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

Volume Author/Editor: Moses Abramovitz

Volume Publisher: NBER

Volume ISBN: 0-870-14087-6

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

Publication Date: 1950

Chapter Title: Investment in Stocks of Finished Goods Made from Agricultural Materials

Chapter Author: Moses Abramovitz

Chapter URL: http://www.nber.org/chapters/c9143

Chapter pages in book: (p. 424 - 456)

Chapter 19

Investment in Stocks of Finished Goods Made from Agricultural Materials

We turn now to the last of the groups for which some empirical evidence is available. The behavior of the volume of finished goods inventories made from agricultural materials (as distinct from the rate of change in such inventories) was examined in detail in Chapter 12. I estimated that the total stock of such goods had a value of about $1.4 billion, or approximately 35 percent of the total inventories of finished goods held by manufacturers at the end of 1939 (see App. E). From the viewpoint of their cyclical behavior and of the forces determining that behavior, however, they are not a homogeneous class. Indeed, as we shall see, a large portion belong with finished goods made from nonagricultural materials. To establish the distinctions that are necessary is the objective of this chapter.

The distinction between finished goods made from nonagricultural and from agricultural materials represents an attempt to give objective expression to quite another principle of classification. As explained earlier, the difference I am really after is between goods whose production cycles are predominantly influenced by cycles in demand and goods whose production cycles are predominantly influenced by cycles in the supply of raw materials which are themselves independent of short-term fluctuations in demand. Dividing goods into those made from materials of agricultural and nonagricultural origin is only a partly satisfactory approximation, but it is the sole convenient objective criterion I can use.

Classification according to origin of materials is satisfactory in one sense. Commodities made from nonagricultural materials do have production cycles dominated largely by cycles in demand.

Thus this group, as indicated in Chapters 11 and 18, is fairly homogeneous. The distinction is unsatisfactory, however, in that commodities made from agricultural materials do not necessarily have production cycles that respond predominantly to impulses from the side of supply. A decline in the current output of materials, for example, will not impinge seriously on the output of goods manufactured from such materials if additional supplies (a) can be obtained from stock carried over from earlier periods or (b) can be fairly promptly imported.[1] If such alternative sources exist in requisite degree, cycles in the production of the fabricated good will be more heavily influenced by demand, and stocks of finished goods will, if durable and staple, tend to behave in the manner described in Chapter 18.

A second complication is that, just as in the case of goods made from nonagricultural materials, we must differentiate between perishable and durable finished goods. The latter can be allowed to accumulate when output rises or demand falls off; the former must be disposed of fairly promptly. This suggests that finished goods made from agricultural materials can be divided into two main classes, each with two subdivisions:

1 Perishable

   a) Goods whose output cycles are controlled largely by factors independent of demand (I shall call these 'supply-dominated')
   b) Goods whose output cycles are strongly influenced by fluctuations in demand (I shall call these 'demand-dominated')

2 Durable

   a) Goods with 'supply-dominated' output cycles
   b) Goods with 'demand-dominated' output cycles

[1] In the usual case the supply of materials is independent of the demand for the manufactured product because it is influenced by the effects of weather on the crop. In some cases, however, the difficulty of matching supply and requirements can arise if the material is a minor byproduct of the output of some other commodity. In that case, the difficulty can be overcome in whole or in part if additional supplies can be obtained by special effort or expense. A case in point is inedible tallow; see Ch. 12.

1 *Perishables*

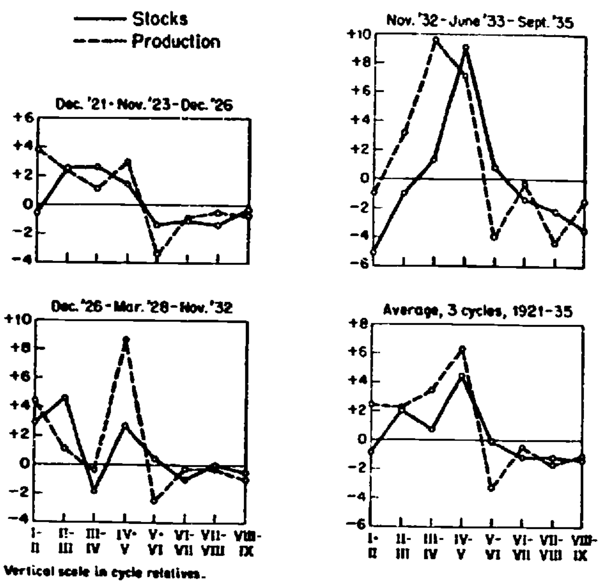
Our collection contains three examples of commodity stocks that are perishable after fabrication: cold storage holdings of pork, lard, and beef. As explained in Chapter 12, stocks of these commodities serve to iron out seasonal disparities between supply and demand. Because they are perishable, little attempt is made to carry over stocks in frozen or cured form from years of large supply (or small demand) to years of small supply (or large demand). Postponing for a moment questions about what determines the supply of frozen and cured meats and lard, we can say that stocks tend to be large in years when supply is large primarily because the carryover between the season of heavy animal slaughter and the season of light slaughter is large. Between the slack season of one year and the flood season of the next, however, only very small stocks will be carried regardless of the rate of supply during the preceding year.

These facts do not, of course, determine a precise relation between the annual output of a year and the average stocks carried during the year because the size of the carryover depends not alone upon the output during the heavy season, but also upon expectations concerning prices in the ensuing slack season. However, if I am right in thinking that only minimum stocks are carried over from slack to flood seasons, it will also be true that stocks in the slack season will be largely unaffected by output during that period. For the stock with which the slack season opens will have been determined by output in the preceding season of large supply, together with price expectations then held. Beginning stocks will therefore be gradually liquidated almost regardless of ouput during the slack season. Consequently, if the seasonally corrected rate of production begins to rise (or fall) during the season when supply is ordinarily light, the effect may not register on stocks until the next season of heavy marketings. Some irregular tendency for cold storage stocks of meat and lard to lag behind production may, therefore, be a concomitant of conditions in the industry.

If this theory is valid, the rate of change in stocks would tend to rise and fall with (or soon after) the rate of change in output. Experience seems to be generally consistent with this expectation for we find that the rates of change in stocks and output trace similar patterns in all three commodities (Charts 83-5). There is also some evidence of a tendency for the rate of change in stocks to lag behind that in production. At the same time, instances of disagreement between the direction of change in production and in stocks of each commodity are numerous. As indicated above, these may be attributed in part to the fact that inventory accumulation to meet the sales of the season of slack production depends somewhat on price expectations which may alter independently of the rate of output.[2]

Chart 83

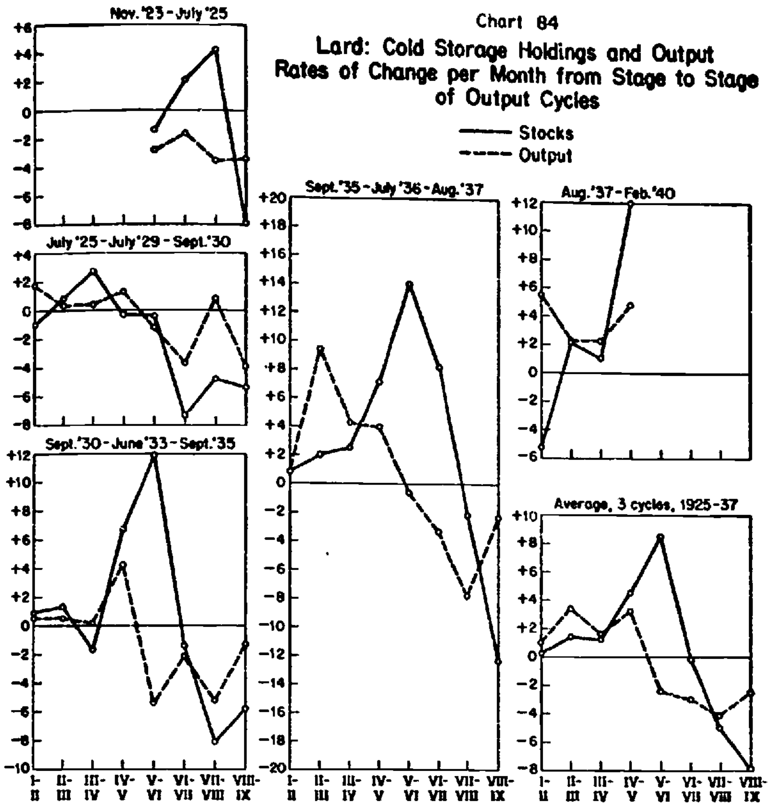
Pork: Cold Storage Holdings and Quantity Frozen or Placed in Cure
Rates of Change per Month from Stage to Stage
of Cycles in Freezing and Curing



Vertical scale in cycle relatives.

Turning to the behavior of this group during business cycles, it is well to recall a distinction made in Chapter 12. There also we discovered that the stocks of all three commodities conformed to cycles of output in their own industry (that is, pork stocks to pork output, lard stocks to lard output, etc.). During business cycles,

[2] There is also the possibility, indeed certainty, of errors in the original data on production or stocks or in the seasonal correction, which are, of course, magnified when we calculate rates of change.

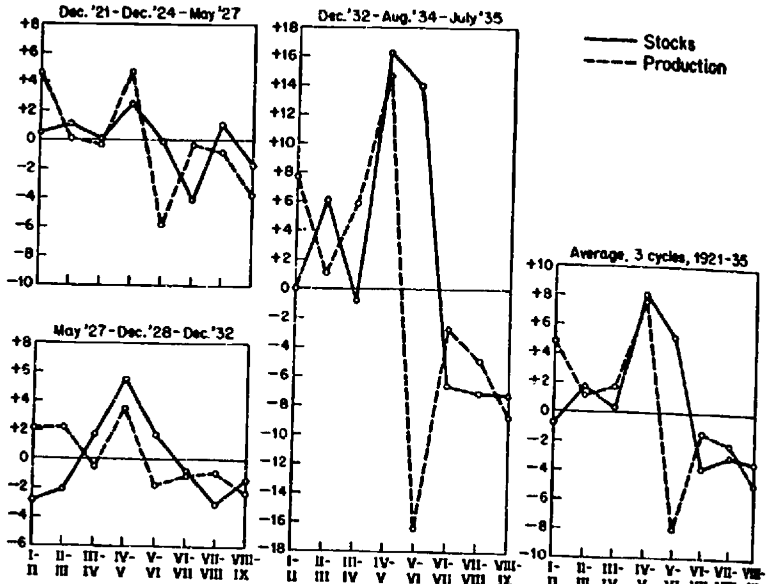


Vertical scale in cycle relatives.

however, pork and lard stocks fluctuated irregularly, but beef stocks tended to rise and fall with general business. This difference was easily explained. The stocks of all three commodities were influenced primarily by their rate of output. The output of all three commodities, in turn, depended upon the rate of slaughter: of hogs (in the cases of cured and frozen pork and of lard) and of cattle (in the case of cured and frozen beef). Hog slaughter, however, tends to fluctuate irregularly during business cycles because the rate of slaughter is closely tied to the rate of breeding 12 to 15 months earlier. Breeding decisions in turn are heavily influenced (inversely) by the price of corn, which in turn moves irregularly during business cycles in response to the haphazard effects of the weather on the corn supply. Cattle breeding too is influenced by the supply of feed, but the rate of slaughter is less closely tied to

Chart 85

Beef and Veal: Cold Storage Holdings and Quantity Frozen or Placed in Cure
Rates of Change per Month from Stage to Stage
of Cycles in Freezing and Curing



Vertical scale in cycle relatives.

earlier breeding decisions than in the case of hogs. Because cattle are slaughtered when they are older, the stock of cattle is large relative to the rate of slaughter and the age range over which cattle may profitably be marketed is wider. It is possible, therefore, for an increase in the demand for beef to cause the rate of slaughter to rise, and for a decline in demand to cause the rate to fall. In the first case, cattle are slaughtered when they are younger, and herds tend to diminish; in the second case, herds tend to increase, the slaughter of many cattle being postponed.

The animal population may, of course, be likened to a stock of materials. Hog stocks bear the same relation to breeding and slaughter as a stock of goods in process does to the input of raw materials and the output of finished goods because the age at which hogs are marketed cannot be altered much without serious loss.[3] Thus the number of hogs slaughtered can rise, in normal

[3] Beyond a point, close to the normal age when hogs are slaughtered, feeding for a longer period will rarely repay the cost.

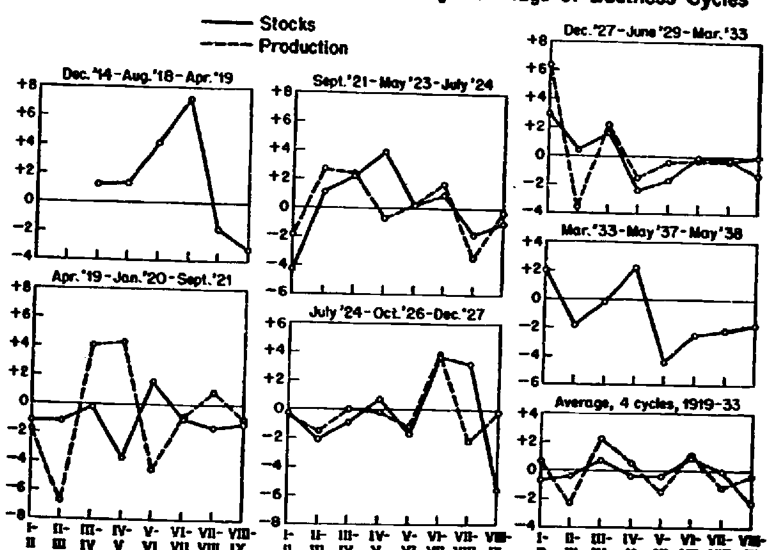
circumstances, only if more hogs have been bred 12 to 15 months before. In the case of cattle, however, the stock of animals on the hoof can be drawn down when demand increases and allowed to rise when demand declines. Here the output of an agricultural commodity (fresh or frozen beef) is responsive to short term changes in demand because current requirements can be met by drawing on a stock.

Do these differences influence the movements of the rates of change in production and stocks during business cycles as they did the movements of production and stocks themselves? It is immediately apparent from Charts 86 and 87 that the rates of change in pork and lard stocks do not behave in any regular fashion during business cycles. This, of course, is only to be expected since production, being strongly influenced by earlier crop conditions, behaves irregularly relative to waves of general prosperity and depression.

Beef, however, is different. The rate of change in beef stocks during business cycles (Chart 88) has elements of regularity. In general during the interwar period, it tended to reach a peak dur-

Chart 86

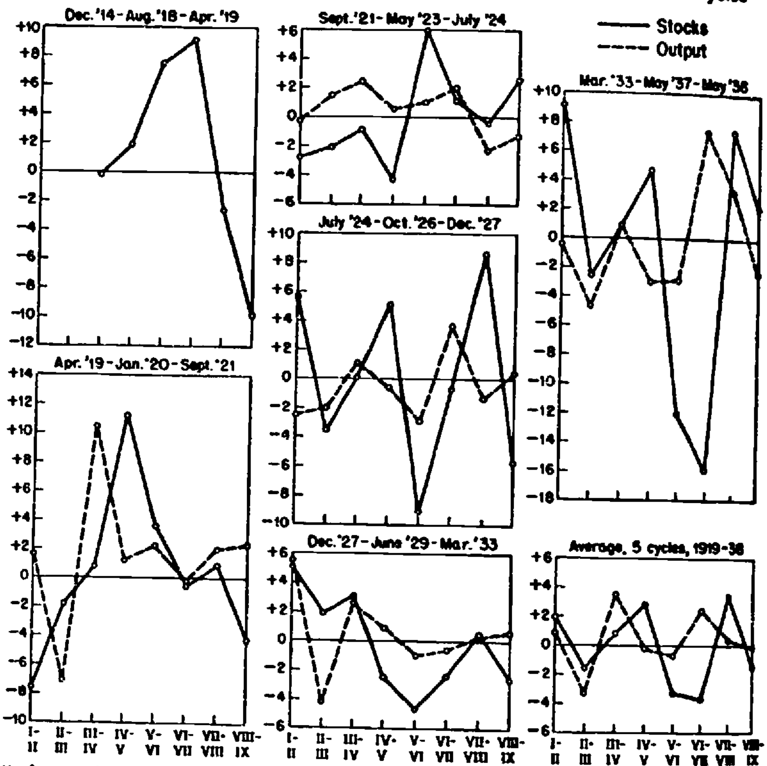
Pork: Cold Storage Holdings and Quantity Frozen or Placed in Cure Rates of Change per Month from Stage to Stage of Business Cycles



Vertical scale in cycle relatives.

ing expansions and to turn down before business reached it peak. Similarly, it tended to reach a trough during business contractions and to turn up before business reached its low point. There were exceptions, but it seems fair to say that this pattern, which may be described as positive conformity to business cycles with the rate of change in stocks leading, was characteristic of the period.

Chart 67
Lard: Cold Storage Holdings and Output
Rates of Change per Month from Stage to Stage of Business Cycles

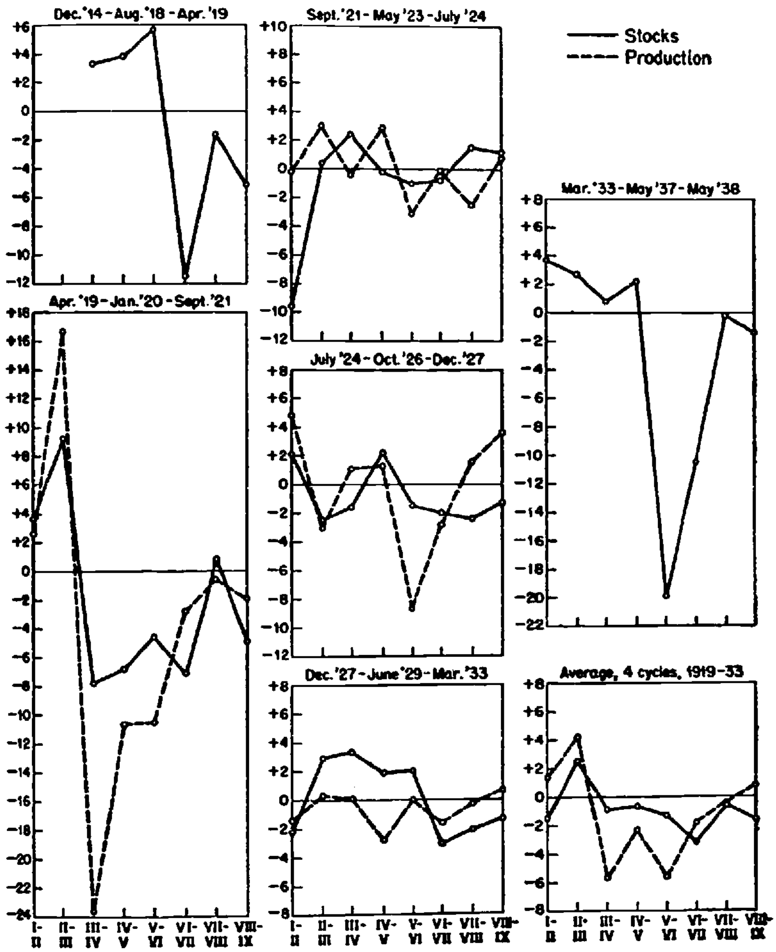


Vertical scale in cycle relatives.

The cyclical pattern of inventory investment in cold storage beef is to be attributed to the similar behavior of the rate of change in frozen and cured beef output. For reasons explained above, the rate of change in beef stocks tends to follow the rate of change in output. The rate of change in output, in turn, appears to have reached peak levels early in expansion and trough levels late in expansion or early in contraction. It therefore resembles the business cycle pattern in the rate of change in the output of consumer goods in general, which also tends to conform to business cycles with a considerable lead. All this, of course, is consistent with our notion that beef output, like that of most consumer goods, is responsive to demand. And given the perishable nature of beef, the pattern of the rate of change in output is transmitted to the rate of change in stocks.

Chart 88

Beef and Veal: Cold Storage Holdings and Quantity Frozen or Placed in Cure Rates of Change per Month from Stage to Stage of Business Cycles



Vertical scale in cycle relatives.

The difference between the irregular behavior of investment in pork and lard stocks and the more regular pattern in beef stocks depends, therefore, on the differences in the forces that control their output. The availability of feed exercises a predominent influence on short term changes in hog slaughter and, therefore, on the supply of meat for curing and of fat for conversion into lard. The presence of a relatively large cattle population, which can be increased or drawn on by altering the age at which cattle are marketed, on the contrary, makes cattle slaughter and, therefore, the supply of beef for freezing and curing, responsive to demand.

2 *Durables: Supply-dominated Output Cycles*

The examples of goods that are durable in fabricated form may also be divided into two categories: those whose output cycles are clearly dominated by fluctuations in the supply of materials and those whose output cycles are influenced in greater or less degree by fluctuations in demand. Two commodities in our collection, crude and refined cottonseed oil, are clearly supply-dominated. A third, evaporated milk, is also best considered in this class.

The major relevant characteristics of production cycles in the cottonseed oil industry have already been discussed (Ch. 10 and 12). Because cottonseed is more bulky and difficult to store than the oil pressed from it, the output of crude cottonseed oil rises and falls in close relation to fluctuations in the supply of cottonseed, that is, to the size of the cotton crop. Crude oil, in turn, is promptly refined so that the three series—the cotton crop, the output of crude oil, and the output of refined oil—rise and fall together and in nearly the same proportion (Chart 41). But since the output of oil is governed by the size of the cotton crop, it tends to fluctuate irregularly during business cycles.

Despite similarities in their output fluctuations, the stocks of the two commodities do not behave in the same way because the relation between the output and utilization of crude oil is not the same as that between the output and utilization of refined oil. Crude oil, as stated, is promptly refined. The stock of crude is relatively small and has the characteristics of a good in process, or pipeline stock, flowing from the crude oil pressing operation to the refining operation. From this it may be inferred that the rate of change in crude oil stocks varies directly and almost synchronously with the rate of change in crude oil output (Chart 89).

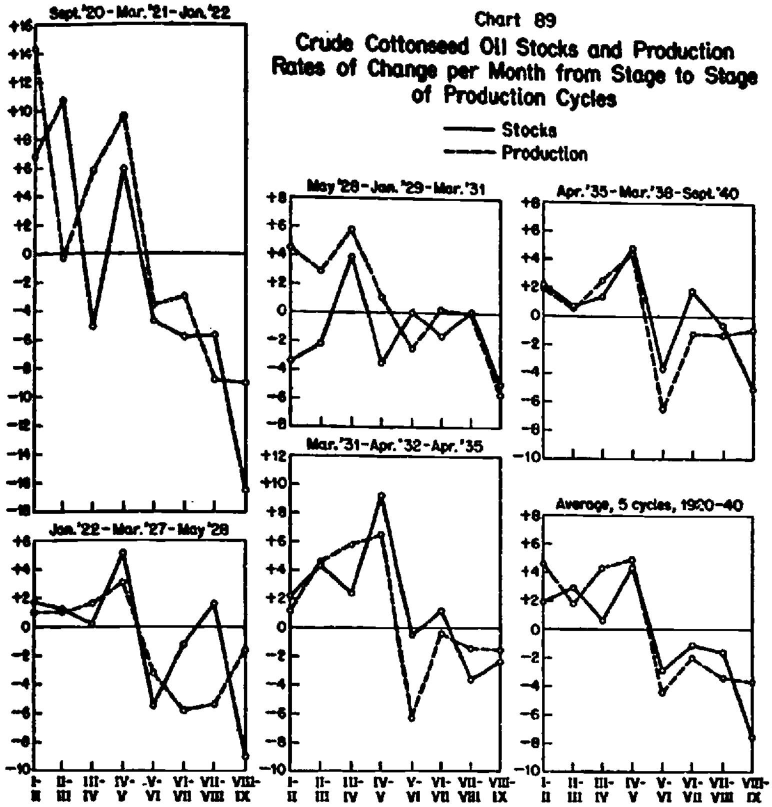


Chart 89
Crude Cottonseed Oil Stocks and Production
Rates of Change per Month from Stage to Stage of Production Cycles

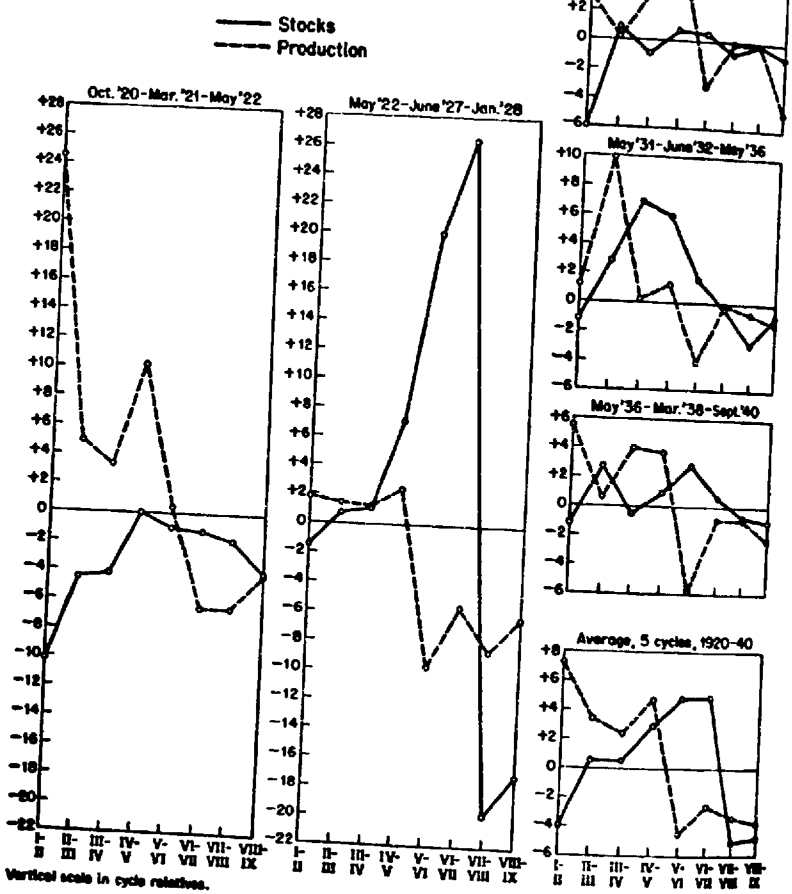
Vertical scale in cycle relatives.

As in the case of crude, the utilization of refined oil is also strongly influenced by output. For when output is large, the price falls and cottonseed oil tends to be substituted for other fats and oils. The relation between refined output and its use, however, is not as close as that between crude output and its use. When the supply of refined cottonseed oil is large, it need not all be consumed at once. It can be stored; and if the low prices that accompany large supply promise better prices in the future, as is likely, stocks will accumulate. Additions to the stock of surplus oil are usually made in refined form and are reflected in disparities between refined oil output and use.

A large supply of oil is not the only factor making for low prices and large stocks. Another factor is a large supply of competing products, which tends to reduce the utilization of cottonseed oil, and a third is a low level of national income, which tends to reduce the utilization of all fats and oils. But these three influences affecting the price and use of cottonseed oil tend to move independently. It remains true, therefore, that utilization of oil tends to move synchronously with cycles in oil output and that the price of cottonseed oil tends to move inversely to output.

In these circumstances it is difficult to say *a priori* at what stage of the cycles in cottonseed oil output the rate of accumulation of

Chart 90
Refined Cottonseed Oil Stocks and Production
Rates of Change per Month from Stage to Stage
of Production Cycles



Vertical scale in cycle relatives.

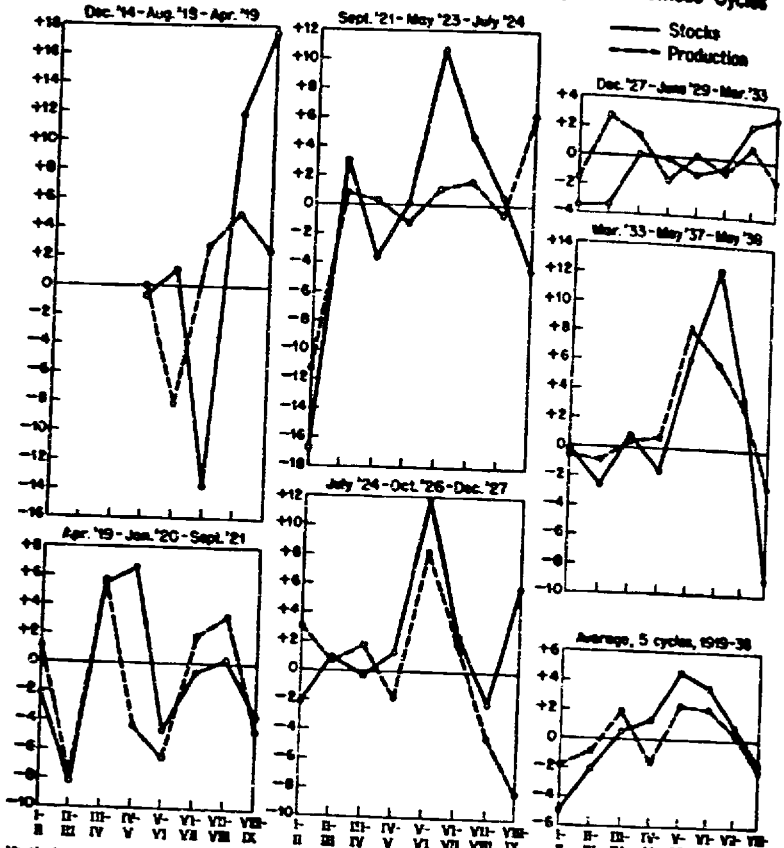
refined oil stocks will tend to reach its peak. At any stage it will be affected by the quantity of stocks already in storage, by the level and movement of prices, and by other signs that seem to foretell future prices. According to Chart 90, the stage of most rapid accumulation tends to be when the level of production is highest, not when the rate of rise in output is most rapid. Similarly, the rate of inventory liquidation is usually most rapid near the troughs of output cycles. The peak rates of change in stocks cluster about stage V of output cycles, and the trough rates about stage I (or IX) regardless of the pattern of the rates of change in output.

During business cycles the rate of change in crude oil output and stocks should move in the same fashion. Since the former, controlled by movements in the cotton crop, moves irregularly during business cycles, so should the latter (Chart 91).

To understand the behavior of the pace of refined oil accumulation during business cycles is again more difficult. We must take account of the relation between inventory accumulation and both utilization and production, and of the behavior of these latter processes during business cycles. We may best begin by noting that if utilization tended to fluctuate independently of output (responding only to the level of income and to the supply of competing products), we would expect the use of cottonseed oil typically to exceed output most at the peak of cycles in utilization. If it did, the rate of the accumulation of stocks would tend to vary inversely to the level of utilization. As shown above, however, the production of cottonseed oil is itself a major influence affecting utilization. And the rate of change in stocks tends to vary positively with the level of production. These offsetting influences prevent any regular relation between utilization and inventory accumulation. The wide fluctuations in the rate of change in stocks during individual cycles in utilization all but cancel out in the averages (Chart 92).

We are left, therefore, with production as the sole influence regularly affecting the pace of inventory accumulation. We should, therefore, expect that the rate of change in stocks will tend to move like the level of production. This tendency is disturbed in individual business cycles by the haphazard impact of other factors, but the similarity between the two series stands out fairly clearly when their behavior over five cycles is averaged (Chart 93).

Chart 91
Crude Cottonseed Oil Stocks and Production
Rates of Change per Month from Stage to Stage of Business Cycles

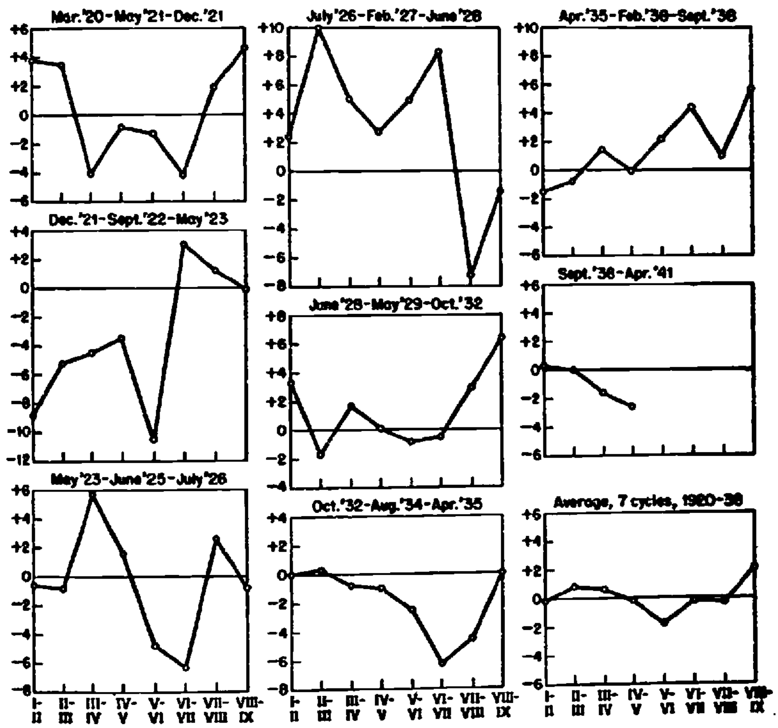


Vertical scale in cycle relatives.

Another commodity to be explained perhaps on lines analogous to refined cottonseed oil is evaporated milk. As indicated in Chapter 12, the output of fluid milk is remarkably stable. The output of evaporated milk, on the contrary, is subject to fairly wide fluctuations due to a combination of influences. Production presumably increases when consumer demand for evaporated milk rises relative to that for other milk products; for then a larger portion of the total output of fluid milk is condensed and canned. Production of evaporated milk should increase also when the demand for milk products in general falls; for canning is one of the principal ways in which surplus milk can be stored until demand revives.

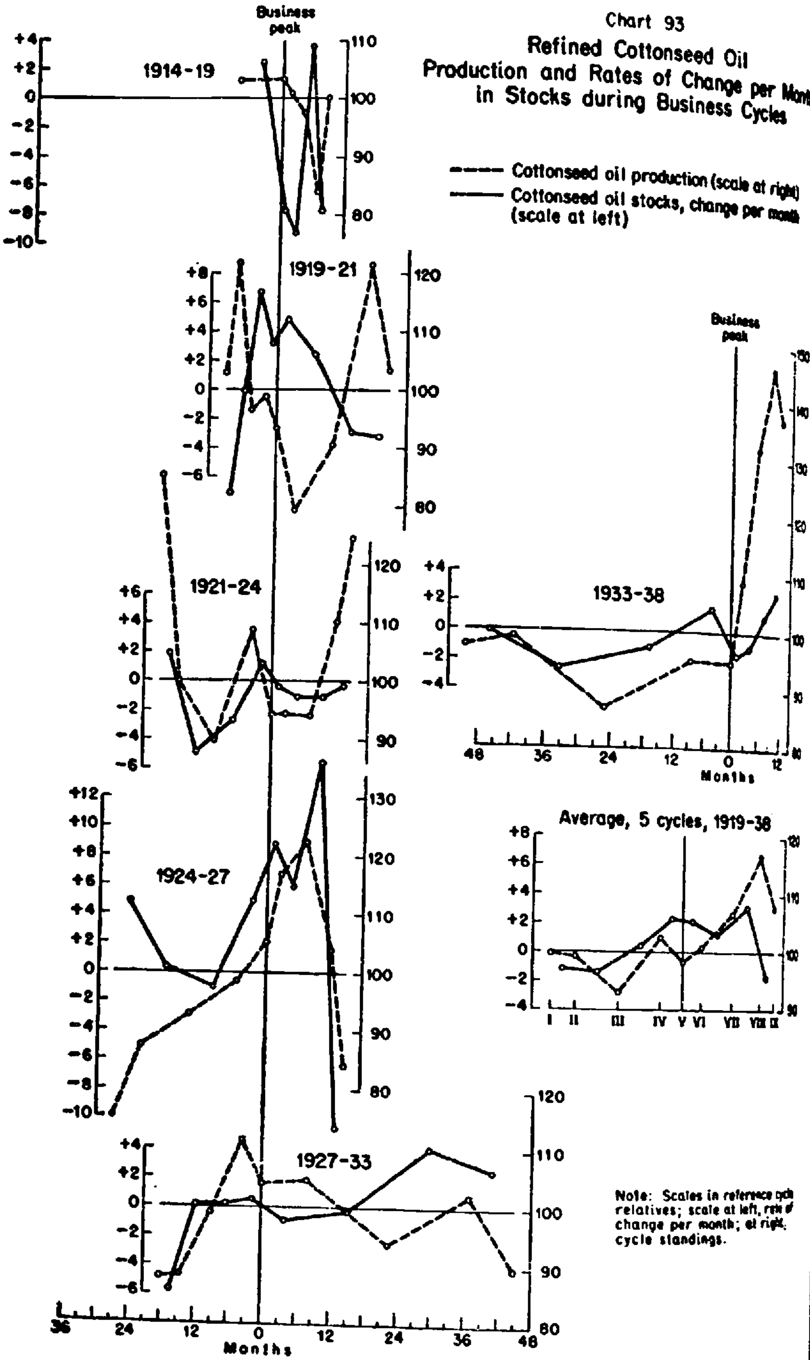
If this analysis is correct, we must expect fluctuations in production often to occur independently of changes in consumer demand for evaporated milk. When they do, stocks of evaporated milk should rise and fall with output. And again stocks will tend to lag behind output because some time passes, after output begins to rise or fall, before it exceeds or drops below consumption. Whether this positive relation between output and stocks is a dominant characteristic of these series depends, of course, on whether the output of evaporated milk typically responds to changes in consumer demand for evaporated milk relative to demand for other milk products, or, inversely, to fluctuations in the demand for milk products in general. Again the patterns reviewed in Chapter 12 suggest that the latter response is more typical. Stocks do tend to conform positively, with a lag, to cycles in output.

Chart 92
Refined Cottonseed Oil Stocks
Rates of Change per Month from Stage to Stage of Cycles
in the Disappearance of Refined Cottonseed Oil



Vertical scale in cycle relatives.

Chart 93
Refined Cottonseed Oil
Production and Rates of Change per Month in Stocks during Business Cycles



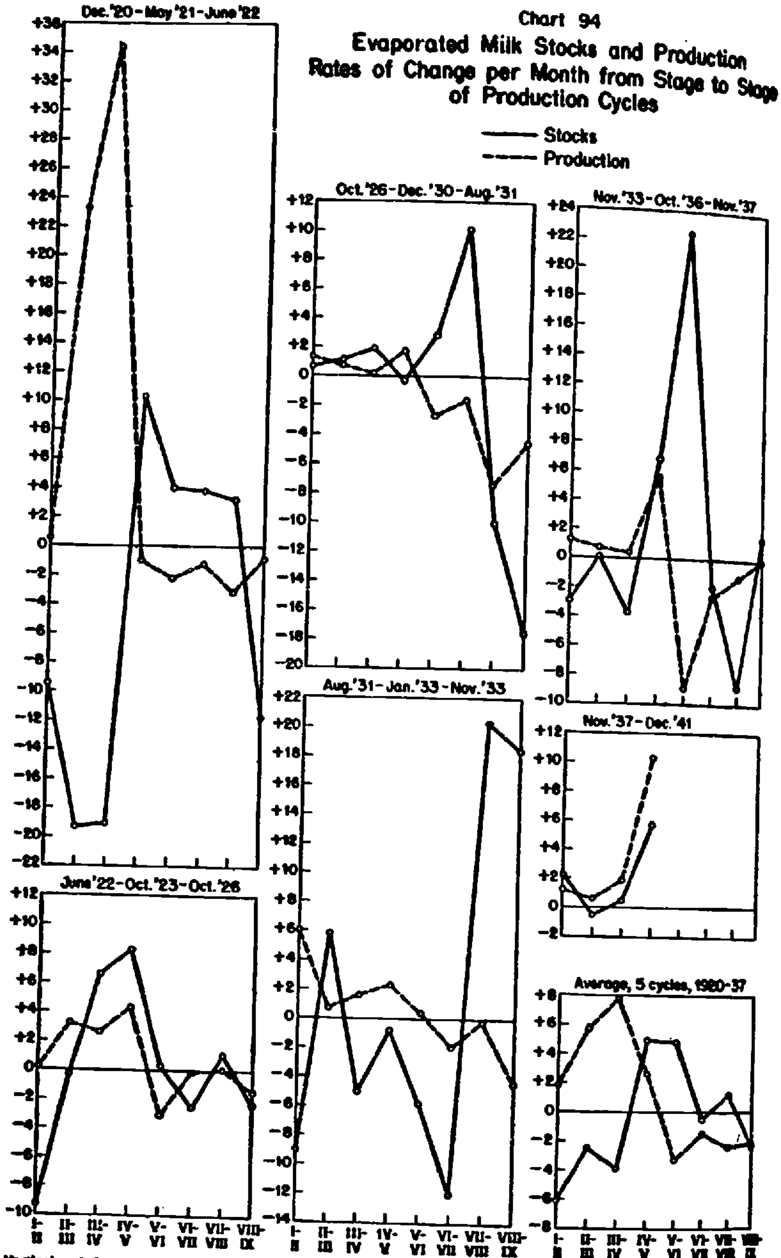
If fluctuations in production were completely independent of consumption, we could say that the rate of increase in stocks would tend to be highest at the peak of production cycles, for production is then likely to be most in excess of consumption. Similarly, the rate of increase would tend to be lowest at the trough of production cycles. When demand for milk products declines, however, prices will drop and the consumption of evaporated milk will be encouraged. And production of evaporated milk will sometimes increase because consumer demand expands. These disturbing factors have apparently not been determining. The rate of change in stocks has usually attained its peak near the peak in production cycles and its trough near the trough in production cycles (Chart 94).

The influence of this tendency is reflected in the behavior of the rate of change in stocks during business cycles. With few exceptions, it has risen and declined with output (Chart 95). And since the production of evaporated milk has acted irregularly during business cycles, the same has been true of the pace of the accumulation of its stocks.

3 *Durables: Demand-dominated Output Cycles*

Two commodities in our collection, linseed oil and leather, are in this category. Linseed oil may be said to represent a transitional case between commodities whose output cycles are determined mainly by the supply of raw materials and those whose output cycles respond chiefly to impulses from the side of demand (see Ch. 12). Its output can be increased, at least tardily, when demand increases because a considerable portion of the output depends upon imports of flaxseed. By increasing imports, production of linseed oil can, after a time, be raised above the level that could be supported by the current domestic crop of flaxseed and current imports. Similarly, when demand falls, output can be cut, at least after the rate of receipts of foreign seed has been reduced. This sluggish adjustment of output to changes in demand is, of course, similar to that characterizing the output of goods made from nonagricultural materials. As a result, the behavior of stocks of linseed oil during cycles in shipments and in business tends to resemble that of finished goods made from nonagricultural materials. Dur-

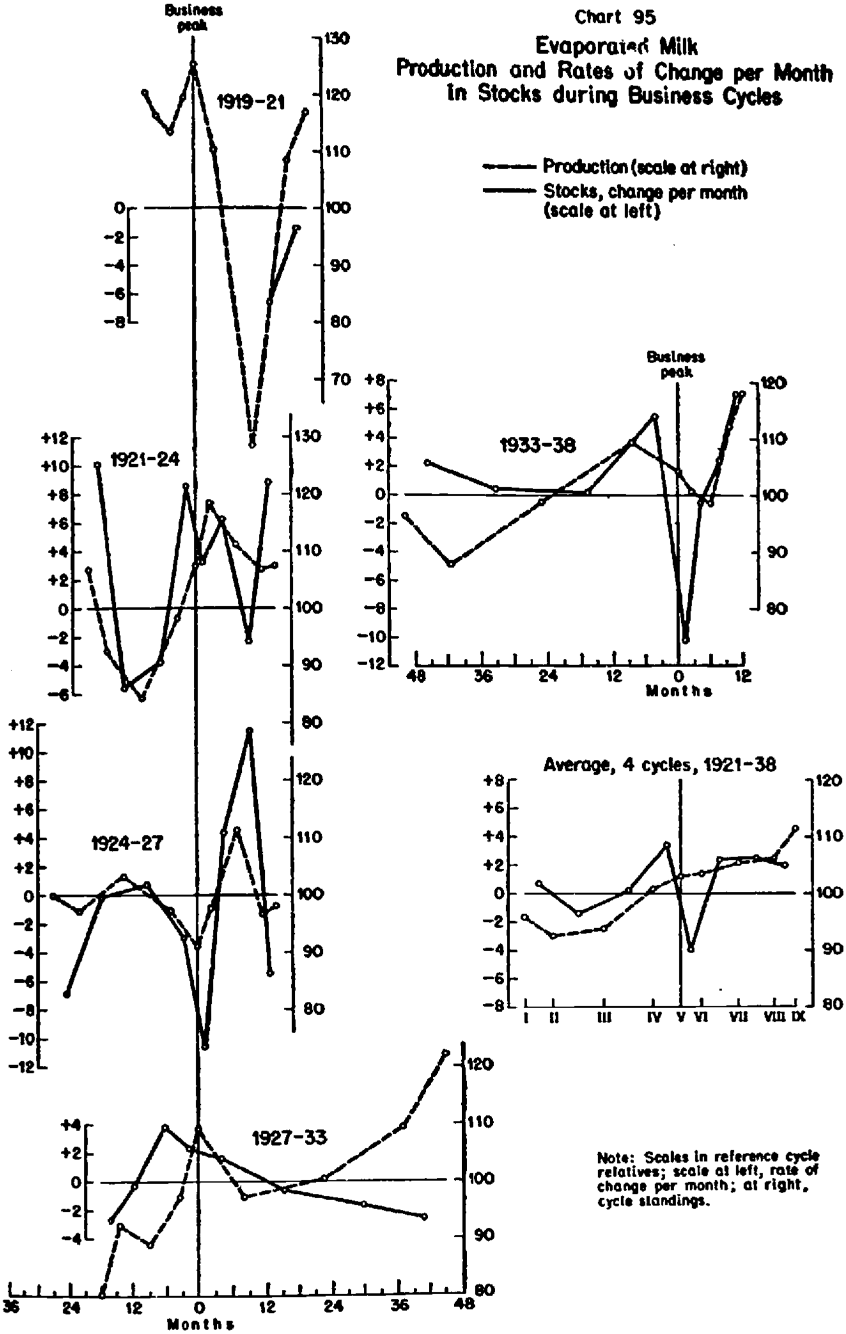
Chart 94
Evaporated Milk Stocks and Production
Rates of Change per Month from Stage to Stage of Production Cycles



Vertical scale in cycle relatives.

Chart 95

Evaporated Milk
Production and Rates of Change per Month
in Stocks during Business Cycles



Note: Scales in reference cycle relatives; scale at left, rate of change per month; at right, cycle standings.

ing short phases they tend to move inversely to shipments; during long phases they tend to move positively with a lag.

But these tendencies are intermingled with the effects of other influences. As just stated, the production of linseed oil responds, though tardily, to changes in demand. And as Chapter 12 has shown, its cycles are correlated also with the size of the domestic crop of flaxseed because flaxseed imports cannot be increased or decreased immediately to offset changes in the domestic supply. Meanwhile, the output of linseed oil rises and falls with the flax-

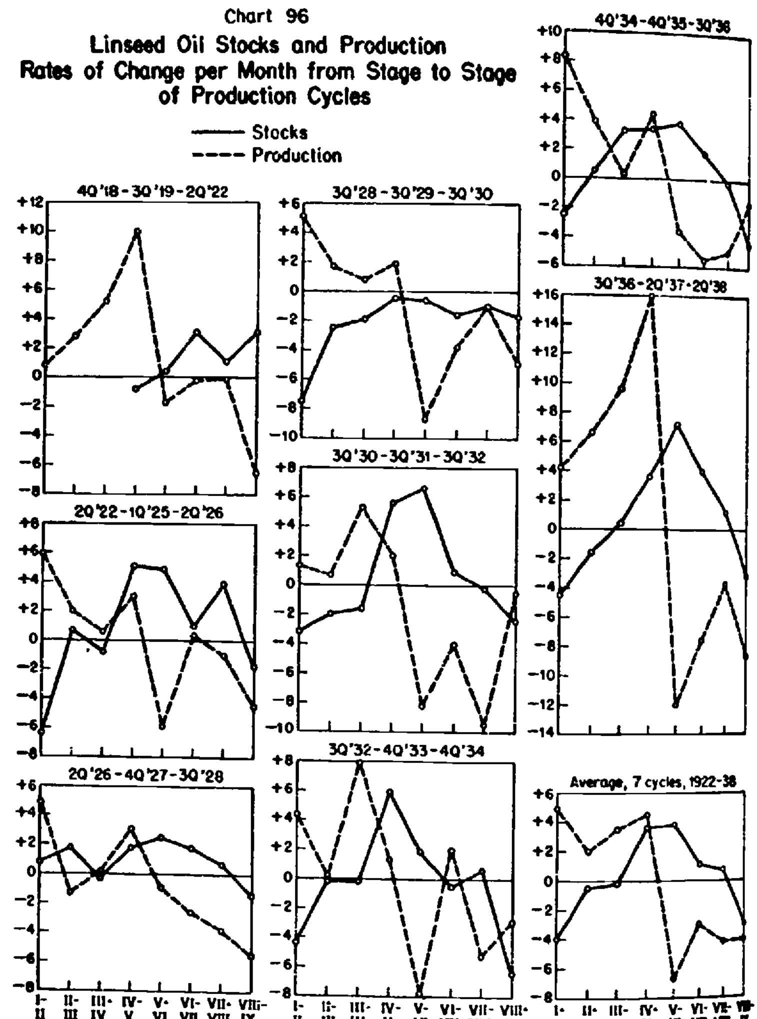


Chart 96
Linseed Oil Stocks and Production
Rates of Change per Month from Stage to Stage of Production Cycles

Vertical scale in cycle relatives.

seed crop. The result is that the production of linseed oil fluctuates in a double cycle: it expands and contracts in response to changes in the demand for linseed oil; and around these movements winds a shorter cycle of production that is governed by the size of the domestic flaxseed crop (Chart 53). Since the cycles of production identified by the National Bureau are chiefly of the second type, stocks of linseed conform positively to production cycles with a lag. The reason, of course, is that a contraction in oil production in response to a short flaxseed crop usually leaves output below shipments; stocks therefore fall. When production begins to recover (either because imports have been stimulated or a large crop has been harvested), some time passes before it rises above shipments. Stocks, therefore, do not begin to rise until some time after production has begun to increase. Similarly on the downturn: when production begins to fall, some time intervenes before it passes below the level of shipments.

So much for the relations among stocks, output, and shipments. The cyclical fluctuations in inventory investment are consistent with these conditions. Let us begin with investment during production cycles. Since these cycles, as identified by the National Bureau, are almost all engendered by changes in the supply of raw materials, output will tend to be most in excess of shipments when it is at a peak. The deficiency of output relative to shipments will tend to be largest when output is at a trough. Consequently, stocks will tend to increase most rapidly (or decline least rapidly) near the peak of a production cycle, and to decline most rapidly (or increase least rapidly) near the trough. These expectations are, of course, the same as those advanced in connection with the supply-dominated cycles of cottonseed oil output.

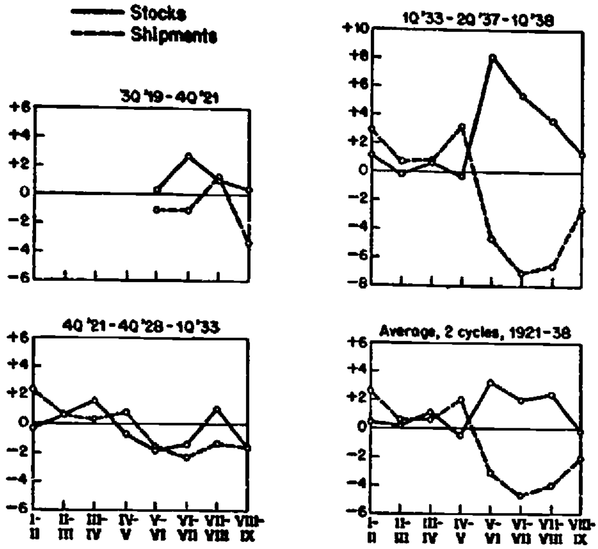
The behavior of the rates of change in linseed oil stocks during production cycles confirms these expectations (Chart 96). The rate of change in stocks reached a peak in the stage immediately preceding or immediately following the peak of the production cycle in 7 of the 8 cycles covered. It reached a trough also immediately before or after the trough of production in 7 cycles. The rate of change in output was much less regular—it reached peaks at various stages of expansion, and troughs at various stages of contraction. Generally speaking, however, as long as output was increasing (that is, as long as the rate of change in output was positive), the rate of change in stocks continued to rise. As long as output was declining, the rate of change in stocks continued to decline.

Since production does respond, though slowly, to fluctuations in demand, our theory calls for inventory investment to behave during shipments cycles like investment in stocks of goods made from nonagricultural materials: for such goods we found that when shipments rise, stocks begin to be liquidated. The rate of liquidation is usually high in the first part of expansions, sometimes increasing. Before the end of expansions, however, the increase in the rate of liquidation tends to level off. There was even evidence that toward the end of expansions, especially long expansions, it tended to diminish. With the onset of contraction, inventories began to be accumulated rapidly, but as contraction proceeded, the rate of accumulation tended to fall off, especially in long contractions.

If we allow for irregular movements in stocks connected with supply-dominated cycles in production, the behavior of investment in linseed oil stocks is consistent with these expectations (Chart 97). In the two relatively short contractions, 1919-21 and 1937-38, stocks at first accumulated rapidly but as the contraction in shipments proceeded, the accumulation became less rapid. At the beginning of the long expansion of 1921-28 stocks were being liquidated, but after 3 years production caught up with shipments, allowing stocks to begin to grow with the trend of activity in the industry. The ensuing long contraction of shipments opened with stocks declining instead of rising as they would ordinarily do when shipments decline, because the domestic flaxseed harvest fell sharply between the crop years 1929 and 1930. The output of linseed oil was, therefore, drastically curtailed. This fortuitous circumstance permitted the liquidation of stocks to begin early rather than late in this contraction. Finally, the long expansion starting in 1933 opened with stocks growing instead of declining. I attribute this to the speculative episode of 1933. Subsequently stocks moved irregulary because of fluctuations in the supply of flaxseed, but the general trend of inventory investment is fairly flat, which is more nearly in accord with our expectations in a long expansion than would have been a rapid and sustained liquidation of inventories.

Chart 97

Linseed Oil Stocks and Shipments
Rates of Change per Month from Stage to Stage
of Shipments Cycles



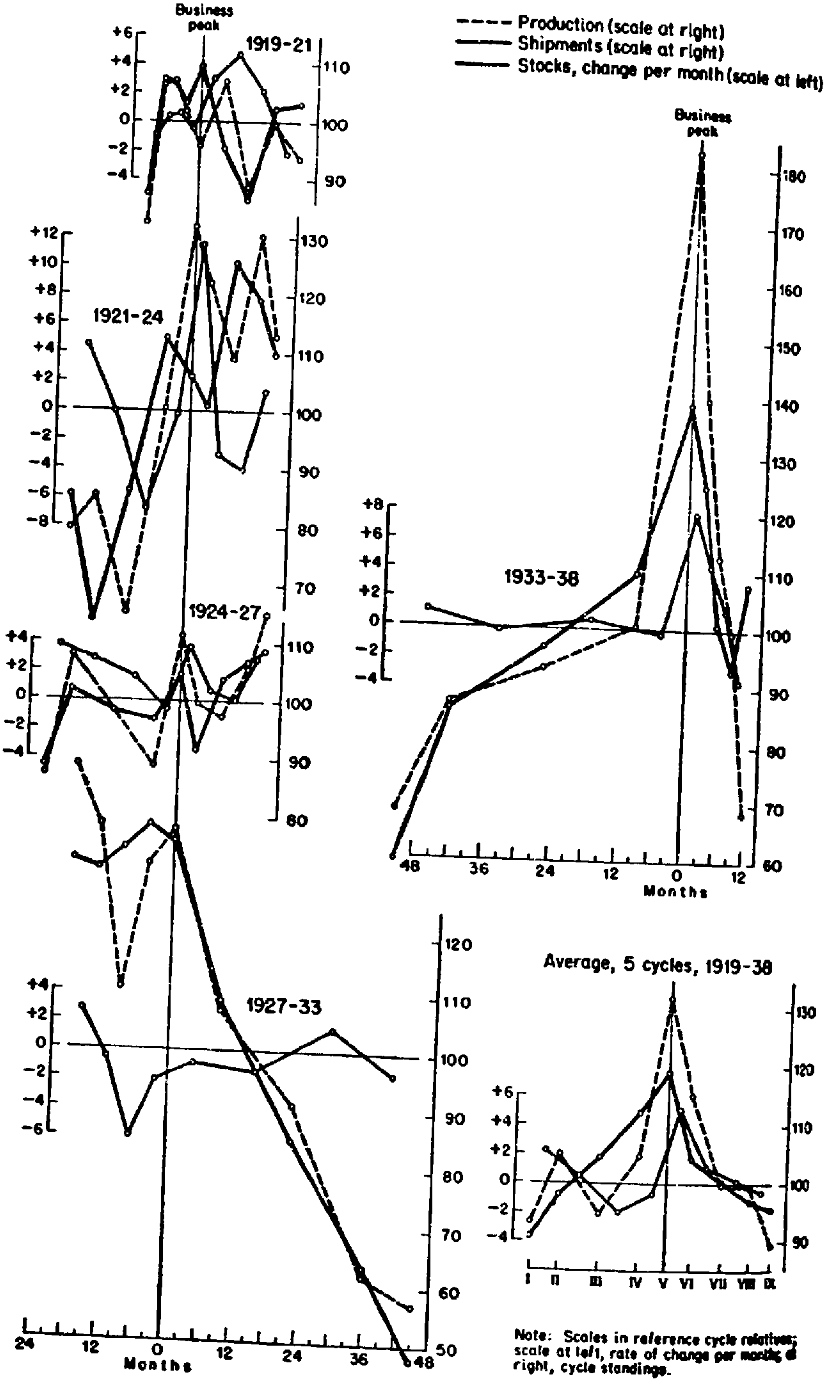
Vertical scale in cycle relatives.

The behavior of inventory investment during business cycles reflects these various influences from the side of demand for oil and the supply of basic materials. Shipments of linseed oil conformed to business cycles with fair regularity. They rose during all 5 expansions between 1919 and 1938; they fell in 3 out of 5 contractions; the rate of increase during expansions was uniformly higher than during neighboring contractions and lower during contractions than during neighboring expansions in three out of four instances. (The National Bureau conformity measure is +100, +20, +78.) In view of the tardy response of production to changes in shipments, it is not surprising to find the rate of change in stocks falling during at least the first part of expansions.[4] Chart 98 shows that this was true on the average and in 4 out of 5 individual expansions. With the onset of contraction, the rate of accumulation rose sharply partly because of the decline in shipments and partly because of the delayed reaction of production to the earlier rise of shipments during expansion. The rate of change in stocks rose at

[4] Either because the rate of accumulation is falling or the rate of liquidation rising.

Chart 98

Linseed Oil: Production, Shipments, and Rates of Change per Month in Stocks during Business Cycles



Note: Scales in reference cycle relatives; scale at left, rate of change per month; at right, cycle standings.

the beginning of contraction in all 5 cycles. It increased toward the end of expansion in 2 cycles and declined toward the end of contraction in 3 cycles.

All this is behavior similar to that characteristic of commodities made from nonagricultural materials. It bears out the argument with which this chapter began: a division of stocks of finished goods into those made from agricultural and nonagricultural materials does not satisfactorily separate goods whose production cycles are dominated by changes in the supply of materials from those whose production cycles respond chiefly to influences from the side of the demand for the finished commodity.

Tanners' stocks of finished cattle hide leather are an even better example of the same tendencies. Although the domestic supply of hides is only a minor byproduct of cattle slaughter, and consequently is insensitive to changes in the demand for leather, cycles in the production of leather are rather closely correlated with cycles in its use (Ch. 10 and 12). Discrepancies between the domestic supply of, and the requirements for, hides are largely offset by changes in imports and by drafts on, or additions to, stocks held by dealers and importers.

The connection between the output and use of leather is much closer than that between the output and shipments of linseed oil, as is indicated by comparing cycles in the production of leather and of shoes, which we take to represent the consumption of leather. For example, between 1923 and 1940 the National Bureau identified seven and one-half cycles in shoe output. It identified corresponding cycles in leather output in all except two cases. Even in these two there was a mild response of leather output, although the movements were not vigorous enough for cycle turns to be marked.[5] Another indication of the rather close connection between the two processes is the National Bureau index of the conformity of cycles in leather and shoe production: +100, +75, +100; and a third is the resemblance of their average cycle patterns (Chart 57). Since leather manufacturers can conduct their business on the same lines as fabricators using nonagricultural ma-

[5] This contrasts with the case of linseed oil. Between 1919 and 1938 there were only two and one-half cycles in shipments but seven and one-half cycles in production.

terials, we may expect cyclical movements of investment in leather stocks to resemble the behavior of investment in stocks of durable finished goods made from nonagricultural materials. The data bear out this expectation.

In earlier examples of durables made from agricultural materials—cottonseed oil, evaporated milk, even linseed oil—the difference between the behavior of inventory investment during cycles in production and in some index representing the utilization of the commodity was sharp. The relation between cycles in leather and in shoe production is so close that this difference is no longer found (Charts 99 and 100). As we have seen, cycles in the output of goods made from nonagricultural materials follow so closely on cycles in shipments that it seemed unnecessary to measure separately the behavior of stocks during cycles in these two types of process.[6]

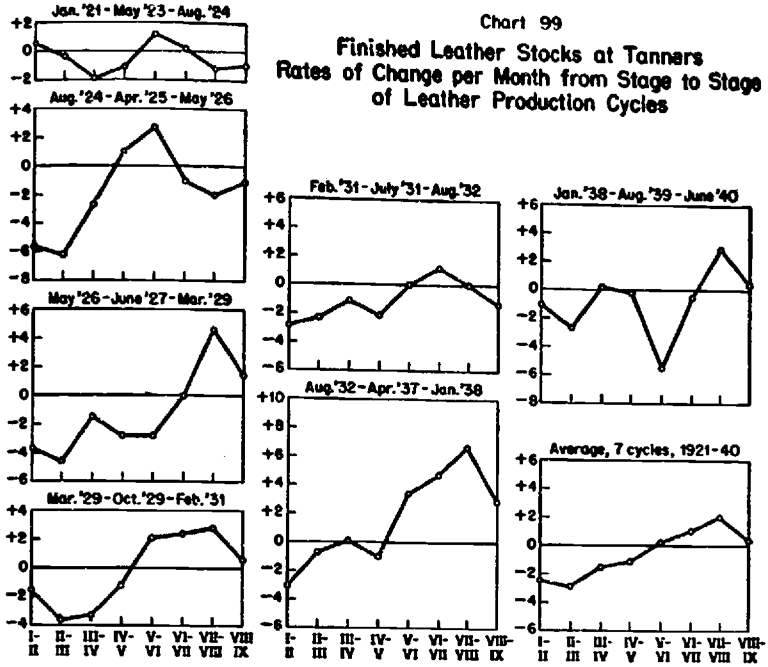
The pattern of investment in leather stocks resembles also the pattern of investment in stocks of finished durables made from nonagricultural materials. Whether we look at the rate of change in leather stocks during cycles in leather or in shoe production, stocks are either being liquidated at the beginning of expansion or, if they are being accumulated, the rate is low. The rate of liquidation tends to increase during the early part of expansion; later it tends either to level off or actually decline. With the onset of contraction, the rate first rises markedly, then tapers off as the contraction proceeds,[7] and when the next expansion begins it drops. All

[6] This is not to say that production and shipments cycles in this type of commodity are virtually identical. However, the peaks and troughs of production and shipments so nearly coincide that the cyclical pattern of stocks will look much the same whether we mark off cycles by turning points in shipments or in production.

[7] The tendency for the rate of liquidation of leather stocks to decline before the end of expansion and the rate of accumulation to decline before the end of contraction seems more pronounced during cycles in leather production than during cycles in shoe production. This may be a significant characteristic of investment in this commodity and perhaps generally. If, as we suppose, manufacturers at first adjust output tardily and incompletely to declines in demand and only later, under the pressure of accumulating stocks, reduce output more drastically, the gap between output and shipments would naturally be more nearly closed by the time output reaches a trough than it is when shipments do. In the present instance, taking shoe production as an index of leather shipments, this seems to be the case.

Chart 99

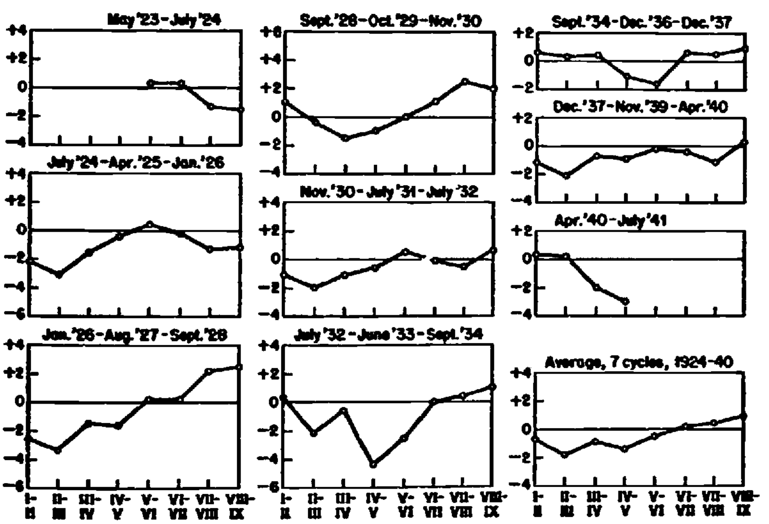
Finished Leather Stocks at Tanners
Rates of Change per Month from Stage to Stage of Leather Production Cycles



Vertical scale in cycle relatives.

Chart 100

Finished Leather Stocks at Tanners
Rates of Change per Month from Stage to Stage of Shoe Production Cycles

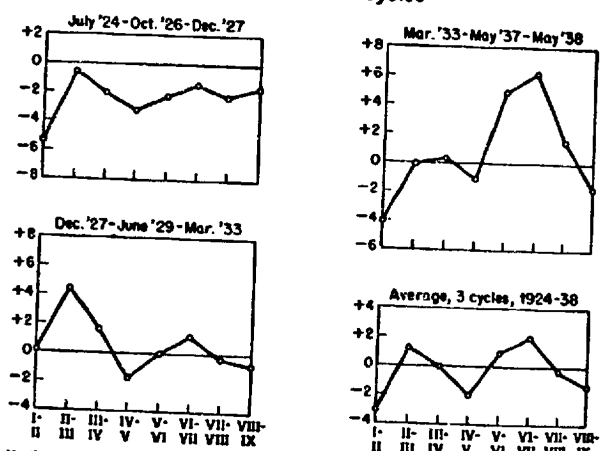


Vertical scale in cycle relatives.

this, of course, is behavior made familiar by the evidence on finished durables derived from nonagricultural materials surveyed in Chapter 18.

These marked similarities, however, are confined to investment during cycles in manufacturing activity (production or shipments). During business cycles, as Chart 101 indicates, the pattern of investment in leather stocks has not closely resembled that of investment in finished durables made from nonagricultural materials because the production and utilization of leather did not conform perfectly to the movements of general business. Although the index of business cycle conformity is high for both shoe and leather production,[8] many movements were not related to business cycles. Shoe production had 6 cycles in a period when there were only 3 business cycles. Leather production had 5 cycles in a period when there were 4 business cycles; more important, its peaks and troughs did not correspond closely with business peaks and troughs. The rather irregular pattern of investment in leather stocks during business cycles is a consequence.

Chart 101
Finished Leather Stocks at Tanners
Rates of Change per Month from Stage to Stage of Business Cycles



Vertical scale in cycle relatives.

[8] The conformity indexes for shoe production were +100, +50, +100 for three cycles, 1924-38; those for leather production were +50, +100, +100 for four cycles, 1921-38.

4 Conclusion

This analysis enables us to define the classes of finished goods made from agricultural materials that are significant for the cyclical behavior of inventory investment. The few commodities available for study precludes wholly persuasive empirical support for the conclusions below, but I think that the foregoing argument and review of evidence points to the following theory:

1) Stocks of finished goods made from agricultural materials do not constitute a homogeneous class of inventories. The crucial distinction turns on whether cycles in the production of a commodity are wholly, or almost wholly, governed by changes in the supply of materials. Three major conditions are required to bring about this result. One is that the output of materials fluctuates, at least in the short run, independently of the demand for fabricated goods. A second is that the materials should be drawn almost entirely from domestic sources. For if shortages or surpluses in domestic supplies can be counteracted by a fairly prompt variation in the rate of imports, the production of the fabricated product can be freed in large degree from the influence of domestic crop conditions. The third prerequisite is that the materials be difficult to store in crude form. When they are, the current supply must be promptly processed. On the other hand, if the crude materials can be stored, shortages in the current supply can be offset by drawing on stocks, and surpluses can be allowed to accumulate. If neither imports nor changes in stocks are available to offset shortages or surpluses in the domestic supply of crude materials, the rate of processing will necessarily be dominated by the domestic supply. But if either imports or stocks are available in requisite degree, fabrication can be substantially divorced from the vagaries of crops in this country and will tend to follow cycles in demand. Strictly speaking, only commodities that meet these conditions have supply-dominated production cycles and are the proper subject of this chapter. Others are better classed with the commodities studied in Chapter 18.

2) If cycles in the production of a fabricated commodity are supply-dominated, in the sense of this analysis, another distinction is important: is the product perishable or durable and staple? If perishable, it must be promptly marketed, that is, sales will be forced

to keep pace with production by appropriate changes in prices. Manufacturers will try to hold stocks at levels roughly proportionate to the current rate of output and sales, and inventory investment will tend to rise and fall with the rate of change in output. And since output under these conditions will tend to fluctuate in response to crop conditions, inventory investment during business cycles will tend to be irregular. The cold storage holdings of pork and lard are good examples.

3) If the finished product is durable and staple the outcome is different. Since production is supply-dominated, it will rise and fall with the supply of raw materials. But when it tends to outrun use, the goods need not be dumped on the market regardless of price, for they can be stored. If cycles in use are relatively independent of those in output—as they may be if use is not stimulated much by a low price or restricted by a high one—the result is simple. During cycles in the output of the finished good, the rate of inventory accumulation will tend to be highest at peaks in production, and the rate of liquidation highest at troughs in production. For if production and shipments are relatively independent, the excess of output over shipments will tend to be largest when output is at a peak. Hence the rate of growth of inventories will be highest at that time. Similarly, output will tend to be most deficient relative to shipments when it is at a trough. At such times, therefore, the rate of disinvestment in inventory will tend to be at a maximum. During cycles in use, on the contrary, the rate of inventory investment will tend to be highest at cyclical troughs and lowest at cyclical peaks. In short, inventory investment will tend to conform inversely to cycles in shipments. The reasons are parallel. If cycles in shipments proceed independently of those in production, shipments will tend to be most in excess of production when they are at a peak; they will run short of production most when they are at a trough. Moreover, if shipments conform to business cycles, as they should do generally since they are determined by demand, inventory investment too will tend to conform inversely to cycles in business at large. This, however, will be only a tendency. Since the rate of accumulation of stocks is strongly influenced also by fluctuations in production, which itself is dominated by the supply of materials, the behavior of inventory invest-

ment during any given business cycle will depend in large part on the vagaries of crops.

If the use of a commodity is sensitive to price, it will tend to rise and fall with output as well as in response to influences from the side of demand. For the price of a commodity whose output is supply-dominated will tend to vary inversely to output; e.g., cottonseed oil. Under such conditions, inventory investment presumably depends in part upon speculative considerations. Inventory holders need not absorb any difference between current output and use. They may accept lower prices and dispose of a bigger volume. Businessmen will, no doubt, be encouraged to hold larger stocks the lower the price; for other things being equal, the lower the price the better the chance that future prices will be higher. But even if one could validly assume that the price level determined the level of stocks, we would still not know when stocks would be accumulated most rapidly. The cyclical behavior of the rate of accumulation can be established only by observation.

In this connection, refined cottonseed oil and evaporated milk are instructive. The pace of accumulation tended to be highest at the peak of output cycles, lowest at output troughs. During business cycles inventory accumulation also tended to vary with the level of output, and since output acted irregularly, inventory investment did too.

4) So much for supply-dominated commodities. The fabrication of agricultural materials may, however, be so divorced from the current domestic supply that it will respond primarily to changes in demand. In the terminology of this chapter, production may be demand-dominated. Inventory investment may then be expected to behave in the fashion described in Chapter 19. If the product is durable and staple, inventories normally begin to be liquidated soon after the upturn of business. The rate of liquidation tends to accelerate in the first part of expansion, then be constant or retard in the second half. With the beginning of contraction, liquidation falls sharply and accumulation soon begins. At first stocks pile up at an increasing rate, but in the second half of contraction, the rate of accumulation tends to level off, even to decline. As might be expected, the tendency for the rate of liquidation to decline in the second half of expansion and for the rate of accumulation to de-

cline in the second half of contraction is more pronounced in long than in short phases, because after liquidation has proceeded for some time, stocks become inconveniently low and the pressure to halt the liquidation becomes more intense. If the expansion continues long enough, production is finally raised above the level of shipments and stocks begin to accumulate. Similarly during contractions: when the accumulation of stocks has proceeded for some time stocks become intolerably large, the pressure to halt accumulation becomes more intense, and if the process continues long enough, production is drastically cut and the liquidation of stocks begins. Finished leather is a good example of a commodity made of an agricultural material in which inventory investment acts in this way. To a lesser degree the same conditions seem to have controlled investment in linseed oil stocks.

5) Demand-dominated commodities will act in this fashion only if the finished product is durable. If the product is perishable, it is hardly plausible that manufacturers would tolerate the accumulation of surplus stocks for a long period when business is declining. In that event, though short lags are probably inevitable, we must expect firms to try to keep stocks of finished goods in close alignment with sales. Inventory investment would then tend to vary with the rate of change in output and sales, though probably with a short lag. The behavior of the rate of change in manufacturing production in general was described in Chapter 15. If we may attribute to perishable manufactures of agricultural origin the behavior found characteristic of manufactured goods in general, we may conclude that the rate of change in their output will usually reach a peak before the peak in business and a trough before the trough of business (Ch. 15). The length of the lead, however, appears to have been irregular. A similar uncertainty, therefore, affects the timing of inventory investment in this class of stocks. And if, as may be true, stocks tend to lag behind output by some brief, but so far unknown, interval, the timing of turns in inventory investment will be affected by another element of uncertainty. Perhaps the most definite statement that can be made now is that inventory investment in this category will tend to reach its peaks during business expansions and its troughs during business contractions and that the lead of its peaks and troughs relative to

business cycle turns will not be longer, and will probably be shorter, than that of the rate of change in output. This rule is, of course, similar to that proposed in Chapter 17 for investment in raw materials. Our collection includes only one example of a commodity whose output responds to short-run changes in demand and that is perishable in finished form: cured and frozen beef.

The size of all these classes of inventories is not exactly determinable. Something can, however, be said about the quantity of finished goods held by industries whose production cycles are demand- and supply-dominated, respectively. As pointed out in Chapter 12 and Appendix E, it seems highly likely that products made from cotton, silk, hides, and rubber, all of which can be and are stored in large quantities in crude form, have production cycles of the type we have called demand-dominated. The output of products made from these materials generally rises and falls with business activity. Stocks of finished goods made from these materials were estimated (App. E) to have had a value of about $560 million at the end of 1939, accounting for 14 percent of all finished goods. Moreover, the majority are undoubtedly durable and staple. Thus the major fraction of this portion of finished goods should, as far as its behavior characteristics go, be added to the durable staples made from nonagricultural materials treated in Chapter 18.

Other finished goods made from agricultural materials had a value at the end of 1939 of about $800 million, accounting for about 20 percent of all finished goods. Not all, however, have supply-dominated production cycles. Grains, for example, may be economically stored for long periods and it seems likely, therefore, that cycles in the production of food products made from grains are not controlled principally by grain crops. As we have seen, the same is true of cattle slaughter and the output of cured and frozen beef. It appears, therefore, that the stocks of finished goods with supply-dominated production cycles may amount to no more than 20 percent of all finished goods and perhaps to as little as 15 percent. Only 6-8 percent of manufacturers' stocks, therefore, may be presumed to exhibit the irregular cycles of inventory investment that seem to be characteristic of commodities whose production cycles are controlled by the supply of materials.