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TIMING COMPARISONS

TIMING RELATIONS can be examined by dating the fluctuations in the series concerned, identifying the movements that match, and measuring the leads and lags between the corresponding turning points. In this chapter, such measures are presented for the available data on new orders, production, and shipments. The analysis proceeds from series relating to individual products and industries, mostly in physical units, to value aggregates for the major divisions and some subdivisions of the manufacturing sector. The former group covers mainly the interwar period; the second group, the post-World War II period. Measures of relative timing in the recent years are also presented for several broadly defined market categories and for a set of deflated major-industry series on new orders and shipments as well as the corresponding production indexes.

Rules about the dating and matching of turning points have been developed and applied in the business cycle studies of the National Bureau. These rules, however, are merely designed to discipline the researcher's judgment, not substitute for it. In general, the turning points to be identified are the local maxima and minima in the series concerned, subject to certain constraints relating to the duration of the movements thus dated: very short peak-to-peak or trough-to-trough fluctuations do not qualify as "specific cycles." The presence of sufficiently marked and long movements must be established first; the precise dating of the turning points comes next. Occasionally, an extremely high or low standing of the series is so isolated that it seems to be the result of some random event or very short-term "irregularity" rather than the culmination of a longer cyclical process. In such cases, a less extreme value of the series, which is surrounded by similar val-

ues, would be selected instead; in other words, a "broader" peak or trough may be preferred to a higher or lower but "narrow" standing (say, a single-month high point occurring at a time when the series still shows a rising trend). Smoothing can help to identify the turns, and we do consult short-term averages (mostly of three to six months) as the need arises; but smoothing may also distort and bias the dating, and caution must be exercised not to let this happen. Whether or not moving averages were used as an aid in the dating process, the dates always refer to the unsmoothed series (after seasonal adjustment).[1]

Individual Industries or Products

Relative Timing of New Orders and Shipments

GOODS MADE TO ORDER. The first set of timing comparisons (Table 4-1) is based on eleven pairs of series for new orders and shipments, representing goods manufactured primarily to order. There are nine producer durable items equally divided between iron and steel products, machinery, and railway equipment; one consumer durable product (furniture); and one nondurable (paper). Seven of the comparisons are between physical series, and four employ current-value data (these are the machinery items—electric overhead cranes, machine tools, and woodworking machinery—and furniture).

Table 4-1 demonstrates that in manufacture of this type new orders lead shipments with a very high degree of regularity. This general finding can be viewed as a statistical reflection of a fairly obvious causal relation. Indeed, it is not the leading pattern of new orders itself but the few lapses from it that might need explanation. Of these, however, some are probably spurious, a result of the difficulty of marking a specific peak or trough in a jagged turning segment.

[1] On the dating of specific cycles, see Arthur F. Burns and Wesley C. Mitchell, *Measuring Business Cycles*, New York, NBER, 1946, pp. 56–66. The rules followed in matching the specific-cycle turns in two activities are analogous to those for the timing observations at business cycle turns (*ibid.*, pp. 116–28). The turns in the series to be compared were, as a general procedure, dated independently, with the aid of these rules. Individual timing comparisons based on such markings may well deviate from the expected patterns; but unless the results were clearly unsatisfactory and capable of reasonable improvement, we were careful not to modify the markings made according to the accepted rules. This insured against arbitrary decisions or inadvertent forcing of the evidence.

As another safeguard, the turning points in most of the series used in this book were dated independently by another member of the NBER staff. The consensus between the dates was very good, though some differences remained, of course, and were resolved by the author's decision. The assistance in this work by the late Miss Sophie Sakowitz is gratefully acknowledged.

The quantitative aspects of the data in Table 4-1 are of primary interest. The average leads of new orders at shipment turns (column 10) vary over a wide range of from eleven to less than two months. The items are ranked by the length of these leads, from longest to shortest. Railway equipment, heavy and specialized machinery, and structural steel (which includes some of the most elaborate steel products) constitute the upper part of the list, with mean leads of six months and more. Industries or groups of commodities that are presumably less heavily weighted with complex or specialized types of product—pig iron, steel sheets, paper products, furniture, and woodworking machinery—are characterized by shorter average leads (four months and less). Coincidences, lags, and short leads of three months or less are much more frequent, relative to all leads, at the bottom than at the top of the table (see columns 5–8). This is a suggestive array, although with the amount and type of data on hand we would not wish to push the matter beyond the broad observations offered.

The leads of orders vary substantially, not only between the different industries and products but also between successive observations for any single item in the table. The extent of their intercycle variability may be judged from the figures in columns 11 and 12, which ought to be read along with the corresponding entries in columns 9 and 10 (the former being average deviations of the individual timing comparisons, and the latter the mean leads from which they are measured). The average deviations vary from five to less than two months and tend to be larger in the upper than in the lower part of the table. They are thus positively associated with the corresponding mean leads, a relation that is probably not uncommon. However, other things aside, it takes a larger average deviation to cast doubt upon the nature of a timing relation when the mean lead is long than when it comes close to zero.[2]

[2] Thus, when the mean timing figure is −11.0, even an average deviation of five months will not disqualify it as an indication of leads of substantial duration (this is the situation for railroad passenger cars). On the other hand, an average deviation of five months associated with a mean of, say, −1.0 or less, would point to the presence of leads and lags of significant length at the individual turns; an average of such mutually offsetting observations would not be likely to represent any consistent timing patterns.

A comment should be added on the type of averages and variability measures used. For the data in this section, means and mean absolute deviations were computed some time ago, following the standard procedures then used by the business cycle unit of the National Bureau. Extension of the analysis to other measures such as medians and standard deviations appeared unwarranted. However, for the aggregative series discussed later in this chapter all four types of summary statistics are used.

Table 4-1

Timing of Turns in New Orders at Turns in Shipments, Eleven Industries or Products [a] Representing Manufacture to Order, Various Periods, 1919–55

Period Covered [b] (1)	All Turns: No. of Order Turns Covered (2)	All Turns: No. of Shipment Turns Covered (3)	All Turns: No. of Shipment Turns Matched (4)	No. of Timing Observations [c] at Peaks or Troughs That Are: Leads (5)	Exact Coinci-dences (6)	Lags (7)	Rough Coinci-dences [d] (8)	Av. Lead (–) or Lag (+) (months): Peaks or Troughs [c] (9)	Av. Lead (–) or Lag (+) (months): All Turns (10)	Av. Dev. from Av. Lead or Lag (months): Peaks or Troughs [c] (11)	Av. Dev. from Av. Lead or Lag (months): All Turns (12)
RAILROAD PASSENGER CARS											
1919–55	26	22	22	11				−11.4	−11.0	4.6	5.0
				11			1	−10.6		5.3	
RAILROAD LOCOMOTIVES											
1920–38	15	13	13	5		1		−5.7	−7.3	3.2	3.9
				6	1		1	−8.7		4.2	
RAILROAD FREIGHT CARS											
1919–54	21	21	19	8		1		−9.1	−7.1	6.1	4.9
				9		1	2	−5.2		3.0	
ELECTRIC OVERHEAD CRANES											
1926–45	8	8	8	3	1		1	−6.5	−6.9	3.5	4.1
				4			1	−7.2		4.8	
FABRICATED STRUCTURAL STEEL											
1926–55	20	14	14	7			1	−6.9	−6.6	2.1	3.6
				6			3	−6.4		5.1	

MACHINE TOOLS											
1927–55	11	9	9	4		1	1	−10.0	−6.0	6.5	4.7
				4		1	3	−2.8		3.0	
MERCHANT PIG IRON											
1919–24	5	5	5	2			1	−4.0	−4.0	3.0	2.4
				3			2	−4.0		2.0	
STEEL SHEETS											
1919–32	9	9	9	4			2	−5.8	−3.9	4.2	3.9
				3	2		4	−2.4		3.0	
PAPER, EXCLUDING BUILDING PAPER, NEWSPRINT, AND PAPERBOARD											
1937–52	10	8	8	4			1	−5.2	−2.6	2.2	2.8
				2	1	1	4	0		1.0	
FURNITURE (GRAND RAPIDS DISTRICT)											
1923–46	10	9	8	3	1		3	−2.0	−2.2	1.5	1.8
				3	1		2	−2.5		2.0	
WOODWORKING MACHINERY											
1923–39	10	10	10	5			3	−2.8	−1.6	1.4	1.7
				2	2	1	5	−0.4		1.3	
ALL ELEVEN ITEMS [e]											
	145	128	125	56	2	2	13	−7.2	−6.3	4.4	4.4
				53	7	5	28	−5.4		4.5	

[a] Ranked by the length of the average lead, all turns (column 10), from longest to shortest.

[b] Identifies the complete specific-cycle phases in the shipment series.

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

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

[e] Summary of the timing measures for the industries or products covered. Entries in columns 3–8 are totals, entries in columns 9–12 are averages weighted by the numbers of observations for each item.

The leads of new orders for the same group of products were on the whole longer at the peaks than at the troughs in shipments. The average of all peak observations for the eleven items covered in Table 4-1 is a lead of 7.2 months; the corresponding mean for the trough observations is 5.4 months. Since the capacity position of many firms at top levels of output and deliveries is presumably strained, longer average leads of orders at peaks conform to the economist's expectations.[3] However, in only seven components of this sample do the mean leads at peaks exceed those at troughs, in five of them by large margins. This is not a fully convincing record, but some additional evidence in support of the longer peak leads will be provided by timing comparisons for other groups of data.

GOODS MADE TO STOCK. Table 4-2 presents the timing measures for a sample of seven durable goods made primarily to stock. Of these, five are used principally by consumers (oil burners and the four items of enameled sanitary ware), and two are used principally by producers (oak flooring and southern pine lumber). This group of products contrasts with the sample of Table 4-1, representing manufactures to order. There we dealt mainly with producer goods: metal products and equipment for industry and transportation, including goods that are highly complex or specialized or large-unit and expensive. Here we have a small group of items that are much more standardized and closer to the needs of consumers, associated most of all with residential construction.

Tables 4-1 and 4-2 are arranged in the same manner, so that it is easy to compare them by corresponding columns. Together, the two tables include all but one of the individual industries or products for which we have matched series on new orders and shipments.[4]

[3] An extension of this argument leads to the presumption that "a good index of orders is likely to prove a better forecaster of business cycle recessions than of business cycle revivals" (Wesley C. Mitchell and Arthur F. Burns, *Statistical Indicators of Cyclical Revivals*, NBER Bulletin 69, 1938 (reprinted in Geoffrey H. Moore, ed., *Business Cycle Indicators*, Princeton for NBER, 1961, Vol. I, p. 182, n. 13).

[4] The one exception to this is foundry equipment, which proved particularly difficult to classify. For lack of data the test of the Q/U ratios could not be applied to it. According to information received from the Foundry Equipment Manufacturers' Association, this is a very heterogeneous group of products. Time lags of shipments against orders are reported to vary greatly among the different types of equipment, ranging from as low as 3 to 4 weeks to as high as 9 to 12 months. The proportion of short orders cannot be reliably estimated, although an inspection of the charts suggests that it might be large, since there is a good deal of parallelism between the cyclical fluctuations as well as the seasonal patterns in new orders and shipments.

The timing patterns of the two groups of data are distinctly different. The leads of new orders over shipments tend to be both shorter and less regular for the sample of goods made to stock than for that of goods made to order. The average of all the individual comparisons underlying the timing measures shown in Table 4-2 is a lead of 1.2 months. The corresponding over-all average in Table 4-1 is a lead of 6.3 months. None of the products sold mainly from stock shows a mean lead of orders of more than two months. The *longest* of these leads differs little from the shortest of the comparable leads for the group of items made to order: the last of the ranked entries in column 10 of Table 4-1 is −1.6; the first of the ranked entries in column 10 of Table 4-2 is −1.9. In other words, there appears to be little overlap between the two arrays: the one for made-to-order commodities stops descending (toward ever shorter leads) approximately where the other begins.

At troughs, the timing of orders and shipments is synchronous, or very nearly so, for each of the products covered in Table 4-2. Two order series lag, on average, and one is coincident (column 9). At peaks, the timing means, with one exception, are all leads. In each case these averages indicate that there is more of a tendency for new orders to lead shipments at peaks than at troughs. However, this tendency is weak; the timing of the two variables for this group of products is characterized by rough coincidence (including short leads or lags of three months or less, and "exact" coincidences). The weighted timing averages for the group as a whole are −2.0 months at peaks and −0.4 months at troughs. Even at peaks, then, the central tendency is toward a short lead within the roughly coincident range.

The variability of the timing observations for goods made to stock is large (columns 11 and 12). For all turns matched in this set of comparisons, the average deviation from the mean lead of only 1.2 months is 2.6 months.

SUMMARY. Table 4-3 presents distributions of all timing comparisons between new orders and shipments for the two groups of products. Here the nature of the differentiation among the recorded comparisons —whether it is due to intercycle or to interindustry variation—is disregarded. The figures provide further demonstration of the contrast between the two groups. For goods made to order the distributions

Table 4-2

Timing of Turns in New Orders at Turns in Shipments, Seven Products [a] Manufactured Primarily to Stock, Various Periods, 1913–55

Period Covered [b] (1)	All Turns: No. of Order Turns Covered (2)	All Turns: No. of Shipment Turns: Covered (3)	All Turns: No. of Shipment Turns: Matched (4)	No. of Timing Observations [c] at Peaks or Troughs That Are: Leads (5)	Exact Coincidences (6)	Lags (7)	Rough Coincidences [d] (8)	Av. Lead (–) or Lag (+) (months): Peaks or Troughs [d] (9)	Av. Lead (–) or Lag (+) (months): All Turns (10)	Av. Dev. from Av. Lead or Lag (months): Peaks or Troughs [e] (11)	Av. Dev. from Av. Lead or Lag (months): All Turns (12)
OAK FLOORING											
1913–55	25	23	23	9	1	2	7	–2.6	–1.9	2.5	2.3
				5	5	1	9	–1.2		1.8	
OIL BURNERS											
1933–51	9	9	9	2	2		3	–3.0	–1.6	4.0	2.2
				2	2	1	5	–0.4		0.9	
SOUTHERN PINE LUMBER											
1919–53	23	23	23	6	5		10	–2.1	–1.3	2.2	1.7
				6	5	1	10	–0.7		1.3	
KITCHEN SINKS											
1919–25	6	6	6	1		2	2	–3.0	–1.2	6.7	5.2
				2		1	1	+0.7		4.9	

Table 4-2 (concluded)

Period Covered[b] (1)	All Turns: No. of Order Turns Covered (2)	All Turns: No. of Shipment Turns Covered (3)	All Turns: No. of Shipment Turns Matched (4)	No. of Timing Observations[c] at Peaks or Troughs That Are: Leads (5)	Exact Coincidences (6)	Lags (7)	Rough Coincidences[d] (8)	Av. Lead (−) or Lag (+) (months): Peaks or Troughs[d] (9)	Av. Lead (−) or Lag (+) (months): All Turns (10)	Av. Dev. from Av. Lead or Lag (months): Peaks or Troughs[c] (11)	Av. Dev. from Av. Lead or Lag (months): All Turns (12)
BATHTUBS											
1918–25	6	6	4	1		1	2	−0.5	−0.5	2.5	1.5
				1	1		2	−0.5		0.5	
LAVATORIES											
1919–25	6	6	6	1		2		−0.3	−0.2	6.4	5.5
				2		1	1	0.0		4.7	
MISCELLANEOUS ENAMELED SANITARY WARE											
1919–24	4	4	4	1		1	1	+2.0	+2.8	3.0	3.8
				1		1	1	+3.5		4.5	
ALL SEVEN ITEMS[e]											
	79	75	75	21	8	8	25	−2.0	−1.2	3.2	2.6
				19	13	6	29	−0.4			

Note: For notes a through e, see Table 4-1.

Table 4-3
Distribution of Leads and Lags of New Orders at Shipment Turns in Monthly Data

Leads (−) or Lags (+), by Length in Months	Number of Timing Observations for				Percentage of Timing Observations for					
	11 Items Made Primarily to Order[a]		7 Items Made Primarily to Stock[b]		11 Items Made Primarily to Order[a]			7 Items Made Primarily to Stock[b]		
	Peaks (1)	Troughs (2)	Peaks (3)	Troughs (4)	Peaks (5)	Troughs (6)	All Turns (7)	Peaks (8)	Troughs (9)	All Turns (10)
−31 to −36		1				1.5	0.8			
−25 to −30	1				1.7		0.8			
−19 to −24	2				3.3		1.6			
−13 to −18	5	6	2		8.3	9.2	8.8	5.4		2.7
−7 to −12	17	16	4		28.3	24.3	26.4	10.8		5.3
−4 to −6	20	13	3	5	33.3	20.0	26.4	8.1	13.2	10.7
−1 to −3	11	17	12	14	18.3	26.2	22.4	32.5	36.8	34.7
0	2	7	8	13	3.3	10.8	7.2	21.6	34.2	28.0
+1 to +3	0	4	5	2	0	6.2	3.2	13.5	5.3	9.3
+4 to +6	1	1	3	1	1.7	1.5	1.6	8.1	2.6	5.3
+7 to +12	1	1		3	1.7		0.8		7.9	4.0
Total	60	65	37	38	100.0	100.0	100.0	100.0	100.0	100.0
Summary										
Long leads (−4 to −36)	45	36	9	5	74.9	55.3	64.8	24.3	13.2	18.7
Rough coincidences (−3 to +3)	13	28	25	29	21.7	43.2	32.8	67.6	76.3	72.0
Long lags (+4 to +12)	2	1	3	4	3.4	1.5	2.4	8.1	10.5	9.3
Total	60	65	37	38	100.0	100.0	100.0	100.0	100.0	100.0

[a] This sample consists of the industries and products covered in Table 4-1.
[b] This sample consists of the products covered in Table 4-2.

reach up into the classes of very long leads, show the highest frequencies in the classes running from −4 to −12 months, and recede in the regions of coincidences and lags. For goods made to stock the classes of very long leads are empty, and those of short leads and coincidences most heavily populated (compare columns 5–7 with columns 8–10). Approximately two-thirds of all observations for goods made to order are intermediate and long leads of more than three months, while nearly three-fourths of all observations for goods made to stock are rough coincidences.

Relative Timing of New Orders and Output

The sample of individual industries for which we have matched data on new orders and output (all in physical terms) is, regrettably, very small. It includes three of the items that represented manufacturing to order in Table 4-1 (merchant pig iron, steel sheets, and paper), two of the products made primarily to stock from Table 4-2 (oak flooring and southern pine lumber), and one commodity made primarily to order, for which no comparisons with shipments could be made (paperboard).

Timing comparisons between new orders and production based on these data are summarized in Table 4-4. They demonstrate the tendency for the turns in new orders to anticipate the turns in output. All of the timing averages in columns 9–10 are leads of new orders, although most of these leads are short, about 3 months or less. The mean leads at troughs are shorter than those at peaks for all but one item. Of the observations at peaks, somewhat more than half are rough coincidences; of the observations at troughs, over two-thirds.

For the four made-to-order items, the average lead at all turns is 2.6 months, and for the two made to stock, it happens to be the same. There is no evidence here of any significant differentiation between the timing patterns of the two groups. This is consistent with the notion that new orders guide and hence anticipate production even in those industries in which they are customarily filled from stock shortly after receipt.

However, it would be rash to make further generalizations from this meager evidence. It would be unwise to infer that the lags of outputs, unlike those of shipments, are not likely to differ systematically in length and regularity as between manufacture to order and manu-

Table 4-4

Timing of Turns in New Orders at Turns in Production, Six Industries or Products,[a] Various Periods, 1917–56

Line	Period Covered[b] (1)	All Turns: No. of Order Turns Covered (2)	All Turns: No. of Production Turns Covered (3)	All Turns: No. of Production Turns Matched (4)	No. of Timing Observations at Peaks or Troughs[c] That Are: Leads (5)	Exact Coincidences (6)	Lags (7)	Rough Coincidences[d] (8)	Av. Lead (−) or Lag (+) (months): Peaks or Troughs[c] (9)	Av. Lead (−) or Lag (+) (months): All Turns (10)	Av. Dev. from Av. Lead or Lag (months): Peaks or Troughs[c] (11)	Av. Dev. from Av. Lead or Lag (months): All Turns (12)
	MERCHANT PIG IRON											
1	1919–24	5	5	5	2				−5.5	−5.4	1.5	1.7
2					3				−5.3		1.8	
	PAPER, EXCLUDING BUILDING PAPER, NEWSPRINT, AND PAPERBOARD											
3	1937–52	10	8	8	4			1	−6.2	−3.0	2.3	3.5
4					1	2	1	4	+0.2		0.9	
	OAK FLOORING											
5	1917–55	25	19	19	9	1		5	−3.1	−2.8	2.3	2.2
6					6	2	1	7	−2.4		2.2	
	STEEL SHEETS											
7	1919–32	9	9	9	2	1	1	3	−3.5	−2.7	5.2	3.9
8					2	3		4	−2.0		2.8	
	SOUTHERN PINE LUMBER											
9	1918–53	23	21	21	5	2	3	5	−1.1	−2.3	2.7	2.4
10					9	2		6	−3.5		2.0	

	PAPERBOARD, TOTAL											
11	1926–56	19	17	17	8	1		7	−2.3	−1.5	1.5	1.3
12					4	3	1	8	−0.5		0.8	
	ALL SIX ITEMS ABOVE[e]											
13		91	79	79	30	5	4	22	−2.9	−2.6	2.7	2.5
14					25	12	3	29	−2.2		2.3	
	FOUR ITEMS MADE TO ORDER[f]											
15		43	39	39	16	2	1	11	−3.7	−2.6	3.0	2.7
16					10	8	2	16	−1.5		2.0	
	TWO ITEMS MADE TO STOCK[g]											
17		48	40	40	14	3	3	11	−2.1	−2.6	2.0	2.3
18					15	4	1	13	−3.0			

[a] Ranked by the length of the average lead, all turns (column 10), from longest to shortest.

[b] Identified by the complete specific-cycle phases in the production series.

[c] For each item, the entry on the odd-numbered lines is for comparisons at peaks; the entry on the even-numbered line, for comparisons at troughs.

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

[e] Summary of the timing measures for the six industries or products covered. Entries in columns 2–8 are totals; entries in columns 9–12 are averages weighted by the number of observations for each item.

[f] Summary of the timing measures for merchant pig iron; paper, excluding building paper, newsprint, and paperboard; steel sheets; and paperboard (lines 1–4, 7, 8, 11, and 12). Totals and weighted averages are explained in note e.

[g] Summary of the timing measures for oak flooring and southern pine lumber (lines 5, 6, 9, and 10). Totals and weighted averages are explained in note e.

facture to stock. The timing records of Table 4-4 cannot support such a generalization. The difficulty here is due not only to the smallness but to the character of the sample. That is, the items covered, in terms of the order-shipment comparisons, belong to the least differentiated segments of our two samples; those segments which show the contrast between the two types of manufacture most clearly are omitted (because corresponding production data are not available). Merchant pig iron, steel sheets, and paper are found in the *lower* part of Table 4-1, that is, among the made-to-order products that have short leads of orders relative to shipments. Oak flooring and southern pine lumber, again, are located in the *upper* part of Table 4-2; they rank first and third according to the length of their order leads among the components of the made-to-stock group. The accompanying tabulation compares the mean leads of orders relative to production with the mean leads of orders relative to shipments for *the same* groups of commodities. The to-order group therefore includes only three items: merchant pig iron; paper, excluding building paper, newsprint, and paperboard; and steel sheets. The to-stock group, however, includes both oak flooring and southern pine lumber, as in Table 4-4.

	Average Lead of New Orders at:					
	Peaks		*Troughs*		*All Turns*	
	(*figures in parentheses are the corresponding average deviations*)					
Three items made to order						
Comparisons with production	−5.0	(3.8)	−2.1	(2.8)	−3.4	(3.5)
Comparisons with shipments	−5.2	(3.0)	−2.0	(2.3)	−3.5	(3.0)
Two items made to stock						
Comparisons with production	−2.1	(2.5)	−3.0	(2.0)	−2.6	(2.3)
Comparisons with shipments	−2.3	(2.4)	−0.9	(1.5)	−1.6	(2.0)

These figures do show the lead of new orders at all turns in output to be somewhat longer for goods made to order than for goods made to stock, but they make it clear that this is due entirely to the characteristics of the timing at peaks, not at troughs.[5] In the comparisons with shipments, on the other hand, order leads are shorter for goods

[5]The average leads in the first line of the tabulation above are longer than those in Table 4-4 because paperboard has been excluded from the group of goods made to order. We have no shipment data for paperboard, and wish to cover in the tabulation only those products for which we can compare new orders with *both* shipments and production.

made to stock, at both troughs and peaks. As a result, the difference in the timing of orders for the two groups of goods at all turns is less for the comparisons with production.

Small differences between averages based on small numbers of observations are, of course, of dubious statistical significance; they are presented here as only mildly suggestive. But these observations do seem sensible in view of our expectations: that output and shipments would be closely synchronous in manufacture to order; that output would lag behind orders, too, though probably only slightly, in manufacture to stock; and that even those manufacturers who ordinarily work to stock would become more "order oriented" when their business was at its peak levels.

Major-Industry Aggregates

This section deals with the relative timing measures for the OBE-Census series on the value of manufacturers' new orders and shipments, and also compares the timing of deflated series for N and S and the corresponding production indexes. The major-industry data for these comparisons were described in Chapter 3 and shown there in several charts.

These charts will be referred to repeatedly and should be consulted. They elucidate both the strengths and the weaknesses of the method of analyzing cyclical timing relations. They show turning points that are easily identified, along with others that are less certain and a few that are rather problematic. They convey a strong impression of the (expected) parallelism between the matched series, allowing for the greater amplitudes and earlier timing of new orders. But they also provide examples of shipments "skipping" certain cyclical turns and movements in orders. They show both that which is continuous and that which is episodic, and thus supplement effectively the timing observations at turning points and the regression measures that summarize average relationships over time.

New Orders vs. Shipments: Timing Comparisons at Successive Peaks and Troughs

Table 4-5 lists the individual leads of new orders at successive turning points in shipments for each of the major industries and their group-

Table 4-5

Timing Relations Between Value Aggregates of New Orders and Shipments, by Business Cycle Turning Zones, Major Manufacturing Industries, 1948–62

Industry	Lead (–) or Lag (+), in Months of New Orders at Turns in Shipments in Turning Zone Associated with											
			Korean War [a]								Business Retardation 1962 [a]	
	1948 Recession: Peaks (1)	1949 Revival: Troughs (2)	1950–51: Peaks (3)	1951–52: Troughs (4)	1953 Recession: Peaks (5)	1954 Revival: Troughs (6)	1957 Recession: Peaks (7)	1958 Revival: Troughs (8)	1960 Recession: Peaks (9)	1961 Revival: Troughs (10)	Peaks (11)	Troughs (12)
All manufacturing	–1	–4	n.s.	n.s.	–6	–9	–2	–3	–1 [h]	0	–2	–3
Durable goods, total	–5	–4	n.s.	n.s.	–6	–12	–14	–3	–2 [b]	–1	–1	–3
Primary metals	–1	–3	–3	0	–1	–11	–12 [c]	–2	–4 [d]	–10	–3	–5
Blast furnaces, steel mills	n.a.	n.a.	n.a.	n.a.	n.i.	–11	–19 [c]	–2	–4 [d]	–11	–3	–3
Fabricated metal products	n.i.	–7	–1	–4	–6	–11	–2	–5	–2	0	0	0
Electrical machinery [e]	–5	–3	0 [f]	+6 [f]	–2	–5	–1	–4	–3 [g]	+1 [g]	–4	–2
Machinery except electrical [e]	–6	–1	n.s.	n.s.	–3	–5	–1	–6	–12	–8	–3	–1
Transportation equipment	n.i.	n.i.	n.s.	n.s.	–7	–12	–8 [h]	–6	–3	0	n.t.	n.t.
Other durable goods [i]	+2	0	0	0	–4	–7	+1	0	–3	0	n.t.	n.t.
Nondurables, total	+1	–1	0	–9 [j]	–9 [j]	0	–2	0	0	0	n.t.	n.t.
Reporting unfilled orders [k]	–4	–5	–4	–5	–5	–1	+2	–3	–6	0	n.t.	n.t.

Notes to Table 4-5

n.s. = no turn in shipments.
n.i. = not identified (timing of new orders or shipments or both uncertain).
n.a. = data not available.
n.t. = no turning points.

Note: Measures for all manufacturing industries; durable goods industries, total; and nondurable goods industries, total; and measures on the other lines 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).

[a] These pairs of peaks or troughs represent "extra" turns, not related to any cyclical recession or revival recognized as such in the National Bureau chronology of U.S. business cycles. The timing comparisons in columns 11 and 12 refer for the most part to the dates marking the beginning and end of minor movements or retardations (see Charts 3-1 and 3-2).

[b] Based on peaks that occurred in April–June 1959, before the major steel strike in the second half of the year. After the strike, shipments rose again briefly to about the same peak levels in January 1960, while the increase in new orders was much smaller and still shorter (Chart 3-1).

[c] The length of these leads is partly a consequence of the 1956 steel strike. The peaks in new orders have on this occasion definitely preceded, and the peaks in shipments definitely followed, the strike (see Chart 3-2).

[d] Prestrike peaks in the first half of 1959 (Chart 3-2).

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

[f] Shipments show only a short and small decline between January and July 1951. New orders, however, fell substantially between January 1951 and January 1952. These comparisons match major and minor turns (Chart 3-2).

[g] Refer to dates marking the beginning and end of a retardation in shipments (September 1959–February 1961). The former date is matched with the June 1959 peak in new orders, and the latter date with a minor trough in new orders in March 1961 (see Chart 3-2).

[h] Based on the secondary peak in new orders in December 1956, which matches the peak in shipments in August 1957. The comparisons between extra turns which occurred in these series in 1955–56 are not shown in this table (see Chart 3-2).

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

[j] These measures may be questioned because they refer to movements with very small amplitudes which are particularly difficult to date (see Chart 3-1).

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

ings. Eight of the twelve columns of the table refer to "turning zones" associated with the recessions and revivals in general economic activity. This arrangement is possible because the series covered conform well to business cycles, as suggested by Charts 3-1 and 3-2 and shown in detail later (Chapter 11). However, new orders also show widespread "extra" cycles associated with the Korean developments in

1950–52, which in some of the industries are matched by movements in shipments. Also, the slowdown of the economy in 1962 has been connected with retardations or declines (mostly mild and short) in new orders and shipments of several major industries. Thus Table 4-5 distinguishes twelve turning-point zones in the period covered by our data —eight corresponding to the recent business cycle chronology, as determined by the National Bureau, and four (columns 3–4 and 11–12) relating to two special episodes.

Most of the recorded comparisons for the durable goods industries in the Korean period are short leads and coincidences, but it would be wrong to conclude that the actual delivery periods were then generally short. One must stress the fact that no comparisons can be made in these turning zones for the machinery and transportation equipment industries and indeed for the most comprehensive aggregates—all manufacturing and total durables. The rapid expansion of new orders in 1950–51 left shipments far behind, resulting in a large-scale backlog accumulation. Even after their drastic decline in 1951, new orders still exceeded shipments; that is, the stock of unfilled orders kept on expanding through that period, though shipments continued their gradual rise. This implies that the delivery lags must have been very long and increasing in this period. The evidence of the backlog-shipment ratios bears out this presumption (Chapter 6). The method of turning-point comparisons obviously cannot provide the relevant measures where movements in new orders are not matched in shipments.

The rapid sequence of a buying surge and relapse in 1950–51 was followed in 1952–53 by a rather hesitant rise of new orders, with shipments now moving closely along. Only in the transportation equipment industry did new orders continue to exceed shipments in this phase; and then, when orders finally turned down decisively at the outset of 1953, shipments remained at high levels for seven more months before declining in July 1953 (Chart 3-2). Judging from the old OBE series for motor vehicles and nonautomotive transportation equipment separately, the lags of shipments behind new orders at the 1952–53 peaks were apparently long in both of these industries (see Chart 3-4). Elsewhere, the paired series nearly overlapped, and in some industries (primary metals and nonelectrical machinery) shipments in fact exceeded new orders most of the time in 1952–53; shipments were coincident with new orders or lagging by short intervals at the 1953 downturns.

On the whole, however, unfilled orders were still very high at the time, absolutely and relative to shipments, and the lags in the comprehensive aggregates were substantial (see Table 4-5, column 5, and the charts).

In 1953 new orders for durable goods dropped sharply, while output and shipments, cushioned by the still large backlogs, declined but slightly. At the end of the year, the decline in new orders was halted, but there was very little rise in the following eight months: Between September 1953 and May 1954, durables orders, after seasonal adjustment, remained virtually stable at monthly rates of about $10 billion (Chart 3-1). Most manufacturers apparently did not think this situation justified a prompt response of stepped-up activity. The mild business contraction then in process was dominated by the business objective of getting inventories under better control, i.e., closer to the desired balance with orders and sales. As long as new orders were still much lower in value than production and shipments, their slow recovery could be met by a retardation rather than by a reversal of such contractionary adjustment processes as the reduction of output schedules and inventory liquidation. Thus output and shipments continued to decline mildly through the first three quarters of 1954, and turned up only after incoming orders finally caught up with shipments, and backlogs stopped declining.

Inspection of charts for the component major industries confirms that the long leads of new orders at the 1954 troughs in shipments represent a real and widespread phenomenon.[6] As summarized in Table 4-5, column 6, new orders for each of the listed durable goods industries led shipments by intervals of considerable length (from 5–7 to 11–12 months). The 1954 episode contrasts in this respect with the other trough zones in which the lags of shipments were generally short. But then, consistent with the argument above, the declines in new orders tended to be much shallower on these other occasions, and the subsequent recoveries (whereby N regained the levels of S) were much more vigorous.

The dating of the peaks associated with the recessions of 1957 and

[6] For total durables, the trough in new orders is difficult to date because of the long flat bottom in 1953–54 (Chart 3-1). But the long lag of S relative to N in this period stands out clearly for total manufacturing. For the major durable goods industries, the existence of similar lags at the 1954 revival is definitely indicated, despite some difficulty in detail occasioned here and there by the erratic movements in the compared series. It may also be noted that the earlier OBE data for the durable goods industries leave no doubt about the long lag of shipments in 1954 (see Moore, ed., *Business Cycle Indicators*, Vol. I, Chart 14-1, p. 431).

1960 is made difficult by the "flattop" pattern of the series in 1955–56, with superimposed large erratic fluctuations, and by the effects of the steel strikes in 1956 and 1959. The long lag of shipments for total durables behind the December 1955 peak in new orders illustrates well the high sensitivity of relative timing measures to small differences in trends. While the movement of *N* tended to be downward and that of *S* upward in 1956 (Chart 3-1), these were both rather slow drifts interrupted by shorter irregular variations. It could be argued that a secondary (somewhat lower) peak in new orders occurred late in 1956, just a few months before the downturn in shipments, although the interpretation underlying the long lead specified in Table 4-5 (column 7) appears to be more consistent with our procedures and the data. On the other hand, the corresponding lead of *N* relative to *S* for all manufacturing is as short as two months, simply because new orders rose slightly during 1956 instead of declining slightly (otherwise, the series for total manufacturing and total durables can be seen, in the charts, to have followed a very similar course).

In 1959, new orders for both all manufacturing and total durables reached their peaks in April, before the steel strike; but shipments show in each case two peaks of about the same height, one in May or June 1959 and another in January 1960 (Chart 3-1). The prestrike downturns in *S* lagged the peaks in *N* by one or two months, as recorded in Table 4-6, column 9; the poststrike downturns in *S* lagged the peaks in *N* by eight months. Matching the former turns and treating the latter ones as secondary is the preferred alternative here. The other choice would appear to bias the results in the direction of overly long lags. It may also be noted that in primary metals, the industry principally affected by this disturbance, the prestrike peaks in both *N* and *S* were definitely higher than the poststrike ones (Chart 3-2). Buying and deliveries were undoubtedly strongly stimulated by anticipation of the work stoppage; after the strike was over, the need to replenish stocks caused a new rise in new orders, but one that was smaller and very short-lived; and shipments, though they increased more and ran higher than new orders, declined as promptly in 1960. The wide repercussions of these developments are of interest: The double-peak pattern in 1959–60 can be seen clearly in such diverse industries as transportation equipment (motor vehicles) and the group of "other durables."

Table 4-5 suggests that the leads of new orders may have become shorter in the more recent years. In the five turning zones 1958–62, long leads are few, while short leads and coincidences are relatively frequent (columns 8–12). Moreover, Charts 3-1 and 3-2 show that the paired series for N and S have tended to run closer together since the late 1950's than they did earlier in the postwar period. The ratios of unfilled orders to shipments (U/S) have been undergoing fluctuations with decreasing amplitudes around distinctly *downward* trends. The corresponding series on unfilled orders proper (in current dollars) show much weaker trends; some of them seem to show mild downward inclinations, but others have none.[7] From all this one can infer that, in the aggregate, producers in each of the major industries concerned must have acquired the capacity to handle the same volume of orders in less time.

Independent evidence suggests, in agreement with the above, that the impressive growth of manufacturing capacity in the decade following the war and immediate postwar readjustments may have come to exceed the growth of manufacturing output.[8] High average rates of investment in plant and equipment would indeed be expected in times of strong pressures of demand against capacity, such as prevailed in large areas of industry during those years (except only for the relatively brief recession periods). However, by the late 1950's, the demand pressures had apparently started to abate, and this at the very time when industry had acquired an unprecedented ability to meet them without undue strain. Later on, signs of excess capacities began to replace those of excess demand, as the 1957–58 recession gave way to a rather short and vigorless expansion, which was followed by another brief recession in 1960 and then again by a very gradual recovery, interrupted by temporary slowdowns, in 1961–62. Not until very recently, in 1964–65, did the extraordinarily long business expansion that started early in 1961 develop a symptom that was particularly characteristic of the previous upswings, namely, the outpacing of shipments by the faster-rising new orders in manufacturing (see Chart 3-1).

[7] Evidence on these points is presented in Chapter 6 (Charts 6-4 and 6-5 and the accompanying text).

[8] According to the estimates in *Business Plans for New Plants and Equipment, Annual Surveys*, prepared by the McGraw-Hill Department of Economics, the index of manufacturing capacity, 1948 = 100, stood at 167 by the end of 1957—an increase of two-thirds in nine years. Meanwhile, the FRB index of manufacturing output (also 1948 = 100) increased only to 141 in 1957.

Average Measures of Relative Timing

Table 4-6 is based on the 108 individual timing comparisons listed in Table 4-5, plus eight additional observations which cannot be assigned to any of the twelve turning zones identified in the latter table.[9] Ninety-four of these measures refer to pairs of turning points marking major movements that can definitely be classified as "specific cycles" under the NBER criteria; twenty-two refer to "minor" turns marking shorter but still distinct movements.

The total number of turns in shipments covered in Table 4-6 is 118, and all but two of these are matched by like turns in new orders (columns 2 and 3). There are more instances of unmatched turns in new orders mainly because of the already noted extra declines in these series during 1951–52 (columns 1 and 3).

The means of the timing comparisons are all negative (columns 8 and 9), that is, new orders lead shipments in each of the industries at both peaks and troughs by intervals long enough to be observable in monthly data. Leads account for about 77 per cent of the observations, coincidences for 15 per cent, and lags for nearly 8 per cent. The percentage of leads is larger at peaks than at troughs, while the reverse is true of the percentage of exact coincidences.[10] Most of the leads are short as are virtually all the lags; consequently, the proportion of "rough coincidences" is high (59 per cent), though still smaller than that of leads.

Individual long leads influence most means but in a fairly moderate degree. The medians are on the whole smaller than the means, but not by very large amounts, and the two statistics yield similar rankings of the industries. Our analysis here relies on the means, but elsewhere medians have been used as well for closely related data (Table 6-6).

Most of the mean absolute deviations listed in the last two columns of Table 4-6 vary between one and three months. In a normal distribution, 57.5 per cent of the observations would be within the range of plus and minus one average deviation on both sides of the mean; in a moderately skewed distribution, this would still be approximately

[9] These include the following (compare Chart 3-2): a lead of one month of *N* relative to *S* at the 1963 peak and the following 1963 trough in primary metals and in blast furnaces. The other four comparisons, all in transportation equipment, include a six-month lag at the 1955–56 peak in the series, a one-month lead at the trough in the same period, coincident timing at the 1959 trough, and a one-month lag at the 1960 peak.

[10] At peaks, the proportion of leads is approximately 81 per cent; of coincidences, 9 per cent; and of lags, 10 per cent. At troughs, the corresponding figures are 73, 22, and 5 per cent.

true. Thus with a mean lead of, say, three months, most of the comparisons would be expected to fall in the class of leads of six months or less; but the presumption of skewness means that among the observations outside that range long leads would be more frequent than short lags.[11]

The peak-trough differences among the average leads of new orders in column 8 seem to vary irregularly: for five industry groups, the peak figures are the larger ones, but in five others, they are the smaller ones. However, Table 4-5 suggests that the long leads of orders at the upturn were largely concentrated in one period, namely, in the zone of troughs associated with the business revival of 1954. When this particular episode is excluded, considerably smaller average leads at troughs are obtained, which tend to fall short of the corresponding measures for peaks, as illustrated by the following figures:

	Average Lead of Orders	
	Peaks (Table 4-5, col. 8)	*Troughs (excl. 1954)*
Durable goods, total	−5.6	−2.8
Primary metals	−3.6	−3.5
Blast furnaces, steel mills	−6.8	−4.2
Fabricated metals	−2.2	−3.2
Electrical machinery	−2.5	−0.4
Nonelectrical machinery	−5.0	−4.0
Transportation equipment	−2.2	−2.0
Other durable goods	−0.8	0.0
Nondurable goods, total	−2.0	−2.5
Reporting unfilled orders	−4.0	−3.5

Wide fluctuations in demand and production will often give rise to large variations in the degree of capacity utilization, from slack to

[11] A comment may be added on the use of mean absolute deviations vis-à-vis that of standard deviations, which have more convenient mathematical properties though a somewhat less simple meaning. Given a specific distribution, the two measures are proportional. The ratio of the average deviation to the standard deviation depends but slightly on the form of the distribution; for a variety of forms, the constant of proportionality was found to be approximately 0.8 (see Robert G. Brown, *Smoothing, Forecasting, and Prediction of Discrete Time Series*, Englewood Cliffs, N.J., 1962, pp. 282–90). This is also true for similar measures shown elsewhere in this book (Table 6-6): There the ratios of the average to standard deviations all exceed 0.7 and are heavily concentrated between 0.8 and 0.9.

Table 4-6

Summary Measures of Timing of Value of Manufacturers' New Orders at Turns in Value of Manufacturers' Shipments, Major Industries,[a] 1948–64

All Turns			No. of Timing Observations at Peaks or Troughs[c] That Are				Av. Lead (−) or Lag (+) (months)		Av. Dev. from Av. Lead or Lag (months)	
No. of Order Turns Covered[b]	No. of Shipment Turns[b]			Exact Coinci-		Rough Coinci-				
	Covered	Matched	Leads	dences	Lags	dences[d]	Peaks or Troughs[c]	All Turns	Peaks or Troughs[c]	All Turns
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
ALL MANUFACTURING INDUSTRIES										
12(2)	10(2)	10(2)	5			4	−2.4	−3.1	1.2	1.9
			4	1		3	−3.8		2.2	
DURABLE GOODS INDUSTRIES, TOTAL										
12(2)	10(2)	10(2)	5			2	−5.6	−5.1	3.5	3.3
			5			3	−4.6		3.0	
PRIMARY METALS										
14(4)	14(2)	14(2)	7			5	−3.6	−4.1	2.5	3.1
			6	1		4	−4.6		3.5	
BLAST FURNACES, STEEL MILLS										
9(2)	9(2)	9(2)	4			2	−6.8	−6.1	6.4	5.0
			5			3	−5.6		4.3	
FABRICATED METAL PRODUCTS										
11(0)	11(0)	11(0)	4	1		4	−2.2	−3.5	1.5	2.9
			4	2		2	−4.5		3.2	

ELECTRICAL MACHINERY[e]										
14(2)	12(6)	12(6)	5	1		4	−2.5	−1.8	1.5	2.2
			4		2	3	−1.2		3.1	
MACHINERY EXCEPT ELECTRICAL[e]										
12(2)	10(2)	10(2)	5			3	−5.0	−4.6	3.2	2.8
			5			2	−4.2		2.6	
TRANSPORTATION EQUIPMENT										
13(4)	12(2)	10(2)	3		2	2	−2.2	−3.0	4.6	4.2
			3	2	0	3	−3.8		4.2	
OTHER DURABLE GOODS[f]										
10(0)	10(0)	10(0)	2	1	2	4	−0.8	−1.1	2.2	2.1
			1	4		4	−1.4		2.2	
NONDURABLE GOODS INDUSTRIES, TOTAL										
10(4)	10(4)	10(4)	2	2	1	4	−2.0	−2.0	2.8	2.8
			2	3		4	−2.0		2.8	
REPORTING UNFILLED ORDERS[g]										
12(2)	10(0)	10(0)	4		1	1	−3.4	−3.1	2.2	2.1
			4	1		3	−2.8		1.8	

[a] The series are those covered in Table 4-5. They all start in 1948 (or 1947) except blast furnaces and steel mills, which start in 1953. As in Table 4-5, the earlier OBE data are used for 1948–53 (including the determination of timing measures associated with the 1953 recession), and the new, revised Census data are used for the period since 1953.

[b] All turns covered are counted, except a few that could not be positively identified (such as some uncertain turns at the beginning or end of a series). The figures in parentheses give the number of minor turns included.

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

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

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

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

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

strain, while small movements in the broad range of normal operations will have no comparable impact. Hence it would not be surprising to find that large swings in new orders and shipments are associated with greater discrepancies between these series than are observed in periods of stable trends. The lags of shipments behind new orders may accordingly also show a tendency to be longer for the major movements. These notions receive some broad support from our charts; as suggested before, the leads of new orders relative to shipments appear to have decreased in recent years while the cyclical movements in these series have become generally smaller. The tabulation below shows that larger average leads of new orders are in fact obtained when those observations that are associated with minor turns are excluded.[12]

	Average Lead of New Orders Relative to Shipments (in months)			
	Peaks		*Troughs*	
	All (Table 4-6, col. 8) (1)	*Major Turns Only* (2)	*All (Table 4-6, col. 8)* (3)	*Major Turns Only* (4)
All manufacturing industries	−2.4	−2.5	−3.8	−4.0
Durable goods industries	−5.6	−6.8	−4.6	−5.0
Primary metals	−3.6	−4.2	−4.6	−5.2
Blast furnaces, steel mills	−6.8	−11.5	−5.6	−8.0
Fabricated metal products	−2.2	−2.7	−4.5	−5.4
Electrical machinery	−2.5	−2.2	−1.2	0.0
Machinery except electrical	−5.0	−5.5	−4.2	−5.0
Transportation equipment	−2.2	−6.0	−3.8	−6.0

Timing Differences Among the Major Industries

The major industries in the Census-OBE compilation cannot be divided between goods made to order and goods made to stock, but can be grouped according to the durability of their products.[13] It will

[12] The excluded observations are those in columns 11 and 12 of Table 4-5 and those listed in note 9 above. For the group of other durable goods and the nondurable goods industries, all the comparisons made refer to major turns.

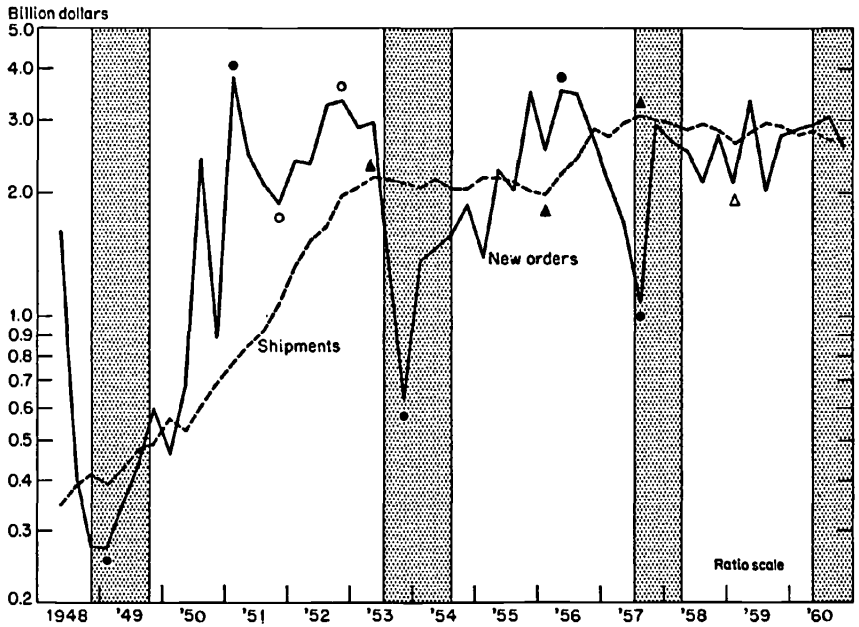
[13] See, however, the crude distinction, by the prevalent type of manufacture, drawn between the major industries in Table 2-5, columns 3 and 4.

be recalled that the durable goods industries as a whole have very low ratios of finished stocks to unfilled orders, and the total nondurables very high ratios. This indicates that manufacture to order prevails heavily among the former; and manufacture to stock, among the latter (Chapter 2). Hence, one would expect the leads of new orders to be substantially longer for the durable goods than for the nondurable goods sector of manufacturing. In fact, the difference between the respective averages is large, the typical lead being estimated as five months for the durables and as two months at most, but probably less, for the nondurables.[14] However, the assumption underlying the data is that all but four of the major nondurable goods industries produce to stock only. There is reason to think that this assumption is not quite valid (see Chapter 2, note 18 and the text to which the note applies). To the extent that this is so, the true lead in the nondurables sector may be understated, and, therefore, the difference between the averages is likely to be overstated. The industries in the nondurables sector for which the reported new orders and shipments differ show an average lead of incoming business of 3.1 months.

The averages for the major industries conceal wide differences in length among the leads for the smaller and more homogeneous component industries. Probably the most drastic example of this is provided by transportation equipment, which includes motor vehicles and parts made largely to stock and nonautomotive equipment made to order, typically with long delivery lags. According to the data shown in Chart 3-4 (which are of the pre-1963 vintage) the average lead of new orders for nonautomotive transportation equipment was 11.5 months—by far the largest one of the major-industry leads. This is understandable in view of the size and complexity of such items as ships, airplanes, or locomotives. It will be recalled that the longest average leads in Table 4-1, ranging from seven to eleven months, were those of the three principal types of railroad equipment. Corroborating evidence is also available for the aircraft industry. Chart 4-1 presents the quarterly series on the aggregate value of new orders and shipments of aircraft manufacturers, compiled by the Bureau of the Census and the Civil Aeronautics Administration for 1948–60. The similarity

[14] The average leads according to Standard and Poor's data for 1949–58 (Appendix B, Part 1) are similar: 4.3 months for durables and 1.7 months for nondurables. Exclusion of the questionable observations at the 1952–53 shipments turns (see Table 4-5, note j) would drastically reduce the average lead for the nondurable goods sector.

Chart 4-1
Value of New Orders and Shipments of Aircraft Manufacturers, Quarterly, 1948–60



Note: Shaded areas represent business cycle contractions; unshaded areas, expansions. Dots identify peaks and troughs of specific cycles in new orders; black triangles, shipments. Circles and white triangles identify short cycles in new orders and shipments, respectively.

Source: Bureau of the Census and Civil Aeronautics Administration (seasonal adjustment by NBER). Data for the third and fourth quarters of 1950 and the first and second quarters of 1951 are not available. For shipments, linear interpolation was used over the period in question. New orders were estimated by adding to computed shipments the change, during the given quarter, in the backlog of aircraft orders (computed from the published Census-CAA figures on end-of-quarter backlogs). The resulting estimates for both shipments and new orders agree well with related evidence (Standard and Poor's monthly indexes of aircraft orders and sales; see App. C).

of the cyclical course of these series to that of the OBE series for total nonautomotive transportation equipment (cf. Charts 3-6 and 4-1) emphasizes the great importance of aircraft within that total. Aircraft orders led at the sales peaks in the second quarter of 1953 and the third quarter of 1957 by two and five quarters, respectively. No comparisons at troughs are available.

A very different picture is presented by motor vehicles and parts, where new orders moved ahead of shipments by much shorter and more variable intervals (Chart 3-6). Here the timing relation is blurred in the early 1950's, possibly reflecting the changes in the military-civilian mix of demand during the Korean period, but the two series are roughly coincident since 1955 (see the text accompanying Chart 3-6 on the corresponding contrast in relative amplitudes). In terms of aggregate shipments and new orders, the motor vehicle subgroup is, of course, much more important than the nonautomotive subgroup within total transportation equipment.[15] Accordingly, the timing measures for transportation equipment as a whole differ sharply from those for the nonautomotive group, and differ less from those for the motor vehicle division. The timing relation between new orders and shipments of total transportation equipment is difficult to establish, in large measure because of the dichotomy just discussed.

In the two metalworking industries—primary metals and fabricated metal products—new orders led shipments by about three to four months, while the average lead of orders received by blast furnaces and steel mills was as long as six months (Table 4-6). Electrical machinery shows short average delivery lags (two months), while the corresponding measures for nonelectrical machinery are in the 4–5 months' range. Aggregation is likely to suppress substantial differences among the lead times for the components of these major industries. The averages for machinery, for example, include figures for heavy and specialized equipment as well as for more standardized and less complex items. Data for individual types of equipment show considerable variation here: In Table 4-1 the average lag of shipments is seven months for electric overhead cranes and two months for woodworking machinery. These comparisons are merely suggestive because the data cover different periods. Timing measures based on the subdivisions of the major-industry series for the durable goods sector (Appendix E, Part 1) will shed more light on this subject.

At the other end of the scale from nonautomotive transportation equipment with its long delivery lags (averaging nearly one year) is the group of "other durable goods industries" for which the lags are very

[15] In terms of unfilled orders, on the other hand, motor vehicle manufacturers, who produce largely to stock, are much less important. The aircraft industry alone held 28 per cent of total manufacturers' unfilled orders in April 1956, while the motor vehicle industry held only 5 per cent of the total (see *Survey of Current Business*, June 1956, p. 3).

short (averaging about one month). The main components of this group are furniture; lumber; and stone, clay, and glass products. Furniture, according to industry reports, is manufactured largely to order but apparently at short notice; it has the second shortest shipment lag in Table 4-1. Clay and glass products and lumber are made predominantly to stock (Table 2-1), and the long records for oak flooring and southern pine suggest that lumber products typically have short order leads (Table 4-2).

Timing of Production Relative to New Orders and Shipments in Real Terms

Table 4-7 shows the timing comparisons between deflated new orders and production for each of the eight "turning zones" that can be identified from the data in the period 1948–58. These measures are based on the deflated series and indexes introduced in Chapter 3 (the pre-1963 OBE data); in reading the table and the comments below, it will be helpful to consult Charts 3-5 and 3-6.

The measures for total manufacturing and the durable goods sector indicate that outputs were quite slow to follow new orders at peaks associated with the recessions of 1953 and 1957 and at troughs of the intervening revival period of 1954. On these occasions, production and new orders in constant prices tended to move in opposite directions for as long as 7 to 15 months. These observations must be qualified by noting that such divergent movements in these aggregates were typically very gradual, sloping gently upward or downward in the vicinity of their turning points; also, that the developments were influenced by outside events, notably the 1956 steel strike. Nevertheless, the conclusion that production lags were relatively long in these periods is not really in doubt. In 1948 and again in 1949, production turned four months after new orders in constant prices for both total manufacturing and the durable goods sector as a whole; and at the 1958 upturns the lags of outputs were generally still shorter in the manufacturing industries (compare columns 1–2 and 5–8 in Table 4-7).

The volume of manufacturers' unfilled orders varied greatly over the period 1948–58, both absolutely and relative to production and shipments, and one would expect the lags of output to be longer when order backlogs are larger. Between 1952 and 1956, unfilled orders and their ratios to shipments were indeed much larger than in 1948–49 and

in 1958. But other factors, in particular, autonomous expectations concerning future demand trends, undoubtedly also influence the relative timing of production.

The large waves of forward buying that marked the first year of the Korean War were not replicated in the flow of output, which instead was well maintained at high rates during that period. Aggregate production of durable goods underwent only a mild and brief decline at the end of this phase, in mid-1951, and gained slowly but steadily thereafter, while current ordering was hesitant and very erratic. Even if direct timing comparisons cannot be made here because there are no turns in output to match those in new orders, this should not obscure the substantial lag of production behind orders at that time, in the sense that the sustained strength of production reflected the great accumulation of unfilled orders in the months past. The vigor with which production rebounded after the interruption of the steel strike in mid-1952 must have still been due in large measure to that backlog factor, since new orders were not gaining much in the second half of 1952 and were weakening perceptibly in the first half of 1953.

An important observation that can be made with the aid of Table 4-7 and Charts 3-5 and 3-6 is that outputs lag significantly behind new orders in constant prices not only for durable goods but also for nondurable goods. As stressed before, production to order plays a much smaller role for nondurables than for durables. Production to stock, which prevails in industries manufacturing nondurable goods, is presumably scheduled largely according to market sales forecasts. The finding that outputs tend to follow new orders in these industries indicates, therefore, that new orders serve as an important basis for such forecasts (see section on "Sales Forecasts" near the end of Chapter 2). Since new orders are measures of *past* sales, this argument implies also that sales forecasts contain substantial "autoregressive" elements; that is, future sales (outputs needed) are predicted to a large extent by extrapolating past sales, a plausible though somewhat speculative inference.[16]

[16] That projections of past events are commonly used as tools of prediction requires little proof or elaboration; after all, there is often little else to go by. Autoregressive forecasts will earn a measure of success if applied to time series whose successive values are sufficiently correlated with each other. The relatively smooth series for nondurable goods producers suggest that this requirement may be satisfied by sales of many individual companies in this group (even though individual sales are probably often less well autocorrelated than the industry aggregates).

Table 4-7
Timing Relations Between Manufacturers' New Orders in Constant Prices and Production, by Business Cycle Turning Zones, Major Industries, 1948–58

Industry	Lead (−) or Lag (+) in Months of New Orders at Turns in Production in Turning Zone Associated with								Av. Lead (−) or Lag (+) (months)		
			Korean War								
	1948 Recession: Peaks (1)	1949 Revival: Troughs (2)	1950–51: Peaks [a] (3)	1951–52: Troughs [a] (4)	1953 Recession: Peaks (5)	1954 Revival: Troughs (6)	1957 Recession: Peaks (7)	1958 Revival: Troughs (8)	Peaks (9)	Troughs (10)	All Turns (11)
All manufacturing	−4	−4	n.p.	n.p.	−7	−7	−12	−2	−7.7	−4.3	−6.0
Durable goods, total	−4	−4	n.p.	n.p.	−7	−7	−15	−3	−8.7	−4.7	−6.7
Primary metals	+1	−3	−10	−1	+2	−3	−9	−2	−4.0	−2.2	−3.1
Fabricated metal products	n.i.	0	+4	−11	−6	−6	−4 [b]	−1	−2.0	−4.5	−3.4
Machinery, total	n.p.	−5	n.p.	n.p.	−7 [b]	−2	−7	−4	−7.0	−3.7	−5.0
Electrical machinery [c]	n.i.	−2	−2	+5	−4	−2	−3	−3	−3.0	−0.5	−1.6
Machinery except electrical [c]	−1	0	n.p.	n.p.	−3	−7	−13 [d]	−3	−5.7	−3.3	−4.5
Motor vehicles and parts [e]	n.a.	n.i.	+5	0 [b]	−13 [b]	−10	−3	−1	−3.7	−3.7	−3.7
Nonautomotive transportation equipment [e]	n.a.	[f]	n.p.	n.p.	−10	−11	−8	−4	−9.0	−7.5	−8.2
Other durable goods [g]	−3	0	+3	+1	−6	−6	−12 [h]	−1	−4.5	−1.5	−3.0
Nondurables, total	n.i.	−6 [b]	−7	−4	−1 [b]	0 [b]	−7	0	−5.0	−2.5	−3.6
Reporting unfilled orders [i]	[j]	−3	−5	−4	−1	−1	−6 [k]	−3	−4.0	−2.8	−3.3
Textile mill products [e]	n.i.	−3	−5	−9	−1	−1	−7	−3	−4.3	−4.0	−4.1
Leather and leather products [e]	[j]	−7	−3	−2	−5	+3	−5	n.i.	−4.3	−2.0	−3.2
Paper and allied products [e]	n.i.	−3	−9	−4	n.p.	n.p.	−5	+1	−7.0	−2.0	−4.0

Notes to Table 4-7

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

n.a. = data not available.

n.p. = no matching turn in production.

[a] These pairs of peaks and troughs represent "extra" turns, not related to any cyclical recession or revival recognized in the National Bureau chronology of U.S. business cycles.

[b] Based on turns in short cycles or retardations in deflated new orders or production. Although a few of these comparisons are somewhat doubtful, they are listed in the table and included in the averages of columns 9–11 (the more uncertain cases are mentioned in the notes below).

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

[d] A secondary peak in new orders occurred in October 1956, two months before the specific-cycle peak in production.

[e] Based on unpublished data received from the OBE and seasonally adjusted by the Census electronic computer method for the NBER.

[f] Timing of the trough in new orders is uncertain, but the low in this series occurred in July 1949, eight months before the trough in production.

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

[h] In the period covered by this long lead, the decline in new orders and the rise in production were very gentle, but the direction of these movements is clear.

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

[j] Timing of the high values in 1948 indicates that new orders led production by two months for the group of nondurable goods industries with unfilled orders and by one month for leather, but the comparisons are uncertain.

[k] Measured from the early peak of new orders in July 1955 to the *beginning* of a long movement of production along a high plateau (January 1956–September 1957). An uncertain but conservative estimate of the lead.

While the tendency for deflated new orders to anticipate outputs is distinct enough in the nondurable goods sector (both total and those industries reporting unfilled orders), the resulting leads are on the whole shorter than those observed for the durable goods industries (compare the aggregates in Table 4-7). Production of nondurables definitely declined in 1951, responding to the contraction of quantities newly ordered and shipped in the third quarter of 1950 and the first half of 1951 (Chart 3-5). This is unlike the concurrent developments in the durable goods sector, where production, reacting to similar but much larger relative movements of new orders, merely flattened off in 1951. Thus the distributed-lag process, whereby large fluctuations in the receipts of orders are smoothed out in the course of production, is

strongly in evidence here for the durables, much less so for the nondurables.

The average leads of deflated new orders at turns in outputs suggest considerable differences among the industries, some of which may be recognized as familiar and reasonable (note, for example, the long leads recorded in Table 4-7 for nonautomotive transportation equipment). It is interesting to observe that the average leads tend to be longer at peaks than at troughs (columns 9 and 10).

In about 80 per cent of the observations listed in Table 4-7, deflated new orders lead output, demonstrating the regularity with which this behavior occurs. More than 90 per cent of the recorded turning points in production and orders can be matched with each other, which indicates that the correlation between the cyclical movements in these series is high indeed.

It remains to compare the timing of turning points in production and shipments in constant prices, on which the series for 1948–58 yielded 69 observations. The results may be summarized without being shown in tabulated form. As suggested by Charts 3-5 and 3-6, output and deflated shipments tend to rise and decline at about the same time. Indeed, nearly 70 per cent of the timing comparisons between these series are rough coincidences, that is, leads or lags of less than three months and exact coincidences (the latter alone account for slightly more than 20 per cent of the observations).

In the model of pure production to order, output should precede shipments, although by very short intervals, as a simple technical matter. In the model of pure production to stock, on the other hand, output could either anticipate or follow shipments, but the latter alternative is more likely because of uncertainty about future demand. The first of these statements is logically compelling, the second is persuasive, and both are already familiar; but it is difficult to demonstrate either of them empirically with the comprehensive series on hand. Nevertheless, it may be worth noting that lags of output relative to deflated shipments are much more frequent than leads for the nondurable goods industries and for the "other durable goods" group, where production to stock dominates (there are 19 lags, 4 leads, and 5 coincidences in this set of comparisons). For the remaining industries that account for most of the durable products manufactured in large part to order, leads of output vis-à-vis real shipments are as numerous as lags

(the count here is 15 lags, 15 leads, and 11 coincidences). These differences may not be very sharp, but they do seem broadly reasonable.

Market Categories

Consumer Goods, Equipment, and Materials

The new Census series on new orders and shipments classified by market categories were described in Chapter 3 and are shown in Chart 3-3. Table 4-8 presents the measures of relative timing for these data.

In general, new orders and shipments of consumer goods move closely together and have synchronous timing. For the nondurable "consumer staples," the two series are dominated by trends and follow an identical upward course. No timing comparisons are made here, as there are no major fluctuations and turning points, but Chart 3-3 makes it clear that any deviations between *N* and *S* for this category are small and apparently random. The short series for consumer durables (other than automobiles), which begin in 1960, also contribute no observations to Table 4-8. They too show closely similar and coincident movements, consisting of a mild decline during the 1960–61 recession and a marked upward trend thereafter (Chart 3-3). Home goods and apparel, a group including nonautomotive household equipment and some nondurables, does provide several turning-point comparisons which clearly indicate coincident timing of new orders and shipments (Table 4-8).

In contrast, shipments of equipment for industrial and commercial uses fluctuate much less than, and definitely lag behind, new orders. The lags, as measured at the recent turning points, average about five months (fourth line). The longest delivery lags, as well as the largest differences in amplitude between new orders and shipments, are for the defense products: Defense orders lead shipments by 11 to 14 months.

The most variable, or least regular, of the timing relations appears to be that for automotive equipment (fifth line), but Chart 3-3 shows that substantial deviations between *N* and *S* have occurred here on only a few occasions in the early part of the period covered, notably in 1953–54. The two series fluctuated widely in the late 1950's but kept

Table 4-8
Timing Relations Between Value of New Orders and Shipments, by Business Cycle Turning Zones, Nine Market Categories, 1954–62

Market Category [a]	Lead (−) or Lag (+) in Months, New Orders at Turns in Shipments in Turning Zone Associated with					Av. Lead (−) or Lag (+) (months)			Av. Dev. from Av. Lead or Lag, All Turns
	1954 Revival: Troughs (1)	1957 Recession: Peaks (2)	1958 Revival: Troughs (3)	1960 Recession: Peaks (4)	1961 Revival: Troughs (5)	Peaks (6)	Troughs (7)	All Turns (8)	(9)
Home goods and apparel	0	0	−1	0	0	0	−0.3	−0.2	0.3
Nonautomotive equipment and defense [b]	−7	−9	−4	−1	−6	−5.0	−5.7	−5.4	2.3
Defense products	−11	−11	−17	−17	−6	−14.0	−11.3	−12.4	3.7
Other	[c]	−3	−2	−7	−7	−5.0	−4.5	−4.8	2.2
Automotive equipment	−10	+4	−5	0	0	−1.6 [d]	−5.0 [d]	−2.1 [d]	3.9 [d]
Machinery and equipment [b]	−7	−3	−5	−10	−4	−6.5	−5.3	−5.8	2.2
Materials, supplies, and intermediate products [b]	−10	−3	−3	−3	0	−3.0	−4.3	−3.8	2.5
Construction materials, etc. [b]	−1	0	0	−1	0	−0.5	−0.3	−0.4	0.5
Other materials, etc. [b]	−11	−5	−3	−3	0	−4.0	−4.7	−4.4	2.9

Notes to Table 4-8

[a] For composition of these categories, see Chapter 3.

[b] For these items, new orders and shipments show mild but distinct declines in 1962, corresponding to the retardation of the general business expansion in that year. The tabulation below show the timing comparisons between the resulting minor turns and the averages including these additional observations:

	Lead (−) or Lag (+) of Orders at 1962 Turning Points		Av. Lead (−) or Lag (+), 1954–62 (incl. 1962 comparisons)			Av. Dev. from Av. Lead, 1954–62, All Turns
	Peaks	Troughs	Peaks	Troughs	All Turns	
Nonautomotive equipment and defense products	0	−2	−3.3	−4.8	−4.1	2.7
Machinery and equipment industries	−4	−4	−5.7	−5.0	−5.3	1.8
Materials, supplies, and intermediate products	−2	−6	−2.7	−4.8	−3.9	2.4
Construction materials	0	0	−0.3	−0.3	−0.3	0.4
Other materials	−2	−4	−3.3	−4.5	−4.0	2.3

[c] Timing of new orders is uncertain, but the lead appears to be at least 9 months. If this observation were included, the averages would read −6.0 for troughs and −5.4 (with an average deviation of 2.3) for all turns (compare the entries in columns 7–9 in this line).

[d] The averages include two timing comparisons (−5 for troughs and +1 for peaks) in addition to those listed to the left. These observations relate to the extra rises in 1956–57 (see Chart 3-3).

much to the same course; and since 1959 they have followed even more closely similar paths, with simultaneous timing. This type of behavior would be expected in the light of the earlier discussion, since motor vehicles account for the bulk of the output in this market category.

Approximately coincident timing is characteristic of new orders and shipments in the construction materials group, while leads of orders prevail in the group of other materials, where they average about four months. Shipments in the latter category, which includes most of the output of the sensitive metalworking industries that produce typically to order, are about four to five times as large as in the former. Accordingly, the relative timing measures for total materials, supplies, and intermediate products reflect primarily the measures for "other materials, etc." rather than those for construction materials.

Before the official market-category data were first published, in 1963, an attempt was made to construct for this study series on the current value of new orders and shipments for materials, consumer durable goods, and equipment. The idea was simply to group the industries in the detailed OBE classification used in Table A-1 in Appendix A into categories representing primarily the production of the above types of goods. The resulting estimates, which cover 1948–61, are inevitably crude. Nevertheless, the summary measures based on these approximations do not seem altogether unreasonable.[17] In particular, the average timing measures obtained from the old data are broadly consistent with the presumably more reliable evidence of the recent market-category series as reported in Table 4-8 for 1954–62.[18]

Defense Products

While the bulk of orders received by manufacturers comes from the private business sector of the American economy, the amounts placed by the U.S. government and by foreign buyers are large, and their change over time is of much interest. Regrettably, comprehensive series on government and foreign orders have not been compiled for any extended length of time. Only some selected and fragmentary information is available, but it deserves attention.[19]

Special interest centers on military orders, both because of their size and the presumption that they may differ considerably from civilian orders and thus have a particular role as a major "exogenous" factor. Also, this is the only class of government orders on which there exists a significant amount of aggregative data.

The impact of the defense program on the economy results from fiscal measures that are expressed in two sets of data: obligations and ex-

[17] A summary of measures of cyclical conformity, timing, and amplitude for the grouped series and the constructed aggregates was published in *The Uses of Economic Research*, Forty-third Annual Report of the National Bureau of Economic Research, New York, 1963, pp. 66–68.

[18] The class of consumer durables based on the old data includes motor vehicles, which in the new classification are treated separately as part of "automotive equipment." The mean leads here are two months or a little more, which is probably not very different from what would be obtained by combining the new series for consumer durables and motor vehicles (as a rough approximation, consider a weighted aggregate of the items in the first and fifth lines of Table 4-8). Most of the estimates for equipment from the old data suggest an average lead of new orders of about five months, and a very similar timing is indicated by the measures for the new series on nonautomotive equipment other than defense products. For materials, the leads based on the 1948–61 estimates average somewhat less than what is indicated by the new series for 1954–62 in Table 4-8, but the estimates all lie in the relatively narrow range of two to four months.

[19] Data on export orders and shipments are particularly limited, and they refer to a rather special subject. For these reasons, the discussion of the export series is included in Appendix F.

penditures. Obligations measure the value of contract placements and other work undertaken during the given period. Expenditures represent the actual payments made in a given period against obligations made at earlier times. What the Defense Department defines as an "obligation" for hard goods is thus, as a rule, a "new order" to a durable goods manufacturer. On the other hand, "expenditures" on hard goods for defense are part of the payment for shipments from a durable goods manufacturer and are therefore roughly comparable to the value of manufacturers' shipments for the goods.[20]

Chart 4-2 shows two pairs of quarterly, seasonally adjusted series. The two curves in the lower part, covering the period 1950–62, represent Department of Defense obligations and net expenditures for procurement and research, development, and testing and evaluation.[21] The two upper curves trace the course of new orders and shipments for defense products according to the new Census data on "market categories," which begin in 1953.

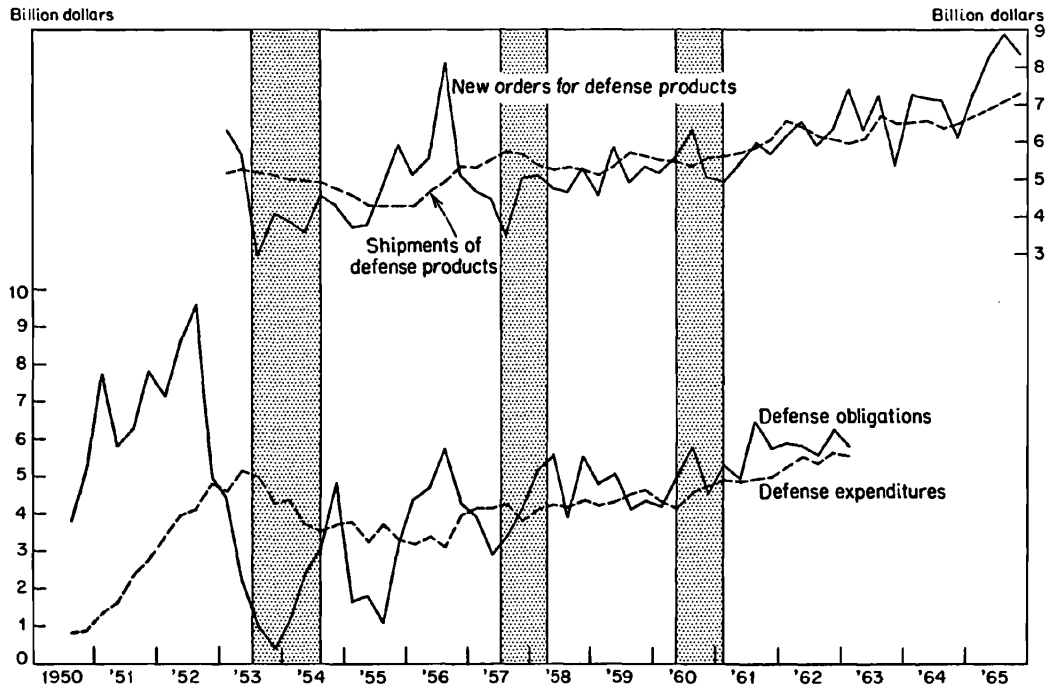
The movements of expenditures, like those of shipments, are for the most part rather small, smooth, and gradual from quarter to quarter. In contrast, obligations, like new orders, show much greater short-term variability, both of the apparently "systematic" movements and the shorter "irregular" fluctuations. The largest deviations between the matched series occurred during the Korean War: Obligations greatly exceeded expenditures from mid-1950 to mid-1952, then fell precipitously below expenditures through 1953. In this period, the basic movements in the two series were so large and sustained that they agreed in direction most of the time, despite the long lag of expenditures visible at the 1952–53 peaks. At other times, however, when the fluctuations in obligations were shorter, the two series often moved in

[20] The foregoing explanation of the obligations and expenditure data is based on the testimony of Charles J. Hitch, Assistant Secretary of Defense, *Hearings on the Economic Report of the President, 1961*, Joint Economic Committee, 87th Cong., 1st sess., Washington, D.C., 1961, p. 616.

[21] The source of the fiscal-year totals for the entire period covered and of the quarterly data since III-1953 is the Department of Defense, *Monthly Report of the Status of Funds*. The figures for the period II-1950–IV-1960 are taken from Hitch, *Hearings*, pp. 667–68 (the data through II-1953 are estimated). The figures for the period since I-1961 are taken directly from the *Monthly Reports*. Seasonal adjustments were made for NBER by the Census electronic computer method.

The categories included are: (1) the purchase of major items of equipment such as aircraft, missiles, ships, tanks, vehicles, artillery, electronics, ammunition, etc.; and (2) the support of research, development of new weapons and equipment, procurement of items under development for evaluation, and the maintenance of laboratories and test facilities. The data cover "hard goods" and exclude "soft goods" such as subsistence, petroleum products, and clothing, and organization equipment and supplies.

Chart 4-2
Defense Products: New Orders and Shipments, 1953–65, and Obligations and Expenditures, 1950–62



Note: Shaded areas represent business cycle contractions; unshaded areas, expansions. Series are seasonally adjusted.

Source: New orders and shipments: U.S. Department of Commerce, Office of Business Economics. Obligations and expenditures: Department of Defense, Fiscal Analysis Division; seasonal adjustment by NBER.

opposite directions.[22] From 1957–58 on, a substantial stabilization was achieved, with obligations showing the same slow upward trend as expenditures but much larger irregular movements around that trend.

The relationship of new orders for, and shipments of, defense products is similar to that of defense obligations and expenditures, and the trends in the two pairs of series have a broad resemblance over the period of overlap (1953–62). The shorter movements frequently diverge, as might be expected, but even they show at times a fair amount of correspondence.[23]

The Census series of new orders and shipments for defense-oriented products run at considerably higher levels than the Department of Defense series of obligations and expenditures. For example, Census shipments totaled $21.9 billion in 1960, while Defense expenditures totaled $17.9 billion, that is, about 18 per cent less. It seems likely that the Census figures are overstated because they include nondefense purchases of outputs of the industries classified as "defense-oriented" (communication equipment, aircraft and parts, and ordnance).[24]

The contrast between the large fluctuations of defense obligations and orders on the one hand, and the smooth and relatively mild movements of defense expenditures and shipments on the other hand, deserves to be stressed. The Defense Department series suggest that delivery periods for military hardware are on the whole quite long, though they may vary considerably for different items and perhaps also for different periods. (The Korean developments of the early 1950's were associated with a particularly large wave in obligations which could not help but cause severe strains on the industries affected.) Direct timing comparisons for the Census series, though they are few and difficult, certainly indicate that defense shipments lag behind new orders by long intervals (Table 4-7, third line). What the data suggest, then, is what would be expected, namely, that expenditures, like de-

[22] The double rise-and-fall sequence in obligations during the period from III-1953 to II-1957 is an example. Expenditures followed a gradual downward course between II-1953 and III-1956 (see Chart 4-2).

[23] Note in particular the similarity between the trough-peak-trough patterns of new orders and obligations in 1955–56–57. As an example of more divergent movements, compare the two series in 1953–55: The sharp peak of obligations in IV-1954 has no counterpart in new orders.

[24] There are other sources of divergence between the two sets of data, some of which would work in the opposite direction, but these are probably much less important. The Defense series of obligations are "gross" in the sense of including some interdepartmental transactions, but the amount of the resulting double counting (which cannot be eliminated) is said to be "relatively modest and fairly constant from year to year" (Hitch, *Hearings*, p. 616).

liveries and installations, follow orders with substantial distributed lags.[25]

By subtracting defense obligations or orders from total new orders of durable goods manufacturers and defense expenditures or shipments from total shipments of these manufacturers, a crude picture can be obtained of the recent changes in the corresponding "civilian" series. It is shown in Chart 4-3.[26]

After expanding vigorously in the first nine months of the Korean War period, business ceased gaining or started contracting in many sectors—primarily those industries whose sales depend in the main on household spending and residential construction. Industries related to defense, however, continued experiencing increases in activity.[27] Our graph shows that the aggregate of new durables orders from civilian buyers declined sharply in 1951, changed little during most of 1952, and recovered decisively only in 1953. In contrast, defense obligations had a strong upward trend in the first two years of the conflict, i.e., through mid-1952 (Chart 4-2). As a consequence, total new orders for durable goods showed considerably more strength in 1952 than did the civilian orders (Chart 4-3), which suggests that defense buying had a substantial stimulative effect in this period.

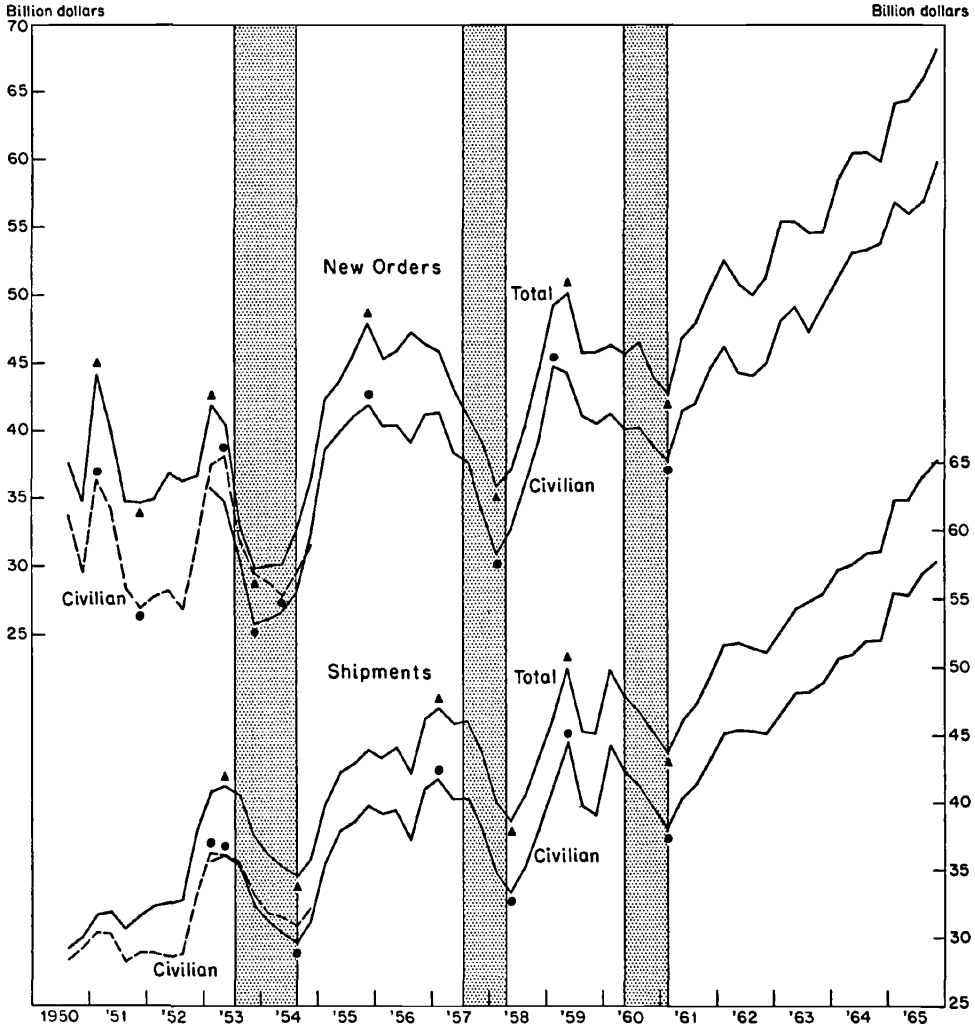
In the last months of 1952 and through 1953, new purchase commitments for defense declined sharply (Chart 4-2), thereby assuming temporarily the opposite role of a depressant. Manufacturers' new orders turned down in the first quarter of 1953, and shipments turned down in the second (Chart 4-3); one suspects that the cutbacks in military orders contributed significantly to these reversals. However, simple graphical comparisons are not sufficient to analyze such relationships. Since the levels of the defense series are low relative to the corresponding totals for durable manufactures, the civilian components must bulk

[25] It appears plausible that expenditures should be more evenly distributed over time than shipments or deliveries, particularly in the case of contracts concerning large and complex items or "jobs." This point is difficult to test with our fragmentary data. In Chart 4-2, expenditures seem a little more erratic than shipments, but this may be due to differences in aggregation. Expenditures did follow the upward course rather more consistently than shipments in the years 1956–62.

[26] Defense obligations and expenditures were used to compute the civilian series shown in the chart as broken curves for 1950–54; defense orders and shipments were used to compute the civilian series shown as solid curves for 1953–65. For 1953–62, the analysis was carried out in two alternative variants, based on the Defense and on the Census data. The two variables differ in some details but support about the same broad conclusions.

[27] These developments can be inferred from the behavior of the GNP components and other aggregative series. See Bert G. Hickman, *The Korean War and United States Economic Activity, 1950–1952*, Occasional Paper 49, New York, NBER, 1955, pp. 21–23.

Chart 4-3
New Orders and Shipments of Durable Manufactures and Their Estimated "Civilian" Components, Quarterly, 1950–65



Note: Shaded areas represent business cycle contractions; unshaded areas, expansions. Dots identify peaks and troughs of specific cycles in the civilian series; black triangles, in the totals. Series are seasonally adjusted.

Source: Total new orders and shipments: Bureau of the Census. Civilian new orders and shipments: estimates based on Commerce and Defense Department data.

large in the totals; hence, these totals must be closely correlated with their civilian components. The general impression conveyed by Chart 4-3 is indeed that of a parallelism between the total and the civilian series for either variable. The paired series draw apart when the defense component grows larger and draw together when the defense component is reduced, as illustrated by the curves for new orders in 1951–52 and in 1953.

It should also be realized that the residual method of computing civilian orders and shipments is in one sense apt to underestimate the influence of defense purchases. Increasing defense obligations presumably give rise to new orders by the contractors themselves, since the contractors need to acquire inputs for the handling of the government orders. Durable goods orders of this kind are included in Chart 4-3 in the series on civilian orders. In short, the civilian series reflect all the indirect (positive and negative) "multiplier" effects of military purchases. They exclude only the direct effects measured by the defense series themselves.

The 1957–58 recession was also preceded by a decline in defense obligations and orders, which, however, was much milder and shorter than the contraction in obligations that occurred before (and partly during) the 1953–54 recession. The defense cutbacks were not only much smaller than those initiated in 1952, they were also much more quickly reversed.[28] Expenditures of the Defense Department, as here measured, did not decline significantly in 1957–58, whereas they did during the previous recession (Chart 4-3). These observations suggest that in 1957, unlike 1953, the defense cutbacks did not constitute a major factor in the recession.

In the 1958–60–61 cycle the defense series varied less than in the earlier postwar cycles. There is an indication of the 1959–60 budget tightness in these series, particularly in obligations from III-1959 to I-1960 after which expenditures and shipments rose fairly steadily and

[28] Defense obligations were allowed to fall to a nadir of $0.6 billion in IV-1953 and they were still low, though definitely gaining, in the first half of 1954 (Chart 4-2). As concern grew over the continuing recession, the government decided, in May, to allocate a larger portion of the funds budgeted for fiscal 1955 to the next few months (see Wilfred Lewis, Jr., *Federal Fiscal Policy in the Postwar Recessions*, Washington, D.C., Brookings Institution, 1962, pp. 165–87). The defense programs, particularly obligations, accounted for the great bulk of this intrafiscal shift. Most of the increase in the first half of the fiscal year appears to have been offset by reductions in the second half (compare Chart 4-2 for about 1954–55). In 1958, efforts to speed up government spending were again made, but this time defense procurement was to be excluded from that policy.

obligations and orders increased at a similar over-all pace, with some occasional spurts and falls. A large increase in military new orders and stepped-up deliveries began late in 1964 and continued in 1965–68, reflecting the steady intensification and painful persistence of the war in Vietnam (Chart 3-2). At the end of 1968, new orders of defense product industries reached an annual rate of $50 billion, and Department of Defense gross obligations incurred for procurement alone rose to a rate of $27 billion. Afterward, orders and obligations began to decline slowly from these peak levels, while shipments and expenditures were still a little lower than orders and still creeping upward. Finally, late in 1969, defense expenditures did turn gradually downward, but new orders and obligations gained again. In this period of war and inflation, as in others before, there is little doubt about the inflationary effects of huge increases in military outlays (not offset by reduction in civilian demand).

In conclusion, new orders for defense products undergo large irregular variations, which can be and sometimes are an important source of economic instability. But these movements have sometimes been stabilizing, too, and they are always strongly smoothed in the production process as well as in expenditures.

Summary

New orders systematically lead shipments of those individual industries or products that represent goods manufactured primarily to order. Leads of N relative to S also prevail in the timing observations for a sample of goods made largely to stock, but they are both shorter and less regular. Similar distinctions can be made among the lags of output behind new orders in physical terms.

According to the postwar aggregate value data, the leads of new orders at turns in shipments are substantially larger for the durable goods sector of manufacturing than for the nondurables one: The respective average leads are about five months and two months or less. In general, the results conform to expectations in that the lags of shipments are longest for heavy, made-to-order equipment and the shortest for standardized items.

Except for the particular episode of long lags of shipments at the

upturns associated with the business revival of 1954, new orders have typically preceded deliveries by longer intervals at peaks than at troughs. This would be expected, since the capacity position of many firms is presumably strained at the top levels of aggregate output. The data also suggest that the delivery lags became on the whole shorter in the late fifties and early sixties as compared with their average duration in the earlier postwar years. This is attributed to both the relative easing of demand pressures and the completion of large build-ups of manufacturing capacity in the period between the end of the Korean War and the escalation of the war in Vietnam.

Production indexes for durable goods have lagged behind deflated new orders by substantial intervals, especially at peaks. Importantly, significant (although much shorter) lags of output are also observed for nondurable goods. Autoregressive sales forecasts based on recent order figures could help account for such lags in production to stock. The timing of production relative to shipments in constant prices is on the average roughly coincident for the comprehensive aggregates, with some tendency to lag in the stock-oriented nondurable goods industries.

Comparisons for the new market-category series show approximately coincident timing of N and S for consumer goods and construction materials. Shipments of metal products and equipment for commercial and industrial uses lagged by some 4 or 5 months, on the average. The longest delivery lags, of 11–14 months, are observed for the defense products.