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Volume Author/Editor: Victor Zarnowitz

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Chapter Author: Victor Zarnowitz

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PART II

CAUSES AND IMPLICATIONS OF CHANGES IN UNFILLED ORDERS AND INVENTORIES

6

UNFILLED ORDERS AND INDUSTRIAL ACTIVITY

THIS CHAPTER GIVES a description and interpretation of the behavior of unfilled orders in relation to shipments and other measures of industrial activity, beginning with a formulation of some expectations about these relations.

For goods made to order and subject to fluctuations in sales and delivery periods, new orders might be expected to lead unfilled orders. This hypothesis is based on a generalization of the following cyclical pattern: (1) In expansions, N first rises and then declines, moving throughout above the level of S, which increases steadily. (2) In contractions, symmetrically, N first declines and then rises, moving throughout below the level of S, which decreases steadily. It follows that U increases in expansions and decreases in contractions, since $N > S$ during the former and $N < S$ during the latter. This implies a lag of U behind N at both peaks and troughs, and suggests the likelihood of a roughly coincident timing of U and S.[1] This rests on two assumptions: that new orders have larger fluctuations than shipments, and that they turn ahead of shipments. These should be safe premises to make in the case of manufacture to order and, as already shown, the data bear them out for a variety of industries and products. However, they are not the only relevant facts. Backlog movements, especially when they are large, can themselves strongly influence the scheduling of production and hence the timing of output and shipments.

[1] Using the symbols introduced earlier, this typical turning-point sequence would be written as $N \rightarrow U, S$ (with the arrow pointing from the leader to the lagger and the comma denoting roughly coincident timing). If S turned down *before* N fell below the level of S, U would lag behind S at the peak; if S turned down *after* that happened, U would lead S (and an analogous statement applies, *mutatis mutandis*, at the trough). Unless the discrepancies between N and S are quite large, the timing differences between U and S are not likely to be very great either.

Where backlogs are small, either because the typical delivery periods are short or because production is largely to stock or both, they are also likely to behave less systematically, and their relation to shipments may be quite loose. S would then follow N with a short lag and might turn ahead of U (instead of together with or after U, as was assumed before). On the other hand, where delivery periods are long and backlogs large, production is to a large extent concerned with orders on hand and correspondingly less dependent on currently received (new) orders. Shipments and output are here closely correlated; therefore, S, too, would be relatively more responsive to U and less to N. Given a large backlog just accumulated, one would expect the lags of S relative to U to be pronounced on the downgrade, since an ample stock of orders can sustain production for some time, even when new orders are declining.

An Historical Survey of the Principal Evidence

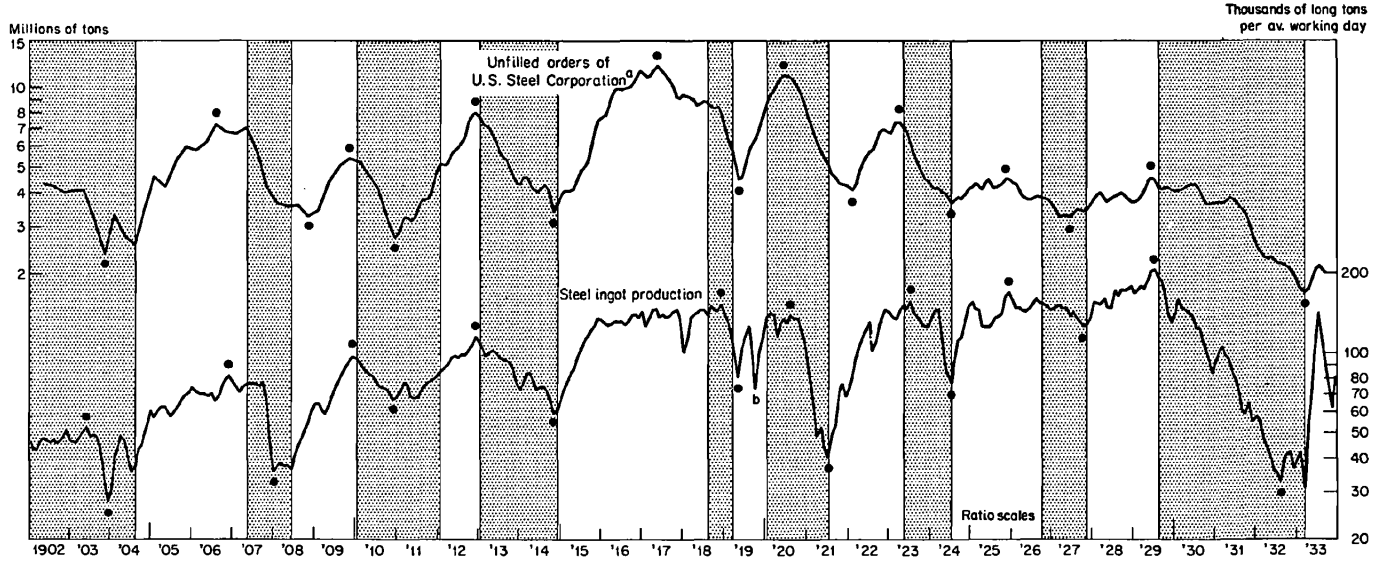
Data for Steel, 1902–33

The earliest historical series on unfilled orders is that of the United States Steel Corporation. The published figures (1902–33) have been regarded as "accurate barometers of the trend of the steel industry and even of general business conditions." [2] In part, their prestige was undoubtedly derived from that of U.S. Steel as the industry leader and was aided by the paucity of available rival indicators. But, some overstated language aside, this series is indeed worthy of considerable attention as a tool of analysis; and it certainly could have been quite helpful to contemporaries as a smooth and highly sensitive cyclical indicator with roughly coincident or slightly leading timing characteristics.

No shipments series to match the U.S. Steel backlog data is available, but steel production has long been measured by the output of ingots as they come from the hearth or converter. Accordingly, Chart 6-1 presents the two series after seasonal adjustments and in the usual form suitable for cyclical comparisons: The dots denote the peaks and

[2] Quoted from a description in Bureau of the Census, *Record Book of Business Statistics, Part II*, Washington, D.C., 1928, p. 7.

Chart 6-1
Unfilled Orders of U.S. Steel Corporation and Steel Ingot Production, 1902–33



Note: Shaded areas represent business cycle contractions; unshaded areas, expansions. Dots identify peaks and troughs of specific cycles. Series are seasonally adjusted.

[a] Quarterly, 1902–10; monthly, 1910–33.

[b] Labor strike.

troughs of the series; shadowed areas in the background denote general business recessions.

There is a one-to-one correspondence between the specific cycles in the two steel series; both unfilled orders and production rose in each business expansion and declined in each contraction. Steel backlogs led output at eight peaks and coincided with output at one. One of these leads, in 1917–18, at the end of World War I, was very long (19 months). This could have been a consequence of the massive backlog accumulation that had occurred at an earlier period when strong demand pressures caused capacity shortages. The other leads at peaks were all short: three of one month each and three of two to four months. At troughs, there were four coincidences, three leads, and two long lags. On the average, backlogs had a short lead relative to production at peaks and nearly synchronous timing at troughs: The means are −3.9 and +0.6; the medians, −1.5 and 0 months.

After the war, unfilled orders of steel had relatively short cycles of declining amplitudes and a decidedly downward trend. Their peak in 1920 was just a little lower than the all-time high of 1917, but the peaks of 1923, 1925, and 1929 were much lower; in fact, the *highest* values of this series in the late twenties lie at about the same level as the first postwar *troughs* in 1919 and 1923 (Chart 6-1). In contrast, steel output was high most of the time during this period and had a rising trend. The implication of a simultaneous decline in order backlogs and rise in output is that the average delivery periods were falling markedly. Indeed, ordering in small quantities and at short intervals, commonly known as "hand-to-mouth buying," was a widespread phenomenon in the 1920's, causing increased concern right up to the onslaught of the depression.

Buying in small lots, mainly or exclusively for immediate requirements, had been a business practice in earlier times. But in the twenties, many regarded it as a new and particularly worrisome problem, perhaps because it came after a long period of rising prices, and a few years of intensive forward buying and inventory accumulation during the war and postwar inflation of 1916–20.[3] The complaint of producers-sellers was that the "buyers' market" was imposing on them the higher costs of handling small orders, greater uncertainty, and more severe limitations on business planning. Actually, many prices were

[3]Cf. Leverett S. Lyon, *Hand-to-Mouth Buying*, Washington, D.C., 1929.

weak or declining in these years, particularly after 1925, and this, as on previous occasions, was a major cause of hand-to-mouth buying. At the same time, the amounts spent by business on plant and equipment were substantial and showed a moderately rising trend. Thus the productive capacities—for manufacturing, transportation, communication—were expanding and improving. Buyers, aware that suppliers could cover their requirements on short orders, appear to have taken liberal advantage of this situation.

Aggregative Indexes, 1920–33 and 1935–44

For the years 1920–33, a monthly index of unfilled orders based on seventeen commodities has been compiled by the Department of Commerce.[4] The U.S. Steel Corporation series accounts for nearly 40 per cent of the total weight in this index, which helps to explain the similarity of the two series (compare the upper curves in Charts 6-1 and 6-2). However, the general trend and cyclical characteristics of steel backlogs were shared broadly by other components of the Commerce unfilled orders index. Chart 6-2 shows the latter along with the Federal Reserve index of manufacturing production. The divergent trends in the two indexes during the twenties are of the same kind as those found in the steel series, which suggests that the tendency to place short orders was common to buyers of a wide variety of manufactured products. The cyclical timing comparisons again indicate a lead of unfilled orders at output peaks and a more irregular, on the average roughly coincident, timing at troughs.[5]

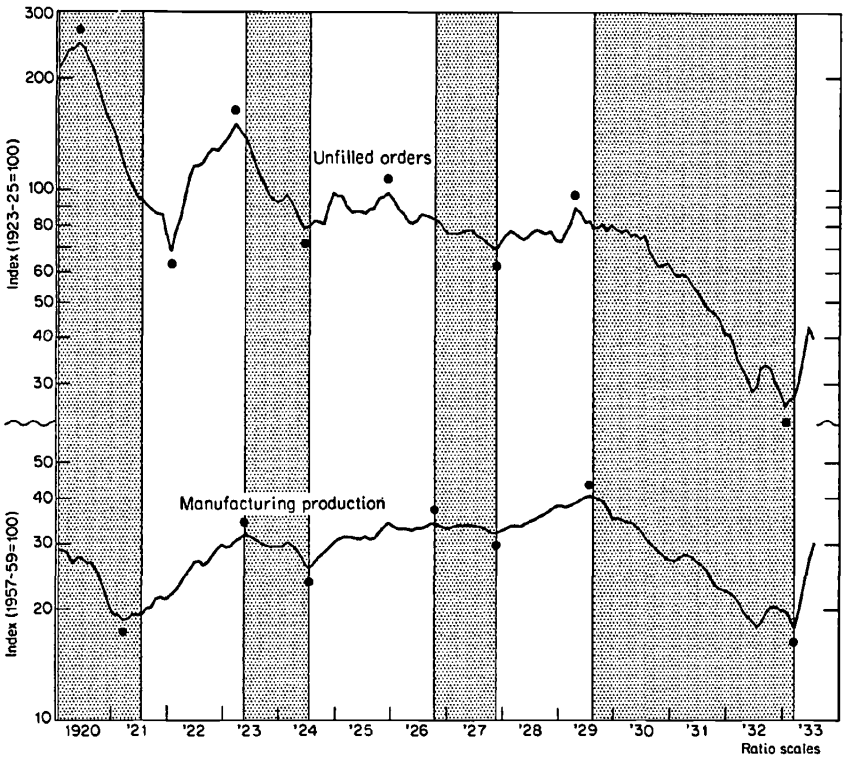
Not surprisingly, unfilled orders fell more rapidly than production during the Great Depression. Between 1929 and 1938, the Commerce index of backlogs declined from approximately 90 to 26 points, or by 71 per cent. The index of manufacturing production went down from 40 to 18 points, or by 55 per cent. This may perhaps exaggerate the

[4] See *Survey of Current Business*, January 1928, pp. 22–23, for a description of this index and data for 1920–27. The composition of the index and the percentage weights of the groups are: textiles (cotton finishing, hosiery, knit underwear, pyroxylin-coated textiles), 16; iron and steel (pig iron, steel, sanitary enamelware), 47; transportation equipment (freight cars, ships, locomotives), 10; lumber products (flooring, furniture), 20; paper (boxboard), 2; brick and glass (common brick, face brick, paving brick, illuminating glassware), 5.

All these series, as well as the combined index, were seasonally adjusted for the National Bureau by the Census electronic computer method.

[5] Backlogs led at the three successive peaks in production by 2, 9, and 3 months (on the average, by 4.7 months). They lagged by 10 months at the 1921 trough in production, but turned up at about the same time as production in the following three recoveries; the mean here is a short lag of unfilled orders (of 1.8 months), the median a short lead (of 0.5 months). Cf. Chart 6-2.

Chart 6-2
Indexes of Unfilled Orders and Manufacturing Production, 1920–33



Note: Shaded areas represent business cycle contractions; unshaded areas, expansions. Dots identify peaks and troughs of specific cycles. Series are seasonally adjusted.

contrast; the production index is a much more comprehensive aggregate than the unfilled orders index. However, the result makes good sense, at least qualitatively. A dwindling of advance orders was inevitable since prices were falling, pessimistic expectations were spreading, and investment goods, which are primarily produced to order, were being hit harder than any other category by the slump in demand.

Most of the new and unfilled order series published by trade associations were discontinued in the early 1930's, and so were the Commerce indexes based on a cross section of these statistics. A new index of the value of manufacturers' backlogs, compiled by the National

Industrial Conference Board, begins in 1935. These figures, introduced in May 1941, refer to three aggregates: (1) durable goods manufacturers (said to cover ten industries); (2) nondurable goods manufacturers (seven industries); and (3) the combined index (all seventeen industries). Chart 6-3 shows the NICB indexes for the durable and nondurable goods sectors separately, and the corresponding NICB shipments indexes.[6]

At the time of the 1937 downturn, industry on the whole was still operating considerably below capacity. The peaks in unfilled orders for both durable and nondurable goods occurred in April 1937, coinciding with the peaks in the corresponding shipments series (Chart 6-3). At these peaks, backlogs were still rather small, absolutely and relative to shipments, even though they had increased substantially during the slow recovery of the thirties, because they had risen from painfully low levels. In January 1935, the ratio of backlogs to shipments was 0.7 for all durable goods; in April 1937, the ratio was 1.3. This is still a low figure compared to the ratio of more than 3.0 in March 1941, when backlogs were said to average from three to eight times more than monthly shipments of the various durable goods industries.[7]

Because they were so low, unfilled orders could provide very little support to production in 1937. Once new orders turned down, which according to the NICB estimates occurred in December 1936 or March 1937,[8] output and shipments had to turn down very soon. There was simply no reserve of unfinished advance commitments to stem or even cushion the fall, and the downturns in both shipments and order backlogs were, as the chart shows, abrupt.

After declining steeply during the recession, the two durables series unmistakably turned up in June 1938 (the month of the general business trough). Through the third quarter of 1939 their recovery pro-

[6] The unfilled orders indexes include the following industries: Durable goods—automobile equipment, building equipment, electrical equipment, iron and steel, machinery, metal products, nonferrous metals, office equipment, railroad equipment, and household furnishings; nondurable goods—boots and shoes, chemicals and drugs, clothing, leather, paper manufactures, and textiles.

The shipments indexes cover the same industries plus two durable goods industries (cement and glass) and one nondurable goods industry (rubber goods).

See National Industrial Conference Board, *Conference Board Economic Record*, New York, May 24, 1941, pp. 223–24, for a description of the unfilled orders indexes and data for 1935–41. For a description of the value-of-shipments indexes and the corresponding data for 1929–40, see *ibid.*, December 26, 1940, pp. 1–11.

[7] Cf. *Conference Board Economic Record*, May 24, 1941, p. 223.

[8] The level in March was only slightly lower than that in December. See Chart 10-1.

Chart 6-3
Value of Manufacturers' Unfilled Orders and Shipments, 1935–44 and 1939–49

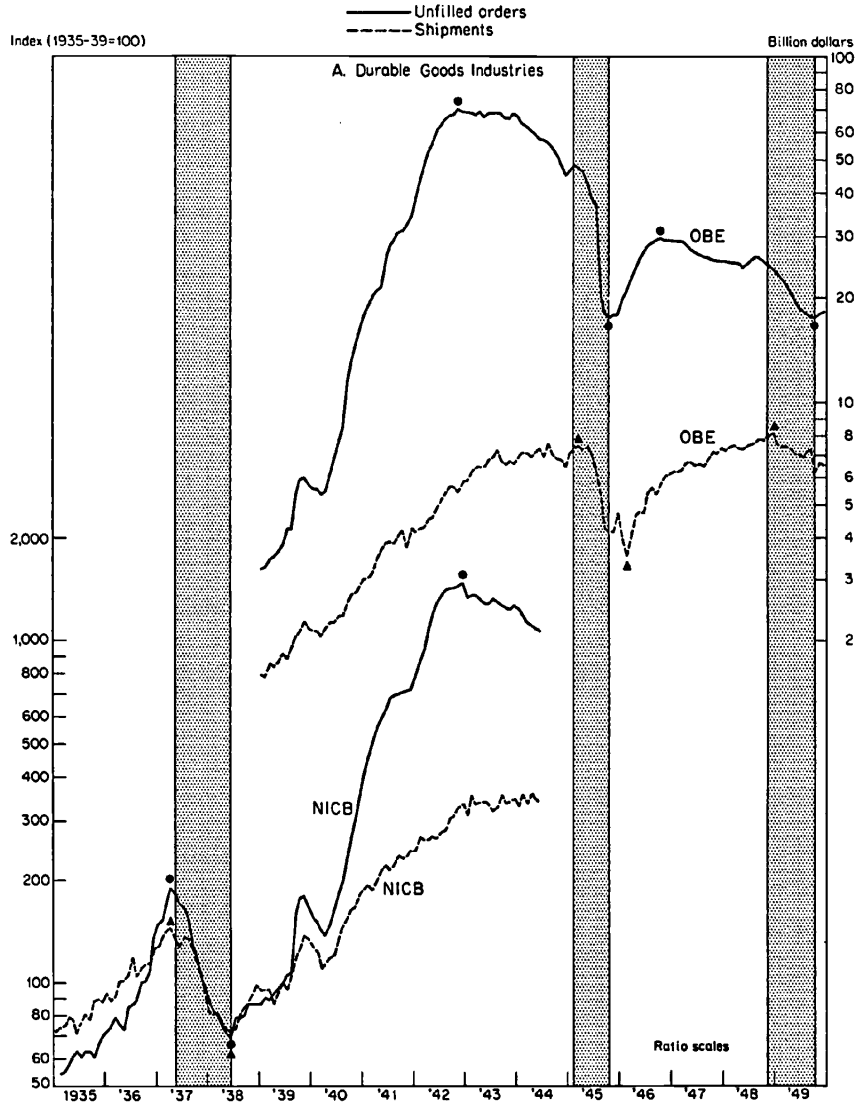
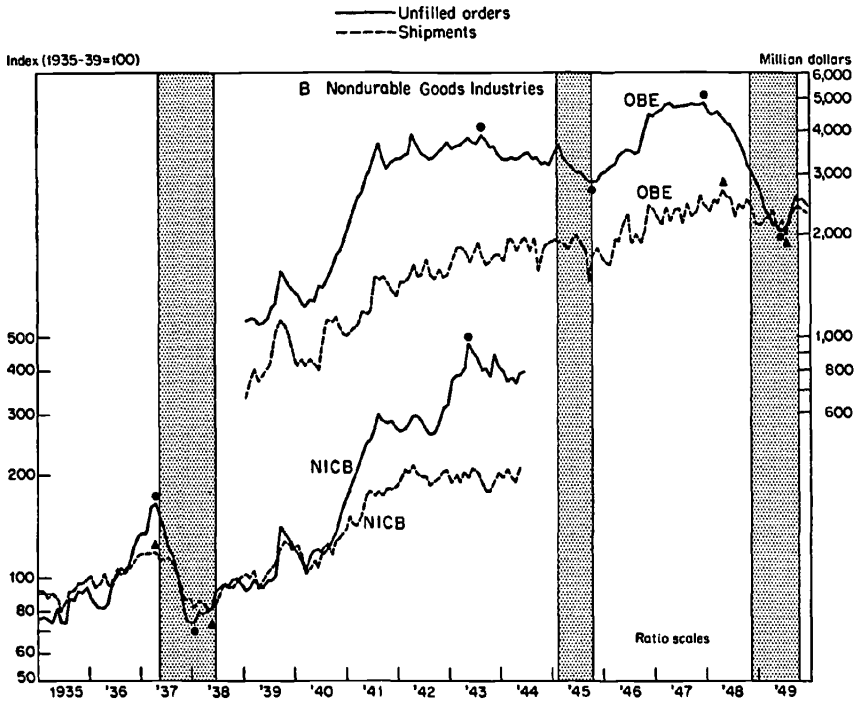


Chart 6-3 (concluded)



Note: Shaded areas represent business cycle contractions; unshaded areas, expansions. Dots identify peaks and troughs of specific cycles in unfilled orders; triangles, sales (value of shipments). Series are seasonally adjusted.

Source: National Industrial Conference Board (NICB) and U.S. Department of Commerce, Office of Business Economics (OBE).

ceeded at similar rates. But then, with the outbreak of the war in Europe and the beginning of the great armament program in the United States, aggregate demand began to outstrip supply, despite fuller utilization of the existing productive resources and the addition of new ones. This is clearly apparent in the chart, which shows that during the period of approximately forty months from mid-1939 through 1942, shipments increased from 100 to about 350 but unfilled orders increased from 100 to nearly 1,500! For nondurables, the levels and increases were of course much smaller throughout, but even here the rise in backlogs was very marked (from 100 in 1939 to a peak of over 450 in

mid-1943) and was much larger than the rise in the rate of deliveries (which just about doubled in the same period).

These movements are easy to understand qualitatively. Production, though expanding greatly, was nevertheless lagging well behind the rapidly rising demand, causing large extensions of the average delivery periods. This was the time of a vast shift in the whole pattern of production as required by the armament program of the government. The creation of complex war industries involved unprecedented investment in new plant and machinery and related equipment. Despite the heavy unemployment that still existed in 1939, shortages soon developed of skilled and semiskilled labor needed in the new industries. Bottlenecks were also reported in some key raw materials, steel capacities, machine-tool production, and shipping.[9]

Comprehensive Current-Dollar Estimates, 1939–49

The aggregative Department of Commerce series on the value of manufacturers' order backlogs for all durable goods industries and a group of reporting nondurable goods industries begin in 1939. These are the most comprehensive data available, and they correspond to the Commerce estimates of the value of manufacturers' new orders, shipments, and inventories. A breakdown of these figures by major industries, however, is not available before 1948.

Chart 6-3 shows the Commerce series on unfilled orders and shipments for 1939–49. During 1939–44, the period covered by both the NICB indexes and the Commerce aggregates, the behavior of the corresponding series in the two sets is very similar, especially for durables (for nondurables there are some more significant differences in 1942–43).

In addition to confirming broadly the findings on the relative changes provided by the NICB indexes, the Commerce figures offer some interesting level comparisons. They show that unfilled orders of all manufacturers underwent an enormous rise in the four years from 1939 to 1942: from $4 billion to about $74 billion. All but $2 billion or $3 billion of these backlogs were in durable goods. At the same time, shipments increased greatly but in far less spectacular manner; sales of durable goods, for example, rose from $1.6 billion to $5.9 billion.

[9] See the annual reviews for 1940 and 1941 in *Survey of Current Business*, February 1941 and February 1942. Also see *Conference Board Economic Record*, May 24, 1941, pp. 225–28.

The first, relatively small wave in backlogs occurred between August 1939 and March 1940 and reflected protective buying against anticipated wartime scarcities and rising prices. New orders fell back to the level of shipments as soon as it became evident that the expected shortages were not about to materialize. Comparing these developments with those observed during the first year of the Korean War strongly suggests that situations of this sort will produce similar reactions (see Charts 3-1 and 3-2 and accompanying text, above).

The next and far greater rise in backlogs, which started in the spring of 1940, mostly represented the excess of new orders for defense products placed by government agencies (mainly with durable goods manufacturers) over the outputs that the producers could supply on relatively short notice. However, orders for civilian goods also increased substantially in this period as a result of rising incomes and, probably, of renewed fears of shortages. After a slowdown in the second half of 1941, unfilled orders for durables rose rapidly in 1942, the first year of active war for the United States, despite impressive increases in production and shipments. The bulk of these orders called for the delivery of war goods by companies converting to war production; the backlogs of nondurables stayed high but increased just a little and erratically. In 1943, unfilled orders leveled off and started declining. The flows of critical materials for war production were by then generally controlled by priorities and allocations, which most likely made "forward buying" more difficult and less needed. Industry was now geared to war needs, and new orders conformed well on the whole to actual requirements, as did the production schedules.

To the extent that the price ceilings imposed upon most categories of goods and services in April 1942 were effective, prices were prevented from rising in counteraction to excess demands. This in itself would tend to contribute to backlog accumulation of purchase orders.[10] But a large part of the output of durable goods manufacturers was actually excluded from the general price-ceiling legislation. The exemption applied to "distinctively military" goods and to products made largely to order at prices determined in individual contracts.[11]

[10] On the relation between price changes and backlog changes, see Chapter 7.

[11] Harvey C. Mansfield and Associates, *A Short History of OPA*, Office of Price Administration, Washington, D.C., 1947, pp. 46–47. Soon after the General Maximum Price Regulation (GMPR) was issued, another regulation (MPR 136) provided a pricing formula for machinery of all sorts. This held a manufacturer to his own price-determining method as of the base period (spring 1942) but did

New orders for durable goods ceased expanding in March and unfilled orders in November 1942; but shipments maintained their rate of growth through the summer of 1943, then oscillated around a high and slightly rising level for about 18 months, and did not turn down decisively until after March 1945 (see the OBE series in Chart 6-3). Presumably, the huge accumulation of backlogs in the early phase of the war helped to keep up production and shipments for a considerable time in the subsequent phase. However, one must add that the downward drift of the backlogs was, according to the Commerce estimates, very mild initially; so no significant decline resulted before 1944. In contrast to the abrupt downturn in 1937 (when backlogs were still low), the big wartime wave in durable unfilled orders was gently rounded off at its peak late in 1942.[12]

At the end of the war, order backlogs dropped sharply under the impact of cancellations of military contracts, but they rose again in 1946. Shipments turned upward only four months after backlogs, in February 1946.

The expansion in backlogs of durable goods that began late in 1945 lasted only one year, and at its end the aggregate value of the accumulated orders was much smaller than it had been during the war. However, the increase in the rate of output was in this phase limited by the difficulties of conversion from wartime to peacetime production, and backlogs were, in effect, still very large relative to shipments (see Chart 6-3). Hence, shipments could again continue to rise gradually for a long time after backlogs ceased growing. The lags of shipments on this occasion were as long as 23 to 26 months for total manufacturing and all durables.[13]

In nondurables, which account for a minor proportion (about 5 to 7 per cent) of total order backlogs of manufacturers, the wartime expan-

not effectively control the labor time and quantities of materials entering into his computation. The decision not to attempt to establish ceilings for military goods was taken tentatively when the GMPR was issued, then confirmed officially in the autumn of 1942. However, large volumes of raw and semifabricated materials used in the production of such goods were left under the general price control of the OPA.

[12] A late version of the NICB figures shows a more pronounced decline of durable backlogs in 1943 (see Chart 6-3), but this series, which was shortly afterward discontinued, is believed to give less reliable evidence here than the Commerce series.

[13] However, among the major component industries, electrical and nonelectrical machinery are the only groups to which lags of this magnitude can be traced (see below, Table 6-1, column 1). Also note the mildness of the 1947–48 decline in durable backlogs and a secondary peak in this series in August 1948 (Chart 6-3).

sion was, of course, much smaller in percentage terms than it was in durables. In contrast, the first postwar wave (1945–49) was relatively larger in nondurable backlogs, reflecting the shifts in demand and the difficulties of reconverting the industries in the period of transition to a peacetime economy.

Major-Industry Series Since 1948

Charts 6-4 and 6-5 present the major-industry series on unfilled orders and their ratios to the value of shipments.[14] The prevalence of horizontal or downward trends is a common characteristic of these series in the decade 1952–62 which followed the great backlog accumulations of the Korean War period. Later in the 1960's, however, rising tendencies are again strongly in evidence for unfilled orders of most component industries and the over-all aggregates.

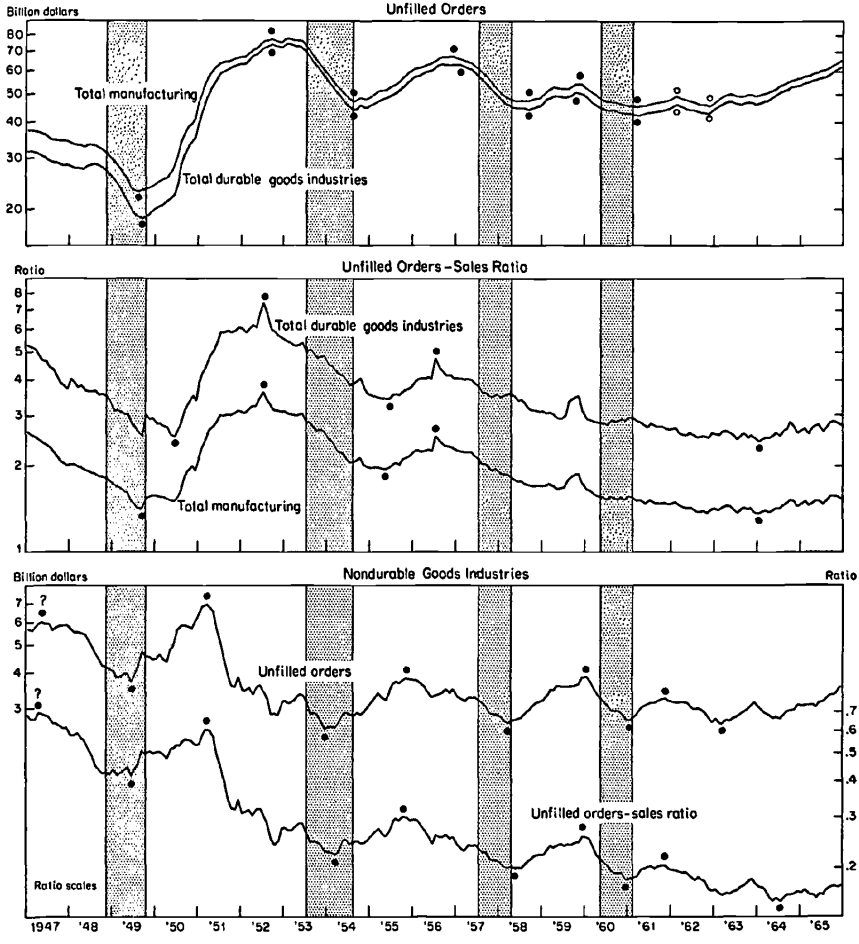
Another feature of these series is the dominance of large cyclical movements during most of the postwar period and the drastic reduction in their amplitudes in the late fifties and the sixties. Unfilled orders of durable goods manufacturers increased vastly in the first phase of the Korean War, 1950–52, then declined much less in the second phase and during the recession of 1953–54. Between 1954 and 1962, three increases in total and durables backlogs occurred which were progressively smaller and shorter; of the three corresponding decreases, each was about equal to the preceding rise in size and duration. As this implies, the successive peak levels of backlogs declined, while the successive trough levels differed little. In other words, the fluctuations in unfilled orders had a downward drift and became at the same time shallower in amplitude.

The aggregates resumed a rather steady upward movement at the end of 1962 (Chart 6-4). After four years, this long climb brought them back to the top levels of 1952, and by mid-1969 most of these series had risen to new all-time heights.[15] This, however, refers to current-dollar values; in constant dollars, the backlogs of the mid-1960's would be smaller than those of the early 1950's. Furthermore, the re-

[14] Data on unfilled orders in the post-World War II period correspond to the data on shipments, inventories, and new orders and come from the same source: The monthly Industry Survey of the OBE before the 1963 revision, and the current Census Bureau compilation thereafter. The OBE industry series begin in 1948; the Census series in 1953. The published data relate to the two-digit industries and (after the revision) to broad market categories.

[15] Unfilled orders for durable goods reached a level of $76 billion in October 1966, just a little above their standing in November 1962. In May 1969, their new peak level was nearly $87 billion.

Chart 6-4
Value of Unfilled Orders and Ratios of Unfilled Orders to Shipments, Total Manufacturing, Total Durable Goods Industries, and Nondurable Goods Industries Reporting Unfilled Orders, 1947–65



Note: Shaded areas represent business cycle contractions; unshaded areas, expansions. Dots identify peaks and troughs of specific cycles; circles, short cycles or retardations. Series are seasonally adjusted.

Source: U.S. Department of Commerce, Office of Business Economics and Bureau of the Census.

Chart 6-5
Value of Unfilled Orders and Ratios of Unfilled Orders to Shipments, Seven Major Durable Goods Industries, Quarterly, 1953–65

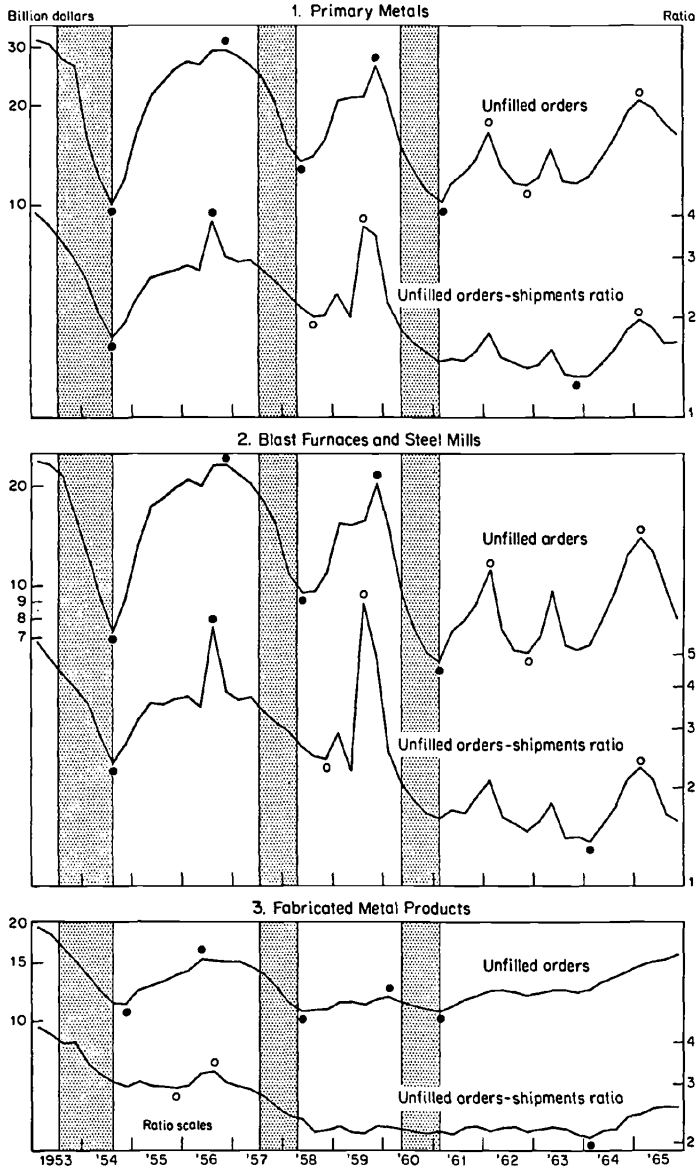
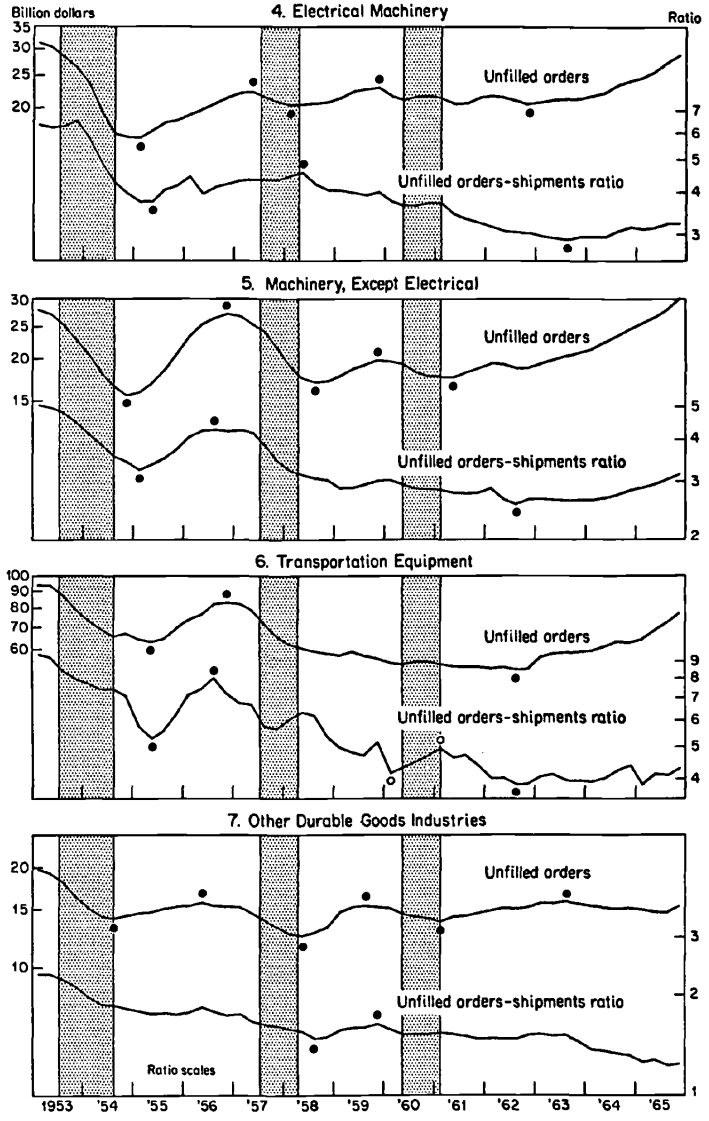


Chart 6-5 (concluded)



Note: Shaded areas represent business cycle contractions; unshaded areas, expansions. Dots identify peaks and troughs of specific cycles; circles, short cycles or retardations. Series are seasonally adjusted.

Source: Bureau of the Census.

cent over-all ratios of unfilled orders to sales are much smaller than they were during the earlier postwar booms.

While this seems to describe the over-all picture fairly, there were differences among the major component industries. Thus the machinery industries show relatively mild fluctuations and more rising trends in their order backlogs; the primary metals series show huge fluctuations and declining trends (Chart 6-5).

Total Backlogs and Backlog-Shipment Ratios

Over long stretches of time, industrial capacities are kept large enough by past and continuing capital formation to accommodate demand at moderate growth rates. Thus, output and shipments had upward trends in 1921–29, but unfilled orders show little of any trend (or some slight downward drift) in the same period (Chart 6-2). This implies that the backlog-shipment (U/S) ratios, an indicator of relative demand pressures, declined in the 1920's. A similar situation prevailed during much of the decade following the Korean War (Charts 6-4 and 6-5).

Cyclically, unfilled orders and shipments move in the same direction much of the time, but the fluctuations of unfilled orders are much larger.[16] Hence, the cyclical course of the backlog-shipment ratios is influenced more strongly by the major movements of U than of S, and in fact tends to reflect closely the course of U for each industry. By the same token, however, the cyclical movements of the ratios tend to be smaller in relative amplitude than the corresponding movements of the backlog series. On the other hand, the U/S ratios are subject to much more frequent and larger irregular month-to-month variations than are the U series, which are remarkably smooth. This reflects not only the much greater smoothness of the backlog values, which are "stock" variables, compared to the shipments values, which represent "flows," but also any cumulation of the errors of observation of U and S in the ratios that combine both.

Strike effects deserve to be specially noted as one type of the major sporadic disturbances that are conspicuous in some U/S ratio series. The industry principally affected is, of course, primary metals. Since its shipments fall drastically during major steel strikes and its backlogs are not much affected, its U/S ratios show needlelike rises and falls

[16] Charts 3-1 and 3-2 show value-of-shipments aggregates comparable to the unfilled orders series in Charts 6-4 and 6-5.

during the strikes in 1949, 1952, 1956, and 1959 (Chart 6-5). Moreover, intensified buying in anticipation of a strike can cause a temporary valley in the ratio series immediately preceding the rise in the strike months (such developments are strongly in evidence in 1949 and 1959). The strike effects cause a certain amount of difficulty in dating some of the turning points in the series.[17]

The backlog-shipment ratio often lags behind troughs in total backlogs but not peaks (Charts 6-4 and 6-5). As already noted, the peaks of large backlog expansions led the downturns of shipments by long intervals. The ratio should begin to decline at least as soon as U does, if S is still rising; indeed, it should turn down earlier if the expansion of U in its terminal phase is slowed down to rates lower than those at which S is expanding. Actually, our charts show that leads of U/S relative to U at peaks are not uncommon, although they tend to be short.

At troughs, in contrast, the timing of unfilled orders and shipments is in most cases roughly coincident. When the two start rising together, the percentage increase of U will often initially be less than that of S, which implies that the upturn of the U/S ratio will lag. For the ratio to turn upward at once, in fact, new orders should increase rapidly in the early expansion phase, overshooting shipments by large amounts and thereby giving rise to sufficiently large positive ΔU. Apparently, this does not occur frequently. Moreover, backlogs have often lagged shipments at troughs since 1954, though usually not by long intervals (see below, Table 6-1). Where this happens, the upturn in U is likely to come at a time when the rise in S is already well on its way, which would accentuate the lag of the U/S ratio.

Market-Category Series Since 1953

The new series on unfilled orders classified by market categories, and their ratios to shipments, are presented in Chart 6-6. These data

[17] The strike peak in 1949 came shortly after the trough in the U/S series for primary metals and can thus be ignored. (That trough was presumably accented, but was certainly not caused, by prestrike buying; compare, for example, the behavior of U and U/S during this episode in Chart 6-5.) In contrast, the strike peak in 1952 came at the time when the ratio series reached its highest levels; it therefore can be regarded as approximately coincident with the "true" specific-cycle peak in this series. The situation was similar in 1956, though here there was still a slight rise in the ratio in the first quarter of 1957. Finally, in 1959 the deep prestrike valley must be disregarded in dating the troughs; but the long strike brought such a pronounced increase in the ratio that the existence of a peak here is not seriously in doubt (cf. also the movement of total backlogs in this period).

It may be added that measures of peak and trough levels and cyclical amplitudes are very strongly affected in these cases, even where the timing measures are not. In an analysis of the peak and trough values of the U/S ratios later in this chapter, we shall in effect smooth out the extreme effects of the strikes (see Table 6-4).

correspond to the series on new orders and shipments analyzed in Chapters 3 and 4.[18]

The recorded course of these aggregates begins from top levels attained early in 1953 and describes steep declines in 1953–54, followed by large expansions in 1955–56 and contractions in 1957–58. After that, the series generally drift downward through 1962, with only very small cyclical variations. Finally, there are the long upward movements after 1963, initially somewhat hesitant but later proceeding at very impressive and sustained rates. Late in 1966 most of these series had already regained their peak levels of 1953.

This is the "typical profile" against which one might consider the differences among the market categories. Thus, the movements of 1955–58 add up to large and almost symmetrical trough-to-trough waves in equipment industries and in the larger part of the category of materials, supplies, and intermediate products. For construction materials, the expansion phase of this cycle was longer but less pronounced, and the contraction phase was more accentuated. The rise in order backlogs for defense products came late (in the last quarter of 1955) and was relatively short (about one year). The ensuing decline in this series lasted, with minor interruptions, through 1962.

The diminution of cyclical movements after the 1957–58 recession was most drastic for the equipment-producing group of industries and for construction materials, and least for home goods and apparel and consumer staples. The expansions of the 1960's have been very large in unfilled orders for equipment, defense products, and materials. The rise in consumer goods backlogs has been much more modest (Chart 6-6).

In the consumer goods category, it is interesting to observe that its total unfilled orders show a succession of clearly outlined specific cycles, even though the corresponding series on new orders and shipments differ by very small amounts (see Chart 3-3). This cyclical pattern is probably largely due to the consumer durables component of this market category. Unfilled orders for consumer durables, available

[18] See in particular Chart 3-3 and Table 4-9 and the accompanying text. For two categories, consumer staples and automotive equipment, no separate figures on unfilled orders are published, though the series on new orders and shipments are available. As shown in Chart 3-3, new orders and shipments run very close to each other for consumer staples and, after 1955, for automotive equipment. This implies that at least the reported *changes* in unfilled orders are small for these products. The *levels* of these backlogs are probably low, too, and the random elements in the changes are likely to be relatively large.

Chart 6-6
Value of Unfilled Orders and Ratios of Unfilled Orders to Shipments, Seven Market Categories, Monthly, 1953–66

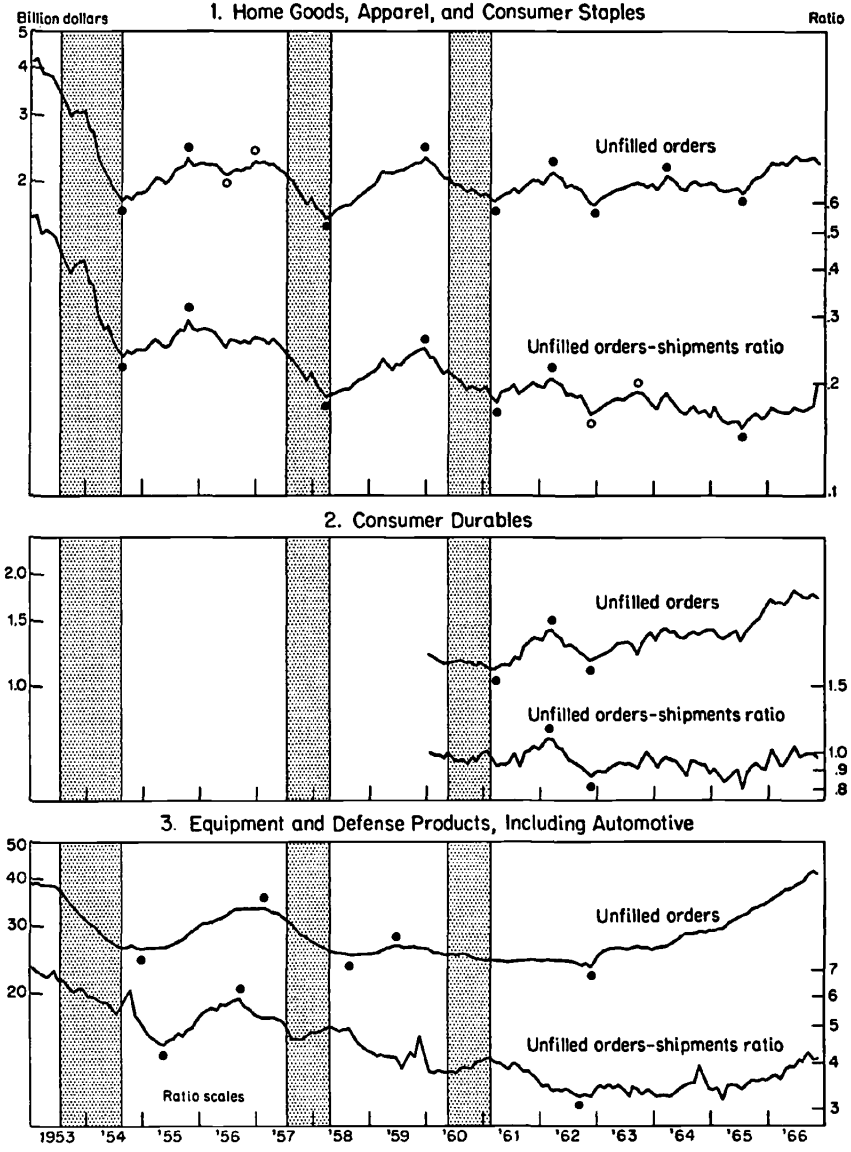
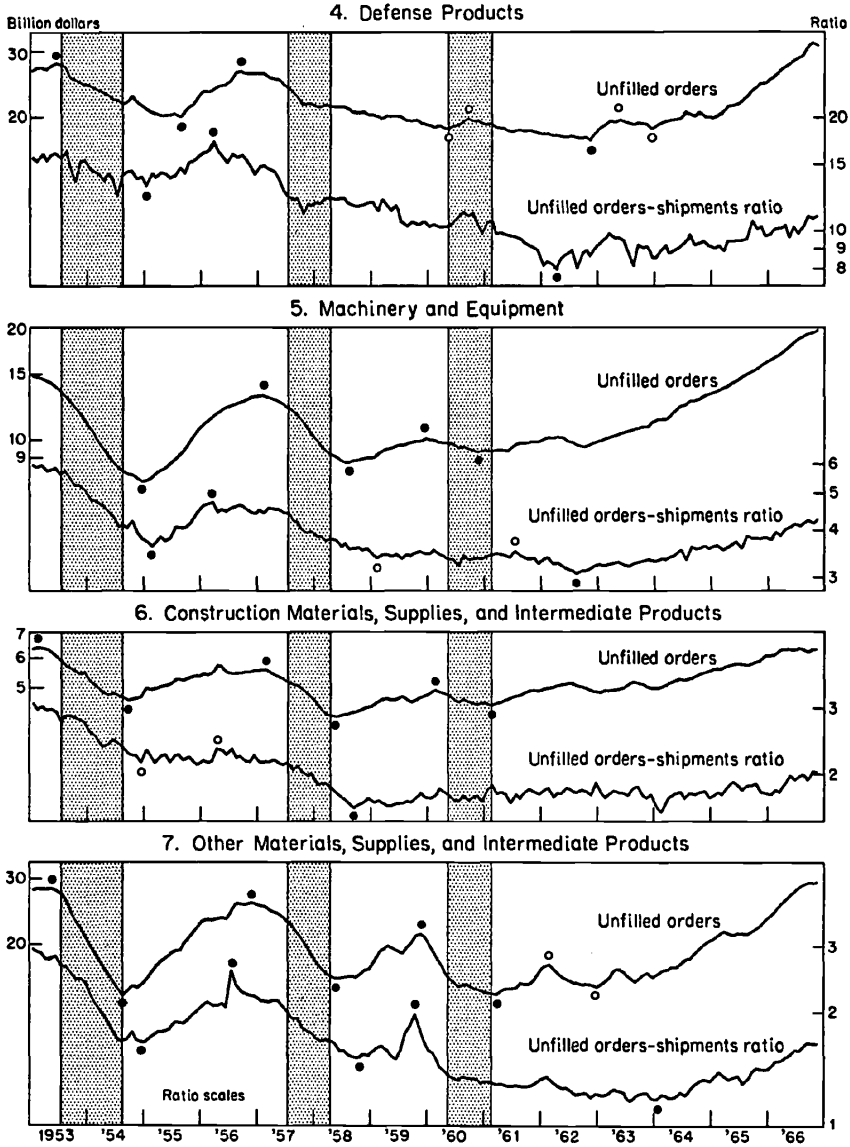


Chart 6-6 (concluded)



Note: Shaded areas represent business cycle contractions; unshaded areas, expansions. Dots identify peaks and troughs of specific cycles; circles, minor turns and retardations.

Source: Bureau of the Census.

since 1960, show broad movements parallel to those of unfilled orders for the total category of home goods, etc., and the timing of the two series in the early 1960's is virtually identical.[19]

Unfilled orders for the different market categories vary greatly in size. Their end-of-month stock values, in billions of current dollars, range as follows in the period 1953–69:

Home goods, etc.	1.6–4.2	Machinery and equipment industries	7.8–25.1
Equipment and defense	23.8–48.9	Construction materials, etc.	4.2–10.9
Defense products	17.4–34.0	Other materials, etc.	14.7–29.0

Thus equipment and defense products accounted for the largest part of the backlog of orders and consumer goods for the smallest, with materials ranking in between. Defense orders represented a larger proportion of the aggregate backlog of commitments to supply machinery and nonautomotive equipment than did the orders on other predominantly private accounts.[20]

The general characteristics of the *U/S* series for the market categories compiled through 1966 are much like those of the corresponding data for the major industries. The ratios show downward trends in the decade 1953–62, interrupted by rises in 1955–56 and 1958–59, and upward movements in the last three or four years that are covered. The longer trends and the short irregular variations are more pronounced and the cyclical fluctuations are less pronounced, in the *U/S* ratios than in backlogs proper. By the end of 1966, unfilled orders for the equipment and defense and materials categories had regained or slightly exceeded their highest 1953 levels, but the backlog-shipment ratios were still considerably lower in 1966 than in 1953. Where turning points in the ratios series can be identified and matched with the

[19] Consumer durables include household furniture, fixtures, and appliances, and various other items such as kitchen articles, hand tools, watches, and personal goods. Home goods, etc., includes knitting and floor covering, apparel, and leather products, additional consumer staples such as food and beverages, tobacco, paper and printed products, drugs, etc. See section on "Market Categories" in Chapter 3 for more detail. In 1960–63, consumer durables accounted on the average for approximately two-thirds of total unfilled orders of the category of home goods, apparel, and consumer staples.

[20] This is in part due to the much longer average delivery periods for the defense products, as indicated by the high *U/S* ratios for this category (see text below). Within total *shipments* of machinery and equipment except automotive, the shares of defense products and of all other items tend to be more nearly equal.

turning points in the corresponding backlog series, rough coincidences or short leads of the ratios are often found at peaks, and lags at troughs.

The *U/S* ratios for the different market categories also vary greatly in their average size and in the amplitudes of their movements. Thus the ratios for home goods, etc., range from 0.15 to 0.56; and those for defense products, from 8.0 to 17.3. Between these extremes are the figures for machinery and equipment (3.1 to 7.2), construction materials (1.6 to 3.1), and other materials (1.2 to 2.9).

Measures of Relative Timing

Major-Industry Series

Turning points in unfilled orders and shipments can be compared in each of the zones associated with postwar recessions and revivals in business activity, with a few exceptions in the nonautomotive transportation equipment and the nondurable goods industries (Table 6-1). No "extra" movements and additional timing observations are recorded here for the Korean War period, unlike the comparisons with new orders in Chapter 4.[21] On the other hand, unfilled orders did undergo minor declines in connection with the business retardation in 1962, which give rise to extra comparisons with shipments in this period (columns 9 and 10).

The leads of unfilled orders at peaks in shipments of durable goods show a definite and strong tendency to get shorter, as can be seen by comparing the odd-numbered columns 1, . . . , 9 in the table. From the measures for the six component industries, the average leads or lags for the five successive peak zones are −9.2, −7.3, −3.5, +1.8, and −1.0 months. However, there are indications of longer leads of *U* relative to *S* at the most recent (1969) peaks in these aggregates (−5 for total durables). It will be recalled that the downward trend of un-

[21] The contractions in unfilled orders of durable goods start generally in 1952 and continue through the 1953–54 recession; their beginning dates match the peaks in shipments that can be associated with the 1953 business downturn. The declines in 1951 did not carry new orders below the levels of shipments; hence backlogs continued to increase and had no "extra" movements and turns in this period.

Backlogs of nondurables turned down early in 1951, and so did shipments. These turns cannot be associated directly with the 1953 recession, and the recording of their comparison in column 3 of Table 6-1 is merely a matter of convenience. However, here too, backlogs show no substantial extra movements; their decline lasted well into the 1953–54 recession (while shipments increased in 1952 and early 1953; see Chart 3-1).

Table 6-1
Timing of Value of Unfilled Orders at Turns in Shipments, by Business Cycle Turning Zones, Major Manufacturing Industries, 1948–62

Industry	Lead (–) or Lag (+) in Months of Unfilled Orders at Turns in Shipments in Turning Zone Associated with: 1948 Recession: Peak (1)	1949 Revival: Trough (2)	1953 Recession: Peak (3)	1954 Revival: Trough (4)	1957 Recession: Peak (5)	1958 Revival: Trough (6)	1960 Recession: Peak (7)	1961 Revival: Trough (8)	1962 Business Retardation: Peak [a] (9)	1962 Business Retardation: Trough [a] (10)	Av. Lead (–) or Lag (+) (months): Peaks: 1948–53 [b] (11)	Peaks: 1957–62 [c] (12)	All (13)	Troughs (14)
All manufacturing	–23	–2	–10	–1	–2	+5	+6 [d]	+2	–2	–1	–16.5	+0.7	–6.2	+0.6
Durable goods, total	–26	–1	–10	–1	0	+5	+4 [d]	+1	–1	–1	–18.0	+1.0	–6.6	+0.6
Primary metals	0	–1	–11	0	–3 [e]	+2	+5 [d]	+1	–1	+3	–5.5	+0.3	–2.0	+1.0
Blast furnaces, steel mills	n.a.	n.a.	n.a.	0	–3 [e]	+2	+5 [d]	0	–1	+5	n.a.	+0.3	+0.3	+1.7
Fabricated metal products	n.i.	0	–10	+1	–12	+1	+8	0	+2	0	–10.0	–0.7	–3.0	+0.4
Elect. machinery [f]	–23	–2	+1	+5	+2	–3	+1	+4 [g]	–3	+2	–11.0	0.0	–4.4	+1.2
Machinery exc. elect. [f]	–22	0	–14	+1	0	–1	–5	+1	–2	–1	–18.0	–2.3	–8.6	0.0
Transport. equip. [h]	–3	–2	–8	–3	–13	n.u.	n.u.	n.u.	n.u.	–1	–5.5	–13.0	–8.0	–2.0
Other durable goods [i]	+2	+1	–2	+2	+5	+1	0	+1	n.t.	n.t.	0.0	+2.5	+1.2	+1.2
Nondurables industries reporting unfilled orders [j]	–12	–1	–2 [k]	+2	–16	0	–6	–1	n.s.	n.s.	–7.0	–11.0	–9.0	0.0

Notes to Table 6-1

Note: All measures for all manufacturing, total durables, and nondurables and measures for the component industries in columns 6–12, are based on the new Census data (1963 revision). The other measures are based on the earlier OBE data (the revised series for the component industries begin in 1953).

n.a. = data not available.

n.i. = not identified (timing uncertain).

n.u. = no turn in unfilled orders.

n.s. = no turn in shipments.

n.t. = no turning points.

[a] These pairs of peaks or troughs represent "extra" turns, not related to a cyclical recession or revival recognized in the National Bureau chronology. All of the comparisons in column 9 and some of those in column 10 refer to dates marking the beginning and end of minor movements or retardations rather than to specific-cycle turns.

[b] Averages of entries in columns 1 and 3.

[c] Averages of entries in columns 5, 7, and 9.

[d] Based on peaks in shipments that occurred in May–June 1959, before the major steel strike in the second half of the year (Charts 3-1 and 3-2).

[e] Based on poststrike peaks in shipments (Chart 3-2).

[f] The pre-1953 measures are based in part on unpublished data received from the Department of Commerce, Office of Business Economics.

[g] Based on secondary troughs in unfilled orders and shipments.

[h] Unfilled orders are compared with shipments excluding motor vehicles and parts.

[i] Includes professional and scientific instruments; lumber; furniture; stone, clay, and glass; and miscellaneous industries.

[j] Includes textiles, leather, paper, and printing and publishing.

[k] Relates to turning points in March and May of 1951. See note 21 in this chapter.

filled orders in 1952–61 was followed by an upward movement of somewhat larger over-all amplitude in 1962–69.

The comparison for nondurables does not show any regular tendency of this sort, but here, too, leads of U relative to S are dominant at peaks and occasionally are long (as before the 1948 and the 1957 recessions).

Short leads and lags prevail throughout at troughs, as shown by a comparison of the even-numbered columns 2, . . . , 10. The averages for the six component durable goods industries at the successive trough zones are −0.7, +1.0, 0, +1.4, and +0.6 months. The averages by industry are also of the same type, mostly short lags of shipments (column 14).

A plausible interpretation of these findings is that they indicate an important link between the size of order backlogs during the expansion and the timing of the downturns of shipments. The evidence supports

the hypothesis that the rise of shipments is prolonged (the downturns lag more) when backlogs are large. However, the output-supporting potential of unfilled orders may vary with changes in productive capacities, relative strength of current demand, and expectations.[22]

The roughly coincident timing of unfilled orders at troughs in shipments contrasts with the lead at peaks, especially the long lead in the first part of the period. Since the upturn in unfilled orders, as we date it, would sometimes come at the end of a "bottoming-up" phase, short lags are not inconsistent here with some active role for the backlog factor. Even a stabilization of unfilled orders following a period of decline may help end the contraction in production and deliveries; and an upturn in unfilled orders, signalizing an influx of new business above the current rates of manufacturing operations, is likely to have a definite stimulating effect.

It is clear that the leads and lags in Table 6-1 vary greatly over time for most industries, and cannot therefore be adequately described by the means in columns 11–14.[23] The purpose of the means is merely to highlight the broad tendencies just discussed.

Average Measures for Subdivisions of the Durables Sector

Measures of the relative timing of unfilled orders and shipments are summarized in Table 6-2 for the detailed industry categories of the pre-1963 OBE compilation. (The underlying data correspond to those used in Appendix E.)

The recorded observations are grouped into (1) those relating to the early postwar peaks, 1948–53; (2) those relating to the more recent peaks, 1957–60; and (3) those at all covered troughs, 1949–61. There were two peak zones in the earlier and two in the later period, and four trough zones. For some industries, however, fewer observations are available, particularly for the early postwar peaks.

In those durable goods industries where manufacture to order is

[22] Note, e.g., that the lags of S at the 1952 peaks of U, although still long, were on the whole significantly shorter than the lags in the 1940's. The U/S ratios were higher in 1952–53 than in 1947–48, but their reduction required more time in the earlier than in the later period. (The ratio for the durable goods industries declined from 5 to 3 in approximately two years during the late forties; it declined from 7 to 5—in terms of generally higher monthly sales rates—in about seventeen months during the mid-fifties.) This may reflect the growth of industrial capacity and efficiency of production; later, when the demand pressures generally subsided, the same forces manifested themselves more directly in the downward trends of the U/S ratios.

[23] The average deviations from these means vary from 2 to 12 months for the 1948–53 peaks, from 1.8 to 7.6 months for the 1957–62 peaks, and from 0.4 to 2.3 months for the troughs.

Table 6-2
Average Timing of Unfilled Orders at Turns in Shipments, by Subperiods and Type of Turn, Thirty Manufacturing Industries, 1948–61

Industry	Average Lead (–) or Lag (+) of Unfilled Orders at Turns in Shipments [a] (months)			
	Peaks [b]			Troughs, All Covered
	1948–53	1957–60	All Covered	
	(1)	(2)	(3)	(4)
Primary metals				
Iron and steel	–6.0	–3.0	–4.5	–0.2
Primary nonferrous metals	–10.5	+0.5	–5.0	+3.5
Other primary metals	–5.5	+1.5	–2.0	0
Fabricated metal products				
Heating and plumbing [c]	n.a.	+6.0	+6.0	0
Structural metal work [c]	n.a.	–3.5	–3.5	+2.5
Tin cans and other [c]	n.a.	–5.5	–5.5	+0.5
Electrical machinery				
Electrical generator apparatus	–9	+10 [d]	+0.5	+10.3
Radio, TV, and equipment	+1	+5 [d]	+3.0	+2.7
Other electrical equipment	–4	+1.5 [e]	–0.3	–3.2
Machinery exc. electrical				
Metalworking machinery	+10	–4 [d]	–7.0	+0.7
General industrial machinery	–18	–4.5	–9.0	+1.5
Special machinery	+1	–13 [d]	–6.0	–2.3
Engines and turbines	–15	–6.5	–9.3	+1.5
Construction machinery	+1	–7.0	–4.3	+3.5
Office and store machines	0	–11 [e]	–5.5	+3.0
Agricultural implements	+1.5	+0.5	+1.0	+8.7
Household and service appliances	+0.5	+4.0	+2.2	+4.8
Other machinery and parts	–15	+1.0	–4.3	+1.2
Transportation equipment				
Motor vehicles	–7	–1.5	–3.3	+0.5
Motor vehicle parts and accessories	–4.5	0	–2.2	+0.5
Aircraft	–4	–13 [d]	–5.5	–7
Other nonautomotive equipment	–5	–6.5	–6.0	–2.2
Other durable goods				
Lumber	+1	–2.0	–1.0	–0.3
Furniture	+5	+1.5	+2.7	+0.7
Stone, clay, and glass products	–1.0	–1.0	–1.0	+4.5
Professional and scientific instruments	–1	–3.0	–2.3	+0.7
Miscellaneous incl. ordnance	–2.0	n.a.	–2.0	+5.0
Nondurable goods industries				
Textile-mill products	–2.3	–2.0	–2.2	+0.6
Leather and leather products	–2.0	–19.5	–9.0	–2.0
Paper and allied products	–8.0	0 [d]	–6.0	+2.2

Notes to Table 6-2

n.a. = not available.

[a] Numbers with decimals represent averages. Negative or positive integers refer to cases in which only one observation was available for the given period and type of turn. (In column 1, such figures refer to the 1953 peak zone, i.e., no observations were available in these cases for the 1948 peak zone.)

[b] Column 1 covers the turning zones associated with the recessions of 1948 and 1953; column 2, those associated with the recessions of 1957 and 1960.

[c] The series begin in 1955, and their first turning points are peaks associated with the 1957 recession.

[d] Single observation; no comparison could be made in the 1960 peak zone.

[e] Single observation; no comparison could be made in the 1957 peak zone.

strongly represented, the tendency for the average leads of U relative to S to be longer at the earlier than at the later postwar downturns shows up clearly in Table 6-2. Of the nineteen industries in this sector for which comparisons can be made (all those in primary metals, electrical machinery, machinery other than electrical, and transportation equipment), eleven show reductions in the backlog leads and five show increases (columns 1 and 2).[24] On the other hand, the results for the group of "other durable goods" show roughly coincident timing of U and S at both the early and the late postwar peaks. There are also no apparent systematic differences between the two subperiods in the observations for the nondurable goods industries.

At troughs, rough coincidences are predominant throughout, with a tendency toward short lags of U and S. This finding, too, is consistent with the results based on the previously introduced data for the major industries.

Market Categories

One-to-one correspondence exists between the cyclical movements of U and S for each of the three groups, machinery and equipment, construction materials, and other materials, despite their divergent trends in the decade starting in 1953 (Charts 3-3 and 6-6). The series for defense products show similar agreement, except in 1959–62 when unfilled orders for defense kept declining almost without interruption while shipments underwent sizable fluctuations. The series for consumer goods also have matching turns except in the early 1960's.

Of the thirteen timing comparisons at peaks identified in Table 6-3,

[24] In three cases, the averages are short lags at the early, and longer lags at the late, peaks.

Table 6-3
Timing of Value of Unfilled Orders at Turns in Shipments, by Business Cycle Turning Zones, Six Market Categories, 1954–62

Industry	Lead (–) or Lag (+) in Months of Unfilled Orders at Turns in Shipments in Turning Zone Associated with							Av. Lead (–) or Lag (+) (months)	
	1954 Revival: Troughs (1)	1957 Recession: Peaks (2)	1958 Revival: Troughs (3)	1960 Recession: Peaks (4)	1961 Revival: Troughs (5)	1962 Business Retardation Peaks [a] (6)	1962 Business Retardation Troughs [a] (7)	Peaks (8)	Troughs (9)
Home goods, apparel, and consumer staples	+8	0	+5	n.m.	n.m.	n.s.	n.s.	[b]	+6.5
Equip. and defense prod.									
Total incl. automotive	+2	–6	+1	–6	n.u.	n.u.	–1 [c]	–6.0	+0.7
Defense prod.	–7	–10	n.u.	n.u.	n.u.	n.u.	–4	[b]	–5.5
Machinery and equip.	+2	0	+1	–7	–4	–4	–2	–3.7	–0.8
Materials, supplies, and intermediate products									
Construc. materials, etc.	+10	0	+2	+8	0	+2	+1	+3.2	+3.3
Other materials, etc.	0	–2	+2	+6	+2	–1	0	+1.0	+1.0

n.m. = not matched.

n.s. = no turn in shipments.

n.u. = no turn in unfilled orders.

[a] These pairs of peaks or troughs represent "extra" turns not related to a cyclical recession or revival recognized in the National Bureau chronology. Except in nonautomotive equipment and defense, the declines of shipments during this period qualify as minor movements rather than specific-cycles contractions.

[b] Only one comparison at peaks is available (see column 2).

[c] Based on the December 1962 upturn in shipments of nonautomotive equipment and defense products. Shipments of automotive equipment expanded throughout in 1961–63. Unfilled orders are much more important in the nonautomotive than in the automotive equipment category.

Table 6-4

Timing of Unfilled Orders at Turns in Production and Shipments, Ten Individual Industries or Products,[a] Various Periods, 1919–63

Period Covered[b] (1)	All Turns: No. of Unfilled Order Turns Covered[c] (2)	All Turns: No. of Shipment or Production Turns: Covered[c] (3)	All Turns: No. of Shipment or Production Turns: Matched (4)	No. of Timing Observations at Peaks or Troughs[d] That Are: Leads (5)	Exact Co-incidences (6)	Lags (7)	Rough Co-incidences[e] (8)	Av. Lead (–) or Lag (+) (months): Peaks or Troughs[d] (9)	Av. Lead (–) or Lag (+) (months): All Turns (10)
I. TIMING AT TURNS IN SHIPMENTS									
STEEL SHEETS									
1919–32	9[f]	9	9	2	1	1	3	–1.0	+1.5
					2	3	3	+3.6	
ELECTRIC OVERHEAD CRANES									
1928–45	7	7	7	2	1		3	–0.7	–2.3
					3	1	2	–3.5	
FOUNDRY EQUIPMENT									
1925–38	6	6	6	2	1		3	–1.3	+1.5
				1		2	1	+4.3	
WOODWORKING MACHINERY									
1921–38	11	11	11	4	1		4	–1.4	–1.0
				4	1	1	6	–0.7	

FURNITURE									
1927–38	9	9[g]	9	2	1	1	4	−0.8	+1.0
				1	2	2	3	+2.4	
RAILROAD FREIGHT CARS									
1925–54	14	16	14	7			2	−6.0	−3.1
				5	1	1	5	−0.1	
MACHINE TOOLS									
1950–63	10	9	9	4				−10.0	−7.1
				5			1	−4.8	
OIL BURNERS									
1933–51	13	9	8	2		1	3	−1.0	+1.9
				1		4	2	+3.6	
OAK FLOORING									
1920–55	23[g]	25[h]	23	3	4	5	11	+0.8	+1.3
				2	1	8	4	+2.0	
II. TIMING AT TURNS IN PRODUCTION									
STEEL SHEETS									
1919–32	9[f]	9	9	2		2	1	+1.2	+2.8
						5	3	+4.0	
PAPERBOARD									
1926–56	21[i]	19[g]	18	8	1		8	−1.7	−1.3
				4	3	2	8	−1.0	
OAK FLOORING									
1920–55	23[g]	19[g]	17	4	3	2	9	−0.4	−1.1
				4	2	2	6	−1.8	

Notes to Table 6-4

[a] Data are in current dollars except for the following: steel sheets, paperboard—tons; freight cars, oil burners—numbers; oak flooring—board feet.

[b] The dates identify the years of the first and the last turn in shipments or production at which the timing of the series can be determined.

[c] Includes some minor but well-established turns (see notes f–i). Comparisons based on these turns are included in the figures in columns 4–10. All numbers refer to the periods listed in column 1.

[d] For each item, the entry on the first line is for comparisons at peaks; the entry on the second line, for comparisons at troughs.

[e] Includes exact coincidences and leads or lags of one, two, or three months.

[f] Includes one turn that may be regarded as a minor rather than a specific-cycle turn.

[g] Includes two minor turns.

[h] Includes six minor turns.

[i] Includes four minor turns.

seven are leads and three are lags of U relative to S; of the nineteen comparisons at troughs, five are leads and thirteen are lags. Most of the leads are relatively long (4 months or more), while most of the lags are short (1 or 2 months). Rough coincidences (observations in the range of ± 3 months) account for less than half of the comparisons at peaks and for about two-thirds of those at troughs.

Backlogs appear to lead shipments for defense products and to lag shipments for consumer goods, but these results rest on an extremely slender basis and might at best have some suggestive value. For the total equipment category and its nondefense component, the evidence is stronger that U led S at peaks and that the two variables were approximately coincident at troughs. Lags and coincidences prevail among the observations for the two materials categories, and the timing averages here are short lags at both peaks and troughs (see Table 6-3, columns 8 and 9).

Individual Industries or Products

Table 6-4 summarizes the timing comparisons between unfilled orders and shipments or output for ten different products or groups of products. Those items are from the sample used in Chapters 3 and 4 for the analysis of the relationships with new orders. Most of the series go back to the 1920's; in several cases, they extend to the post-World War II years.

The products include some items of equipment which definitely represent manufacture to order and have substantial average delivery

periods, some materials made mainly to order but with short delivery periods, and some staples made typically to stock. Railroad freight cars and machine tools exemplify the first, steel sheets the second, and oak flooring the third category. However, the sample gives a rather weak representation to goods made to order and having long delivery lags. This may help to explain the preponderance among these observations of rough coincidences, including many short lags of backlogs, particularly at troughs. For goods made to stock or on very short notice, new orders and shipments usually run closely together and whether N exceeds S or vice versa is often governed by random influences. Where this is true, unfilled orders should show relatively little systematic movement over stretches of time but many small and short irregular variations. These variations in the backlog series should cease and the series should begin expanding only after cyclical or other forces that can cause long systematic runs of positive N-S differences have become dominant. While this argument, *mutatis mutandis,* also applies in principle to runs of negative differences and the beginning of backlog contraction, the two situations are actually not symmetrical, or at least need not be. This is because of delivery delays and backlog accumulations during a business boom; these may occur in any industry and when they do, output and shipments can "feed" on unfilled orders and are likely to lag behind the latter on the downgrade.

A related fact to which the observed timing patterns can be attributed is that unfilled orders were generally small in the interwar years except in the immediate aftermath of World War I; in the depressed thirties, of course, their levels were extremely low. While many time series may be used to illustrate the great economic upheaval that marked the transition to the wartime economy of the 1940's, there can be only a few that showed the contrast as sharply as did the order backlogs, especially for durable goods. From the comparisons underlying Table 6-4, it appears that the timing relations between unfilled orders and shipments changed markedly with the advent of the war. (For example, in the period before 1941, the mean lags of S behind U for railroad freight cars, in months, were 3.8 at peaks and 1.2 at all turns; in the period after 1941, the corresponding figures were 9.0 and 5.5. For electric overhead cranes, the over-all lags were 0.8 months before 1941 and 6 months after.

Backlog-Shipment Ratios

Peak and Trough Values

Table 6-5 lists the successive high and low standings of the *U/S* ratios for the major manufacturing industries and the averages of these values classified by industry and type of turn. The ratios are based on the Census data shown in Charts 6-4 and 6-5, and on the old OBE data for component industries and some of their groupings, which permit coverage of the earlier postwar years, 1948–53.[25]

The backlog-shipment ratios are throughout much higher for the durable goods than for the nondurable goods industries. Even the lowest of the individual ratio series for the durables exceed on most occasions the highest of the ratio series for the nondurables.[26]

In the durable goods sector, transportation equipment has the highest mean ratios; electrical machinery is second; nonelectrical machinery, third; fabricated metals, fourth; and primary metals, fifth. Other durable goods shows the lowest ratios. The ranking is the same for the peak, trough, and "all turns" measures. Among the nondurables, the ranking is also the same at either turn: textiles, leather, printing, and paper, proceeding from the highest to the lowest ratio (Table 6-5, columns 12–14).

The ranks of the industries according to the *U/S* ratios in the different peak and trough zones are highly correlated. This is shown by the "coefficient of concordance," W, which measures the degree of agreement among any number of rankings on a scale ranging from zero (complete randomness) to one (perfect consistency, i.e., preservation of the same ranks).[27] For a subset of observations relating to durable

[25] An analysis of the *U/S* ratios based on the OBE data for 1948–61 was completed before the new series became available in 1963. It shows good agreement with the results which incorporate the revised data.

[26] Compare other durable goods with textile-mill products in Table 6-5.

[27] Let m be the number of rankings and n, that of the items to be ranked. The total of ranks in each of the m arrays is $n(n+1)/2$ and the grand total is $mn(n+1)/2$. (In the present case, it is the industry components of a sector that are ranked and there is a ranking for each period; that is, m refers to the columns and n to the lines of Table 6-5.) If the ranks were randomly allocated, one would expect their sum for each item to be the same, namely $1/n$th of the grand total or $m(n+1)/2$. On the other hand, if the rankings were in perfect agreement, the sums of the ranks for the different items would be $m, 2m, 3m, \ldots, nm$ (in some order not identifiable in advance). The sum of squares of the deviations of these rank totals from $m(n+1)/2$ is $S_{\max} = m^2(n^3 - n)/12$; and the ratio of the sum of squares of the actual deviations (S) to $S_{\max}$ is

$$W = S/S_{\max} = 12S/m^2(n^3 - n).$$

For a complete statement of the theory underlying the measurement of concordance, see Maurice G. Kendall, *Rank Correlation Methods*, London, 1948, Chap. 6.

goods industries, $W = .702$. A few columns are not included in this measure because of gaps caused by the "no turns" entries in the table, but the correlations among the ranks in these columns are even higher.[28] For the subset of the four nondurable goods industries, $W = .916$. These values (calculated with adjustments for tied ranks) are highly significant according to the usual statistical tests.[29]

In short, I find that relatively high backlog-shipment ratios are consistently characteristic of some industries, while low ratios are typical of others, although all these series are subject to trends and fluctuations which are often pronounced. This parallels the results presented early in this book for the stock-backlog ratios (Chapter 2).

Compared with orders and shipments, the U/S series show much less variability over time. Most of the variability is contributed by the peak values whose average deviations from the mean range from 0.1 to 2.1; the range of the corresponding dispersion measures for the trough values is from zero to 0.9.[30] The largest deviations are associated with the largest mean ratios, notably those in blast furnaces, electrical machinery, and transportation equipment.

The figures for the three peak periods in the 1950's reflect the general decline of the backlog-shipment ratios in that decade. For most industries, the U/S values were lower in 1958–60 than in 1955–56 and lower in 1955–56 than in 1951–52 (cf. columns 3, 5, and 7).

Backlog-Shipment Ratios and the Delivery Lags

As ratios of a stock (measured in dollars) to a flow (in dollars per unit period), the variable U/S has a time dimension. For example, if ship-

[28] The computation of W requires that the rankings be complete in each case. The reported value of W refers to the six major durable goods industries listed, and to the periods covered in columns 1–4, 7, 10, and 11. The ranks in columns 5 and 6 (with no entries for nonelectrical machinery) are similar, and they show a correlation of 0.9; the ranks in columns 8 and 9 are identical, and they, too, correspond closely to the others, except that here no measures are recorded for either of the machinery industries.

The concordance coefficients provide a convenient formula for deriving the average of all rank correlation coefficients (Spearman's) that can be computed for the m rankings. Such average correlation equals $\bar{R} = (mW - 1)/(m - 1)$.

[29] The calculated F values are 13.98 for the durables and 56.61 for the nondurables. The test is applied to W after a continuity correction (in which S is decreased by 1 and S_{max} increased by 2). The value of F is computed as $F = (m - 1)W/(1 - W)$, and tables of F are consulted, using the degrees of freedom $n_1 = (n - 1 - 2)/m$ and $n_2 = (m - 1)[n - 1 - 2)/m]$. The 1 per cent significance points ($F_{.99}$) thus found are of the order of 5.0 and 10.0, respectively; the observed F exceeds even the $F_{.999}$ points.

For more detail on this test, see Helen M. Walker and Joseph Lev, *Statistical Inference*, New York, 1953, pp. 283–86.

[30] Standard deviations exceed the average deviations by very small, often very trivial, fractions and are also small relative to the corresponding means.

Table 6-5

Ratios of Unfilled Orders to Shipments, Successive Peak and Trough Values and Averages by Type of Turn, Major Manufacturing Industries, 1948–66

Industry	Peak and Trough Values of Unfilled Orders-Shipments (*U/S*) Ratios [a]											Average *U/S* Ratio at		
	Peak 1947–48 [b] (1)	Trough 1949–50 (2)	Peak 1951–52 (3)	Trough 1954–55 (4)	Peak 1955–56 (5)	Trough 1957–59 (6)	Peak 1958–60 (7)	Trough 1960–61 [c] (8)	Peak 1961–63 [c] (9)	Trough 1962–64 (10)	Peak 1965–66 [d] (11)	Peaks (12)	Troughs (13)	All Turns (14)
All manufacturing [e]	3.1	2.1	5.7 [f]	3.0	4.0	n.t.	n.t.	n.t.	n.t.	2.1	2.7	3.9	2.4	3.5
Durable goods	5.3	2.5	6.8 [f]	3.4	4.7	n.t.	n.t.	2.8	3.0	2.5	3.3	4.6	2.8	3.8
Primary metals	3.3	2.4 [g]	4.5 [h]	1.8	3.8 [i]	2.0	3.9 [j]	1.5	1.9	1.3	2.0	3.2	1.8	2.6
Blast furnaces, steel mills	n.a.	n.a.	5.6 [k]	2.4	6.5 [l]	2.3	8.1 [j]	1.6	2.2	1.4	2.4	5.0	1.9	3.6
Fabricated metal products	4.5	2.7	5.7	2.9	3.3	2.1 [m]	2.4 [m]	2.0	2.3	2.0	2.9	3.5	2.3	3.0
Elect. machinery [n]	4.5	3.4	9.7	3.6	n.t.	n.t.	4.7	n.t.	n.t.	2.8	3.5	5.6	3.3	4.6
Machinery exc. elect. [n]	4.8	2.7	7.2	3.2	4.4	2.8 [m]	3.0 [m]	n.t.	n.t.	2.5	3.7	4.6	2.8	3.8
Transport. equip.	4.2	2.2	11.0 [n]	5.2	8.2	5.4 [m]	6.5 [m]	4.1	5.1	3.8	5.5	6.8	4.1	5.6
Other durable goods [o]	1.9	1.3	2.8	1.7 [m]	1.9 [m]	1.5	1.7	1.4	1.5	1.2	n.t.	2.0	1.4	1.7
Nondurable goods [p]	1.9	1.0	2.0	0.9	1.2	0.8	1.0	0.7	0.8	0.6	0.7	1.3	0.8	1.1
Textile-mill products [q]	2.5	1.1	3.1	1.2	1.9	1.2	1.6	1.1				2.3	1.2	1.7
Leather and leather products [q]	1.5	1.1	1.6	0.8	1.6	0.9	1.5	1.1				1.6	1.0	1.3
Paper and allied products [q]	0.9	0.6	1.1	0.6	0.6	0.4	0.5	0.4				0.8	0.5	0.6
Printing and publishing [q]	1.9	0.7	1.2	0.6	0.8	0.5	0.9	n.i.				1.2	0.6	0.9

Notes to Table 6-5

n.a. = not available.
n.i. = not identified.
n.t. = no turning point.

[a] Each of the successive peak and trough zones is identified by the annual dates of the earliest and latest turns in the *U/S* ratios.

[b] The highest ratios in 1947–48 (data for 1947 are available only for the three most comprehensive series). These are not necessarily the specific-cycle peak values of these ratios. (Since unfilled orders of the durable goods sector declined through 1947 while shipments rose—see Chart 6-3—the ratios for 1948 must be lower than the earlier peak ratios for a number of industries.) Earlier data required to establish the peak ratios for several industries are not available.

[c] These observations refer to minor turns in the *U/S* ratios. Similar observations in other periods are identified in note m.

[d] The highest ratios reached by the time this analysis was completed (the latest available figure refers to November 1966). For the industries in which the *U/S* ratios continued to grow, these values underestimate the true peak ratios.

[e] Industries reporting unfilled orders include the durable goods industries and the four major nondurable goods industries listed on the last four lines.

[f] Average of four monthly values, June–September 1952; used to reduce the reliance on individual ratios, which were strongly affected by a steel strike (Chart 6-4). Averages elsewhere in this table (see notes g–j and l below) were used for the same reason.

[g] Average of three monthly values, July–September 1949.

[h] Average of three monthly values, April, May, and September 1952.

[i] Average of four monthly values, June–September 1952.

[j] Averages of six monthly values, July–December 1959.

[k] Highest value in 1953, the first year covered by this series; probably somewhat lower than the peak ratios in 1952 (judging from the total primary metals data; see Chart 6-5).

[l] Average of six monthly values, June–November 1956.

[m] Refer to minor turns in the *U/S* ratios.

[n] Based in part on unpublished data received from the U.S. Department of Commerce, Office of Business Economics.

[o] Includes professional and scientific instruments; lumber; furniture; stone, clay, and glass; and miscellaneous industries.

[p] Includes textiles, leather, paper, and printing and publishing.

[q] Based on unpublished OBE data for 1948–61.

ments per month are $10 billion and unfilled orders equal $30 billion, the ratio $U/S = 3$ means that the backlog equals three months' worth of current shipments. Alternatively, the ratio indicates that the backlog could be eliminated in three months at the current rate of operation—provided that no new orders were received. Under the more realistic assumption that new orders continue to add to the backlog, even while shipments continue to reduce it, the current value of *U/S* does not tell

how U is going to change or at what rate. These developments depend on the future time paths of N and S.

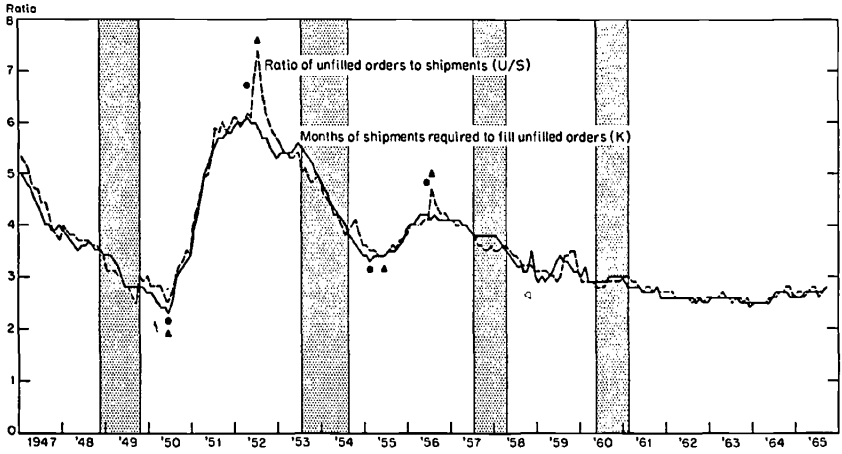
In this connection, it is instructive to consider a recent suggestion that such ratio measures can be improved by using the rates of shipments in later periods instead of the current rate.[31] The procedure rests on the assumptions that customers are served on a first-in first-out basis (orders keep their chronological places in the queue) and that new orders and deliveries are evenly distributed over the periods of observation. Given the backlog U_t at the end of month t, one then asks how many months of the *subsequently* observed shipments would have been needed to liquidate that backlog. That is, one cumulatively adds $S_{t+1}, S_{t+2}, \ldots, S_{t+k}$, and determines the value of k for which $\Sigma_{i=1}^{k} S_{t+i} = U_t$. Like the ordinary ratio U_t/S_t, k can be interpreted as a "number of months." In each case, a stock variable, U_t, is related to flow magnitudes, S_{t+i}, although U_t/S_t uses a single rate of shipments (for the current month, $i = 0$), while k incorporates different, future rates.

Variations in shipments could have such patterns and be large enough to make the estimates of U/S and k significantly different. However, for U.S. durable goods industries, our calculations show that this is not the case. Chart 6-7 compares two estimates of the "average delivery periods" for these industries: the current ratio of unfilled orders to shipments, U/S, and the Steuer-Ball-Eaton measure of "waiting time" defined above as k. The two series are closely similar, although k is somewhat smoother than U/S and considerably less affected by occasional large shocks such as the 1952 strike. While k is indeed conceptually preferable to the ratio of U_t to S_t, it takes more time to compute, and the return on these extra costs seems small. Hence only U/S ratios are used elsewhere in this book. The results of the experiment presented in Chart 6-7 are encouraging, since they suggest that much the same broad conclusions are obtained from an analysis of the current ratios as from a different and presumably better estimation method.

The observed backlog-shipment ratio clearly tells us nothing definite about the magnitude of the lead of new orders relative to shipments. Nevertheless, one might expect a positive association between the size of the ratio and the average length of time that buyers have to wait for delivery on orders currently placed. At least, changes in U/S over

[31] See M. D. Steuer, R. J. Ball and J. R. Eaton, "The Effect of Waiting Times on Foreign Orders for Machine Tools," *Economica*, November 1966, pp. 389–90.

Chart 6-7
Two Estimates of Delivery Periods, Durable Goods Industries, 1947–65



Note: Shaded areas represent business cycle contractions; unshaded areas, expansions. Dots identify peaks and troughs of specific cycles in the *K* index; triangles, the *U/S* ratio. Series are seasonally adjusted.

Source: Bureau of the Census.

time may serve as an approximation to changes in the average waiting or delivery periods. Also, there is some reason to believe that a cross-sectional relationship may exist: An industry that has a backlog of unfilled orders that is large relative to output and shipments is presumably an industry in which production to order is important and delivery periods are substantial. By the same token, an industry with low *U/S* ratios is likely to have only a small proportion of its output made to order.

Industry Averages for the Ratios and Lags

Comparisons of the average *U/S* ratios and the average leads of *N* relative to *S* for the major manufacturing industries (Table 6-6) do show some correspondence between the two sets of measures. Transportation equipment has the highest ratios and the longest leads, while the "other durables" group has the lowest ratios and the shortest leads among the major components of the durable goods sector. Leather, paper, and printing have very low *U/S* ratios and also, on the average,

Table 6-6

Means, Medians, and Standard Deviations of Backlog-Shipment Ratios and of Leads of New Orders at Turns in Shipments, Major Manufacturing Industries, 1948–64

Industry and Statistic[a]	Backlog-Shipment Ratios[b] at Turns in: New Orders P (1)	New Orders T (2)	Shipments P (3)	Shipments T (4)	Timing[c] of New Orders at Turns in Shipments (mos.) P (5)	Timing[c] of New Orders at Turns in Shipments (mos.) T (6)
ALL MANUFACTURING[d]						
M	3.2	2.8	2.9	2.7	2.4	3.8
Md	2.9	2.5	2.8	2.5	2	3
SD	0.9	0.7	0.7	0.4	1.9	2.9
DURABLE GOODS						
M	3.8	3.4	3.6	3.2	5.6	4.6
Md	3.7	3.0	3.1	3.0	5	3
SD	1.0	0.8	0.9	0.5	4.6	3.8
PRIMARY METALS[e]						
M	2.9	2.7	2.8	2.5	3.6	4.6
Md	2.8	2.6	2.9	2.0	3	3
SD	0.7	1.0	0.8	1.1	3.6	4.0
BLAST FURNACES, STEEL MILLS[f]						
M	2.9	2.8	2.6	2.1	6.8	5.6
Md	3.0	2.6	2.0	2.0	3.5	3
SD	0.6	1.0	0.9	1.6	7.2	4.4
FABRICATED METAL PRODUCTS						
M	3.3	3.3	3.1	3.1	2.2	4.5
Md	2.9	3.1	2.8	2.7	2	4.5
SD	1.1	1.1	1.2	1.2	2.0	3.0
ELECT. MACHINERY[g]						
M	4.5	4.8	4.4	4.9	2.5	1.2
Md	4.2	4.4	4.0	4.2	2.5	2.5
SD	1.0	1.6	1.1	2.0	1.7	3.7
MACHINERY EXC. ELECT.[g]						
M	3.7	3.2	3.5	3.1	5.0	4.2
Md	3.7	3.1	3.5	3.1	3	5
SD	0.8	0.4	0.8	0.3	3.8	2.8
TRANSPORT. EQUIP.						
M	6.5	6.4	5.6	6.0	2.2	3.8
Md	6.0	5.9	5.2	6.5	3	1
SD	2.1	1.1	1.6	1.1	5.2	4.7

(continued)

Table 6-6 (concluded)

Industry and Statistic [a]	Backlog-Shipment Ratios [b] at Turns in New Orders P (1)	New Orders T (2)	Shipments P (3)	Shipments T (4)	Timing [c] of New Orders at Turns in Shipments (mos.) P (5)	T (6)
OTHER DURABLE GOODS [h]						
M	2.0	1.9	1.9	1.9	0.8	1.4
Md	1.9	1.8	1.8	1.8	0	0
SD	0.3	0.5	0.3	0.5	2.3	2.8
NONDURABLE GOODS [i]						
M	1.4	1.0	1.3	0.9	3.4	2.8
Md	1.1	0.9	1.1	0.9	4	3
SD	0.4	0.3	0.4	0.2	2.8	2.0
TEXTILE-MILL PRODUCTS [j]						
M	2.0	1.4	1.8	1.3	3.6	4.2
Md	1.7	1.3	1.7	1.2	4	5
SD	0.5	0.4	0.5	0.2	1.9	2.3
LEATHER AND LEATHER PRODUCTS [j]						
M	1.2	1.1	1.1	1.2	0.6	4.0
Md	1.2	1.0	1.2	1.2	0	4
SD	0.1	0.1	0.2	0.1	1.2	1.0
PAPER AND ALLIED PRODUCTS [j]						
M	0.8	0.6	0.7	0.6	3.5	(0.5)
Md	0.8	0.6	0.6	0.6	3.5	(0.5)
SD	0.2	0.1	0.1	0.1	2.5	2.5
PRINTING AND PUBLISHING [j]						
M	1.0	0.7	0.8	0.8	0.0	(0.5)
Md	0.8	0.8	0.7	0.8	[k]	[k]
SD	0.5	0.1	0.4	0.0	0.7	0.5

P = troughs.

T = peaks.

Note: The entries for the individual durable goods industries are based on the older (pre-1963) OBE data for the period 1948–52 and on the new Census data (1963 revision) for 1953–62. The entries for all manufacturing and for the durable goods aggregate are based on the new data. The entries for the four individual nondurable goods industries are based on the older data for 1948–61 only. The same series were used earlier in this chapter for unfilled orders and shipments (see, e.g., Tables 6-1 and 6-2); the series for new orders are of the same vintage and cover the same years.

[a] M = arithmetic mean; Md = median; SD = standard deviation.

Notes to Table 6-6 (continued)

[b] The dates of the turns are those used in the measures of the leads of new orders relative to shipments (the leads included in the averages of columns 5 and 6).

[c] All the figures denote average leads of new orders relative to shipments, except those in parentheses, which are lags. The means (M) are the same as the corresponding entries in Table 4-6, column 8, and in Appendix E, Table E-1, columns 11 and 12, lines 28–31, written without sign. See Tables 4-5 and E-1 for the full record of timing underlying these measures. The medians and standard deviations (Md, SD) are based on the same observations as the means.

[d] All industries reporting unfilled orders; includes the durable goods industries and the four major nondurable goods industries covered in the last twelve lines.

[e] The values of the *U/S* ratios at the 1952 troughs in new orders and shipments were estimated by averaging over selected months (April, May, and September for the new orders chronology and June–December for that of shipments) to dampen the effects of the steel strike. In 1959, prestrike turns were used.

[f] Data begin in 1953. In 1959, prestrike turns in *N* and *S* were used.

[g] Based in part on unpublished data received from the U.S. Department of Commerce, Office of Business Economics.

[h] Includes professional and scientific instruments; lumber; furniture; stone, clay, and glass; and miscellaneous industries.

[i] Includes textiles, leather, paper, and printing and publishing.

[j] Based on unpublished OBE data for the period 1948–61.

[k] Only two observations are available.

very short leads. These results do not depend greatly on whether the *U/S* ratios are measured at their own turning points or at those of new orders or shipments. In Table 6-6, ratios at turns in both new orders and shipments are presented. Typically, the values of *U/S* are higher at the turning points of *N* than at those of *S* but the differences are small (compare columns 1 and 3, and columns 2 and 4).

It appears in several instances that the average leads show haphazard interindustry differences, while the average *U/S* ratios yield more systematic and meaningful results. The leads provide a fair basis for discrimination only in the extreme cases. The correspondence between the industry ranks according to the two measures is also limited to these cases.

General considerations suggest that no more than a loose association may be expected between these two quite different and independently derived sets of estimates. One major reason lies in aggregation over industries with different types of manufacture and different incidence and lags of delivery. The observable timing relations between *N* and *S* can be quite sensitive to the characteristics of the resulting

compositions.[32] For example a major industry as diversified as electrical machinery has large order backlogs for many products and thus relatively high U/S ratios. At the same time, the lags of S behind N are typically rather short in this industry, which may be caused by offsetting effects of aggregation.

Further complications may arise because of vagaries in the course of sales or new orders and the effects of the resulting uncertainty and errors of prediction. In manufacture to stock, scheduling production depends on expectations of market sales. When these turn bearish early, production may well be curtailed with little delay, even if total order backlogs for the industry's other products are still large. In fact, it should be clear that large backlogs do not *insure* long lags of output at peaks in new orders even in manufacture to order, except in the probably rare cases where suppliers are committed to rigid production schedules under large long-term contracts. Large backlogs do *enable* firms to continue producing at high rates in the face of declines in current demand, but when such declines are expected to be severe and persistent enough, the costs of maintaining the high rates of output will appear greater than the costs of changing the rates. Production cutbacks will then be made. Thus the short lags of the electrical machinery shipments may also occasionally or in part reflect prompt reactions to early changes in expectations of market sales.

The peak-trough differences in the ratios are generally small, often inappreciable, and sometimes "perverse" in the sense that the peak values are smaller than the trough ones (columns 1–2 and 3–4). Much of this is due to discrepancies in timing between the ratios and either new orders or shipments. The average lags of shipments show large but by no means uniform or systematic differences between peaks and troughs. For example, as noted in Chapter 4, some of the lags at troughs were unusually long for particular reasons.

[32] Suppose that industry A sells all but one of its products from stock; the single item it makes to order accounts for a small proportion of the value of its output but requires a long delivery period. On the other hand, suppose industry B produces only to order, with sizable delivery periods for its individual products; but the time patterns involved are such that the over-all average delivery period for the value aggregates of all its products is short. Then industry A would have low U/S ratios, in terms of values of total backlogs and shipments, and substantial lags of S behind N. This is because for most of A's output $N = S$, but for a small part of it, which alone determines the lag, the two variables differ and N precedes S by long intervals. Industry B would, on the contrary, have relatively high U/S ratios and short lags of S behind N. This is because, by assumption, B has at any time a large volume of advance orders to be processed but the delivery lags on its products largely cancel each other out, leaving short average lags only in the relation between its aggregate new orders and shipments.

Because of the limitations of data and measures, it seems inadvisable to go into the detail of the comparisons by industry and type of turn.[33] On the whole, the *U/S* ratios are far more stable and well-behaved than the timing comparisons, which are particularly sensitive to irregular and episodic influences. The ratios show much less dispersion than the timing measures, as can be seen by comparing the respective standard deviations and averages in Table 6-6. Hence the averages of the *U/S* values are more representative of their distributions than are the averages of the *N-S* leads of theirs.

Table 6-7 presents measures of the same type for twenty-seven subdivisions of the durable goods sector. It was hoped that the difficulties arising from aggregation would be somewhat reduced in these comparisons, which apply to more narrowly defined industrial categories. The table is based on the older OBE data and has a simplified format.[34]

Both the average backlog-shipment ratios and the average leads of new orders indicate substantial and apparently systematic differences between the subdivisions of several major industries, namely, nonelectrical machinery, transportation equipment, and the other durables group. It is significant that in each of these cases the two measures identify the same component industries as having extreme ranks. Thus metalworking machinery and engines and turbines have the highest *U/S* ratios and the largest *N-S* leads, while office and store machines, agricultural implements, and household appliances are at the other end in either ranking. Aircraft ranks high and motor vehicles low according to either measure. Among the "other durables," only one subdivision has high average *U/S* values—professional and scientific investments—and this is also the only industry in the group that shows long lags of shipments behind new orders.

The main counterexample is electrical machinery, where the relatively high backlog-shipment ratios observed before for the group as a whole appear to be common to all three subdivisions, while the order leads are on the average short.

[33] There is little doubt that errors of measurement adversely affect the present results. In particular, the combination of low *U/S* ratios and relatively long lags of *S* behind *N* may arise partly from overestimation of the lags at turning points.

[34] For the *U/S* ratios, only the values at turns in shipments are used (the corresponding measures at new-order turns are very similar). The means and the medians of the ratios differ little, too, and only the former are included.

The Relations Over Time

The cross-sectional hypothesis—that those industries which have high (low) average U/S ratios would also tend to have relatively long (short) average leads of new orders relative to shipments—turned out to have some limited support in the data. Its counterpart for time series is that, over the cycle, long leads of N relative to S would occur when the U/S ratio for the given industry is high, and short leads when the ratio is low. This, too, is unlikely to be a regularly observable relationship for several reasons, some already noted, and others noted below.

The vagaries of individual observations are particularly troublesome here, since the analysis is concerned directly with comparisons at successive turns rather than with averages. But more is involved than technical difficulties of estimation. The relative timing of new orders, output, and shipments depends on other systematic factors in addition to the rates of capacity utilization and the size of backlogs. Expectations influence the speed and strength of reactions to changes in demand, while being themselves affected by the size and other characteristics of current and earlier changes.

The greater and the more sustained the change in demand, the more definite the expectations and the stronger the response. This point seems reasonable on a priori grounds and also consistent with the evidence. Thus the reaction of the industry to a sluggish and hesitant reversal in new orders would tend to be slower or weaker than the reaction to a more decisive and visible reversal. A related influence is the size of the changes before the turn. Consider a recovery preceded by large declines in new orders and much smaller declines in shipments (which implies a sizable backlog decumulation). In this case, new orders have relatively low levels at the upturn and for some time thereafter, and backlogs continue to be reduced; whether or not incoming business will regain its strength is still uncertain, and as long as this is so, output and delivery rates are more likely just to be stabilized than appreciably increased. The developments in 1953–54 illustrate this. At the 1953 peaks, the lags of shipments behind new orders were generally shorter than at the 1954 troughs. Backlogs were ample, absolutely and relative to shipments, throughout this period, but they were larger in 1953 than in 1954. In 1953, the declines of new orders were large and steep, from levels about equal to those of shipments. In

Table 6-7

Average Ratios of Unfilled Orders to Shipments and Average Leads of New Orders at Peaks and Troughs of Shipments, by Subdivisions of Durable Manufactures, 1948–61

Industry [a]	Value of *U/S* Ratios at Turns in Shipments [b]		Timing [c] of New Orders at Turns in Shipments [b]		
	Mean (1)	Standard Deviation (2)	Mean [d] (3)	Median (4)	Standard Deviation (5)
Primary metals					
Iron and steel (5, 5)	3.2	0.8	2.2	2	1.6
	3.2	1.3	4.4	1	4.6
Primary nonferrous metals (5, 5)	1.5	0.2	1.2	1	1.7
	1.7	0.4	(0.8)	0	1.2
Other primary metals (5, 5)	2.6	0.8	3.4	3	2.7
	2.5	1.2	3.4	3	2.2
Fabricated metal products [e]					
Heating and plumbing (2, 2)	3.6	0.4	(0.5)	[f]	1.5
	5.0	0.4	6.0	[f]	2.0
Structural metal work (2, 2)	2.4	0.9	2.0	[f]	5.0
	1.9	0.4	5.0	[f]	1.0
Tin cans and other (2, 2)	1.6	0.2	2.5	[f]	0.5
	1.4	0.2	1.5	[f]	0.5
Electrical machinery					
Electrical generator apparatus (4, 4)	5.5	1.3	0.2	1	3.3
	5.7	0.4	0.8	1.5	5.0
Radio, TV, and equipment (5, 5)	5.5	2.1	(0.8)	0	1.9
	7.2	2.5	1.8	2	3.2
Other electrical equipment (5, 5)	4.3	1.5	1.2	0	1.9
	4.9	0.7	6.5	7.5	4.0
Machinery except electrical					
Metalworking machinery (2, 3)	6.8	2.0	14.0	14	1.0
	3.4	0.7	8.0	6	6.7
General machinery (5, 5)	5.4	1.3	4.0	5	3.9
	5.6	1.3	4.6	4	1.7
Special machinery (4, 4)	4.4	1.1	5.5	5.5	0.5
	4.0	2.1	5.3	7	3.9
Engines and turbines (4, 3)	5.7	0.5	16.3	20	7.4
	7.4	1.4	3.5	2.5	2.7
Construction machinery (4, 5)	3.5	1.2	6.5	8	3.8
	3.1	1.1	2.8	1	3.1

(continued)

Table 6-7 (concluded)

Industry [a]	Value of *U/S* Ratios at Turns in Shipments [b]		Timing [c] of New Orders at Turns in Shipments [b]		
	Mean (1)	Standard Deviation (2)	Mean [d] (3)	Median (4)	Standard Deviation (5)
Machinery except electrical (cont.)					
Office and store machines (4, 5)	1.8	0.3	3.3	4	0.9
	1.9	0.3	0.8	−0.5	3.8
Agricultural implements (4, 4)	2.8	0.7	1.0	1	0.7
	3.1	0.8	1.3	1	1.2
Household and service appliances (6, 6)	2.6	0.5	2.7	4	2.6
	3.1	0.9	3.5	1.5	4.4
Other machinery and parts (3, 4)	4.3	0.9	4.7	5	3.7
	3.8	0.6	4.5	5	1.5
Transportation equipment					
Motor vehicles (6, 6)	1.0	1.0	3.8	2	6.5
	1.9	1.8	3.4	2.5	4.1
Motor vehicle parts and accessories (6, 6)	3.8	1.3	4.6	4	2.7
	3.6	1.4	3.0	1	3.8
Aircraft (3, 3)	14.7	3.4	12.0	[f]	2.0
	17.5	4.3	11.0	[g]	[g]
Other nonautomotive transportation equipment (3, 4)	6.5	2.0	6.5	[f]	1.5
	6.6	1.5	9.0	12	4.2
Other durable goods industries					
Lumber (2, 3) [h]	0.7	0.2	2.0	[f]	2.0
	0.8	0.5	0.7	1	0.5
Furniture (2, 3) [h]	0.8	0.2	1.0	[f]	1.0
	0.9	0.2	0.3	0	0.5
Stone, clay, and glass products (5, 5)	1.4	0.3	1.2	3	2.7
	1.5	0.3	0.4	0	3.2
Professional and scientific instruments (3, 3) [h]	5.8	0.9	7.0	[f]	1.0
	5.7	0.2	7.7	7	2.5
Miscellaneous including ordnance (3, 3) [h]	1.4	0.7	0	[f]	2.0
	1.2	0.3	0.3	−1	1.9

Notes to Table 6-7

[a] The first figure in parentheses gives the number of observations on the *U/S* ratios at peaks; the second, the number at troughs.

[b] For each item, the entry on the first line is for peaks; the entry on the second line, for troughs.

[c] All the figures in columns 3 and 4 denote average leads of new orders relative to shipments, except those in parentheses, which are lags.

[d] Same as the corresponding entries in Appendix E, Table E-1, columns 11 and 12, written without sign. See that table for the full record of timing underlying these measures. The medians and standard deviations in columns 4 and 5 are based on the same observations as the means.

[e] The series on unfilled orders for the components of the fabricated metals industry begin in 1955.

[f] Only two observations are available.

[g] Only one observation is available.

[h] The series on unfilled orders for these industries begin in 1953.

1954, new orders moved up hesitantly from levels well below those of shipments.

All possible obstacles notwithstanding, rank correlations between the successively observed lags of shipments behind new orders and the corresponding *U/S* ratios are positive for most of the durable goods industries. For the durables aggregates, Spearman's correlation coefficients, adjusted for tied ranks, are .648 and .836, depending on whether the ratios are measured at turns in new orders or at turns in shipments. For transportation equipment, the corresponding coefficients are .607 and .621; for fabricated matals, .548 and .388; and for blast furnaces and steel mills (since 1953), .603 and .230. In the first two cases, both figures are significant; in the others, at least the larger figure in each pair is.[35] However, the rank correlations for the other major components of the durable goods sector are low enough to be of doubtful or no significance.[36]

Evidence supporting the relationship is provided by data for individual industries, which go back to the years before World War II. Table

[35] Predominantly positive results were also obtained in earlier calculations based on the older (pre-1963) data. For the averages of seven major industries, the rank correlation is .64; for the averages of twenty-seven industrial subdivisions, it is .60. These measures use *U/S* ratios taken at turns in new orders; when the ratios at the turns in shipments are used instead, somewhat lower correlations (of .57 and .52, respectively) are obtained.

[36] The significance points for rankings of ten or fewer items are given in *Biometrika Tables for Statisticians*, Vol. 1, ed. E. S. Pearson and H. O. Hartley, Cambridge, 1958, Table 44, p. 211.

Table 6-8
Rank Correlations Between Leads of New Orders, Backlog-Shipment Ratios, and Related Measures, Five Industries, 1919–56

Industry	Timing Measures: New Orders Relative to Shipments (S) or Production (Z) (1)	Timing Measures: Period Covered [a] (2)	Number of Paired Observations [b] (3)	Coefficients of Rank Correlation [c] Between Timing Measures and: Ratio: U/S or U/Z (4)	Coefficients of Rank Correlation [c] Between Timing Measures and: Production as Per Cent of Capacity (5)
Steel sheets	S	1919–32	9	0.50	0.63
Woodworking machinery	S	1923–38	10	0.44	
Furniture	S	1926–45	8		0.33
Paperboard	Z	1926–56	17	0.31 [d]	0.52
Oak flooring	S	1918–54	19	0.11	

[a] Identifies the dates of the first and of the last turning point in shipments or production.

[b] Equals the number of ranks used in the correlations; refers to the periods listed in column 2.

[c] Spearman's coefficient adjusted for the presence of "ties" or duplicated rank standings. The underlying data are three-month averages centered on the month of turn in shipments or production, as indicated in column 1. Backlogs = U.

[d] Correlation between the leads of new orders relative to output (see column 1) and ratios of backlogs to output (U/Z).

6-8 shows that the correlations between the leads of new orders and the corresponding U/S ratios are all positive for these limited materials. For one industry, paperboard, production rather than shipment figures were used, with similar results.

The leads of new orders are also positively correlated with the rates of capacity utilization in the given industry at the turning points. These correlations are somewhat higher than those with the backlog-shipment (or backlog-output) ratios (cf. cols. 4 and 5).

While none of these associations is close, their consensus in sign is not likely to be accidental. It supports the presumption that the lags of production behind orders tend to be longer, the larger the relative size of backlogs and the higher the capacity utilization.

Summary

Unfilled orders (U) would be expected to move in the same direction as the business cycle, since there is a tendency for new orders (N) to exceed shipments (S) in expansions and for $N < S$ in contractions; also, U should lag behind N, whereas its timing relative to S would probably be roughly coincident. However, this scheme is partly oversimplified because of the implicit treatment of the order backlogs as merely a product of the past history of N and S without any active influence of its own. Actually, backlog movements can themselves strongly affect the scheduling of production and the timing of shipments. Where the backlogs are large and the delivery periods are long, production and shipments are concerned in a large measure with old orders on hand rather than with current orders; that is, they then depend relatively more on U and less on N. At high peak levels of U, the lags of S would often be long, since an ample stock of orders can sustain production for some time, even when the current order receipts are declining (witness the wartime and postwar developments in 1917–18 and 1942–48).

Where backlogs are small, either because the typical delivery periods are short or because production is largely to stock, they are likely to behave less systematically and their relation to shipments may be rather loose. In the decade 1952–62, following the build-up of the Korean War period, backlogs had horizontal or downward trends and drastically reduced cyclical movements. At both the peaks and troughs of this period, unfilled orders have for the most part had either rough coincidences or lags relative to the corresponding shipments series. Afterward, long upward movements have reasserted themselves in the order backlogs of durable goods industries, and shipments show again a sizable lag at the recent peak of these backlogs in 1969.

The U/S ratios have a time dimension and provide some indications of the changing average duration of delivery lags. The ratios for the durable goods sector have been declining most of the time in the years 1953–63 (from levels of 6.0 or more to about 2.5). Afterward, through 1969, they were generally larger (mostly close to 3.0, with a high of 3.5 in October 1967), but still much lower than in the 1950's. For most of the industries, cyclical fluctuations of U/S resemble those of U but are smaller. The U/S ratios often lag behind total backlogs at troughs, but

coincide with or lead backlogs at peaks. This conforms to expectations: Demand pressures reach their greatest intensity before aggregate output peaks, but revival of production at low levels of capacity utilization does not imply an immediate lengthening of the average delivery or waiting times.

The average size of backlogs differs greatly among the industries: It is, of course, large for durable goods and small for nondurables (the latter account for no more than 5–7 per cent of total unfilled orders of manufacturers). The U/S ratios show similar interindustry differences. In the durable goods sector, transportation equipment has the highest average ratios; electrical and nonelectrical machinery rank second and third; fabricated and primary metals, fourth and fifth; and other durables show the lowest ratios. In terms of market categories, defense products show the highest U/S figures, followed in descending order by machinery and equipment, materials, and consumer goods.

An industry with a high (low) average U/S ratio is probably an industry with a large (small) proportion of output accounted for by advance orders that have long delivery periods. This, however, does not imply that a close relation must exist between these ratios and the average lags of S relative to N at turning points, because of the disturbing effects of uncertainty about the future course of sales, of aggregation, of other measurement errors, etc. Actually the hypothesis of a positive association between these two quite different and independently derived sets of estimates does receive a modest degree of support from the data. Also, rank correlations between the successively observed lags of shipments at turns in new orders and the corresponding U/S ratios are typically positive although not high.