UNFILLED ORDERS, PRICE CHANGES, AND BUSINESS FLUCTUATIONS*

Victor Zarnowitz

I. The Problem and the Conceptual Framework

Backlog Accumulation. Short-run changes in the backlog of orders received by manufacturers but not yet filled can be a very revealing measure of the varying demand and supply conditions that confront an important segment of the American economy. In the years since 1939 for which aggregate data on manufacturers' orders are available, the average volume of backlogs, especially for durable goods which account for the bulk of unfilled orders, has been large, both in dollar value and relative to manufacturers' sales (see Table 1). The large cyclical fluctuations in unfilled orders, both in absolute amounts and relative to current shipments, reflect the tendency for the average delivery periods to lengthen and shorten in periods of expanding and contracting demand, respectively.

In the late 1940's and 1950's, following the long period of war economy, strong pressures of demand on capacity prevailed much of the time in large areas of industry. For buyers, this often meant inability to get goods at their current prices *without longer-than-usual delivery delays*. Many suppliers must have been working at levels of output where average variable costs and marginal costs were rising, the latter often very sharply. In this zone of inelastic supply, the one-sided effect of capacity constraint becomes manifest: during a single month, a firm cannot fill from current output more orders than its physical capacity to produce permits, but it can receive orders far in excess of that amount. When orders are accepted at such a rate and the increase in unfilled commitments becomes greater than that in shipments, substantial delays must presently appear between the receipt of an order and the beginning of work on it. The appearance of such lags in production starts is a sign that demand has exceeded supply at the prevailing price.

Conditions of this sort would be expected to favor, and feed on, high-level expenditures on plant and equipment. But in time such investment spending results in the growth of manufacturing capacity. During the recent post-war period, that growth was certainly rapid by historical standards and apparently also relative to the expansion of manufacturing output.[1] By

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[1] According to the estimates in *Business' Plans for New Plants and Equipment*, annual surveys prepared by McGraw-Hill Department of Economics, the index of manufacturing capacity rose 67 per cent between 1948 and 1957. In the same nine years, the FRB index of manufacturing output increased only 41 per cent.

Inspection of charts on the ratios of backlogs to shipments for the major manufacturing industries provides another indication of the large increases in industrial capacities during this period, for time series of these ratios fluctuate around distinctly *downward* trends. The corresponding series on unfilled orders in absolute terms show no such strong trends; some of them seem to have mild inclinations downward; others have none. (These relations are reflected in Table 1; cf. the figures in columns (2) and (8)

TABLE 1. — LEVEL AND AMPLITUDE OF MANUFACTURERS' UNFILLED ORDERS, SALES, AND BACKLOG-SALES RATIOS, 1946–59

UNFILLED ORDERS				SALES (VALUE OF SHIPMENTS)				RATIOS OF UNFILLED ORDERS TO SALES			
Specific Peak (P) or Trough (T)[a]			Amplitude of Rise (+) or Fall (−)[c]	Specific Peak (P) or Trough (T)[a]			Amplitude of Rise (+) or Fall (−)[c]	Specific Peak (P) or Trough (T)[a]			Amplitude of Rise (+) or Fall (−)[c]
Date (1)		Level[b] ($ billion) (2)	(%) (3)	Date (4)		Level[b] ($ billion) (5)	(%) (6)	Date (7)		Level[d] (8)	(%) (9)
DURABLE-GOODS INDUSTRIES											
Oct. 1946	P	29.6	—	Dec. 1948	P	8.1	—	Feb. 1946	P	5.99	—
Sept. 1949	T	17.6	−40	Oct. 1949	T	6.3	−23	Sept. 1949	T	2.41	−60
Sept. 1952	P	75.1	+327	July 1953	P	13.4	+114	July 1952	P	7.72	+220
Nov. 1954	T	44.1	−41	Oct. 1954	T	10.5	−22	May 1955	T	3.51	−55
Jan. 1957	P	61.0	+38	Jan. 1957	P	14.9	+43	July 1956	P	4.54	+29
Oct. 1958	T	43.4	−29	April 1958	T	11.5	−23	June 1959	T	2.98	−34
NONDURABLE-GOODS INDUSTRIES[e]											
Dec. 1947	P	4.8	—	April 1948	P	2.6	—	March 1947	P	2.16	—
June 1949	T	2.0	−58	July 1949	T	2.1	−21	June 1949	T	0.92	−57
March 1951	P	6.1	+202	May 1951	P	3.2	+53	April 1951	P	1.97	+114
Dec. 1953	T	2.5	−59	Jan. 1954	T	2.7	−14	March 1954	T	0.92	−53
Nov. 1955	P	3.6	+45	Jan. 1957	P	3.4	+26	Oct. 1955	P	1.12	+22
June 1958	T	2.5	−30	May 1958	T	2.9	−15	July 1958	T	0.83	−26

[a] Cyclical turning points selected according to the rules adopted in the work of the National Bureau chronology (cf. Arthur F. Burns and Wesley C. Mitchell, *Measuring Business Cycles*, New York, NBER, 1947, 55–66). The series to which these turns refer are all monthly and, except for the unfilled orders of durable-goods manufacturers, are seasonally adjusted. Unfilled orders for durable goods (total) show no significant seasonal variation.

[b] Rounded off from data given in million dollars. The corresponding amplitudes were computed from unrounded figures. Unfilled orders are end-of-month "stock" figures; sales are monthly "flow" rates.

[c] Based on the trough standings for the rises and on the peak standings for the falls.

[d] Expressed in months of sales. Unfilled orders, as of the end of the month, divided by sales for the same month.

[e] The group reporting unfilled orders includes textiles, leather, paper, and printing and publishing. Order backlogs of other nondurable-goods industries are considered zero or negligible in the reported data.

SOURCE: U.S. Department of Commerce, Office of Business Economics.

1957, finally, the demand pressures appeared to abate and excess capacities began to replace excess demands. It must be recognized that the exceedingly large average size of order backlogs in the preceding years reflected the long-lasting effects of wartime developments and induced distortions. But it would be unwarranted to regard large backlog accumulations per se as inherently due to such special or exogenous factors. After all, widespread business booms are a recurrent phase of the United States economy.[2]

Although it is of considerable interest to relate the observed backlog accumulations to investment in capital stock and the ensuing growth in capacity output, this is not the subject of the present analysis. This paper is concerned primarily with short-run price adjustments to demand pressures, and the long-run supply adjustments must remain in the background. Of interest here is why excess demand in some industries resulted in such an accumulation of unfilled orders and in queuing of buyers, instead of being more nearly absorbed by price increases, as was apparently the case in other industries. To put the matter in extreme terms, assume a general expansion in demand and consider two industries, both working at full capacity (in the zone of steeply rising marginal costs) and experiencing the same degree of demand pressure. If one of them reports only increases in prices and none in backlogs and the other only backlog accumulation with stable prices, what would be the industry or market characteristics responsible for such a contrast?

for the successive peak dates.) From this, it can be inferred that, in the aggregate, producers in each of these industries must have acquired the capacity to handle the same volumes of orders in less time.

[2] Certainly such evidence as is available, including the recent aggregative data as well as the earlier and longer series for individual industries, offers little support for the view that "we must expect only under extraordinary circumstances to encounter the backlog of orders . . ." [William J. Baumol, *Business Behavior, Value and Growth* (New York, 1959), 80]. In the cyclically sensitive manufacturing industries, unfilled orders appear to be, on the contrary, not only very large at the height of a boom but also quite substantial in more moderately prosperous times. The reasons for this are explored later in this paper.

The problem seems to have attracted very little explicit interest in the literature. However, Machlup views the second of these hypothetical situations as symptomatic of pricing that is based on costs only, in disregard of changes in demand, and notes that if such "administered" prices prevailed in most markets an approximation to a model of "cost-push" inflation would obtain.[3] In practice, he observes, this is hardly the case since many markets are competitive; moreover, even in those markets where prices are administered, forces of the "demand pull" are not absent in boom periods since customers, anxious to get service, will then often outbid the seller's list price and make it irrelevant. Nevertheless, Machlup recommends study of a theoretical system in which all prices are held at some set (cost-determined) levels even in the face of excess demand, saying that "if there are, in actual fact, *many* industries where backlogs of orders accumulate while prices fail to rise and where job vacancies grow in number while wages fail to rise, then the model has some relevance . . . ."[4]

From the evidence examined for the present study, it is clear that expansions in demand which result in backlog accumulations also lead to price increases of varying but usually sizable amplitudes. This is a significant fact, and it cannot be lightly dismissed on the grounds that there is no need to establish the extreme case — that a sufficiently close approximation to it will do. For if *both* prices and backlogs rise in apparent response to an expansion in demand (new orders), then the model of "cost-plus pricing" is no longer a sufficient explanation and may not even apply at all. The process may instead be interpreted as a natural adjustment to the demand increases by firms that are basically profit maximizers. In this paper it will be argued that such an interpretation is indeed quite sensible, given the nature of demand expectations in cyclically sensitive industries, the necessity for these producers to avoid uncertainty and plan ahead, and the fact that these are typically firms for which price and output variations are not the only means of adjustment to a change in actual or expected business conditions.

Media and Models of Adjustments to Business Change. Rises and falls in demand, reflected in fluctuations in the volume of orders received at given prices, can be met by (A) increases and decreases in the current output and/or price, (B) depletions and replenishments of the inventory of the product, and (C) accumulations and decumulations of the order backlog. Despite the great importance in practice of (B) and (C), the former adjustment has been given a belated and still rather incomplete treatment and the latter is as yet largely ignored in economic analysis. On the other hand, adjustments of type (A) received early and extensive attention in the conventional theory of price.[5]

In the limiting case of instantaneous reactions of type (A), finished stock is always nil and so is the backlog. The smaller the flexibility of inputs, the more shifts in demand are absorbed by price changes and the less by output changes. According to the degree of input flexibility, there is a whole scale of relative price and output adjustments bounded by two extremes: at one end, horizontal marginal costs and reaction in output only, and, at the other, vertical marginal costs and reaction in price only.

It is well known that the marginal calculus of cost and revenue assures, in this pure model relying on (A) only, a continuous or period-by-period maximization of profit; [6] also, that the

[3] See Fritz Machlup, "Another View of Cost-Push and Demand-Pull Inflation," this *Review*, XXVIII (May 1960), 125–139.

[4] *Ibid.*, 128.

[5] In the industry studies of the 1930's, certain segments of the economy were said to react to fluctuations in demand primarily through output changes, others mainly through price changes. Large parts of manufacturing were included in the former category and contrasted with agriculture, which was regarded as representative of the latter. Here, too, the stock and backlog adjustments were given little attention. The introduction of backlog changes as another dimension of the process observed in manufacturing shows how industrial output can, to a certain extent, be stabilized even in the presence of large demand shifts and a high degree of price stability. In sectors in which there are no backlogs, as in agriculture, relative output stabilization of this kind is obviously precluded.

[6] Included here, of course, is the classical model of pure competition, in which an individual firm can adjust only its output rate in response to changes in the market price, which it accepts as a datum. Shifts in demand manifest themselves to the firm only as the price changes into which they are translated by the market. Marginal costs rise with the firm's output rate and are equal to price at the maximum-profit point.

model disregards some of the basic ingredients of economic life — uncertainty, lags of adjustments, cost of change as a function of size and frequency of change. In manufacturing, particularly, the importance of these elements is accentuated by the fact that the demand for many industrial products is highly volatile in the short run and subject to large and varying cyclical movements. Rapid and frequent fluctuations in production rates, however, are undesirable because they are a frequent proximate cause of increased costs and reduced operating efficiency.[7] The greater the input flexibility, the less is the urgency to stabilize production relative to demand, but input flexibility is never complete over the whole range of output variation (though it may be high over a substantial part of that range). Thus, the interaction of demand and cost factors in an unstable and uncertain world often favors the role of stocks and backlogs as adjustment instruments or shock absorbers.

The relative importance of these models of adjustment depends in part on business conditions in a given industry. A model which brings this out very strongly, providing at the same time a sharp contrast to the pure model of price-output adjustments (A), would employ (B) and (C) in the following cyclical sequence. Assume that new orders move cyclically in such a way that their rate exceeds that of capacity production in the latter part of expansion. Then, in the first part of the contraction in buying, the level of production is sustained by drawing upon the backlog of orders carried over from the expansion. As the backlog is exhausted and the contraction of new orders continues, production is supported by working up a surplus inventory of the product. During the first half of the subsequent buying expansion, that surplus finished stock is sold first (in addition to the current output), whereupon, in the second half, a backlog of unfilled orders is again accumulated.

In making maximum use of (B) and (C), this cyclical model magnifies out of proportion certain elements of reality. It implies that backlogs originate only in a strong boom and disappear in a slump, and vice versa for finished stock. Although a tendency toward such behavior probably does exist for certain products, it is too weak to show up in the aggregates or even in the more narrowly defined series in our sample. The model also treats backlogs and stock accumulations in a strictly parallel fashion, whereas in fact the two have some implications that are quite different. The risk that some of the unfilled orders may be canceled during a contraction varies among industries but seldom seems to be large and often is not significant.[8] The risk associated with the accumulation of unsold finished stock, on the other hand, is, as a rule, much more serious and always present in some degree, given the uncertainty of future demand. Needless to say, new orders do not behave in the neat symmetrical manner assumed in the model. Instead, they are for the most part notoriously difficult to predict, and this uncertainty favors the use of (C) rather than (B). As a basic criticism, production stabilization, however important to the firm for cost considerations, is presumably not itself the primary objective, as the pure model of the stock-with-backlog adjustments would imply, and should thus be treated as a means subordinate to, not as a goal commensurate with, profit maximization.

Furthermore, the short-run response mechanism found in practice frequently depends upon certain structural industry or market characteristics. It is not only in the advanced stages of vigorous business expansions and in the early stages of contractions that backlogs of unfilled orders appear, because it is common practice for firms in many lines of manufacturing to undertake production in response to demand ("to order") rather than in anticipation of demand ("to stock"). The important distinction between production to order and production to stock has, on the whole, been neglected in economic theory, which — no doubt for good historical and logical reasons — proceeds on the basic assumption that firms plan their output to meet the expected, but un-

[7] Changes in the output rate will be accompanied by changes in the size and/or the rate of utilization of the work force, which are expensive in various ways: terminal pay, training outlays, overtime premiums, idle time, possible impairments of good labor relations, morale, or productivity.

[8] See my "Timing of Manufacturers' Orders During Business Cycles," in Geoffrey H. Moore (ed.), *Business Cycle Indicators* (Princeton for NBER, 1961), 450–451.

known, market demand. But in the present context, production to order is clearly of major importance.

Plan of Study. Section II of this study examines aspects of industry structure that bear in an essential way upon the dynamic processes to be explored subsequently. One result is the demonstrably large weight of production to order within the manufacturing sector. This would be expected to enhance the importance of backlog adjustments relative to stock adjustments — (C) versus (B).

Section III deals principally with the relationship between changes in price and changes in delivery period and backlog — (A) versus (C). This is treated first in general analytical terms (formulated mathematically in the Appendix), then statistically. It shows that changes in unfilled orders and delivery periods do indeed function as a major instrument for stabilizing the flows of output and shipments relative to those of new orders. The role of uncertainty and competition receives attention in this context. Section IV, finally, provides a summary.

II. Orders, Production, and Industry Structure

Manufacture to Stock and to Order. It will be helpful to consider two models: one, pure production to stock, and the other, pure production to order. In the first, new orders are shipped immediately upon receipt and hence are virtually synchronous with and equal to shipments. Orders that could not be so filled but would have to be taken for future production and delivery are either not placed or not accepted; in the absence of such *advance* orders in the real sense, there are no backlogs. Here the firm has to maintain at all times a sufficiently large unsold inventory of finished products to meet current sales. In contrast, the second case, by assuming production to order only, implies that there are no *unsold* stocks of the finished product.[9] Lacking such stocks, the firm cannot, of course, handle any orders for immediate delivery of the product in question, but is limited to advance orders to be filled from its future output.[10]

Pure production to stock admits adjustments of current output and price (A) and of stock (B); those of order backlogs (C) are obviously precluded. In pure production to order, price adjustments are available to a firm that can influence price. The rates of output reflect those of new orders with lags; the greater the input flexibility, the closer the relationship. It is only with these qualifications, then, that one can refer here to the type (A) adjustments. However, while the volume of output under contract is determined by past orders, the short-period rate of output is not rigidly prescribed, since it also depends on the delivery dates which are often subject, to a considerable extent, to the discretion of the producer. The planned and the unplanned changes in the delivery periods are closely associated with fluctuations in unfilled orders, and these are the "backlog adjustments" (C) that one would presume to be particularly important in this case. The stock adjustments (B) are here, of course, not feasible.

A manufacturing concern is generally a multiproduct firm, often with a highly diversified output. Some of its products may be made to stock and others to order. Some may also shift from one category to the other at certain times. In particular, a product normally sold from stock may temporarily be made to order when orders for it run at peak levels and customers allow lags on their deliveries. But there are good reasons to believe that to a large extent some goods are produced to order and others

[9] This ignores cancellations of orders, which may give rise to some unsold finished stocks, but the relevant data indicate that the importance of cancellations is on the whole relatively small (except at times for military contracts); and surely those cancellations that occur after the ordered items have been produced must be the least frequent of all because of the large risk of loss, an effective protection against which will be sought by the seller. (Cf. *Ibid.*) More evidence will be presented in my NBER monograph "Orders and Production in Manufacturing Industries: A Cyclical Analysis" (in preparation).

[10] To formulate these two models algebraically, let o_t and s_t be the flows of orders received and shipped, respectively, during the t^{th} unit period, say, month, and let z_t be the corresponding flow of output or production. Then

$$o_t - s_t = u_t - u_{t-1} = \Delta u_t, \qquad (1)$$

$$\text{and} \quad z_t - s_t = q_t - q_{t-1} = \Delta q_t, \qquad (2)$$

where u_t is the backlog, that is, stock of unfilled orders, and q_t is the finished-product inventory on hand, both measured at the end of the month t. In pure production to stock, $o_t = s_t$ and $\Delta u_t = 0$ in each period, so that u_t is always zero. In pure production to order, $z_t = s_t$ and $\Delta q_t = 0$ in each period, so that q_t is always zero.