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CHAPTER 4

METHODS OF EXTENDING DESCRIPTION AND UNDERSTANDING: THE SUBCYCLE

To progress further with the inquiry, it will be necessary to drop to a far deeper level of study than might have been possible had the mere sequence of events shown causal connections. We need to examine a wide variety of data not limited to the flow of goods and prices. We need to improve our ability to utilize these records for the purpose of observing and describing behavior. We need to study objectives, techniques, evaluations, and actions of businessmen; for only through such knowledge can useful hypotheses be formulated concerning the dynamics of interconnection among economic events.

Information on Business Decisions

The most obvious place to look for information on how a problem is viewed and how decisions are made is in the offices of the businessmen who view and decide. An assistant to the president of some ten companies for a period of about two years apiece, with time to attend executive conferences and to study statistical records, might talk with some assurance about how, in these firms, changes in sales were sensed, what response they elicited in production scheduling and buying, what part gross and net margins or anticipation of price change played in the vertical transmission of demand. But even had this phenomenal experience been achieved, it is unlikely that the ten cases would reveal a common denominator in objectives and method for widely diverse businesses and personalities. Consequently the analyst trying to learn how business procedures impinge on the problem he is studying must resort to makeshift methods. Here the makeshifts consist, in the main, of the running reports and comments of trade journals, numerous case studies collected at the Harvard Business School, and interviews with businessmen.

As to the interviews, it might seem that an hour or more spent discussing the oceanic area over which the problems float would be little more than useless. But in actual practice these interviews have a progressive pattern. The first ones drift, the purpose being to try to discover what are the things that, say, a shoe retailer looks at and for. We want to learn how changes in business tides are perceived and what responses are elicited. The businessman himself should show by his choice of subject whether it is sales, orders, prices, margins, profits, inventories, inventory-stock ratios, reports of salesmen, trade gossip, or all these things and others too that carry the news to executive offices. For, it is the proper *question* even more than the proper *answer* that must be learned from discussions in the field. After the questions have become clarified by learning how problems are sensed, structured, and attacked, after time series have been consulted to check and elaborate each new insight, and after the logic of the unfolding patterns has been worried through, the interviews start to focus on specific issues. Certainly they do tend to focus in this way; after a while people seem to be saying the same things; what they say gives order and meaning to the statistical evidence. At this point, the explorative discussions can come to an end.

Obviously, conversations of this sort serve a different purpose than do the questionnaire studies designed to assemble information from a carefully selected sample on a clearly conceived question applicable to a defined universe. In this study, discussions have been used primarily to determine, rather than to test, hypotheses.

Types of Time Series

Some 150 monthly series have been assembled. They deal with prices, deliveries, production, sales, stocks, and orders for shoes, leather, or hides; and with relationships among these data. They have all been corrected for seasonal patterns. Most of the statistics are not available prior to the end of 1920 and, because of the peculiar conditions existing during World War II, none have been studied after the close of 1941—the wish to terminate the study prohibited resumption of the analysis after 1945. Many of the series do not cover the entire period, short as it is.

The statistics cover the area between the appearance of raw hides on the market and the sale of finished shoes. But they cover it in different ways. First there

are, in effect, meter readings at nine stages in the continuous flow of goods from the beginning to the end of the process.[1] Secondly, were these data to apply to the same universe, they would automatically yield, by subtraction, eight other flow series—those referring to increases or decreases in stocks lying between two sequential input and outflow series. There are data of this sort for only some of the intervals; but even for the others, the derived information on hypothetical changes in stocks is instructive. Thirdly, records of the size of stocks that are at a given moment awaiting processing, in process, or awaiting sale at each of the various stages provide an important sort of information.

Time series may also describe other sorts of phenomena than the flow or stocks of goods at a selected point. We may be interested in the volume of goods for which bills had been issued, confirmed orders written, unofficial blanket orders placed, delivery instructions issued. In many ways, information of this sort may be more significant in helping to understand the process of demand transmission than time series dealing with the flow of goods. Unfortunately our supply of it is all too sparse.

Time series on stocks, on flows of goods, on changes in stocks, and on enabling instruments may be informative directly for what they tell of the economic processes with which they deal and indirectly for what they indicate about the foundation of business judgments concerning buying, producing, and selling. Other sorts of time series also serve the latter function. Most of our stock-sales ratios are of this type; first differences in sales have some of the same quality. Shoe, leather, and hide prices are important and fascinating members of the group.

Describing Typical Behavior

The testimony of time series is too rich for consumption in a raw state. Each historical event in the journal account of monthly business statistics cannot be treated as a separate universe. Explicitly or implicitly, typical behavior must be defined at least as a starting point from which to understand and organize the individual occurrence.

The National Bureau of Economic Research has developed a well-rounded scheme for describing typical behavior of individual activities during business cycles and the extent of its central tendency. The method likewise provides a shorthand description of how fluctuations designated as specific or reference cycles in each activity compare with one another. The comparisons include the timing of peaks and troughs, the amplitude of waves, and the shape of their banks.

Comparisons of the timing, amplitude, and shape of specific cycles in two or more activities provide, in effect, a study of the correlation between them. But the comparisons are limited to those relatively few occasions when matching specific-cycle peaks or troughs appear. Simple or multiple correlation by fitting equations achieves comparisons at regular intervals. But when the intervals are years, the picture is too coarse for our purposes; when they are months, the labor involved is excessive except when a clear hypothesis has been developed implying regular quantitative relationships without substantial variation in timing associations (variable leads and lags). For the large amount of experimentation required to develop the hypothesis, multiple correlation of monthly data is totally unsuited. It would be highly desirable, then, to obtain more points at which one could catch hold of the slippery back of a time series than are provided by specific- or reference-cycle turning points, at the same time that less labor and more flexibility are achieved than inevitably attach to correlation by equation fitting.

Study of the three charts in the previous chapter (1, 2, and 3) suggests a way. They reveal the presence of movements distinctly shorter in duration and also slighter in intensity than those designated specific cycles, which nevertheless seem to be found in many of the series at about the same time. Note, for example, the small fluctuation in the course of the contraction between 1923 and 1924 and, in the course of the expansion between 1924 and 1926, the reversal or retardation of the long depression toward the end of 1930, the double bottom in 1932, the sharp rise and subsequent fall in 1933, another one in the following year, and so on.

The presence of these minor waves raises two compelling questions concerning possible lines of study. First, are they found in most of our series? If so, they may help in the study of correlation among activities in the industry. Once identified independently for each series, a comparison of their incidence in various activities would enrich comparison based on cycles alone. Second, do they exist at about the same time in a considerable variety of activities? If so, their presence needs to be explained. The need would both afford a guide for, and impose restrictions on, an explanation of the cyclical process within the shoe, leather, hide sequence. An endeavor to answer these questions required two preliminary steps.

[1] The stages, many of which have been obtained by using information on stocks, are: hide movement into sight, deliveries of cattle hide to tanners, cattle-hide wettings, cattle-hide production, deliveries of leather to dealers and leather-goods manufacturers, shoe production, shoe sales by wholesalers, receipts of shoes by department stores, and retail sales of shoes.

Identifying Subcycles

First, each time series was examined for the presence of minor waves. Specific "subcycles" consist of waves bounded by *either* specific-cycle turns *or* minor specific peaks or troughs. Next, an industry chronology was constructed for subcycles and cycles.

MARKING SPECIFIC SUBCYCLES

For each series, specific-cycle turning dates were marked in accordance with the usual procedure followed by the National Bureau. In addition, the data were examined for the presence of lesser movements too slight to fall within "the lower limit of the range of amplitudes of all fluctuations that we class confidently as specific cycles," or too short to be considered "of the same order of duration as business cycles," [2] yet too long or too steep to be judged a run of random movements. Occasionally, these movements are characterized by merely a retardation of the predominant movement instead of by a rise and fall. To warrant inclusion as a subcycle, such retardation must consist of a virtually horizontal area on a rising or falling bank rather than of a mere lessening of the rate of rise or fall. No subcycles were included whose peaks were less than five months from the previous or following peak, and the same rule held for troughs. After these specific subcycles were identified, peaks or troughs were marked according to the same principles as those used in dating specific cycles. *The peaks and troughs marked as specific-cycle turning points and those marked as the turning points of minor waves together constitute the specific-subcycle turns for the activity in question.*

This method of identifying specific subcycles is subjective. Also, there is no way of proving in any particular instance that the specific subcycle identified is not merely a manifestation of the autoregressive characteristics of time series. To minimize the difficulties, however, certain precautions were taken: subcycles were marked independently in each series, with the time chronology on the chart hidden so that the year to which the data applied was not known; fluctuations that are primarily the result of a few very high or low months were excluded since only movements showing a fairly persistent upward or downward progression (or leveling of a previous movement) or a clear difference in level for several months in the neighborhood of peaks and troughs were marked.

NEED FOR A REFERENCE FRAME

After specific subcycles have been marked independently for two activities, comparison between the two series with respect to subcyclical contours and timing can be very instructive. It helps to uncover differences in the typical duration of a fluctuation; it indicates whether waves occur contemporaneously most of the time, whether there are characteristic leads or lags, whether one series tends to rise and fall more than the other. Information of this sort for subcycles augments the sparse observations based on cyclical behavior and promises aid in uncovering dynamic relationships.

But particularly in the early stages of an investigation, it is exceedingly valuable to collect information in a flexible form, one that permits rapid and easy comparison among a wide variety of data. For this purpose, it is convenient to describe the characteristics of all activities with respect to some common frame of reference rather than to commit description to particular comparisons. When such particular comparison between two series is desirable, it can be made through the intermediary of the reference frame with only slight loss of accuracy. A reference chronology of some sort provides the required frame.

Any set of dates having about the correct periodicity would facilitate interseries comparisons. But a reference chronology can serve an additional purpose when its dates have meaning of their own. Such meaning will be present if subcycles are actually a valid species of fluctuation. One cannot tell at this stage of the investigation whether they are a real and significant phenomenon in the shoe, leather, hide sequence. However, specific subcycles are found to occur at about the same time in a wide variety of activities in the industry. Also, explanations for them emerge in what businessmen tell of their objectives, problems, and procedures. Certainly, therefore, it is provident to build a reference chronology with the care necessary to serve a double purpose—that of providing a flexible comparison among individual activities and of describing fluctuations that may prove to be economic phenomena of some interest. Accordingly, a reference frame for the industry was constructed; it aims to catch the central tendency of fluctuation in major activities in the manufacture and distribution of shoes, leather, and hides. The following description of how the chronology was arrived at is necessarily technical and may well be glossed over by those who are more interested in findings than in method.

The Shoe, Leather, Hide Reference Chronology

Twenty-two of the more important time series in the shoe, leather, hide group were selected for study. They were chosen as the most dependable and representative ones available. Various sorts of data were

[2] Arthur F. Burns and Wesley C. Mitchell, *Measuring Business Cycles*, National Bureau of Economic Research, 1946, pp. 58 and 57, respectively.

included—sales, production, deliveries, prices, stocks, stock-sales ratios—relating to all stages of the industry sequence; series that showed in advance little tendency to move with the industry or business tide were excluded.[3] For each series, specific subcycles were selected. Study of these specific subcycles reveals considerable concurrence in the minor as well as major movements in many of the series; and this similarity could be formalized in a shoe, leather, hide (SLH) subcycle reference chronology.

First, periods were located in which most of the twenty-two series underwent specific-subcycle movements. Then, in each of these time spans a reference peak or trough was selected which fell more or less in the center of the cluster of specific-subcycle turns. The reference date was chosen so that in most cases the sum of the leads and lags of the specific-subcycle turns for all of the twenty-two test series associated with a given reference turn was as close to zero as was consistent with selecting a month well toward the center of the scatter.[4]

The next step involved a final decision as to which movements to include and which to exclude. Only those in which there was quite general participation should enter the chronology. But since participation is a matter of degree, the decision requires, in effect, locating the marginal inclusion. To obtain an objective criterion, we calculated the conformity [5] of each of the test series to each of the tentatively selected reference phases and summarized by reference phases. This led to the exclusion of two tentatively selected movements.[6] Those finally admitted to the chronology are listed in Table 8. A glance down the columns shows which movements represent the marginal inclusions. The contraction from December 1926 to October 1927 is a case in point; the trough date was a troublesome one to locate. The movement was included partly because a contraction in business as a whole has been recognized at about that time. Its impact on the leather industry was damped by the strong rise in hide prices that began late in 1926 and lasted for almost two years. Another borderline case was the short recession in early 1936. Finally, a trough not included in the table was tentatively selected in January 1921; the small number of series then available prevented a firm decision.

The table shows that the average conformity index for all the phases was 83. This is approximately equivalent to a percentage conformity of 91, which means that, on the average, a series failed to conform to between two and three of the twenty-seven phases. In order to make sure that this reasonably high conformity is not simply a function of the tendency of the leather industry to fluctuate in consonance with business cycles, the conformity was calculated only for those subcycle phases that interrupt major movements (marked with asterisks). The average conformity index is only slightly lower for these phases than for the others (last two lines). There is, as might be expected, a wide variation among series in their average conformity. Seven of the test series—those involving shoe and leather production of some sort—had indexes of +100, whereas retail sales and movement of hides into sight had the lowest conformity index, +62. Conformity can, of course, be much lower still: for retail shoe prices, for example, it is +14 after adjustment for the lag.

At this stage of the analysis it is obviously necessary to build into the technique for increasing comparisons a method for distinguishing between characteristic behavior at major and that at minor turns. For we cannot rule out the possibility that the character of the association between many activities would differ between times when major reversals of business trends were in process and when they were not. To allow for this flexibility, a SLH-*cycle* chronology was designated according to principles identical to those used in selecting the dates for the SLH-*subcycle* chronology. Using the National Bureau's standards for locating specific cycles, the periods during which they occurred in most of the test series were located and the SLH-subcycle reference date already selected for that period was chosen as the SLH-cycle reference date. These reference-cycle dates are in italics in the stubs of Table 8.

For the most part, in this group of industries the waves of activity of the same order as business cycles took place at the same time as cycles did in general business. The dates for both chronologies are given in Table 9. The one exception was the short recession between 1926 and 1927, which in the shoe, leather, hide industry was too weak to be called a major movement, though it does appear as a minor one—a marginal minor one. However, only two turning dates for the SLH reference *cycles* are identical to the dates for the nine business-cycle reference peaks or troughs between 1921 and 1938; in four cases they lead, and in one they lag.

[3] See Table 8, note b, for list of series. They are each described in Appendix B.

[4] The objective of minimizing the aggregate lead or lag and that of keeping in the center of the array were typically not contradictory. Only in the cases when a few series had an exceptionally long lead or lag was it necessary to emphasize the second criterion at the expense of the first, thus, in effect, reducing the weight assigned to series for which the lead or lag was abnormally long.

[5] See notes to Table 8.

[6] A brief expansion had been tentatively selected with a trough in October 1931 and a peak in March 1932; also a brief contraction with a peak in February 1935 and a trough in July 1935.

TABLE 8

Conformity of Twenty-two Test Series to Each Phase of the SLH-Subcycle Reference Chronology, 1923–1940

SLH-SUBCYCLE REFERENCE CHRONOLOGY [a]						TEST SERIES [b] CONFORMING [c] TO REFERENCE PHASE			
Reference Date									Adjusted
Trough		Peak		Trough		Contraction or Expansion	Phase Duration (months)	Unadjusted % of Total	% of Total	Conformity Index
		May	*1923*	Oct.	1923	C	5	94	100	+100
Oct.	1923 *	Feb.	1924 *			E	4	62	91	+81
		Feb.	1924	*July*	*1924*	C	5	75	88	+75
July	1924	Feb.	1925			E	7	88	94	+88
		Feb.	1925 *	Mar.	1926 *	C	13	88	94	+88
Mar.	1926	Dec.	1926			E	9	77	79	+57
		Dec.	1926 *	Oct.	1927 *	C	10	45	82	+64
Oct.	1927	Feb.	1928			E	4	91	93	+86
		Feb.	1928 *	Feb.	1929 *	C	12	68	89	+77
Feb.	1929	*Sept.*	*1929*			E	7	82	93	+86
		Sept.	1929	Dec.	1930	C	15	100	95	+91
Dec.	1930 *	July	1931 *			E	7	73	91	+82
		July	1931	*July*	*1932*	C	12	100	95	+91
July	1932	Nov.	1932			E	4	82	91	+84
		Nov.	1932 *	Mar.	1933 *	C	4	68	91	+84
Mar.	1933	July	1933			E	4	100	98	+95
		July	1933 *	Nov.	1933 *	C	4	82	95	+91
Nov.	1933	May	1934			E	6	68	93	+86
		May	1934 *	Sept.	1934 *	C	4	86	91	+82
Sept.	1934	Dec.	1935			E	15	91	86	+73
		Dec.	1935 *	June	1936 *	C	6	64	80	+59
June	1936	Apr.	1937			E	10	95	89	+77
		Apr.	*1937*	*Feb.*	*1938*	C	10	100	100	+100
Feb.	1938	Jan.	1939			E	11	77	91	+84
		Jan.	1939 *	May	1939 *	C	4	64	86	+75
May	1939	Dec.	1939			E	7	86	95	+91
		Dec.	1939 *	Apr.	1940 *	C	4	91	100	+100
Averages:										
All twenty-seven phases							7.5			+83
All contractions							7.7			+84
All expansions							7.3			+82
Countercycle subcycle phases *							6.5			+80
Other phases							8.2			+85

* Italics indicate SLH-cycle (as distinguished from SLH-subcycle) reference dates; countercycle subcycle phases (subcycle expansions during reference-cycle contractions and vice versa) are marked by an asterisk.

[a] The method of choice of the SLH-subcycle reference chronology is described in this chapter and in Appendix A, sec. 8.

[b] The twenty-two test series are: retail shoe sales, dollars (31), pairs (33); chain-store shoe sales (30); department-store shoe sales (27); index of factory payrolls, boots and shoes (128); production of women's shoes (43); production of men's shoes (44); total shoe production (39); domestic consumption of cattle hides (45); shipments of all cattle-hide leathers (89); cattle-hide leather production (64); receipts of raw cattle hides by tanners (103); total cattle-hide movement into sight (94); cattle hides from uninspected slaughter (93); net imports of raw cattle hides (105); department-store shoe stocks (49); cattle hide and leather stock awaiting sale (117); cattle hide and leather stock awaiting processing (116); sales-stock ratio for shoe departments of department stores (55); turnover rates of finished stock of hides and leather (122); wholesale price of Chicago packer hides (21); and wholesale price of sole leather (17).

[c] A series is said to conform to the reference phase when it rises between the initial and terminal reference dates of an expansion or falls during a contraction. The "adjusted" measures take into account the characteristics of each series with respect to timing and trend; they (1) allow for a specified systematic lead or lag relative to the reference chronology and (2) count retardations in a rise as a fall and vice versa. The percentage figures measure the proportion of all phases conforming in one of these senses. The conformity index is obtained by rating conforming phases as +100, nonconforming phases as −100, and no movement as zero, summing and dividing by the number of phases (see Appendix A, secs. 12 and 13).

TABLE 9

Comparison of SLH-Cycle and Business-Cycle Reference Chronologies, 1921–1938

	Business Cycle [a]	*SLH Cycle* [b]	*SLH-Cycle Leads (−) or Lags (+) (months)*
Trough	July 1921	Jan. 1921 [c]	−6
Peak	May 1923	May 1923	0
Trough	July 1924	July 1924	0
Peak	Oct. 1926	[d]	
Trough	Nov. 1927	[e]	
Peak	June 1929	Sept. 1929	+3
Trough	Mar. 1933	July 1932	−8
Peak	May 1937	Apr. 1937	−1
Trough	June 1938	Feb. 1938	−4

[a] Turns are those in the National Bureau of Economic Research business-cycle reference chronology.

[b] The method of choice of the SLH-cycle reference chronology is described in this chapter and in Appendix A, sec. 9.

[c] Tentative.

[d] The comparable turn was a minor one, the subcycle peak of December 1926.

[e] The comparable turn was a minor one, the subcycle trough of October 1927.

Subcycles in the Flow of Shoes, Leather, and Hides

In Charts 4, 5, and 6, specific subcycles have been marked for physical and dollar measures of output and prices at each of the five stages of the shoe, leather, hide industry. The SLH-subcycle reference chronology constitutes the vertical grid; it is schematized by the triangles next to the top. The pattern at the very top depicts the SLH-cycle reference chronology.

Table 10 shows how the timing relationships among the five series change, first, when a shift is made from the *business-cycle* to the *SLH-cycle* reference frame, and, second, when the smaller movements are included and thus the *SLH-subcycle* reference chronology is adopted. The average cycle timing is given, first based on the business-cycle and then on the SLH-cycle reference chronology. Since the turning dates for the SLH-cycle reference chronology most frequently lead the business-cycle dates (a characteristic of turns in the five activities themselves), the five series—whether given in physical units or dollars—must lead by smaller amounts or lag by longer intervals when related to the SLH- rather than to the business-cycle chronology. The difference in the sequence when the activities are converted from physical to dollar units is once more apparent.

Turning to subcycles of which there are a considerable number, Table 10 shows that the rank order for the physical measures is virtually the same as for the few observations for cycles. But the extent of the average lead or lag, except for wholesale sales, is less for subcycles; indeed, these figures may be read as indicating turns virtually synchronous with the SLH-subcycle chronology, except in the case of wholesale sales. The frequency distributions given in the table support this view, since less than half of the matched turns share the sign of the average timing. Only in the case of wholesale sales is there a heavy predominance of leads—20 out of the 24 matched turns—to support the average lead of two months. In general, the subcycle timing measures reinforce the judgment arrived at by studying the individual specific-cycle turns: the wholesale stage is the only point in the sequence where a sound basis exists for pronouncing the timing other than synchronous.

The sequence of the dollar figures at subcycle turns is roughly similar to that of the physical volume series and differs substantially from the cycle timing for dollar measures. Study of Charts 4 and 5 suggests why. Compared with the physical flow of goods, the four price series depicted in Chart 6 are far more sharply affected by major than by minor movements. Indeed, shoe prices do not conform at all to many of the minor movements in the reference scheme. Further, major peaks or troughs in prices sometimes occur at a different time than does the corresponding major peak or trough in the physical flow of goods, though they are likely to occur close to a minor movement in these series—note, for example, the peak in hide prices early in 1928, the troughs in shoe and leather prices in 1933. Consequently, when physical volume data for the five stages are multiplied by the relevant price series, the location of the major turns in the resultant measures is more likely to be seriously affected than the location of the minor movements. In general, the direction of difference between the major and minor turns reflects the characteristics of the relevant prices. Because retail prices lag, major turns lag minor ones in dollar retail sales; because hide prices lead, major turns lead minor ones for the value of movement of hides into sight.

In subsequent discussions, specific subcycles in various activities are often compared with one another rather than with the reference chronology. However, the measuring of timing and amplitude characteristics against the SLH reference frame for each series has been the backbone of the preliminary work when comparisons required constant shuffling and reshuffling. Appendix C presents some of these basic measures for most of the more important data that have been used. These comparisons against a single frame also provide a summary view of the industry upon which the two final chapters rely heavily.

TABLE 10

Timing of Specific-Subcycle Turns at Five Stages Related to Three Reference Chronologies, 1921–1940

	BUSINESS-CYCLE CHRONOLOGY: SIX TURNS ONLY [a]		SLH-CYCLE CHRONOLOGY: SIX TURNS ONLY [b]		SLH-SUBCYCLE CHRONOLOGY: ALL TURNS [c]								
								Number of Matched Specific Turns					
									Leading		Syn-	Lagging	
	Mean Lead (−) or Lag (+)		Mean Lead (−) or Lag (+)		Mean Lead (−) or Lag (+)		Number of Reference		Over	1 or	chro-	1 or	Over
	Months	Rank	Months	Rank	Months	Rank	Turns	Total	2 Mos.	2 Mos.	nous	2 Mos.	2 Mos.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
In physical units:													
Retail shoe sales (33)	−1.5 [d]	5	+1.0 [d]	4.5	+0.3	4	23	21	1	5	5	8	2
Wholesale shoe sales (35)	−4.8	1	−2.2	1	−2.0	1	28	24	7	13	2	2	0
Shoe production (39)	−3.8	2	−1.2	2	−0.3	2	28	26	2	8	11	4	1
Leather production (64)	−2.5	3	+0.2	3	+0.2	3	28	28	1	7	9	10	1
Hide movement into sight (94)	−1.7	4	+1.0	4.5	+0.4	5	28	23	2	3	7	7	4
In dollars:													
Retail shoe sales (31)	−1.2 [d]	5	+3.8 [d]	5	+0.5	4	23	19	2	2	7	5	3
Wholesale shoe sales (34)	−5.4 [e]	2	−5.7	1	−1.1	1	28	24	6	10	3	4	1
Shoe production (41)	−2.8	4	−0.2	4	−0.2	2	28	24	2	6	8	8	0
Leather production (65)	−4.2	3	−1.5	3	+0.7	5	28	26	0	6	10	7	3
Hide movement into sight (95)	−5.8	1	−3.2	2	+0.1	3	28	26	3	8	4	8	3
Prices:													
Shoes, retail (9)	+3.2 [d]	3	+5.8 [d]	3	+5.1	4	23	9	0	0	0	3	6
Shoes, factory (2)	+4.3	4	+7.0	4	+4.4	3	28	16	1	0	1	3	11
Leather (19)	−0.8 [f]	2	+1.8 [f]	2	+0.7	2	28	23	1	6	3	8	5
Hides (22)	−5.2	1	−2.5	1	+0.1	1	28	26	2	10	3	8	3

[a] The six turns in the National Bureau of Economic Research business-cycle reference chronology included are the peaks that fall in 1923, 1929, and 1937, and the troughs that fall in 1921, 1933, and 1938; those excluded are the troughs in 1924 and 1927 and the peak in 1926, since their inclusion would detract from the reliability of the averages, as indicated previously in Chapter 3. The specific turns included are those considered related to the reference chronology under the standard rules (see Appendix A, sec. 10b).

[b] The dates of the SLH-cycle reference chronology are given in Table 9; the July 1924 turn was excluded because its inclusion would detract from the reliability of the averages, as in the case of the three business-cycle turns excluded (see note a). The specific turns included are those considered related under rules identical to those followed for relating to business-cycle turns (see Appendix A, sec. 10b).

[c] The dates of the SLH-subcycle reference chronology are given in Table 8. The number of turns included for each series (column 7) depends on the date when a series of turns begins. The specific turns included are those considered related to the subcycle chronology; they are shown in Charts 4, 5, and 6. The method of relating is described in this chapter and in Appendix A, sec. 10b; see, however, notes to Charts 4 and 5 for an exception in the case of a trough in retail sales in 1928. Comparisons cover reference turns 1923 through 1940.

[d] Four turns only, 1929–1938, since the data are available only from 1926.

[e] Five turns only, since there is no specific turn related to the June 1929 reference turn.

[f] Four turns only, since there are no specific turns related to the July 1921 and May 1923 business-cycle reference turns or to the January 1921 and May 1923 SLH-cycle reference turns.

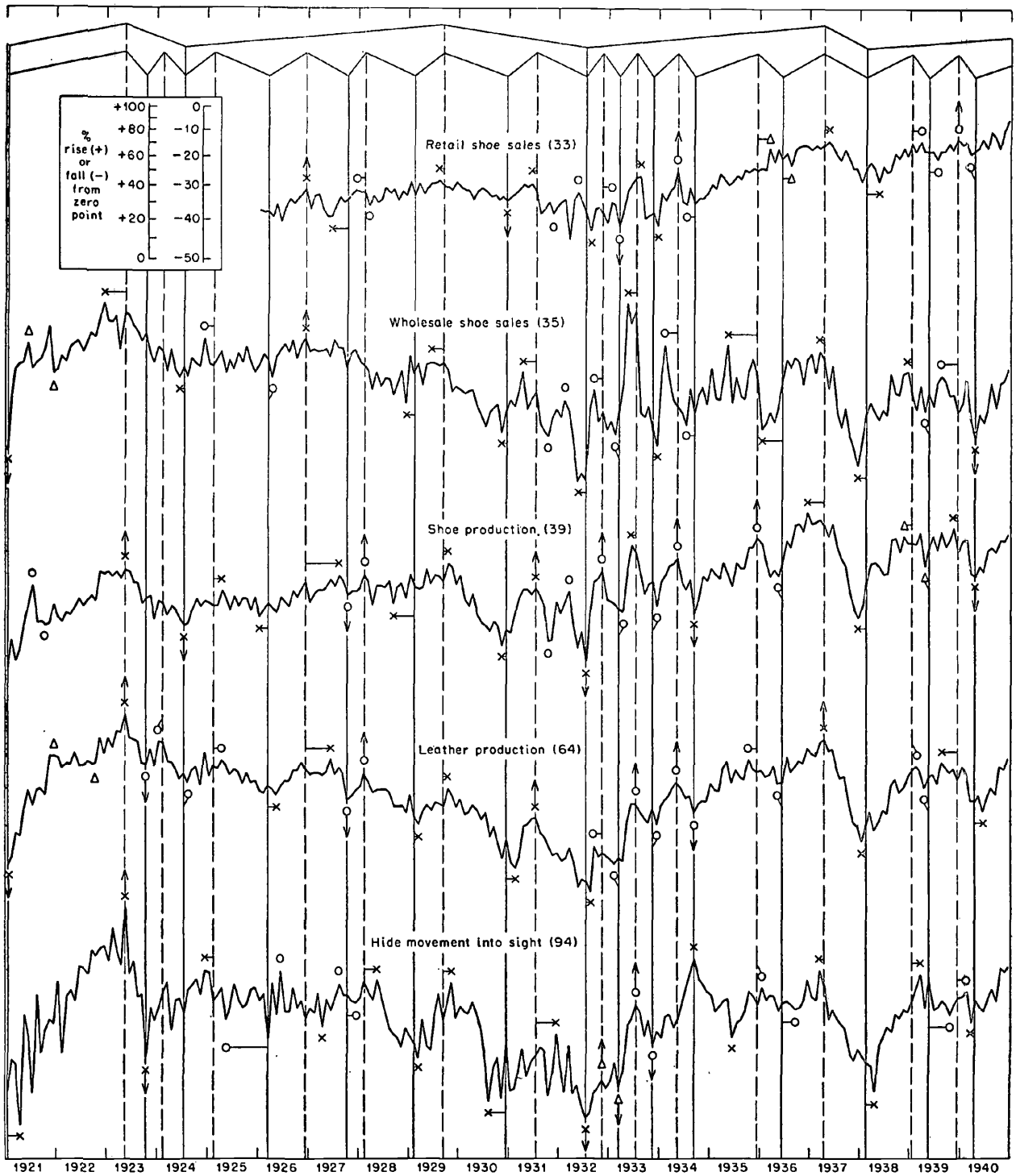
Subcycles Elsewhere

These observations provoke curiosity about possible differences in the dynamics of major and minor waves. One might hope to gain insight through a study of this kind on whether there are such differences. To anticipate, the investigation has suggested that the minor movements are less critically associated than the major ones with strong increases or decreases in consumer buying, though, significantly, changes during minor waves (sometimes merely changes in the rate of change) do exist. On the other hand, the minor waves are strongly linked to procedures that affect inventories on hand and on order. Indeed, inventory investment often plays almost as strong a part in absolute terms in the minor as in the major waves. The inclusion of inventories on order would accentuate the role of stock. The source of these fluctuations in inventories on hand and on order is highly complex, and differs at various stages of the vertical sequence; but the factors that seem to govern them in the shoe, leather, hide industry are by no means peculiar to it. On the contrary, one would expect to find them in many if not most business environments.

Does this mean that short cycles of the sort found in shoes and leather are also found elsewhere? To answer this question adequately, a new investigation would be required. Here I simply present a few measures of the conformity of data for other industries to subcycles in the shoe, leather, hide industry. In Table 11 the subcycle chronology devised for this industry provides the frame of reference. Gauged against this

CHART 4

Specific Subcycles in Output Measured in Physical Units, at Five Stages, 1921–1940



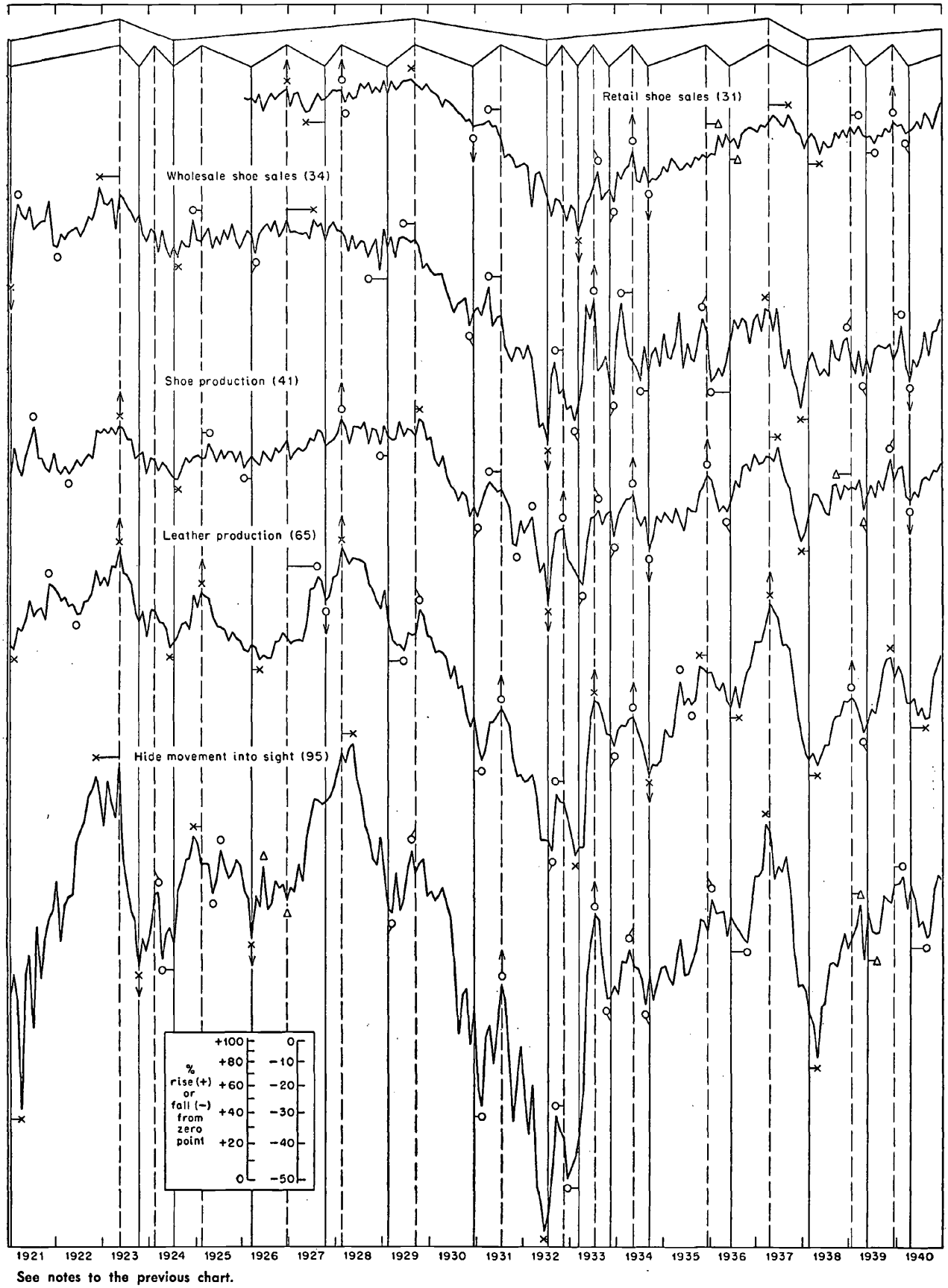
Peaks and troughs in the *SLH-subcycle* reference chronology are shown by broken and solid vertical lines. The two diagrams at the top of the chart differentiate the SLH-cycle from the SLH-subcycle reference turns.

Specific-cycle turns are marked by ×, specific-subcycle turns by O, and retardations by △. When a specific turn is matched with a reference turn, a horizontal line or vertical arrow indicates the association. The trough in retail sales in March 1928 was not related to the reference trough eleven months later since the rules seemed to yield an arbitrary result in this case.

Parenthetic figures after names of series identify their descriptions in Appendix B. "Leather production" refers here as elsewhere to the production of cattle-hide leather only.

CHART 5

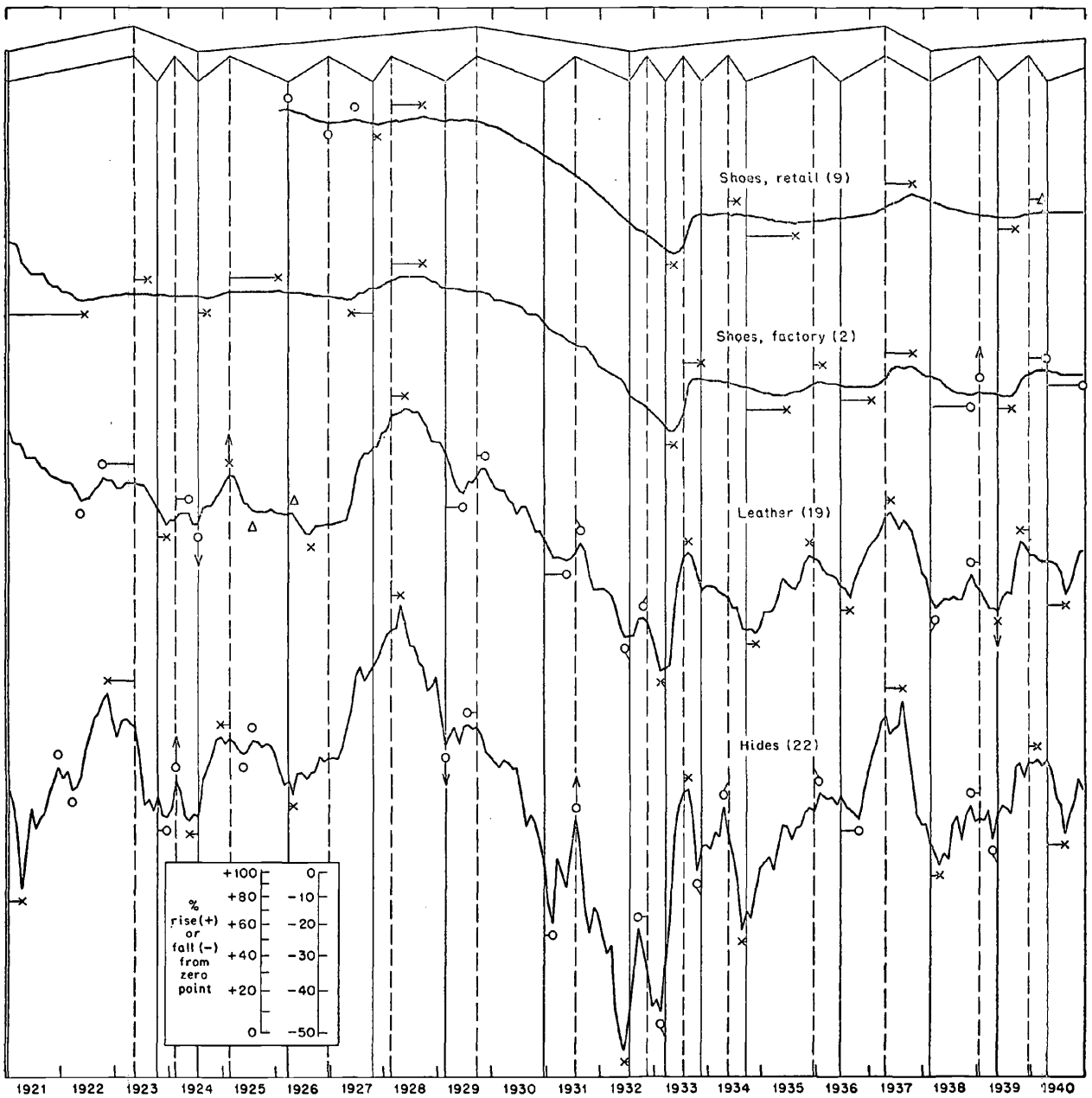
Specific Subcycles in Output Measured in Dollars, at Five Stages, 1921–1940



See notes to the previous chart.

CHART 6

Specific Subcycles in Shoe, Leather, and Hide Prices, 1921–1940



Peaks and troughs in the *SLH-subcycle* reference chronology are shown by broken and solid vertical lines. The two diagrams at the top of the chart differentiate the SLH-cycle from the SLH-subcycle reference turns.
Specific-cycle turns are marked by ×, specific-subcycle turns by O, and retardations by △. When a specific turn is matched with a reference turn, a horizontal line or vertical arrow indicates the association.
Parenthetic figures after names of series identify their descriptions in Appendix B. "Leather price" refers here as elsewhere to the price of cattle-hide leather only.

ill-suited chronology, many very broadly based series show quite a high conformity index, including activities associated with producers' goods (the Federal Reserve Bank of New York's index of production of producers' goods and indexes of slab zinc shipments and steel ingot production) as well as consumers' goods. The table shows also that two of the subcycles found in the shoe, leather, hide sequence—the ones with a peak in February 1928 and a peak in December 1935—tend to be particularly unrepresentative of industry at

TABLE 11
Conformity of Twenty-five Selected Activities to the SLH-Subcycle Chronology, 1923–1941

	CONFORMITY INDEX [a]	
	All Subcycles	*All but Two Subcycles* [b]
Personal income payments (Commerce) [c]	+53	+71
First differences in income payments [d]	+75	+71
Total factory payrolls (index, BLS)	+62	+82
First differences in factory payrolls [d]	+92	+100
Total factory employment (index, BLS)	+77	+91
Department-store sales (index, FRB)	+62	+91
Distribution to consumer (index, FRB-NY) [e]	+62	+91
First differences in department-store stocks [f]	+50	+95
Consumers' goods production (index, FRB-NY)	+85	+91
Physical volume of business activity (index, Babson)	+77	+91
Bank debits outside New York City	+62	+73
Revenue-freight ton miles, Class I railroads (ICC)	+77	+100
Industrial production (index, FRB)	+77	+91
Durable manufactures production (index, FRB)	+69	+91
Nondurable manufactures production (index, FRB)	+77	+100
Producers' goods production (index, FRB-NY)	+77	+91
Metal products production	+69	+91
Steel ingot production [g]	+76	+100
Slab zinc shipments	+85	+91
Textile production (index, FRB)	+77	+91
Automobile tire inner tube production	+38	+64
Common-stock prices (index, Standard and Poor's)	+62	+82
Wholesale price of finished products (index, BLS)	+31	+27
Wholesale price of semimanufactured goods (index, BLS)	+77	+82
Wholesale price of raw materials (index, BLS)	+46	+45

[a] The conformity indexes were adjusted for timing and trend (see Table 8, note c).

[b] Two SLH cycles were excluded: one with a trough in October 1927, a peak in February 1928, and a trough in February 1929; the other with a trough in September 1934, a peak in December 1935, and a trough in June 1936.

[c] This series does not begin until 1929, hence only eighteen reference-subcycle phases are covered.

[d] Centered five-month averages were used; they were adjusted for a lead of two months.

[e] This series ends in the middle of 1939, hence only twenty-five reference-subcycle phases are covered.

[f] Constructed from an FRB series deflated for change in price. The data are centered five-month averages of month-to-month change in stocks.

[g] This series ends December 1939, hence only twenty-six reference-subcycle phases are covered.

Source: The following abbreviations have been used: Babson (Business Statistics Organization, formerly Babson Statistical Organization), BLS (Bureau of Labor Statistics), Commerce (Dept. of Commerce), FRB (Board of Governors of the Federal Reserve System), FRB-NY (Federal Reserve Bank of New York), and ICC (Interstate Commerce Commission). The series not specifically identified are standard series from a variety of sources in the National Bureau of Economic Research files on which seasonal adjustments and sometimes other sorts of operations have been performed.

large. Omitting them, indexes of over 90 appear for about two-thirds of the series. First differences tend to show higher conformity than the data themselves; this observation reappears constantly in our work.

Because of the interesting role that hide prices appear to play both as mirror and instigator of subcyclical fluctuation in the shoe, leather, hide sequence, Table 12 shows the conformity of a few other prices to specific subcycles marked for hide prices. Here again, greater conformity is shown by rates of change than by prices proper. In general, the data certainly do not exclude the possibility that subcycles may be present for a wide variety of activities, or that they may frequently occur at about the same time.

TABLE 12
Conformity of Six Price Series to Specific Subcycles in Hide Prices, 1923–1940

	COMPARISONS FOR PRICES PROPER [a]		COMPARISONS FOR FIRST DIFFERENCES IN PRICES [a]	
	Timing Adjustment (months)	*Conformity Index* [b]	*Timing Adjustment (months)*	*Conformity Index* [b]
Stock market, industrials	0	+75	0	+88
Steel scrap	0	+83	0	+94
Slab zinc	0	+67	0	+75
Crude rubber	0	+50	−1	+56
Nonagricultural commodities, wholesale	+2	+17	+2	+81
Industrial commodities	+2	+50	+1	+81

[a] The reference frame to which conformity is measured is provided by specific subcycles marked in hide prices—in prices proper (columns 1 and 2, 25 phases) and in first differences in prices, smoothed by a centered five-month average (columns 3 and 4, 33 phases).

[b] The conformity indexes were adjusted for timing and trend (see description of the computation in Table 8, note c).

Source: Hide prices are series 22 in Appendix B; the other series were obtained as follows: stock market, industrials—a National Bureau of Economic Research average of the Dow-Jones Company high and low average prices for 20–30 common stock issues; steel scrap, slab zinc, and nonagricultural commodities, wholesale—Bureau of Labor Statistics; and industrial commodities—Business Statistics Organization, formerly Babson Statistical Organization.

These speculations are hard to resist, but they are for the moment quite beside the point. Whether or not the minor movements prove of some general interest, they do seem to be widely diffused in the shoe, leather, hide industry. Their inclusion in this study serves the double purpose of facilitating the examination of the correlation and typical timing associations among individual activities, and of uncovering a basic process that needs to be described and explained.

The Puzzle and the Plan of Attack

The five major time series studied in the previous chapter, to which we have briefly returned here, pre-

sent an enigma. Although it may take, on the average, over a year for cattle hide to move from the backs of cattle to the feet of man, although discretionary differences in the timing of production schedules at the several stages are possible, although these schedules are usually made out by different people acting independently, peaks and troughs in the physical flow of goods tend to occur together at four of the five stages. (The wholesale stage anticipates the rest.)

The chapters that follow deal with this problem at the deeper level that it requires. For the most part, a stage includes the operations of one set of enterprises such as retailers, manufacturers, tanners, or providers of raw hides. Theoretically it covers these operations from the sale of the product to the purchase of the basic "raw" material.

This structure is fundamental and embodies an important finding. Though the major vertical steps in the industry appear to reach peaks and troughs at about the same time, orders lead by several months. The reader may be surprised to learn that he has already observed this fact in a disguised form. It is the key to the mysterious lead of wholesale sales, for sales by wholesalers resemble orders in several respects. The lead appears again in shipments of hides and of leather, because here too some of the characteristics of orders adhere to the activity. It appears, of course, in the one series available on actual orders, which applies to shoes and leather combined.

We are challenged, then, to explain the lead in orders and why it changes so little from stage to stage. We need to understand the relation between orders received, production, and orders placed. Consequently analysis ought to be bounded for each stage by orders received and placed; in practice, however, it is usually necessary to include either too much or too little. In any event, interrelationships and their explanations seem essentially different at each of the major stages as they are studied one by one.