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Chapter Title: Fluctuation in Ownershzp and Inventory Models

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11. *Fluctuation in Ownership and Inventory Models*

The first of the two previous chapters concentrated on empirical evidence of the need to keep stocks aligned with sales, and the second on evidence of the need to time purchasing with an eye to conditions in the materials markets. This segmented approach, which in even more exaggerated form has characterized all of the empirical work in this book, must now be abandoned.

I want instead to attempt to read the data in the context of all of the factors that potentially influence stocks and their interrelationships. Also I want to project the implications of the procedures, which result in positive and negative inventory investment, in terms of their impact on the relation between selling and materials buying (a question that has occupied parts of Chapters 7 and 8). Integrated with the analysis of stocks and total ownership, this will afford a comparison between the findings of this study and other analyses of the amplifying and accelerating attributes of inventory investment. I find that when the several aspects of a model are specified for department stores, on the one hand, and durable goods manufacturers on the other hand, the amplifying and accelerating processes that result are rather different for the two sorts of enterprise.

TWO CONCEPTUAL PROBLEMS

The two objectives of this chapter each raise a conceptual problem that requires a moment's analysis. First, to examine the interrelationship of all of the factors that influence stocks, it is necessary to define and somehow cope with the failure to meet objectives and its manifestation—unintended stocks. Second, to analyze the relation between selling and buying, it is necessary to define selling: does it take place when sales orders are written or when the goods are shipped to customers?

Error and Inventory Objectives

The interrelations between the two influences on inventory fluctuation which the figures have highlighted, the sales link and market conditions, must be affected by any other influence that bears on the ownership of materials. Many of these have remained invisible in the data. They include a wide variety of opportunity costs, such as that of flexible production schedules, selling effort, and the executive time and other costs of formulating and enforcing precise inventory objectives.

But they also include downright error in the sense of more or less clearly formulated inventory objectives which are not met. The recognized error and resulting unintended inventory investment must be corrected in some way. Desired stocks are necessarily defined in terms of *future* demands, market expectations, and other factors; this implies predictions, and predictions are seldom accurate. Even when correction is firmly intended, it may take time to achieve; unintended or error

stocks exist until the correction is effected.

The size of potential error depends on several matters—how well the target information can be predicted; the quality of the information system; the length of time between the target date and the time, in advance of that date, when action directed toward an achievement of intentions must be taken; the level of discipline in the organization; the possibility of piecemeal progressive correction.

If study focuses on stock on hand, error can be exceedingly troublesome. Its detection implies a virtually complete knowledge of intended inventory change, of the character of forecast, and of the machinery whereby objectives are acted upon. Yet without this information it is very difficult indeed to use empirical data to suggest what businessmen are trying to do and why; since they do not succeed in doing it, the data do not reveal it. The distributed-lag notion that has been used in econometric analysis tries to circumvent the difficulty. But, as suggested in Chapter 1, when calculations indicate that an inventory objective, as defined, is only half achieved in the course of the year, the dodge does not seem very effective.

Eventually it should be possible to learn enough to fill in more of the information that is essential to describing the path whereby action moves toward specifying and achieving inventory intention in various sorts of business enterprises. But in the meantime there is, I think, a different way around the difficulty. It is, of course, as indicated at the outset of this study, to include stocks on order as well as on hand.

If ownership turns out to be different than presently desired, the difference can be reversed. Desired ownership is partly defined by a set of desired relationships to a number of variables—sales, costs, and so on. Prediction of the ownership that will be optimal in the future implies a prediction of how the relevant variables will behave. Errors in these guesses are one source of discrepancy between actual and desired ownership. Difference may also result from a change in the relationship that is desired. But whatever the reason, new orders can correct promptly if the error is recognized and if it is deemed worthwhile to reverse it. Changes in the price of finished goods, sales pressure, and a number of other strategies may be brought into play. But certainly a most usual and important strategy is to modify the volume of new orders.

For errors of underestimation the correction can be virtually immediate; all that is required is an increase in new orders for materials. For errors of overestimation, correction may take a bit more time, since particular items may be overstocked by more than feasible reduction in new orders can immediately reverse. Even cancellation of orders may be unable to achieve the objective.

Of course the correction that orders effect may be less than optimal. Its first impact is on stock on order whereas one might prefer to change the amount of stocks actually on hand or, for that matter, in the process of production or finished. But as a rough approximation the level of total materials ownership may be regarded as hovering not too far from the desired level, if not month by month at least quarter by quarter.

Accordingly I make the assumption that unintended or "error stocks," in the restricted sense in which I have defined them, are sufficiently unimportant to neglect in statistics on materials ownership. The assumption relieves me of the embarrassing necessity of constructing a model which I do not know how to construct—one dealing with a detailed set of objectives, a time path of expectations and a time path of actions overlaid on one another as relevant information is generated.

However, and this is an important qualification, error of a more passive sort may be both present and large. I refer to ownership which on the one hand is different from what would presently be deemed ideal, but which on the other hand is not subject to explicit and high-priority correction. In other words, if the calculation is made, and it may not be made

except as a visceral judgment, the opportunity costs of the sequence of procedures that would recognize and keep the error in check are too high. This passive unintended stock both on hand and on order is a no-man's land between stocks that conform to some formulated intention and stocks whose failure so to conform is, under the circumstances, worth the opportunity costs of identification and swift correction.

Orders and Shipments

The orientation of this study toward including materials stocks on order as well as those on hand was based on the belief that a basic aspect of management conceptualization and behavior was thereby duplicated. Procurement is oriented in terms of buying, which implicitly if not explicitly affects stock on hand as well as on order. Thus far I have largely ignored the question of whether there is a counterpart at the selling end of the business. The counterpart would assert that the basic conception of "demand" to which the sales-linked stock objective (or indeed any other stock objective) responded consisted of customers' orders rather than of shipments to customers (or production). Certainly this is a possibility that must be considered. My general conclusion is that it is more realistic to keep consideration of the stock-flow alignments focused on shipments, and to deal with the further impact of new sales orders in terms of the way in which they diverge from shipments; specifically, to deal with them in terms of the rate of change in unfilled orders, commonly called back orders or order backlogs.

This question has no operational implications in connection with the department store data, since customers' orders and sales are virtually identical. But in connection with the data for durable goods manufacturing, the difference can be quite significant and therefore it will be useful to take the detour necessary to spell out the whys and wherefores.

The basic reason is simply that there are costs associated with holding goods. Ideally, therefore, materials should be acquired just soon enough for them to arrive, with an acceptable likelihood and at an acceptable acquisition cost at the shipment (or processing) station at just the time when the work is scheduled to be performed. The time at which customers order an article is related to these scheduled times, but the relationship differs under at least four circumstances that need to be distinguished.

Variant 1. When the time between the writing of an order and the time when production of them must begin is long. The disparity can be due to delay in starting production because of backlogs already on the books. Or many months may be required actually to produce articles, and a scheduled flow of materials may be required throughout the processing period. Under either circumstance the efficient servicing of sales, other things the same, does not require that materials orders parallel sales orders; it requires rather that materials are ordered just on time to arrive with acceptable probability and at acceptable ordering costs at each production station as needed for production to get under way. However, as we have rehearsed all too often, many factors other than sales can influence procurement policy and argue in favor of buying before the efficient dates.

A firm order for the final product largely removes one set of risks which would otherwise attend advance acquisition—the risk of obsolescence, that is, of having purchased materials that will not be needed. Thus a backlog of sales orders provides a period of option during which materials can be bought ahead if it is judged desirable to do so at what is in effect a lower cost than if the backlog were not present.

Variant 2. When the purchasing may in large part be linked to a particular order as for variant 1, but the interval between the writing of an order and the start of produc-

tion is short. In this case, materials purchasing and sales orders may have a systematic relationship, with orders leading by short intervals. The order in effect foretells shipment of the finished goods by the length of the production period, and helps thereby to effectuate sales-linked inventory objectives. Materials which are ordered at the time the sales order is written may arrive in time to be used in its fabrication, and if not they will at least replace the units of stock which were actually used.

Variant 3. When sales are customarily made from stock. This means that there is no necessary tie between a particular sale and a particular purchase of materials. Procurement is geared to the necessities of efficient production, efficient stock management, and expected shipments. In this case, then, sales orders and shipments of the company's product are virtually identical.

Variant 4. When only some sales are made from stock and some or all of such sales consist of goods that the purchaser orders to fill in depleted stocks. This portion of total sales may have a tendency to reach highs and lows ahead of the bulk of all other sales orders.[1] The pattern of these fill-in orders may forecast changes in total sales orders or shipments in the near future and thus serve to guide procurement toward realizing its inventory objective. But here the distinction is not between orders and shipments; it is between some portion of orders which are virtually identical to the same portion of shipments and different from the rest of orders, which in turn may be identical to shipments (variant 3) or different in one of the two ways described as variant 1 or 2.

In variants 1 and 2 there can be differences between the time pattern of sales orders and shipments. For one thing, it is the pattern of shipments or, more particularly, production starts and other production stages that sets the requirements for materials that are needed to achieve physical efficiency in processing and shipments, other things the same. Second, variants 1 and 2 provide a good forecasting technique which makes it possible to enforce whatever shipments or production-linked inventory objectives may be held. In connection particularly with variant 1, though sometimes also with variant 2, advance knowledge of requirements reduces the risk and therefore the cost of altering the timing of buying with a view to future prices or market conditions—at least the wrong items will not be bought. Indeed it may be risky not to buy ahead in order to "fix materials prices" to correspond with the cost of materials as figured in the selling price.

In variants 3 and 4, orders and shipments are identical, but in the case of variant 4 one part of either shipments or orders can serve the function of aiding to forecast shipments and thereby to enforce a stock objective.

These observations imply the way in which demand should be conceptualized as it moves backward through a firm from its customers to its suppliers. The demand from the customer is best viewed in the first instance as shipments (or, where the data are available, as demand for materials at various critical stations such as the start of or other points in the process of production). Demand so defined gives rise to inventory objectives for goods both on hand and on order, and is therefore both directly and indirectly a basic determinant of the orders placed with suppliers. However, the pattern of sales orders can have an important further bearing on materials orders. For one thing, it can, via its role as a forecast of shipments, make it possible to enforce inventory objectives. Second, insofar as shipments and new sales orders differ, this difference is identified by the rate of change in

[1] The reason for the lead is not material to the argument. It is implicit, I believe, in the tendency for forecasts to be based on current sales and for these forecasts to be the basis for advance orders. The advance orders will then be in error by the amount that sales have changed. These rates of change in sales tend to lead sales proper. (See R. P. Mack, *Consumption and Business Fluctuation*, pp. 105 and 243.)

back orders. The level of these back orders, and perhaps their rate of change, influences some of the cost of alternative materials purchasing and inventory schemes, and is therefore important to purchasing and inventory policy.

DEPARTMENT STORES

For department stores the data fall neatly into the ideal conceptual framework. Customers' orders are identical for all intents and purposes to department store sales and therefore unfilled sales orders are negligible. All inventory on hand and on order is presumably covered by the two sets of statistics. Orders placed for materials cover orders for all of the merchandise sold.

Dynamics of the Sales-Stock Link

The link of ownership to sales has appeared to be firm and relatively precise according to the picture presented in Chapter 9 and elsewhere. It is evidenced both by a marked parallelism between sales and ownership proper and also, a more sensitive test, between rates of change in the two series. The latter association is shown in curves 2 and 3 of Chart 15. Table 40, line 4, gives the individual timing comparisons. Seven of the twelve matched turns are virtually synchronous—within one month of one another—and only two differ by more than three months. Eighty-four per cent of the months are in like phase on a synchronous basis. To explain the association, the merchant may be pictured as judging whether and about how fast sales have been increasing (or decreasing) over the past few months and whether they are likely to in the immediate future. He then adjusts his buildup in stocks on hand and on order in an appropriate fashion.[2] If sales are expected to be higher by a given amount than at some reference date, stocks should also be higher by at least as much plus whatever stock cushion is needed and likewise if sales are lower. The adjustment consists of additions to and subtractions from new orders which would otherwise have been placed. (I am ignoring other adjustments, such as markdowns, which are also used.) The pattern of the adjustment would be that of the rate of change in sales, and its volume would depend on the character of the ownership-sales objective.

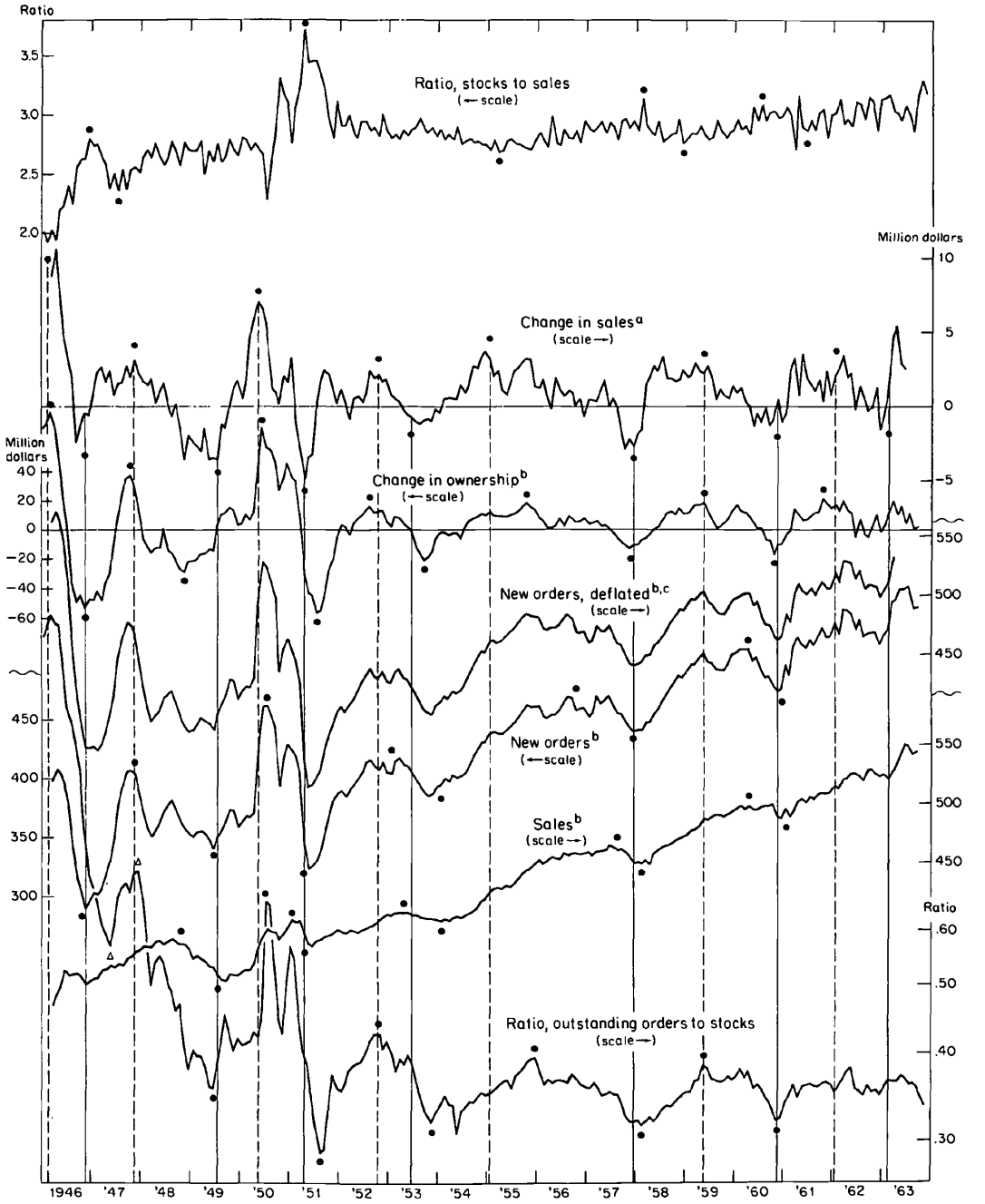
In actual practice, provisions are likely to have a shingled pattern. Advance orders are placed for some fraction of the expected season's requirements; expectations are based on corresponding periods of the previous year adjusted for special sales, weather, and other elements affecting last year's figure, and for trends over the intervening months. The adjustment can, in effect, mean that forecasts are virtually based on deseasonalized sales of previous months. Fill-in orders, placed as close to the time when they will be needed as speed of delivery permits, reflect more recent sales history. At-once orders, for immediate delivery, may provide a further form of adjustment. Both fill-in and at-once orders will reflect rates of change in sales, assuming that current or previous sales provide a common denominator of forecasting procedures.[3]

[2] The actual judgment is likely to compare the rate at which sales are "going ahead" relative to the corresponding months of the previous year; an ad hoc judgment may be made as to how appropriate the base months are. I have computed this set of ratios (using seasonally adjusted data, which are not appropriate), and differenced them, but they appear to be less well correlated with change in ownership than the moving average of recent change. This could mean that the ad hoc judgments which are made to adjust the formal calculations for recognized abnormalities are of some importance.

[3] The basis of these generalizations were discussed in connection with shoe retailing in my *Consumption and Business Fluctuations,* pp. 95–112. The sales-linked portion of buying was called "stable-market orders." For department stores as a whole, buying procedures were discussed in Ruth P. Mack and Victor Zarnowitz,

CHART 15

Changes in Sales Compared with Selected Series, Department Stores, 1946–63



Note: Vertical dashed and solid lines mark, respectively, peaks and troughs in change in sales. [a] Five-month average of five-month average; turns marked in the original five-month average prior to second smoothing. [b] Five-month centered moving averages; turns marked in underlying monthly data except for change in ownership. [c] New orders deflated by retail price index of commodities other than foods and autos, 1957–59 = 100.

TABLE 40

Timing: Change in Sales, Ownership, and New Orders, Department Stores, 1946–1962

Line	Reference Series[c]	Section A: Months Lead (-) or Lag (+) for Matched Turns[a] Chronology[b]											
		P	T	P	T	P	T	P	T	P	T	P	T
		1947	1947	1948	1949	1951	1952	1953	1954	1957	1958	1960	1961
	Specific Series: Change in Sales												
1	Subcycles	-11[r]	-8[r]	-12	-3	-9	-14	-9[r]	-14[r]	-30	-4	-12	-3
2	Ratio stocks to sales	-10[r]	-8[r]	ß	ß	-11	ß	ß	-21	-37	-12	-14	-7
3	Change in stocks, inverse	+6	+6	+19	+11	+6	+13	+7	+14	+24	+15	+8	+13
4	Change in ownership	-1	0	+1	+8	-1	-3	+2	-3	-9	+1	0	+1
5	New orders	-3	+1	0	+1	-2	0	-3	-7	-21	0	-11	-1
5a	New orders, trend corrected	-3	0	0	+1	-2	0	+1	-7	-10	0	-1	-1
6	Change in stocks	-3	-6	-1	+1	-5	-5	-1	-5	-11	-2	-10	-1
7	R: stocks to sales, inverse	-1	+4	ß	ß	0	ß	ß	-2	-2	+5	+4	+7
8	R: outstanding orders to stocks	-1	-6	-1	+1	-1	-4	0	-5	-11	-2	0	0
	Specific Series: New Orders												
9	Subcycles	-8[r]	-8[r]	-12	-4	-7	-14	-6	-7	-9	-4	-1	-2
10	Change in ownership	+2	0	+1	+7	+1	-3	+5	+4	+12	+1	+11	+2
11	Receipts	-2	-7	-2	-1	-6	-5	0	0	-6	0	0	0
12	D.I. vendor performance	ß	-6	-1	+3	-2	-11	+6	+1	+12	0	+6[r]	+9[r]
13	Sales	ß	ß	-11	-1	-6	0	-4	0	-10	-2	0	-1
13a	Change in sales	+3	-1	0	-1	+2	0	+3	+7	+21	0	+11	+1
	Specific Series: Change in Ownership												
14	Vendor performance	ß	-6	-2	-4	-3	-8	+1	-3	0	-1	-5	+7
	Specific Series: Ratio Outstanding Orders to Stocks												
15	Change in stocks	-2	0	0	0	-3	-1	-1	0	0	0	-10	-1

(continued)

TABLE 40 (concluded)

Line	Reference Series[c]	Section B: Average Timing of Turns — Number Matched (−)	(+)	(0)	Median[e] P	Median[e] T	Median[e] All	Average Deviation[f] P	Average Deviation[f] T	Average Deviation[f] All Turns Wt'd	Section C: Percentage of Months in Like Phase[d] — Timing Adjustment[g]	% Mos. 7/46–12/61	% Mos. 1/48–12/61
	Specific Series: Change in Sales												
1	Subcycles	12	0	0	-11.5	-6.0	-10.0	4.2	4.3	4.8	4.2	-9,-10,-11	69	67
2	Ratio stocks to sales	8	0	0	-12.5	-10.0	-11.5	7.2	4.5	6.0	5.9	-11,-12	52	53
3	Change in stocks inverse	0	12	0	+7.5	+13.0	+12.0	5.3	2.0	4.5	3.7	+12,+13	68	71
4	Change in ownership	5	5	2	-0.5	+0.5	0	2.3	2.7	2.5	2.5	0	84	83
5	New orders	7	3	2	-3.0	0	-1.5	5.0	1.7	4.0	3.3	-1,-2	74	74
5a	New orders, trend corrected	6	2	4	-1.5	0	-0.5	2.5	1.5	2.2	2.0	-1,0	85	86
6	Change stocks	1	11	0	-4.0	-3.5	-4.0	3.5	2.3	2.9	2.9	-2 to -5	81	81
7	R: stocks to sales, inverse	3	4	1	-0.5	+4.5	+2.0	1.5	2.5	3.0	2.0	0,+2,+4	77	77
8	R: outstanding orders to stocks	8	1	3	-1.0	-3.0	-1.0	2.0	2.3	2.3	2.2	-1	85	86
	Specific Series: New Orders													
9	Subcycles	12	0	0	-7.5	-5.5	-7.0	2.5	3.2	2.8	2.8	-7	81	81
10	Change in ownership	1	10	1	+3.5	+1.5	+2.0	4.0	2.5	3.2	3.2	+2	79	79
11	Receipts	7	0	5	-2.0	-0.5	-1.5	2.0	2.2	2.2	2.1	-1,-2	86	88
12	D. I. vendor performance	4	6	1	+3.7	+0.5	+1.3	4.6	5.2	5.2	4.9	+1	69	72
13	Sales	7	0	3	-6.7	-0.7	-1.5	3.5	0.7	3.1	3.1	-1,-2	82	82
13a	Change in sales	7	3	2	-3.0	0	-1.5	5.0	1.7	4.0	3.3	-1,-2	74	74
	Specific Series: Change in Ownership													
14	Vendor performance	8	2	1	-1.7	-3.5	-2.7	1.9	3.5	2.8	2.8	-3	83	84
	Specific Series: Ratio Outstanding Orders to Stocks													
15	Change in stocks,	6	0	6	-1.5	0	-0.5	2.3	0.3	1.5	1.3	-1,0	91	91

Notes to Table 40

[a]Specific series are matched with the indicated reference series (see note c) in accordance with the standard NBER rules. A double relaxation of rules is marked r; it applies to cases for well-conforming series in which two like turns are matched, though an unlike turn lies between them. The figure is underlined when subcycle chronology is the reference series, a minor cycle in the specific series has entered a comparison; or, when two individual series are compared, a minor cycle in either series has entered a comparison. When the business cycle chronology provides the reference, minor specific cycle turns are ignored. The meaning of other symbols is:

⊕ turn in the reference series does not appear in the specific series.

♋ turn in the specific series does not appear in the reference series.

⊙ there is no turn in either series in the neighborhood of the chronology date.

[b]Chronology dates are years when business cycle turns occur. They indicate the sequence and approximate time when the specific turns occur for which timing comparisons are given.

[c]Reference series are the series whose specific cycles plus minor cycles constitute the reference dates with which matching cycles in the specific series are compared.

[d]The number of months during which the specific series is in like phase with the reference series is expressed as a percentage of the total number of months covered between dates as given.

[e]Median is the average timing of the center two or three turns.

[f]Average deviation from the median. The "weighted" (wt'd) average is the deviation from the median for peaks and for troughs separately, weighted by the number of turns.

[g]In determining months in like phase a timing adjustment is made which maximizes confluence. Before counting the months in phase, the specific series is in effect moved to the right to allow for a lead and to the left to allow for a lag if by so doing the percentage of months in like phase (as rounded) is increased. If the months in phase are as large or larger without an adjustment, this is indicated by a "timing adjustment" of 0.

In some cases we wish to know the percentage of months in phase on a synchronous basis, regardless of whether the percentage in phase is thereby maximized. If so, the "timing adjustment" is given as "none."

The fact that there is no systematic lag in change in ownership suggests that errors can be corrected within the month, either by at-once delivery of merchandise or by increasing or decreasing new orders relative to what they would otherwise have been. The responsibility of outstandings in effectuating intentions is suggested by the behavior of the ratio of stocks on order to stocks on hand; the ratio constitutes the bottom line in Chart 15. By and large, outstandings become relatively larger when rates of change in sales are in rising phase—that is, when a decline slows or a rise accelerates—and outstandings become relatively smaller when a rise slows and a decline accelerates. In line 8 of Table 40 a comparison of change in sales and the outstandings-stock ratio reveals 85 per cent of months are in like phase after allowing for a one month's

"Cause and Consequence of Changes in Retailers' Buying," *American Economic Review,* March 1958, pp. 19–32. The formula used to represent the two portions of stable-market orders, advance buying and corrective orders, followed the general notions discussed in the text above.

Closely similar ideas are described in Richard M. Cyert and James G. March, *A Behavioral Theory of the Firm,* Englewood Cliffs, N.J., 1963. They made an intensive study of a department in a large retail department store and a less extensive study of about a dozen others. They believe that the decision process they report "could be generalized with trivial changes to other departments in the same merchandizing group and could be generalized with relatively modest changes to most other departments outside the immediate group" (p. 129). They distinguish between advance orders and reorders. Advance orders consist of some percentage of the sales of the corresponding period of the previous year; reorders represent the rest of the last year's total plus "minimum amount of stock desired at all times" minus stock presently at hand "including stock ordered." Reorders cover the period that represents the minimum time that suppliers require to make deliveries.

lead of change in sales; twelve turns are matched, eight of which are within plus or minus two months of one another.

Though outstandings move sooner and more agilely than do stocks, it is notable that at least the rate of change in stocks is subject to a similarly rapid response. We noted this in the sharp parallelism between outstandings proper and the rate of change in stocks. It is visible here in the higher degree of correspondence between the rate of change in stocks and the outstandings-stock ratio (note that stocks proper are the denominator of the ratio): 91 per cent of the months are in like phase on a synchronous basis (Table 40, line 15).

These strong empirical associations seem to reflect what I have termed the shingled pattern of ordering. If current sales have been underestimated, retailers do two sorts of things: (1) They increase orders for at-once delivery; since these orders represent only a small part of total stocks (which in the aggregate are influenced by the level of sales), the influx of at-once orders influences primarily the rate at which stocks change. (2) They increase orders for longer term; since the base level of outstandings is relatively small, and the correction may be applied to requirements for several future months, the influx is likely to represent a sufficient portion of the total to determine its level rather than simply its rate of change.

If current sales have been overestimated, again, orders for both immediate and advance delivery will be affected. At-once orders will not need to cover shortages, and the usual complement of things that are better bought after all the news is in may tend to be smaller. Mark downs may help to turn stocks. The advance preseason orders will have covered a large enough portion of the season's requirements so that orders of intermediate term can be relatively low. Indeed, any excuse to cancel orders may be grasped. In addition, current buying for the *next* season may be more conservative.

These manifestations of effective effort to keep rates of change in sales and in ownership moving together seem to reflect the importance to successful retail store operation of precise inventory objectives enforced with determination.

Other Influences

But the association of ownership and sales that aggregate figures show differs in an important respect from what a simple physically efficient association with sales, other things the same, would imply: The adjustment is too large. Toward the end of Chapter 9 we tried to say how much too large changes in ownership may have been. The estimates were based on alternative assumptions about physically efficient ownership-sales relationships.

On the average, department store ownership equaled about four months' sales. Yet the increase and decrease in ownership during its specific cycle movements average 6¼ times the specific cycle increase and decrease in sales. Obviously change was more than proportional. Had it remained proportional at a hand-to-mouth level, cyclical fluctuation in ownership would have been 3¼ times that of sales. But the study of the purposes that stocks serve suggests that the efficient sales link tends to imply constant incremental rather than average relations at least in the short run. An incremental association of 2 would have meant, of course, that ownership rose and fell during cyclical phases just twice as much as did sales (a trifle more when buffer stock is allowed for).

An alternative way of expressing the problem the figures pose is to note that a constant average ratio, at hand-to-mouth levels, would have explained only about 70 per cent of actual change in ownership even if we assume that all specific change in ownership was somehow caused by the corresponding specific cycles in sales (Table 33, line 10a). If the incremental rather than average association had been the effective sales link, only 38 per cent

of all change would have been attributable to cyclical changes in consumer demand (line 10c) even at the liberal incremental ratio of 2.

How can the rest of the fluctuation in ownership be accounted for? One possibility would be that it is unintended, though there is little reason to suppose that ownership (as distinguished from stocks on hand) would need to be seriously out of line for long. That it is not unintended in the sense that it moves up when sales move down or vice versa was indicated by the substantial confluence of the two series. Indeed, 88 per cent of the total specific cycle fluctuation in ownership occurred when sales were in like phase.[4] Apparently, then, the disproportionate volatility of ownership must be explained in terms of events that tend to parallel the direction of change in consumer demand.

Lack of appropriate data on conditions in the markets in which the wares carried by department stores are bought prevents adequate exploration of what some of these events might be. All that we can do is observe the not uninteresting parallelism between the quite inappropriate series, the rate at which vendors' performance (primarily in durable goods industries) deteriorates or improves, and the efforts of merchants to build up or draw down supplies, as reflected by the number of months' supply held on order or the rate of change of stocks on hand.

Interplay Between Demand and Market Considerations

Taken together, these conclusions require that the exaggerated association of change in ownership and in sales may be explained in terms that account for a tight link to consumer buying and its rate of change, and yet allow for amplification on the one hand and other influences on the other hand.

Start with the individual store that has been "going ahead" by encouraging amounts (doing better than the corresponding period of the previous year). Buying must increase sufficiently to replace the merchandise sold and to take care of the normal needs for efficient servicing of sales. Good and improving profits provide funds for carrying the increase in stocks that this implies. Profits also provide funds for supporting further commitments at what may be felt to be low opportunity costs if there are reasons to buy more heavily. Will such reasons exist?

One reason may simply be the management rule of thumb which stipulates that the constant sales-stock ratio should be maintained. If this rule is in general currency in the store, the chances are that increasing sales make stocks look light; the incremental ratio is less than the average ratio, so that the average stock-sales ratio declines. Perhaps, if the increase of sales in the particular store is not part of a general increase in consumer buying, stocks would not be augmented in line with a constant average stock-sales ratio. Instead, management might simply rejoice in "improved stock turnover."

If, on the contrary, sales of most general merchandise stores are improving along with expanding consumer income and buying, a different set of occurrences is to be expected. Then stocks may increase not only by the amount of the turnover rule of thumb but by more. As more customers feel more affluent, several qualitative changes in sales are likely to occur which affect the size of stocks on hand and on order. For one thing, customers "trade up"; that is, they buy more heavily in the higher price lines. This may justify adding new higher price lines to the previous range, or it may simply suggest enriching assortments in the higher lines already carried; but in either case higher stocks are required. For an-

[4] The figure is an average of phase-by-phase ratios. The numerator for, say, an expansion phase is the rise in ownership between trough and peak dates for the specific cycle expansion in sales; the denominator is the rise in ownership during the matched specific cycle phase in ownership. Measures for a nonconforming cycle after the Korean peak were omitted.

other thing, customers may be more interested in high-style items and novelties, and this likewise tends to augment stocks. Affluence may also cause customers to become somewhat more interested in good service, including ample stocks, in contrast to low prices.

Not only customers but merchants, too, may be in an affluent mood and therefore receptive to changes in customers' preferences as they interpret them. But it is quite possible also that changes have occurred in cost structures. I have already mentioned the possibility that financing costs for stores that do not rely on commercial borrowing may actually decline. Salaries may have risen and availability of sales help declined; if so, it may seem advantageous to increase the efficiency of the sales force by carrying larger stocks.

These considerations explain why stocks rise when sales do and why, as the actual sales-ownership ratios indicate, they may rise more than the efficient sales-stock link would prescribe, other things the same.

There is another striking piece of evidence, on which these speculations touch at best somewhat feebly: the close association between the *rate of change* in sales and in ownership. The efficient-service function, since this involves a strong incremental association, would of course tend to produce the empirically observed parallelism between change in ownership (since ownership is presumably little influenced by the inevitable failures of forecasts) and changes in consumer buying. However, I rather doubt that the clarity of the incremental sales-ownership association can be explained without placing primary responsibility on the procedures for creating, perceiving, and correcting unintended change in stocks.

For department stores, unintended change must be present most of the time. Orders must be placed ahead of time in order to have goods on hand when needed. Orders must be placed on the basis of forecasts of sales. But forecasts are typically inexact because clairvoyance is, at best, rare, and retailers have no information on advance orders of their customers. There is, therefore, an inevitable discrepancy between most forecasts and actuality. The first impact is on stocks. But because successful store management depends on close control of stocks, they must be precisely planned. Also essential is machinery for perceiving discrepancy between plans and actuality. Accordingly, the errors of forecasts result in what I have called unintended, not passive, change in stocks, and steps are taken to correct the error. There are many ways of doing so, and here we consider only one of them, an important one, adjustments (which may be positive or negative) in new buying.

The pattern of the adjustment is determined by the character of the error. As explained earlier, the error tends to be something very close to first differences in sales with opposite sign. Correction of this discrepancy through alteration in new buying reverses the sign.

But the conventional shingled pattern of buying and its seasonal patterns may have a capacity to intensify the corrective factor. The first impact of, say, underestimation is likely to be in the "at-once" order; provisions are found to have been too low. New orders may need to be placed *both to make up for the earlier underprovision and to forestall like future mistakes.* If so, the correction would apply the current pattern of monthly or biweekly rate of change to expected sales of several order periods. Similarly, the fill-in order, anticipating sales of some weeks hence, may need to correct for underestimation of requirements when the preseason order was placed.

We have spoken thus far of the impact on stocks and buying of the level and rate of change in sales. These several influences could occasion a rise in stocks on hand and on order relative to the previous efficient-service requirements if there were no changes whatsoever in conditions in the markets in which merchandise was purchased.

However, these changes stimulate and are stimulated by actual and expected changes

in the markets in which retailers buy. This interplay takes on increasing importance as our analysis proceeds. Combined with the fact that members of an industry have differing sensitivities to market-oriented change, it becomes the core of what is described in the last chapter as an ecological theory of fluctuation. It will therefore be useful to rehearse rather patiently how retailers are likely to proceed and to react. Much of the necessarily conjectural aspect of the analysis could be removed by appropriate investigations.

Some suppliers, those that have been lucky in developing popular numbers, will approach ceilings in productive capacity. If so, they probably will quote longer delivery periods and refuse to promise prompt fill-in orders at short notice. Perhaps they threaten that present prices apply to advance orders only, and they cannot guarantee that the same price will apply later on in the season. But whether or not these changes actually do take place, it is likely that retailers may fear that they will. If the changes actually do occur in connection with the merchandise on which fortune has smiled, fear that they will occur elsewhere is encouraged.

Seasonal patterns of buying may foster the development of market stringency or laxness. The preseason order covers requirements for some stipulated portion of the expected sales for a number of months—a "season" of perhaps a third of a year (durations differ for different seasons). There are advantages to placing orders early, but it is critically important not to buy more than will surely be used (after also allowing leeway for short-term buying intended to meet the unforeseeable whims in consumer buying). Consequently the preseason order must never exceed something short of the least that will be required.

When business improves, two things are likely to change. First, the estimate of the least that will be sold moves up; it is not impossible that the guess as to the least could move up even if the guess as to the most likely does not change.[5] Second, the advantage of placing orders early increases since failure to do so threatens poor selections, slower or unreliable deliveries, and even higher prices. Note that the retailer is *forced* to form a judgment about future conditions since he automatically takes some position—either a long or a short one—when he places his preseason order. Buyers, uncertain about what position to take, will be hungry for market news and prone to imitate what the recognized smart managements are doing.

I have been speaking of the impact of expectations about market conditions and consumer buying on retailers' preseason buying. But this buying itself must also have an impact on actual market conditions, as well as on further expectations about them. Actions based on expectations tend to be partially self-validating.

For one thing, conventional seasonal patterns, particularly the advance preseason order, may have a capacity to magnify the impact of changed expectations. The point is conjectural, but worth a moment's thought. The preseason order covers a portion of requirements for a number of months. If the portion is increased, the additional buying at the preseason date will apply to each of, say, four months which constitute the season. For example, assume that sales are expected to be $100 a month for four months, 40 per cent of which represents the usual preseason order, a total of $160. A shift in market evaluation which dictates 55 per cent advance coverage instead of 40 per cent implies an increase of $4 \times \$15$, or $60. This could constitute a very large absolute increase in business for companies receiving the orders; in one month, extra orders for 60 per cent of the monthly business are received. If sales are also expected to rise, the additional buying would of course be still larger. Thus if sales

[5] This is a fancy point. It implies that the shape of the probability distribution can change (kurtosis increase) with no change in its mean value.

were expected to be 10 per cent higher, the buying would be 55 per cent of $440, or $242, an increase of $82. Though these orders may actually be filled on a month-by-month pattern which is free of the bunched increase, I wonder whether the bunching of orders does not nevertheless influence market reactions. News of large absolute increases in orders received are more likely than news of small ones to spread around a market and influence opinion and even anticipatory actions of buyers and sellers.

Thus far we have considered influences that generate primarily from the side of demand. They provide ample reason for ownership to rise and fall with sales and with rates of change in sales. They explain also how, in both cases, response can be greater than required to enforce the efficient sales-stock link, other things the same.

But broadly expanding sales imply higher consumer income, and this in turn implies that business conditions in general tend to be good. If so, demand for, say, men's shirts by department stores competes with demand from other sorts of retailers. Firms supplying shirt manufacturers with materials are also experiencing increasing demand for other clothing and industrial materials. Demand from any or all of these sources may either support or initiate pressures on supply, which in turn cause fear of further pressure, action to forestall shortages, and thereby actual further pressure, and so on through rings of cause and effect.

Materials Orders of Department Stores and the Acceleration Principle

The argument may be summarized in terms of all the major factors that determine the pattern of materials buying for department stores and its relation to consumer buying.

1. *Provision for expected sales.* Merchandise that is expected to be sold must of course first be purchased. To do so, forecasting procedures are required in so far as goods are not ready for sale instantaneously upon the placement of an order for them, and in so far as goods on order are not perfect substitutes for goods on hand. Department store merchandise is ready for sale shortly after its arrival in the stores. However, substantial quantities of merchandise must be ordered many weeks or even months ahead of time, and for these, forecasts of requirements are necessary. Ignoring pertinent qualifications, this element of retailers' buying may be thought of as having, broadly, the pattern of earlier consumers' buying.

2. *Sales-linked stock.* As the level of sales change, stocks that service them must change roughly in proportion to the rate of change in sales.

The essence of propositions 1 and 2 form the law of "derived demand" as set forth many years ago by J. M. Clark.[6] The pattern of derived demand will depend, on the one hand, on the levels and shape of fluctuations in final demand, since this determines the pattern of rates of change and their relation to demand proper. On the other hand, it depends on the size and character of the capital ratio. The capital ratio refers in effect to what I have called the efficient-service requirement, other things the same.

Since rates of change tend to lead data proper, the new-capital requirement (increases or decreases in stocks) has the pattern of rates of change in sales and tends to lead sales proper. Because department stores require relatively large stocks, the capital ratio is large and this leading element is correspondingly emphasized. But the extent of the emphasis is moderated by the fact that the efficient-service requirement is not a constant average ratio but more nearly a constant incremental ratio and one which is less than the average. Thus far the analysis parallels that

[6] John Maurice Clark, "Business Acceleration and the Law of Demand: A Technical Factor in Economic Cycles," *Journal of Political Economy*, March 1917, pp. 217–235 (reprinted in *Readings in Business Cycle Theory*, New York, 1944, pp. 235–260).

of J. M. Clark. The fact that we can inspect data on orders, which Clark could not, provides the wherewithal for a sharp demonstration of the Clarkian logic.

But we have found that demand as conveyed to retailers' suppliers is not merely derived demand in this simple sense. Factors in addition to the previous two are at work; they are:

3. *Changes in opportunity cost of stocks.* The desired stock-sales ratio reflects change in the cost of carrying stock relative to meeting management objectives in some other way. One form this can take results from the qualitative changes in demand associated with prosperity and recession and what this means concerning the selections that retailers want to offer customers. Another form is that of a trade-off for selling costs.

4. *Attention to the timing of buying.* Conditions in materials markets and expectations concerning them cause attention to the timing of buying—the decision concerning when expected requirements are purchased. These changes feed on actual conditions of supply such as levels of capacity, utilization, quoted delivery terms, and news of related markets; they feed on changes in demand; they feed on the interaction between these supply- and demand-oriented circumstances, and expectations concerning them, in a potential merry-go-round of cause and effect. I might add that John Maurice Clark made the points of this and the preceding paragraphs nearly fifty years ago.[7]

5. *Correction of error.* The high importance of stock control in retail stores implies not only sharp definition of requirements but prompt correction for failure to conform to the stipulations. Failure of total "in-sights" (total ownership) to conform will result from faulty prediction of sales. If sales of the past are the basis of prediction, correction will have the pattern of rates of change in sales. The required correction would presumably imply reversing the undesired change in stock resulting from the incorrect guess about what would be sold. Depending on just how objectives are formulated, it may also imply correction of service stock to a level appropriate to the actual rather than forecast level of sales. The pattern of these corrections will depend on the pattern of ordering. Thus a shingled

[7] "The chief reasons for keeping a stock are, first, to give the customer a wide selection of goods which he can actually inspect and, secondly, to give assurance of being able to fill large orders without delay. . . . Obviously, the larger the order, the greater the danger of being sold out, unless the stock is increased in a corresponding proportion, or something not too far short of it. (Note the last phrase.) The increase in demand would not seem to make it necessary to keep any wider range of goods in stock. But if we are thinking, not of what is necessary, but of what is profitable, we have a different situation" (Clark in *Readings in Business Cycle Theory,* p. 250).

"The size of stock is one element in the quality of service rendered by any dealer, which means that it is something in which he is likely to economize when business is poor, and to be liberal when he can afford it." Clark goes on to say that in good times customers "would be less influenced by a slight saving in price, which can only be made sure of after close study of the qualities of the goods, than by an obvious superiority in quality of service and range of selection. When the buyer's mind swings in this direction the merchant is invited to respond in kind if he wishes to attract his share of the increase in business. . . . A time of general activity in business is a time when large stocks are good tactics commercially. One other fact which may make merchants more willing to invest in considerable stocks is that a time of growing demand for some one commodity, or a time of general increase in activity, are both times of rising prices for the intermediate products called for in the business affected. This makes these commodities a profitable investment so long as credit can be had on easy terms with which to enlarge one's holdings. Merchants tend to assure their future supplies by buying either outright or for future delivery" (*Ibid.,* p. 251).

"Taking all these things into consideration, one is justified in concluding that an increase in demand naturally tends toward an increased investment in dealers' stocks, which is, if anything, more than in proportion to the increase in sales, unless limited by (1) difficulty in getting added credit to carry the extra 'working capital,' (2) an extremely sharp rise in supply prices, (3) the fear that the prosperity is temporary, or (4) the inability of manufacturers to make deliveries (*Ibid.,* p. 252)."

I have quoted the discussion at some length because I have had the feeling upon rereading it that my book can be thought of as an effort to explore and extend these insights of J. M. Clark of about half a century back.

pattern of the sort described earlier implies a stepwise adjustment. It may also involve some magnification of error associated with highly seasonal sales and ordering; the question invites study.

I would like to defer the discussion of feedbacks which the model implies. They are discussed in both of the following chapters. But the reader must have noted that I may be storing up trouble for myself. On the one hand, feedbacks, and therefore multiplier effects, can take the form not only of income but also of expectational elements. On the other hand, my emphasis on orders, and the speed with which they can be delivered suggests that there is no justification for separating plans, actions, and corrections by formal periods. Lloyd Metzler's analysis of inventory cycles has featured the role of mistaken forecasts. But the dynamics that he emphasized moved from current income (which formed the basis of expected sales) to *subsequent* production, which, via the income payments that it generated, determined actual sales.[8] The errors that new orders are capable of reflecting do not involve this long and somewhat artificial causal chain. More of this later.

What then does the analysis suggest about the pattern of retailers' orders for merchandise compared to their final sales to consumers? Because of the need to forecast on the basis largely of past experience, and because of the high management priority accorded inventory control, paragraphs 1, 2 and 5 should dominate the recurrent picture. But this strong impact of rates of change superimposed on current levels of sales, which the large stocks and correction pattern imply, may tend to be further reinforced by the operation of the cost and market oriented aspects of the model, paragraphs 3, 4, and 5. Indeed, at times, elements generated on the side of supply or from other markets may visibly imprint their influence on total buying.

Chart 15 compares this hypothetical picture with the actual one. At troughs, sales cease to fall very nearly at the same time that they reach their maximum rate of decline.[9] At troughs, then, either one of the demand-oriented influences—expected sales or demand for capital (change in stock)—will cause new orders to turn at about the same time. It seems reasonable therefore that the median timing of new orders compared with that of rate of change in sales was, except for the 1954 trough, plus or minus one month (Table 40, line 5).

At peaks, however, sales slowed their rate of rise well before they began to fall (compare Chart 15, curves 2 and 6). Change in ownership—an empirical receptacle for all the aspects of the model except point 1—turned within plus or minus two months of changes in sales at five of the six peaks. At three of these peaks, the magnification that change in sales underwent as a consequence of ownership objectives meant that the location of the turns in total materials orders was strongly influenced by the rate of change in sales; on these occasions orders turned no more than three months after the centered rate of change in sales. However the peak in new orders that occurred in 1956 and 1960 occurred many months after sales ceased to rise at an accelerating rate. Apparently the strong trend rise in sales kept the dollar value of new orders rising very gently after the factors embodied in the increasing rate of rise in ownership had started to decline (Table 40, lines 10 and 13a).

The model postulates that factors outside of the final demand-associated complex of events can also influence the pattern of backward transmission of fluctuation. Evidence of their influence on ownership has previously been discussed. But on new orders, the impact of price expectations, lengthening delivery periods, and the like does not take a form in which these influences are visible insofar as

[8] Lloyd Metzler, "Nature and Stability of Inventory Cycles," *Review of Economic Statistics*, August 1941.

[9] Five troughs can be matched. The timing of change in sales relative to sales proper is 0 for two of them, −2 in 1958 and 1961 and −7 in 1954.

they do not parallel changes in final demand. That much of the influence does follow this parallel course has been indicated by the measures of exaggerated amplitude of fluctuation that have been presented: Retailers' buying has about two times the specific cycle amplitude of the fluctuations in consumer buying (see Table 24, line 1).

DURABLE GOODS MANUFACTURERS

The available data for durable goods fit poorly into the conceptual framework required for comprehensive analysis of fluctuations in ownership and its impact on the backward transmission of demand.

First, there are the all too familiar technical shortcomings of the data: the difficulty of using book-value figures to compare stocks and flows at various stages of processing; the fact that there is no way consistently to match, for the same companies, sales orders (or shipments or production) with inventories of materials on hand and on order and with orders placed for those materials (or receipts of them).

Second, we have studied only one of the three major sorts of stocks on hand—stocks of materials. The dynamics of change in materials stocks, and the backward transmission of demand as a whole, ought to cover the business alternatives concerned with whether to accumulate or draw down stocks at any stage of the productive process. The focus on the "raw" materials stage alone is a limitation that needs to be kept in mind.[10]

Finally, since the time pattern of customers' orders may differ substantially from that of shipments to them, "demand" confronts the problem discussed at the beginning of the chapter. Following the thinking there set forth, I shall focus on the association of stocks and shipments and observe, as a second step, the impact of changes in unfilled sales orders.[11]

Indeed, for some purposes, particularly the examination of how stocks of materials on hand relate to the "need" for them, the most appropriate definition of demand might be production starts, rather than shipments of finished goods. However, there is no statistical information on this series of events. Shipments, then, will have to suffice.

The Sales Link—"Excess Stocks" and Materials Orders

In Chapter 9, the over-all movement of shipments and stocks of all durable goods manufacturers were seen to show substantial parallelism. However, their conformity to business cycles inhibits ascribing direct causal implication to the relationship, particularly since the more responsive stockpile—ownership—shows poor association with shipments (see Table 31).

Rates of change provide a more sensitive test. And Table 41, line 3, shows in detail that there is little apparent tendency for manu-

[10] Reference to the total stock-shipment ratio, the bottom curve of Chart 3, and to the rate of change of all stocks, the fifth curve of Chart 6, suggests that many statements concerning materials stocks may apply to total stocks. This would be still more likely to be the case if stocks were measured in terms of equivalent units of output, the most appropriate notion for examination of process, rather than in book-value terms. The latter underweights the importance of raw and, to a lesser extent, in-process stocks.

[11] This has some advantages also in terms of the technical difficulties of the data. Final products, defined as products of the machinery and transportation industries, fail to include the final products sold to firms in other industries, and thus include too little. On the other hand, final products, defined as products of all durable goods industries, include products that are intermediate and primary materials as well, and thus include too much. It has been judged the lesser disadvantage to include too much in dealing with shipments, and too little when dealing with outstanding orders. For the latter it is important not to cover as cause the very changes in outstanding orders for materials which, as effect, is a major focus of interest in this book.

TABLE 41

Timing: Change in Demand and in Stocks on Hand and on Order, Durable Goods Manufacturers, 1946–61

Line	Reference Series[c]	Section A: Months Lead (-) or Lag (+) for Matched Turns[a] Chronology[b] P 1947	T 1947	P 1948	T 1949	P 1951	T 1952	P 1953	T 1954	P 1957	T 1958	P 1960	T 1961
	Specific Series: Change in Shipments, All Durables												
1	Subcycles	⊕	⊕	⊕	-7	-8	-11	-9	-10	-9	-3	-13	-3
2	Change ownership	⊙	⊕	⊕	-2	-8	-6	+4	-1	-1	0	+3	+7
3	Change stocks, materials	⊕	⊕	⊕	-2	-4	-10	-8	-8	-15	-4	0	+2
4	Change in outstandings	⊙	⊕	⊕	-2	-8	-6	-4	-1	-1	+1	+3	+7
5	New orders, materials	⊙	⊙	⊕	-4	-7	-5	-3	-3	-15	-2	+2	-2
6	Change new orders, materials	⊙	⊙	⊕	+1	0	+2	+4	0	0	+3	+9	+16
7	Change production, all dur.	⊕	⊙	⊙	-2	-2	-12	0	-2	-3	+1	+2	-2
8	New orders, mat. deflated	⊙	⊕	⊕	-4	-7	-8	-3	-3	-5	-2	+2	-2
	Specific Series: Ratio: Material Stocks to Shipments, All Durables, Inverted												
9	Subcycles	-5	+1	-8	-8	-6	-6	-5	-9	-24	-1	-13	-1
10	Change shipments	⊗	⊗	⊗	-1	+2	+5	+4	+1	+6	+2	0	+2
11	Change ownership	⊗	+2	+1	-3	-6	-1	+8	0	+5	+2	+3	+9
12	Change stocks, materials	-1	-3	-8	-3	-2	-5	-4	-7	-9	-2	0	+4
13	Change outstandings	⊗	+3	+1	-3	-6	-1	+8	0	+5	+3	+3	+9
14	New orders, materials	⊗	⊗	-8	-5	-5	0	+1	-2	-9	0	+2	0
15	New orders, mat. deflated	⊗	+3	-3	-5	-5	-3	+1	-2	+1	0	+2	0
16	Change outstanding orders, final product	+2	⊕	⊕	-1	-7	⊕	⊕	+1	-4	+7	-1	+1
17	D.I. vendor performance	⊗	+3	+3	-1	-1	-3	+7	-1	-3	+3	-6	+10
18	Corporate profits	⊗	⊗	-8	-3	-3	-8	-3	0	-4	-2	-1	-1
	Specific Series: New Order, Materials												
19	Subcycles	⊕	⊕	0	-3	-1	-6	-6	-7	-15	-1	-15	-1
20	Change outstanding orders, materials	⊙	⊕	+9	+2	-1	-1	+7	+2	+14	+3	+1	+9
21	Change stocks, materials	⊕	⊕	0	+2	+3	-5	-5	-5	0	-2	-2	+4
22	Shipments, all durables	⊙	⊙	-1	-3	-2	-7	-6	-9	-9	-1	-4	0
23	Shipments, final product	⊙	⊙	-1	-5	⊗	⊗	-6	-9	-9	-1	-5	0

(continued)

TABLE 41 (concluded)

Line	Reference Series[c]	Section B: Average Timing of Turns — Number Matched (− + 0)	Median[e] P	Median[e] T	Median[e] All	Average Deviation[f] P	Average Deviation[f] T	Average Deviation[f] All Turns	Average Deviation[f] Wt'd	Section C: Percentage of Months in Like Phase[d] — Timing Adjustment[g]	% Mos. 7/46–12/61	% Mos. 1/48–12/61
	Specific Series: Change Shipments, All Durables											
1	Subcycles	9 0 0	-9.0	-6.7	-8.7	1.2	3.1	2.5	2.3	-9	68	71
2	Change ownership	5 3 1	+1.0	-1.0	-0.7	4.0	3.0	3.5	3.4	-1	73	73
3	Change stocks, materials	7 1 1	-11.5	-7.3	-8.7	6.5	4.3	4.9	5.3	-4, -5	68	67
4	Change in outstandings	5 4 0	+1.0	-0.7	-0.3	4.0	3.3	3.7	3.6	-1	72	73
5	New orders, materials	8 1 0	-5.0	-3.0	-3.3	5.2	1.0	2.9	2.9	-3	68	73
6	Change new orders, materials	0 6 3	+2.0	+2.0	+2.0	3.2	3.6	3.4	3.4	+2	75	77
7	Change production, all dur.	6 2 1	-1.0	-2.0	-2.0	1.8	2.6	2.2	2.2	-2	81	82
8	New orders, mat. deflated	8 1 0	-4.0	-3.0	-3.3	2.8	1.6	2.1	2.1	-3	76	81
	Specific Series: Ratio: Material Stocks to Shipments, All Durables, Inverted											
9	Subcycles	11 1 0	-7.0	-3.5	-6.0	4.8	3.7	4.2	4.2	-6	73	74
10	Change in shipments	1 7 1	+3.0	+1.7	+2.0	2.0	1.5	1.7	1.7	+2	82	85
11	Change in ownership	3 7 1	+3.0	+1.0	+1.7	3.6	2.8	3.3	3.2	+2	80	78
12	Change stocks, materials	10 1 1	-3.0	-3.0	-3.0	3.0	2.3	2.7	2.7	-3	82	82
13	Change in outstandings	3 7 1	+3.0	+1.5	+2.3	2.8	3.2	3.4	3.0	+3	80	78
14	New orders, materials	5 2 3	-4.0	-0.7	-1.0	4.2	1.5	3.2	2.9	-1,0	76	81
15	New orders, mat. deflated	5 4 2	-0.3	-1.0	-0.7	2.5	2.2	2.3	2.3	0	86	87
16	Change in outstanding orders, final product	4 4 0	+0.5	+1.0	0	3.8	2.0	3.0	2.9	0,+1	76	77
17	D. I. vendor performance	6 5 0	-0.3	+1.0	+0.3	3.9	3.5	3.8	3.7	0	77	76
18	Corporate profits	9 0 1	-3.3	-2.0	-3.0	1.6	2.0	1.9	1.8	-3	83	89
	Specific Series: New Order, Materials											
19	Subcycles	9 0 1	-7.3	-3.3	-4.5	6.0	2.3	4.3	4.2	-4, -5	74	74
20	Change outstanding orders, materials	2 8 0	+5.7	+2.3	+2.5	4.9	2.3	3.9	3.6	+2, +3	73	77
21	Change stocks, materials	5 3 2	-0.7	-1.7	-1.0	2.1	3.3	2.8	2.7	-1, -2	77	83
22	Shipments, all durables	9 0 1	-4.0	-3.7	-3.5	2.4	3.1	2.8	2.8	-3, -4	85	83
23	Shipments, final product	7 0 1	-5.5	-3.0	-5.0	2.2	3.2	2.8	2.8	-5	82	80

For notes see Table 40, notes a through g.

facturers to enforce an incremental association. Even after allowing for a lag of four or five months for inventory investment relative to change in shipments, only 69 per cent of the months are in like phase.

There seems little reason to ascribe the lag and poor correspondence to unavoidable error. In view of the foreknowledge of shipments that new sales orders provide for fabricators of heavy machinery, stocks certainly could be kept more closely associated with shipments if there were reason to do so and to pay the cost of doing so. Besides, the association is also poor between change in shipments and change in ownership for which a target size could presumably be enforced simply by modifying current ordering. Line 2 of the table shows only 73 per cent of months in like phase after allowing for a one-month lag of change in ownership.

However, needless to say, a company does not ignore the level of shipments in designing the level of stocks, nor can the speed with which shipments rise or fall be ignored. Disparities that are "too large" must be defined at least in operating terms. Do the figures point to any such definition?

A relaxed type of association is suggested by the fact that since 1948, though not before, there seems to be a tendency for a fall in shipment to have been preceded by a retardation in at least the rate at which stocks rise; similarly an upturn in sales was preceded by a slower rate of fall in stocks (Chart 16, the association between curves 3 and 6). But it is hard to describe the operational meaning of this association. What it could mean seems to be suggested in a more comprehensible way by the stock-shipments ratio. It is shown as the second curve in Chart 16. I would like to think of the curve as the locus of "excess stocks." This notion starts with the thought that there is some ideal association between shipments and stocks of materials required to service shipments efficiently. To illustrate, assume that it is one month's supply (.5 months for the book-value data assuming value added is 50 per cent of the shipment price). Then, by definition, when the ratio is above a line drawn at .5, "excess stocks" are positive; and when below it, they are negative, that is, deficiency exists. Since the ratio seldom fell below .5, stocks were never too low according to this definition but only too large in varying degrees.[12]

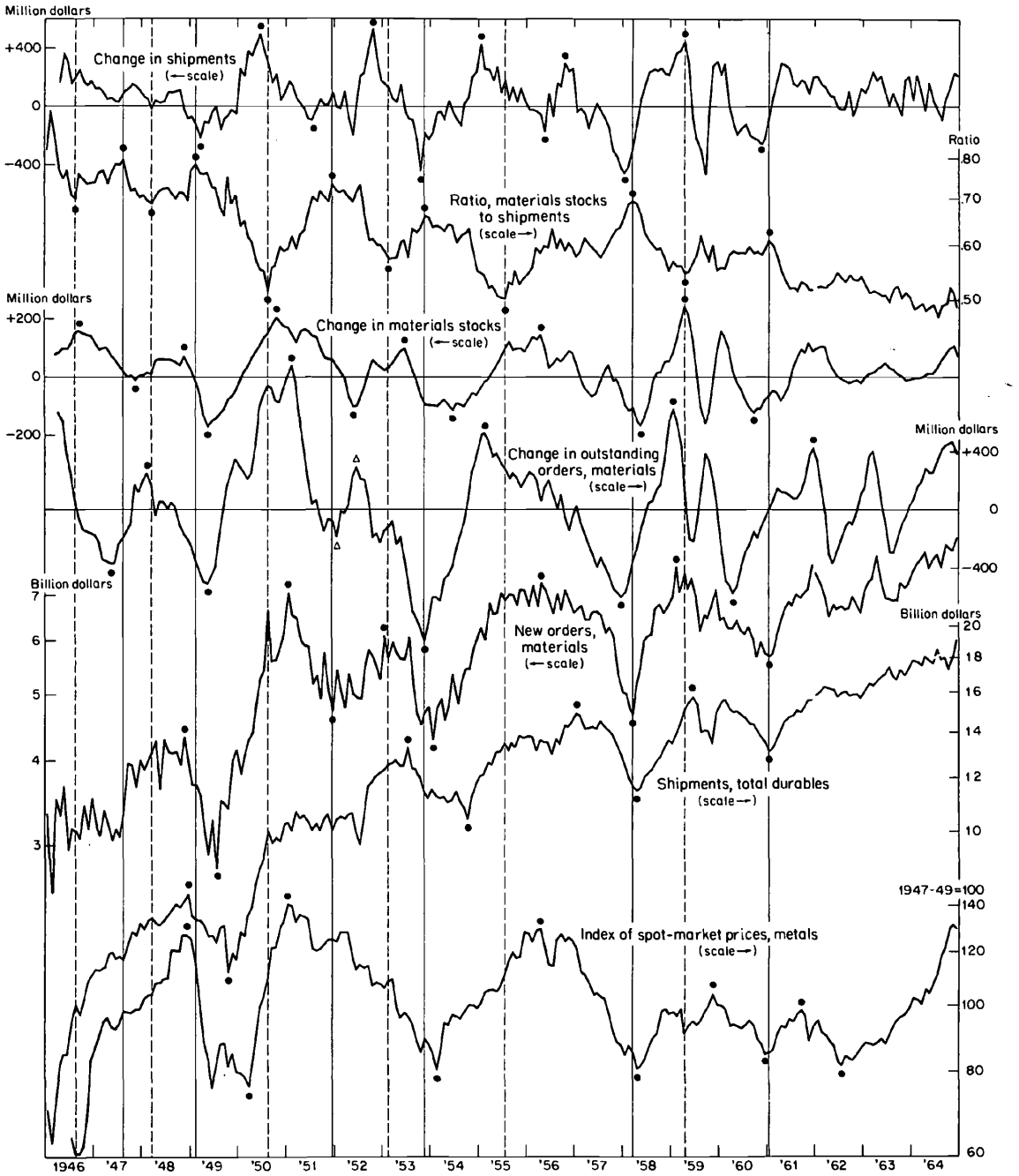
Comparison between the two top curves of Chart 16 suggests that the rate of change in sales and the stock-shipments ratio are inversely correlated. Table 41, line 10, indicates that, allowing for a two-month lead of change in shipments, the two series are in opposite phase 82 per cent of the months, 85 per cent from 1948 on. Of course, sales are in the denominator of the ratio and therefore even the rate of change in sales might, because of the arithmetic, have a tendency to be inversely related to it. But changes in stocks, the numerator (third curve), have an inverse association also; 82 per cent of the months are in opposite phase with stock investment lagging three months (Table 41, line 12).

The typical relationships can be described in these terms. Both stocks and shipments are rising, and stocks more slowly than shipments (the ratio is falling). But producers find the rise in their shipments slowing down a bit. Though they may start to reduce materials buying, stocks, nevertheless, rise *relative* to shipments—excess stocks, as defined by the ratio, begin to build up (trough in the ratio). Before long, shipments may start to fall, but

[12] What the desirable level actually is needs to be empirically determined. But for so complex an aggregate as all durable goods producers, the question is perhaps not too interesting. If the proper figure is higher than .5, what I refer to as small excess stocks would be a stock deficiency. The contours of the curve would be unchanged. If the desirable stock-sales ratio were more nearly a fixed incremental than fixed average ratio, and the incremental ratio differed from the averages, the contours may change. I have computed a series assuming a fixed incremental ratio of .5. Had this series been used instead of the one based on a constant average ratio, the argument that follows would be unchanged. Experiments suggest that this would also have been true had the incremental ratio been .33 instead of .5.

CHART 16

Ratio of Materials Stocks to Shipments Compared with Selected Series, 1946–64



Note: Dashed lines mark the troughs and solid lines the peaks in ratio of materials stocks to shipments.

the cumulation of "excess stocks" continues either because stocks continue to rise or, falling, do so more slowly than shipments. As the fall in shipments starts to retard, retrenchment in stocks has a chance to catch up; the ratio reaches a peak and reverses as stocks start to decline faster than sales. As sales begin to rise, this *relative* reduction in stocks continues either because they have not started to rise or because they do so at a slower rate than do sales. This persists as long as sales continue to rise at an accelerating rate. But soon after they cease to do so, excess stocks cease to decline and start once again to build up.

This description does not seem to me to suggest a sharp inventory objective which is incapable of prompt enforcement. For one thing, the fact that orders are often on the books many months before shipments need to be made, or even production begun, suggest that stocks *could* have been acquired at just the most efficient time. But even if this had not been the case, why would it not be possible to enforce a stock objective by ordering materials from jobbers, or other manufacturers, paying if necessary a premium price for prompt delivery? If, on the other hand, stocks are too high, suppliers could have been asked to postpone deliveries. It seems reasonable to suppose that these things are not done for the reason that they are not worth doing. It is advantageous neither to formulate a stock objective with so strong an emphasis on alignment with shipments nor to pay the cost of monitoring and enforcing it.

The picture is rather that of a soft stock objective—a link of stocks to sales consisting, figuratively, of a set of elastic bands that pull stock in some prescribed direction, but give ground in response to pulls exerted by other management considerations.

Needless to say, many other considerations are present. The movement of the stock-shipments ratio reflects the impact of these factors at the point where materials stocks on hand have been affected. Some of the factors may have a fairly direct and prompt impact on stocks; for example, the combination of uncertainty about delivery conditions and ample funds may cause a buildup, via orders for fast delivery, of stocks on hand as insurance against possible shortages. But other factors, focusing on outstandings, will influence stocks on hand only after a considerable interval; classic examples are anticipatory orders with long delivery periods, or those intended to forestall an expected rise in price. Finally, the pattern of withdrawals from stockpiles, and failures to anticipate these, must also be listed among the factors that influence the size of materials stocks. Actions focusing both on outstandings and on the pattern of withdrawals from stock will cause current stock objectives to be blurred by the impact on stocks of actions undertaken at some earlier time which have, in a sense, committed the stock reservoirs to receipts or drains that tend to oppose the present direction in which the rubber bands are pulling.

This interpretation emphasizes the possibility that an intention to validate a sales-stock link may be so overlaid with other current objectives, and the residue of earlier ones, that it could not be seen in aggregative data; at least not without a complicated and correct conceptual model, good data of an unusual sort, and, of course, multivariate analysis.

But if efforts to enforce sales-linked objectives would be visible at all in the gross figures, they might be expected to be clearest at the point where the instrument of control is used. The act of ordering materials is the chief instrument, and accordingly we examine the patterns of ordering in the hope of identifying action intended to correct excess or deficiency in sales-linked stocks. Outstanding orders for materials and their rates of change also show the results of these actions. But since current actions are only one of the things that affect their size (see the analysis at the start of Chapter 10), it is more useful to concentrate on the flow of new orders for materials.[18]

[18] In line with these thoughts, as Table 41, line 13, indicates, change in outstandings tends to turn earlier than the ratio matched inversely, and to have poor positive conformity with the rate of change in shipments (line 4).

The fifth curve in Chart 16 is new-orders for materials. (It is actually the sales orders of the materials-producing durable goods industries.) The generally inverse association with the stock-shipments ratio is clear enough. The peaks and troughs in orders are generally close to the dotted and solid lines drawn through the troughs and peaks in the ratio. Table 41, line 14, indicates that the association is about synchronous on the average. However, the over-all correspondence, matched inversely, is only 81 per cent of months in like phase, starting in 1948. But the particulars of the individual turns suggest a more meaningful connection. For one thing, six of the ten matched turns are within plus or minus two months of one another. For another thing, the longer leads can be explained in terms of market behavior. At the peak of the ratio in 1949 (excess stocks hypothetically had reached their low), metals prices were falling rapidly, and this could account for the continued fall in new orders. Producers wanted to wait before resuming buying, in view of the weakness which the rapid fall in prices signified. At the three peaks in orders in 1948, 1950, and 1956, the lead of the ratio seems explicable in terms of strong movements in prices. The periods of delay between the beginning of excess stocks (trough in the ratio) and the peak in orders were quite precisely the periods of rapid rises in prices to unusual highs. Compare them with the bottom curve in the chart. Presumably the optimism and increasing market stringency that this implies caused producers to buy more materials than they otherwise would. "More" turned out to mean enough to keep new orders rising. In 1956, new orders turned down and the ratio up at virtually the same time; and metals prices were low and level.

For durables as for department stores, the process generates materials orders which reach peaks and troughs before those of shipments of the finished goods in which the materials are used. Inspect curves 5 and 6 in Chart 16. Table 41, in lines 22 and 23, calculates that new materials orders lead shipments at all turns except one synchronous one. For all durable goods shipments (which cover more ground than we want) the median lead was three or four months and the correspondence was high; 85 per cent of the months were in like phase. For shipments of the final-products industries only (which covers less ground than we want), the median lead was five months and the correspondence a bit lower.

I have explained the relation between excess stocks and materials orders in terms of usual and special conditions at particular times. The net result is a strong lead in orders relative to shipments. But I want to suggest a revision of this explanation, which has been based entirely on book-value figures, because of the ambiguity that prices imply in this context. The strict logic of the argument that links "excess" stocks to buying calls for a relation between physical quantities. The ratio, our measures of excess stocks, approaches this, since there is at least some degree of similarity of the prices of numerator and denominator. To make valid comparisons, new orders should be deflated for the price element in book-value figures. When this is done, the lag of new orders relative to troughs in the ratio in 1948 and 1956 disappears, though the descent is slow after the peak. The only substantial lags that remain occur at the time of the acute fall in prices in early 1949 and rise in 1950. For the rest, materials orders rise as excess stocks build up and fall as excess stocks disappear. The two series can be compared at the top of Chart 17; the ratio, curve 2, has been inverted in this chart, so that direct rather than inverted association with new orders is to be expected. Eighty-six per cent of months adhere to this pattern on a synchronous basis (Table 41, line 15).

In pointing to the unusual regularity of this association, one should not lose sight of its logical and empirical link to the rate at which shipments change. The difficulty of catching up with acceleration in shipments is the reason for the inverse movement of the ratio. The rate of change in shipments can be compared directly with materials orders in

the context of the simple accelerator mechanism of the kind which seemed to apply to the buying of retailers. Using the deflated new-order series, beginning in 1948, 81 per cent of months were in like phase with centered change in sales leading by three months; alternatively this may be regarded as a synchronous association with change in sales during the previous five months (Table 41, line 8). The longer leads at peaks occurred in 1950 and 1955, when market conditions were tightening rapidly, and at least one of the two longer leads at troughs occurred in 1949, when markets were strongly deflationary. The rise in new orders in 1947 was not present in the rate of change in sales, and the latter rose in 1956 while new orders continued to fall. I stress the ratio as an intermediate causal link because of its most impressive empirical attributes (of which there are more to come), and because the logic of its operation seems to me to correspond realistically to business perceptions and techniques.

But without learning more about how objectives are formulated and enforced, it is foolish to push any particular association very far. These basic facts seem to stand out: (1) Materials orders clearly turn consistently earlier than shipments of finished products. (2) The lead is strongly associated with some sort of sales-linked inventory objective, albeit one constructed of lastex. (3) The fact that it is made of lastex, and that all sorts of other factors cause it to stretch and retract, makes one hesitant about calling the association another clear example of the impact of derived demand having the usual acceleration attributes. It has the empirical manifestations—the lead and greater amplitude. But to what extent is the sales-link causally responsible?

Other Influences and Their Link with Shipments

The answer must in the first place comprehend the amplitude of change, and here I need to shift back to ownership. Even for department stores, unplanned changes in stocks (primarily presumably of an unintended sort) made it undesirable to focus on change in stocks for empirical observation of the causal link to sales. For durable goods manufacturers, passive as well as unintended change in stock appears to be important. Changes in ownership can presumably be more deliberate. Of course, the very absence of sharp parallelism between change in ownership and in shipments means that the amplitude of change in ownership will reflect other influences than that of the sales link; nevertheless, magnitudes are of interest. It is useful to ask to what extent the magnitude of change exceeds what an efficient sales-link might demand.

Table 34 spoke to this point. There we saw (line 13) that on the average about 3.4 months' supply was on hand and on order; [14] however, the incremental association, the ratio of the specific cycle increase in ownership to that of sales, was equivalent to about 5.5 months' supply (line 11). If the ratio had remained at a hand-to-mouth level, the incremental association would have represented 3.2 months' supply, whereas a constant incremental relation of 2, or more likely 1.5, months would seem to define the efficient sales link more realistically, assuming nothing else changed.

The calculations can be interpreted in terms of the proportion of total specific cycle change in ownership that the several varieties of sales links explain. Apparently the constant hand-to-mouth average relation covered about two-thirds of the total, whereas the incremental association of 2 accounted for 45 per cent, and an association of 1.5 for about a third (lines 10a, c and b).

The large cyclical rises and falls in ownership relative to that of shipments must represent the impact of other elements that bear on the patterns of procurement. But here, as for department stores, we cannot even start

[14] The book value of ownership averaged 1.69 times shipments. Assuming value added represents 50 per cent of the value of product, this represents about 3.4 months' supply.

to measure their joint impact by looking at the times when shipments could not be responsible because ownership was moving in a contrary direction. Only 14 per cent of the total rise and fall in ownership occurred when ownership and shipments were in opposite subcyclical phases.[15] In general these figures tell about the same sort of story as did the corresponding ones for department stores; there is more change in ownership than the sales link justifies, most of which nevertheless is confluent with cycles in sales.

However, the explanation for durable goods manufacturing must, I believe, be cast less in terms of problems of forecasting and correction of errors, and more in terms of shifts in market conditions. Because shipments, ownership, and market conditions all, broadly, move up and down with general business conditions, they also move up and down with one another. However we can, I think, go somewhat farther by way of identifying the impact of market conditions and its relationship to shipments than this statement suggests.

For one thing, we saw in Chapter 10 that a number of factors indicative of changing costs and market conditions seemed to have patterns corresponding to changing materials ownership of durable goods manufacturers after the influence of shipments had been subdued by differencing or expressing outstandings in terms of months of shipment. It seems clear, in other words, that these factors are there and influential.

For another thing, we saw in Chart 16 that the influence of shipments on buying seems to have at least two forms. The first reflects the obvious need to replace the materials shipped out in the form of finished goods, and, further, to maintain stocks at some appropriate level. Whether this need takes the form of a constant average or incremental relationship is perhaps not too important at the moment. The second is a rather elastic influence impersonated by the stock-sales ratio which reflects a cumulation of discrepancies from the average level of replacement needs. When the discrepancies are negative they stimulate more buying, and when positive less buying. Though these discrepancies themselves may reflect short-term rates of change in shipments, they may have the capacity to reveal aspects of the interplay between short-term demand and market conditions, the presence of which is so tantalizingly difficult to photograph. Chart 17 seems to suggest this liaison apparatus at work.

The stock-sales ratio is depicted in the second curve of the chart. It has been drawn so that its inverse impact can be viewed as a direct one.[16] Below it are drawn each of the major factors that the previous analysis has indicated show an association with the phenomenon of market fluctuation. The particular forms included in this chart are based on the findings of Chapter 10. They are intended to maximize the general picture of parallelism. Timing measures were given in Table 41.

In general the chart conveys the basic notion that all of these phenomena may belong to the same family of events. It suggests a few of the family characteristics:

First, we see in the top two curves the impressive correspondence previously noted between the periods when the ratio showed that deficiencies were building up or declining and those when the physical volume of new orders for materials were increasing and decreasing respectively.

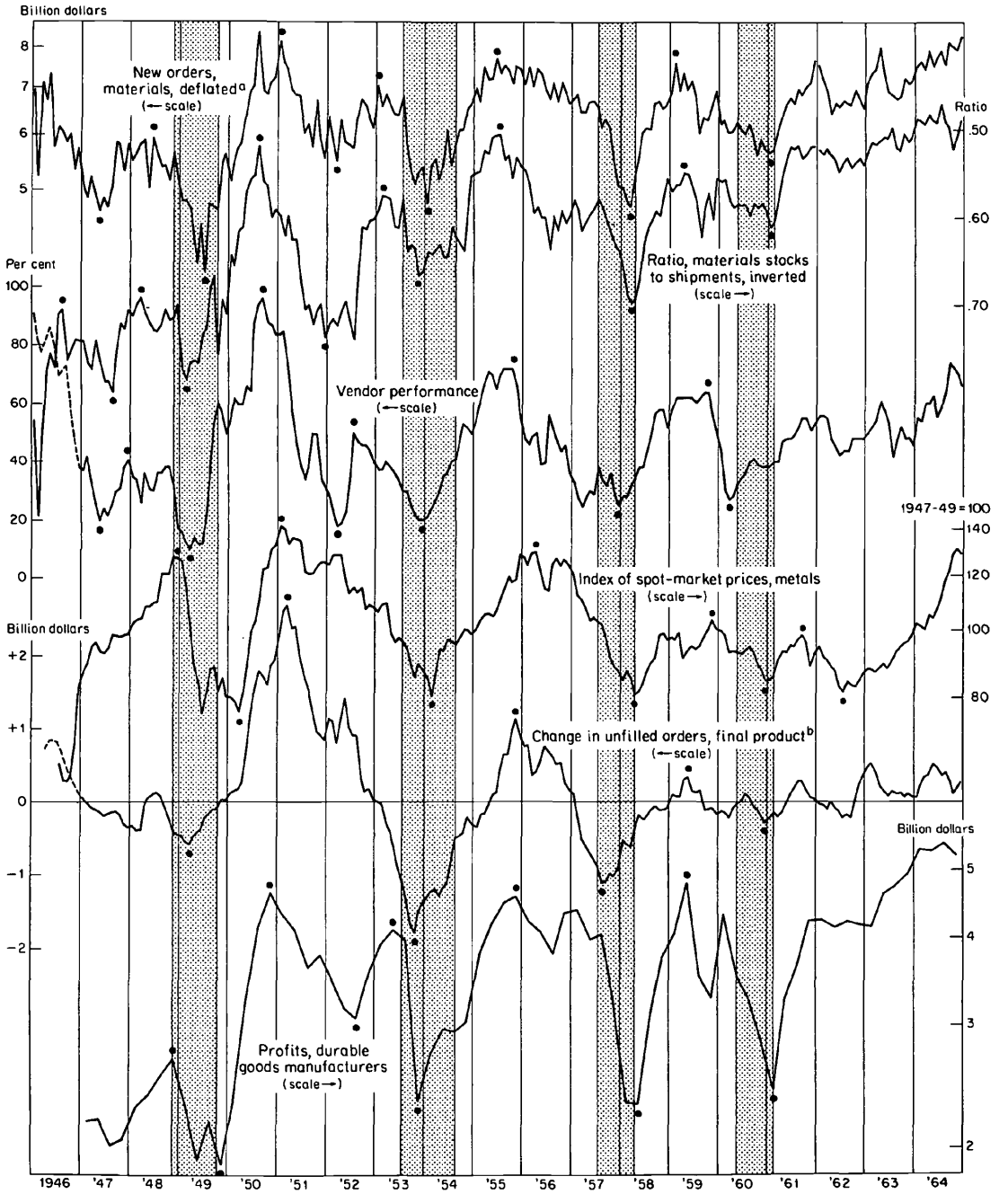
Second, the chart suggests that periods of increasing deficiencies and rising new orders for materials were usually times when a number of other things were also taking place: more vendors were lengthening their delivery periods; more producers were themselves piling up sales orders for future delivery; in the aggregate, these occurrences were decreasing at a declining rate or increasing at an increas-

[15] For a description of the measure see note 4, above.

[16] The scale also has been increased so that, moving upward on the chart, the figures start at about .80 and ascend to about .50.

CHART 17

Ratio of Materials Stocks to Shipments Compared with Selected Series, Durable Goods Manufacturers, 1946–64



Note: Shaded areas represent business contractions.

[a] Deflated by wholesale price index for metals and metal products, 1957–59 = 100.

[b] Five-month centered moving average of month-to-month change.

ing rate. Two other things were occurring at most of the times: profits and the price of metals were rising. Consider the meaning of each briefly in turn.

Lengthening delivery periods for materials (third curve) probably reflect pressure on plant capacity. Pressure may take the form of a rate of increase in orders which it is uneconomical to produce at the rates at which orders are written, or it may take the form of levels of demand that put pressure on the physical capacity of plants. The data on capacity reviewed in Chapter 10 were consistent with the latter interpretation, among others. In the company of the changes visualized in Chart 17, we are prompted to ask whether the pressure on capacity, and associated delays in delivery periods, may itself result in part from the spurts in materials buying resulting from the interplay among the complex set of influences that we have been discussing.

An increasing rate of change in backlogs of sales orders (curve 5) means, of course, that new sales orders are growing relative to shipments of final products. In accordance with the argument at the start of this chapter, this may be thought of as a qualitative change in demand. Advance orders for materials required to manufacture products for which advance sales orders have been written may be placed with far less of the risk otherwise attendant on advance purchase of materials. Indeed, failure to cover may be considered risky.

Profits (bottom curve) provide the wherewithal for financing heavier commitments and, I have argued, sometimes at lower opportunity cost than average return on investment. They also stimulate optimistic expectations and actions. Table 41, line 18, shows a notably close association between profits and the stock-shipments ratio three months earlier. Beginning in 1948, 89 per cent of the months were in like phase.

How the prices of basic metals are involved in the complex of events is difficult to say. One obvious causal connection—one moving from actual change in prices to expected change in prices to changed levels of inventories that should be held—is ruled out by the timing association. This point was developed in Chapter 10. I shall suggest a different sort of possible causal relationship in the final chapter. In the meantime, it is worth noting that their behavior may reflect result as well as cause—the pressure of demand on prices.

Some particulars of how these market-linked factors interact with the sales-linked elements are suggested by their behavior during the several episodes. The usual pattern may simply be that of mutual reinforcement. However, in a few cases divergences are suggested. In 1949 and 1951–52, excess stocks had ceased to build up five months before new orders picked up. These were, as indicated earlier, both times when prices were falling drastically; perhaps this, and other market conditions associated with it, tended to delay the resumption in buying.

Conversely, the continued increase in buying after the deficiencies at the time of the Korean War boom had started to decline was associated with a continued rise in prices and a level of output that was checked no doubt by capacity limitations in many firms. Producers of heavy equipment and armament were certainly among those whose backlog of unfilled orders were rising and at an accelerating rate. But materials producers as well were also slow in meeting orders, as the vendor performance index shows. Thus, expectation of shortages, or rising prices, caused more advance buying, which caused more shortages. High profits provided ample funds which could be temporarily invested in stocks both profitably and with due regard for future liquidity. These factors were strong enough to keep materials purchasing rising, even though shipments were no longer rising at an accelerating rate and the effort to reverse the growing deficiency in stock on hand had met with success. Much the same sequence of statements

apply to mid-1955, except that in this case the continued buoyancy of market factors served not to postpone the peak in new orders but to greatly dampen the decline compared with what the sale-linked set of factors would otherwise have ordained.

The years following the business trough in early 1961 are particularly interesting, since they differ from the earlier period in a number of ways which seem internally consistent. In the first place, when recovery set in in early 1961, shipments rose only gradually and at a rate which underwent relatively little acceleration. After mid-1961, the stock-sales ratio likewise continued to record only a most gradual increase in stock deficiency.

In line with this unusual start, on the side of demand, of a prosperous period, there seems likewise to have been little stimulation of buying from the market-oriented elements. Orders for final products declined only slightly in the previous recession and increased only slowly and steadily during the expansion that followed. As a result, backlogs moved very gradually upward and their rate of increase was free of cyclical shapes. Capacity utilization was generally low, and "worsening" of vendor performance leveled off in 1961 and did not rise further until 1964. Profits increased, but the motive to invest them in inventories was absent. Sensitive metals prices fluctuated only very mildly until toward the end of 1963.

Possibly the new scientific methods of inventory management also played some part in preventing the usual spurts in materials buying. Of particular relevance is the possibility that better information and control techniques has reduced unintended stocks. But it is most hazardous, I believe, to heavily underscore this element in the complex of interrelated events. For one thing, most of the work on data processing for inventory management applies to finished stocks rather than purchased materials. But more important, the usual post-trough spurt in forward buying did not take place. The outstanding-sales, or ownership-sales, ratios slipped consistently downward after their peak in later 1959 until well into 1964 (see Chart 2). The ratio of stocks to sales recorded neither excess nor deficiencies; it oscillated around the level of .50, or, adjusted for value added, one month's supply. These facts are consistent with materials buying that is confined to requirements for actual production plus a true sales-linked inventory demand. And certainly a tendency of this sort would have been reasonable in view of the absence of the usual acceleration of final demand and the low level of utilization of the vast new plant capacity that had built up over the past five years or more. As we all know as this book goes to press, the situation did not last.

Acceleration Model for Durable Goods Manufacturers

The picture that the time-series sketch seems to imply that though a model of materials inventory for durable goods manufacture and for department stores would cover the same major elements, these elements would assume different forms and have different relative importance in the two types of enterprises. I shall state the particulars baldly; they are actually fields of investigation.

1. *Provision for expected shipments.* Unlike department stores, durable goods manufacturers often have some foreknowledge of requirements. As the discussion early in this chapter indicated, sales orders can provide (though in different ways for different sorts of firms) the basis of some very good guesses about what materials will be needed, and in ample time to purchase them.[17] In so far as

[17] A recent investigation by Michael Lovell provides provocative information on this point. ("Sales Anticipations, Planned Inventory Investment, and Realizations," in *Determinants of Investment Behavior*, Robert Ferber (ed.), New York, NBER, 1967.) When the statistics on sales anticipations now collected by the Office of Business Economics were used in explaining inventories, the addition of outstanding sales orders does not improve the result. Lovell notes that "this rather

this is the case, new orders for materials can actually precede shipments of finished goods and related production requirements.

2. *Sales-linked stock.* As shipments change, stocks must change in line with efficient service requirements, thereby implying something like a constant incremental ratio which is smaller than the average ratio. But an objective of this sort with respect to most durable goods materials is unlikely to carry the same management priority as does a corresponding objective for merchandise stocks of department stores.

3. *Changes in opportunity cost of stock.* Prosperity-linked changes in costs are likely to reduce the opportunity costs of stocks on hand and on order. This can occur by means of changes that reduce the cost of carrying stock, e.g., larger backlogs of sales orders which reduce risk, larger prosperity profits which, in so far as they need to be kept liquid, provide low-cost financing for stocks. It can occur by means of higher cost of alternatives to stock, such as high hire or overtime cost of flexible production schedules.

4. *Attention to the timing of buying.* Durable goods manufacturers must give considerable attention to just when they buy materials which they expect to require. On the one hand, conditions in materials markets are subject to substantial change capable of making it expensive to buy at the wrong times. On the other hand, manufacturers may often be able to extend or contract market positions in materials without much risk at least of buying goods that will not be needed.

5. *Correction of error.* Attribute 1 of the model implies that errors in forecasting sales will not have the systematic relation to rates of change that seemed to apply to department stores. Indeed, for many firms, error in procurement associated primarily with errors in forecasts of shipments may be relatively minor. Attribute 4, on the other hand, implies that other factors influencing procurement will often be faultily foretold—market changes are volatile. Also, conditions which were correctly foretold at the time when buying was done may change, and thus cause ownership to be presently too large or too small and accordingly require correction. In part, this correction will involve materials outstanding, since it is in the goods-on-order segment that much of the first import of market-oriented buying falls. But as orders are delivered, stocks on hand are affected, and accordingly their volume too may be judged too large or too small. Note, however, that all of these characteristics involve a good deal of ambiguity about when ownership is too large or too small. If so, the correction of error is likely to be less a matter of enforcement of some precise norm than of resistance to the extent of departures from the norm. Thus, as stocks diverge from their normal relationship to shipments, either because of changes in utilizations, in buying, or in the pattern whereby outstandings are delivered, pressures to reverse the discrepancies build up and are acted upon.

surprising result may well be explained by the possibility that in earlier studies unfilled orders were serving as a proxy for anticipated sales volume. . . ." This could mean that anticipations were themselves based in important part on the behavior of backlogs.

Basic Characteristics of the Model

The models that I have sketched incorporate much that is familiar. They reassert, particularly, some of the basic thinking and findings of Franco Modigliani and his collaborators, Charles Holt, Kalman Cohen and others.[18] The emphasis I have placed on the

[18] A summary of a good bit of this work may be found in Charles C. Holt and F. Modigliani, "Firm Cost Structures and the Dynamic Responses of Inventories, Production, Work Force, and Orders to Sales Fluctuations," in *Inventory Fluctuations and Economic Stabilization, Part II,* materials prepared for the Joint Economic Committee, 1961 (87th Congress, 1st Session). See also Charles C. Holt, F. Modigliani, J. F. Math, and H. A. Simon, *Planning Production Inventories and Work Force,* Englewood Cliffs, N.J., 1960.

relevance of changing costs and opportunity costs of stocks is paralleled by their analysis of the impact of changes in production volume and in levels of factory activity. For "warehouse stocks," they believe that these elements are largely absent because of the relative costlessness of shifting the variations in demand to suppliers. This sort of thinking implies that different models are required for some sorts of enterprises than for others—a notion that in a different form appears very strongly in the two models I have presented. These similarities are reassuring since we have all approached the study of inventory behavior by addressing ourselves to the functions that stocks serve in individual enterprises and to the cost structures that are relevant to efficient management.

Nevertheless, the work reported in the foregoing chapters does suggest certain emphases which differ enough from other work to have substantial implications.

For one thing, full attention to opportunity costs implies that the behavior of stock will be different not only for the various sorts of stockpiles, a notion developed by Moses Abramovitz long ago, but also for different sorts of businesses. This is sharply demonstrated by the very different behavior of materials stocks in department stores and in durable goods manufacture (both a "warehouse" variety).

A second matter of emphasis is far richer in analytic consequences. The germinal notion is the serious attention to materials ordering as distinguished from materials receipts. This brings to the fore three sets of considerations: First, the large changes in orders outstanding that can result from changes in actual or expected market conditions. Changes in outstandings leave an imprint on stocks. Moreover, since leadtimes have strong cyclical patterns, cyclical fluctuation in stocks will tend to be larger than it would be if this set of influences were absent. Incidently, this last remark applies also to many of the other changes in cost structures, which likewise have conforming cyclical patterns.

The second set of considerations concerns the speed and relative costlessness with which corrective action can be taken in the form of adjusted new orders when stocks or total materials ownership departs from desired levels. In consequence one cannot be satisfied to interpret sales-stock relationships in terms of distributed lags, a common device in econometric analysis. For ownership, the association is, we find, actually synchronous. This line of thought implies that if one must concentrate on stock rather than ownership it is essential to envision the particulars of forecasting, ordering (including the cascade of orders of different term), and enforcement techniques and priorities. However it may often be more informative to make the analysis in two groups: first explain ownership and second explain the flow of outstandings into stock.

The third set of consequences generated by my emphasis on orders is more subtle and more important. Orders placed for materials are orders received by suppliers. The information conveyed by the order and the associated expectations can touch off actions which have "multiplier effects" but without the usual time lags. They can coincide with or precede, as well as follow, the initial inventory investment, a subject taken up in the following chapter.

Finally, the emphasis on how expectations about supply conditions affect demand and vice versa, necessary implications of market-prospect-oriented buying, raises questions concerning how demand-and-supply conditions, and expectations concerning each, interact. Obviously these interactions must constitute an important part of an inventory model for durable goods manufacturing. However, as with the department store model, the feedback elements cannot be specified until some remaining questions are considered. Market information is rapidly conveyed; it can be acted upon almost immediately; the impact of these actions on markets, and on suppliers,

and thus on the further information that is conveyed and further expectations aroused, is likewise swift. *Why, then, are the contours we have examined not that of a sharp rise, a sharp fall, followed by perhaps a period of doldrum?* I shall propose an answer to this question in the last chapter. But first it is necessary to review the impact of these inventory and buying waves on economic fluctuations at large.