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Volume Author/Editor: Moses Abramovitz

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Chapter Author: Moses Abramovitz

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Chapter 6

Inventory Turnover and the Amplitude of Inventory Cycles

A substantial bloc of theoretical opinion has long held that downturns of business are precipitated, if not caused, by overproduction, the mark of which is an overaccumulation of stocks. A test of these arguments naturally leads to an inspection of inventory turnover rates. True, one might interpret any accumulation of stocks above some average or trend level as dangerous, a depressant to orders and output. But common sense suggests that larger stocks are required to carry on a larger volume of business and that an undue accumulation implies that stocks are heavy, not absolutely, but relative to the volume of business. This chapter is concerned primarily with turnover rates measured in their inverse form, that is, ratios of inventories to sales or to output. As a subsidiary subject we inspect the amplitudes of cycles in inventories and sales. This information, together with the data about timing surveyed earlier, takes us a certain distance toward understanding fluctuations in inventory turnover rates. Section 5 considers the significance of our findings for the theories of cycle turns alluded to above.

1 *Average Inventories Relative to Sales*

To lend a certain concreteness to the cyclical measures presented later we first consider how large inventories usually are in comparison with sales (Table 30). Between World Wars I and II manufacturers kept inventories equal to about 21 percent of their annual sales on the average. In other words, their inventories were equal to about two and one-half months' sales and turned over between 4 and 5 times a year. These estimates, however, based on end of year inventories, do not take proper account of the differ-

TABLE 30

Inventory-Sales Ratios in Manufacturing, Current Prices, 1919-1938
(percentages)

(1)	1919 -21 (2)	1921 -24 (3)	1924 -27 (4)	1927 -32 (5)	1932 -38 (6)	Av. 1919 -38 (7)
Total manufacturing	22.82	23.63	21.43	21.30	19.96	21.43
Food, beverages & tobacco	14.10	12.35	12.18	14.17	14.22	13.58
Textiles & textile products	22.02	27.20	26.45	24.09	20.38	23.57
Leather & leather products	34.78	34.08	25.83	27.61	23.35	27.76
Rubber & related products	30.78	23.57	20.90	23.61	20.92	23.08
Lumber & wood products	26.25	24.95	25.68	34.63	29.66	29.24
Paper, printing & publishing	17.30	18.92	15.10	13.94	14.00	15.28
Chemicals & allied products	26.22	27.63	24.18	21.65	20.60	23.14
Stone, clay & glass products	21.30	21.30	18.92	25.00	24.27	22.83
Metals & metal products	27.22	27.73	24.55	25.18	24.92	25.62
Miscellaneous	29.40	29.98	29.35	27.71	n.a.	28.87

n.a.: not available.

Ratios were computed from annual data on a calendar year basis. End of year inventories (Kuznets' estimates) for successive year ends were averaged and divided by calendar year sales to get inventory-sales ratios for calendar years.

For source of sales data see text, note 1. Figures in column 7 are simple averages of the calendar year ratios. Figures in other columns are averages for successive business cycles, measured from trough to trough. The average for each cycle includes all years from trough to trough; the troughs are weighted one-half each and the intervening values one each.

ence, if any, between the average for the year and stocks held on December 31. This is unquestionably serious for individual industries, but it may not be for manufacturing as a whole. Department of Commerce monthly figures, which unfortunately begin only in 1939, do not reveal any marked seasonal pattern for the holdings of all manufacturers (Chart 15).

The denominators of the ratios are the gross sales of each company aggregated by industry and for manufacturing industry as a whole. Because a large portion of the sales of manufacturing firms are made to other manufacturers, the figures tend to understate the size of stocks compared with net sales after intra-manufacturing transactions have been eliminated. The difference can be gauged roughly by comparing the value of product in manufacturing with 'value added'. For Census years 1919-39 value added by manufacturing averaged about 43 percent of the value of product. On the average, therefore, the value of inventories must have been about half of net output as measured by value added (the

average inventory-sales ratio = .21 ÷ .43 = .49). Value added, again, is smaller than net sales since it excludes the value of materials purchased from other than manufacturing firms. Thus inventories must have been somewhat less than 50 percent of net sales.

This, however, is a digression. We are primarily interested in the inventory-gross sales ratios presented in Table 30. These are remarkably similar for the large industrial groups distinguished. The ratios in groups other than foods and paper, where inventories were relatively low, were between 23 and 29 percent, roughly equivalent to 2.8-3.5 months' sales and to turnover rates of 3.4-4.3.

The figures as a whole suggest a mild downward drift in inventory-sales ratios during the two decades. The trend in the total is fairly well repeated in the various industries except foods, lumber, and stone, clay and glass.

2 *Cyclical Features of Inventory-Sales Ratios*

The computation of inventory-sales ratios based on company accounts is complicated by an awkward fact: inventories are for December 31 while sales are for calendar years.[1] The figures were made comparable by averaging the standings of stocks at the beginning and end of each year. The effect, to dampen fluctuations in stocks somewhat, and therefore to reduce the influence of inventory fluctuations on the movement of the inventory-sales ratios, is probably an advantage for the present purpose. As argued above (Ch. 3, Sec. 2) cyclical amplitudes based on annual data tend to be smaller than those based on monthly data. But the differences between the cyclical amplitudes of monthly and calendar year series tend to be larger than those between monthly and single-date annual series.[2] Making calendar year estimates of stocks by averaging beginning and end of year figures should operate to off-

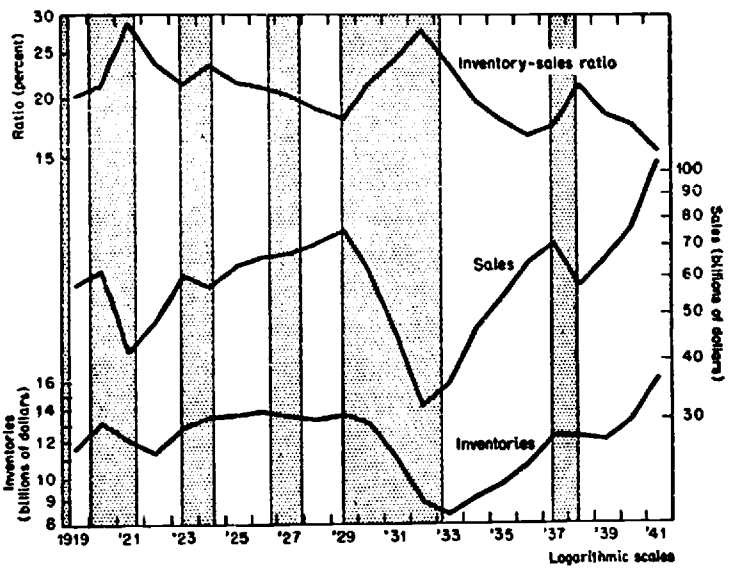
[1] We compute inventory-sales ratios from Kuznets' estimates of inventories in current prices and the gross sales of manufacturers in the same industry groups. Derived from data for corporations in *Statistics of Income*, they are raised to represent the sales of all corporations. The raising ratios are those used to move from corporate to total inventories. *Statistics of Income* did not publish gross sales figures until 1922. In the earlier years, therefore, gross sales are estimated from gross income after adjustment to the level of gross sales in 1922 when they constituted about 95 percent of gross income.

[2] Cf. *Measuring Business Cycles*, p. 261.

set this tendency. And it seems unlikely that the resulting series have smaller cyclical amplitudes than true calendar year inventory series.[8]

The general cyclical behavior of the inventory-sales ratios is illustrated in Chart 12 which is arranged to show the movements of the ratios for total manufacturing during business cycles and to allow comparison with sales and inventory cycles. The inverted pattern of the ratio during both business and sales cycles is apparent and so also is the approximate coincidence of turns in the ratio with those in sales and business at large. Of 7 cyclical turns in sales for which there are corresponding turns in the ratio, six coincide with an opposite turn; in 1937 the ratio turns a year earlier. It sometimes turns before, sometimes after, business activity, as might

Chart 12
Total Manufacturing: Inventory-Sales Ratio, Sales and Inventories, Current Prices



Source: see text, Sec. 2, note 1.
Contractions (shaded) and expansions (unshaded) are marked off by the monthly reference chronology.

[8] An alternative, to estimate end of year sales (that is, the annual rates of sales at the ends of years) by averaging the sales of each pair of adjoining years, was rejected on two counts. It would have involved comparing inventories with sales as much as 12 months apart. And it would have reduced still further the cyclical amplitude of sales as compared with both monthly and single-date annual inventory figures.

be expected in an annual series whose monthly analogue tends to rise and fall synchronously with business at large.

Timing measures for total manufacturing are presented in Table 31. The small average leads are hardly significant in view of the preponderance of coincidences with the turns of sales and of the virtually even distribution of leads and lags with respect to reference dates. Additional indications of timing might perhaps be gleaned from measures for individual industry groups, but since we must depend upon annual series and since the inventory elements in our ratios are merely averages of year end figures, it would be unwise to press these data further.

TABLE 31

Inventory-Sales Ratios in Total Manufacturing, Current Prices
Timing at Turns of Cycles in Sales and Business, 1918-1938

REFERENCE SERIES	NUMBER OF Leads	Lags	Coin.	AV. LEAD (−) OR LAG (+) MONTHS
Sales (annual)	1	0	6	−1.7
Business cycles (monthly reference dates)	4	3	0	−2.6

Timing measured invertedly; see Ch. 3, note 5.

However diffidently we put our views about timing, we need not hesitate to speak about the conformity of the ratios. The regularity of their inverted behavior in the aggregate is borne out by conformity measures computed for both total manufacturing and for the ten industry groups (Table 32). That the tendency to inverted conformity to cycles in both business activity and manufacturers' sales runs through all manufacturing industry is immediately apparent.

These observations about conformity and timing are consistent with those made upon a set of inventory-shipments ratios based on the NICB monthly indexes of inventories and shipments.[4] These short series, covering only four reference cycle turns, are plotted in Chart 13. Based on monthly data, they are free from the diffi-

[4] As indicated in Chapter 5, sales data from company accounts represent the value of goods billed to customers. The value of shipments is, therefore, the equivalent of sales in this special sense.

TABLE 32

Inventory-Sales Ratios in Manufacturing, Current Prices
Conformity to Cycles in Business and Sales

	NO. OF PHASES	INDEX OF CONFORMITY TO BUSINESS[a]			NO. OF PHASES	INDEX OF CONFORMITY TO SALES[b]		
		Exp.	Contr.	Cycle		Exp.	Contr.	Cycle
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Total mfg.	10	−60	−60	−100	7	−100	−100	−100
Food, bev. & tob.	10	+20	−60	−56	7	−33	−100	−100
Textiles & textile prod.	10	−100	−60	−78	9	−100	−100	−100
Leather & leather prod.	10	−20	−60	−78	9	−100	−60	−78
Rubber & rel. prod.	10	−20	−60	−78	7	−100	−100	−100
Lumber & wood prod.	10	−60	−100	−100	9	−50	−100	−100
Paper, print. & pub.	10	−100	−40	−100	5	−100	−100	−100
Chemicals & allied prod.	10	−60	−60	−56	7	−100	−100	−100
Stone, clay & glass prod.	10	−100	−100	−100	7	−100	−100	−100
Metals & metal prod.	10	−60	−60	−56	7	−100	−100	−100
Miscellaneous	9	−60	−100	−100	7	−100	−100	−100

[a] Period covered: 1919-38 for calendar year series (except miscellaneous 1919-37). Conformity measured on a synchronous basis by reference to NBER calendar year reference dates.

[b] Period covered: 1920-38 (except food, leather, and rubber 1919-38, and miscellaneous 1920-32). Conformity measured on a synchronous basis by reference to turns in annual sales.

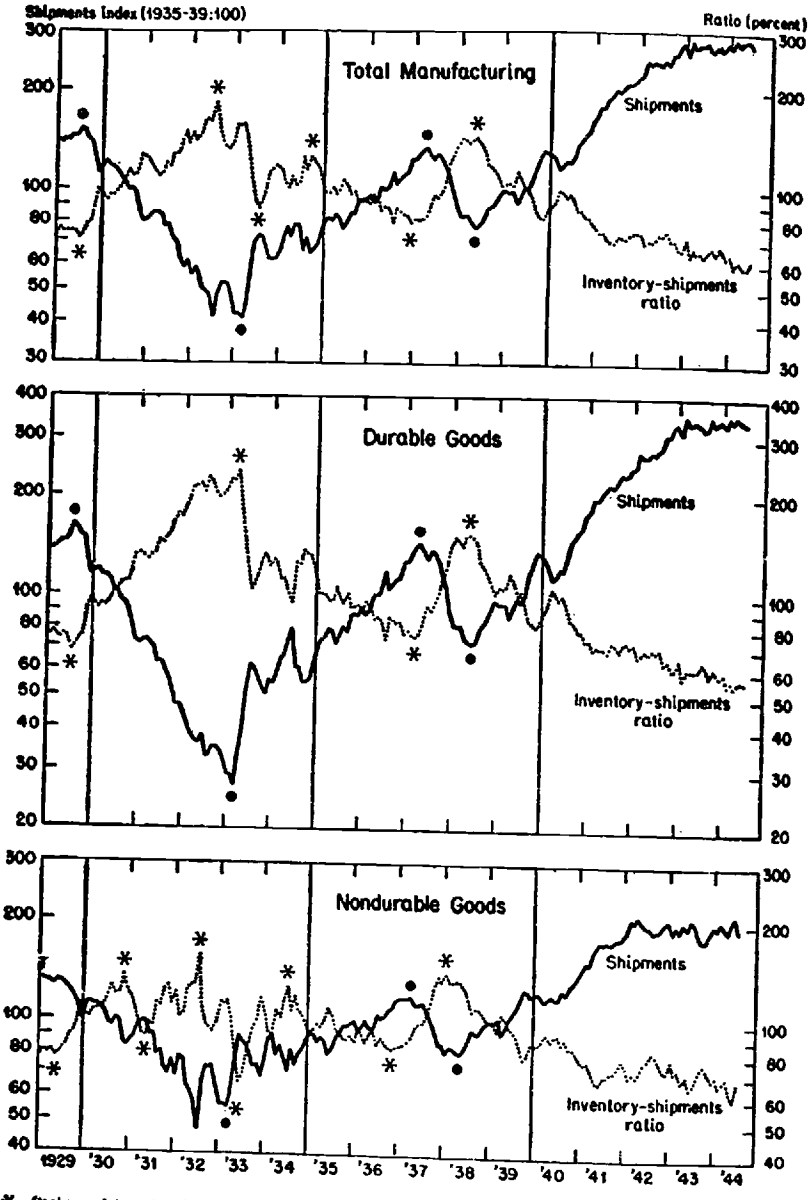
culties that make annual data so awkward to use. The inverted conformity of the ratio to both business cycles and shipments is apparent whether we look at the series representing all manufacturing or those representing durable and nondurable goods industries separately.

The timing measures are summarized in Table 33. Comparisons were made with the turns of both shipments and business cycles. For the total and for nondurable goods industries, alternative comparisons were made. The first set suggests that the ratio for nondurable goods industries—taken invertedly—tends to lead both shipments and business cycles, that the ratio for durable goods industries tends to move synchronously, and that when the two are combined, the total tends to lead by about three months.

The few comparisons on which these measures rest reduce our faith in the conclusion. Moreover, shipments of both nondurable goods manufacturers and of all manufacturers have a double trough near the bottom of the great depression, the first in July 1932 and the second in March 1933. The corresponding inventory-sales ratios have a double peak with identical dates. The more prominent of the two peaks in the ratios was the early one; the more prominent of the two troughs in shipments was the later one.

Chart 13

National Industrial Conference Board Indexes of Manufacturers' Shipments and of Inventory-Shipments Ratios



* Peaks and troughs of cycles in inventory-shipments ratio.
● Peaks and troughs of cycles in shipments.

Logarithmic scales

Following our rules, we marked the peaks in the two ratios in July 1932 and the troughs in the two shipment series in March 1933. Our ordinary timing comparisons, therefore, indicate that the ratios lead both business cycles—the reference trough also is March 1933—and shipments. In this situation it is sensible to disregard our regular procedure and take account of the later peak of the ratios. When we do, the leads at this turning point disappear, and we have a second set of comparisons. In it the average lead of the ratio for nondurable goods industries is less pronounced, and that of the series representing all manufacturing barely apparent. The significance of such short average leads based on so few comparisons is dubious.

Whether inventory-sales ratios, taken invertedly, tend to lead or not, they plainly do not decline markedly as a rule until the

TABLE 33

Inventory-Shipments Ratios Based on National Industrial Conference Board Monthly Indexes of Inventories and Shipments
Timing at Turns of Cycles in Shipments and Business, 1929-1944

	TIMING AT TURNS IN SHIPMENTS CYCLES		TIMING AT TURNS IN BUSINESS CYCLES (mo. ref. dates)	
NUMBER OF	1st comparison	2d comparison	1st comparison	2d comparison
TOTAL MANUFACTURING				
Leads	2	1	2	1
Lags	0	0	1	1
Coincidences	2	3	1	2
Av. lead (−) or lag (+), mo.	−3.2	−1.0	−3.0	−1.0
DURABLE GOODS INDUSTRIES				
Leads	2		1	
Lags	0		1	
Coincidences	2		2	
Av. lead (−) or lag (+), mo.	−0.5		−0.2	
NONDURABLE GOODS INDUSTRIES				
Leads	3	2	4	3
Lags	1	1	0	0
Coincidences	0	1	0	1
Av. lead (−) or lag (+), mo.	−3.5	−1.2	−4.8	−2.8

Timing measured invertedly; see Ch. 3, note 5.
See text for an explanation of the difference between the first and second comparisons.

trough of business has been passed or rise markedly until the peak of business has been passed. In comparison with its total cyclical amplitude, increases in the inventory-sales ratio before business peaks and declines before troughs were very small (Charts 12 and 13). It seems clear that regardless of the timing of its turns, the ratio remains very low at business peaks, very high at troughs.

3 *Cyclical Features of Inventory-Output Ratios*

From ratios based on inventories and sales in current prices we turn to ratios based on inventory measures corrected for price changes and on indexes of output. The inventory data are indexes of Kuznets' estimates in 1929 prices; the output data are FRB indexes of manufacturing production for comparable industry groups.[5] To make the output figures comparable with the inventory data, which are for December 31, the December and January standings of the production indexes were averaged.

The inventory-output ratio for total manufacturing has the appearance of an inverted replica of the output index, and its inverted behavior during business cycles is apparent (Chart 14). These observations on the behavior of the ratio for all manufacturers are fully confirmed by conformity measures computed for the total and the various industry groups (Table 34), which, as indicated, were computed on the assumption that the ratios move synchronously with both output and business cycles.[6]

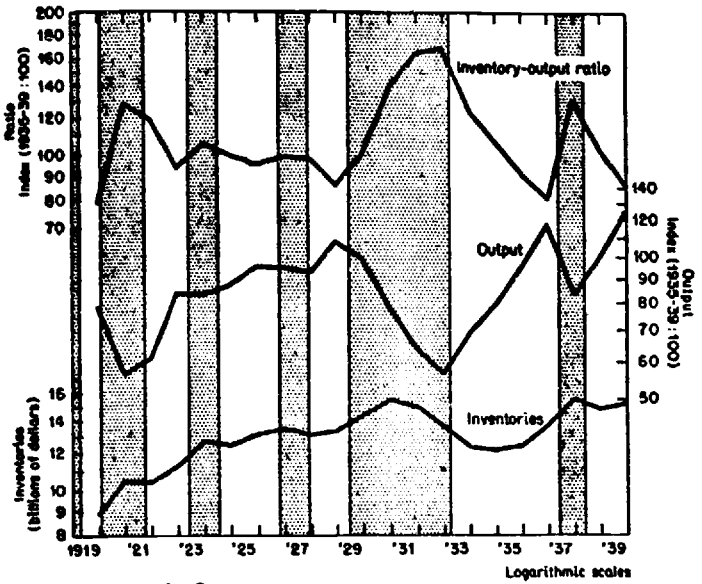
This assumption with respect to timing must now be questioned. Unfortunately the problem of measurement is again vexed by the character of our data. As in the case of all annual data that are available for only a short period, measures made on end of year inventory-output ratios may not accurately reveal the true timing of the cycles in the series. In most cases we do not know the actual degree of distortion, and we have to depend upon tests like those of Chapter 3, Section 2, as a general guide. In the present instance we can do better. We know that the timing of the turns of the inventory-output ratios is strongly influenced by that of the year end

[5] See Ch. 5, note 10, for a description of how the published FRB indexes were combined for this purpose.

[6] Only nine groups are distinguished here because it is impossible to compile a satisfactory index of output comparable with inventories held in the miscellaneous manufacturing group.

Chart 14

Total Manufacturing: Inventory-Output Ratio, Output and Inventories, Constant Prices, End of Year



Source: see text, Sec. 3.
Contractions (shaded) and expansions (unshaded) are marked off by the monthly reference chronology.

TABLE 34

Inventory-Output Ratios in Manufacturing, Conformity to Cycles in Business and Output

	NO. OF PHASES	INDEX OF CONFORMITY TO BUSINESS[a]			NO. OF PHASES	INDEX OF CONFORMITY TO OUTPUT[b]		
		Exp.	Contr.	Cycle		Exp.	Contr.	Cycle
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Total mfg.	9	−100	−60	−100	9	−100	−60	−100
Food, bev. & tob.	9	−50	−60	−25	7	−33	−100	−100
Textiles & textile prod.	9	−100	−60	−75	15	−100	−43	−100
Leather & leather prod.	9	−50	−60	−50	9	−50	−60	−100
Rubber & rel. prod.	8	0	−50	−14	8	−50	−100	−100
Lumber & wood prod.	9	−50	−100	−75	9	−100	−60	−100
Paper, print. & pub.	9	−50	−60	−50	5	−100	−100	−100
Chemicals & allied prod.	9	−50	−20	−25	7	−33	−50	0
Stone, clay & glass prod.	9	−50	−100	−62	7	−100	−100	−100
Metals & metal prod.	9	−50	−100	−100	9	−100	−100	−100

Source: See text.
Period covered: 1919-37 for all series except rubber (1920-37).
[a] Conformity measured on a synchronous basis by reference to December 31 peaks and troughs of business.
[b] Conformity measured on a synchronous basis by reference to turns of end of year output series.

output estimates used in computing the ratios. Moreover, we have at hand the monthly indexes from which the year end data were derived. By comparing their turns, we can take account of one element of possible bias in the annual ratio. If the year end figures are a good indicator of the timing of production in the interwar period they will appear to turn synchronously with monthly output on the average. If not, they will tend to distort the timing of output relative to business cycle turns, and the errors will tend to be injected into the timing measures of the inventory-output data computed from the end of year production series (Table 35).

The turns of the inventory-output ratios, taken invertedly, apparently lead those of monthly output (col. 2-4). The ratio for total manufacturing, for example, appears to lead by five months. None of the nine groups seems to lag and five seem to lead by two months or more. A substantial majority of the individual comparisons were leads.

A large portion of this apparent lead, however, must be attributed to the fact that the timing of turns of the year end production series, which helps fix turns of the ratio, is apparently biased with respect to turns in monthly output (col. 5-7). If the shapes of the production cycles did not distort the timing of the year end series, we would expect the leads and lags in columns 5 and 6 to be about equal in number and the average timing measures in column 7 to approximate zero. Instead, the year end output series tends markedly to lead the monthly series. Except in foods and chemicals all or most of the leads in the ratios can be traced to the biased leads in the year end output series. If we subtracted the apparent lead of each year end production series from that of the ratio for the same group, we would not find any consistent tendency for the groups to lead or lag. Moreover, the residual differences from synchronous timing would be less than two months for total manufacturing and for all except three of the nine groups. Such narrow margins in annual data are not to be relied upon.

Our conclusions are much the same when we consider the timing of the ratio at business cycle turns (col. 8-10). The apparent leads are longer than at output turns. But again, after allowing for the bias injected by the year end output figures, the leads appear substantial in only a few groups. A part of the residual leads, of

TABLE 35

Inventory-Output Ratios in Manufacturing
Timing at Turns of Cycles in Output and Business, 1918-1938

	TIMING AT TURNS IN OUTPUT CYCLES					
	INV.-OUTPUT RATIOS[a]			OUTPUT[a]		
	NO. OF Leads	Lags	Av. lead (−) or lag (+) months	NO. OF Leads	Lags	Av. lead (−) or lag (+) months
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Total manufacturing	9	1	−4.6	8	2	−3.4
Food, beverages & tob.	4	2	−3.3	3	3	+0.2
Textiles & textile prod.	6	3	−2.8	9	3	−4.2
Leather & leather prod.	4	5	−0.1	4	4	+0.1
Rubber & related prod.	6	3	−0.1	5	4	+1.3
Lumber & wood prod.	8	0	−3.6	7	1	−4.5
Paper, printing & pub.	6	2	−2.8	5	1	−3.3
Chemicals & allied prod.	4	2	−4.3	3	3	−0.4
Stone, clay & glass prod.	7	1	−1.0	6	0	−1.5
Metals & metal prod.	6	4	−0.9	5	5	−0.9
Sum of 9 groups	51	22		47	24	

	TIMING AT TURNS IN BUSINESS CYCLES						
	INV.-OUTPUT RATIOS[a]			MONTHLY OUTPUT			
	NO. OF Leads	Lags	Av. lead (−) or lag (+) months	NO. OF Leads	Lags	Coin.	Av. lead (−) or lag (+) months
	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Total manufacturing	10	0	−5.8	4	3	3	−1.2
Food, beverages & tob.	7	0	−5.4	3	3	2	−0.4
Textiles & textile prod.	7	0	−4.9	5	2	3	−1.1
Leather & leather prod.	6	3	+0.5	5	4	1	+0.7
Rubber & related prod.	9	0	−7.7	8	0	1	−7.7
Lumber & wood prod.	7	1	−3.8	2	5	3	−0.4
Paper, printing & pub.	6	2	−2.9	3	4	3	−0.5
Chemicals & allied prod.	6	2	−4.1	2	5	1	+1.8
Stone, clay & glass prod.	7	1	−3.8	7	2	1	−2.6
Metals & metal prod.	6	4	−1.0	3	4	3	−0.1
Sum of 9 groups	61	13		38	29	18	

Timing measured invertedly; see Ch. 3, note 5.
[a] December 31.

course, stems from the lead of monthly output relative to business cycles, as indicated in columns 11-14. This part is a real, not an illusory, contribution to the timing of the ratios. It is valid for the 20 years the data cover. But one may question whether the short average lead of output relative to business cycles during the interwar period is a persistent feature of the cyclical behavior of output.

This review, therefore, leaves us in doubt about the true timing

of inventory-output ratios at the turns of output and business cycles. There may be some tendency to lead by a short interval, but we cannot trust our data to reveal it. I conclude that if inventory-output ratios lead at all, the interval is short, and the ratios remain low at business peaks and high at troughs.

4 *Causes of the Inverted Pattern of the Ratios*

TIMING OF INVENTORY CYCLES

This section and the next two are designed to carry us a certain distance toward understanding the reasons for the inverted behavior of inventory-sales and inventory-output ratios during cycles in business activity and in sales and output. We have already reviewed the data that point to one of the reasons. Inventories tend to lag at turns of both business activity and sales and output. Suppose now that the amplitude of inventory fluctuations, measured from troughs to peaks and back, equals the amplitudes of sales and output cycles similarly measured. Then the lag of inventories behind business cycle turns and the almost synchronous movement of sales and output with business means that stocks will rise less during business expansions and fall less during contractions than do sales and output. And stocks must also, indeed, *a fortiori,* rise less during expansions and fall less during contractions of sales and output than do sales and output themselves. Unless the amplitude of fluctuations in inventories exceeds those in sales and output, inventory-sales and inventory-output ratios must fall during expansions and rise during contractions of business, sales, and output.

The effect of the lag of inventory cycles does not depend upon any special assumption about the relative amplitudes of stocks and sales. It tends to produce ratios that conform inversely whatever the relative amplitudes of inventories, sales, and output. If inventories have narrower amplitudes than sales and output, the ratios would vary inversely even if inventories did not lag. But a lag would cause the ratios to fall further during business expansions and to rise further during contractions. If the amplitude of inventories is wider than those of sales and output, the ratios would vary positively unless inventories lagged behind (or led) the turns of business, sales, and output by a sufficient interval. The lag tends to offset the effect of wider inventory fluctuations, if they exist.

The tendency for inventories to lag is part of the explanation of the inverted pattern of the ratios. It is not the whole story, however, for the amplitude of aggregate stocks is, in fact, narrower than those of sales and output.

AMPLITUDES OF CYCLES IN INVENTORIES, SALES, AND OUTPUT

To judge the vigor of cyclical fluctuations, we use the National Bureau measure of the amplitude of specific cycles. Its computation is described in Chapter 3 where the reliability of such measures made from annual data is discussed. At this point, we need merely note that the measures are based on the same sets of annual data as those from which the annual ratios studied in Sections 2 and 3 of this chapter were computed. The amplitudes of inventory cycles, however, are computed from the original end of year data rather than from the calendar year estimates obtained by averaging data for successive year ends. Thus the smoothing effect that such averages have on cycle movements is avoided. The data we use, therefore, are end of year inventories in current and in 1929 prices, calendar year sales in current prices, and end of year (average of December and January) indexes of output. For reasons explained in Chapter 3, all these sets of annual data tend to yield lower amplitudes than corresponding monthly series. But the degree of understatement will tend to be about the same, though there is some evidence that calendar year data reduce the amplitudes that would be yielded by monthly data somewhat more than end of year figures.[1]

Table 36, presenting average amplitudes of all cycles distinguished in each series between 1919 and 1938, strongly suggests that the amplitudes of stocks are smaller than those of sales or output (col. 3 and 6; 9 and 12). For manufacturing as a whole the amplitudes are more than twice as wide. In current prices the amplitude of sales exceeds that of stocks in nine out of ten industry groups. The average amplitude of output is wider than that of inventories in constant prices in seven out of nine groups.

These observations might be thought conclusive were it not for one disturbing element: the number of cycles in stocks and in sales and output is often different. For total manufacturing in cur-

[1] See *Measuring Business Cycles*, p. 261.

TABLE 36

Inventories (Current Prices) and Gross Sales, and Inventories (Constant Prices) and Output: Average Amplitudes of All Specific Cycles, 1919-1938

	INVENTORIES AND SALES, CURRENT PRICES					
	INVENTORIES			GROSS SALES		
	No. of cycles	Total amp.[a]	Per mo. amp.[a]	No. of cycles	Total amp.[a]	Per mo. amp.[a]
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Total manufacturing	4	39.0	0.7	3	79.1	1.2
Food, beverages & tob.	2	83.8	0.8	3	56.9	0.8
Textiles & textile prod.	4	46.3	0.9	3	64.0	1.0
Leather & leather prod.	3	48.1	0.9	3	53.5	0.8
Rubber & related prod.	4	65.8	1.3	3	90.5	1.4
Lumber & wood prod.	2	58.6	0.6	4	62.9	1.2
Paper, printing & pub.	5	29.1	0.6	2	106.6	1.1
Chemicals & allied prod.	5	39.6	1.0	3	68.5	1.1
Stone, clay & glass prod.	3	40.5	0.6	3	81.2	1.2
Metals & metal prod.	3	68.2	1.1	3	122.6	1.8
Miscellaneous	4	54.6	1.2	3	76.0	1.6
	INVENTORIES IN 1929 PRICES, AND OUTPUT					
	INVENTORIES			OUTPUT		
	No. of cycles	Total amp.[a]	Per mo. amp.[a]	No. of cycles	Total amp.[a]	Per mo. amp.[a]
	(8)	(9)	(10)	(11)	(12)	(13)
Total manufacturing	4	26.4	0.5	4	61.3	1.2
Food, beverages & tob.	2	60.8	0.8	2	52.6	0.6
Textiles & textile prod.	3	40.3	0.8	5	50.4	1.2
Leather & leather prod.	5	35.7	1.0	4	46.0	0.9
Rubber & related prod.	2	131.0	1.4	4	90.1	1.8
Lumber & wood prod.	3	54.5	1.0	3	91.4	1.4
Paper, printing & pub.	2	41.2	0.6	2	86.9	1.0
Chemicals & allied prod.	2	52.6	0.7	2	78.4	0.8
Stone, clay & glass prod.	3	47.2	0.7	2	137.5	1.6
Metals & metal prod.	3	53.8	0.8	4	101.8	2.0
Miscellaneous						

The cycles of individual series do not cover a uniform period. For each series measures begin with the first and end with the last turn in 1919-38.

[a] Rise and fall, in specific cycle relatives.

rent prices, for example, stocks had four cycles, sales only three. We know, however, that a long cycle in one series, A, that extends over a period covering two cycles in another series, B, will tend to have a wider amplitude than the average of the two shorter cycles. This will be true even though the total movement of series B from the initial trough of its first cycle to the higher of its two peaks and down to the terminal trough of the second cycle is as large as the total movement of series A in its single cycle. Conceivably,

therefore, part of the seeming difference in the amplitudes of inventories and sales and output may be traced to this cause.

Some reassurance can be gained from Table 36. Even if we confine attention to groups in which the comparisons are based on the same number of cycles or where the number for sales and output exceeds that for the corresponding inventory series, the amplitude of stocks is narrower than that of the corresponding sales or output series in 10 comparisons out of 13. Two of the three exceptions occur when stock cycles are fewer than sales or output cycles.

Additional confirmation can be had by inspecting the rise and fall per month instead of the total rise and fall. These measures, which represent simply the total rise and fall in each cycle divided by the length of the cycle in months, tend to avoid the difficulties due to differences in the number of cycles because the total rise and fall of a long cycle is divided by more months than are the narrower amplitudes of the two or more cycles sometimes found during the same period in a corresponding series. In current prices the monthly change in total sales is 1.2 percent of its average standing during cycles in sales; for inventories, only 0.7 percent. The average monthly change in output is again 1.2 percent of its average standing during output cycles; that of inventories in 1929 prices, only 0.5 percent. With few exceptions, differences of the same kind, though not always of the same size, are found for the various industry groups.

Finally, we turn from amplitudes based on all cycles in each series to measures based only on comparable cycles. We eliminated all cycles from the inventory series that could not be matched closely with similar cycles in the corresponding sales or output series, and vice versa. When a long cycle in, say, sales was accompanied by two or more short inventory cycles that together constituted a major inventory cycle, we ignored the smaller interruptions and compared the long sales cycle with a single long inventory cycle (Table 37).

Once again, the conclusion that sales and output have more vigorous cycles than inventories is confirmed. In current prices the total rise and fall of aggregate sales far exceeds that of total inventories: it is over 69 for sales, only 45 for stocks. All cycles in output could be matched with those in inventories in 1929 prices for total

TABLE 37

Inventories (Current Prices) and Gross Sales, and Inventories (Constant Prices) and Output: Average Amplitudes of Corresponding Specific Cycles, 1919-1938

	INVENTORIES AND SALES, CURRENT PRICES				
	INVENTORIES			GROSS SALES	
	No. of cycles	Total amp.[a]	Per mo. amp.[a]	Total amp.[a]	Per mo. amp.[a]
(1)	(2)	(3)	(4)	(5)	(6)
Total manufacturing	2	45.0	0.8	69.4	1.2
Food, beverages & tob.	2	83.8	0.8	85.4	0.8
Textiles & textile prod.	3	60.4	0.9	64.0	1.0
Leather & leather prod.	2	69.8	0.9	71.1	1.0
Rubber & related prod.	2	124.6	1.2	131.8	1.3
Lumber & wood prod.	1	107.6	0.8	137.5	1.0
Paper, printing & pub.	1	64.4	0.9	86.7	1.2
Chemicals & allied prod.	2	46.2	1.0	53.0	1.2
Stone, clay & glass prod.	3	40.5	0.6	81.2	1.2
Metals & metal prod.	3	68.2	1.1	122.6	1.8
Miscellaneous	3	72.5	1.6	76.0	1.6

	INVENTORIES IN 1929 PRICES, AND OUTPUT				
	INVENTORIES			OUTPUT	
	No. of cycles	Total amp.[a]	Per mo. amp.[a]	Total amp.[a]	Per mo. amp.[a]
	(7)	(8)	(9)	(10)	(11)
Total manufacturing	4	26.4	0.5	61.3	1.2
Food, beverages & tob.	1	115.5	0.7	70.1	0.5
Textiles & textile prod.	3	40.3	0.8	42.3	1.0
Leather & leather prod.	0				
Rubber & related prod.	0				
Lumber & wood prod.	2	61.2	0.9	79.9	1.2
Paper, printing & pub.	0				
Chemicals & allied prod.	0				
Stone, clay & glass prod.	2	59.2	0.6	137.5	1.6
Metals & metal prod.	3	53.8	0.8	133.6	2.2
Miscellaneous					

See Table 36, note.

[a] Rise and fall, in specific cycle relatives.

manufacturing; the measures in Table 37 are, therefore, the same as in Table 36—61 for output, 26 for inventories. In current prices all ten industry groups showed wider amplitudes for sales than for comparable stocks cycles. The same was true in four of the five comparisons that could be made of indexes of physical volume. And with one exception, foods (for which the monthly amplitudes for sales and inventories are equal), the rates of movement per month confirm the measures of total amplitude. We conclude,

therefore, that inventories have narrower amplitudes than sales and output. Hence the relative amplitudes of sales, output, and stocks cycles combine with the lag of inventories to account for the inverted pattern of the inventory-sales and inventory-output ratios.

OTHER FACTORS

These findings take us a certain distance, but not very far after all, toward understanding the movements of the ratios. We still want to know why inventories lag and why their amplitudes are relatively small. Later chapters will help supply answers to our questions about the timing of inventory cycles. We shall see that goods in process of fabrication in individual firms vary almost synchronously with output, that stocks of purchased goods tend to lag a few months in some cases and many months in others, that stocks of finished staples move inversely or with a very long lag, and that there is reason to think that stocks of finished nonstaples tend to lag by shorter intervals. The reasons for these differences we leave to later discussion. Here we take note of three implications of the diverse timing of different kinds of stocks relevant to the present subject.

The first is a technical point. The relatively small amplitudes of cycles in aggregate inventories held by the various industry groups are not independent of the timing differences of the various kinds of stocks making up each aggregate. The fact that inventories of different kinds reach peaks and troughs at widely different times means that the relative cyclical amplitude of the aggregate will be considerably smaller than the average cyclical amplitude of its components. It seems likely that the cycles of the components of total sales and output in each industry group will be more bunched in time than are those of inventories. Hence the amplitudes of aggregate sales and output more nearly approximate the average amplitude of their components than is the case with inventories. This helps account for the small amplitude of the cycles in aggregate stocks compared with those in sales and output.

The second point is that just as we have found that the tendency for inventories to lag is broadly characteristic of the various industry groups, so we shall see that the tendency to lag characterizes most of the various functional categories of stocks—purchased

materials, finished goods, etc.—held by the various industry groups. This fact reduces the possibility that, as a general rule, any substantial category of stocks actually rises more relatively between the troughs and peaks of business or of sales and output cycles than do sales and output themselves. Hence it reduces the possibility that inventory-sales and inventory-output ratios for any substantial category of stocks will stand higher at the upper than at the lower turning points of business cycles. It does not, of course, render such a result impossible. But if inventories of a certain kind tend to lag behind sales, their amplitude must exceed that of the sales cycle in order that their ratio should rise during expansions of sales and fall during contractions. Goods in process is the only category of stocks for which the investigations reported in later chapters do not indicate a lag. As it presumably moves in cycles of about the same amplitude as output the ratio of goods in process to output probably does not vary significantly during business cycles.[8]

Third, the wide variation in the timing of the various components of aggregate stocks makes it possible that variation in timing alone accounts for the relatively small amplitude of aggregate stocks in each industry group. Conceivably, therefore, some substantial classes of stocks have cycles with a wider amplitude than output, lag only a few months, and have an inventory-output ratio that moves positively during cycles in business, output, or sales. The largest category of stocks for which this possibility arises is purchased materials which, as we shall see, accounts for about 40 percent of all manufacturers' stocks. We reason by elimination. Goods in process, by the nature of their relation with output, presumably have a fairly constant turnover rate. Since stocks of finished staples move inversely to output and shipments, their ratios to sales and output must behave inversely.

Purchased materials comprise the only other substantial category of stocks. Telling against the notion that its ratio conforms positively is evidence that it lags at turns in business activity. To dispose of the possibility that there is any large category of stocks for which the inventory-sales or inventory-output ratio conforms

[8] Changes in the commodity composition of output may, however, account for some change in the aggregate of goods in process relative to aggregate sales or output.

positively to business cycles would require indexes of the various categories of stocks sufficiently representative to enable us to measure the amplitude of inventory fluctuations reliably. Unfortunately our sample of stocks of purchased materials, the category especially interesting from this viewpoint, is not adequate for this purpose. The possibility that its ratio varies positively rather than inversely must, therefore, remain open—a consideration that affects the argument of the next section.

5 *Significance for the Theory of Cyclical Turning Points*

This chapter began with the observation that a common view about the causes of cyclical downturns holds that in the course of expansion there is, sooner or later, a piling up of stocks—presumably in relation to sales—and that the efforts of businessmen to liquidate these surpluses cause a decline of orders and output that ushers in a recession. Contraction is then a period of inventory liquidation which eventually leaves businessmen short of stock. This induces them to increase orders and output, thereby setting in motion the forces of revival.

Lloyd Metzler's explanation of cyclical turning points also depends upon the behavior of inventory-sales ratios (see Ch. 1). He argues that a revival in sales catches businessmen unawares and causes inventory-sales ratios to fall. Purchases and production are, therefore, enlarged not merely by enough to satisfy increased sales, but by additional amounts in order to raise the inventory-sales ratio to the level desired. The expansion of incomes thus engendered causes further increases in sales which again stimulate output to satisfy current demand and to rebuild stocks. As long as inventory-sales ratios remain below the levels businessmen think profitable, the force of expansion continues, for output is successively increased in order to accumulate stocks. When inventory-sales ratios have been restored to desired levels, purchases and production fall because the demand for goods to add to stocks evaporates, and the processes of contraction begin. The decline in sales again catches businessmen by surprise and causes inventory-sales ratios to rise. The attempt to liquidate stocks furnishes the motive power for further contraction, which lasts until the ratios have been reduced to the desired level.

A test of these theories is, of course, plagued by lack of an objective standard by which to judge a surplus or deficit of stocks. The most natural and obvious standard is the ratio of inventories to sales or output. To adopt this standard assumes implicitly that in the absence of special factors, businessmen try to keep some constant ratio between stocks and sales or output. A relatively high ratio means a surplus of stocks except, say, when prices are expected to rise in the near future. A relatively low ratio means a deficit unless prices are expected to fall.

By this standard the theories just mentioned are clearly not valid for manufacturing industries if they are supposed to apply to total stocks. Manufacturing inventory-sales and inventory-output ratios relating aggregate stocks to aggregate sales or output are at or near their lowest levels when business cycles reach their peaks. They are at or near their highest levels when business cycles reach their troughs. These theories, therefore, are not in accord with the facts for manufacturing industries.

The implications of our observations for Metzler's theory may be stated in another way. If businessmen wish to keep a constant ratio between inventories and sales, Metzler's theory implies that the decline in the ratio caused by the initial rise in sales must be reversed before the end of an expansion. Similarly, the rise in the ratio caused by the initial decline in sales must be reversed before the end of a contraction. His theory assumes, therefore, that if a constant level of the inventory-sales ratio is desired, the actual ratio will vary inversely to business cycles with a lead sufficient to permit it to rise (fall) to normal levels before the peak (trough). Our observation about ratios in manufacturing industries, however, suggests that while they vary inversely, we cannot be sure that they tend to lead. If they do, the lead is short, and the levels of the ratios are typically well below normal at business peaks and well above at troughs.

The inventory-sales ratios that businessmen consider profitable may, of course, vary with the volume of business. If the desired ratios decline as sales increase, actual inventory-sales ratios may become too high before the peak in business even though they also decline with sales. But there is no way now of knowing whether

the desired ratios do decline with sales and, if so, whether they decline faster than the observed ratios.[9]

It may be claimed also that a change in price expectations near the peaks and troughs of business causes businessmen to regard their inventory holdings, relative to sales, as too high and too low, respectively. For example, the disappearance of bullish attitudes toward the end of expansion causes manufacturers to liquidate stocks. Similarly, the disappearance of bearish attitudes toward the end of contractions causes businessmen to desire to hold more goods. Such assertions may possibly prove valid, but they are not elements in the theories considered here, and we cannot test them.

There remains the possibility that some substantial part of manufacturers' inventories—stocks of purchased materials, for example—behaves according to the theory. As pointed out above, purchased materials may have a wider amplitude of fluctuation than sales or output. Hence, the ratios of purchased materials to output and sales may stand as high at business peaks as at troughs, or higher, even though the stocks of such goods tend to lag some months behind sales. Moreover, even if the ratio varies inversely when we consider cycles as a whole, it may rise markedly before the peaks of business and fall markedly before the troughs. We cannot exclude these possibilities, but there is no evidence now to support them.

[9] J. M. Clark outlines a set of considerations that lead him to opposite conclusions about the stocks businessmen like to hold per unit of sales. He expects the ratio between inventory 'required' and sales to rise during expansions and fall during contractions. His argument is directed to the situation of wholesalers and retailers, but much of it seems to be applicable to manufacturing. See *Journal of Political Economy*, March 1917.