Volume Title: Postwar Cycles in Manufacturers' Inventories

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Volume Publisher: NBER

Volume ISBN: 0-870-14094-9

Volume URL: http://www.nber.org/books/stan62-1

Publication Date: 1962

Chapter Title: Purchased-Materials Inventories and Inventory Investment

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Chapter URL: http://www.nber.org/chapters/c2001

Chapter pages in book: (p. 27 - 60)

# 4

# Purchased-Materials Inventories and Inventory Investment

Abramovitz began his investigation of purchased-materials behavior by adopting a preliminary hypothesis that "stocks of raw materials generally grow and decline with manufacturing activity." [1]

Although he recognized that movements in prices may play a role, this hypothesis provided the principal basis for his inquiry. Purchased materials were seen to move in response to changing levels of output, but with delays occasioned principally by lack of immediate availability of the materials in question. The analysis based upon this hypothesis consisted principally of estimating the length of the average period of delay in securing materials. This estimate was based on a special study made during the preparation of the 1929 Census of Manufacturers, which classified materials used by manufacturers according to their origins.[2] On the basis of this study Abramovitz concluded that "most raw materials stocks held by manufacturers are likely to vary positively with a short lag" and that total manufacturers' stocks of purchased materials might be expected to conform closely to business cycles, "lagging 3 months or somewhat more at turning points." [3] Moreover, movements in purchased-materials inventory investment were expected to be a lagged reflection of movements in the rate of change in output. Evidence at hand did not permit him to estimate how long the lag might be. He simply noted that "a lag of investment in raw materials behind the rate of change in output of even 6 months would still leave this class of investment leading business cycle turns by several months. This, of course, is presumably subject to considerable irregularity, especially near business peaks, corresponding to the irregularity in the timing of turns in the rate of change in output." [4] In an analysis of the behavior of 10 raw-materials inventory series, however, he found support for the tentative conclusions reached in his estimate of typical timing based on availability of materials.[5]

No study such as that used by Abramovitz is available for the postwar period, and there is no basis for an accurate comparison of

[1] Abramovitz, "Inventories and Business Cycles With Special Reference to Manufacturers Inventories," New York, NBER 1950, p. 178. His definition of raw materials as "goods purchased by manufacturers but not yet manipulated by their owners," is used in this study as a description of "purchased materials." It should be noted that purchased materials defined in this way include not only raw or semiprocessed materials, but also fully fabricated component parts, such as carburetors purchased by automobile manufacturers or small motors purchased by the producers of electric fans.

[2] Abramovitz divided these stocks into three groups according to source. The first group included commodities purchased from manufacturers or mines in this country. The stocks which were presumed to be available from suppliers on relatively short notice accounted for approximately two-thirds of all purchased materials used by manufacturers in 1929. A second group, comprising about 10 percent of the raw materials purchased by manufacturers, was composed of imports. These stocks are not easily adjusted to changes in requirements. The third group, accounting for approximately a quarter of manufacturers' raw materials, included products (principally agricultural) whose availability is subject to short-term movements that are independent of current demand. Abramovitz noted that materials in either of these last two classes might actually be quickly available if they were storable and typically held in large quantities by middlemen (e.g., cotton stored by cotton merchants). Ibid., pp. 184–187, 314.

[3] Ibid., p. 317.

[4] Ibid., p. 467.

[5] Ibid., pp. 192–239.

postwar and interwar composition of stocks. Fortunately, however, there is recent direct evidence relating to the availability of purchased materials. The National Association of Purchasing Agents has published monthly, since April 1955, statistics on purchasing leadtimes as reported by their members. Each respondent reports monthly the basis of its purchasing policy for principal purchased materials within one of the following categories: Hand-to-mouth buying, 30-day requirements, 60-day requirements, 90-day requirements, 120-day requirements, or more.

These NAPA statistics indicate that, in the main, purchased materials are readily available, but to a greater or lesser degree depending on the stage of the business cycle. This is apparent in the following data which show the percentage of purchasing agents reporting leadtimes of 60 days or less for production (purchased) materials in business cycle peak and trough months (see also chart 16):

| | *Percent* |
|---|---|
| Peak, July 1957 [1] | 75 |
| Trough, April 1958 | 91 |
| Peak, May 1960 | 79 |

[1] June data were used because no July data were published.

Clearly, Abramovitz' assumption that most purchased materials are available within a relatively short span of time is valid for the postwar period. But has this condition led to the type of inventory and investment behavior which he concluded would be the logical outcome of such ready availability? In the sections that follow we shall examine the behavior of purchased-materials inventory and inventory investment, note certain characteristics not envisioned by Abramovitz and inquire into the reasons for the observed behavior.

## Behavior of Inventories

### Timing and Conformity of Inventories: Comparisons with Sales Turns

The timing of purchased materials to sales turns, as shown in table 11, varies widely from turn to turn in the individual industry series and among the series at each peak and trough. Nevertheless, the conformity to sales turns is generally high and approximately the same for durables and nondurables industries (about 80 percent of sales turns can be matched by inventory turns in each category).

TABLE 11.—*Timing and conformity of manufacturers' purchased-materials inventories at sales turns*

A. TIMING MEASURES [1]

| Industry | Lead (−) or lag (+) in months, in zones associated with reference turns | | | | | |
|---|---|---|---|---|---|---|
| | 1948 peak | 1949 trough | 1953 peak | 1954 trough | 1957 peak | 1958 trough |
| Total manufacturing | −1 | +4 | +1 | +6 | +10 | +6 |
| Durable-goods industries, total | −17 | +4 | +1 | +8 | +2 | +4 |
| Nondurable-goods industries, total | +4 | +5 | [3] | [3] | +7 | +11 |
| Primary metals | −6 | +7 | −1 | +10 | ---- | ---- |
| Machinery (including electrical) | −17 | +3 | +1 | +5 | ---- | ---- |
| Transportation equipment (including motor vehicles) | −24 | +1 | +1 | +12 | ---- | ---- |
| Stone, clay, and glass | −2 | +2 | [3] | +13 | ---- | ---- |
| Food and beverages | −14 | +6 | [3] | +7 | ---- | ---- |
| Paper | +2 | +13 | [4] | [4] | ---- | ---- |
| Chemical | +6 | +9 | [2] | +15 | ---- | ---- |
| Petroleum and coal | −13 | +13 | [3] | +12 | ---- | ---- |
| Rubber | +7 | +7 | 0 | +12 | ---- | ---- |

B. SUMMARY OF TIMING (9 INDUSTRY SERIES) [1]

| | At sales peaks | At sales troughs |
|---|---|---|
| Leads, more than 3 months | 5 | 0 |
| Rough coincidences | 6 | 3 |
| Leads, 3 months or less | (2) | (0) |
| Coincidences | (1) | (0) |
| Lags, 3 months or less | (3) | (3) |
| Lags, more than 3 months | 2 | 13 |

C. SUMMARY OF CONFORMITY

| | 9 industry series | | 4 durable-goods industries | | 5 nondurable-goods industries | |
|---|---|---|---|---|---|---|
| | All turns | All turns except Korean | All turns | All turns except Korean | All turns | All turns except Korean |
| Number of comparisons | 44 | 34 | 20 | 16 | 22 | 18 |
| Matching inventory turns | 33 | 20 | 16 | 15 | 17 | 15 |
| Percentage of matching turns | 75 | 88 | 80 | 94 | 77 | 83 |

[1] Inventory series have been deflated to 1956. 1957–58 turns based on undeflated data. Timing of inventory turns for "Korean" cycle is not shown since there were only 3 inventory turns that could be matched with sales turns related to this episode. See table 12 for timing comparisons of inventory turns with "Korean" reference turns.

[2] No sales or inventory turns occurred. Most recent inventory turn to occur was peak in May 1952 associated with Korean war cycle.

[3] Inventory turn occurs, but no sales turn.

[4] Sales turn occurs but no inventory turn; preceding inventory peak was related to Korean war cycle. Inventory peaks occurred in series as follows: Nondurable-goods industries, November 1951; stone, clay, glass, March 1952; food and beverages, May 1951; chemical, June 1952; petroleum and coal, June 1952.

Source: Based on material from Department of Commerce.

In spite of diversity, there is a well-established characteristic in the timing of both the comprehensive and industry purchased-materials series during the 1948–54 period: turns in these series occur earlier relative to sales at peaks than they do at succeeding troughs. This is true for 24 of the 26 turns in the industry series that could be matched with a specific sales cycle, and for all turns in the deflated comprehensive series.

In addition, turns frequently lead at peaks, on some occasions by very substantial intervals. Lags at troughs are sometimes quite long, well over a year for certain of the industry series. Abramovitz made no provision for the occurrence of substantial leads in stocks relative to sales or output or for substantial lags at troughs. Purchased-materials stocks were presumed to be so clearly associated with output that only lags due to delays in procurement could occur.

Nevertheless, these timing characteristics find support in certain of his prewar data. The timing for three purchased materials which he believed behaved typically is as follows: [6]

| | At peaks in activity | | | | At troughs in activity | | | |
|---|---|---|---|---|---|---|---|---|
| | Number of— | | | Average lead (−) or lag (+) in months | Number of— | | | Average lead (−) or lag (+) in months |
| | Leads | Coincidences | Lags | | Leads | Coincidences | Lags | |
| Raw cotton at mills | 3 | 0 | 5 | +1.5 | 0 | 1 | 6 | +5.1 |
| Raw silk at mills | 1 | 0 | 3 | +0.5 | 1 | 0 | 2 | +1.0 |
| Raw cattle hides at tanners | 2 | 1 | 2 | +1.2 | 1 | 0 | 3 | +6.2 |
| 3 commodities | 6 | 1 | 10 | | 2 | 1 | 11 | |

When timing comparisons are made at the 1957 peak and the 1958 trough the results are more ambiguous. The durables and nondurables series show shorter lags at peaks than at troughs, but the total manufacturing series shows a 10-month lag at the peak in the sales series and a 6-month lag at its subsequent trough. This paradoxical difference in the timing patterns of the aggregate and its two components is due, not to differences in the timing of durables and nondurables sales turns (which are virtually coincident), but to the fact that the two component inventory series do not decline significantly for a number of months following their peaks; in November 1957 they actually show simultaneous increases sufficient to cause the aggregate to register a peak in that month.

It is difficult to draw conclusions regarding this recent episode. The fact that the data have not been deflated and that prices did rise slightly at this time makes it not unlikely that appropriate deflation would have caused the series to show earlier turns at peaks. A second source of difficulty is the unusual behavior of manufacturing activity during this cycle. Output and sales reached peaks approximately half a year prior to the peak in general business activity, but showed no sharp decline until the business cycle turn. Under such conditions there was not, perhaps, the usual incentive to reduce stocks.

Nevertheless, on the basis of all the evidence, it seems justifiable to regard as significant the tendency for purchased materials to turn earlier at sales peaks than at troughs. Moreover, it is apparent that purchased materials may turn coincidentally with sales turns or even earlier and that lags at troughs may be of considerable duration.

[6] As indicated above, Abramovitz worked with a limited sample of 10 commodity series in investigating the behavior of purchased-materials stocks. Of these 10 series, only 8 were available in monthly or quarterly form; only the 3 shown appeared "to be supplied to manufacturers under conditions that afford the degree of responsiveness of supply to changes in demand that characterizes most raw materials purchased by manufacturers * * *," ibid., pp. 190, 393.

The 1957–58 experience does not invalidate these findings; it merely indicates that purchased materials inventory turns may lag at sales peaks as well as at troughs.

### TIMING AND CONFORMITY OF INVENTORIES: COMPARISONS WITH REFERENCE TURNS

Timing and conformity of purchased-materials turns to business cycle turns (table 12 and chart 5) reveal tendencies similar to those pointed out above. Purchased-materials series typically turn earlier at business cycle peaks than at troughs. Among the industry series this earlier timing is manifested in leads or roughly coincident timing at peaks, and in lags at troughs. Thirteen peaks could be matched with business cycle reference peaks. Five of these turns led by more than 3 months, seven were roughly coincident, and only one lagged more than 3 months. (Rubber products lagged behind the reference peak of 1948 by 8 months.) Some of the leads were quite long, as much as 18 months. Eighteen troughs could be matched with business cycle troughs, of which 16 lagged more than 3 months and 2 were roughly coincident. Lags ranged from 3 to 16 months.

Using business cycle turns as a basis for comparison, the conformity rating of the durables is higher than that of nondurables. Purchased-materials stocks of durables show a somewhat higher conformity to sales turns associated with business cycle turns than the nondurable. In addition, the durable sales turns, themselves, conform better to business cycles; i.e., there are fewer "skipped" phases. The net result is that the durables purchased materials show a slightly higher conformity to business cycles, the four durables series matching business cycle turns in 15 of 16 possible comparisons, whereas nondurables matched in only 16 of 20.

TABLE 12.—*Timing and conformity of manufacturers' purchased-materials inventories at reference turns*

A. TIMING MEASURES[1]

| Industry | Lead (−) or lag (+) in months | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Business cycle | | Korean cycle | | Business cycles | | | |
| | Peak November 1948 | Trough October 1949 | Peak February 1951 | Trough June 1952 | Peak July 1953 | Trough August 1954 | Peak July 1957 | Trough April 1958 |
| Total manufacturing | −3 | +6 | +9 | +4 | +1 | +8 | +4 | +5 |
| Durable-goods industries, total | −16 | +4 | +13 | +2 | +1 | +10 | −4 | +4 |
| Nondurable-goods industries, total | −1 | +8 | +9 | (2) | (2) | +7 | +1 | +10 |
| Primary metals | −5 | +7 | (2) | (2) | −1 | +10 | ------- | ------- |
| Machinery (including electrical) | −16 | +5 | +14 | +3 | 0 | +7 | ------- | ------- |
| Transportation equipment (including motor vehicles) | −18 | +3 | +9 | +1 | +1 | +14 | ------- | ------- |
| Stone, clay, and glass | −3 | +4 | +11 | (2) | (2) | +6 | ------- | ------- |
| Food and beverages | −16 | +9 | +3 | (2) | (2) | +9 | ------- | ------- |
| Paper | 0 | +10 | +15 | (2) | (2) | 0 | ------- | ------- |
| Chemical | +1 | +6 | +16 | (2) | (2) | +8 | ------- | ------- |
| Petroleum and coal | −17 | +16 | +16 | (2) | (2) | +14 | ------- | ------- |
| Rubber | +8 | +10 | (2) | (2) | 0 | +13 | ------- | ------- |

B. SUMMARY OF TIMING (9 INDUSTRY SERIES)

| | At business cycle peaks | At business cycle troughs |
|---|---|---|
| Leads, more than 3 months | 5 | 0 |
| Rough coincidences | 7 | 2 |
| Leads, 3 months or less | (2) | (0) |
| Coincidences | (3) | (0) |
| Lags, 3 months or less | (2) | (2) |
| Lags, more than 3 months | 1 | 16 |

C. SUMMARY OF CONFORMITY

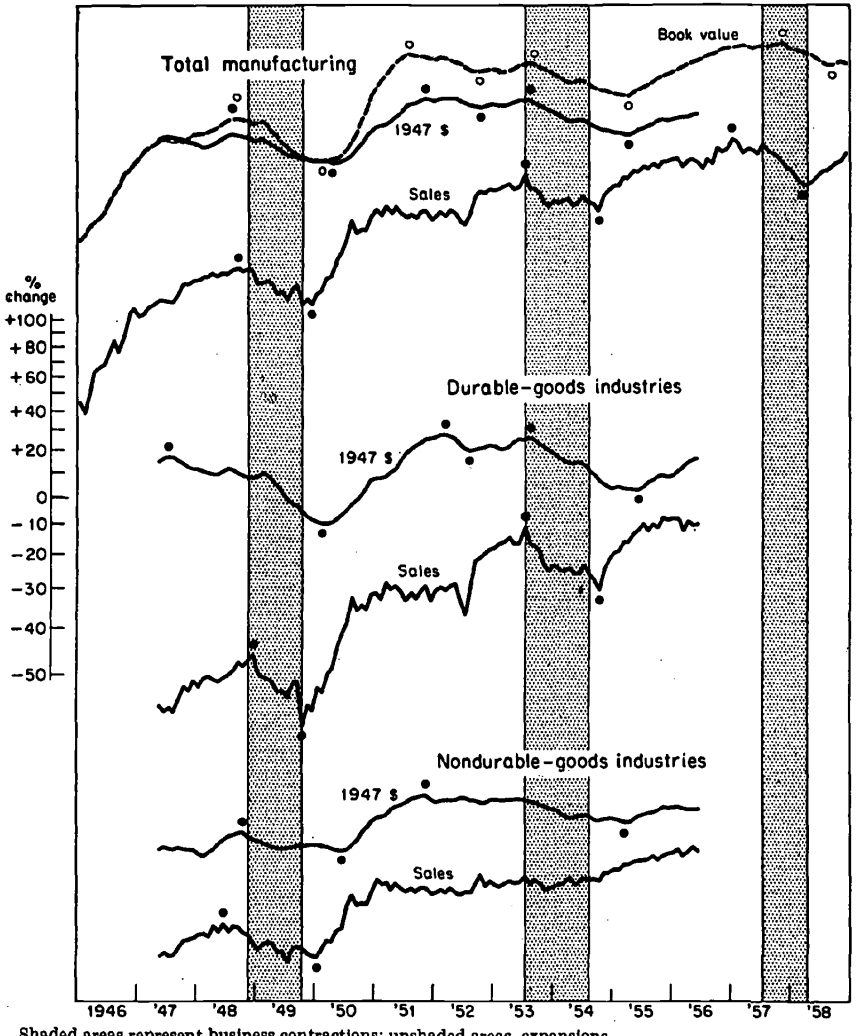
| | 9 industry series | | 4 durable-goods industries | | 5 nondurable-goods industries | |
|---|---|---|---|---|---|---|
| | All turns | All turns except Korean | All turns | All turns except Korean | All turns | All turns except Korean |
| Number of comparisons | 54 | 36 | 24 | 16 | 30 | 20 |
| Matching inventory investment turns | 40 | 31 | 20 | 15 | 20 | 16 |
| Percentage of matching turns | 74 | 86 | 83 | 94 | 67 | 80 |

[1] Inventory series have been deflated to 1956. 1957–58 turns based on undeflated data.
[2] No matching inventory turn.

Source: Based on material from Department of Commerce.

CHART 5

PURCHASED-MATERIALS INVENTORIES AND SALES: TOTAL MANUFACTURING, DURABLE- AND NONDURABLE-GOODS INDUSTRIES, 1946–58




Shaded areas represent business contractions; unshaded areas, expansions.
Dots identify peaks and troughs of deflated inventory cycles; circles, of undeflated cycles. All sales data are undeflated.

Source: Department of Commerce. Data deflated by the author.

When measured against Korean reference dates, turns in the comprehensive as well as the industry series show very long lags at peaks, quite in contrast to the leading tendency demonstrated at business cycle peaks. It should be noted that the Korean cycle was unique in that manufacturers reported exceptionally high levels of order backlogs at the beginning of 1951 and that there was a marked difference in the behavior of durables and nondurables. These matters will be discussed in a subsequent section.

## Behavior of Inventory Investment

The total manufacturers' purchased-materials investment series shows four cyclical movements from 1945 to 1954, two occurring in the course of each business cycle. (See Chart 6.) In each pair of investment cycles the first is the major movement. The second involves a relatively small increase prior to the sharp declines in both inventory investment and inventories proper which conform closely to the two business cycle recessions.

Differences between the behavior of durables and nondurables occurred during these two secondary movements. For the durables series, there was no significant resurgence of inventory investment immediately following the major movement which reached its peak in the third quarter of 1946, but there was a well-developed upswing (reaching its peak in the second quarter of 1953) following the major investment movement of 1949–50. On the other hand, the nondurables showed a much stronger investment cycle following the initial major postwar cycle, but no cyclical movement following the period of intensive inventory accumulation which reached its maximum level in the final quarter of 1950.

## Timing and Conformity of Investment: Comparisons With Sales Turns

The timing and conformity analysis presented in table 13 for the comprehensive and industry series not only substantiates the preceding observations but also provides detail on the essential timing characteristics and relative cyclical sensitivity of the durables and nondurables series.

Among the durables, two of the four industry series (machinery and transportation equipment) showed inventory investment expansion movements in 1948, which were merely declines in the rates of disinvestment, but all showed investment expansions conforming to the final stage of sales expansions that culminated in 1953. Among the nondurables the tendency was clearly different: all industry series showed inventory investment cycles in 1948, but none (except the rubber-goods series) conformed to sales movements in the latter half of the succeeding expansion.

Table 13.—*Timing and conformity of manufacturers' purchased-materials inventory investment to sales turns*

A. TIMING MEASURES[1]

| Industry | Lead (−) or lag (+) in months, in zones associated with reference turns—Korean war | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1948 peak | 1949 trough | 1951 peak | 1952 trough | 1953 peak | 1954 trough | 1957 peak | 1958 trough |
| Total manufacturing | −4 | −7 | [2] | [2] | −2 | −11 | −17 | +2 |
| Durable-goods industries, total | −7 | −5 | [2] | [2] | −2 | −2 | −17 | +1 |
| Nondurable-goods industries, total | −1 | −14 | [2] | [2] | [2] | [2] | +4 | +5 |
| Primary metals | −6 | −5 | +8 | +2 | −2 | 0 | ---- | ---- |
| Machinery (including electrical) | [4] −7 | −7 | [2] | [2] | −7 | −11 | ---- | ---- |
| Transportation equipment (including motor vehicles) | [4] −9 | −7 | [2] | [2] | −2 | −11 | ---- | ---- |
| Stone, clay, and glass | −5 | −4 | 0 | +11 | +4 | +7 | ---- | ---- |
| Food and beverages | −4 | +4 | [2] | [2] | [5] | [5] | ---- | ---- |
| Paper | 0 | +4 | +3 | +5 | [2] | [2] | ---- | ---- |
| Chemical | +2 | +7 | +5 | [5] | [5] | −2 | ---- | ---- |
| Petroleum and coal | −1 | −2 | [2] | [2] | [5] | +11 | ---- | ---- |
| Rubber | +1 | +10 | [6] | [6] | −2 | −5 | ---- | ---- |

See footnotes at end of table, p. 35.

TABLE 13.—*Timing and conformity of manufacturers' purchased-materials inventory investment to sales turns*—Continued

B. SUMMARY OF TIMING AND CONFORMITY

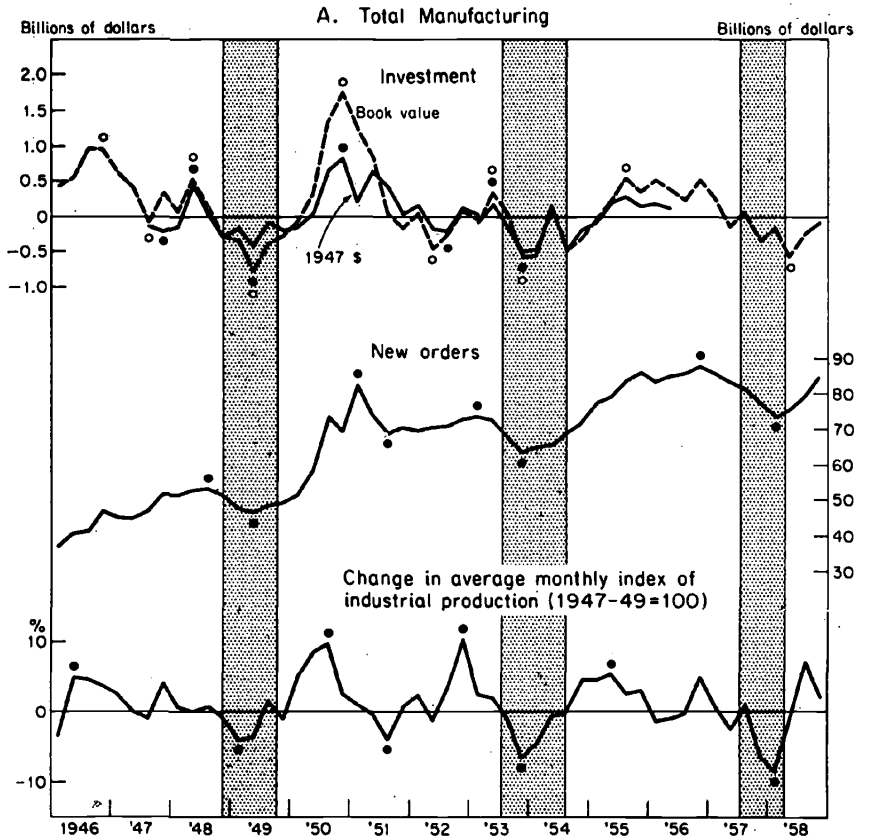
| Timing and conformity comparisons | 9 industry series | | 4 durable-goods industries | | 5 nondurable-goods industries | |
|---|---|---|---|---|---|---|
| | All turns | All turns except Korean | All turns | All turns except Korean | All turns | All turns except Korean |
| Number of comparisons | 42 | 34 | 20 | 16 | 22 | 18 |
| Matching inventory investment turns | 37 | 30 | 20 | 16 | 17 | 14 |
| Percentage of matching turns | 88 | 88 | 100 | 100 | 78 | 78 |
| Leads, more than 3 months | | 13 | | 11 | | 2 |
| Rough coincidences | | 10 | | 3 | | 7 |
| Leads, 3 months or less | | (6) | | (2) | | (4) |
| Coincidences | | (2) | | (1) | | (1) |
| Lags, 3 months or less | | (2) | | (0) | | (2) |
| Lags, more than 3 months | | 7 | | 2 | | 5 |

[1] Inventory investment series have been deflated to 1956; 1957–58 turns based on undeflated data.
[2] Inventory investment turn occurs, but there is no sales turn.
[3] No turn occurs in either sales or inventory investment.
[4] Peak was submerged—a decline in disinvestment.
[5] Sales turn occurs but no matching inventory investment turn.

Source: Based on material from Department of Commerce.

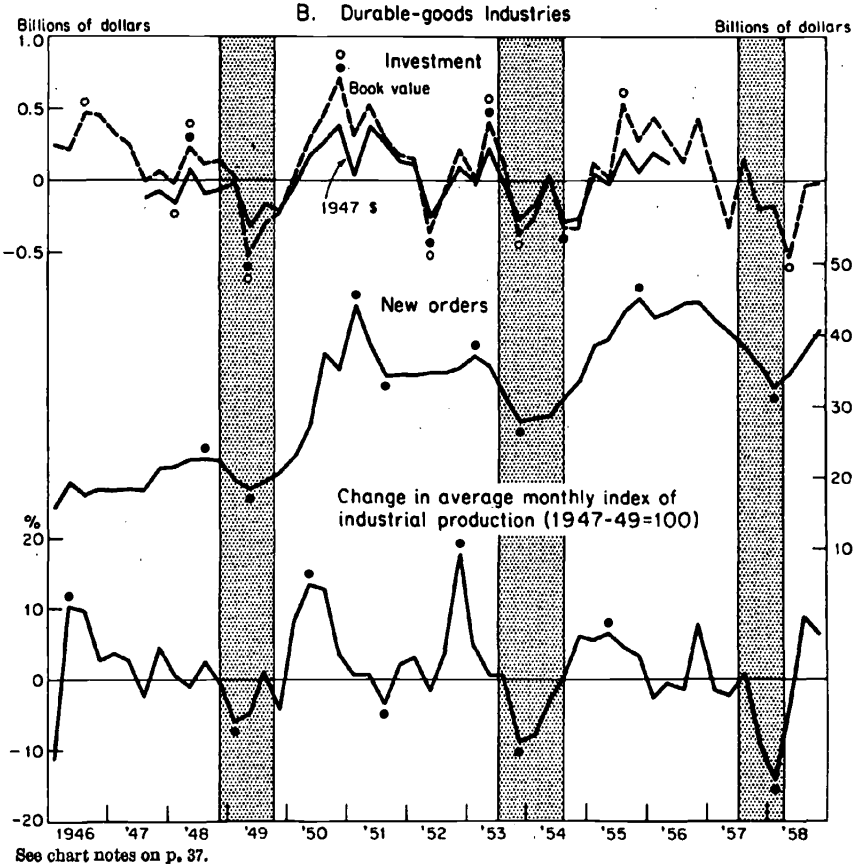
CHART 6

PURCHASED-MATERIALS INVENTORY INVESTMENT, NEW ORDERS AND CHANGE IN INDEX OF INDUSTRIAL PRODUCTION, 1946–58



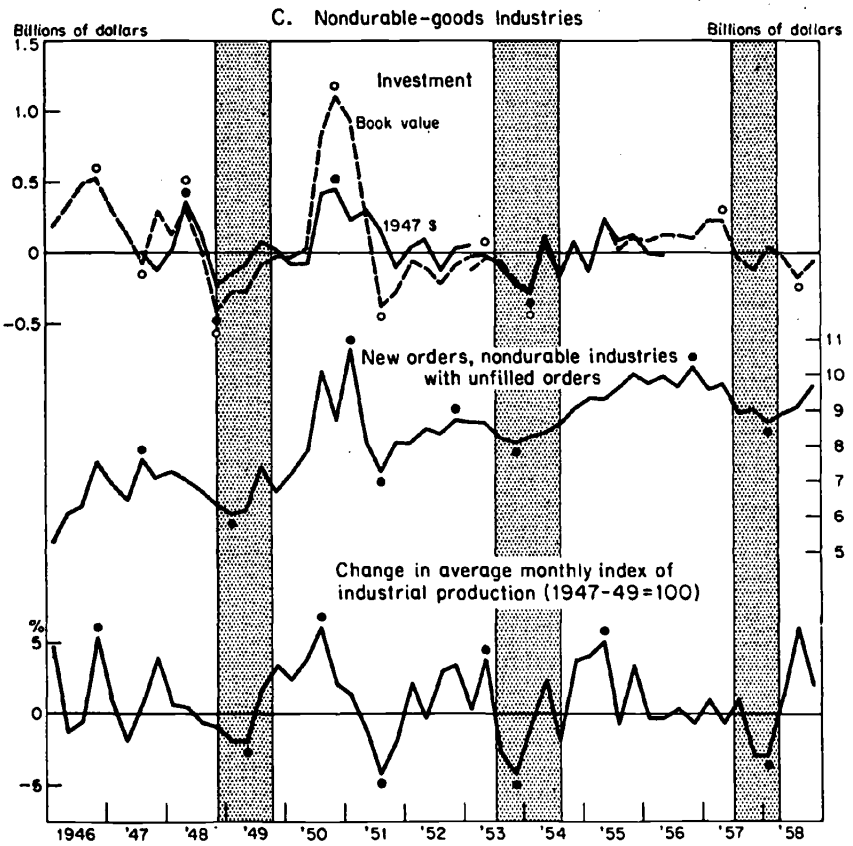

See chart notes on p. 37.

CHART 6—Continued




See chart notes on p. 37.

CHART 6—Continued




Shaded areas represent business contractions; unshaded areas, expansions.
Dots identify peaks and troughs of deflated investment cycles; circles, of undeflated cycles. All new orders data are undeflated.

Source: Investment and new orders data from Department of Commerce. Data deflated by the author. Industrial production series from Federal Reserve Board.

In general, conformity was higher among the durables: All 20 sales turns were matched by stock turns, whereas among the nondurables only 17 of the 22 sales turns could be matched. Moreover, the tendency to lead was much better established for durables than for nondurables. Only 2 of the 16 turns in the durables series which occurred at major sales turns (turns associated with business cycle turns) show a lag, whereas among the nondurables a lag appears in 7 of the 14 turns.

### TIMING AND CONFORMITY OF INVESTMENT: COMPARISONS WITH REFERENCE TURNS

Comparison of inventory investment movements to business cycle turns provides additional evidence that this investment is sensitive to business cycle influences and, further, that the durables group is significantly more sensitive to these forces than the nondurables.

Turns in purchased-materials inventory proper could be matched with reference turns (including the Korean subcycle reference turns) in 40 of 54 possible comparisons (table 12). Table 14 shows that inventory investment turns could be matched in 44 of the 54 comparisons.

The durables show a perfect conformity score (inventory investment turns could be matched in each of the 24 comparisons). The nondurables could be matched in only 20 of 30 possible comparisons. Further, as was true in the comparisons with sales turns, the durables inventory investment showed a stronger tendency to lead: 15 of the 16 durables investment turns matched with business cycle reference turns led or turned roughly, coincidently, 10 of the 14 nondurables investment turns matched in the same way showed similar timing.

TABLE 14.—*Timing and conformity of manufacturers' purchased-materials inventory investment at reference turns*

A. TIMING MEASURES [1]

| Industry | Lead (−) or lag (+) in months | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Business cycle | | Korean cycle | | Business cycles | | | |
| | Peak November 1948 | Trough October 1949 | Peak February 1951 | Trough June 1952 | Peak July 1953 | Trough August 1954 | Peak July 1957 | Trough April 1958 |
| Total manufacturing | −6 | −5 | −3 | +2 | −2 | −9 | −23 | +1 |
| Durable-goods industries, total | −6 | −5 | −3 | −1 | −2 | 0 | −23 | +1 |
| Nondurable-goods industries, total | −6 | −11 | −3 | [3] | [3] | −6 | −2 | +4 |
| Primary metals | [3] | −5 | −6 | +2 | −2 | 0 | ---------- | ---------- |
| Machinery (including electrical) | [4] −6 | −5 | −3 | −1 | −8 | −9 | ---------- | ---------- |
| Transportation equipment (including motor vehicles) | [4] 0 | −5 | +3 | −1 | −2 | −9 | ---------- | ---------- |
| Stone, clay, and glass | −6 | −2 | +3 | +5 | +4 | 0 | ---------- | ---------- |
| Food and beverages | −8 | +7 | −3 | −10 | [3] | [3] | ---------- | ---------- |
| Paper | −2 | +1 | +6 | +5 | [3] | [3] | ---------- | ---------- |
| Chemical | −3 | +4 | +6 | [3] | [3] | −9 | ---------- | ---------- |
| Petroleum and coal | 0 | +1 | +15 | [3] | [3] | +12 | ---------- | ---------- |
| Rubber | −3 | +13 | [3] | [3] | −2 | −3 | ---------- | ---------- |

B. SUMMARY OF TIMING AND CONFORMITY

| Timing and conformity comparisons | 9 industry series | | 4 durable-goods industries | | 5 nondurable-goods industries | |
|---|---|---|---|---|---|---|
| | All turns | All turns except Korean | All turns | All turns except Korean | All turns | All turns except Korean |
| Number of comparisons | 54 | 36 | 24 | 16 | 30 | 20 |
| Matching inventory turns | 44 | 30 | 24 | 16 | 20 | 14 |
| Percentage of matching turns | 88 | 83 | 100 | 100 | 67 | 70 |
| Leads more than 3 months | ---------- | 11 | ---------- | 9 | ---------- | 2 |
| Rough coincidences: | | 14 | | 6 | | 8 |
| Leads, 3 months or less | ---------- | (8) | ---------- | (3) | ---------- | (5) |
| Coincidences | ---------- | (4) | ---------- | (3) | ---------- | (1) |
| Lags, 3 months or less | ---------- | (2) | ---------- | (0) | ---------- | (2) |
| Lags, more than 3 months | ---------- | 5 | ---------- | 1 | ---------- | 4 |

[1] Inventory series have been deflated to 1956. 1957–58 turns based on undeflated data.
[2] No matching inventory investment turn.
[3] This turn cannot be marked because data begin in early 1948. The data show, however, that there was a well-defined peak at least 6 months prior to reference peak.
[4] Peak was "submerged"—a decline in disinvestment.

Source: Based on material from Department of Commerce.

CYCLICAL AMPLITUDE OF INVENTORY INVESTMENT

In addition to their higher conformity to business cycles, the durables series also move with greater amplitude than the nondurables. This characteristic is clearly shown for inventory investment in table 15. When measured in relative terms, amplitude of total change (peak to trough or trough to peak) is found to be larger for durables in every phase. Relative changes computed on a per-month basis alter the results in only one phase: the abrupt contraction in nondurables from the second to the fourth quarters of 1948 is larger than for durables.

Purchased-materials stocks in durables industries are somewhat smaller than in nondurables, averaging around 40 percent of total purchased materials for the period as a whole, and this serves to reduce somewhat the cyclical impact of the sensitive durables inventory investment movements. When the magnitude of change in durables and nondurables inventory investment is measured in dollars rather than relative to inventory levels (table 15), the latter half of 1948 is once again the only phase in which the contraction in nondurables inventory investment is found to be larger than in durables.

TABLE 15.—*Amplitude of change in purchased-materials inventory investment cycles, by phase, 1948–58*

| Industry | Peak–trough (1948–49) | Trough–peak (1949–50) | Peak–trough (1950–52) | Trough–peak (1952–53) | Peak–trough (1953–54) | Trough–peak (1953–55) | Peak–trough (1955–58) |
|---|---|---|---|---|---|---|---|
| | Total change (relative) [1] | | | | | | |
| Total manufacturing | −7.15 | +10.28 | −7.82 | +2.43 | −4.57 | +7.44 | −7.20 |
| Durable goods | −8.60 | +14.94 | −12.12 | +7.23 | −9.69 | +12.72 | −14.78 |
| Nondurable goods | −8.27 | +9.28 | | | [2] −3.93 | +6.38 | −5.00 |
| | Change per month (relative) [1] | | | | | | |
| Total manufacturing | −0.60 | +0.57 | −0.37 | +0.81 | −0.38 | +0.35 | −0.34 |
| Durable goods | −.72 | +.83 | −.67 | +.60 | −.65 | +.61 | −.70 |
| Nondurable goods | −1.38 | +.39 | | | [2] −.44 | +.42 | −.13 |
| | Total change (millions of dollars) [3] | | | | | | |
| Total manufacturing | −843 | +1,220 | −1,017 | +336 | −627 | +1,143 | −1,136 |
| Durable goods | −415 | +700 | −626 | +406 | −513 | +921 | −1,089 |
| Nondurable goods | −588 | +680 | | | [2] −320 | +507 | −415 |
| | Change per month (millions of dollars) [3] | | | | | | |
| Total manufacturing | −70 | +68 | −48 | +112 | −52 | +54 | −54 |
| Durable goods | −35 | +39 | −35 | +34 | −34 | +44 | −52 |
| Nondurable goods | −98 | +28 | | | [2] −36 | +34 | −11 |

[1] Expressed as percentage of the mean level of inventories during the phase. Mean level is an average of the beginning and ending inventory levels of the terminal quarters of the phase.

[2] To permit comparision with change in durable goods, purchased-materials investment change in nondurable goods has been measured from the second quarter of 1953 to the first quarter of 1954.

[3] All 1948–54 data have been deflated (1947 dollars). Measures for the two most recent phases are based on undeflated (book value) data.

Source: Based on Department of Commerce data.

### TIMING AND CONFORMITY OF INVESTMENT: COMPARISONS WITH RATES OF CHANGE IN OUTPUT

Abramovitz' analysis led him to expect that rates of change in purchased materials would lag behind rates of change in output. Timing analysis of the postwar data tends to bear out this expectation. In table 16 all turns in rates of change in output for total manufactures and for durables manufacturers could be matched by turns in purchased-materials investment, typically with a lag of investment behind output. Timing was irregular, however, especially for the nondurables category. It ranged from coincident to a 12-month lag for total manufacturers, from a 3-to 9-month lag for durables, and from a 6-month lead to a 24-month lag for nondurables. The industry series shows the relationship to be closest where expected, among the durables (particularly the total machinery series), and to be poor or nonexistent among the five available nondurable series. The latter, by the nature of conditions under which materials are procured, would not be expected to show a close timing relation between rates of change in output and inventory investment. On the other hand, some of the lags are much too long to be explained in terms of delays in procurement and, for some of the series, irregularities in timing would seem to be too great to find a place in the theory. Also there are leads in the investment turns which are contradictory to Abramovitz' hypothesis.

### FACTORS INFLUENCING THE BEHAVIOR OF PURCHASED MATERIALS

Thus far we have seen that Abramovitz' theory, although it goes far to explain the general behavior of purchased-materials inventories and investment, does not provide for the occurrence of certain observed timing relative to turns in sales, the business cycle as a whole, and rates of change in output.

TABLE 16.—*Timing of purchased-materials inventory investment to rates of change in output*

| Industry | Lead (−) or lag (+), in months | | | | | | | | Percent of months in phase, mid-1948 through 1958 [1] |
|---|---|---|---|---|---|---|---|---|---|
| | 1949 troughs | 1950 peaks | 1951 troughs | 1952 peaks | 1953 troughs | 1955 peaks | 1958 troughs | Average timing | |
| Total manufacturing | +3 | +3 | +12 | +6 | 0 | +3 | +3 | +4.3 | 86 |
| Durable-goods industries | +3 | +6 | +9 | +6 | +9 | +3 | +3 | +5.6 | 82 |
| Nondurable-goods industries | −6 | +3 | [3] | [3] | +3 | +24 | +6 | [3] | [3] |
| Primary metals | −6 | +6 | +3 | +6 | +6 | [3] | [3] | +3.0 | |
| Machinery (including electrical) | 0 | +3 | +9 | 0 | 0 | [3] | [3] | +2.4 | |
| Transportation equipment (including motor vehicles) | −6 | +9 | +9 | +6 | +3 | [3] | [3] | +4.2 | |
| Stone, clay, and glass | +6 | +12 | [3] | [3] | +9 | [3] | [3] | [3] | |
| Paper | +9 | +12 | +15 | [3] | [2] | [3] | [3] | [3] | |
| Chemicals | +9 | +12 | [3] | [3] | 0 | [3] | [3] | [3] | |
| Rubber | [3] | [3] | [3] | +6 | +9 | [3] | [3] | [3] | |

[1] Undeflated investment data used for 1956–58. Months in phase computed after adjustment for average timing.
[2] No timing comparisons were possible.
[3] Data lacked sufficient comparability for computation.

Source: Inventory investment computations based on material from Department of Commerce deflated by the author; output computations based on Federal Reserve Board Index of Industrial Production (Manufacturing). Food and beverages and petroleum and coal industries omitted because no timing comparisons were possible.

We may now ask if there are not other significant factors omitted by Abramovitz. Victor Zarnowitz has established that the durable-goods industries produce principally to order and that backlogs of unfilled orders vary in size in the course of the business cycle.[7] In addition, the National Association of Purchasing Agents data show that "lead times" for procurement of materials vary cyclically. Abramovitz' contention that inventory objectives are related to output levels makes no provision for the possible effect that changes in the size of unfilled order backlogs have upon the willingness of selling firms to hold purchased materials. Neither does his theory provide for the impact of altered conditions of availability upon the desired inventory levels of purchasing firms.

It is reasonable to suppose that both these phenomena are important. The necessity of carrying stocks arises principally from the need to avoid the penalties suffered when interruptions occur in production or in the delivery of merchandise by a firm to its customers. Production stoppages, slowdowns, or the inability to supply merchandise in the required type or amount within a time period considered convenient and reasonable by the purchaser entail additional production costs and result in lost sales. They may also damage customer relations thereby reducing the market share of the firm. Consequently, management acts to avoid such risks by carrying stocks in a quantity adequate to provide sufficient protection against delays in delivery by suppliers as well as protection against increases in its own sales requirements. Just what constitutes "sufficient" protection is a matter for individual managers to decide. There are costs and risks incident to carrying additional stocks (e.g., costs of storage and insurance, risk of obsolescence, and adverse price movements) which must be set against the protection they provide. On the basis of all these factors, it would be logical to assume that increased backlogs of unfilled orders (or other assurances of steady or rising future output) or deteriorating availability of materials add to the desirability of carrying additional purchased materials stocks and that decreased backlogs or increased availability reduce the need for stocks.

In the sections which follow these two factors, the level of unfilled orders and availability of materials, along with a third—price movements—are considered in detail.

## UNFILLED ORDER BACKLOGS

Zarnowitz has noted that unfilled orders typically lead at peaks in activity, but turn roughly coincidently with activity troughs.[8]

After a major trading movement the large backlog of orders which will have accumulated can provide the basis for expanding shipments for some months, even while the backlog is declining. On the other hand, such a lead is not likely to occur during the latter part of a recession, since any increase would immediately tend to increase the level of production and, where inventories of finished stocks are held or the period of production is short, the level of shipments.

It follows that during late expansion, declining backlogs of orders constitute an invitation to trim any purchased-materials stocks that

[7] Victor Zarnowitz, "The Timing of Manufacturers' Orders During Business Cycles," in Business Cycle Indicators, Geoffrey H. Moore, editor, Princeton for NBER, 1961, vol. I, pp. 426, 451.
[8] Ibid., p. 451.

may have accumulated excessively during the preceding speculative period. Of course, declining order backlogs seldom signal the oncoming recession as clearly as they may appear in retrospect to have done, but they serve at least to put the manufacturer on his guard. Once made, the decision to curtail stocks is implemented with relative ease. Existing purchase orders may be canceled or, more probably, delivery postponed. Seen in this light changing levels of unfilled orders appear as a reasonable explanation of the observed early turns in purchased-materials stocks at business cycle peaks.

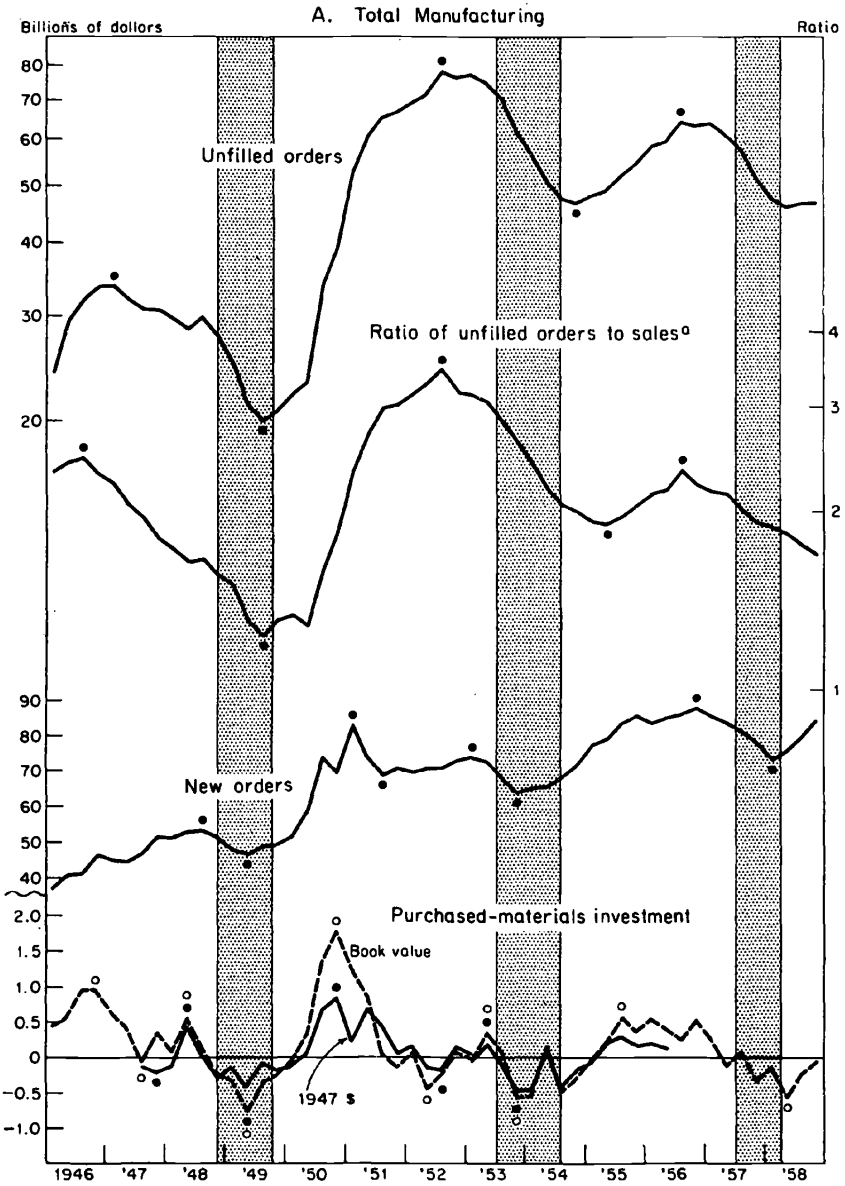
In late recession, however, there will be no comparable influence to exert pressure for larger stocks. Although new orders may turn up before the end of the recession phase, there will be little incentive to press for a higher level of purchased-material stocks until unfilled orders have begun to accumulate. When the decision to add to stocks is finally made, there still remains the delay occasioned by processing the orders and making delivery.

Although these observations may account for the observed lagging tendency of purchased-materials stock turns at troughs, they do not explain the duration of some of these lags. This may occur for any, or all, of the following reasons. (1) Since postwar recessions have been a year or less in duration the reduction of stocks which were at excessive levels during expansion may not have been completed. (2) The manufacturer may be expected to be less aggressive in raising purchased-materials stock levels in early expansion than he is in lowering these stocks in early contraction, since he is not under the same pressure to do so. The beginning of recession is accompanied by demands to conserve working capital, by a rapid increase in availability of goods (this point is discussed at length below), and by expectations of more favorable terms of purchase. In the early months after the trough, however, the manufacturer has no assurance that the incipient recovery will not collapse; prices are not as yet firming appreciably, and materials can still be procured with relatively little delay. (3) The manufacturer may fail to foresee the extent of the pickup as he places his purchase order and an undesired liquidation of inventories occurs; for this reason he underestimates. There is no evidence to indicate which of these is most important, but it is not unreasonable to suppose that all have played a part.

It will be observed in chart 7 that upward movements in purchased-materials inventory investment are substantial only when the increases in new orders are sufficiently in excess of the increases in shipments to bring about rapid accumulations of order backlogs, or when large order backlogs are not significantly reduced by current shipments at the time that a new surge in orders occurs. This generalization sheds light on the great bulge in total purchased-materials investment which occurred in 1946 and the small amplitude (relative to the very large increases in new business) of the second investment cycle which immediately preceded the 1948–49 recession. Similarly, it is helpful in explaining the huge movement in purchased-materials investment in 1950 and the relatively small movement which occurred just prior to the business cycle peak of August 1953. In each of these cases the major movements occurred under conditions of large and rising backlogs. The succeeding smaller movements, however, occurred under conditions of declining backlogs even though the upward movements of new orders were quite sizable.

CHART 7

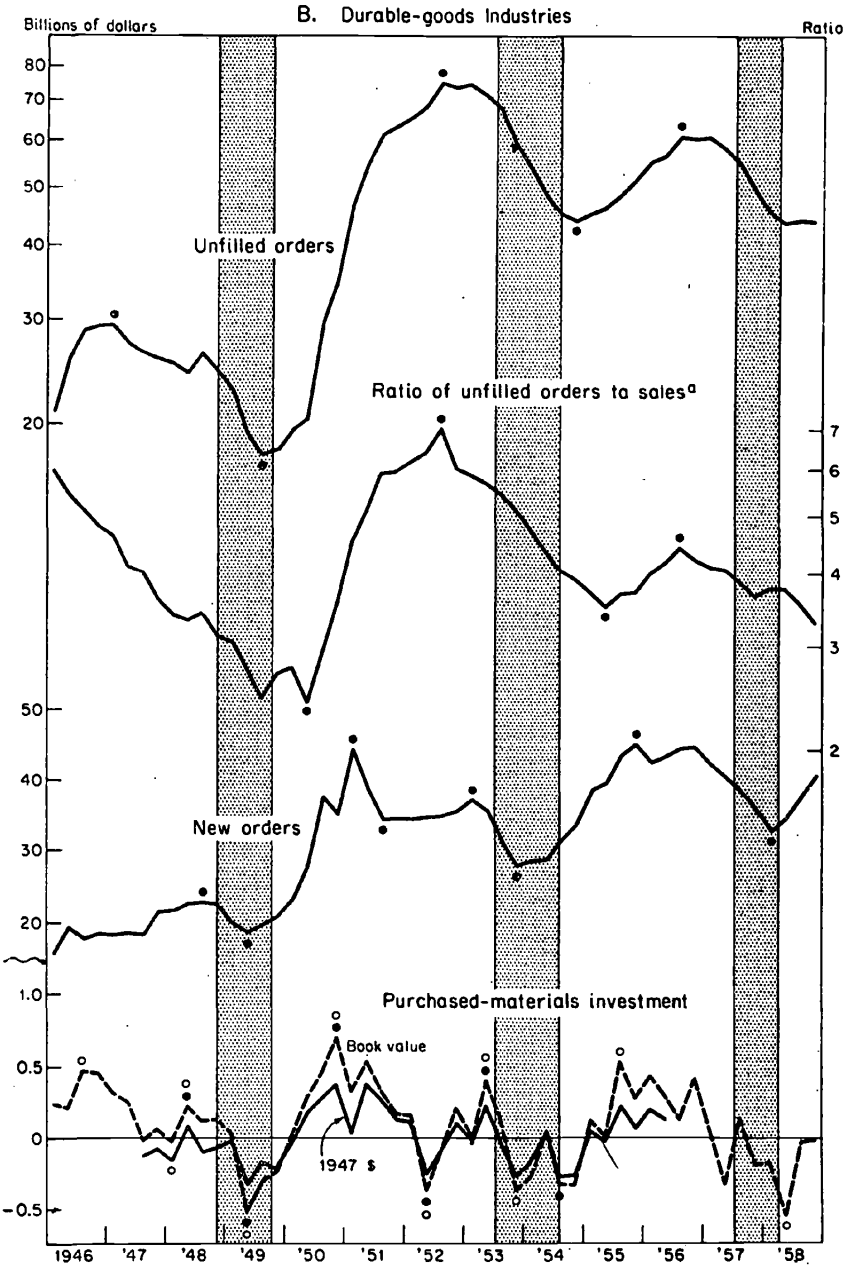
MANUFACTURERS' UNFILLED ORDERS, RATIOS OF UNFILLED ORDERS TO SALES, NEW ORDERS, AND PURCHASED-MATERIALS INVESTMENT, 1946–58




[a] Ratio computed for midmonth in quarter.

See chart notes on p. 45.

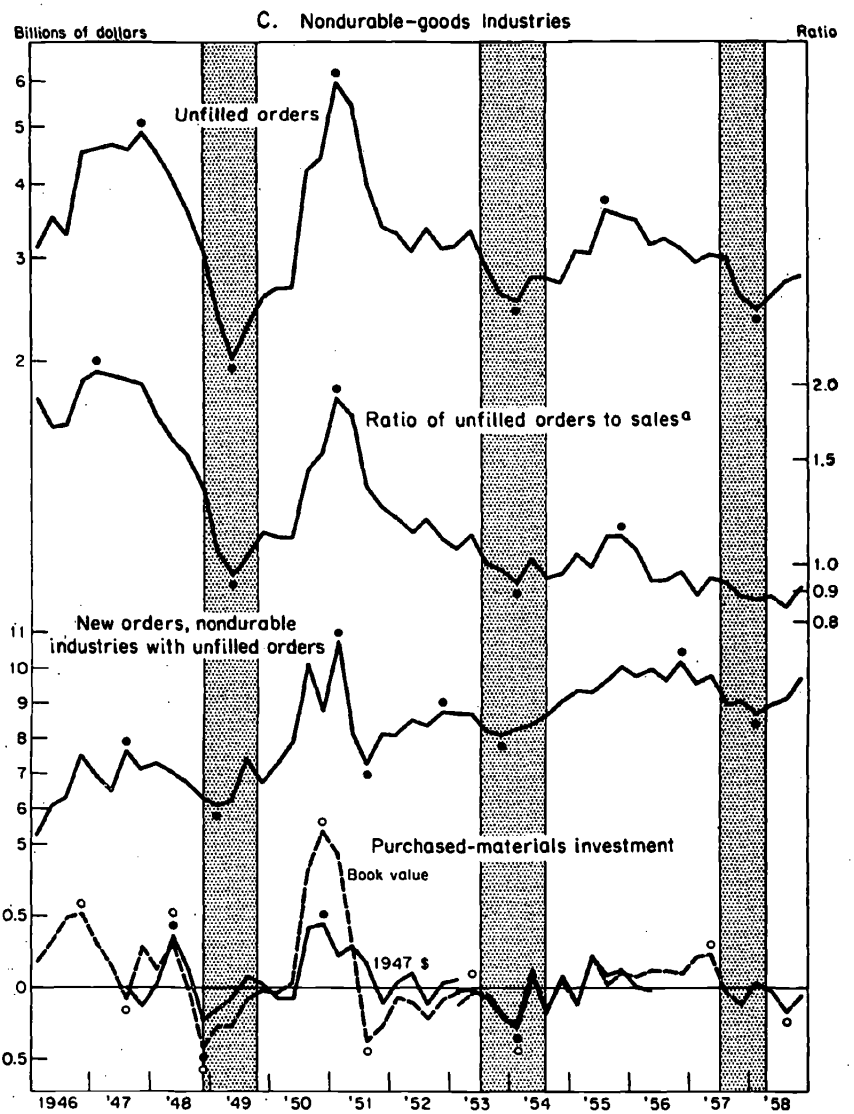
CHART 7—Continued




[a] Ratio computed for midmonth in quarter.

See chart notes on p. 45.

CHART 7—Continued




[a] Ratio computed for midmonth in quarter.

Shaded areas represent business contractions; unshaded areas, expansions.
Dots identify peaks and troughs of deflated investment cycles; circles, of undeflated cycles. All other data are undeflated.

Source: Department of Commerce. Data deflated by the author.

In addition, an explanation is provided for the previously observed differences in the behavior of durables and nondurables purchased-materials investment preceding the business cycle peaks of 1948 and 1953. It will be recalled that in the former of these two episodes, durables purchased-materials stocks were declining for months prior to the peak in shipments, with an inventory cycle evident after mid-1947 only in the rate at which disinvestment occurred; but nondurables showed a well-developed second postwar cycle in purchased-materials investment from third quarter 1947 to fourth quarter 1948. In 1952–53, the opposite was the case; nondurables declined after fourth quarter 1950, with only small irregular movements in inventory investment noted, whereas durables displayed a well-established cycle from second quarter 1952 to fourth quarter 1953.

The explanation is to be found in the differences in order backlogs during these two periods (chart 7). In the months immediately following the war, durables and nondurables experienced sharp increases in orders which were sufficient to carry unfilled orders to record peacetime heights. Under these conditions manufacturers increased their stocks of purchased materials sharply. Following this initial wave of demand there was a second wave (i.e., expansion of new orders) which occurred in both durables and nondurables (chart 6), but with quite dissimilar developments. In the nondurables the resurgence in demand in the last half of 1947 resulted in a sustained level of unfilled orders at close to record heights through the first quarter of 1948 (chart 7) and was the occasion for a second investment cycle in purchased materials.[9] In the durables, the second wave of demand which began in late 1947 and continued through most of 1948, though relatively much more substantial than that in nondurables, was easily accommodated as manufacturers reconverted from wartime operation. The result is striking: durables unfilled orders fell almost continuously from the beginning of 1947 until the end of the recession, and there was only a submerged second cycle in the deflated purchased-materials investment series.

Beginning in 1949, both categories experienced upward movements continuing through the two great surges in buying in the third quarter of 1950 and first quarter of 1951, prompted by the Korean war; but after early 1951, movements in the two categories were dissimilar. When it was discovered that there were not to be important consumer shortages, the demand for a variety of nondurables declined and a well-defined recession in the related nondurables industries occurred. New orders fell sharply until 1951, when sales reached a trough. The recovery from this recession, which reached a peak in 1953, was comparable in amplitude of movement to that of 1947–48. The volume of goods demanded was not sufficient, however, to increase the level of unfilled orders, and sales which had been sustained previously by order backlogs gradually declined in spite of the increase in the volume of new business. Under these conditions deflated purchased-materials investment declined throughout the latter part of the business cycle expansion.

In the durables category, defense orders sustained shipments and output to the degree that no well-marked recession developed, although there was a sharp downward movement in new orders from first to

[9] It will be noted that a peak in unfilled orders was reached in November 1947, but order backlogs fell very little until after March 1948.

third quarter 1951. The backlog of unfilled orders rose continuously until September 1952 and remained at approximately this level until April 1953. Under these conditions the upsurge in new orders which lasted until May 1953 brought a concomitant increase in purchased-materials investment.

The relation between the level of unfilled orders and the vigor of inventory investment suggests that the capacity level may play a significant role in inventory investment and in the strength of recovery movements in the manufacturing sector. During a period characterized by extensive industrial overcapacity it is not to be expected that there will be a substantial accumulation of unfilled orders.[10] Under such conditions firms would tend to refrain from any substantial purchased-materials investment. This attitude, if generalized, would work significantly against the development of a full-fledged recovery.

### AVAILABILITY OF MATERIALS

Fortunately, there are data on cyclical variations in availability of materials used by industrial firms. These data are found in vendor performance statistics collected by the Purchasing Agents Association of Chicago, and in quarter-to-quarter changes in total manufacturers' unfilled orders (Department of Commerce).

The vendor performance series is derived from monthly reports, submitted by member agents, in which each respondent states whether vendors' deliveries are slower, about the same, or faster than in the preceding month.[11] These reports have been consolidated into a diffusion index by combining for each month the percentage of agents reporting increased delays in delivery with one-half of the percentage reporting no change.

The index presumably records the approximate rate of change in availability of materials. When the value of the index is greater than 50, a rising series indicates that availability of materials is declining at an accelerating rate and a declining series indicates continued deterioration, but at a decreasing rate. Conversely, when the index value is less than 50, a declining series indicates accelerated improvement in supply conditions, and a rising series, that the rate of improvement is slackening.

The series for manufacturers' unfilled orders provides essentially the same type of information. Unfilled orders are the accumulated difference between new orders received (less cancellations) and shipments. In a given period, the change in the level of unfilled orders will be the difference between the volume of received orders and the volume of shipments. If orders exceed shipments, unfilled orders will rise, and the larger backlog of unfilled orders will often make it necessary for the firm to quote longer delays to its customers. If, on the other hand, the firm is able to reduce the backlog, it may be able to reduce delays in delivery.

Accordingly, the rates of change in unfilled orders should provide a measure of the acceleration of deterioration, or of improvement in

[10] An upward movement in orders would result in some accumulation of unfilled order backlogs because there is a necessary period which must elapse in the production process. This period prevents the outflow (shipments) from equaling the inflow (orders) as long as the inflow is rising. The unfilled orders which thus accumulate, however, are likely to be quite small in comparison to the backlogs which would arise with similar demand conditions and significant constraints upon increases in output.

[11] This series should not be regarded as merely an index of regional supply conditions, for firms in the highly diversified Chicago industrial area purchase from suppliers located throughout the United States.

supply conditions, in the same manner as does the vendor performance series. Such differences between the behavior of the two series as may appear, should stem from the difference in coverage,[12] or from the fact that one is a value series, and thus affected by price changes, whereas the other is a diffusion index unaffected by price.

It is interesting that these are the same unfilled orders data which were examined in relation to the inventory objectives of selling firms. But the logic is apparent: high or rising unfilled order backlogs bring assurance of a high level of operation to the seller, but to the buyer they bring delays in delivery and problems of procurement. As a result, both seller and buyer find justification for high levels of purchased-materials stocks. The converse holds for low or rapidly falling backlogs.

When the vendor performance and unfilled orders series are compared they are found to move in a similar manner. The troughs associated with the three business cycle recessions are coincident on two occasions and differ by only 3 months on the other. The major peaks in each of the 1950–51 and 1955 series are 6 months apart on one occasion, and 3 months on the other (chart 8 and table 17).

In addition to these major movements, the vendor performance series records very clearly two brief upswings, one beginning in 1947, the other beginning in 1952. These movements are less well defined in the unfilled orders series.

Another basis for comparing the series is the date at which they fall below the zero line, indicating the beginning of overall improvement in supply conditions, or rise above it, indicating the start of overall deterioration. The two series show close timing agreement in the dates at which supply conditions begin to become worse (chart 8). At two of these comparisons (third quarter 1949 and third quarter 1958), the turns are coincident; at the remaining one (late 1954), timing varies by 3 months. In comparisons of points at which supply conditions improve, the series agree less well. On one occasion (late 1946–early 1947), timing varies by 6 months; in the other comparisons, the unfilled orders series lags by 18 months (1951–52) and by 12 months (1955–56). A possible explanation for these substantial lags is that the total unfilled orders series, in contrast to the diffusion index in which each firm has equal weight, reflects in a larger measure the sluggish movements of order backlogs related to Government defense contracts (the extended lag following May 1951) and producers' durable equipment (the lag in 1956).

[12] The vendor performance series is based upon a sample whose coverage cannot be measured precisely, although it is restricted to the performance of manufacturers who supply industrial concerns. The unfilled orders series is well defined as to coverage but provides information on all manufacturers, regardless of their role as suppliers.

TABLE 17.—*Timing of vendor performance series to quarterly change in unfilled orders and unfilled-orders-to-shipments ratios, all manufacturers, 1947–58*

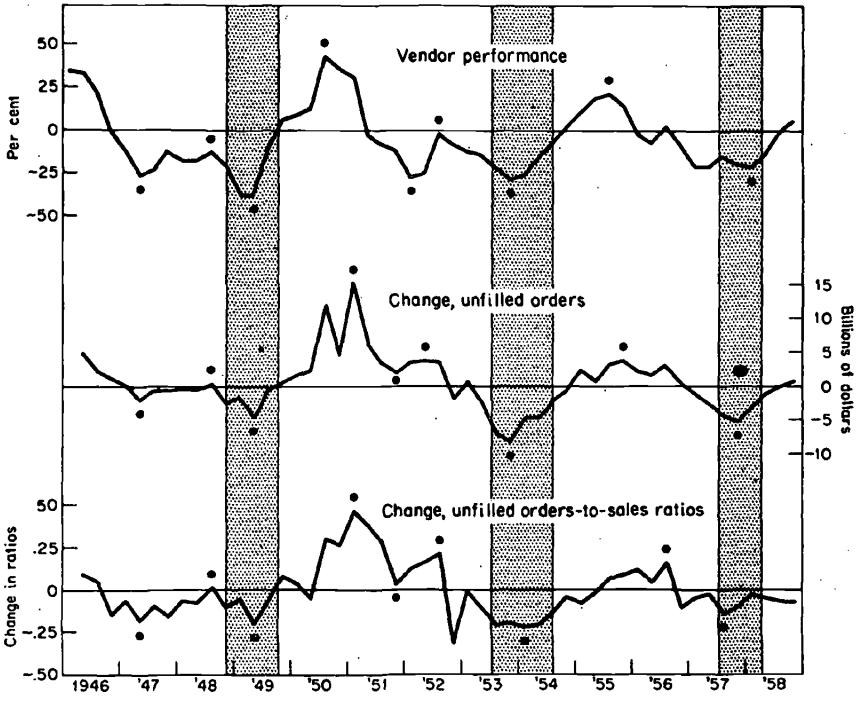
| | Trough | Peak | Trough | Peak | Trough | Peak | Trough | Peak | Trough |
|---|---|---|---|---|---|---|---|---|---|
| Turns in vendor performance [1] | May 1947 | August 1948 | May 1949 | August 1950 | February 1952 | August 1952 | November 1953. | August 1955 | February 1958 |
| Turns in quarter-to-quarter change: | | | | | | | | | |
| Total manufacturers unfilled orders. | 0 | 0 | 0 | +6 | −3 | −3 | 0 | +3 | −3 |
| Unfilled-orders-to-shipments ratios. | 0 | 0 | 0 | +6 | −3 | 0 | +3 | +12 | −6 |

[1] Percent of purchasing agents (Chicago area) reporting increased delays in delivery plus one-half of those reporting no change.

Source: Vendor performance series compiled from statistics collected by Purchasing Agents Association of Chicago; other series based on material from Department of Commerce.

CHART 8

VENDOR PERFORMANCE AND CHANGE IN UNFILLED ORDERS AND RATIOS OF UNFILLED ORDERS TO SALES, ALL MANUFACTURERS, 1946–58




Shaded areas represent business contractions; unshaded areas, expansions.
Dots identify peaks and troughs of specific cycles.
Data are quarterly. For description of vendor performance series, see table 17. Change in unfilled orders data are end-of-quarter to end-of-quarter. Changes in unfilled orders-to-sales ratios are from midquarter month to midquarter month.

Source: Vendor performance data from Purchasing Agents Association of Chicago; other data from Department of Commerce.

Another method by which the unfilled orders data may be made to reflect supply conditions is to express them as a ratio to current shipments. Such a ratio should measure the average delay (in months), assuming that the current rate of shipments is a reliable measure of current ability to supply goods.

There are two possible objections to this measure, however. First, production requires a significant interval. The current rate of shipments is therefore influenced by previously existing demand conditions and does not necessarily represent accurately the current ability of manufacturers to fill orders. Second, these data measure shipments by manufacturers who produce to stock out of finished goods as well as by manufacturers who produce to order. Accordingly, the total shipments series may be a faulty standard of current ability to make shipment on order.

Quarter-to-quarter changes in ratios of unfilled orders to shipments are presented in chart 8, and appropriate timing measures in table 17. Timing of this series is substantially the same as that for the rates of change in unfilled orders except in one comparison, the peak in 1956.

The turns in the data proper show less close agreement, but there is no substantial difference except at the most recent turn.

The behavior of these series demonstrates certain cyclical characteristics which are apparent in each of the three postwar business cycles:

1. Availability of materials reaches its maximum at approximately the trough of the business cycle and begins to deteriorate with the beginning of recovery, or very shortly thereafter. In no instance does either the vendor performance series or the unfilled orders rates-of-change series rise above the zero line prior to the reference trough. Supply conditions deteriorate at an accelerating rate during early expansion and then at a diminishing rate.
2. By mid-expansion, supply conditions begin to improve, although the high levels of unfilled orders in the three observed expansions attest to substantial delays. The improvement may proceed at varying rates, but it is continuous throughout the latter half of the expansion.
3. In the final months of expansion and during early recession, availability improves at an accelerating rate. The maximum rate of improvement is attained before the end of the recession.

## PRICE MOVEMENTS

Although it is not within the scope of this study to analyze the behavior of prices, it seems reasonable to suppose that there exists a more than incidental relationship between cyclical movements in prices of purchased materials and changes in the rates of their accumulation. During periods of rising demand, tightening supply, and rapid inventory accumulation, price increases are likely to occur. Under certain conditions such price rises may, in turn, set off inventory buying which will give rise to still further pressure upon prices; under other conditions the interaction with inventory movements might be expected to be small.

Recent work by Victor Zarnowitz sheds new light on the conditions which may cause cyclical price movements. Zarnowitz has advanced and tested the hypothesis that "in industries in which a high or substantial share of output is produced to order, price change is a positive function of the change in the [unfilled order] backlog volume." [13] He finds, as set forth in a recent progress report, that for major industries which have a relatively high degree of competition, high coefficients of correlation between price change and backlog change may be noted. But "in industries with heavily predominant elements of imperfect competition or oligopoly the association between price changes and backlog changes, while still positive, is rather weak." [14] Zarnowitz concludes that "while the response of prices is thus found to be in the direction consistent with the hypothesis, its extent is often small, e.g., the elasticities of price change with respect to backlog change are mostly low (less than unity for all the major manufacturing industries examined with the exception of textile-mill products)." [15]

These findings suggest two points which are relevant to the present study: (1) For many industries, especially in the durable goods sector where inventory investment movements are most volatile, the influence of price changes on inventory behavior may be of rela-

[13] 40th Annual Report of the National Bureau of Economic Research, New York, 1960, pp. 40–41.
[14] Ibid.
[15] Ibid.

tively little importance; and (2) the relationship between price movements and changes in unfilled order backlogs is consistent with and lends support to the hypothesis that the amplitude of movement in purchased-materials inventory investment is conditioned by the level and rate of change of unfilled orders.

The conditions of "excess demand" which, Zarnowitz finds, accompany price fluctuations are the same as those which prompt a high level of inventory accumulation, because (*a*) the price changes which are observed and anticipated by purchasing firms stimulate inventory accumulation, (*b*) the delivery problems which accompany such market conditions make additional purchased-materials stocks desirable, and (*c*) inventory accumulation itself influences price movements (i.e., there is a reciprocal relationship).

## Inventory Objectives and the Purchasing Process

In the foregoing section it was shown that the availability of materials fluctuates cyclically. The next task is to examine series which provide evidence of the manner in which inventory objectives and purchasing policy are affected.

### MOVEMENTS IN NEW ORDERS AND PURCHASED-MATERIALS INVESTMENT

There is a strong tendency for purchased-materials investment to move in a manner similar to new orders. For the comprehensive data, this is evident at most turns during the entire period. Among three of the industry series [16] one (machinery) shows similar movements throughout the period, a second (transportation equipment), for part of the period, and a third (primary metals) displays a considerable degree of irregularity.

It will be noted (table 18 and chart 6) that the important departures from good conformity occurred during periods when unusual conditions existed. The inventory investment series for total manufactures, durables, and transportation equipment all show lags of 9 months behind new orders at the 1952 investment troughs. This appears to be due principally to the exceptionally large backlog of unfilled orders among the durables which did not diminish significantly until after mid-1952. Under these conditions purchased-materials investment declined very sluggishly, the contraction finally terminating in a sharp downward movement of both stocks and investment in the second quarter of 1952. The abruptness of this decline may be at least partially attributed to the extensive steel strike which occurred at that time and which reduced the flow of this raw material for almost 2 months.

[16] Of the nine industry classifications for which stage of fabrication inventory data are available, it was possible to procure new orders figures for only three: primary metals, total machinery, and total transportation equipment.

TABLE 18.—*Timing of purchased-materials inventory investment to new orders* [1]

| Industry | Lead (−) or lag (+) in months in zones associated with reference turns | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Korean war | | | | | | Percent of months in phase | |
| | 1948 peak | 1949 trough | 1951 peak | 1952 trough | 1953 peak | 1954 trough | Mid-1948 through 1955 | Mid-1948 through 1958 |
| Total manufacturing | −3 | 0 | −3 | +9 | +3 | 0 | 79 | 76 |
| Durable-goods industries, total | −3 | 0 | −3 | +9 | +3 | 0 | 80 | 86 |
| Nondurable-goods industries, total | +9 | −3 | −3 | 0 | +6 | +3 | 83 | 79 |
| Primary metals [2] | (3) | −3 | −6 | +3 | 0 | +6 | 60 | (3) |
| Machinery (including electrical) | 0 | 0 | −3 | 0 | −6 | +3 | 87 | (3) |
| Transportation equipment (including motor vehicles) | +6 | +3 | 0 | +9 | +12 | +3 | 63 | (3) |

[1] Inventory investment series are quarterly data. Computations were based on undeflated inventory data to permit comparisons with new orders material for which no deflation was possible. As a matter of caution a comparison was made based on deflated inventory data. The results were approximately the same as those shown. New orders data are quarterly totals.

[2] This series showed 2 extra cycles not found in new orders.

[3] Not available.

Source: Based on material from Department of Commerce.

In addition to this departure from close agreement, the transportation-equipment investment series also shows a 12-month lag behind new orders at its last (second quarter 1953) peak. Here again the explanation would appear to be found in the behavior of order backlogs, for unfilled orders continued to rise in the transportation equipment industry after they had turned down elsewhere. New orders for transportation equipment turned down after the second quarter of 1952, but remained above the level of shipments until the end of the first quarter 1953.

Although all turns in new orders for primary metals could be matched from 1949 on, there were two extra cycles in the investment series with the result that overall conformity was low. The poor conformity of the primary metals series cannot be explained on the same grounds as given for the transportation equipment series, but no close conformity should be expected. Producers of primary metals utilize basic ores and other raw materials which are procured only with considerable delay. It is not to be anticipated that investment in these stocks will move as sensitively as the inventory investment of machinery manufacturers, for example, whose purchased-materials stocks are drawn to a considerable degree from standardized, readily available metals and metal parts.

I have extended the analysis to the 1956–58 period for total manufacturers, total durables, and total nondurables. Chart 6 shows the related new orders and inventory investment series moving together in what appears to be the same close relationship noted for the earlier period. Table 18 substantiates this: the percentages of months in phase are not significantly altered by adding the data for these three more recent calendar years.

But why does this close association between orders and purchased-materials investment exist? If the new orders data are looked upon as a purchase orders series, their close relationship to purchased-

materials inventory investment are revealed:[17] (*a*) When manufacturers are attempting to increase stocks at increasing rates they will tend to increase purchase orders above previous levels; (*b*) when manufacturers are attempting to decrease the rate of accumulation of purchased stocks, but either desire or permit them to continue to rise, they will tend to place smaller orders than previously; (*c*) during periods when manufacturers are attempting to reduce stocks outright, they will reduce their orders still more; and (*d*) when manufacturers are allowing their stocks to continue to fall but are attempting to decrease the rate of liquidation they will increase the size of their orders.

Thus it is clear that the pattern of new orders placed will be strongly influenced by action taken to adjust inventories. Moreover, the effect should occur in a roughly instantaneous fashion. In late expansion when manufacturers wish to reduce the rate of inventory accumulation or decrease stocks outright, they will reduce orders placed and request delays of goods currently scheduled for delivery. It may not be within the power of these ordering firms to halt immediately the increase in purchased materials, for they are likely to be committed to their suppliers for a sizable quantity of goods scheduled for future delivery. It would be surprising, however, if they could not sharply alter the rate of accumulation on very short notice. Similarly, in late recession manufacturers who wish to reduce the rate of decline in purchased-materials stocks or to increase them outright will immediately increase orders. Again, the manufacturer may not be able, nor may he desire to halt instantaneously the direction of movement in purchased stocks, but he should be able to alter sharply the rate of liquidation.

### CYCLICAL CHANGES IN PURCHASING POLICY

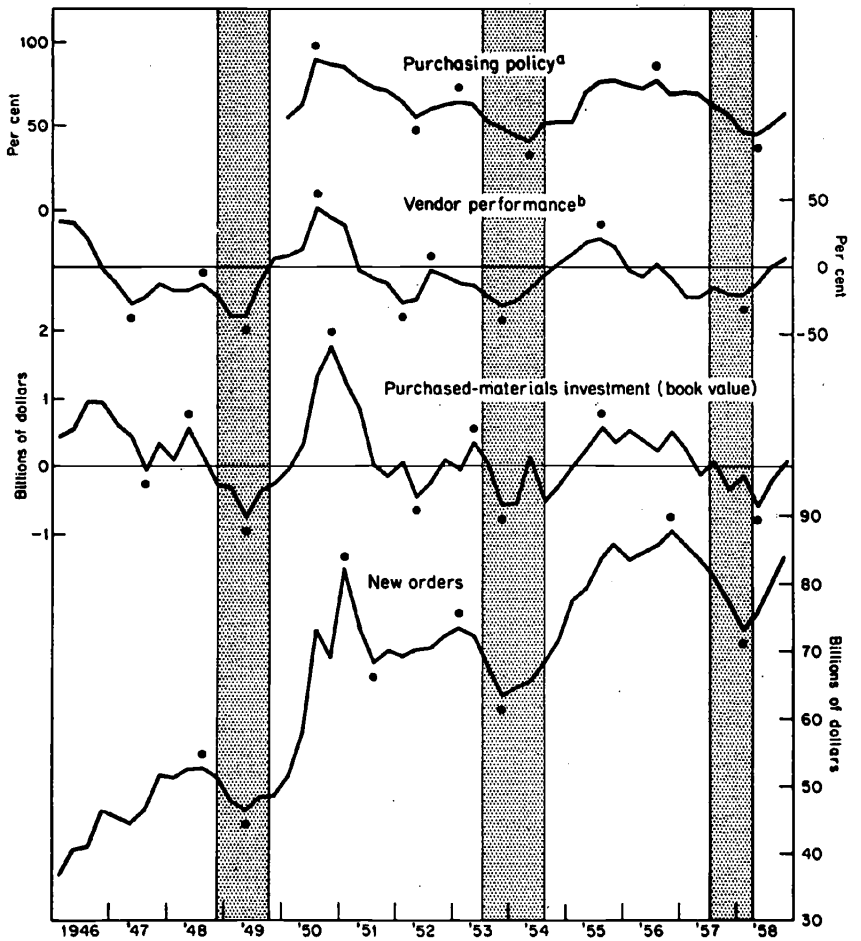
The data relating to cyclical behavior of buying policy originates in reports to the National Association of Purchasing Agents regarding current purchasing policy. Firms are reported as purchasing predominantly on a hand-to-mouth basis, on the basis of 30-day requirements, 60-day requirements, 90-day requirements, 6-month requirements, 1-year requirements or more. The data have been consolidated into two categories: percentage of firms purchasing on the basis of current requirements (30 days or less) and percentage purchasing on the basis of more than current requirements (60 days or more). The latter series is presented in chart 9.

Although this time series is not long, it provides considerable information on the cyclical variations which occur in purchasing policy. The first data became available in January 1950, only 3 months after the reference trough in late 1949. We are able to observe, therefore, almost the entire expansion of 1949–53, the complete expansion of 1954–57 and the first year of the most recent expansion, as well as the recessions of 1953–54 and 1957–58. Of particular

[17] The Department of Commerce new orders series concern orders received but there are two reasons why such data may reflect new orders placed as well. (1) To the extent that the orders reported as received originate with other firms within the same industry they are, of course, authentic purchase orders data for that industry. The larger the industry group, the more likely is this to be the case. (2) To the extent that orders received by manufacturers give rise to purchase orders which have the same pattern of timing, new orders received may be regarded as a proxy for purchase orders placed by reporting firms. Evidence that firms tend to place purchase orders synchronously with the receipt of new orders has been presented by Ruth Mack and Victor Zarnowitz. See Ruth P. Mack, "Consumption and Business Fluctuations," New York, 1956 and Ruth P. Mack and Victor Zarnowitz, "Causes and Consequence of Changes in Retailers' Buying," American Economic Review, March 1958, 18–49.

CHART 9

PURCHASING POLICY, VENDOR PERFORMANCE, TOTAL MANUFACTURERS' PURCHASED-MATERIALS INVESTMENT AND NEW ORDERS, 1946–58




[a] Purchasing policy series is percent of purchasing agents reporting 60 days or more delay in delivery. January 1950 to April 1955 data cover all purchases; subsequent data, production materials only.
[b] For description of series see table 17.

Shaded areas represent business contractions; unshaded areas, expansions.
Dots identify peaks and troughs of specific cycles.

Source: Purchasing policy series compiled from National Association of Purchasing Agents data. Vendor performance series compiled from Purchasing Agents Association of Chicago data. Other series compiled from Department of Commerce data.

interest is the behavior of the purchasing-policy series in early expansion and during recession. In each of the three expansions, observable in whole or in part, the early months are characterized by very sharp increases in the percentage of firms purchasing on the basis of more than current requirements. Between January and June of 1950 (the remainder of the year is excluded because of the crisis buying which accompanied the outbreak of Korean hostilities) the percentage of firms purchasing on this long-range basis rose from 53 to 69 percent.

In the period June 1954 to December 1955, it rose from 41 to 80 percent,[18] and from April 1958 to April 1959, it rose from 43 to 68 percent.

It will also be noted that during the two complete expansions observed, the percentage of firms purchasing in the 60-day-or-longer range reached a maximum by midphase. The range of purchase began to shorten well before the reference peak, but the sharpest drop occurred during the period extending approximately from the reference peak month to the date of the reference trough. In the period from May 1953 to May 1954, the series fell from 64 to 40 percent; and in the period from May 1957 to February 1958, it fell from 71 to 41 percent.

Taken together the series representing purchasing policy, supply conditions, new orders, and purchased-materials investment provide valuable insight into the processes by which inventory objectives fluctuate in the course of the business cycle.[19]

As already observed, movements in the new-orders series appear, to a significant extent, to reflect buyers' efforts to adjust stocks; i.e., a rising volume of orders would seem to reflect attempts of buyers to decrease the rate of disinvestment in purchased goods or to increase the rate of investment; and a declining volume of orders, attempts to reduce the rate of investment in purchased goods or to increase the rate of disinvestment. Of course, the new-orders data are comprised principally of purchases for production or for resale rather than for inventory accumulation; in general, their rise and fall must be largely in response to changes in final demand. Nevertheless, inventory investment demand is superimposed upon this demand, and the data give evidence that the former influences significantly the timing of turns in the aggregate order series. This was inferred in the previous section from the similarity in the timing of turns in new orders and in purchased-materials investment. It is now supported further by the close agreement between timing of both of these series and the purchasing-policy series.

[18] The data are not perfectly comparable throughout, however. Prior to May 1955 agents submitted reports in which all types of purchases were combined. From May 1955 forward, reports were made on the basis of three categories: production materials, maintenance and materials repair, and capital expenditures. Only data covering production materials buying are shown for this latter period.

[19] This discussion is based on chart 9 and table 19, which concern vendor-performance, purchasing-policy, orders, and purchased-materials investment series.

TABLE 19.—*Timing comparisons: Vendor performance, purchased-materials investment, total manufacturers new orders, purchasing policy series, 1946–58*

A. TIMING TO PURCHASING POLICY SERIES

| Series compared | Peak, August 1950 | Trough, May 1952 | Peak, February 1953 | Trough, May 1954 | Peak, August 1956 | Trough, May 1958 |
|---|---|---|---|---|---|---|
| Vendor performance | 0 | −3 | +6 | −6 | −12 | −3 |
| Purchased materials investment | +3 | 0 | +3 | −6 | −12 | 0 |
| Total manufacturers' new orders | +6 | −9 | 0 | −6 | +3 | −3 |

B. TIMING TO PURCHASED MATERIALS INVESTMENT SERIES

| Series compared | Trough, August 1947 | Peak, May 1948 | Trough, May 1949 | Peak, November 1950 | Trough, May 1952 | Peak, May 1953 | Trough, November 1953 | Peak, August 1955 | Trough, May 1958 |
|---|---|---|---|---|---|---|---|---|---|
| Vendor performance | −3 | +3 | 0 | −3 | −3 | −9 | 0 | 0 | −3 |
| Purchasing policy | (1) | (1) | (1) | −3 | 0 | −3 | +6 | +12 | 0 |
| Total manufacturers' new orders | (2) | +3 | 0 | +3 | −9 | −3 | 0 | +15 | −3 |

[1] Not available.
[2] No turn.

Sources: Vendor performance data compiled from statistics collected by Purchasing Agents Association of Chicago; purchasing policy series compiled from data published by the National Association of Purchasing Agents. Other series based on material from Department of Commerce.

In general, during periods in which total new orders are rising, the purchasing-policy series is also rising (i.e., the typical purchase range is lengthening), thereby indicating that the volume of orders placed during these periods of expanding trade is rising in relation to current operating requirements. It is at this time that realized disinvestment is declining sharply (in the very early months of expansion) or realized investment is rising (as the expansion progresses).

During periods in which total new orders are falling, the purchasing-policy series, declines, revealing that the volume of purchase orders is falling in relation to current operating requirements (i.e., the typical purchasing range is shortening). During such periods realized investment is found to be decreasing (or realized disinvestment increasing).

The inference that the rise and fall in orders reflects, to a significant degree, the efforts of firms to alter the rate of accumulation or deaccumulation of stocks, is supported by the fact that orders lead turns in business cycles. Since turns in manufacturers' shipments, as well as turns in retailers' sales, show no similar tendency to lead cycle turns, it may be presumed that the early turns in orders do not reflect a reversal in end-use demand, but rather an attempt by businessmen to adjust their stocks or their purchase commitments.

In addition, the role played by supply conditions in cyclical variations in purchasing policy is an important one. To be sure, it is not possible to distinguish conclusively between cause and effect here: supply conditions deteriorate because purchasing policy alters and orders increase; purchasing policy may change and orders may increase in turn, because supply conditions deteriorate. Yet, the similarity of movement in the vendor-performance and purchasing-policy series indicates some degree of causation in the role played by supply condi-

tions, particularly in the light of the functions exercised by purchasing executives.[20] It is difficult to imagine that the changes in vendor performance observed in the data do not prompt executives to revise their inventory target levels. Indeed, if purchasing agents were not influenced by such considerations, one of their major associations would not collect and publish the data on vendor performance examined here.

The influence of supply conditions may operate in two ways during expansions: (1) Deterioration in supply conditions makes it more difficult to achieve inventory objectives, so realized inventory investment will be somewhat less than that desired; and (2) deterioration in supply conditions influences the inventory objective itself.

The second is by no means a simple concept. If it were, we might expect to find that the purchasing range would be rising as long as availability is deteriorating; that is, as long as the vendor-performance series lies above the zero line. In fact, however, the turn in the purchasing-policy series occurs at approximately the same time as that in the vendor-performance rate-of-change series.

One can only speculate regarding the explanation of this intriguing relationship. One suggestion is that purchasing agents may view the declining rate of deterioration in vendor performance as a signal that delivery conditions will begin to improve in the near future, and thus, via a change in anticipations, the range of purchase is shortened.

## Summary and Conclusions

Although there are variations in the behavior of individual industry series, certain characteristics of purchased-materials behavior appear to be clearly established. Purchased-materials stocks conform well to cyclical movements, turning earlier at sales and business cycle peaks than at troughs. Turns in the comprehensive series tend to coincide with business cycle peaks and lag at business cycle troughs. This timing characteristic docs not carry over to inventory investment behavior: the comprehensive investment series show leads at all business cycle turns. In these movements the durables series show a higher conformity and a greater amplitude of movement.

The well-established tendency of inventory investment turns to lead reference turns during the period under study is of major significance for business cycle analysis. In late expansion the decline in the level of inventory investment has constituted a source of declining demand for the factors of production, and during late recession the decline in the rate of disinvestment has provided a source of new strength in the economy. To the extent that these observations are typical, purchased-materials investment may be regarded as one of those highly strategic forces which serve to turn the cyclical tide.

Abramovitz' theory does not provide for the occurrence of certain observed timing in the inventory and investment series. Moreover, it fails to consider the possible role of unfilled-order backlogs, availability of materials, and price behavior of purchased goods in influencing inventory behavior. In an effort to provide a fuller explanation, these influences were examined.

[20] Note that the two series are reported by different purchasing agent groups, so that they are, at least statistically, independent.

The amplitude of movements in purchased-materials investment was found to be related to the size and direction of movement of manufacturers' unfilled-order backlogs. Series reflecting availability of materials were constructed from the vendor-performance data of the Purchasing Agents Association of Chicago and from unfilled-orders data. From the behavior of these series it was observed that—

(1) Availability of materials reaches its maximum at approximately the trough of the business cycle and begins to deteriorate with the beginning of recovery, or shortly thereafter. Supply conditions deteriorate at an accelerating rate during early expansion and then at a diminishing rate.

(2) By midexpansion, supply conditions begin to improve although there are still substantial delays in delivery.

(3) In the final months of expansion and during early recession availability improves at an accelerating rate. The maximum rate of improvement is attained before the end of the recession.

There is evidence that industrial prices move in response to the same conditions of demand and supply that influence purchased-materials inventory investment. It is reasonable to suppose that they not only respond to such forces but also play a causal role. However, for many industries, especially in the durable-goods sector, the influence may be relatively small.

In a final section, the behavior of inventory objectives and purchasing policy was observed in relation to the availability of materials and realized inventory investment. Data relating to leadtime of purchase show that the cyclical behavior of purchasing policy is well-developed; the series move in a manner similar to that of the series reflecting availability of materials. Moreover, the timing of the purchasing-policy series agrees rather closely with that of manufacturers' new orders and purchased-materials inventory investment. Taken together these series tell of a sensitive process by which rising inventory objectives and deteriorating supply conditions are matched by rising orders and an ever-increasing rate of inventory accumulation in the earlier stages of expansion. Reversal begins in late expansion, but the sharpest declines in inventory objectives, orders, and realized inventory investment, as well as the sharpest improvement in supply conditions, occur during recession.