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Volume Title: Consumption and Business Fluctuations: A Case Study of the Shoe, Leather, Hide Sequence

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Volume Publisher: NBER

Volume ISBN: 0-870-14090-6

Volume URL: <http://www.nber.org/books/mack56-1>

Publication Date: 1956

Chapter Title: Fluctuations in Tanners' Output and Hide Buying

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Chapter URL: <http://www.nber.org/chapters/c4808>

Chapter pages in book: (p. 175 - 201)

CHAPTER 13

FLUCTUATIONS IN TANNERS' OUTPUT AND HIDE BUYING

Cattle-hide tanners sell most finished cattle-hide leathers directly to manufacturers of leather goods (chiefly shoe manufacturers) and buy their primary raw material—cattle or kip hides—from packers or hide dealers. We are concerned here as elsewhere with the relation between this selling and buying.

At first thought, it might seem that the pattern of tanners' purchases must follow, over time, the smooth pattern of meat packing. For, hides are primarily a by-product of the meat industry and, indirectly, of the milk industry. Slaughter of cattle for meat is not highly responsive to changes in the incomes of consumers or to other factors that parallel cyclical fluctuations in business.

But in reality, only a portion of the hides reaching the central markets of the country—no more than two-thirds on the average during the period of this study¹—are by-products in the full sense of the word; and even for this portion, total supply and tanners' buying are by no means identical in the short run. The rest of the supply moves to tanneries from back country or abroad only when conditions are propitious. How this word must be defined we shall learn in the next chapter; clearly the price mechanism is a critical element.

The important point at the moment is that it is not possible to arrive at an a priori conclusion concerning how the characteristic fluctuation in tanners' sales of leather will be passed back to hide dealers or packers in the form of purchases of hides. Instead, we must study the objectives and conditions in the tanning industry that determine the volume of hides bought and its association with the volume sold in the form of leather.

In endeavoring to do so, we have the usual kit of tools, though in different supply. The literature offers substantial aid.² Time series are far more profuse than for retailing or shoe manufacturing; we have records of both the completion and the commencement of

¹ Federally inspected slaughter was 52 per cent of the total, and I assume that somewhat under a half of "country hides," which averaged 34 per cent of the total supply, came from packing plants which, though they could be quite large and in many respects like the federally inspected group, did not ship across state lines.

² The physical operation of tanneries is described in a number of good books. Also there is one very full source book of information on diverse aspects of the industry: Merrill A. Watson, *Economics of Cattlehide Leather Tanning*, Rumpf, 1950.

production as well as of receipts of raw hides and shipments of finished leather. Data on the three intervening stock piles are also available for all cattle-hide leathers and for upper and sole leather separately.

The third sort of information on which I have ordinarily relied—personal interviews—has at this stage proved much less helpful than usual, and the reason is most instructive. Tanners were no less cooperative than other businessmen. The difficulty lay with the interviewer. Not prepared for the focus of thought and action that characterizes this processing stage, I persisted in asking questions built around an inappropriate scheme—questions involving inventory objectives, routines for matching buying to sales, indicators of changing customers' demand or of changing market prospects. These questions provided an awkward mold in which to cast thinking about the tanning business. Consequently, answers were troubled, confused, conflicting.

The investigation proceeds in three steps. First, the relationship between outflow of leather and inflow of hides in tanneries is studied. Then certain major business problems and procedures are studied with a view to developing the correct approach to the study of the empirical materials. Finally, the time series are examined in an effort to verify and render more specific the general notions previously developed.

This is the order of presentation. It was not the order of study. Because of the deficiencies in the preliminary interviews, the time series were examined without the benefit of properly framed questions. The result was confusion. For though it is always necessary to arrive at an hypothesis by a series of successive approximations in which a question is put to the data and the answer causes a revision of the question, it is very hard indeed to start without the question, or, as I did, with a poorly balanced series of questions. Although this is a most unpleasant way to conduct an investigation, in the end, it is reassuring to know that the figures refused to support a story alien to them.

Fluctuation in Leather Shipments, Hide Receipts, and Inventory Investment

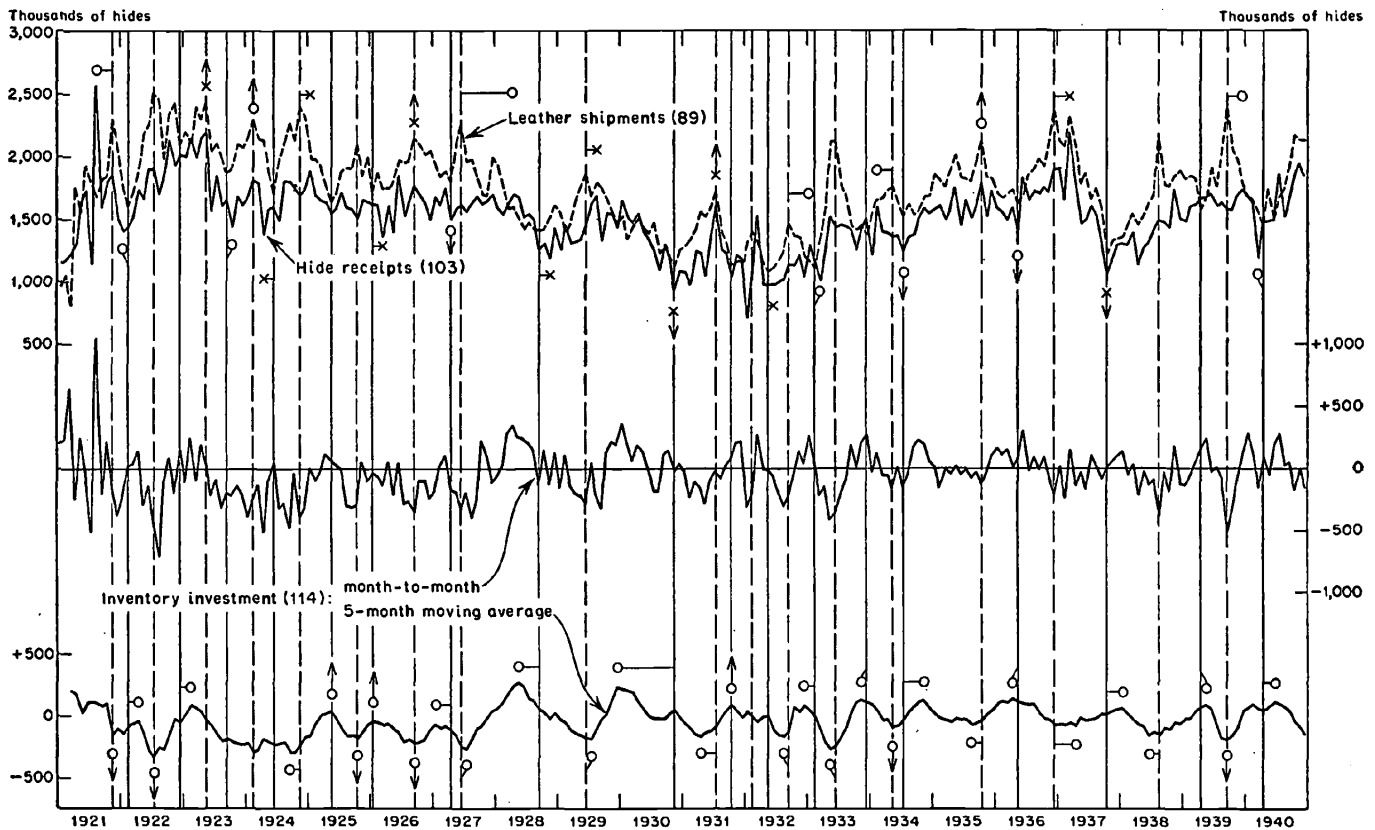
Failing the ideally appropriate information (data on new orders), we examine the estimates on tanners' shipments of leather and their receipts of hides, which

are fortunately available and of good quality. The former series is identical to the one that has been called receipts of leather by leather-goods manufacturers; its probable relationship to orders has been discussed. Tanners' hide buying is represented primarily by information on receipts of hides at tanneries. For domestic hides, the lion's share of the total, receipt follows purchase by a few days or weeks. For imported hides, the period between the order and receipt is longer; six weeks seems to be typical for South

The entrance of raw hides into tanneries and their exit in the form of finished leather are shown in Chart 30. The two series seem to follow the same general course. True, some minor movements are not shared; in 1927 and 1928 the peak in shipments of leather came much earlier than the peak in hide receipts (and, incidentally, in hide prices). Nevertheless, the timing of most of the turns is quite close. For 25 matched turns other than the one just mentioned, the average deviation is only 1.3 months from the average lag of

CHART 30

Tanners' Leather Shipments, Inventory Investment in Leather and Hides, and Hide Receipts, 1921-1940



Specific-subcycle peaks and troughs (broken and solid vertical lines) in *leather shipments* (series 89 in Appendix B) are used as reference frame. Specific-subcycle turns in *inventory investment* are marked by O and are matched inversely; specific peaks are matched with reference troughs and specific troughs with reference peaks. A horizontal line or vertical arrow indicates the association. The moving average is centered.

American hides, which formed a substantial segment of total imports. By and large, hide receipts (like leather shipments) are likely to show a reasonably sensitive though imperfect association to the ideally appropriate information on hide orders placed.³

³ I have tried to estimate hide orders by entering receipts of imported hides two months earlier (presumably at the time they may have been ordered), while assuming that domestic hides are ordered the same month received. This series, called "hypothetical hide orders," is used at several points in this chapter. Since there is no possibility of making analogous estimates for leather orders, they have not been used in this section where

hide receipts relative to leather shipments of 0.4 month. But 29 per cent of all months covered (1921-1940), are in unlike phase, not a low figure.

The chart also suggests that leather shipments have the wider subcyclical fluctuation of the two series. Our specific-subcycle amplitude measures confirm the impression: on the average, leather shipments rise or fall per month 3.6 per cent of their average level, and the corresponding figure for hide receipts is 2.4 per

the matter of the *relation* between outflow and inflow is the center of attention.

cent. But in those specific cycles associated with business-cycle turns, outflow and inflow for tanneries had virtually the same amplitude (1.23 and 1.26 per cent per month, respectively).

The difference between receipts of hides and shipments of leather, both expressed in equivalent hides, constitutes positive or negative inventory investment. These monthly investment figures (smoothed by a centered five-month moving average) are plotted in the lower part of Chart 30. Apparently tanners' total inventory investment undergoes subcyclical fluctuations broadly inverse to leather shipments and little associated with those of hide receipts. Matched inversely (synchronous timing), investment is in opposite subcyclical phase to leather shipments 26 per cent

and to hide receipts (matched directly and lagged two months) 33 per cent of the months.

Table 49 gives the change in hide receipts and in stocks occurring between each specific peak and trough in leather shipments, phase by phase. About two-fifths (38 per cent) of the total fluctuation in shipments reappears in the total fluctuation in receipts; the rest is lost in increases or decreases in tanners' stocks. However, if only major movements in shipments are considered (those associated with the SLH reference cycles), the muting role of inventory investment is considerably less marked (37 per cent remains), and hide receipts (accounting for 63 per cent of the fluctuation in shipments) make the chief adjustment. Indeed, relative to the shorter phases, the proportions are al-

TABLE 49

Amplitude of Fluctuation in Tanners' Leather Shipments, Inventory Investment in Leather and Hides, and Hide Receipts during Each Subcyclical Phase in Their Shipments or Receipts, 1922-1940

(conforming, or nonconforming [-], amplitude in thousands of hides)

I. REFERENCE FRAME: SUBCYCLES IN LEATHER SHIPMENTS

SUBCYCLES IN SHIPMENTS ^a			PHASE DURATION (months) (1)	AMPLITUDE PER PHASE ^b		
Peak	Trough	Peak		Shipments of Leather ^c (2)	Receipts of Hides ^c (3)	Inventory Investment (3) - (2) (4)
July 1922	Dec. 1922		5	159	-153	-312
	Dec. 1922	May 1923	5	9	-10	-19
May 1923	Sept. 1923		4	344	407	+63
	Sept. 1923	Feb. 1924	5	281	183	-98
Feb. 1924	June 1924		4	313	200	-113
	June 1924	Nov. 1924	5	430	173	-257
Nov. 1924	May 1925		6	567	140	-427
	May 1925	Oct. 1925	5	236	-7	-243
Oct. 1925	Jan. 1926		3	77	-47	-124
	Jan. 1926	Sept. 1926	8	193	77	-116
Sept. 1926	Apr. 1927		7	131	90	-41
	Apr. 1927	June 1927	2	173	-23	-196
June 1927	Sept. 1928		15	691	230	-461
	Sept. 1928	June 1929	9	360	117	-243
June 1929	Nov. 1930		17	587	407	-180
	Nov. 1930	July 1931	8	379	337	-42
July 1931	Oct. 1931		3	374	250	-124
	Oct. 1931	Feb. 1932	4	145	-70	-215
Feb. 1932	May 1932		3	227	117	-110
	May 1932	Sept. 1932	4	242	123	-119
Sept. 1932	Feb. 1933		5	145	-57	-202
	Feb. 1933	June 1933	4	792	320	-472
June 1933	Dec. 1933		6	540	87	-453
	Dec. 1933	May 1934	5	251	-10	-261
May 1934	July 1934		2	118	50	-68
	July 1934	Oct. 1935	15	377	310	-67
Oct. 1935	May 1936		7	269	17	-252
	May 1936	Dec. 1936	7	497	220	-277
Dec. 1936	Oct. 1937		10	817	657	-160
	Oct. 1937	Aug. 1938	10	474	277	-197
Aug. 1938	Apr. 1939		8	166	-190	-356
	Apr. 1939	Sept. 1939	5	464	-57	-521
Sept. 1939	Apr. 1940		7	561	203	-358
Aggregate for all thirty-three phases			213	11,389	4,368	-7,021
Percentage of fluctuation in shipments				100%	38.4%	61.6%

(continued on next page)

TABLE 49 (continued)

2. REFERENCE FRAME: SUBCYCLES IN HIDE RECEIPTS

SUBCYCLES IN RECEIPTS ^a			PHASE DURATION (months) (1)	AMPLITUDE PER PHASE ^b		
Peak	Trough	Peak		Receipts of Hides ^c (2)	Shipments of Leather ^c (3)	Inventory Investment (2) - (3) (4)
May 1923	Jan. 1922	May 1923	16	530	451	79
	Oct. 1923		5	380	305	75
Feb. 1924	Oct. 1923	Feb. 1924	4	157	242	-85
	Apr. 1924		2	170	145	25
Jan. 1925	Apr. 1924	Jan. 1925	9	187	45	142
	Mar. 1926		14	233	313	-80
Sept. 1926	Mar. 1926	Sept. 1926	6	167	280	-113
	Apr. 1927		7	90	131	-41
Apr. 1928	Apr. 1927	Apr. 1928	12	53	-369	422
	Nov. 1928		7	360	53	307
Aug. 1929	Nov. 1928	Aug. 1929	9	243	228	15
	Nov. 1930		15	480	551	-71
July 1931	Nov. 1930	July 1931	8	337	379	-42
	June 1932		11	430	447	-17
Jan. 1933	June 1932	Jan. 1933	7	183	49	134
	Mar. 1933		2	20	-165	185
Feb. 1934	Mar. 1933	Feb. 1934	11	270	288	-18
	July 1934		5	87	29	58
Oct. 1935	July 1934	Oct. 1935	15	310	377	-67
	May 1936		7	17	269	-252
Mar. 1937	May 1936	Mar. 1937	10	283	465	-182
	Oct. 1937		7	720	785	-65
Dec. 1939	Oct. 1937	Dec. 1939	26	517	430	87
	Mar. 1940		3	263	247	16
Aggregate for all twenty-four phases			218	6,487	5,975	512
Percentage of fluctuation in receipts				100%	92.1%	7.9%

^a The data in column 2 are the amplitude of specific subcycles, for which dates are given below, for the series which is used as reference frame.

^b 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. Standings at reference peaks and troughs are typically taken as centered three-month averages of monthly data (see Appendix A, sec. 15).

^c A description of the series will be found in Appendix B: leather shipments 89; hide receipts 103.

most exactly reversed. This is a familiar finding; at the other stages in the industry, too, inventory investment is relatively more important in affecting the relationship between selling and buying for short than for long phases.⁴

It is interesting to consider the role of investment from the opposite angle—as a method of absorbing or augmenting in leather shipments the fluctuations of hide receipts. The second section of the table gives the figures. Since investment shows little association, either positive or negative, to fluctuation in hide re-

⁴ This finding becomes progressively more marked as the length of cycles increases. The per cent of fluctuation in leather shipments associated with fluctuation in inventory investment listed for decreasing average durations are: specific cycles in shipments associated with SLH reference cycles, 37; all specific cycles in shipments, 43; specific-subcycle phases in shipments lasting six months or longer, 55; all specific subcycles in shipments, 62; specific-subcycle phases in shipments lasting less than six months, 71.

ceipts, nearly all of the fluctuation in receipts is reflected directly in that of leather shipments; in about half of the phases inventory investment conforms, in half it fails to. Less than 10 per cent of the total fluctuation in hide receipts takes the form of inventory investment, in spite of the fact that the calculations are biased in that direction.⁵ It is interesting that the proportions remain about the same (90 and 10 per cent) when only those specific movements associated with SLH reference cycles are considered. This is a very different picture from the comparable one for shoe manufacturing or shoe retailing.

These statistics pose a provoking question: Why is it that the successful operation of a tannery appears

⁵ The method lumps erratic fluctuations in receipts with sub-cycle ones, and the former will almost of necessity appear in inventory investment too. Thus when receipts provide the reference frame, there is a tendency to overstate the role of inventory investment relative to customers' buying.

to result in muting the short fluctuations in the demand for leather, whereas the successful operation of a retail shoe store or shoe-manufacturing plant tends to exaggerate fluctuation as demand moves back to the next earlier stage?

Business Problems Conditioning Tanners' Buying

In an effort to answer the question we cannot, of course, simply concentrate on inventory behavior but must, as usual, study the basic production and buying, and even selling, problems through which the tanner picks his way toward profitable operation.

PRODUCTION AND SELLING PROBLEMS

The vegetable tanning of sole leather—and this ancient art is still the one commonly used for the production of leather soles—requires two or three months. This means that, even were it possible to obtain hides from packers or dealers almost immediately, it would typically not be feasible for a tanner to wait until orders for sole leather are on his books before he acquires the hides to be used in filling them. Almost of necessity, sole-leather orders are filled from finished or in-process inventories. These inventories were large in the interwar period—almost an eight-month supply; a little over half were in the form of finished leather or cutstock. Viewed the other way around, finished sole leather is so durable and staple a product that it is possible for trade customs that imply large finished stocks to take root—customs affecting ordering and production.

As it is, production can follow a far smoother course through time than would be possible if a closer link to orders had to be maintained. This is important because it is expensive for a sole-leather plant to operate at a level very different from its planned capacity, since the size of the packs and the time in each process is not readily adjusted. I am told that the preferred method of reducing output is to close down the plant for a day or more a week. Large inventories also mean that buying can be smoother and more sensitively adjusted to seasonal and other patterns in the availability of hides of a desired quality than could otherwise be the case. This is important in view of the basic by-product character of hides and the consequent limited flexibility of supply.

The tanning of upper leather, on the other hand, is a relatively swift operation in which the use of chemicals, notably chrome salts, makes it possible to complete tanning and finishing in a few weeks, though a month or more is often required for the convenient routing of the successive preparatory, tanning, and

finishing operations. Orders are often written with a delivery date six weeks or more away, consequently it is physically possible to buy hides to be made up into specific lots of side upper leather for which orders are on hand. Also, side leather is required in all sorts of colors, qualities, and surface finishes, so that large stocks of finished leather are a far riskier property than equal quantities of sole. But since hides are in large measure a by-product, with the associated elements of inflexibility in their supply, it would be advantageous to free hide buying (under stable market prospects) of the need to duplicate all the ups and downs of leather selling. The solution is to split the manufacturing operation in the middle. After the basic tanning processes have been completed, leather can be dried and stored in the crust awaiting specification of color and finish.

All this suggests that stocks of in-process and finished upper leather will not be as large as those of sole leather; they averaged three and three-quarters months' supply for the interwar period, less than half the months' supply of sole leather. It suggests, too, that stocks in process (including the semifinished dried leathers awaiting finishing operations) will be somewhat larger relative to production and to finished stocks than for sole. And indeed they are; in spite of the far shorter production period, in-process stocks of upper leather constituted a somewhat larger proportion of all stocks than was the case for sole leather. They were 54 per cent of the total upper leather stocks of tanners—an average of about two months' supply over the interwar period.

Under stable market prospects, then, the exigencies of the production process and of procuring desirable sorts of hides counsel a looser relation of buying to selling than is found in shoe retailing or even shoe manufacturing. This is made possible by the large stocks of finished or partly finished goods that it is feasible to carry. It is made necessary, at least in the case of sole leather, by the long time that tanning requires.

SHIFTING PROSPECTS CONCERNING AVAILABILITY OF HIDES

In the business enterprises that we have studied thus far, consideration of market prospects seemed to influence the timing of buying through its impact on expected prices, speed of deliveries, adequacy of selections, and the confidence with which these several expectations were held. Much of what was said in Chapters 9 and 11 applies likewise to the purchasing of hides, but there are important differences. By and large, these differences, arising from the physical and

economic setting in which tanners operate, lead one to expect that changing market prospects will not play as important, or at least as readily isolated, a part in tanners' buying as in shoe manufacturers' or retailers'.

The tanner has not the same need to insure against possible delays in deliveries. Total stocks are larger. Seasonal bottlenecks, which may have been one reason for an urgency in anticipating tightening markets, are far less emphasized in tanning than in stages closer to the finished consumer good. Another common reason for trying to anticipate tightening markets is a fear of impoverished selections. But leather of a given quality can be made from a fairly wide variety of qualities of hides; it is simply more expensive to make it from some than from others, so considerable substitution between hide cost and other costs is feasible.

Finally, unlike retailers or shoe manufacturers, tanners cannot increase their forward position in actual hides (as distinguished from hide futures) primarily by placing more orders for delivery a longer time in the future. Instead, they must buy more hides for immediate delivery than they otherwise would.⁶ This fact must have a multiple bearing on the timing of buying concerning the nature of which we can only speculate. It seems likely that it is more difficult to combine advantage with respect to price, selection, and prompt delivery in the single act of forward purchase when advance orders cannot be placed. Also, the forward bet may have a higher cost; the *seller* achieves no economies through the better planning of his buying and production that the advance commitments on the part of the buyer make possible. In addition, heavier spot buying involves storage costs and earlier payment dates not involved in advance orders. Spot buying may also have a more direct impact on prices than privately placed advance orders.

In general, the need to insure adequate selections and delivery presents a problem to the tanner that perhaps is best put negatively. The tanner must not fall behind his competitors and must buy spot hides right along with the rest. He does not, however, need to beat the field in the same sense that the retailer or shoe manufacturer does.

SHIFTING PROSPECTS CONCERNING PRICES AND MARGINS

This leaves for consideration the impact of expectations about prices per se on the timing of hide buying. Tanners can hardly be immune to the desire to pay less rather than more. But the relative flexibility of the price of the tanners' wares, in contrast to the relative inflexibility of the shoe manufacturers' or retailers',

may introduce a fundamental difference in how much forward buying is advantageous. The way in which leather prices and hide prices are determined, and the relationship between the two, will bear on how tanners ought ideally to govern shifts in their market position.

We are told that the price of leather is very sensitive to the price of hides. It is not partially insulated by the possibility of substantial elective changes in input, as in the case of shoes. Moreover, the very lack of a direct association between a particular leather sale and the purchase of hides for this leather may tend to make leather pricing rely heavily on current hide prices, rather than on historic prices.

The price that can be obtained for leather may actually depend, in part, on the actions that tanners have taken in an effort to protect themselves against price trends. When shoe manufacturers enter into negotiations with a tanner for the purchase of leather, they try to acquaint themselves with how many hides the tanner has been buying and, if possible, what he has paid for them. Thus, if a price rise in hides has been anticipated by a tanner, and in consequence he has bought rather heavily, the price he can obtain for his leather may be deteriorated *by this very action*. The deterioration may take place immediately. But even if the news of the purchase is kept dark, any relative increase in stocks of finished or semifinished leather that may result as the additional raw materials are processed, will tend to weaken the price that can be won, other things the same. The additional hide buying, on the other hand, is likely to raise hide prices, other things the same. Obviously this problem is more serious for large companies than for small, and there are several very large tanning concerns, especially in the sole-leather field.

These several hints on the possible relation of leather and hide prices and its bearing on tanners' buying may be made more concrete by a study of time series on tanners' gross operating margins over hide costs. Such a series can be computed in accordance with a principle similar to that used for shoe manufacture. The leather cost of a pound of oak-tanned sole leather has been calculated on the assumption that a fixed quantity of packer steer hides was the raw material used.⁷ It would be instructive to make the calculation two ways—on a first-in, first-out (FIFO) and on a last-in, first-out (LIFO) basis. Tanning is one of the industries in which there was strong pressure to keep books on a current-hide-cost basis, and in 1939 LIFO ac-

⁶ Hides can be bought in short cure, but this represents a minor modification of the statement in the text. For the most part, bids are not accepted until the pack is closed (see Chapter 2).

⁷ Because hides lose weight in tanning, a pound of hides make less than a pound of leather. The precise relationship differs considerably; I used a single, presumably representative, figure of 0.7 (Watson, *op. cit.*, p. 95).

counting became acceptable to the Bureau of Internal Revenue. Therefore, I used current hide prices as one basis for calculating margins over hide cost. The question of how to represent historic costs is more difficult, for the requisite information is lacking.⁸ In default of a better system, I used hide prices in the month that gave the closest correspondence between the two time series (sole-leather prices and prices of packer native steers, Chicago). For the earlier half of the period, hide prices two months previous to sole-leather prices provided the best fit; for the later half, current prices. Since there was reason to suppose that a change in practice may well have taken place in the early thirties, the direct calculations of margins were spliced; hide prices two months previous were used before 1933, and current prices, from January 1933 on.⁹

On the basis of experimental assumptions, these calculations try to reproduce the course of margins, defined as the spread between materials cost and selling price, as tanners experienced them and consequently reacted to them. But the experiments are not satisfactory. The difficulty is that they do not recognize two factors that we know to be present. For the early period, when the current hide price was apparently not the effective basis of leather prices, hide costs must have been based on some sort of average of prices actually paid over a period, with a decreasing weight as time receded, rather than simply on price for a particular earlier month, as in our calculation. Second, whatever the cost figure actually computed, businessmen are likely to give it more or less weight in their selling and pricing decisions depending on how realistic at any given time they consider the objective of recovering costs in the selling price. It seemed desirable, therefore, to try to take account of actual realized margins in a somewhat more flexible fashion.

This can be partially accomplished by a regression analysis in which the association between hide and leather prices is dictated by a least-squares solution; leather prices (an average of sole and side prices) are

⁸ In view of the wide fluctuation in hide prices and especially the large size of average inventories and consequently the long time separating the purchase and sale of a specific hide on a FIFO principle, the method of estimation used for leather costs of shoes is not applicable here.

⁹ The timing of specific subcycles of the two price series were compared, with the use of a two months lag of leather prices relative to hide prices prior to 1933 and a synchronous association thereafter. Only 25 per cent of the months were in opposite phase over the twenty year span from 1921 to 1940. The margin calculations also suggest this break in the middle of the period. Before 1933 margins are smoother when calculated on the basis of packer-hide prices two months earlier than leather prices, whereas, beginning in 1933, a synchronous association traces a steadier history of margins.

"explained" in terms of current hide prices (an average for three sorts of hides) and a centered moving average of their rate of change. By using a straight-line formula, we assume that other costs are an unchanged aggregate per hide of leather, and that leather prices change by a fixed amount per unit change in hide prices and in their first differences. This is by no means the best solution of the problem as I now conceive it, but it also does not seem worthwhile to recalculate it.¹⁰ Coefficients were calculated separately for the periods before and after 1932. The equations, stated in dollars per equivalent hide of leather (L) or per hide (H) for months indicated by the subscripts, are:

1922-1932

$$L_0 = \$4.84 + 1.146H_0 - 2.124 \frac{(H_{+2} - H_{-2})}{5}$$

(± 0.031) (± 0.274)

1933-1941

$$L_0 = \$3.56 + 1.007H_0 - 0.493 \frac{(H_{+2} - H_{-2})}{5}$$

(± 0.043) (± 0.201)

The coefficients of multiple correlation are .954 for the first and .923 for the second period. The standard errors of the regression coefficients indicate that both variables play a clearly significant part in the first period though the rate of change may not in the second period.

The size of the correlation coefficients, combined with the knowledge that hide and leather prices are in opposite subcyclical phase only a small proportion of the time,¹¹ means that actual and estimated prices would show a high degree of parallelism both as to major and minor contours. An "unexplained" portion of leather prices nevertheless remains; it is shown in Chart 31. Sole-leather margins are also shown computed directly first on the basis of packer native-steer hide prices two months previous and then on current prices. The preferred series consists of the first 1921 to 1931, and the second 1932 to 1940—the portions of the two series shown by a solid line.

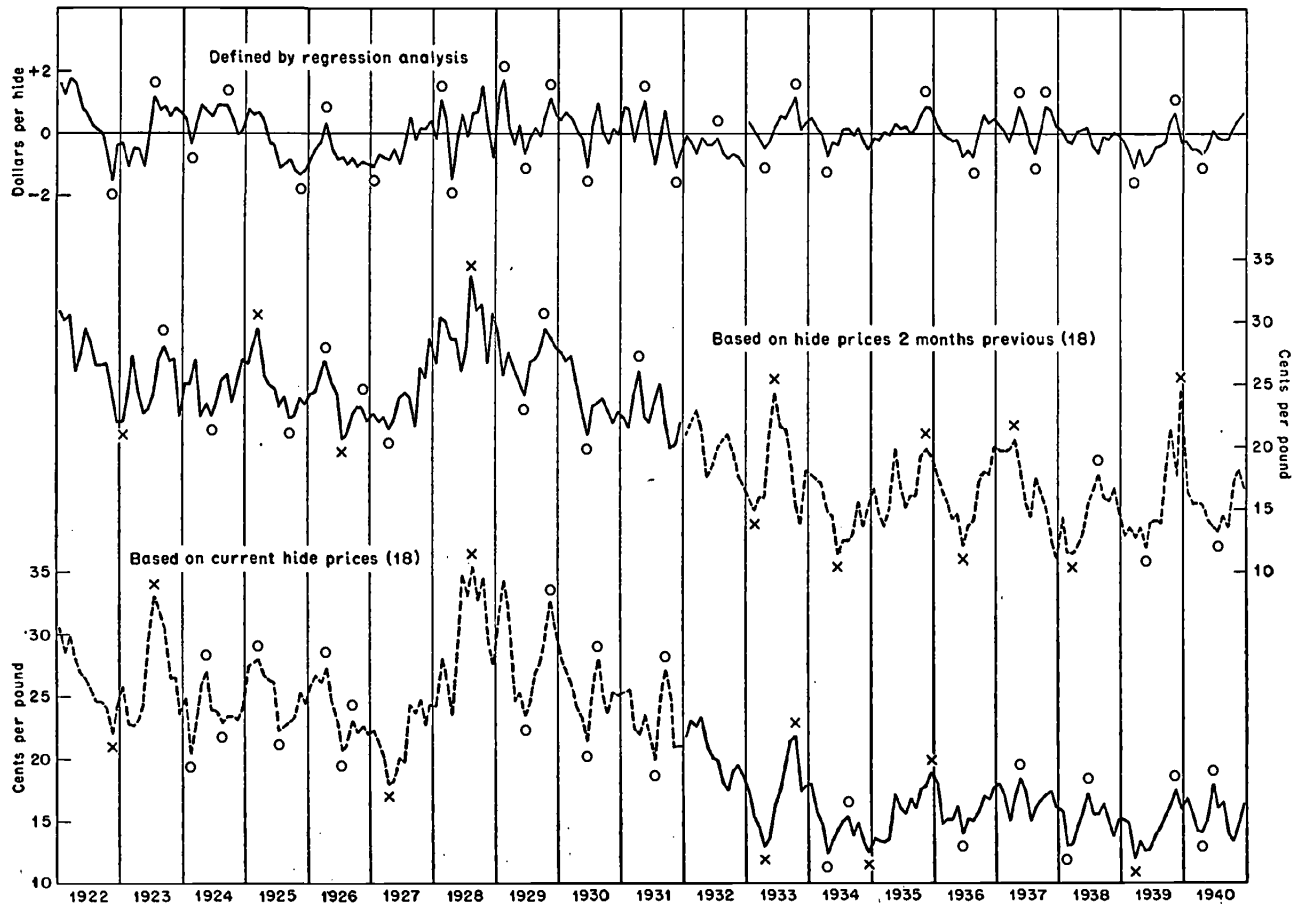
The chart and Table 50 tell several things about these margins that bear on the question of how tanners' expectations about prices may influence their buying. However, caution is in order, for they may suffer not only from the difficulties already mentioned but from still another one. Reported prices of leather are notorious for not reflecting the actual price at which most

¹⁰ I would be inclined to exchange the averaged centered first difference variable for a weighted average of earlier months' prices with a decreasing weight as time receded. Also it might have been preferable to use the price of sole leather only, rather than an average leather price.

¹¹ See note 9.

CHART 31

Tanners' Hypothetical Gross Operating Margins between Hide Cost and Leather Prices, 1922-1940



Specific-cycle turns are marked by X and specific-subcycle turns by O. A solid line shows the preferred portion of the second and third series. See the text for a description of the regression equations.

leather sells; the latter would, in all probability, be more sensitively associated with hide prices than available statistics show.

Table 50 indicates that fluctuation in the size of margins is not an inverse function of fluctuation in the price of raw materials, as was the case for shoe manufacture; such slight association as there is between hide prices and margins is more nearly direct than indirect. This may simply reflect, as the table indicates, a fairly close positive association of margins and the price of leather, at the same time that leather and hide prices show some parallelism. But even in the case of leather prices, the meaning of the statistical correspondence with margins is not at all clear. I am inclined to discount it heavily.¹² Only when a strict LIFO calculation is used (so that the figure is simply

¹² The association between margins and sole leather prices is much clearer when the comparison is made synchronously than when the timing is shifted as in the second section of the table. Compared currently, 15 per cent of the months are in unlike phase, 1921-1931 for the early period, when there is reason

a price spread between current leather price and hide price), may it be said that gross operating margins (in absolute, not percentage terms) tend to be higher when leather prices are rising than when they are falling. Nor can the fluctuating size of the price spread be explained, as far as one can tell, in terms of other costs such as labor.¹³ This waywardness of most of the margin calculations is perhaps the outstanding fact about their course through time.

to believe that the current market price of hides was not the effective basis of hide cost calculations in tanning. When costs are based on the indications of the regression formula, the similarity disappears entirely. If margins are based on percentage-cost calculations the similarity disappears entirely and becomes more nearly an inverse association. Finally, actual leather prices may be much more sensitively geared to costs than the reported data. These facts all suggest that it would not be safe to conclude that by and large tanners' margins widen substantially as leather prices rise and vice versa. The case for it is good, however, when hide costs are calculated on a straight LIFO basis.

¹³ This statement is based on the calculation of a hypothetical labor cost per hide of leather and comparison of its movement with that of the margins.

TABLE 50

Timing of Subcycles: Tanners' Hypothetical Gross Operating Margins Compared with Hide and Leather Prices, 1921-1940

TYPE OF ASSOCIATION ^a	(1)	NUMBER OF TURNS					TIMING (months)		MONTHS IN UNLIKE PHASE AS % OF ALL MONTHS ^c Timing That Maximizes Correspondence	
		All Turns (2)	Matched Turns ^b			Synchronous (6)	Mean Lead (-) or Lag (+) (7)	Average Deviation (8)	Lead (-) or Lag (-) (months) (9)	Correspondence (%) (10)
			Total (3)	Leading (4)	Lagging (5)					
1. REFERENCE FRAME: MARGINS WITH HIDE COST TAKEN CURRENTLY, LIFO (32 TURNS) ^d										
Packer hide prices (21)	{ Inverse	29	20	2	11	7	+2.3	3.2	+2	49
	{ Direct	29	14	12	2	0	-1.8	1.1	-2	35
First differences in packer hide prices ^e	Inverse	28	21	8	9	4	+0.6	2.3	0	38
Sole leather prices (17)	Direct	29	27	11	5	11	-0.4	1.4	0	21
2. REFERENCE FRAME: MARGINS WITH HIDE COST TAKEN TWO MONTHS PREVIOUS FOR 1921 TO 1931 AND CURRENTLY THEREAFTER (28 TURNS) ^d										
Packer hide prices	{ Inverse	29	15	3	7	5	+1.5	2.8	+1	54
	{ Direct	29	15	10	4	1	-0.5	2.2	-1	41
First differences in packer hide prices ^e	Inverse	28	15	6	7	2	+0.6	2.6	0	45
Sole leather prices	Direct	29	25	10	9	6	+0.8	2.2	0	28
3. REFERENCE FRAME: MARGINS AS DEFINED BY REGRESSION ANALYSIS (27 TURNS)										
Cattle hide prices (23)	{ Inverse	29	20	10	1	9	-2.6	3.3	0	48
	{ Direct	29	11	1	10	0	+2.8	2.0	+3	36
First differences in packer hide prices ^e	Inverse	35	15	8	6	1	-0.3	2.4	-2	45
	Direct	35	18	7	7	4	-0.5	2.7	0	50
Cattle-hide leather prices (19)	{ Inverse	27	9	4	4	1	+0.8	2.4	+3	52
	{ Direct	27	18	8	5	5	-0.2	2.7	0	42

^a When the association is inverse, specific peaks are matched to reference troughs and specific troughs to reference peaks.

^b For the rules used in matching specific-subcycle turns for two activities, see Appendix A, secs. 10a, b, c, and d.

^c The method of calculating the percentage of months in unlike phase is given in Appendix A, sec. 14.

^d The margin series are 18 in Appendix B. Reference frame 2, is the portions of lines 2 and 3 on Chart 31 shown by a solid line; see also Appendix A, sec. I.

^e First differences are centered five-month moving averages of month-to-month change in hide prices.

More interesting than the timing of the fluctuation in margins is its amplitude: margins appear to have fluctuated within quite a narrow band. As derived from the regression analysis, about two-thirds of the margin figures lie within a range of $\pm\$0.75$ in the first period and $\pm\$0.45$ in the second. These ranges constitute 6.2 per cent of the average price of an equivalent hide of cattle-hide leather in the first period and 5.3 per cent in the second period and the figure is doubtless wider than a true record of leather prices would show. Over the same period, hide prices moved between extremes in which the high in April 1928 was about six and one-half times the low of June 1932. Though strictly comparable computations could not be made for margins of shoe manufacturers, the band of fluctuations seemed about the same width (after an adjustment for the trend in margins), though leather prices fluctuated far more narrowly than hides.

Industry gossip suggested several facts that tend to keep buying and selling prices closely associated and to limit the ability of the tanner to increase margins

by extending or contracting a market position on the basis of short term expectations. The time series indicated that variation in margins is narrow and disorderly and thus bear evidence on the same point. They seem to reflect a delicate arbitrage between leather and hide prices not unlike the arbitrage between two hide prices separated geographically, or two prices for not quite the same sort of hide. The arbitrage serves to keep price movements parallel, since each price is affected in opposite directions by the transaction. Supporting this view, margins seem to fluctuate within a noticeably narrower band after the mid-thirties, by which time trading in the hide exchange had presumably reached sizeable magnitudes. The open-market trading in hide futures is likely to have made hide prices more responsive to all sorts of influences, including the price at which leather could be sold. This may be one reason for the greater stability of the spread between finished and raw material costs after 1934.

But I have moved ahead of the story. We do not:

yet know whether the heavier or lighter purchase of hides, dictated by the thought that they can or cannot be advantageously converted to leather and sold, accounts for substantial shifts in buying—a question that is tackled later.

Evidence on Factors Influencing Hide Buying

This survey of business problems with which the tanner is confronted, and which must shape his buying policies, seems to emphasize the importance of some factors that we have met at other levels and to subdue others. Emphasized in this environment are those factors bearing on the efficient operation of a factory, the rapid servicing of customers' requirements, and the procurement of raw materials as they become available. Subdued are those involving shifts in market prospects based on anticipation of seasonal bottlenecks or of short-term changes in price or margins. These judgments may be tested and amplified by study of the happily profuse time series.

REFLECTION OF DEMAND IN PRODUCTION OR BUYING SCHEDULES

In Chart 32, flows of cattle hides or of cattle-hide leathers are measured at various steps in the vertical sequence of operations. The first two lines, leather consumption and shipments, are old familiars. "Leather production" measures the flow as it emerges from the

last of the production processes performed upon it by the tanning establishment.¹⁴ "Hide wettings" is the first of the production processes, the washing and soaking that precedes leaching and the removal of hair. "Hide receipts" record the arrival of hides at tanneries. "Hypothetical orders of hides" is the constructed series described above (hide receipts with imported hides recorded two months earlier, presumably when ordered).¹⁵

Perhaps the dominant impression from a study of the chart is the parallelism between the flow of hides through the production process and the flow of leather shipments or leather consumption in finished leather goods. But the amplitude of fluctuation is less for hide receipts than for leather shipments and least for finished leather as it moves into stockrooms after production has been completed. Table 51 indicates that, whether calculated against the reference frame or as the intrinsic specific movements of each series, shipments are the most variable, and production, the least. The timing figures suggest that production and wettings reach maxima or minima later than do the other steps in the sequence.

The short-term similarity seen in Chart 32 in the movements of leather production, wettings, or hide receipts with the movements of either consumption

¹⁴ When sole leather is cut up into shapes by the tanner, production includes this operation.

¹⁵ See note 3.

TABLE 51

Timing and Amplitude Measures for Subcycles in Volume of Leather or Hides Passing through Successive Stages of Processing, 1923-1940

REFERENCE FRAME: SLH-SUBCYCLE CHRONOLOGY ^a

	TIMING (months)		CONFORMITY TO CHRONOLOGY ^b		REFERENCE AMPLITUDE PER MONTH ^c		SPECIFIC AMPLITUDE PER MONTH ^d		
	Mean Lead (-) or Lag (+)	Average Deviation	Timing Adjustment (months) ^e	Conformity Index	Subcycles	Cycles	All Subcycles	Major Cycles ^f	Ratio of Cycle to Subcycle ^g
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Leather:									
Consumption by leather goods manufacturers (45)	-1.0	1.3	{ -1 0	{ +77 +100	{ 1.68 1.56	{ 0.76 0.70	2.07	0.99	0.48
Shipments by tanners (89)	-1.8	1.3	-1	+100	2.68	0.93	3.65	1.23	0.34
Production (64)	+0.2	1.2	0	+100	1.60	0.84	1.96	1.03	0.53
Hides:									
Wettings (68)	-0.4	1.4	0	+100	1.91	0.92	2.25	1.12	0.50
Receipts (103)	-1.2	1.4	-1	+85	1.77	0.99	2.45	1.26	0.51

^a For a description of this, see Appendix A, sec. 8.

^b The method of calculating the index of conformity is given in Appendix A, sec. 13.

^c The method of calculating reference amplitude is given in Appendix A, sec. 15.

^d The method of calculating specific amplitude is given in Appendix A, sec. 16.

^e The average number of months lead, given in column 1, was taken into account by shifting the reference frame forward the

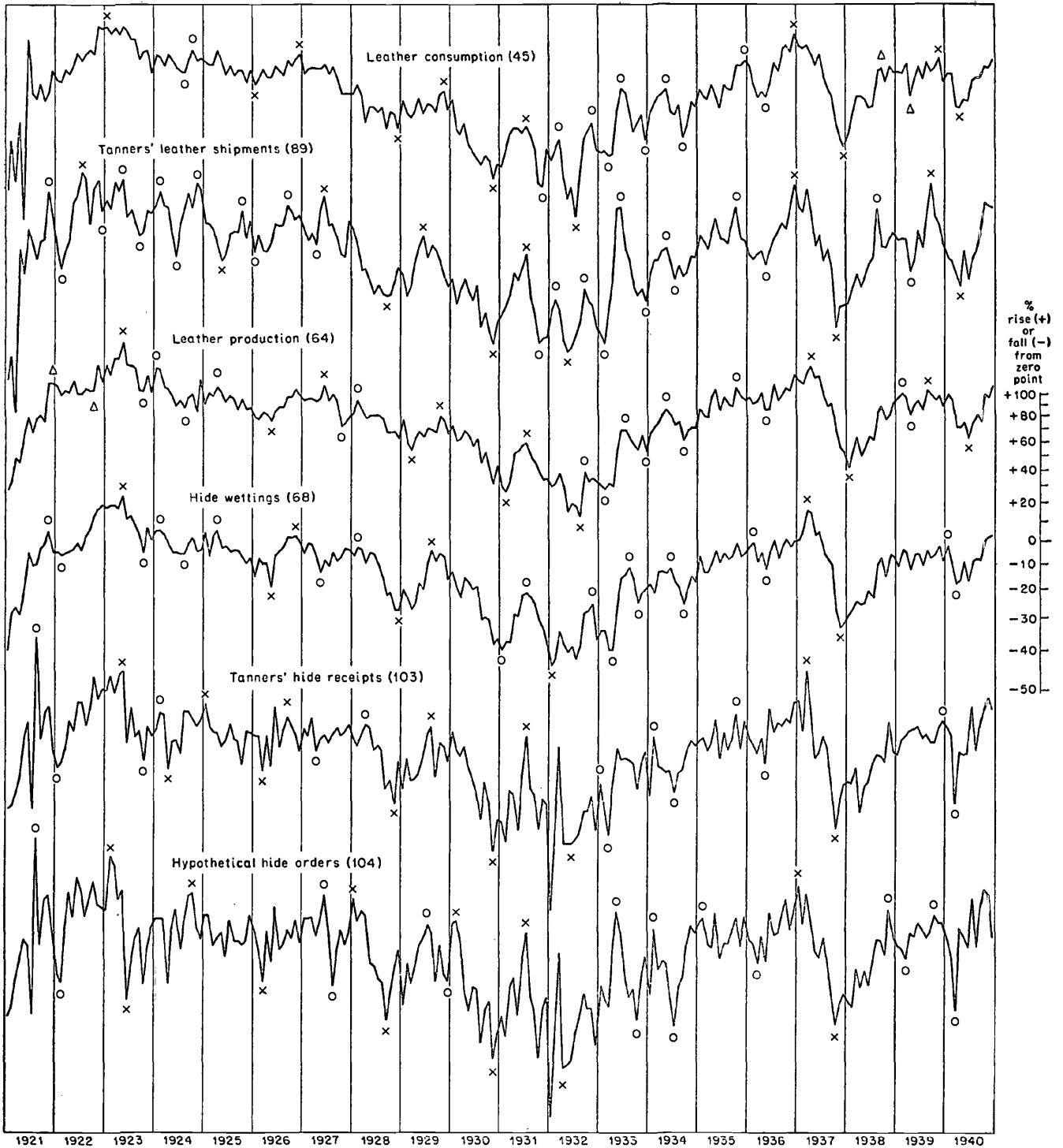
appropriate number of months. The timing adjustment was selected to maximize the conformity and amplitude measures.

^f Specific-cycle amplitude was computed using only those specific-cycle turns associated with the SLH cycle chronology (see Appendix A, secs. 9 and 10e).

^g In calculating the cycle to subcycle ratio, subcycle amplitude was averaged for the same period for which major cycle amplitude was available.

CHART 32

Volume of Leather or Hides Passing through Successive Stages of Processing, 1921-1940



Specific-cycle turns are marked by X, specific-subcycle turns by O, and retardations by Δ.

or shipments or both (which in some sense depict demand) implies that production schedules are not predetermined for several months at a time in conjunction with periodic budgetary procedure. Instead, they are linked in some way to current week-to-week requirements. In this respect tanneries and shoe manufacturing plants resemble one another in spite of the fundamental differences in their operating problems. In neither sort of enterprise do semiannual budgets or other planning and review periods give the actual signal for goods to move into production.

But the time series look as if it would not be easy to say just what does give the signal, nor whether the most sensitive response would be at the level of hide buying, hide receipts, the start, or the finish, of the production process. According to their statements, manufacturers watch the volume of shoe production and translate it into leather requirements (leather consumption). They use the volume of their incoming orders as important guides (shipments are our closest approximation, with the possible exception of the short series on shoe and leather orders). They say that they watch their inventories to make sure that they are not backing up or spooling out too fast (perhaps rates of change in finished stocks catch this notion), and also watch their inventories to see that they are not too large or too small (the size of stocks, especially finished stocks, and their relation to shipments would be relevant).

In order to learn where decisions actually do focus, and indeed whether they focus anywhere, we turn to the time series and examine the correlations between various pairs of series; one member of the pair represents a possible guide to buying or production, the other a point in the flow of goods through tanneries at which the response to the guide may be most clearly registered. If the correlation is notably better between some pairs than others, and if the temporal sequence is in accord, some causal imputation may be tentatively suggested. Table 52 lists the indicators of customers' requirements across the top and the records of tannery activity along the left margin. Two measures of correlation between an indicator and an activity are given—they involve the average deviation from the average timing, in months; and, the percentages of all months in unlike phase after allowance for the number of months' lead or lag that maximizes correlation. A lead of the activity relative to the indicator is not compatible with the imputation of causal association unless the activity is believed to parallel some other activity that precedes it.

Apparently tannery activity is closely linked, in the short run, to customers' requirements, as evidenced in one or another of the several indicators. The comple-

tion of all cattle-hide leathers (production) seems closely linked (as the small average deviation and few months in unlike subcyclical phase suggest) to customers' requirements after they have been registered in, and in a sense converted to, tanners' operating problems in the form of the ratio of leather shipments to finished stocks. It is likely that its power is not necessarily exerted directly but through the tanners' attention to each of its components, shipments and stock, or even a parallel but leading series, orders and stocks.

It is interesting that production of the staple, sole leather, seems to show a strong and appropriately lagging relation to the consumption of leather in shoe manufacture, whereas upper leather, which is likely to be finished to customers' specifications, accords more nearly with shipments. Hide wettings, the commencement of the tanning process, seems associated with the turnover ratio for which both average deviation and months in unlike phase are low; the synchronous timing at this point does not challenge a causal relation. Association also seems evident between wettings and the rate of change in finished stocks. It is shown not so much by the figures in the table¹⁶ as by a comparison of first differences in wettings with inventory investment in leather for which the average deviation for 26 matched terms is only 0.9 months, and the percentage of months in unlike phase 15. Hides seem to enter tanners' yards (receipts) in closer accord with the turnover ratio than with the other indicators, though the synchronous timing casts some doubt on the causal significance unless here too the relation of orders to stocks, rather than of shipments to stocks, may play some part in decisions. That this may be the case is suggested by the exceedingly low average deviation of 1.1 month for a very considerable proportion of the turns in shoe and leather orders compared with those in hypothetical hide orders; however, the proportion of matched phases was not high enough to cause an impressively low percentage of months to fall in unlike phase.

In general, the figures picture the tanner watching very carefully the various advices within his own business and outside of it that bear him information on how selling proceeds and will proceed; they picture him matching the activity of his factory to this running chronicle. A similar impression is conveyed by discussions with tanners.

TOTAL STOCK AND ITS SUBDIVISIONS

This general picture has implications concerning how goods are likely to move from one place in a tannery to another. For if the primary concern at each

¹⁶ The fairly low average deviation of 15 months applies to 23 matched turns, and the relatively high number of months in unlike phase results from a considerable number of unmatched phases in inventory investment.

TABLE 52

Timing of Tannery Activity Compared with Indicators of Customer Requirements, 1921-1940
The following pattern has been followed in each pair of columns and pair of lines:

First line	Average timing of turns, ^a months	(a) columns	(b) columns
Second line	Months in unlike phase; ^b timing that maximizes correspondence	Mean lead (-) or lag (+)	Average deviation % of all months
		Lead (-) or lag (+), months	

REFERENCE FRAMES: INDICATORS OF CUSTOMER REQUIREMENTS AS SPECIFIED IN COLUMN HEADS ^c

TANNERY ACTIVITY	SHOE AND LEATHER ORDERS		LEATHER CONSUMPTION		LEATHER SHIPMENTS				RATIO OF LEATHER SHIPMENTS TO FINISHED STOCKS				FIRST DIFFERENCES IN LEATHER STOCKS; MATCHED INVERSELY ^d							
	(a)	(b)	(a)	(b)	Total		Upper		Sole		Total		Upper		Sole					
					(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)				
Leather production:																				
Total (64)	+1.4	1.6	+1.3	2.2	+1.4	1.6	+0.8	1.3	+0.2	1.7	+2.7	1.8	+3	39%	+2.8	1.5	+3	39%	+3.1	2.8
Upper (66)	+2	28%	+1	32%	0	32%	0	19%	+1	27%	+3	39%	+3	39%	+3	31%	+3	39%	+3	39%
Sole (67)			+0.5	2.4																
			0	28%																
	+1.9	1.5	+1.9	1.5	+2.2	2.1	+2.2	2.1	+2.0	1.6	+2.0	1.6	+3.9	1.8	+5	32%	+3.9	1.8	+5	32%
	+2	21%	+2	21%	+2	35%	+2	35%	+2	27%	+2	27%	+3.1	2.8	+3	31%	+3.1	2.8	+3	39%
Hide wettings:																				
Total (68)	+1.7	2.0	+1.0	1.7	+1.8	1.5	+0.1	1.4	+0.4	1.6	+2.8	1.5	+2.8	1.5	+3.1	2.7	+3.1	2.7	+3.1	2.7
Upper (69)	+2	33%	+1	26%	+2	27%	0	24%	0	28%	+3	31%	+3	31%	+3	43%	+3	43%	+3	43%
Sole (70)			+0.8	2.0																
			0	29%																
	+0.7	2.0	+0.7	2.0	+1.2	1.7	+1.2	1.7	+1.2	1.7	+1.2	1.7	+3.2	1.9	+3	36%	+3.2	1.9	+3	36%
	0	29%	0	29%	+2	37%	+2	37%	+1	27%	+2.6	2.3	+2.6	2.3	+2	33%	+2.6	2.3	+2	33%
Hide receipts (103)	+0.7	1.6	-0.2	1.9	+0.8	1.7	+0.4	1.4	+0.4	1.4	+2.6	2.3	+2.6	2.3	+2	33%	+2.6	2.3	+2	33%
	+2	35%	0	31%	0	29%	0	24%	0	24%										
Hypothetical hide orders (104)	-0.1	1.1	-1.6	2.5	-0.7	1.5	-1.8	1.4	-2	24%	+0.7	1.9	+0.7	1.9	0	28%	+0.7	1.9	0	28%
	0	30%	-1	30%	0	30%	-2	24%	-2	24%	0	28%	0	28%						

^a Comments on timing measures are given in Appendix A, sec. 11a.

^b The method of calculating the percentage of months in unlike phase is given in Appendix A, sec. 14.

^c In sequence from left to right, the series are 38, 45; shipments, 89, 90, 91; ratios, 86, 84, 85, and first differences in series 72, 76, 80 in Appendix B.

^d First differences are centered five-month moving averages of month-to-month change. When the association is inverse, specific peaks are matched with reference troughs and specific troughs with reference peaks.

step in the process is to try to keep goods moving as smoothly as possible toward the customer, it is not possible also to have rigid objectives for the size of stocks and their pattern of change. If, on the contrary, it is the change in stock that is rigidly ordained, it will determine the temporal association between the two operations that bound the stock pool. Both cannot be master. A study of the behavior of the various stock pools should give support to the picture disclosed thus far or question its validity. In addition, it may yield further information about the factors determining the timing and volume of hides purchased. If stocks are not ordinarily the focus of attention, do they become so if limits of some definable sort are transgressed? Do changes in market prospects, either with respect to delivery conditions or price, influence tanners' buying as they seem to influence the buying of leather-goods manufacturers? These influences may be apparent in the behavior of stock piles, though invisible in the pattern of total inflow and outflow and their relationship.

Some notion of the behavior of the various stock piles has been conveyed by the behavior of the contiguous flow series. But it will be useful to get a summary view of them directly. This can be done by means of average reference patterns, shown in Chart 33.¹⁷ Total tanners' stocks are mildly inverse during subcycles and virtually nonconforming during cycles. The inverse pattern of the total results from a strong inverse conformity of stocks of finished leather, only partly nullified by positive conformity of in-process stocks (lagging) and of raw hide stocks (leading). The contribution of each segment to the total is on the right-hand portion of the chart, in which the size of each segment is expressed as a ratio to total tanners' stocks.¹⁸ What has been said of the subcyclical fluctuation of the three components applies for the most part to their movement during cycles too. However, for to-

¹⁷ The technique was developed by Arthur F. Burns and Wesley C. Mitchell, and is described in *Measuring Business Cycles*, National Bureau of Economic Research, 1946. For minor adjustments required to adapt the method to the shorter subcyclical waves see Appendix A, sec. 17. In brief, the whole period for which the patterns summarize behavior is divided into segments by the peak and trough dates of each SLH reference subcycle marked from 1921 to 1940. Then each of the subcycle spans is in turn divided by the application of standard rules into nine segments. In any one activity, the average standing of the data, expressed as a relative with the average value of the subcycle as the base, is recorded for each of the nine segments of time for each of the fourteen subcycles. For a given one of the nine segments, the standings are averaged for all subcycles. Thus the *subcyclical* patterns emerge. The procedure is repeated for the SLH cycles to arrive at the average *cyclical* patterns.

¹⁸ The average patterns expressed as percentages of the average values for the respective series are multiplied by the per cent that each of the three divisions of stock constitutes of the total (1921-1940).

tal tanners' stocks, cycles are, on the average, not systematically evident.¹⁹

These patterns of stock seem to fall in line with the dictates of convenience in the acquisition, processing, and sale of goods. But more than this they do not say. To utilize fully the data on stock to inform on business procedures, rates of change in stocks—the difference between contiguous production flows—may be more revealing than stocks proper, especially when the size of stocks is not the focus of management attention. We know that the several stages of tanning tend to parallel one another. Change in stock piles between any two stages isolates the extent to which the parallelism is less than precise.

Chart 34 shows tanners' total inventory investment and its three components, all in units of hides or equivalent hides of leather. Each one of the components, and, finally, the whole, needs to be examined with some care in relation to the two processes for which it measures differences, month by month.

BEHAVIOR OF STOCKS OF FINISHED LEATHER

Investment in finished leather has strong inverse movements. Even without smoothing by the five-month average, the monthly rate at which tanners' leather stocks drain down or build up (dotted line in the chart) undergoes exceptionally clear wavelike swings. The relationship between shipments, change in finished stock, and flow of leather from production can be encompassed by a glance at the reference-subcycle patterns of Chart 35. Increases in demand are registered in increased shipments and followed by expanding production. But the peak in shipments is reached before the reference peaks, or the peaks in production, and inventory investment shows a high inverse correlation to shipments, leading by a month on the average. The average deviation is 1.2 months and only 23 per cent of the months (matched inversely) are in unlike phase.

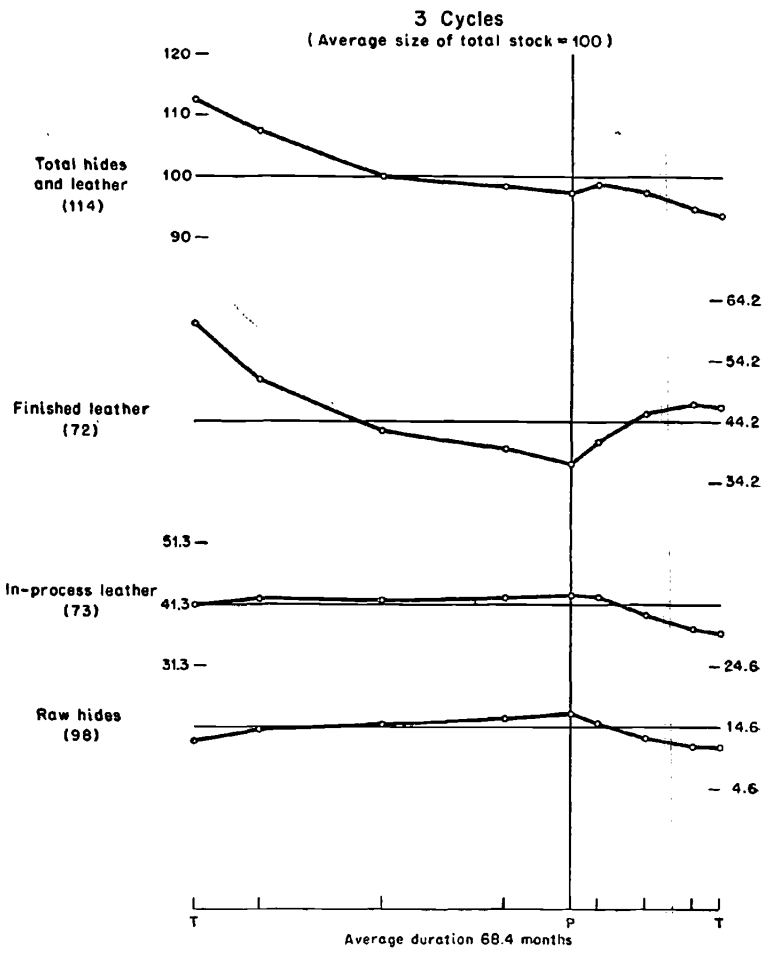
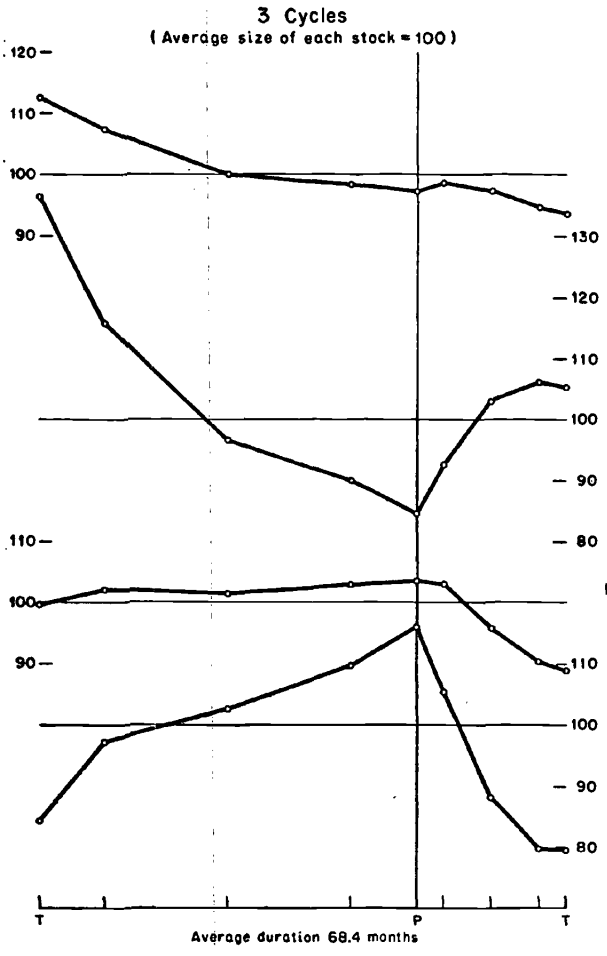
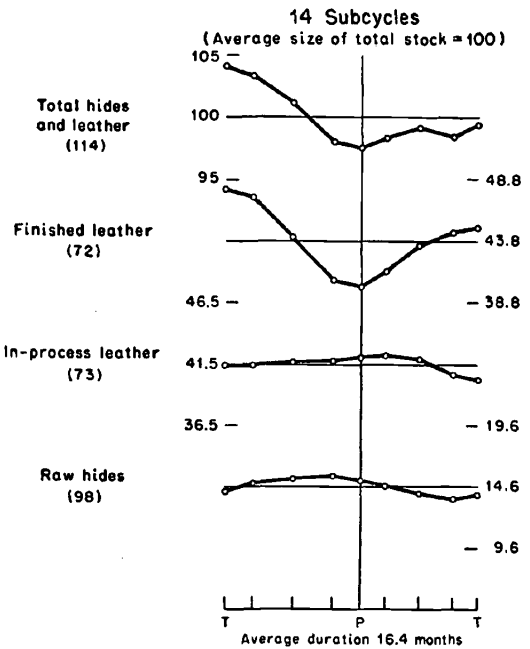
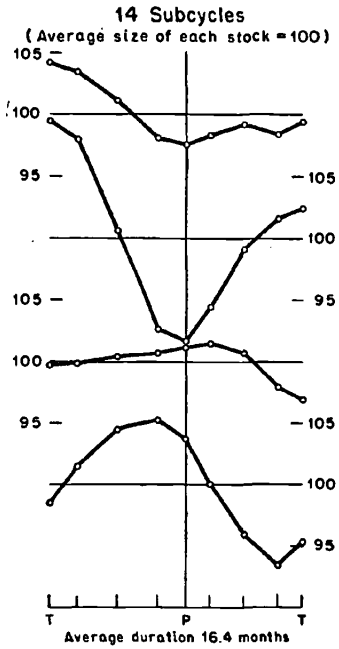
Certainly these figures look as if tanners expected their stocks of finished leather to satisfy the urgent demands of customers before current output can fill the gap.

But can the process be permitted to continue indefinitely? The subcycle patterns indicate that, on the average, the part assigned to changes in stocks tapers to nothing by the time that output starts to decline after a rise, or to rise after a fall. Study of the time series shows that, over the interwar period, the rate of fall in stocks did not exceed an average of 400,000 hides a month for any five-month period; more significantly, the rate at which they were permitted to

¹⁹ Peaks in raw stocks do not lead in the cycle patterns as in the subcyclical ones because of the dominance of the high conforming peak in 1923.

CHART 33

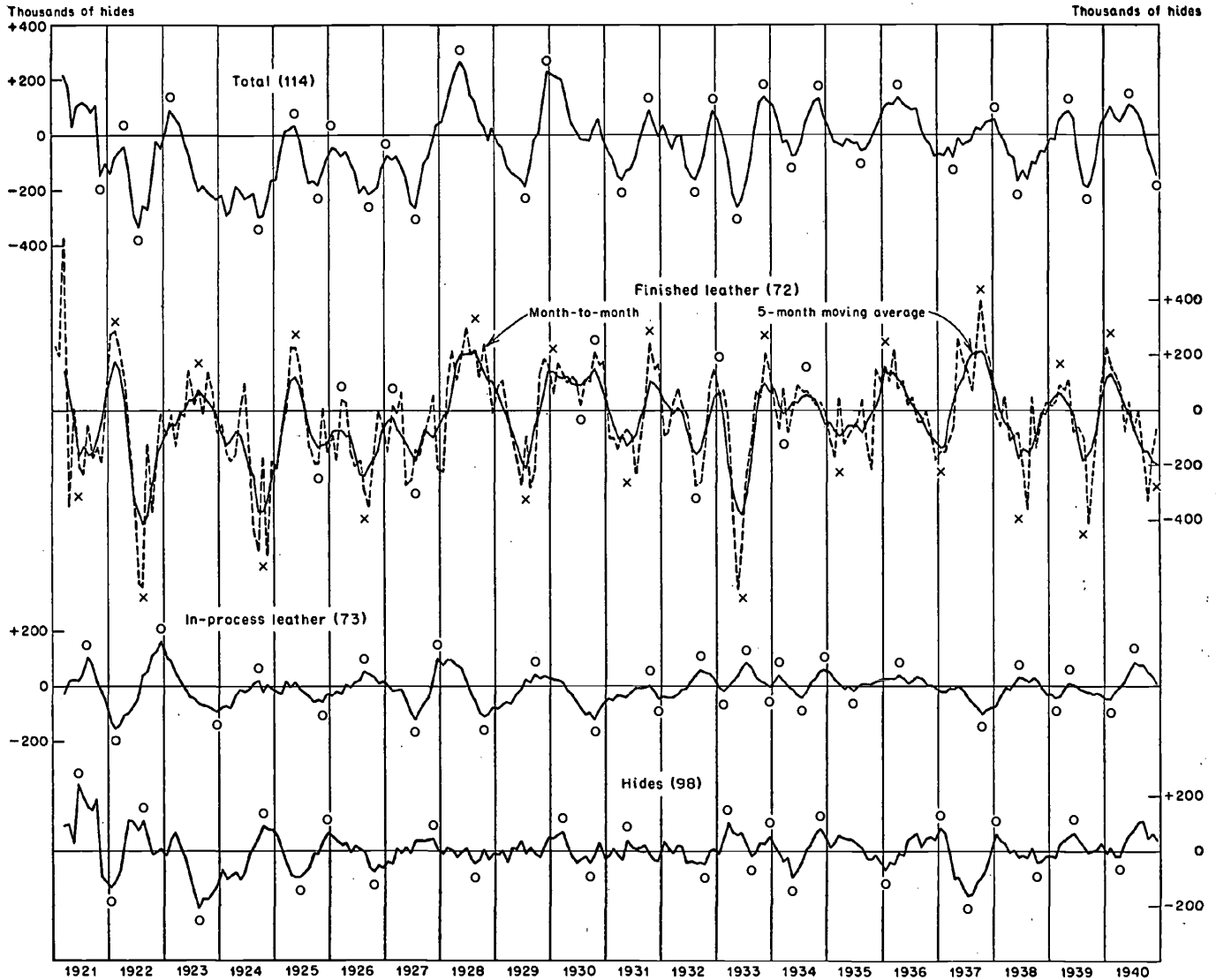
Average Reference Patterns for Tanners' Stocks of Leather and Hides and the Three Components, 1921-1940



Both the horizontal and vertical scales for the subcycle curves are double those for the cycle curves. For description of patterns and units see text notes 17 and 18.

CHART 34

Tanners' Inventory Investment in Leather and Hides and in the Three Components, 1921-1940



Specific-cycle turns are marked by X and specific-subcycle turns by O. For three of the series, major turns could not be usefully distinguished from minor turns.

Except for the month-to-month investment in finished leather, all series are centered five-month moving averages of month-to-month change.

accumulate stayed below about half that figure. Also, as the cycle diagrams in Chart 35 show, the differential rates of shipments and production are corrected long before a major swing in business runs its course. Shipments and output followed quite similar courses, on the average, during the three reference cycles, and inventory investment was little greater during the major declines than during major and minor alike; during the major rises, its pattern was confused and consequently lost.

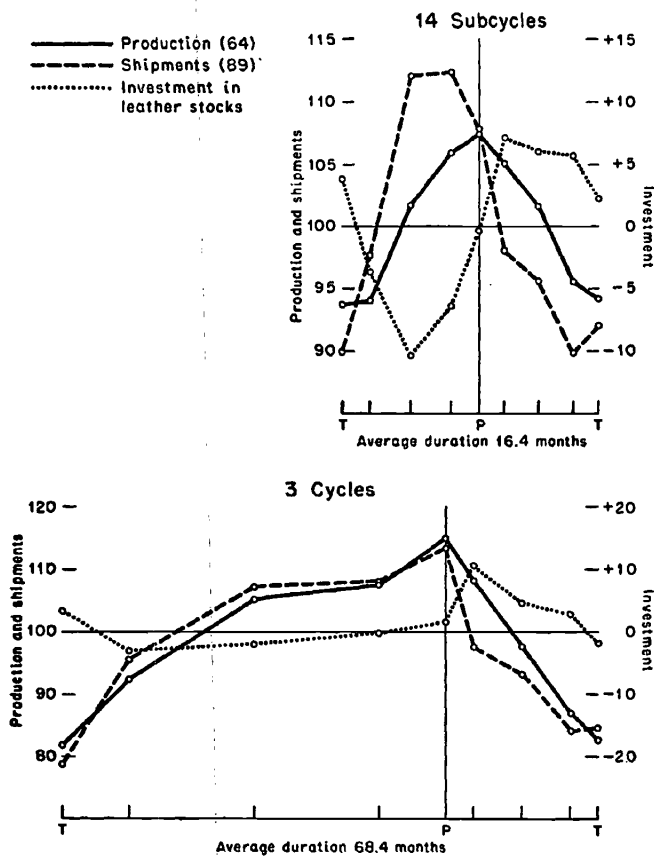
The tolerance of inverse movements of stock when efficiency dictates that they should be tolerated must

be affected by both degree of risk and the strength of the efficiency motive, consequently more tolerance is to be expected in the case of sole- than upper-leather stocks. Chart 36 indicates that the patterns of shipments are quite similar for the two sorts of leather but production responds far more agilely in the case of upper than sole leather. As a result, inventory investment undergoes stronger swings for sole than for upper leather, though the timing is about the same. For stocks themselves, the patterns are not very different for the two sorts of leather, since the fact that stocks are about twice as large for sole as for upper

leather means that a given percentage change involves much more actual inventory investment or disinvestment for the former than for the latter.

CHART 35

Average Reference Patterns for Tanners' Shipments, Production, Investment in Finished Leather Stocks, 1921-1940



Both the horizontal and vertical scales for the subcycle curves are double those for the cycle curves. For description of patterns and units see text notes 17 and 18.

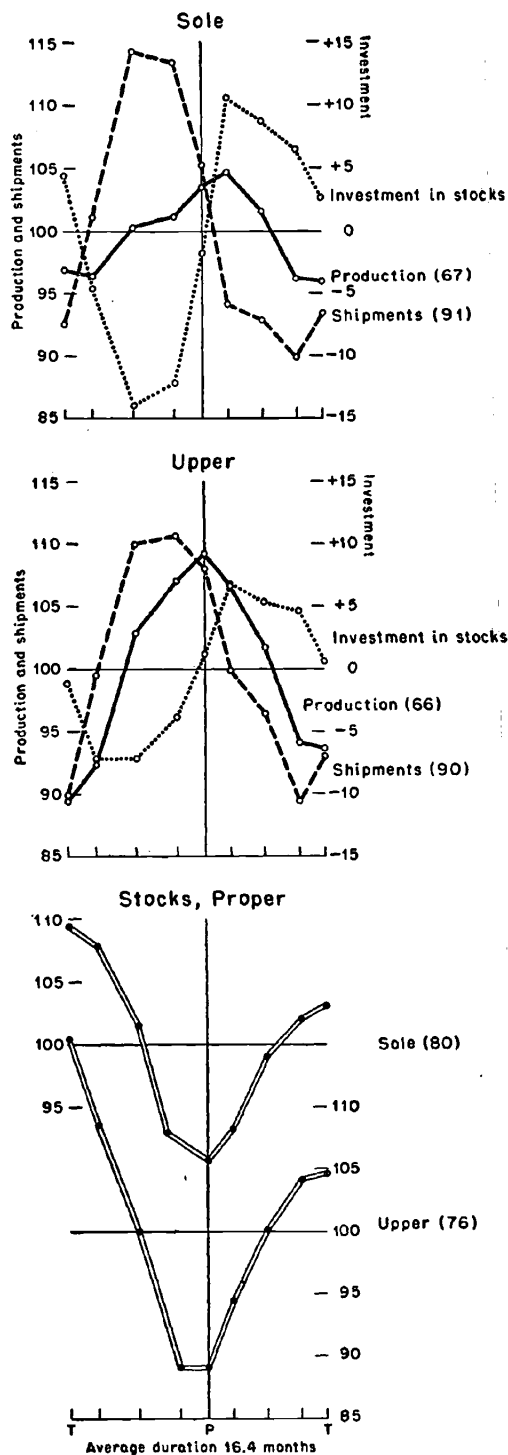
IN-PROCESS STOCKS

The association between the commencement and completion of the production process carries implications for the behavior of stocks in process. The amplitude measures in Table 51 indicate that total wettings have a slightly greater amplitude of fluctuation than finished-leather production. Though this would suggest a generally conforming pattern for investment in in-process stock (wettings minus production each month), it is slight and irregular both for subcycles and cycles, though stock proper conforms for both.

But total cattle-hide-leather stocks in process combine two substantially different segments. The size of in-process stocks is likely to reflect the length of the

CHART 36

Average Reference Subcycle Patterns for Tanners' Shipments, Production, and Finished Stocks of Sole and Upper Leather, 1921-1940



For description of patterns and units see text notes 17 and 18.

production period, and the lengths for sole and upper leather differ considerably. Other factors may influence the size and behavior of in-process stock; and it is instructive to isolate the portion of their behavior attributable, on the one hand, to the time required for physical processing, and, on the other hand, to variations in the processing time. A "minimum-service stock" was calculated from statistics on wettings assuming a typical but invariant time in process. (A two-month minimum period was used for sole leather, a one-month period, for upper leather.) The subtraction of these figures from total in-process stocks gave "hypothetical discretionary stocks."

For upper leather, total stocks do not parallel minimum service requirements; 39 per cent of the months are in opposite phase (synchronous timing). Consequently, the time in process is subject to substantial variation, for it is necessary to finish upper leather to the stipulation of each customer. After basic tanning has been completed, the leather is dried and held in the crust pending sale; when sold, finishing is rapidly completed. Discretionary in-process stocks thus become a secondary reservoir analogous to the primary pool of finished-leather stocks. The behavior of the secondary pool has a tendency to parallel the primary one—finished stock; on a synchronous basis, 28 per cent of the months are in unlike phase.²⁰ In the case of upper leather, then, the course of stocks is explained jointly by the need to provide rapid service for customers and the need to maintain a smooth work flow.

For sole leather, minimum-service stocks are closely parallel in their movement to total in-process stocks. Only 16 per cent of the months are in unlike phase (after allowing for a lead of stocks of one month), with an average deviation of 1.3 months for 24 matched turns. The size of total in-process stocks of sole is dominated by the physical requirements of production. Their behavior accords fairly well with the theoretical model for in-process stocks based on the assumption of a constant time in production, though not so well as to yield a constant lagged input-stock ratio.²¹ However, strong parallelism exists between first differences in wettings and in-process inventory investment; 17 per cent of the months are in unlike phase after allowing for a lag of investment of one or two months.²² Inventory investment slightly leads wettings proper; after allowing for a lead of one month, 23 per cent of the months are in unlike phase.²³

The difference in the behavior of in-process stocks in the manufacture of sole and upper leather during the subcyclical fluctuations in the industry is summarized in Chart 37. For upper leather, neither investment in in-process stock nor stocks proper have a sys-

²⁰ The corresponding figure for sole leather is 36 per cent.

tematic reference pattern. For sole leather, investment in in-process stock conforms and leads, whereas stocks proper parallel input, with a lag. The variability of output is less for sole than for upper leather.²⁴ There is an element of whimsey in the fact that this behavior of in-process sole-leather stocks, which conforms so nicely to the classic acceleration model, occurs at a spot where no one pays much attention to stocks—their size is largely a passive result of the character of the manufacturing process.

RAW STOCKS

Tanners' holdings of raw stocks tend to rise when production rises and to fall when production drops off; indeed the movements of stocks typically anticipate those of output. Investment in stocks lead by a longer interval. As in the case of in-process sole leather, there appears to be some tendency, at least during subcyclical fluctuation, for inventory investment to reach peaks and troughs ahead of output,

²¹ Assuming goods are put into production gradually and evenly throughout the month and that they require two full months to complete:

GOODS PUT IN PROCESS		GOODS ENTERED IN PRODUCTION ON MONTH INDICATED AT LEFT UPON SOME PART OF WHICH WORK IS BEING PERFORMED IN MONTH INDICATED AT TOP							
		Month							
Month	Number of Units	1	2	3	4	5	6	7	8
1	100	100	100						
2	110		110	110					
3	120			120	120	120			
4	150				150	150	150		
5	140					140	140	140	
6	110						110	110	110
7	100							100	100
8	90								90
Total goods in process or com- pleted		100	210	330	380	410	400	350	300
Goods completed				100	110	120	150	140	110
Goods in process at end of month		100	210	230	270	290	250	210	190

Units put in at the beginning of month 1 are completed just before the beginning of month 3, but it takes all of month 3 before the last of the articles started in month 1 are completed. The work still in process at the end of month 3 has been started during months 2 and 3. The starts during months 2 and 3 totaled 230, and averaged 115 per month. Stock at the end of month 3 was 230, to which the leading and averaged input figure bears a ratio of 0.5. The same ratio applies to other months.

The form of the table has been adapted from an analogous one dealing with the value of in-process stock (Moses Abramovitz, *Inventories and Business Cycles*, National Bureau of Economic Research, 1950, Chap. 8, p. 166).

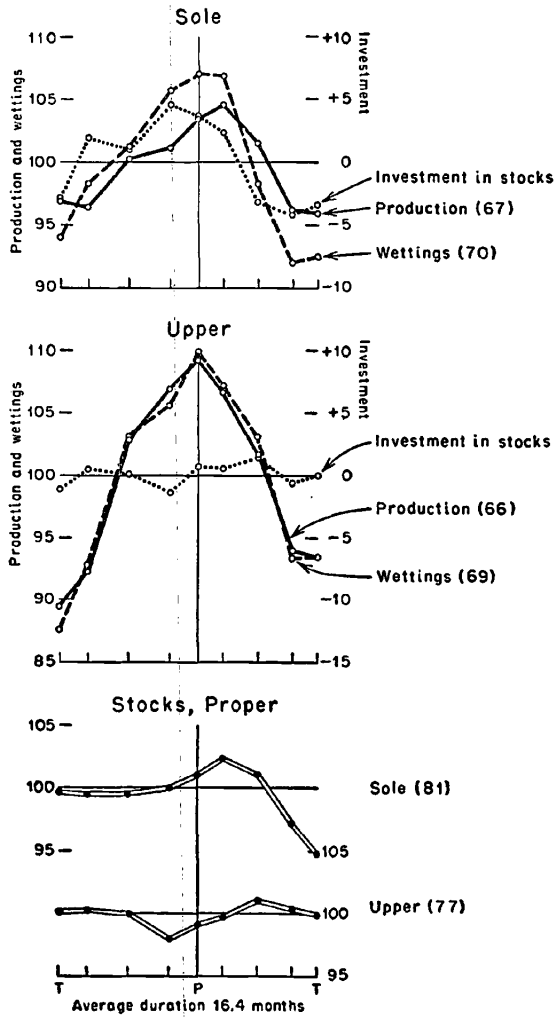
²² The corresponding figure for upper leather is 40 per cent.

²³ The corresponding figure for upper leather (after allowing for a lead of 2 months) is 42 per cent.

²⁴ Specific subcyclical amplitude for sole leather is 1.90 per cent per month of the average standing; the corresponding figure for upper leather is 2.88. For specific cycles matched with reference cycles the figures are 1.07 and 1.35.

CHART 37

Average Reference Subcycle Patterns for Tanners' Production, Wettings, and In-Process Stocks of Sole and Upper Leather, 1921-1940



For description of patterns and units see text notes 17 and 18.

thus contributing to the earlier flow an element that tends to anticipate turns in the later one. The relationships are shown in Chart 38. In trying to analyze this behavior of tanners' raw stocks and to learn what light it throws on the operation of tanneries and the association between buying and selling, we want not only to consider, as for the other stock piles, what they suggest about inventory objectives, but also to exploit their particular position in the sequence of operations. If wettings are predicated on maintaining a smooth work flow, and hide purchases on this and a variety of other considerations, it is possible that the size of stocks or their rate of change at this first port of call may show influences affecting buying

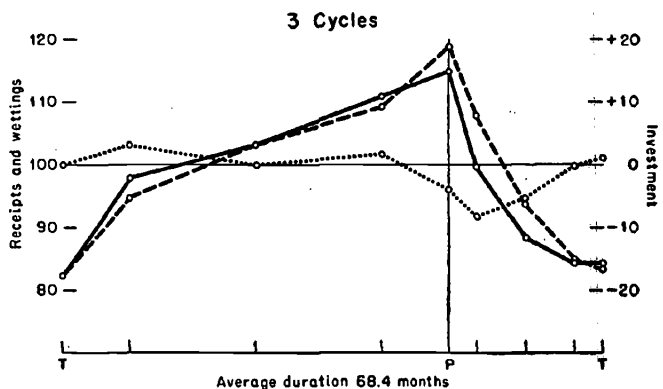
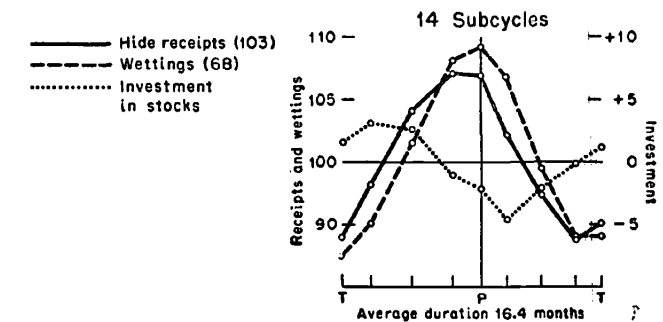
not visible in statistics on total buying. Several sorts of influences may combine to shape the course of raw stocks, and we can examine them one by one. As it is also desirable to study raw stocks both on order and on hand, we make use of the constructed series for hypothetical orders (stocks on hand and on order are computed by recording imports two months earlier, presumably at the time the order for them was placed).

The first factor that may influence the size of raw stocks is the time required for hides to be received and sorted. Were this the only factor, and were it to take an invariant time, raw stocks would vary with hide receipts. Even if the relationship were a loose one, investment in stocks might parallel the rate of change in receipts. But this is not the case; 32 per cent of the months are in unlike phase and the average deviation is high.

To see what other factors may influence stocks, Table 53 was constructed. It is built according to the same two-way principle as the previous one, and shows the same four figures on the relationship between an indicator and an activity. But the burden of the table

CHART 38

Average Reference Patterns for Tanners' Receipts, Wettings, and Investment in Raw Hide Stocks, 1921-1940



Both the horizontal and vertical scales for the subcycle curves are double those for the cycle curves. For description of patterns and units see text notes 17 and 18.

TABLE 58

Timing of Tanners' Hide Stocks Compared with Selected Data, 1921-1940

The following pattern has been followed in each pair of columns and pair of lines:

First line	(a) Columns	(b) Columns
Average timing of turns, ^a months	Mean lead (-) or lag (+)	Average deviation
Second line	Months in unlike phase; ^b timing that maximizes correspondence	% of all months

REFERENCE FRAMES: INDICATORS OF FLOW OF OUTPUT OR PRICE AS SPECIFIED IN COLUMN HEADS ^c

HIDE STOCKS	LEATHER SHIPMENTS		WETTINGS		HIDE PRICES		MARGINS	
	Proper (a) (b)	First Differences (a) (b)	Proper (a) (b)	First Differences (a) (b)	Proper (a) (b)	First Differences (a) (b)	LIFO (a) (b)	Adjusted (a) (b)
Raw:								
Stocks (98)	+1.9 3.1 +1 41%	+3.0 3.7 +3 45%	0.0 2.4 0 35%	+1.3 2.6 +1 47%	+0.7 2.7 0 37%	+1.3 2.6 +1 47%	-0.5 2.4 -1 30%	-0.9 2.4 -1 35%
Stocks on hand and on order (100)	+0.1 1.9 0 35%	+1.5 2.3 +1 36%	-1.8 2.2 -1 33%	+1.2 1.8 +1 32%	-1.5 1.8 -1 28%	+1.2 1.8 +1 32%	-0.6 3.1 -2 44%	-0.7 2.7 -1 44%
First differences ^d in stocks	0.0 2.4 0 36%	-1.0 1.9 -1 32%	-1.4 1.4 -1 31%	-1.7 1.8 -2 39%	-0.4 4.3 -2 51%	-1.7 1.8 -2 39%	-1.8 3.4 -4 89%	-0.7 3.2 0 56%
First differences ^d in stocks on hand and on order	-0.2 1.3 0 30%	-0.8 1.6 -1 29%	-2.1 1.8 -2 43%	-1.2 1.8 -2 36%	-1.8 2.2 -2 44%	-1.1 1.9 -1 35%	-0.7 3.6 -3 53%	-1.4 3.3 -3 51%
Raw and in-process:								
Stocks (112)	+1.3 1.6 +1 37%	+3.4 3.0 +4 40%	+0.6 2.9 0 34%	+1.6 2.5 +2 42%	-0.3 2.7 0 40%	+1.6 2.5 +2 42%	+0.2 2.6 -1 34%	-0.1 2.7 -1 38%
Stocks on hand and on order (113)	0.0 1.6 0 34%	+1.7 2.6 +1 39%	-0.9 2.5 0 34%	+1.4 2.1 +1 35%	-1.1 2.1 -1 31%	+1.4 2.1 +1 35%	-1.9 3.4 -2 38%	-1.8 3.2 -2 41%
First differences ^d in stocks	+1.0 2.0 +1 38%	+0.8 2.2 0 32%	-0.7 2.3 0 30%	-0.5 2.2 0 36%	-0.7 2.3 0 30%	-0.5 2.2 0 36%	-3.3 4.4 -3 52%	-2.2 4.3 -3 53%
First differences ^d in stocks on hand and on order	-0.7 1.6 0 31%	-0.7 1.8 -1 30%	-1.1 1.7 -2 36%	-0.8 2.1 0 35%	-0.8 2.1 0 35%	-0.8 2.1 0 35%	-0.6 3.8 -1 66%	-1.4 3.6 -3 53%

^a Comments on timing measures are given in Appendix A, sec. 11a.

^b The method of calculating the percentage of months in unlike phase is given in Appendix A, sec. 14.

^c The reference frames are the series proper or their first differences in the following: leather shipments 89, leather stocks 72, wettings 68, hide prices 23, margins: LIFO and adjusted 18 in Appendix B.

^d First differences are centered five-month moving averages of month-to-month change.

^e When the association is inverse, specific peaks are matched with reference troughs and specific troughs with reference peaks.

is a persistent denial of noteworthy relationships. In each column, indicators are selected that typically lead enough so that an association with the stock series given in the stub might both be close and have economic meaning. But nowhere does an arresting similarity appear. The one possible exception is the low average deviation in the rate of change in raw stocks on hand and on order and of shipments of finished leather—the average deviation for 25 matched turns is only 1.3 months. Apparently tanners stop increasing the rate at which raw stocks on hand and on order are building up at just about the same time that the rate by which shipments of leather are increasing ceases to rise, and similarly for rates of fall, though occasionally there are movements in one activity not matched by those in the other (the percentage of months in unlike phase is not low). It is possible that these facts also reflect the impact of tanners' unfilled orders, which may usually parallel the rate of change in shipments, or hide buying. (I do not call attention to the low average deviation in the timing of turns for monthly differences in raw stocks and in wettings since it applies to only 19 turns.)

If there are no causal factors visible in the stocks or in their rate of change, the question arises whether they might be if the volume of output is, in a sense, held constant by the computation of a stock-turnover ratio. But tanners' stocks exhibit the same characteristic that appeared for leather-goods manufacturers' stocks; subcycles in turnover of raw stocks either on hand or on order are entirely dominated by the behavior of stocks. Therefore, we cannot judge whether there were times when stock accumulation seems to have been unusually large or small. Nor does there appear to be a tendency for stock turnover to vary only within limits (as seemed to be the case for leather stocks of shoe manufacturers).²⁵

Some of the logic that dictates the separate examination of raw stocks and in-process stocks dictates a study of their combined patterns. Both have a generally positive association to output, and it is possible that stocks move from the raw to the in-process state entirely on the basis of operating convenience; intentions concerning their proper size may involve only the combined sum of raw and in-process stocks. This is, after all, the stock aggregate that we studied for shoe manufacturing. But the comparisons made in Table 53 for raw and in-process stocks are no more informative than for raw hide stocks alone.

The turnover ratio, on the other hand, is informa-

²⁵ The ratios remain uninformative no matter how they are computed. For the most part production is the numerator, though for some calculations wettings were substituted. Hides on hand and on order were used as well as on hand only.

tive. Raw and in-process stocks tend to turn faster when production rises than when it falls; in other words, fluctuations in the ratio are dominated by production (the numerator) rather than by stocks. But when raw hide stocks hypothetically on order are included in the total, the parallelism with output has notable exceptions. There are eleven periods between 1921 and 1940 when, as stocks rise and turnover falls, output rises.²⁶ Here, as in the case of retailers' stocks, it is reasonable to suppose that the unusual behavior of the ratio points to periods when a voluntary extension of the market position was taking place.

Chart 39 shows the ratio and its two components—leather production and tanners' raw and in-process hide stocks on hand and hypothetically on order. (The areas to which I refer are shaded on the chart.) The five-month moving average of change in stocks (also drawn on the chart) shows that stocks were not only rising, but rising at very high rates, during these periods. Table 54 summarizes other characteristics. Orders for imports were in rising subcyclical phase during most of the months (column 1). Since imports take longer to deliver than domestic hides, they are, in effect, the counterpart at this stage of advanced orders at others. Tanners' finished stocks of leather were typically in a contraction phase (column 2). These hints concerning the state of demand are matched by a suggestion of tightening supplies, for packers' hide stocks are falling (column 3). Particularly interesting is the indication (in column 6) that tanners probably were wise to buy when they did. Hide prices were, with one exception, lower during the period when ownership position was presumably being extended than during the following six months when purchases would eventually have had to be made. Still more surprising is the indication in the table (column 4) that these periods were times throughout which that unreasonably reasonable series—the market profile—pictured shoe retailers extending their ownership position (though a number of periods of apparent extension in shoe buying do not show here).²⁷

BEHAVIOR OF TANNERS' TOTAL STOCKS

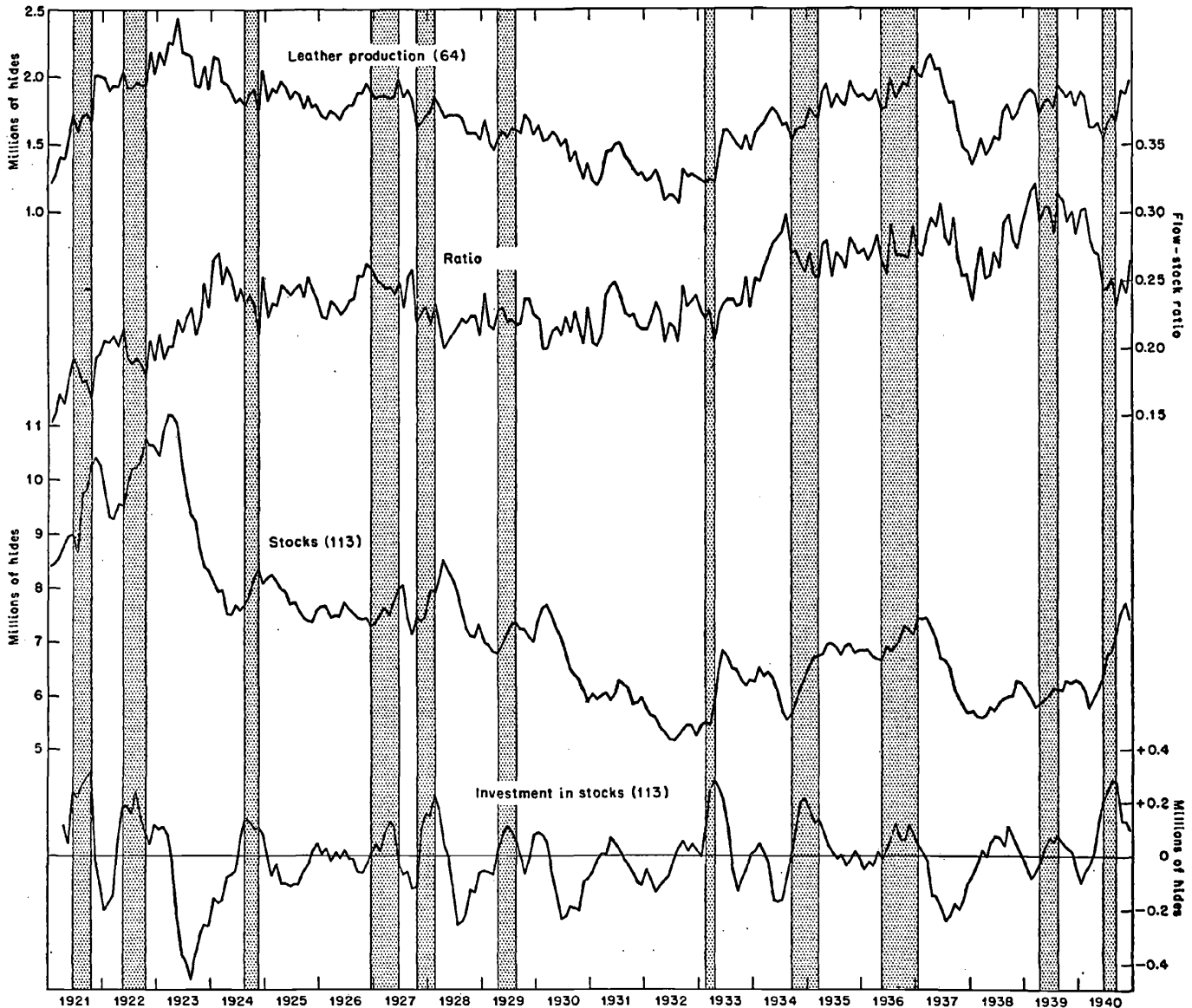
Discussion with tanners suggested that the volume of buying is closely geared to the volume of leather

²⁶ In one case, the period marked in 1922, production remained level between two periods of rapid rise. In two other periods marked in 1929 and in 1936 the ratio remained level though production rose sharply, that is, stocks increased proportionately instead of less, as was usually the case.

²⁷ It does not seem possible to make an analogous calculation for periods of liquidation. Production typically fell when retrenchment took place. Consequently the method is not applicable. In most of the cases when production did rise during a period when

CHART 39

Tanners' Raw and In-Process Hide Stock on Hand and Hypothetically on Order Compared with Leather Production, 1921-1940



Shaded areas are periods of hypothetical market extension; months during which the ratio (120) fell (the rate of turnover slowed down) though production (64) and stocks (113) rose. Three periods were included when the general situation implied by these requirements was present, though the formal requirements were not: from May to October 1922 production was level although stocks rose and the ratio fell; from April to August 1929 and May 1936 to January 1937 the ratio was level though production and stocks rose sharply. Investment in stocks (113) is a centered five-month moving average of month-to-month change. Ratio is ratio of production to stocks, series 120 in Appendix B.

sales. Consequently the difference between the two, or rather between shipments and receipts, may reflect objectives with respect to the size of stocks, or other reasons for buying more at one time than another. The data show, however, that tanners' stocks of hide and leather seem primarily to reflect the reservoir function

of stocks; they have an inverse subcyclical association to shipments.²⁸

Even during periods when ownership position in raw hides and unfinished leather seems, on the basis of criteria just described, to be undergoing extension,

the ratio fell, the retrenchment might simply be attributed to the aftermath of previous extension, since they followed such periods.

²⁸ Total tanners' stocks and leather shipments, matched inversely, are in unlike subcyclical phase 28 per cent of the months, and for first differences of both series the figure is 26 per cent. For stocks on hand and on order, all of the associations are relatively low.

TABLE 54

Periods of Tanners' Hypothetical Market Extension: Selected Characteristics, 1921-1940^a

PERIOD	PERCENTAGE OF MONTHS COVERED DURING WHICH:				RATIO TO AVERAGE STANDING DURING THE PERIOD OF:	
	<i>Orders for Imports Are in Rising Phase</i> ^b (1)	<i>Tanners' Leather Stocks Are in Falling Phase</i> ^c (2)	<i>Packer Hide Stocks Are in Falling Phase</i> ^d (3)	<i>Market Profile Is in Rising Phase</i> ^e (4)	<i>Finished-Stock Turnover Rate Six Previous Months</i> ^f (5)	<i>Hide Prices Six Following Months</i> ^g (6)
June to October 1921	60	100	100	h	0.670	1.155
May to October 1922 ^h	67	100	50	h	0.790	1.054
August to November 1924	75	100	50	h	0.805	1.072
December 1926 to June 1927	100	71	100	h	0.861	1.330
October 1927 to February 1928	80	80	60	100	0.930	1.055
April to August 1929 ⁱ	80	100	80	20	0.804	0.920
February to April 1933	100	100	100	100	0.966	1.869
September 1934 to March 1935	100	57	100	100	1.027	1.237
May 1936 to January 1937 ^j	67	78	78	100	1.024	1.336
April to August 1939	80	80	100	100	1.066	1.242
June to September 1940	100	100	100	100	1.025	1.148
Average	82 ^k	85 ^k	83 ^k	89 ^k	.906 ^l	1.220 ^l

^a Market extension is identified by period when the ratio (120) of cattle-hide leather production to tanners' raw and in-process stock on hand and on order falls though production and stocks rise.

^b Series 106 in Appendix B.

^c Series 72.

^d Series 101.

^e The construction of the market profile is presented on p. 117.

^f Ratio (86) of tanners' leather shipments to their finished leather stock.

^g Series 22.

^h The market profile begins in June 1926.

ⁱ Production did not rise, but remained level, although stocks rose and the ratio fell.

^j The ratio did not rise, but remained level, although production and stocks rose sharply.

^k Average for all months covered by the eleven periods.

^l Average for eleven periods.

total stocks contract as often as they expand (receipts exceed shipments as often as they fall short of them). Moreover, the rate of change in total stocks is typically in falling phase (the deficiency of receipts relative to shipments increases or the excess decreases).²⁹

Margins also need to be examined in the context of motive for the association of buying and selling. Margins may be defined for the purpose as the spread

²⁹ I calculated the percentage of all months designated as periods of hypothetical market extension in Table 54 during which tanners' total stocks were in rising phase. For total stocks of leather and hides proper, the figure was 48 per cent; for first differences in stocks it was 32 per cent. These figures are computed in exactly the same way as those in the last line of Table 54.

Ideally, one would wish to make these comparisons for buying and selling rather than for receipts and shipments, but we have no figures for leather selling. Using data on total tanners' stocks on hand and on order as hypothetical hide buying we can compare this with leather shipments. But this presents a distorted picture. Leather sales probably differ from leather shipments in somewhat the same fashion as hide purchases differ from hide receipts. To include the differences at the input end and exclude it from the output end highlights its importance. Hide purchases, as calculated here, differ from hide receipts precisely at times when imports (the main form that market extension in hides takes) are heavy. Consequently, the mechanics of the comparison weights the answers in favor of coincidence between periods of rising total stocks on hand and on order and periods designated (see Table 54) as market extension in hides. The percentage of months of extension during which tanners' total stocks proper on hand and on order rise is 72 per cent; for first differences, it is 65 per cent.

between current raw hide and leather prices. Before the mid 1930s when trading on the hide exchange was not large, there is a hint in the data of a tendency for tanners to receive increasingly more hides than they ship leather (inventory investment to rise) when the price spread widens (LIFO margins rise); from the middle of 1921 to the end of 1934, 30 per cent of the months were in unlike phase after allowing for a one-month lead in margins. Beginning in 1935 (when, it will be recalled, margins also varied much less than before) all trace of correspondence evaporates. Read in conjunction with tanners' insistence on the necessity to consider the price at which leather sells in determining what to pay for hides, I interpret these figures as underscoring our earlier conclusion: The need to keep buying prices in line with selling prices (which may well influence the detailed pattern of buying with respect to selling) tends to erase at least one-half of the evidence—alteration in the spread between the two prices. The erasures are more complete the more sensitive is the machinery for trading.

An interesting result might follow from the impact of these current price comparisons on buying. Tanners may be responsible for sensitizing the industry to changes originating in the leather or shoe market. Weakness in the leather market may receive no general publicity, since it is felt largely in the course of individual trading transactions and is not reflected

in the sticky reported price of leather. But tanners, realizing that weakness is developing, cannot pay the asking price for hides and still maintain the proper margin. Their hesitation reflects itself in weakening hide prices. But this weakness is apparent to all in daily hide-price open-market quotations. Because so many eyes are focused on the rate at which hide prices are changing—shoe manufacturers' as well as tanners' and hide producers' or dealers'—turns may be set ahead by these actions of tanners directed toward preserving proper operating margins. Their action communicates to hide markets, where it is visible to all, early indications of developing weakness or strength in the leather markets, where it may for a while at least be invisible. One thing is clear, hide prices do exhibit weakness or strength, especially weakness, earlier than leather prices. This is attested to by the fact that though hide prices proper show an average synchronous association to leather prices proper, first differences in hide prices reach peaks or troughs earlier than first differences in leather prices at 16 matched turns, they lag in 3, and are synchronous in 5; their average lead is one and a half months.

However, the statistics on total stocks do seem to have something to say about the operation of tanneries: it concerns the limits within which stocks fluctuate. Inventory investment in leather and hides stayed within virtually the same limits as did inventory investment in leather alone, though it is hard to say what this means.³⁰ More interesting is the relatively narrow band of fluctuation of stocks proper.

After World War I, tanners, having been severely hurt by price declines on swollen inventories, endeavored to reduce their stocks to the level necessary to efficient operation. The downward trend prior to 1927 in each sort of stock and in the total was the result. From then to the end of 1941, stocks varied within absolute limits of a maximum of about 11.6 million hides and a minimum of 9.0 million hides, while production varied between 2.4 and 1.1 million hides a month. Thus, though output increased by 118 per cent of its minimum, stocks increased by 29 per cent of theirs. If this information is combined with the fact that the cyclical pattern of leather and hide stocks is unresponsive and that the subcyclical pattern is inverse, a clearer picture is obtained of what tanners

³⁰ The maximum rate of increase is an average of about 200,000 hides a month over a five-month period, though it was seldom over 150,000. The maximum decrease, though seldom more than 200,000 reached a rate of 300,000 at three different times. Just what these figures mean is hard to say, since the limits are not regular. About all that can be said is that if stocks pile up too fast, action seems to take place—whether automatic or planned—that results in reduced accumulation. The same may be said of the rate of fall in stock, except that the permissive band seems to have been wider.

mean when they say that inventories are virtually like fixed plant: a certain amount is required to do business, and this amount is not subject to much short-term manipulation. Only if broad conditions of operation, purchase, and sale change are stocks likely to undergo substantial change. This was the case after World War I; it may be the case again. But during the fourteen years between 1926 and 1940, stocks were not much changed, except insofar as minor change was implicit in their shock-absorber function.

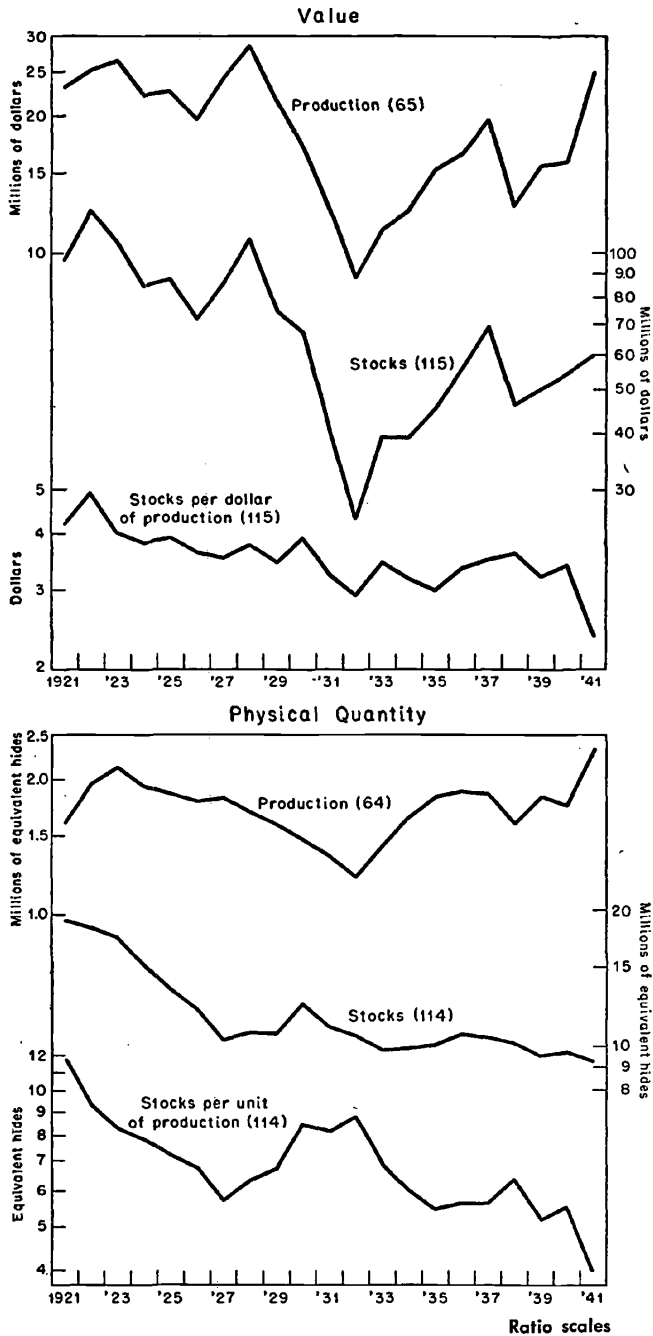
Many reasons have been given why this behavior of stock is feasible in a tannery but not in a retail store or shoe factory: considerations involving inventories are subordinate in tanning to those involving selling, buying, and productive efficiency; the risk of loss through physical deterioration or style obsolescence is low; many of the actual storage costs (the expense of providing leather storage rooms and hide cellars) exist regardless of how much they are used. But there is a further cost directly relevant to the behavior of tanners' total stocks—financing. Tanners pay for hides upon delivery and receive payment for leather upon shipment; hence neither suppliers nor customers finance tanners' inventories. The money tied up in them depends on their cost, and it would be instructive to learn what costs actually had been over the years.

The hide cost of leather is often recorded on an actual lot basis. To approximate such cost on a first in, first out (FIFO) assumption is not very realistic when stocks are as large as those of tanneries. It seemed sensible to abandon an effort to reproduce this true cost and calculate costs at market; for, current hide prices seem always to have played an important part in tanners' thinking, and LIFO accounting was formally adopted by many firms as soon as it was legalized for tax purposes in 1939. The first section of Chart 40 shows these current hide costs estimated for the hide content of tanners' stocks of hides, in-process, and finished leather.³¹ So defined, the value of tanners' inventories fluctuate widely over the years. But they parallel the fluctuations in the value of tanners' leather production calculated at the current price of cattle-hide leathers. In consequence, the hide value of stocks per dollar of output has, the chart reveals, a steady appearance, particularly in view of the wide variations of its two components. Its average deviation (to which the downward trend contributes) from the mean for the years 1921 to 1941 is 10.4 per cent of the mean. The physical-volume measures tell a very different story. Physical production has far

³¹ The level of the figures is somewhat distorted since, in converting pounds or feet of finished and in-process leather to equivalent hides of leather, I made no allowance for loss in hide poundage in the tanning process. The figures should be read as rough approximations.

CHART 40

Value and Quantity of Tanners' Hide and Leather Stocks and Leather Production, Annual, 1921-1941



milder cyclical fluctuations than those of the value of production, since they are not reinforced by parallel movements of leather prices. Stocks in physical units are very stable indeed once they reach the reduced level of 1927. But the ratio of stocks to output in equivalent hides is far more variable than the corresponding dollar ratio. Its average percentage deviation from the mean between 1921 and 1941 is 19.4 per cent. Had

interest rates been uniform over the years, and had hide cost, as calculated, provided a true image of the value set on the hide component of stocks, the dollar ratio in the chart would have traced the change in one important financial carrying cost of stock. Neither assumption is realistic; nor can we correct for the lack of realism. But if we could, it seems clear that the central point would hold—the wide fluctuations in prices that parallel those of output alleviate some of the burden of heavy inventories in times of slack trade.

Summary

Tanners' buying, like that of shoe manufacturers or retailers, follows the course of sales quite closely. The difference between this and the other stages lies in the relatively small divergence between current selling and current buying, which results in changes in stocks on hand and on order. For tanners, there is a tendency for fluctuations in buying to be somewhat less severe than those in selling, so that inventory investment mutes slightly the backward transmission of subcyclical, though not cyclical, fluctuations in sales. The difference between this mild muting and the strong amplification of subcyclical fluctuation at the other stages has very considerable economic significance. Accordingly, it is necessary to scrutinize carefully all the information that may help toward an understanding of the factors responsible for the basic pattern.

The inverse subcyclical pattern of tanners' stocks is possible because stocks are large enough to act as shock absorbers for the short wave, though not for the true business cycle. Large stocks are in part a corollary of the long production process that sole leather undergoes. But they are large also as a matter of choice (note the large stocks of in-process upper leather for which production is swift, and of finished stocks of all sorts of leather).

If a large stock of goods is to be carried, the goods must be resistant to physical and economic deterioration. The tanner can buy hides on a speculative basis and will not typically find himself unable to sell leather made of those particular hides—a class of hazard in forward buying familiar to the shoe retailer or even the shoe manufacturer. This means that the cost of carrying large stocks is not prohibitive. Whether it is advantageous to support such costs as there are depends on what economies in other branches of the business result directly or indirectly from procedures that imply, of necessity, that stocks must be fairly large and somewhat removed from the focus of management attention. We have seen that these economies reach into all branches of the business and involve

the basic strategy of marketing, procurement, and production; they are a function not only of the physical and institutional characteristics of the environment with which tanners cope, but also of the character of prices and pricing. Our investigations and speculations supply a partial and tentative list of the economies.

Jumpy production schedules are impractical and costly both because of the character of the process and of the work force required for tanning and finishing leather. Consequently, hides move into and through production in a way that maximizes evenness in work flow. There is evidence, especially for sole leather, of efforts to guide output on the basis of the relatively smooth course of consumption of leather in finished-leather goods rather than on the basis of tanners' orders or shipments. Jumpy buying is also impractical and costly since the supply of hides that provide optimum materials for the various sorts of leathers is limited. Tanners buy hides as they become available.

The financial cost of smoothing the flow of hides into and through tanneries, which implies inverse subcyclical fluctuations in stocks, is lessened by the highly flexible price of hides. Stocks move inversely during subcycles but tend to reverse their trend over longer movements so that they have little cyclical pattern. In view of the fluctuations in output, this involves a larger number of units of stock per unit of output in bad times than good. But strong positive fluctuations in hide prices, and the positive but smaller fluctuations in leather prices, mean that the dollar investment in hide content of stocks (with the implication this carries for financing cost) tends to bear a fairly constant relation to the value of output.

Relatively large stocks make it possible to meet short-term fluctuations in consumers' buying by building up or drawing down stocks. The rapid deliveries thereby facilitated appear to be considered advantageous or necessary in view of the institutional arrangements that have grown up.

Large stocks of finished product mitigate against the presence of a clearly defined period between a customer's order and the latest date when hides must enter production. Consequently, there is not a distinct period of option during which buying must be done. This means that the tanner is not automatically faced with the problem (familiar to the shoe manufacturer or retailer) of when, within this period, he ought to buy. Instead, tanners seem to make comparison between the price of raw material and finished product at current prices for both. Hides should be bought if it seems likely that current leather prices will cover the cost of manufacture and provide a proper profit. The steadiness of the spread between leather and hide

prices seems to indicate that the enforcement of this principle has worked as a type of arbitrage between leather and hide prices, keeping the one adjusted to the other. The facilities of the Hide Exchange may have helped to achieve this effect. They may also have replaced price-motivated shifts in actual hide buying by purchase and sale of hide futures; but though it seems reasonable that this might have occurred, we find no evidence of it. Thus, when attention focuses on current price relationships, a judgment as to when to buy, in view of price prospects, does not necessarily lead the tanner (like the shoe manufacturer) to buy actual hides ahead if he thinks prices may rise slightly or to wait if they are expected to fall slightly.

Another reason why tanners do not seem to resort readily to shifts in market position is that the price motive for doing so is not reinforced by advantages with respect to deliveries and selections implicit in an advance, as contrasted with a spot, order. For hides, all purchases are spot, though imports share the characteristics of the long-term advanced order for shoes in that they take several months to arrive. They also seem to share the characteristic of being resorted to in times of scarcity or of fear of rising prices. But in tanning, periods when more than usual hide buying is taking place seem to occur less frequently than at the later stages. Apparently, the expectation of either scarcity or higher prices must be strong and clear to activate a marked buying movement for hides. It is interesting to find the figures suggesting that the additional purchases were often well timed in the sense that a lower price was paid than would have applied had purchasing been delayed. But even when tanners seemed to be making special provision against future scarcity or price increases of raw hides, they did not typically increase their total holdings of leather and hides together. Their additional purchasing of hides tended to be counteracted by additional finished leather purchasing of their customers.

Instead of the amplification found at other stages, this general scheme produces a damping of at least minor fluctuations of demand. Does it also produce a tendency to delay turning points instead of the tendency to set turns ahead found at the other stages? As far as I can tell, it does not. There is no evidence that hide buying reaches turns clearly later than leather sales. Even were this the case, it would not necessarily mean that the net influence of tanners' operations delays the turning points in fluctuations. For one thing, as we shall see in the next chapter, it is possible that turns in hide prices and their rate of change may be accelerated by the way in which tanners' buying is distributed between domestic packer hides and coun-

try or foreign hides. But it is also possible that when change originates in the leather markets, tanners may be responsible for giving it an earlier impact on the industry at large than it would have were the need to protect gross operating margins on a current-cost basis less engrained in tanners' operations. Weakness in leather prices is doubtless felt by tanners in the course of their day-to-day trading long before it shows in the statistics or even in actual prices paid for leather. The sensed weakness makes tanners less willing to pay current hide prices and thus tends to transfer the weakness to actual prices paid for hides on the open market where all may see. Here, then, where selling prices respond sensitively to changes in the price of the basic raw material, prices can act as a timing accelerator which tends to advance the date of response in early

compared with later stages. But whether they actually operate to set turns ahead, they certainly operate to convey changes in later stages to the earlier stages, as well as, of course, in the opposite direction—from earliest stage to later ones.

In general, though tanners certainly share with retailers and shoe manufacturers the basic pattern of buying what they expect to sell, the finer aspects of that pattern, carrying considerable economic importance, result in muting of minor fluctuations at this stage, whereas they were amplified at others. However, there is no delay in the transmission of fluctuations and there may even be a timing acceleration. The factors responsible for these differences are found in every corner of the physical, institutional, and financial aspects of the business.