for the current hearings.[1] The presentation is divided into four parts. The first presents certain key facts regarding the magnitude, timing and source of inventory investment instability. The second gives some basic propositions relating to the manner in which inventory changes affect economic activity and the reasons which prompt business firms to hold inventories. These provide a framework for the description of the cyclical behavior of inventory investment presented in section 3, which is a highly condensed account of the behavior of inventory investment behavior during expansion and contraction and of the factors which bring it about. A fourth and final section sets forth some unsettled questions and presents conclusions regarding the current state of knowledge of inventory behavior.

I. What the Record Shows

Examination of the statistical record provides a number of observations which are important for the understanding of the role of inventory changes during business cycles.[2]

1. Inventory changes have contributed very significantly to cyclical fluctuations, accounting for approximately 20 percent of the total cyclical rises and declines in GNP during the postwar period.[3] The contribution has been much greater during recessions (70 percent of all declines in GNP) than expansions (13 percent of all increases in GNP); but inventory changes have constituted a major source of rising demand during the earlier stages of expansion (accounting for 25 percent or more of the change in GNP during the first year of each postwar expansion). This observation that inventory investment typically decline more than other spending in recession and shows its most important increase in early expansion—also holds for the prewar period (1919–39) except during the contraction of 1929–32. It may be regarded as the single most important fact which the data disclose.

[1] For purposes of this discussion the term "inventories" refers to goods held by business firms for resale or for processing into fully fabricated goods. In the main, these remarks will pertain to retailers', wholesalers', and manufacturers' stocks. The latter are classified under three categories: purchased materials, goods in process, and finished goods.

[2] The material in this section is based on [A, chs. 1-3 and 7]. Several of the estimates have been revised to include the most recent business cycle. It should be noted that changes in inventory investment discussed here are measured changes. As pointed out below (sec. III, point 7) it is probable that the role of inventory changes is somewhat larger than is indicated by the statistics, for the data show only the inventory changes which occur not those which businessmen attempt to effect. Since the businessman's efforts to adjust inventories may be partially self-defeating and the desired inventory change may be less than realized (i.e., inventories may be partially self-defeating, the desired inventory change may be less than realized (i.e., measured) inventory change.

[3] This and the immediately following statements abstracts from any induced effects of changes in production for inventory on other components of GNP, e.g., on fixed investment.

2. Movements in manufacturers' inventory investment have played the major role in changes in total nonfarm inventory investment during the postwar period, accounting for 83 percent of total cyclical movements in nonfarm inventory investment in contrast to 56 percent prewar. This increased importance has been due partly to the fact that manufacturers' stocks constitute a larger share of total stocks and partly to the fact that manufacturers' inventory investment has become cyclically more sensitive.

3. Within the manufacturing category the durable goods inventory investment movements are cyclically more sensitive than those of nondurables, conforming more closely to business cycle movements and moving with greater amplitude. This greater sensitivity of durable goods inventory investment is principally due to the fact that durable goods output and sales are more volatile because replacement is relatively postponable during recessions. It is also true that desired stock-sales ratios are higher for durable goods manufacturers due to the necessity of carrying substantial amounts of goods in process. These durables stocks have been relatively larger postwar, a fact which accounts in part for the increased cyclical sensititivty of manufacturers inventory investment.

4. Although manufacturers' inventories held at different stages of fabrication (i.e., purchased materials, goods in process, and finished goods) show somewhat different cyclical behavior, the differences are not great enough to mute significantly the cyclical sensitivity of aggregate manufacturers' inventory investment. Taken as a whole the three categories of inventory do not differ greatly in size or in timing and amplitude of investment movements. Purchased materials and goods-in-process investment have similar timing characteristics typically leading turns in finished goods investment. Nevertheless, finished goods investment shows almost no countercyclical tendencies, turning in advance of, or coincident with, business cycle turns in almost every instance.

5. Although average manufacturers and trade stocks to sales ratios are lower than in the prewar years the cyclical role of inventory investment has not been significantly reduced.[4] Changes in nonfarm inventory investment during contractions appear to play as large a role postwar as prewar. Changes during expansions play a smaller role, but this is true only for expansions taken as a whole. During the first year of expansion in the postwar period, changes in inventory investment have contributed relatively as much to increases in GNP as prewar.

II. Some Basic Propositions Relating to Inventory Investment

Inventory investment—the change in the level of stocks—strongly affects the demand for economic resources. Unlike other types of investment, however, inventory investment typically varies from positive to negative in the course of the business cycle. It is this fact which explains the paradox that whereas the level of total inventories

[4] Mr. Parker comments as follows: "Changes, desired or undesired, in the ratio of inventories to final purchases (rather than sales) have played a far less part in the fluctuations of inventory investment over the past decade, except in cases of maj or strikes, than have changes in 'needs,' largely physical, dictated by final demand itself. The relative stability of 'desired' ratios particularly suggests less fluctuation in investment owing to supply conditions (except for major strikes) than is perhaps indicated by the general tone herein. Changes in ratios certainly play a very much less relative part in instability than was true 20 to 40 years ago, especially as business' inventory response to changes in final demand has meanwhile become more prompt, or sensitive."

has risen and fallen far less markedly than total output, inventory demand has been the most volatile component of GNP during the postwar period.

The following illustration will make this point clear. Assume that inventories vary cyclically over eight periods as shown below:

Period	Beginning inventory	Ending inventory	Inventory investment	Period	Beginning inventory	Ending inventory	Inventory investment
1	100	101	+1	5	107	106	−1
2	101	106	+5	6	106	101	−5
3	106	107	+1	7	101	100	−1
4	107	107	0	8	100	101	+1

It will be seen that inventory levels fluctuate by a maximum of 7 from peak (107) to trough (100), but inventory investment fluctuates by 10 from peak (+5) to trough (−5).

These fluctuations in inventory investment affect production in the following way: Inventories rise by a larger amount in period 2 than in period 1, thereby calling for the use of more economic resources. As inventories continue to rise but by a lesser amount (period 3) and then remain constant (period 4), fewer and fewer resources are required. When inventory levels then decline (period 5), demand is reduced further, for there is a drag upon aggregate demand in the economy due to the fact that stocks are being used up. When the decline in stocks becomes greater (period 6), the drag becomes greater, but when the decline becomes less (period 7), the drag becomes less. Such a weakening of the drag is the equivalent of an increase in demand.

The preceding numerical example was one in which inventory investment fluctuates rather vigorously, but the figures could easily have been presented to show steadier and smaller rates of accumulation and disaccumulation which would have resulted in the same overall movement of stocks. The point is important: any explanation of the important role of inventory investment in business cycles must show more than simply why inventories rise and fall to the extent that they do; it must also show why accumulations occur at sharply increasing rates during the earlier stages of expansion, then at lesser rates, and ultimately decline at sharply increasing rates during contraction.

Such an explanation must start with recognition of the reasons which prompt businessmen to hold inventories. Three principal reasons will serve to provide a basis for discussion: [5] (1) the holding of buffer stocks to avoid interruptions in production or inability to meet customers' requirements because of possible delays in delivery of materials; (2) the smoothing of production over time to reduce average production costs; and (3) the anticipation that terms of purchase will be less favorable in the future.

[5] This discussion draws upon the presentation by Paul Darling in his study paper. [H pp. 21-24.] Mr. Murray L. Weidenbaum comments on this discussion as follows: "The explanation * * * on why businessmen hold inventories impresses me as oriented primarily to retailing and wholesaling. It seems to me that manufacturers, even in the absence of all three of the 'principal reasons' that you cite, would hold substantial inventories, merely because they were currently being used in the production process. Let us conjure up a producer of commodity X, who maintains a constant production rate and who is unconcerned about possible interruptions and delays or price rises of his inputs. I believe that we would find that, at any given point in time, he would still maintain inventories of purchased materials, goods in process, and finished goods."

Regarding the first reason, retailers and wholesalers must hold their stocks in trade and manufacturers must hold purchased materials because neither the supplier's ability to fill orders nor the exact level of future sales are known with certainty. Moreover, buffer stocks must be held between stages of production in the form of goods in process as a safeguard against malfunction at some production level. For manufacturers who do not produce to order finished goods must also be held as protection against uncertainties in production and sales.[6]

The second reason pertains principally to manufacturers' finished stocks though goods in process are often similarly affected. Production costs are usually sharply reduced by smoothing out production. Accordingly, manufacturers smooth their production schedules relative to sales. In consequence, stocks of finished goods and also of partly finished goods in process are drawn upon or allowed to accumulate.

The third case, in which stocks are held against the anticipation of less favorable terms of purchase, relates to merchants' stocks and manufacturers' purchased materials. Businessmen may be expected to increase inventories when price rises are expected and to decrease them when price reductions are in prospect. The expectation of lengthening or shortening delivery periods will elicit similar actions.

Of course, in every case there are costs incident to holding stocks: costs of storage, insurance, interest on invested funds, and risks of spoilage or obsolescence and of price declines. Management must continuously balance these costs against costs which may arise due to inadequate stocks.

III. Inventory Investment Behavior During Expansion and Contraction

Such commonsense observations as the above have provided the basis for testable hypotheses for the several investigators who have studied inventory investment behavior. Out of their studies have come a number of observations regarding the factors which influence inventory investment and the manner in which inventory investment, in turn, influences the business cycle.

1. Effect of changes in the level of economic activity upon inventory investment

Economists have long recognized that where additional stocks are required to service higher levels of output and sales, rising levels of economic activity will give rise to a derived inventory demand and that such derived demand will contribute to the expansion which causes it. Conversely, declining levels of output and sales have the effect of creating a negative derived inventory demand. Inventory reductions will be effected by correspondingly reducing orders placed with suppliers with the result that the initial decline in demand will be amplified.

In the light of the previous discussions of reasons for holding stocks, it may be expected that to a considerable degree businessmen will seek to adjust the desired level of stocks upward with increasing sales and vice versa. This may be expected in the case of merchants' stocks and manufacturers' purchased materials held as protection against

[6] Mr. R. J. Eggert comments as follows: "So long as these changes are within limits considered to be normal, the resulting swings in inventories could be considered to be 'planned.' Some of the changes are unplanned—simply reflecting the inability to adjust production schedules quickly to changes in demand."

uncertainties of delivery, of goods in process held between stages as protection against breakdowns in the production process, and of finished stocks held as a safeguard against uncertainties of sales.

All of the researchers who have attempted to measure the determinants of inventory investment have tested this hypothesis [B, C, F, G, H]. In every case changes in sales appear as an important factor influencing changes in stocks. The effect of changes in sales occurs with a lag and the adjustment is partial (changes in inventories are less than proportional to changes in sales).

Such a finding helps to explain the fact that inventory investment rises most rapidly during the earlier stages of expansion. It is at this time that manufacturers', retailers', and wholesalers' sales rise most rapidly, rates of change reaching their peak well before the peak in the business cycle. Rates of change in inventories (i.e., inventory investment) move in a roughly similar fashion, tending to lag by a quarter or so. During recessions, rates of change in sales fall to the negative side sharply, usually reaching their lowest point somewhat before the trough in the cycle. Here also inventory investment tends to follow suit.

2. Effect of order backlogs on inventory investment

Where manufacturers receive orders in advance of production, the sales to inventory relationship may be somewhat loose. As expansion proceeds unfilled orders accumulate, reaching their peak somewhat before the cycle peak. Under such conditions manufacturers may be expected to accumulate stocks more readily than if they were producing "to stock" (i.e., producing in anticipation of sales which will be filled out of stocks of finished goods). Unfilled orders represent business in hand, and firms possessing such backlogs may proceed with relatively little risk to accumulate the materials necessary for production. To the extent that firms attempt to protect themselves against uncertainties of delivery they may accumulate larger buffer stocks and allow a larger volume of purchase orders to accumulate than if they produced "to stock," for they do not face the risk of unexpected reversals in sales. Incidentally, the larger the stocks on order, the larger the unfilled orders for the next supplier down the line.

In the analyses which have included the levels of unfilled orders among the factors to be tested the variable has been found to add significantly to the explanation of observed inventory changes [F, H, J].

3. Effect of changes in supply conditions and changes in anticipations on inventory investment

During the earlier stages of business cycle expansion demand is rising sharply and unfilled orders are accumulating at an increasingly rapid rate. Purchasing firms are led to revise upward their anticipation of future demand and to take note of the rapid deterioration in supply conditions, seeking protection against being "caught short" by placing orders covering anticipated sales requirements extending further and further into the future [A]. The result is an increasing ownership position for the purchaser—a mixture of rapidly accumulating purchased stocks and increasing number of purchase orders on the books of his suppliers (D).

The point that must be stressed here is that the situation is changing rapidly and that there are signals to which businessmen respond.

In absolute terms supply conditions are typically good during these months of early expansion, for there is still considerable slack in the system. But there is evidence that promised delivery dates are lengthening and that future sales should be projected at higher levels. Under such conditions inventory objectives and purchasing policy are revised.

This description is firmly supported by purchasing agents association data showing percentage of purchasers reporting slower deliveries (vendor performance series) and by data showing the typical leadtime of purchases being used (purchasing policy series). See [A, ch. 4.] Availability of materials is highest at approximately the trough of the business cycle and begins to deteriorate with the beginning of recovery or very shortly thereafter. Well before the end of the expansion, supply conditions attain maximum deterioration and begin to improve. Improvement in supply conditions may proceed at varying rates but is continuous throughout the latter part of the expansion although the high levels of unfilled orders attest to substantial delays. In the final months of expansion and during early recession availability improves at an accelerating rate. The maximum rate of improvement is attained before the end of the recession with maximum availability occurring (as seen above) at approximately the business-cycle trough.

These changes in availability are matched by changes in purchasing policy. As supply conditions deteriorate leadtimes increase. As supply conditions improve, they fall.

Such a description goes far toward accounting for the sharp increases in inventory investment during early expansion and the sharp decline during recession. During early expansion initial increases in demand set up a process by which inventory objectives are continuously revised upward. Deterioration in supply conditions both causes and is caused by heavy inventory ordering. Ultimately the acceleration ceases as more and more buyers secure adequate protection from accumulated stocks and heavy purchase order backlogs and, perhaps too, as sellers with improved capacity are able to deliver goods more promptly. With the onslaught of recession the situation is reversed. Delays in delivery drop sharply, and purchasing policy shifts to a more or less hand-to-mouth basis. Inventory objectives are revised downward. Existing stocks become redundant. New orders fall both because of the reduction in backlogs of unfilled orders for purchased materials and merchants' stock in trade and because of the wish to reduce stocks.

Aspects of this process have been recognized statistically by taking account of the changes which occur in unfilled orders [A, J]. Next to changes in sales changes in unfilled orders have been found to be the most important variable in "explaining" the behavior of inventory investment.

4. Effect of price changes on inventory investment

It was noted above that anticipation of price increases will cause firms to buy further ahead and to carry larger inventories. There is good reason to suppose that the relationship between price changes and inventory investment in purchased materials is an important one. During periods of rising demand, tightening supply, and rapid inventory accumulation, price rises are likely to occur. Such price

increases may, in turn, give rise to still further increase in inventory demand.

Expected rise in prices and worsening supply conditions motivate more advanced buying. The additional buying helps to boost prices and retard deliveries. Because of this ring of cause and effect the impact of price changes on inventory investment has proven to be difficult to measure. One economist has made use of price changes as a variable, explaining movements in purchased materials investment [F]; another recognizes it as important but notes that it has been impossible to separate its effect from that of change in unfilled orders [G].

5. Effect of liquidity and interest rates on inventory investment

The effect of corporate liquidity and interest rates has also proven to be difficult to determine [E]. In the first place, it is difficult to separate the effect of this factor from other forces acting concurrently. Second, it is during recessions and early expansions that corporate liquidity is greatest and interest rates lowest. At such time the level of inventory accumulation is low or negative. These considerations do not prove that liquidity and interest rate changes will not affect inventory policy at a given stage of the business cycle, but the relationship remains uncertain.

6. Effect of capacity on inventory investment

The implication of much that has been said above is that inventory policy is influenced by the extent of overcapacity that exists in the economy. If inventory objectives are revised upward with anticipations of supply tightness and rising prices then anticipations of a lack of excess capacity will make for sharp inventory investment movements and vice versa [A, H]. This matter hos not been studied directly.

7. Income feedback

The impact of inventory demand is probably greater than measurement of changes in the levels of stock reveals. The reason for this is that a businessman's intended inventory investment or disinvestment may be greater than his realized (actual) investment or disinvestment. As firms place orders to increase stocks, or to fix buying prices in advance of an anticipated rise, the increases in demand give rise to increases in production. Increases in production cause increases in income; these increases in income result in changes in consumption and in expenditures for plant and equipment—changes which tend to deplete stocks. Thus, attempts to build up stocks are partially self-defeating. Conversely, attempts to reduce stocks result in declines in income and in final demand which make it difficult to accomplish the desired reductions.

The effect is greater during expansions. This happens because consumption is responsive to income increases, and because the improvement of expectations as well as an enlarged cash flow encourage businessmen to invest in new equipment and facilities. The feedback effect is less important during recessions because consumption is less sensitive to income declines than to increases.[8]

[8] Mr. Darling notes a tendency for feedback during recession to increase in recent cycles. See [H.]

8. Vertical structure

There is good reason to believe that the magnitude of changes in inventory demand is influenced by the structure of the economy. In an advanced free enterprise economy such as ours, manufacturing and distribution are highly specialized. As a result, most goods must pass through a number of stages between production of the raw material and sale of the final product. If all these stages were integrated under one management, inventory objectives could be based on forecasts of final demand. Under existing arrangements, however, individual firms attempt to project their needs on the basis of customers' orders. The firm has no way of distinguishing between orders that represent final demand and orders that represent inventory buildup. During expansions each firm in succession adds increases in inventory demand to final demand as it places its orders. And during recessions each firm deducts inventory decreases. Thus, firms receive false signals and form erroneous expectations. As a result, they add to or reduce stocks excessively, thereby intensifying cyclical changes in output. An example of this is found in the textile industry where output and prices of cloth fluctuate widely even though basic demand is relatively stable.

9. The extent of the impact of inventory investment changes

Recently two attempts have been made to measure the impact of inventory investment changes on economic fluctuations assuming certain interrelationships [I, J]. The approach used was to construct a mathematical model of the American economy which describes as closely as possible the network of interrelationships which has existed among the major economic variables. Assumptions were then made of lesser amplitudes of inventory investment movements than have actually existed and the effects of this changed inventory behavior traced out by a process of simulation. Although both the methods used and the assumptions regarding inventory investment stabilization are different the studies result in similar conclusions, the effect in terms of stabilization of GNP is significant—well in excess of the assumed amount of stabilization in inventory investment itself.

IV. The Current State of Knowledge

From the above it seems clear that much has been learned about both the factors influencing inventory investment movements and the general process by which these movements affect, and are affected by, the business cycle.

Nevertheless, there are serious gaps in our knowledge. In the first place, although we have noted the greater volatility of durable goods inventory movements and observed the industries in which cyclical sensitivity is highest [G] we have no detailed knowledge of inventory at the industry and firm level. Thus we have not yet pinpointed the trouble spots where inventory investment instability is especially high. Our methods of countercyclical policy aim at broad-gaged manipulation of purchasing power, yet the evidence indicates that there is significant concentration of inventory investment instability. Second, our knowledge of how overbuying is magnified from one stage of production or distribution to the next is extremely sketchy. Yet this is surely an important element in inventory investment instability. With all of our statistics we are unable to give a manufacturer an accurate statement of the degree to which increases or decreases in his orders are due to changes in inventory demand and how much to changes in basic demand. Better information on this subject should do much to stabilize purchases and reduce instability. Third, our understanding of the effect of changes in liquidity and interest rates remains limited. Such information as is available does not suggest that monetary policy can be an effective tool in combating inventory investment instability.[9] The whole matter deserves serious study.

Finally, the relationship between capacity and inventory investment should be clarified. Evidence at hand suggests that a "tight" economy will be susceptible to inventory investment fluctuations, yet it must be observed that our European neighbors faced with shortage of capacity for a number of years do not appear to have suffered this fate.

Submitted by task force of the following persons:

Prof. James S. Duesenberry, Harvard University
Mr.. Robert J. Eggert, director of marketing research, Ford Division of Ford Motor Co.
Mrs. Ruth P. Mack, National Bureau of Economic Research
Mr. Sanford S. Parker, chief economist, Fortune magazine
Mr. Murray Weidenbaum, economist, the Boeing Co.
Mr. Nat Weinberg, director, special projects and economic analysis, United Auto Workers Union, AFL–CIO
Prof. Thomas M. Stanback, Jr., New York University and National Bureau of Economic Research

[9] Mr. Eggert observes: "On the other hand, during tight credit there are often requests from business for additional funds. Furthermore, to the extent that monetary policy contributes to general economic stability it will have some impact on changes in final demand that tend to influence inventory changes. The policy implication of this paper is that specific action aimed at especially volatile forms of spending is the best way to make the economy more stable. This premise is not supported with factual information and may or may not be correct. Overall policy action may get better stabilizing results and have less negative side effects.

Efforts to further improve forecasting of business and Government spending and especially consumer spending may also contribute to making inventory changes less severe. Reducing the time span of forward supply commitments may also aid."

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