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II. AVERAGE WEEKLY HOURS AND RELATED ACTIVITIES

SOME AGGREGATE MEASURES

Average hours worked are related to general business conditions through specific activities that influence or are influenced by the length of the workweek. In order to throw light on these relationships, we present Chart 1 and Table 1, which permit us to compare turning points for three

Table 1

Weekly Hours and Related Economic Activities, All Manufacturing, 1921-1956

Lead (−), Lag (+), or Coincidence (0) at Business Cycle Turns, in Months

			LABOR INPUT			OUTPUT AND SALES		
	Business Cycle Turns[a]		*Av. Weekly Hours*	*Employment*	*Man-hours*	*New Orders*	*Sales*	*Production*
T	July	'21	− 5	0	− 1	− 6	n.a.	−3
P	May	'23	− 6	+2	+ 2	− 5	n.a.	0
T	July	'24	0	0	0	−12	n.a.	0
P	Oct.	'26	−11	−9	−10	−12	n.a.	0
T	Nov.	'27	+ 5	+4	+ 5	n.a.	n.a.	0
P	June	'29	+ 4	+1	+ 1	n.a.	+1	+1
T	March	'33	− 8	+1	− 8	0	0	−8
P	May	'37	− 2	+2	− 1	− 5	−1	0
T	June	'38	− 6	0	0	− 1	−1	0
T	Oct.	'49	− 4	0	+ 1	− 3	+2	+1
P	July	'53	− 7	−3	− 3	− 7	0	0
T	Aug.	'54	− 4	0	0	− 8	+2	−1
Averages:								
All Peaks			− 4.4	−1.4	− 2.2	− 7.2	0	+0.2
All Troughs			− 3.1	+0.7	− 0.4	− 5.0	+0.8	−1.6
All Observations			− 3.7	−0.2	− 1.2	− 5.9	0	−0.8

n.a.: Not available.

[a]The February 1945 peak, October 1945 trough and November 1948 peak are omitted. See text and source note on page 16.

(Table 1 continued)

Source: *Labor Input:* Data refer to production workers. NICB data were used to 1935, BLS data thereafter. This was done to provide comparability with later tables which contain no BLS information for the Great Depression. If measures based on BLS data were substituted at the 1933 trough, the resulting labor input measures would be:

	Average Weekly Hours	*Employment*	*Manhours*
T March '33	−7	−8	−7
Averages			
All Peaks	−4.4	−1.4	−2.2
All Troughs	−3.0	−0.6	−0.3
All Observations	−3.6	−0.9	−1.2

No entries were made for the 1948 peak, since the average hours, as reported by the BLS show no specific turn. The NICB series on average hours shows an 11 month's lead at this turn which can be established although the series is discontinued after July 1948. Timing measures for employment and manhours cannot be derived for the NICB series. For the BLS series they both show a lead of 10 months at this turn.

New Orders: 1921-1930 based on indexes compiled by Department of Commerce. 1930-1939 based on NICB indexes. Thereafter based on series published by Department of Commerce. The series cover durable goods industries and those non-durable goods industries which report unfilled orders.

For a more detailed description of concepts and derivation, see Victor Zarnowitz, "The Timing of Manufacturers' Orders During Business Cycles", Table 5 and accompanying text, to be published by the National Bureau of Economic Research.

Sales: 1920-1938: NICB, value of manufacturers' shipments. 1947-1957: Department of Commerce, Manufacturers' Sales.

Production: Federal Reserve Board, Index of Industrial Production, Manufacturing segment.

labor input measures (hours, employment and manhours) and for three series that may bear on, or may be affected by, variations in labor input (new orders, production and sales). The chart includes both the NICB and the BLS series—which enables us to note the fair correspondence in the behavior of the two sets of aggregates for the periods during which they overlap.[1] The table gives the number of months by which the six

[1] There are two notable exceptions to this observation. During the Great Depression, the NICB series shows a considerably earlier turn than the BLS series. In our analysis we shall use the NICB trough in July 1932 rather than the BLS trough in September 1934. Actually, both series show an "extra" cycle between 1932 and 1934, with turning points in the same or neighboring months. Historically, it is the 1932 trough that corresponds to the record depth of the Great Depression. About the historical circumstances, more on later pages.

The second exception concerns the first reference peak after World War II, where the NICB data show a corresponding turn while the BLS data do not. Both series decline during 1948, but the NICB series does and the BLS data do not show a prior expansion sufficiently marked to be considered cyclical. In some analyses, particularly when comparable industrial composition is required, we omit the 1948 turn (Table 1). On other occasions we present the NICB measure and so indicate (Tables 3, 4, 5 and others).

series lead or lag business cycle turning points from 1921 through 1954, according to the National Bureau's reference chronology. War years are omitted, as are measures relating to the 1948 peak, which is scarcely reflected in the behavior of hours in All Manufacturing, as reported by the BLS.

Hours, Employment and Manhours

Over the dozen turns analyzed, employment coincides with, and manhours lead business cycle reversals by only one month—a lead which perhaps should not be interpreted as a significant departure from coincidence. Nor is the average four-month lead of weekly hours the spurious outcome of widely varying behavior. Hours lag at only 2 of the 12 turning points;[2] they lead at 9 turns, and in all but one the lead exceeds two months.

Direct comparison of the timing of hours and employment shows, on the average, a three month lead of hours. Among the twelve comparable turns for All Manufacturing, there are eight leads, one coincidence and three lags of hours over employment. Employment rather than hours dominates turns in total labor input. Hence both employment and manhours turn later than average hours and close to each other. Some observers have suggested that the continued increase of employment, after hours have begun to decline, is forced upon businessmen by the need to replace the lost hours. Even our aggregative data show that this cannot be the whole story since total manhours continue to increase after the downturn of average weekly hours. That is, both employment and total manhours continue to rise at peaks although some adjustment of labor input has already been attempted by a reduction in the length of the workweek. This raises an interesting question. Why should labor input be curtailed by one means, and expanded by another? To shed some light on this process, we shall later look in some detail at the components of the net changes in employment. But first let us compare the cyclical timing of the average workweek with that of related aggregates.

Hours, Orders, Production and Sales

One early and tangible sign of changing demand comes to the businessman as changes in new orders. New orders undoubtedly signal businessmen to reconsider their prospects and modify their labor input. According to Table 1 and Chart 1, new orders tend to lead turns in the general business

[2] A recent revision of the 1929 reference peak, shifting it from June to August, would decrease the observed lag of weekly hours, at that turning point, from four to two months.

cycle, both at peaks and at troughs; the average lead (almost six months) is considerably longer than that of average weekly hours (about four months). However, the lead of new orders over hours is not consistent and can only be observed in 7 out of 12 relatable turns.[3]

For durable goods industries, comparison of new orders and hours can be made for the period beginning with the Great Depression. Again both series show reliable leads over business cycle turns, but orders lead hours in only two of six cases and their average lead is shorter than that of hours (see Table 2). We shall later check the relation of average hours to

Table 2

Weekly Hours and New Orders in Durable Goods Industries, 1933-1956

Lead (−), *Lag* (+), *or Coincidence* (0) *at Business Cycle Turns, in Months*

Business Cycle Peaks	*New Orders*	*Average Weekly Hours*	*Business Cycle Troughs*	*New Orders*	*Average Weekly Hours*
			March '33	0	−7
May '37	−5	− 4	June '38	−2	−5
Nov. '48	−5	−11	Oct. '49	−3	−4
July '53	−6	− 7	Aug. '54	−8	−5
Averages	−5.3	− 7.3		−3.2	−5.2

Source: New Orders: 1933-39 based on NICB indexes; thereafter based on series published by the Department of Commerce (OBE). Leads for new orders are taken directly from Victor Zarnowitz, *op. cit.*, Table 1. Average Weekly Hours: BLS.

new orders in individual industries. For the moment, we cannot regard new orders as a reliable "signal" for initiating reversals in the cyclical direction of average weekly hours, although at times new orders may have played that role.[4]

[3] Regarding the concept and the cyclical behavior of new orders, see Victor Zarnowitz' contribution to "Business Cycle Indicators," edited by Geoffrey H. Moore (to be published for the National Bureau by Princeton University Press). The coverage of the hours and new order series is not entirely the same, because the latter includes only those nondurable industries that report unfilled orders. However, even if the other industries (for which sales and orders are assumed to be identical) were included, this would not materially affect the timing of turns, which is largely dominated by the durable segment.

[4] It is true that this evaluation is based on highly aggregated data. Conceivably, though not very likely, the relationship could be closer at the plant than at the industry level. Furthermore, cues might come from changes in the volume rather than in the value of new orders. Deflation of new order series results indeed in some longer leads, as has been described by Victor Zarnowitz in his "The Timing of Manufacturers' Orders during Business Cycles," Mimeographed, National

Since adjustment in hours is a means to increase or cut production, it is noteworthy that production, on the average, coincides with turns in the business cycle and that production turns follow turns in hours at most individual peaks and troughs. With employment and total manhours continuing their cyclical course for some months after reversals of average weekly hours, total labor input actually leads production but little, and this little can perhaps be explained as the result of the length of production periods and the vagaries of accounting procedures.[5]

Although shipments, and usually sales, follow production of goods, it is nevertheless possible for their turning points to precede those of production. This possibility exists because the modern industrial economy operates with large inventories which are augmented and diminished by sales below or above current production levels. Our aggregative figures, however, do not indicate that sales systematically lead production. Both production and sales coincide in timing (see lower section, Table 1), and thus turn considerably later than hours. This result is not modified if the series are analyzed over comparable periods only. Businessmen obviously do not wait until changes in sales signify the need to adjust labor input.

While we look for possible causal relationships in the timing sequence of hours, new orders, sales, and production, we cannot, of course, expect labor input reversals to be neatly governed by a few variables, such as orders or sales. Decisions on production and labor input are complex. They involve consideration of inventory levels, price movements, wage rates and other costs, retail sales, market prospects and many other factors. We believe, however, that timing comparisons may contribute to the understanding of the interaction between hours and the related activities.

HOW CHANGES IN WEEKLY HOURS COME ABOUT

Overtime and Short Time

Changes in the average length of the workweek can be made in various

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Bureau of Economic Research. However, this lengthening is not systematic and substantial enough to result in regular leads of new orders over average weekly hours. The "signal," of course, need not necessarily be a turning point. The leveling out of new orders or the gradual accumulation and reduction of backlogs may suggest revision of production schedules and of labor input even before turning points in new orders are reached.

[5] The survey week for labor input falls predominantly in the first part of the month, while monthly production data record the output during the full month. Furthermore, many output series measure "finished" output (after the last operation) rather than "current" output (as work is progressing). The former tends to lag the latter, which is more closely related to factor inputs.

ways. An enterprise may cut the average number of hours worked by (1) cutting overtime, (2) reducing the working time of all workers, (3) introducing or increasing short time for part of the work force. While these changes would ordinarily occur during contractions (as an effort to reduce labor-input), part-time work may also be increased in periods of acute labor shortages, particularly during late phases of expansions. A study of overtime and short time should contribute to our understanding of fluctuation in average hours. (Overtime and short time are, of course, only two very broad classes of a frequency distribution of hours, which might merit study in more detail.)

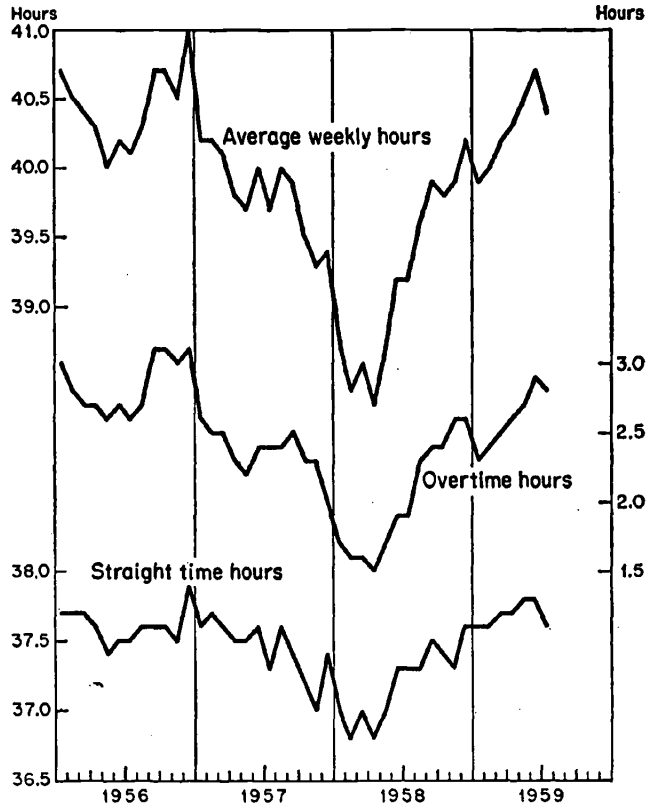
There is another reason to investigate the changes in overtime and short time. Overtime hours are generally paid at premium rates. Hence at peaks they may be the first part of labor input to be cut. For employees who usually work full time, short time is an undesired consequence of weak demand. Hence, at troughs, the hours of workers on short time may be the first to be increased. These considerations lead us to expect overtime and short time to be early indicators of cyclical changes—the former at peaks, the latter at troughs.

Let us begin with a systematic consideration of overtime. There are economic reasons to expect overtime to lead at peaks and to lag at troughs, both the result of management's interest in avoiding labor input at premium rates.[6] Management might be expected to reduce hours paid for at penalty rates as soon as possible, and to increase them as late as possible. What do the statistics show?

Systematic recording of overtime hours by the BLS is too new to permit determination of cyclical turning points. Chart 3 shows that changes in average weekly hours and overtime hours have moved almost, though not entirely, parallel during the three years for which observations are available. The data—which cannot yet be adjusted for seasonal variation—permit at present only a few tentative observations: (1) Overtime hours and average weekly hours tend to exhibit highly correlated changes over the short term; (2) straight time hours tend to move in similar patterns, but have milder amplitudes than overtime hours or average weekly

[6] In principle it is possible for overtime in an industry to lead, coincide with, or lag behind average hours — depending upon the factors underlying the changes in the average. If, in the neighborhood of peaks, overtime is cut in plants working long hours, while other plants still increase hours, overtime will lead hours. If the decline sets in first in weak plants working part-time, overtime may lag. For a systematic analysis of the theoretically possible variants in the relation of overtime and average hours, in each phase of the business cycle, see A. Bluestone, "Overtime Hours as an Economic Indicator," *Monthly Labor Review*, September 1956, p. 1026.

Chart 3
Weekly Hours, Overtime Hours, and Straight Time Hours, All Manufacturing, BLS, 1956-1959



hours; (3) at the very beginning of the contraction, the decline of average weekly hours is clearly dominated by the reduction of overtime; (4) as the contraction continues, the reduction of straight time hours plays an increasing and that of overtime a diminishing role; (5) also in the subsequent expansion, overtime first increased rapidly and then flattened out.[7]

[7] These data have been analyzed in greater detail by Rudolph C. Mendelssohn in an article "Overtime Hours and Economic Trends," *Employment and Earnings*, Bureau of Labor Statistics, May 1958. The author observes that straight time hours and gross average weekly hours lack the early firm commitment shown by overtime hours. (While straight time, between January 1956 and April 1958 decreased by .9 hours, overtime declined by 1.5 hours).

Our Chart 3 confirms the larger amplitude and clearer definition of the decline

The observations on overtime are plausible enough: in contractions overtime reduction is started early, but has a limited scope; the reduction of straight time hours, on the other hand, is typically undertaken only after due deliberation and can lead to a larger reduction of hours than abolishment of overtime. In expansions, overtime may first increase sharply but is soon restrained by the heavy premium payments engendered. It will be interesting to observe whether overtime experiences another spurt in the course of the current expansion, when the labor market tightens.

Additional information bearing on overtime hours and covering a longer period can be obtained from frequency distributions published in the monthly Census report on population characteristics. These report also other classes, but we have selected for analysis percentages of persons (or wage-salary workers) working "41 hours and more" and "48 hours and more." The persons counted in these classes are not necessarily working overtime at premium rates. They might, for instance, hold more than one job and report the combined working time. Or they may be in the executive class and work on a monthly salary.

We have compared cyclical reversals in these percentages with those in average weekly hours, for four turning points of the business cycle (see Table 3 and Chart 4). The percentage of workers working 41 hours and more showed the same leads as average hours at the two peaks (1948 and 1953) but, unlike hours, they showed one coincidence and one lag at the two troughs (1949 and 1954).[8] The percentage of the narrower class of workers, those working 48 hours and more, shows a substantially similar picture.

We can also compare this measure of overtime (per cent working 41 hours and more) with average hours worked in the broad classification, nonagricultural industries, for three turning points. The overtime percentage shows a lead, equalling that of average hours, at the 1953 peak; and short lags, again similar to those of hours, at the 1949 and 1954 troughs (see Table 3). Table 3 also provides timing measures for the percentage of wage-salary workers working 41 hours and more in con-

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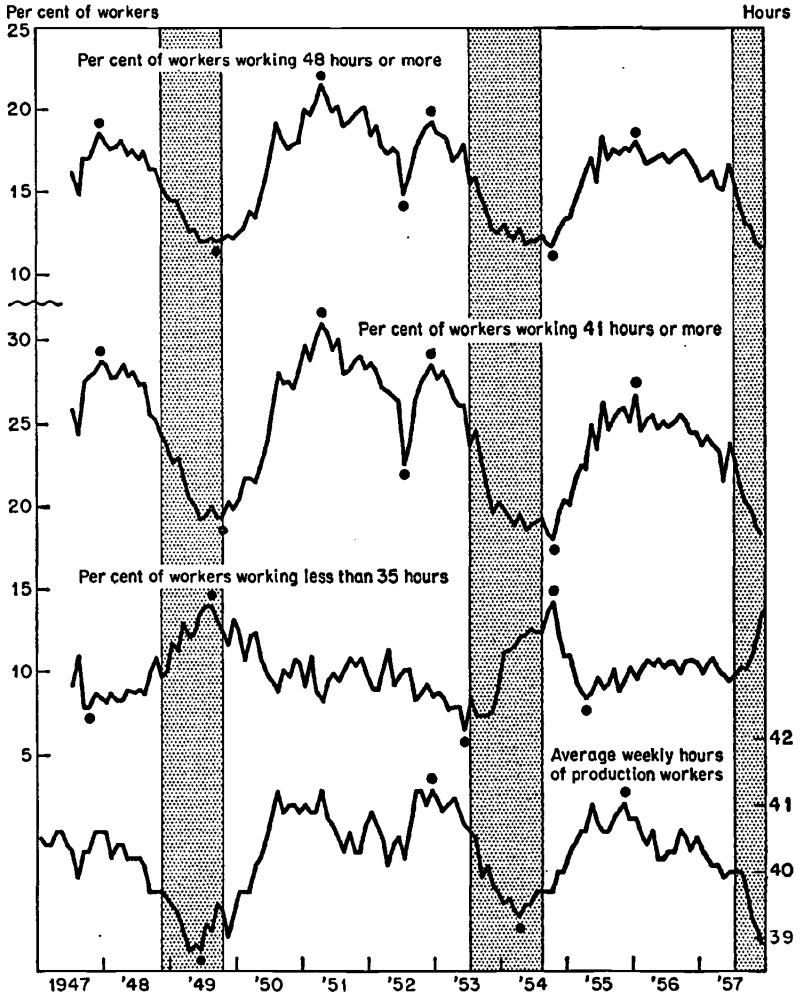
of overtime as compared with straight time hours. However, the decline in gross average weekly hours is similarly well defined. The above article describes also a cross-section study of hours in the machinery (except electrical) industry. The author finds that average overtime work, at a fraction of an hour, persists no matter how low the fall in average hours. An illustration accompanying the analysis shows fractional overtime to be associated with 38 straight time hours, 2 to 6 overtime hours with 39 straight time hours, 7 to 11 overtime hours with 40 straight time hours.

[8] In these comparisons NICB data are used for the 1948 peak, and BLS data for the other three turns in average hours. It will be remembered that the BLS series for All Manufacturing showed no clearly defined peak around 1948.

Chart 4

Per Cent of Wage and Salary Earners in Manufacturing, Working Forty-one Hours or More, Forty-eight Hours or More, and Less than Thirty-five Hours, 1947-1957



Overtime and short time data adjusted for holidays in reporting week.
Shaded areas represent business cycle contractions, according to NBER chronology.
Dots identify peaks and troughs of specific cycles.

struction, transportation, etc. A number of these nonmanufacturing series do not show any clear cycles (Wholesale Trade, Retail Trade, Service Industries). For those which show cycles (Construction, Transportation plus Public Utilities, and "All Other" Industries) the evidence is similar to that examined before: leads at peaks and lags at troughs with the single

Table 3

Weekly Hours, Overtime and Straight Time, 1947-1956

Lead (−), Lag (+), or Coincidence (0) at Business Cycle Turns, in Months

	Business Cycle Turns	ALL PERSONS AT WORK IN NONAGRICULTURAL INDUSTRIES: Average Weekly Hours	ALL PERSONS AT WORK IN NONAGRICULTURAL INDUSTRIES: % Working 41 Hours and More	ALL PERSONS AT WORK IN NONAGRICULTURAL INDUSTRIES: % Working 34 Hours and Less[a]	WAGE AND SALARY EARNERS IN MANUFACTURING: Average Weekly Hours[b]	WAGE AND SALARY EARNERS IN MANUFACTURING: % Working 41 Hours and More	WAGE AND SALARY EARNERS IN MANUFACTURING: % Working 48 Hours and More	WAGE AND SALARY EARNERS IN MANUFACTURING: % Working 34 Hours and Less[a]	WAGE AND SALARY EARNERS % WORKING 41 HOURS & MORE: Construction	WAGE AND SALARY EARNERS % WORKING 41 HOURS & MORE: Transportation and Utilities	WAGE AND SALARY EARNERS % WORKING 41 HOURS & MORE: All Other[c]
P	Nov. '48	n.c.	n.c.	n.c.	(−11)	−11	−11	−13	—	—	− 3
T	Oct. '49	+3	+3	+3	− 4	0	− 1	− 2	+3	+3	+ 8
P	July '53	−7[d]	−7	+2	− 7	− 7	− 7	− 1	−7	−8	[e]
T	Aug. '54	+2	+2	+2	− 4	+ 2	+ 2	+ 2	+6	+5	−10

n.c.: No comparable turn.

[a] Turning points related on inverted basis.

[b] Timing based on hours of production workers. At November 1948 NICB data, at other turns BLS data.

[c] Wholesale trade, retail trade and service industries show no cycles. The "All Other" category is exclusive of these and Manufacturing.

[d] See text, footnote 14.

[e] The nearest turning point occurs 28 months earlier but appears to be related to Korean War activity.

Source: Bureau of the Census, except as noted.

exception of a substantial lead of "All Other" Industries at the 1954 trough.[9]

For one industry, Class I Railroads, ICC information for the interwar period permits us to derive overtime hours worked per month per employee for four peaks and five troughs. As Table 4 shows, the rule of

Table 4

Weekly Hours, Overtime Hours, and Employment on Class I Railroads, 1921-1938

Lead (−), *Lag* (+), *or Coincidence* (0) *at Business Cycle Turns, in Months*

Business Cycle Peaks	*Over-time Hours*	*Aver-age Hours*	*Em-ploy-ment*	*Business Cycle Troughs*	*Over-time Hours*	*Aver-age Hours*	*Em-ploy-ment*
				July 1921	+5	+6	+12
May 1923	−8	−8	+3	July 1924	+4	+8	0
Oct. 1926	−1	+2	−3	Nov. 1927	+6	+5	+14
June 1929	−4	+1	+2	March 1933	0 or −9	0	+ 2
May 1937	−3	−2	+1	June 1938	+9	−5	0
Averages	−4	−2	+1		+5 or +3	+3	+ 6

Source: Interstate Commerce Commission.

leads at peaks and lags at troughs is firmly supported by this evidence. At peaks, overtime hours tend to lead business cycle turns by 4 months, at troughs they lag by 3 to 5 months. Over the turns examined, overtime hours lead average hours at peaks but there was no regular pattern at

[9] Corresponding (unpublished) data of average hours covering the 1954 trough were examined for five industrial segments. Matching turns could be established for three of these segments only. In two of them (Manufacturing, Public Utilities) turns in overtime hours lagged behind those in average hours; in the third segment ("All Other" industries) the contrary was true.

The observations on overtime in manufacturing were based on percentages of workers working long hours. What can we deduce with regard to the timing behavior of the absolute number of workers in this category? When the ratio (percentage) and the denominator (all employees) are "in phase," then the numerator (number of employees working overtime) must be "in phase" too. It follows that when changes in employment coincide with, or lag changes in overtime (the usual pattern), the number of overtime workers cannot be expected to lead the percentage of overtime workers. Can any deductions be made about the timing of average overtime hours per week? Generally, it would seem unlikely that the percentage of overtime workers and the average number of overtime hours per week would move in opposite directions. This contention gains some support from a comparison of average overtime hours per week (BLS) and the percentage of overtime workers (Census) in Manufacturing, for the brief period in which the former are available.

troughs. It will be observed that average hours of railway workers did not exhibit the rather consistent lead over business cycle turns which we found so characteristic of manufacturing. At peaks there are as many lags as there are leads, and at troughs lags even predominate. This must be understood in conjunction with employment trends during the interwar period, which were generally downward and were reflected in some long lags behind business cycle troughs. In relation to employment turns, average hours of railway workers lead in 7 out of 9 cases.

Our findings on overtime are qualified by the fact that we have been able to consider only four turning points. The evidence suggests the following conclusions:

1. The percentage of persons working 41 and more hours leads business cycle turning points at peaks but not at troughs.
2. The leads of overtime hours at peaks are roughly similar to the leads of the corresponding average weekly hours.
3. At troughs, overtime hours tend to lag business cycle turns.

What about the percentages of workers on short time? Are changes in these percentages related to general business activity, and if so, positively (because of increased employment of part time workers during periods of acute labor shortages) or inversely (because of forced part time work during slack periods)? The evidence shows that involuntary short time during slack periods is much more important than the part time employment at high prosperity levels. Thus the net result is inverse conformity of short time to business cycles, as can be seen from the patterns formed by the third curve on Chart 4. These patterns describe percentages of workers working short time. The absolute number of workers on short time shows almost the same cyclical behavior as the percentage data. For recent years, Census classifications permit us to distinguish short time work of different character (usual and temporary) and for different reasons (economic and other).[10] The time period covered by these data is too short for seasonal and cyclical analysis. However, it can be stated that one of the series, the "number of workers, usually on full time but working part time for economic reasons," shows clear (inverse) cyclical changes and an indication of early turning points. This series merits further attention for its possible usefulness as an economic indicator.

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[10] Economic reasons for reduced hours of full time workers are: (1) slack work, (2) material shortages, or repairs to plant and equipment, (3) started new job, (4) job terminated during survey week, and (5) inability to find full time work. Non-economic reasons are (6) own illness, (7) vacations, (8) bad weather, (9) labor disputes, and (10) all other.

It might be surmised that the overall percentage of short time workers leads business cycles at troughs, on an inverted basis. However, for manufacturing, Table 3 and Chart 4 show that the short time percentage in fact leads less at troughs than at peaks, and at business cycle troughs turns later than the corresponding average hours series. The table also shows that short time in all nonagricultural industries lags behind both business cycle turns and the corresponding turns in average hours. The evidence presently available does not suggest that the overall percentage of workers on short time (regardless of reasons) is a particularly promising candidate for a list of reliable leading economic indicators.

On the whole, we found that both overtime and short time contribute to the positive correspondence of changes in average weekly hours and in general business conditions. The behavior of overtime helps to explain the leads of average hours at peaks. It does not explain the lead of hours at troughs—although it contributes to our understanding of why the leads of hours are shorter at troughs than at peaks: short-time tended to show (on an inverted basis) longer leads at peaks than at troughs and this may be regarded as contributing to the lead of average hours as well as to their differential behavior at peaks and at troughs in general business conditions.

Diffusion of Changes in Hours, by Industry

In studying cyclical changes in average weekly hours, we must also consider the diffusion of these changes—that is, the degree to which change, in a given direction, permeates the components of the aggregate. A way to describe the degree of such diffusion is to combine component behavior into so-called diffusion indexes which measure the percentage of component series expanding during a given time period. The diffusion indexes reach their low when a minimum of series expand—which characteristically happens in the neighborhood of the sharpest contraction in the aggregate. Conversely, diffusion indexes at their peak denote that most of the component series are expanding—which characteristically happens in the neighborhood of the steepest rise in the aggregate. The position of the indexes at 50 per cent indicates that there are as many expanding as contracting components. This balance should be expected in the neighborhood of peaks and troughs in the aggregate, although it might easily occur as a consequence of intracyclical fluctuations. Diffusion indexes can be based on all kinds of classifications—industrial, regional, occupational, and so forth. We are here primarily concerned with diffusion indexes summarizing the behavior of the two-digit type industries used by

the BLS, NICB and FRB as major classes of the Manufacturing and Nonmanufacturing divisions.[11]

One characteristic of the diffusion indexes is that—somewhat similar to first differences and rates of change in aggregates—they show change in direction when aggregates may merely show acceleration and deceleration of growth. Thus diffusion indexes tend to lead the aggregates by marked margins. Since average weekly hours were found to be a leading indicator, a diffusion index of hours, with even earlier timing, might be an important tool both for analysis and forecasting. Another advantage of diffusion indexes is that they permit summarization of experiences in different sectors of the economy—such as manufacturing and nonmanufacturing industries—even if no overall aggregates (totals or averages) are available.

Diffusion indexes, like other measures of cyclical behavior, have characteristic limitations.[12] One of these is a tendency to exhibit relatively large random movements that may obscure cyclical characteristics. This difficulty can be overcome, at least to some extent, if the component series are smoothed by short-term moving averages. Since the average workweek falls into the group of series requiring such treatment, we decided to base all our comparisons on smoothed data. However, to simplify the procedure, we smoothed the diffusion indexes themselves rather than the components. Some comparative experiments showed that this shortcut affects the amplitudes of the indexes, but does not materially change the cyclical timing. A constant smoothing term of six months was chosen to equalize the effects of smoothing on the location of turning points.

From the diffusion indexes we can derive an alternative summary measure based on the cumulation of the "net" percentage of expanding series.[13] This has some resemblance to an aggregative measure, but the components are combined with fixed equal weights, and their amplitude is ignored. This cumulative measure permits aggregation of series that cannot be or are not combined (such as hours in nonmanufacturing

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[11] A basic description of diffusion indexes can be found in Arthur F. Burns, "New Facts on Business Cycles," in *The Frontiers of Economic Knowledge* (National Bureau of Economic Research, 1954) and in Geoffrey H. Moore, "The Diffusion of Business Cycles," in *Economics and the Public Interest*, Rutgers University Press, 1955.

[12] For a discussion of these limitations see Arthur Broida, "Diffusion Indexes," *American Statistician*, June 1955, and G. H. Moore's reply in the subsequent issue. A more recent evaluation of the indexes, and the literature on them, is found in S. S. Alexander, "Rate of Change Approaches to Forecasting—Diffusion Indexes and First Differences," *Economic Journal*, June 1958, p. 288.

[13] By "net" is meant the difference between the percentage expanding and 50 per cent. This assures that the summary measure will go up when more (and go down when less) than half the covered series expand.

industries) in such a way that comparison can be made with other measures of levels rather than of changes in economic activity.

Table 5 and Charts 5 and 6 show the timing of both simple and cumulative diffusion indexes of hours for major manufacturing and nonmanufacturing industries; the table also contains averages based on the timing of individual industries in the manufacturing and nonmanufacturing sector. For manufacturing, the timing of the group aggregate is given. The last column contains the timing of the Census series of average weekly hours for the nonagricultural work force[14]—a series based on data other than those that underlie the simple and cumulative diffusion indexes. It is apparent that, for manufacturing, nonmanufacturing, and their combination, the diffusion indexes led substantially at every reference turn. Moreover the lead intervals are two or three times as large as those given by the other measures. Any enthusiasm about these long leads should, however, be tempered by the observations that (1) for some business cycle turns we were not able to determine corresponding turns in the diffusion index; (2) the lead of the diffusion indexes for manufacturing varied between 5 and 24 months; and (3) for the contemporary observer of these indexes, the cyclical character of a given change in direction is not necessarily apparent. Regarding the cumulative indexes we observe that their average timing is close to that of industry averages and aggregates, but that at any given turning point, the timing of these three measures may differ appreciably.

Diffusion of Changes in Hours, by State

An expansion (or contraction) in the length of the workweek may be diffused, not only by industries, but also by geographic divisions.

A diffusion index of average weekly hours in manufacturing based on states is shown in Chart 7, together with the previously discussed index based on the diffusion among component industries.[15] Although the two indexes show some family resemblance and high cyclical correspondence, there are several differences. Most obvious is the larger amplitude of the index based on industries as compared with that based on states. This

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[14] Note that the lead at the 1953 business cycle turn is based on recognition of a peak in hours in December 1952. This affords a more reasonable comparison than would the use of the earlier and higher specific peak indicated in Charts 3 and 6.

[15] For this comparison, a 12-month moving average was applied as smoothing term for both series, in order to avoid the need for seasonal adjustment of the index by states. Reference to Chart 7, as well as comparison of the first two columns of Table 6, demonstrate that patterns and turning points are considerably influenced by smoothing terms of varying length.

Table 5

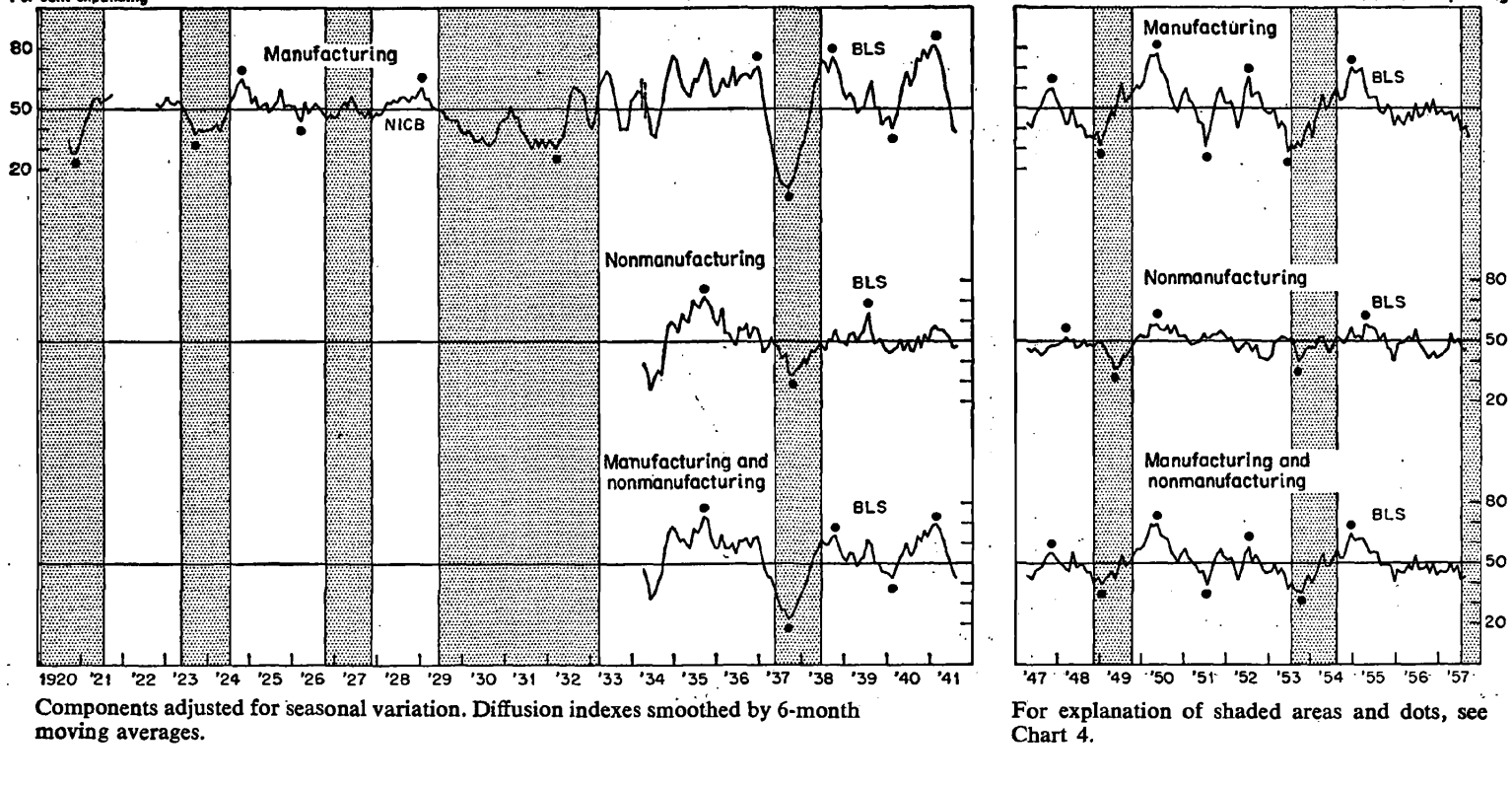
Diffusion Indexes (by Industry) and Other Summary Measures of Weekly Hours, 1921-1956

Lead (−), Lag (+), or Coincidence (0) at Business Cycle Turns, in Months

Business Cycle Turns			MANUFACTURING				NONMANUFACTURING			MANUFACTURING AND NONMANUFACTURING		
			Diffusion Index[a]	Cumulative Diffusion Index[a]	Average of Component Industries	Aggregate	Diffusion Index[a]	Cumulative Diffusion Index[a]	Average of Component Industries	Diffusion Index[a]	Cumulative Diffusion Index[a]	Aggregate[b]
T	July	1921	− 8	− 4	− 4	− 5	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
P	May	1923	n.c.	0	− 2	− 6	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
T	July	1924	−10	− 1	− 1	0	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
P	Oct.	1926	−24	− 9	− 8	−11	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
T	Nov.	1927	n.c.	+ 3	− 1	+ 5	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
P	June	1929	− 5	− 2	− 1	+ 4	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
T	Mar.	1933	−12	− 9	− 2	− 8	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
P	May	1937	− 5[c]	− 4	− 4	− 2	−20	− 4	− 2	−20	− 4	n.a.
T	June	1938	− 9	− 4	− 3	− 6	− 8	+ 1	+ 2	− 9	− 3	n.a.
P	Nov.	1948	−12	−10	−11	−11[d]	− 8	n.c.	− 4	−12	n.c.	n.c.
T	Oct.	1949	− 9	− 5	− 4	− 4	− 5	0	+ 1	− 9	− 4	+ 3
P	July	1953	−12	− 8	− 6	− 7	n.c.	−17	− 9	−12	− 9	[e]
T	Aug.	1954	−14	− 5	− 4	− 4	−11	− 1	− 3	−10	− 5	+ 2

n.a.: Not available.
n.c.: No comparable turn.
[a] Diffusion by industry, 6 month moving average.
[b] Weekly hours, all persons at work excl. farmers (Census). This aggregate is not based on the same data as the diffusion indexes.
[c] Double peak; alternative timing would be −28; see Chart E.
[d] Based on NICB data. BLS data show no turn.
[e] See text, footnote 14.

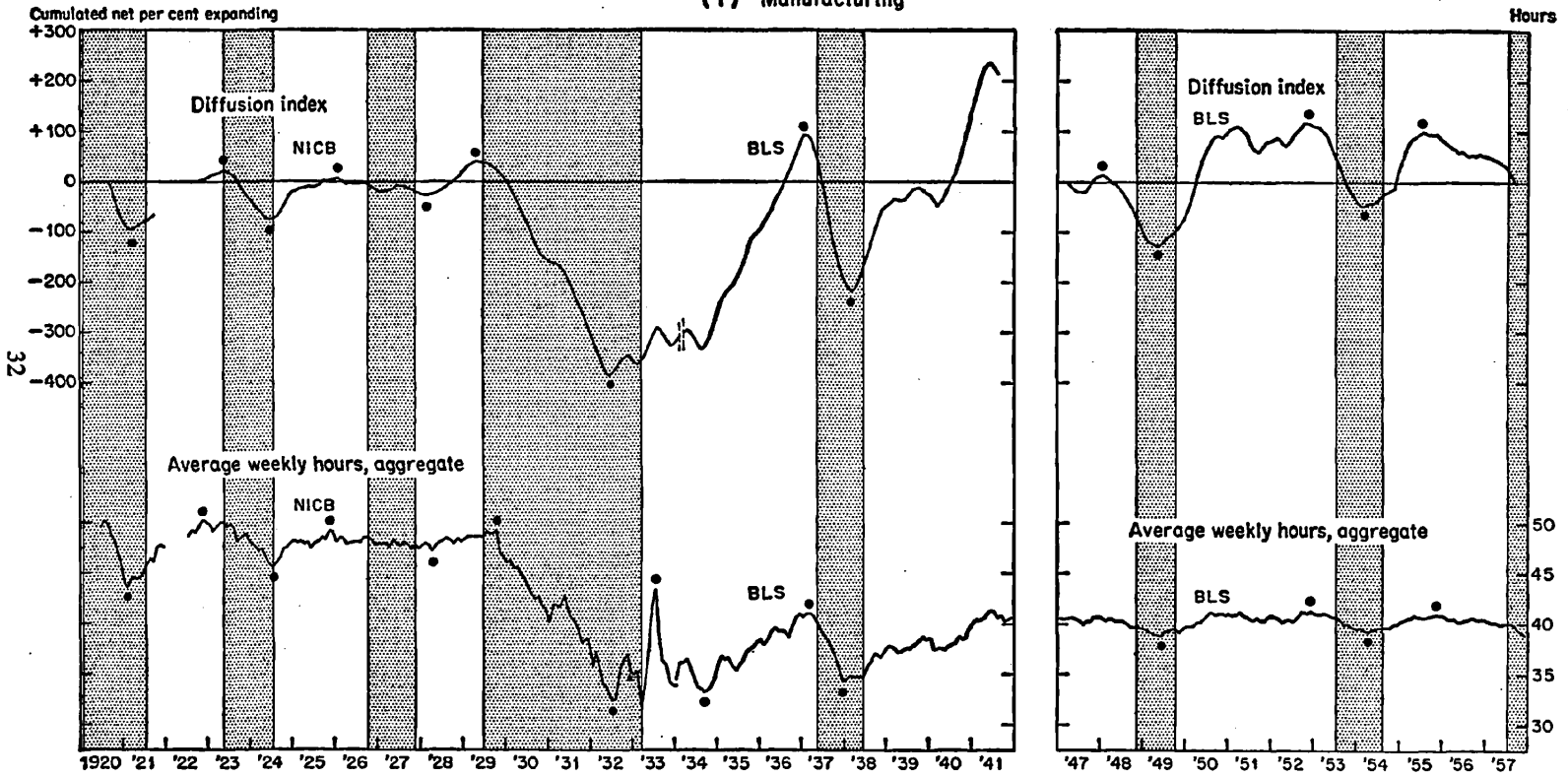
Chart 5
Diffusion Indexes, Average Weekly Hours in Manufacturing and Nonmanufacturing, 1920-1957

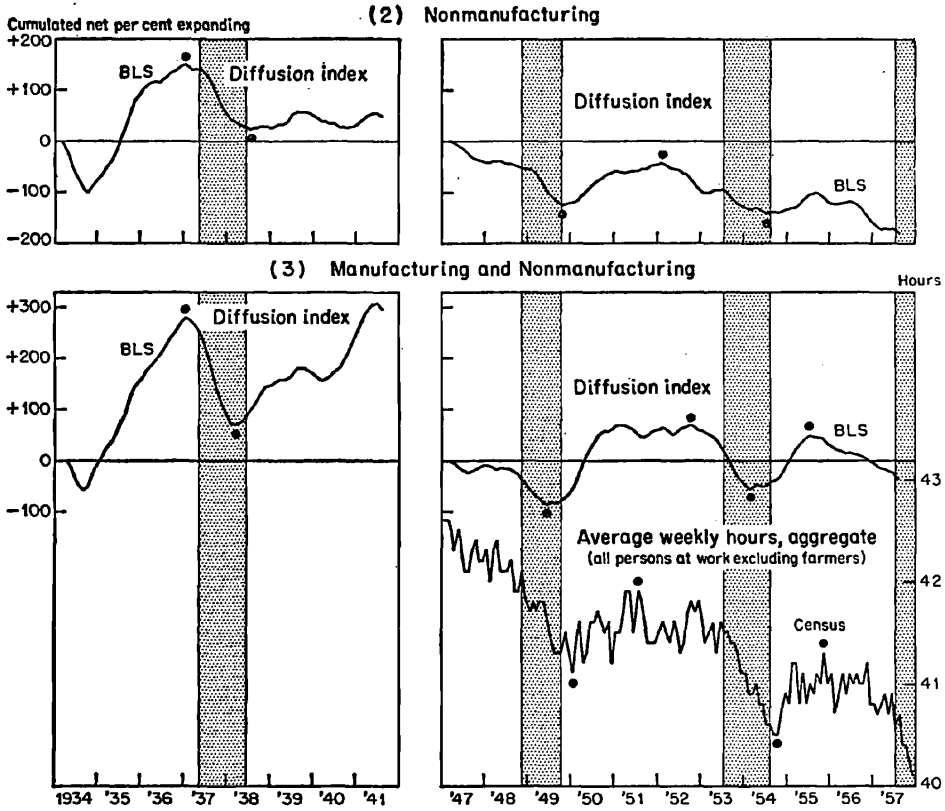


Components adjusted for seasonal variation. Diffusion indexes smoothed by 6-month moving averages.

For explanation of shaded areas and dots, see Chart 4.

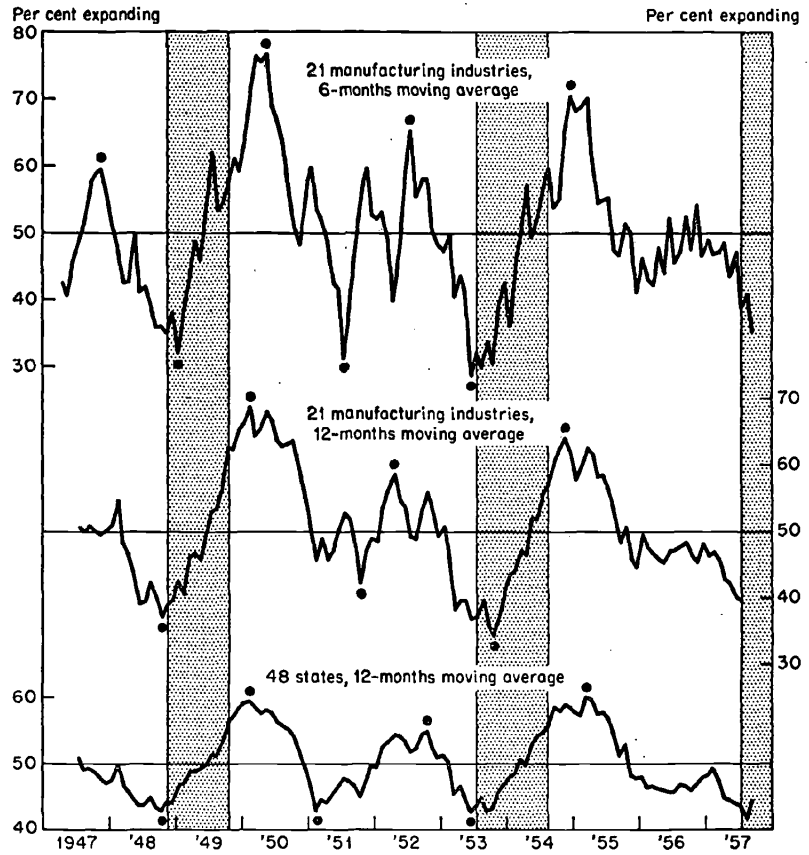
Chart 6
Cumulative Diffusion Indexes of Weekly Hours by Industry, and Related Aggregates, 1920-1941 and 1947-1957
(1) Manufacturing





All series 1920 to May 1934, NICB; all other data, BLS.
Components adjusted for seasonal variation. Diffusion indexes smoothed by 6-month moving averages.
Shaded areas represent business cycle contractions, according to NBER chronology. Dots identify peaks and troughs of specific cycles.

Chart 7
Diffusion Indexes, Weekly Hours in Manufacturing, by Industry and by State, 1947-1957



Shaded areas represent business cycle contractions, according to NBER chronology. Dots identify peaks and troughs of specific cycles.

difference might be explained by considering that (1) a larger number of components reduces the statistical probability of wide swings, and (2) the development of states (particularly those experiencing rapid growth) shows somewhat greater independence from national developments than do the major industry components of manufacturing. There are also differences in the characteristic with which we are most concerned in this paper: the timing of turning points. Take for instance the situation in 1951. The diffusion index by state shows a clear turning point in February while the turn of the diffusion index based on industries occurs in October.

Table 6 permits a systematic comparison of turning points. Of the five comparable turns in the diffusion indexes, two have the same timing.

Table 6

Diffusion Indexes of Weekly Hours, by Industry and by State,[a] 1947-1954

Lead (−), Lag (+), or Coincidence (0) at Business Cycle Turns, in Months

		NONCUMULATIVE			CUMULATIVE		
		BY INDUSTRY		BY STATE	BY INDUSTRY		BY STATE
	Business Cycle Turns	*6 Month Moving Average*	*12 Month Moving Average*	*12 Month Moving Average*	*6 Month Moving Average*	*12 Month Moving Average*	*12 Month Moving Average*
P	Nov. 1948	−12	n.a.	n.a.	−10	n.a.	n.a.
T	Oct. 1949	− 9	−12	−12	− 5	− 4	− 4
P	Feb. 1951[b]	− 9	−12	−12	+ 1	− 1	− 3
T	June 1952[b]	−11	− 8	−16	− 9	− 5	− 5
P	July 1953	−12	−15	− 9	− 8	− 6	− 5
T	Aug. 1954	−14	−10	−14	− 5	− 4	− 4
Peaks		−11.0	−13.5	−10.5	− 5.7	− 3.5	− 4.0
Troughs		−11.3	−10.0	−14.0	− 6.3	− 4.3	− 4.3
All turns		−11.2	−11.4	−12.6	− 6.0	− 4.0	− 4.2

[a] 21 manufacturing industries vs. 48 states, excluding District of Columbia.

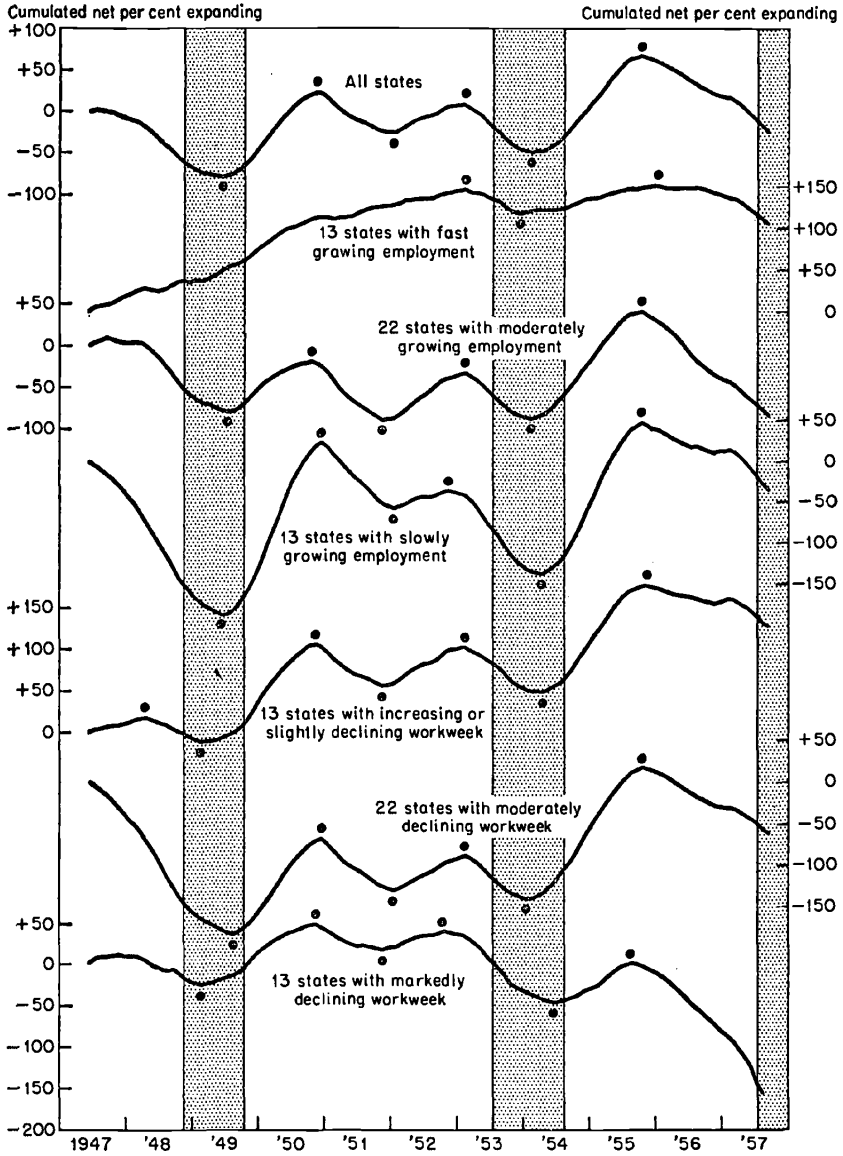
[b] Subcycle turns as given by Ruth P. Mack in her contribution to *Investing in Economic Knowledge*, Thirty-eighth Annual Report, National Bureau of Economic Research, 1958, p. 31. For explanation of concept see her "Notes on Subcycles in Theory and Practice," *American Economic Review*, May, 1957, p. 161.

However in 1952 and 1954 the index by states, and in 1955 the index by industry, experienced an earlier turn. Let us briefly note that the timing situation is very similar for the cumulative form of the diffusion indexes. The leads at business cycle turns are of course much shorter. Here, three of five turns have the same timing.

Some conclusions can be drawn from these comparisons. The diffusion of changes in weekly hours, by industry and by state, shows distinct differences, with regard to pattern as well as timing. However, when a turn does occur in either index, the other soon shows a turn too. Thus the index which turns first can be used as "indicator." This is one of the possible advantages of using "multiple" diffusion indexes for leading indicators such as weekly hours.

In evaluating average weekly hours as an economic indicator, we may well ask whether a segment of the universe would not yield better results, such as clearer turns and longer leads, than the total. For example, diffusion indexes based on hours in rapidly growing states might be expected

Chart 8
Cumulative Diffusion Indexes of Weekly Hours, All Manufacturing, by State Growth Trends, 1947-1957



Shaded areas represent business cycle contractions, according to NBER chronology. Dots identify peaks and troughs of specific cycles.

Table 7

Cumulative Diffusion Indexes of Weekly Hours in All Manufacturing,[a] by State Growth Trends, 1947-1957

Lead (−), Lag (+), or Coincidence (0) at Business Cycle Turns, in Months

Business Cycle Turns	All States[d]	STATES CLASSIFIED BY TREND IN EMPLOYMENT[b]			STATES CLASSIFIED BY TREND IN WORKWEEK[c]		
		13 Fast Growing	22 Moderately Growing	13 Slow Growing	13 With Increases or Small Declines	22 With Moderate Declines	13 With Largest Declines
P Nov. 1948	n.a.	n.a.	n.a.	n.a.	− 7	n.a.	n.a.
T Oct. 1949	− 4	n.a.	− 3	− 4	− 8	− 2	− 8
P Feb. 1951[e]	− 3	n.a.	− 4	− 2	− 3	− 2	− 3
T June 1952[e]	− 5	n.a.	− 7	− 5	− 7	− 5	− 7
P July 1953	− 5	− 5	− 5	− 8	− 5	− 5	− 9
T Aug. 1954	− 6	− 8	− 6	− 4	− 4	− 7	− 2
P July 1957	−21	−18	−21	−21	−20	−21	−23
Averages:							
All Observations							
Peaks	− 9.7	−11.5	−10.0	−10.3	− 8.8	− 9.3	−11.7
Troughs	− 5.0	− 8.0	− 5.3	− 4.3	− 6.3	− 4.7	− 5.7
Averages:							
1953-1957							
Peaks	−13.0	−11.5	−13.0	−14.5	−12.5	−13.0	−16.0
Troughs[f]	− 6.0	− 8.0	− 6.0	− 4.0	− 4.0	− 7.0	− 2.0

[a] 12-month moving average.

[b] Based on percentage changes between years 1947 and 1957. The thirteen states with fast growing employment, in declining order of growth, are: Ariz., N. M., Nev., Cal., Fla., Kan., Texas, Okla., Idaho, Utah, Dela., Colo., Ky. The 22 moderately growing states, listed in the same order, are: Ga., Wash., Ark., Tenn., Neb., Md., Miss., Mo., Mont., N. C., S. C., Iowa, Ind., Oreg., Va., Minn., Ohio, Ala., Wis., N. D., N. J., S. D. The 13 states with slow employment growth are: Conn., Ill., Mich., Wyo., N. Y., N. H., La., Pa., Mass., Vt., Me., W. Va., R. I.

[c] Based on percentage changes between years 1947 and 1957. The 13 states with increases or small declines in hours, starting with the largest increase, are: Colo., Pa., N. C., S. C., Mich., Wash., La., Utah, Cal., Wyo., S. D., Dela., Ind. The 22 states with moderate decline, starting with the smallest decline, are: Va., W. Va., Ohio, N. J., N. H., Md., Idaho, N. Y., R. I., Neb., Oreg., Me., Tenn., Mo., Kan., Conn., Vt., Ga., Mont., Minn., N. D., Ill. The 13 states with largest decline in average hours are: Nev., N. M., Fla., Iowa, Okla., Ark., Ala., Ky., Ariz., Wis., Texas, Miss., Mass.

[d] Excluding District of Columbia.

[e] Subcycle turns as defined by Ruth P. Mack; see preceding table.

[f] Refers to 1954 trough only.

to show particularly early turns at troughs, while hours in less rapidly growing or declining states would show early turns at peaks. Does any one segment of the economy promise to yield an earlier indicator of cyclical turning points? Our work in this field can be regarded only as exploratory. Table 7 and Chart 8 show that cumulative diffusion indexes for 1947-1957 tend to show earlier peaks in the 13 slowest growing and earlier troughs in the 13 fastest growing states—"growth" being measured by employment changes or by trends in weekly hours. The lead in the "early" segment (slow-growing at peak and fast-growing at trough) is, in most averages, larger than that shown by the diffusion index for all states. However, the finding is based on a very small sample of turns; not all the compiled averages show the described features; the difference between the averages is not always typical for individual turns; and the 22 states with moderate growth do not always show timing measures between those of the extremes. Conceivably, other classifications may yield more systematic relationships.[16] For indicator purposes, the use of selected highly sensitive segments of a structure holds promises which seem worth further investigation.

CHANGES IN HOURS AND IN RELATED ACTIVITIES

Changes in Hours, Manhours and Production

So far, we have based our findings about the relationship of hours and other economic activities almost entirely on the sequence of cyclical turning points. What about changes in these variables between the turns? To explore further the process of change, and the timing of its maximum intensity, let us look at diffusion indexes for some of the activities previously discussed on an aggregative basis. Timing comparisons for the postwar years are presented in Table 8. The four diffusion indexes (hours, employment, manhours and production) show, as would be expected, earlier turns than the selected aggregates. And the greater lead of the diffusion indexes can be observed for each activity at each turn.

For weekly hours, the average lead of the diffusion index amounts to

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[16] Bert G. Hickman suggests, for instance, grouping of activities thought to be homogenous with regard to general structure. See "An Experiment with Weighted Indexes of Cyclical Diffusion," *Journal of the American Statistical Association*, March 1958, page 51.

Table 8

Selected Diffusion Indexes and Corresponding Aggregates, Manufacturing, 1947-1956

Lead (−), Lag (+), or Coincidence (0) at Business Cycle Turns, in Months

	Business Cycle Turns	Average Weekly Hours (BLS)	Employment, Production Workers (BLS)	Manhours (BLS)	Manufacturing Production (FRB)
	Diffusion Indexes[a] Relative to Business Cycles				
P	Nov. 1948	−12	−13	−14	−13
T	Oct. 1949	− 9	− 8	− 9	− 9
P	July 1953	−12	− 9	−10	− 9
T	Aug. 1954	−14	− 9	− 7	−10
	Average	−12	−10	−10	−10
	Aggregates Relative to Business Cycles				
P	Nov. 1948	−11[b]	−10	−10	− 1
T	Oct. 1949	− 4	+ 1	+ 1	0
P	July 1953	− 7	− 3	− 3	0
T	Aug. 1954	− 4	0	0	0
	Average	− 6	− 3	− 3	0
	Diffusion Indexes[a] Relative to Aggregates				
P	Nov. 1948	− 1	− 3	− 4	−12
T	Oct. 1949	− 5	− 9	−10	− 9
P	July 1953	− 5	− 6	− 7	− 9
T	Aug. 1954	−10	− 9	− 7	−10
	Average	− 5	− 7	− 7	−10

[a] Diffusion by industry; timing of diffusion indexes based on 6 month moving averages of per cent expanding from month to month.

[b] Timing at November 1948 peak based on NICB data; BLS data show no turn.

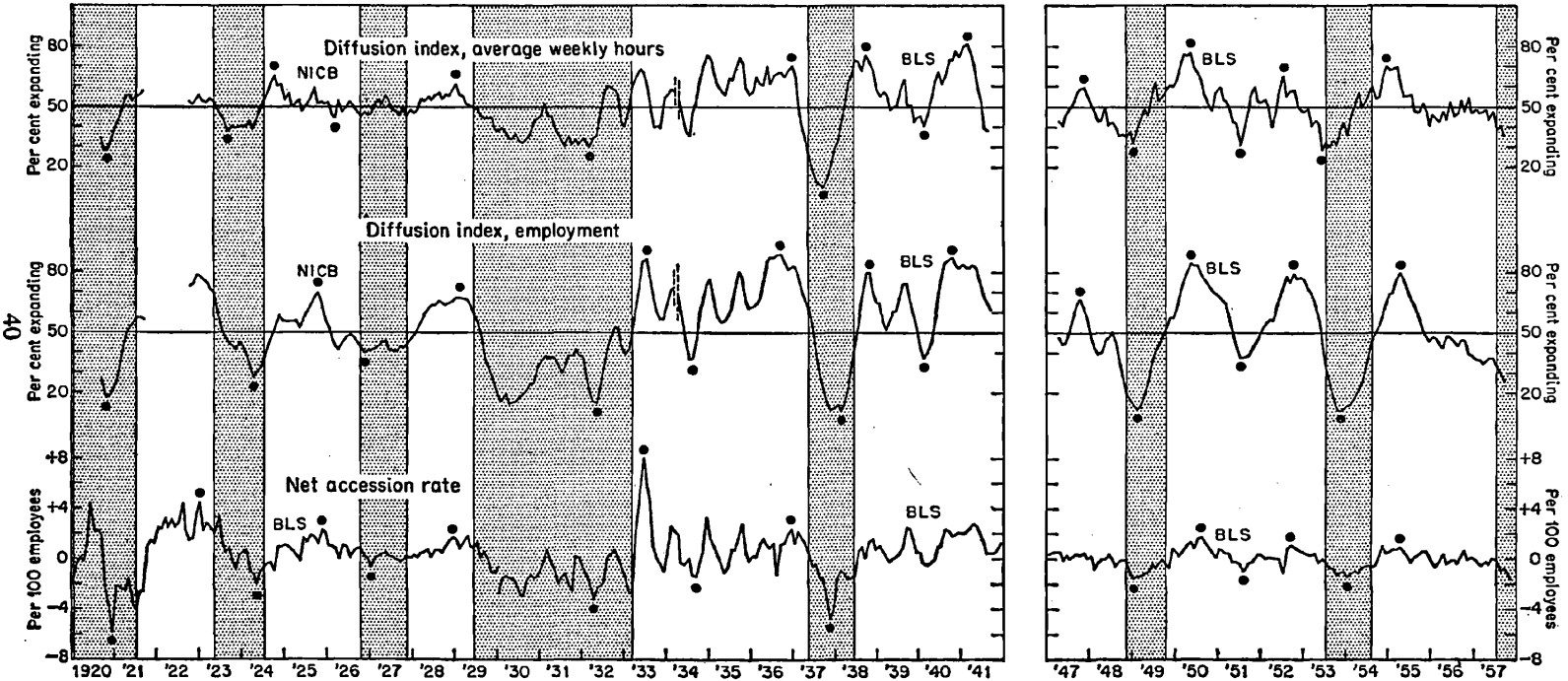
12 months against the 5 months shown by the aggregate.[17] That is, for average hours, the diffusion index leads the aggregate by about half a year.

Is the pronounced lead of average weekly hours over the other three activities also reflected in the relative timing of the diffusion indexes? It is —although to a reduced extent. The lead exists in the averages for the four turns, but not at each turn. And for the averages, the lead is absolutely and relatively smaller in the case of the diffusion indexes than in the case

[17] These measures are based only on the three cycle turns of the BLS aggregate. If the NICB turn in average hours at the 1948 peak is included, the leads amount to 12 months and 6 months respectively.

Chart 9

Diffusion Index of Weekly Hours, Diffusion Index of Employment, and Net Accession Rate, Manufacturing, 1920-1957



For explanation of shaded areas and dots, see Chart 8.

Table 9

Diffusion Indexes[a] and Corresponding Aggregates, Weekly Hours and Production Worker Employment, Manufacturing, 1921-1954

Lead (−), Lag (+), or Coincidence (0) at Business Cycle Turns, in Months

	Business Cycle Turns	AVERAGE WEEKLY HOURS			EMPLOYMENT, PRODUCTION WORKERS			HOURS VS. EMPLOYMENT	
		Diffusion Index Relative to Business Cycle	*Aggregate Relative to Business Cycle*	*Diffusion Index Relative to Aggregate*	*Diffusion Index Relative to Business Cycle*	*Aggregate Relative to Business Cycle*	*Diffusion Index Relative to Aggregate*	*Diffusion Indexes*	*Aggregates*
T	July 1921	− 8	− 5	− 3	− 9	0	− 9	+ 1	−5
P	May 1923	n.a.	− 6	n.a.	n.a.	+ 2	n.a.	n.a.	−8
T	July 1924	−10	0	−10	− 3	0	− 3	− 7	0
P	Oct. 1926	−24	−11	−13	−12	− 9	− 3	−12	−2
T	Nov. 1927	n.c.	+ 5	n.c.	−12	+ 4	−16	n.c.	+1
P	June 1929	− 5	+ 4	− 9	− 4	+ 1	− 5	− 1	+3
T	Mar. 1933	−12	− 8	− 4	−10	+ 1	−11	− 2	−9
P	May 1937	− 5	− 2	− 3	− 8	+ 2	−10	+ 3	−4
T	June 1938	− 9	− 6	− 3	− 4	0	− 4	− 5	−6
P	Nov. 1948	−12	−11[b]	− 1	−13	−10	− 3	+ 1	−1
T	Oct. 1949	− 9	− 4	− 5	− 8	0	− 9	− 1	−4
P	July 1953	−12	− 7	− 5	− 9	− 3	− 6	− 3	−4
T	Aug. 1954	−14	− 4	−10	− 9	0	− 9	− 5	−4
		Averages							
Interwar									
	All Turns	−10[c]	− 3	− 6	− 8	0	− 8	− 3	−3
	Comparable Turns[d]	−10[c]	− 4	− 6	− 7	− 1	− 6	− 3	−3
Postwar									
	All Turns	−12	− 6	− 5	−10	− 3	− 7	− 2	−3
Total Period									
	All Turns	−11	− 4	− 6	− 8	− 1	− 7	− 3	−3
	Comparable Turns[d]	−11	− 5	− 6	− 8	− 2	− 7	− 3	−3

NOTES TO TABLE 9

n.a. = Not available.

n.c. = No comparable turn.

Table 9 footnotes at top of page 42.

[a] Diffusion by industry; six-month moving average of per cent expanding.
[b] Timing at November 1948 peak based on NICB data; BLS data show no turn.
[c] Average lead is −8, if long lead at October 1926 business cycle peak is omitted.
[d] Excludes measures relating to 1923 and 1927 business cycle turns.
Source: NICB to 1935, BLS thereafter.

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of the aggregates. Still, the typical picture is that in the later stages of a business expansion, declines in the workweek begin to spread among industries, and the increased incidence of these declines takes place before a similar process occurs in employment, manhours, and output. Business revivals are preceded by a similar sequence.

Changes in Hours and Employment

The process by which changes in hours and employment come about can be followed in more detail on the basis of Chart 9, which provides a diffusion index of average hours by major industries, and a similar index of employment, on a monthly basis. Our interest in these indexes is twofold: In general, they add to our knowledge of the structural changes which produce fluctuations of the aggregate. More particularly, the characteristically early turns of diffusion indexes suggest that they may have some value as early indicators of impending turns in the aggregates.

Even casual inspection reveals that, for the interwar as well as the postwar period, (1) turns in the diffusion rate of hours lead those in the diffusion rate of employment, and (2) turns in both indexes systematically lead turning points in general business conditions.

A systematic comparison of the turning points of weekly hours and employment, in terms of diffusion indexes and aggregates, is contained in Table 9. The table shows long leads of diffusion indexes relative to business cycle turns (by almost a year for weekly hours and 8 months for employment); long leads of diffusion indexes relative to the corresponding aggregates (by about half a year for both activities); a reflection of the timing relationship of the aggregates in the diffusion index turns (diffusion indexes of weekly hours lead those of employment by 3 months, the same lead as found in case of the aggregates).

There is not a single exception to the characteristic lead of the diffusion indexes of hours and of employment over changes in general business conditions. There also is no exception to the lead of diffusion indexes over the corresponding aggregates. Finally, the timing of diffusion indexes and aggregates, in the interwar and the postwar period, seems to be substantially similar.

Changes in Hours and Employment Determinants (Labor Turnover Rates)

If cyclical turns in hours lead those in employment, and if this is also true

Table 10

Diffusion Indexes of Weekly Hours and Employment, and Labor Turnover Rates, Manufacturing, 1921-1956

Lead (−), Lag (+), or Coincidence (0) at Business Cycle Turns, in Months

Business Cycle Turns			DIFFUSION INDEXES[b] OF		LABOR TURNOVER RATES				
			Av. Weekly Hours	*Employment*	*Net Accession*	*Gross Accession*	*Gross Separation*	*Quit*	*Lay-off (inverted)*
T	July	1921	− 8	− 9	− 7	0	+ 4	+ 1	− 7
P	May	1923	n.a.	n.a.	− 4	− 4	− 3	− 3	− 2
T	July	1924	−10	− 3	− 2	0	0	+ 1	− 1
P	Oct.	1926	−24	−12	−11	−10	−10	−12	−21
T	Nov.	1927	n.c.	−12	−10	− 3	+ 5	+ 3	−10
P	June	1929	− 5	− 4	− 6	− 2	− 4	− 4	− 7
T	Mar.	1933	−12	−10	−11	−28	+ 3	+ 1	−11
P	May	1937	− 5	− 8	− 5	− 5	+ 6	+ 1	− 1
T	June	1938	− 9	− 4	− 7	− 7	+ 8	− 2	− 6
T	Oct.	1949	− 9	− 8	− 9	− 6	+ 6	+ 6	− 5
P	July	1953	−12	− 9	−10	−10	− 2	− 3	− 8
T	Aug.	1954	−14	− 9	− 7	0	+ 5	− 3	− 7
Averages									
All Peaks			−11.5	− 8.2	− 7.2	− 6.2	− 2.6	− 4.2	− 7.8
All Troughs			−10.3	− 7.9	− 7.6	− 6.3	+ 4.4	+ 1.0	− 6.7
All Observations			−10.8	− 8.0	− 7.4	− 6.2	+ 1.5	− 1.2	− 7.2

n.a. = Not available.
n.c. = No comparable turn.
[a] The February 1945 peak, October 1945 trough and November 1948 peak are omitted.
[b] Diffusion by industry; timing based on six-month moving average of per cent expanding.
Source: Diffusion indexes: Table 9. Labor turnover rates: BLS data referring to all employees.

for diffusion indexes, why does employment continue to rise at business cycle peaks, after the downturn of weekly hours? The process of change in the employment aggregate is fairly complex: There are losses due to retirement, accidents, death, induction into armed services, voluntary quits, lay-offs, dismissal and other causes. There are replacements for separations and there is the hiring of new workers. Not all these components of employment change are equally under the control of management. It is of interest to study the behavior of the components and their relations to cyclical changes in hours. In particular, we want to know whether those elements of employment change that are controlled by management lag behind hours in the same way as aggregate employment.

Fluctuations of net accession rates are shown in Chart 9. The net accession rate measures the net monthly change in employment (resulting from all types of accessions and separations) per hundred employees on the payroll during a week situated close to the middle of the month. It is thus more closely akin to first differences, rates of change, or diffusion indexes of employment than to measures of aggregate employment levels.

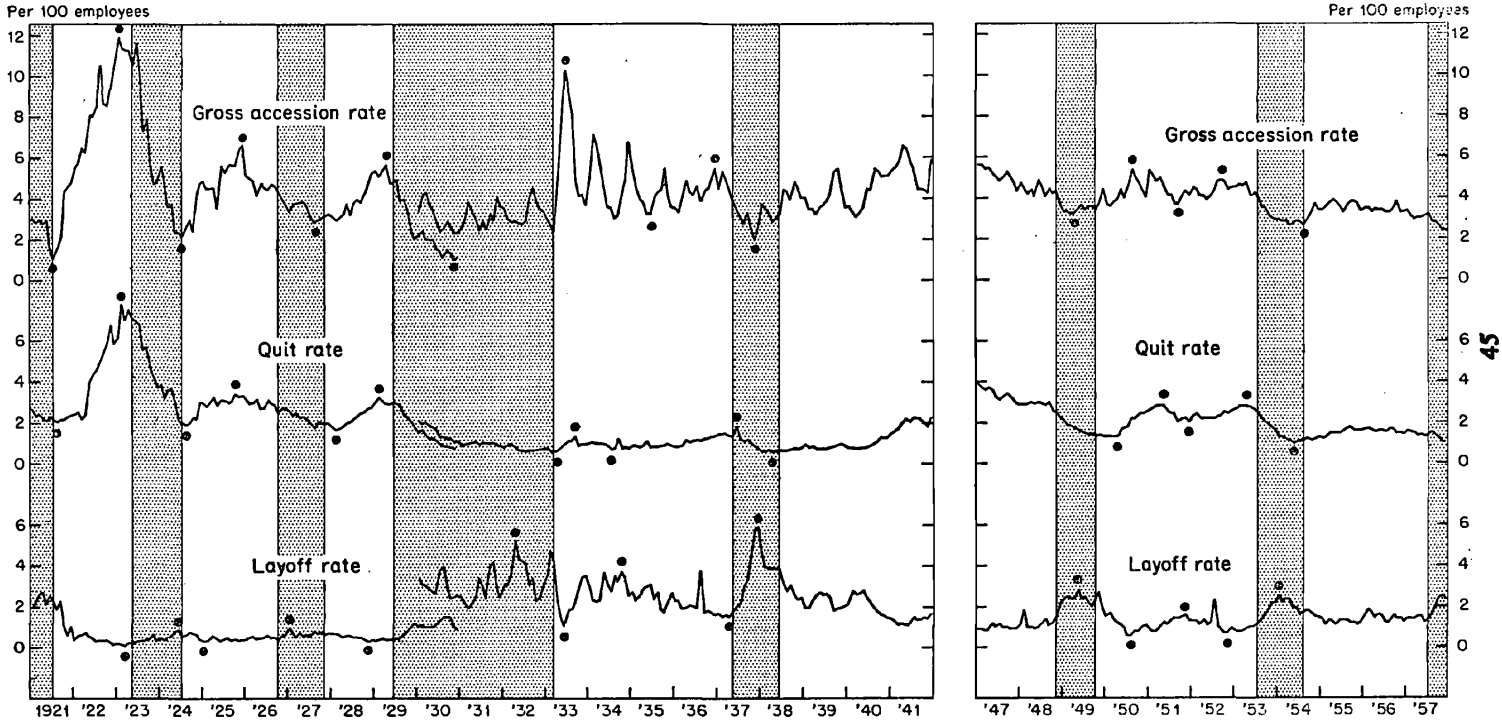
This is clearly reflected in the timing of turning points. For the recent cycle 1949-1953-1954, the lead of the diffusion index of employment as well as that of the net accession rate averages 9 months while employment itself turned virtually at the same time as business conditions at large. Also, for the period as a whole the average timing for the two measures is close, 7 or 8 months for peaks and troughs alike. Comparison between the timing of the diffusion index of employment and the net accession rate, as given in Table 10, shows a high correlation between the leads of the two measures at individual turning points—a clear reflection of the close functional relation between the two measures.

Our interest in the process of adjustment of labor input to changing demand conditions compels us to probe further—to analyze the behavior of the various components of net labor turnover and their relation to changes in average weekly hours.

"Net accessions" are the result of "accessions" and "separations" of employees. Fairly comprehensive information exists on various types of accession and separation rates; and the cyclical behavior of some rates of labor turnover can be demonstrated to correspond tolerably well to that of the absolute number of workers affected.[18] Some basic turnover rates

[18] See the graphs comparing the number of laid-off workers with the corresponding rates, in Geoffrey H. Moore's article "Business Cycles and the Labor Market," which was published in the *Monthly Labor Review*, March 1955, and will be reprinted in "Business Cycle Indicators," to be published for the National Bureau by Princeton University Press. (Note that the two graphs are based on entirely independent source materials.)

Chart 10
Labor Turnover Rates, All Manufacturing, 1921-1941 and 1947-1957



For explanation of shaded areas and dots, see Chart 8.

are presented in Chart 10. Analysis of gross accession rates shows that these rates conform positively with business cycles and that their cyclical phases change well ahead of reversals in business activity at large. Over the cycles included in this study, the lead over business cycle turns is indeed as long as 7 months—3 months longer than that of average weekly hours. Businessmen evidently do not choose, at the approach of cycle turns, to manipulate average hours and leave employment practices unchanged. They also decrease hiring well before business cycle peaks and increase it before troughs. In fact, the reversal of hiring rates occurs well in advance of reductions in hours (although on the average not in advance of turns in the diffusion indexes of hours, see Table 10). Such increase, or decrease, in the hiring rate does not, of course, lead immediately to turns in employment, since accessions, even declining ones, always add to the work force. To understand employment turns we must examine the interaction of accessions and separations.

Gross separation rates differ in timing behavior from gross accession rates. In general, they tend to lead at peaks and lag at troughs (in our sample there is but one lag at peaks, no lead at troughs). Before attempting to interpret this, we must note that gross separations are composed of quits (voluntary separations initiated by employees), lay-offs (separations initiated by management, generally for economic reasons), and discharges (dismissals of workers for cause). Numerically the quits are responsible for a larger part of gross separations than the lay-offs. The discharge rate plays a minor role.[19]

Quit rates show a timing pattern like that of gross separation rates: they tend to lead at peaks and to lag at troughs. Obviously workers become hesitant about quitting well before the peak in business activity is reached; in fact, the average lead of the quit rate at peaks is the same as that of weekly hours. Reduced opportunities (note the leads in accession rates) and increased caution induced by signs of a softening labor market (reduced hours and increased layoff rates)—these are plausible enough reasons for the behavior of workers at the approach of peaks. At troughs the

[19] Over the ten years, 1947-56, the average monthly turnover rates are as follows:

	(per cent)
Gross Accession	4.0
Gross Separation	4.0
Quits	2.1
Lay-offs	1.4
Discharges	.3
Miscellaneous, including Military	.2

situation is different. At five of the seven troughs included in our table, the quit rate rises only after business cycle revivals. Before giving up their jobs, near the bottom of contractions, workers want to be sure of the change of economic climate. And at troughs, the changing demand for labor, reflected by the upturn of accession rates, is spread over unemployed and employed and thus does not affect quit rates to the same extent as in the neighborhood of employment peaks.

The second important component of separation rates is the lay-off rate. This rate reflects—as does the accession rate—discretionary actions of employers to change the short term trends of labor input. Lay-offs conform inversely to business cycles, that is they are at their maximum in the neighborhood of cyclical troughs, at their minimum near peaks.[20] On the average about eight months before troughs, businessmen decrease their hiring and, analogously, seven months before peaks they begin to dismiss more workers. Reversals in lay-offs occur a little earlier than reversals in gross accession, and substantially earlier than those in average hours, the comparison in which we are most interested. Thus also in lay-offs—that is, in the part of separations subject to managerial discretion—businessmen change their policies well in advance of cycle turns, often in fact, before turns in the length of the workweek.[21]

Let us summarize some of our findings. Businessmen modify the average length of the workweek well in advance of reversals in general business activity. While total employment turns close to business turning points, the manipulatable portions of labor turnover—gross hires and lay-offs—show early cyclical turns, on the average even before the reversals of average weekly hours. The lead of hires and lay-offs over hours, however, must be understood in the light of the fact that turnover rates are in the nature of rates of change and thus would tend to precede reversals in levels. Thus the average timing becomes intelligible: First, the percentage of weekly hours series, showing the prevailing pattern (expansion or contraction), changes direction without causing more than a deceleration in the movement of the aggregate. Next, we witness a comparable phenomenon both in employment structure and, at about the same time, in the net accession rate and some of its components. Only afterward do the aggregative measures, such as levels of average weekly hours and finally of employment, reach their cyclical turning points.

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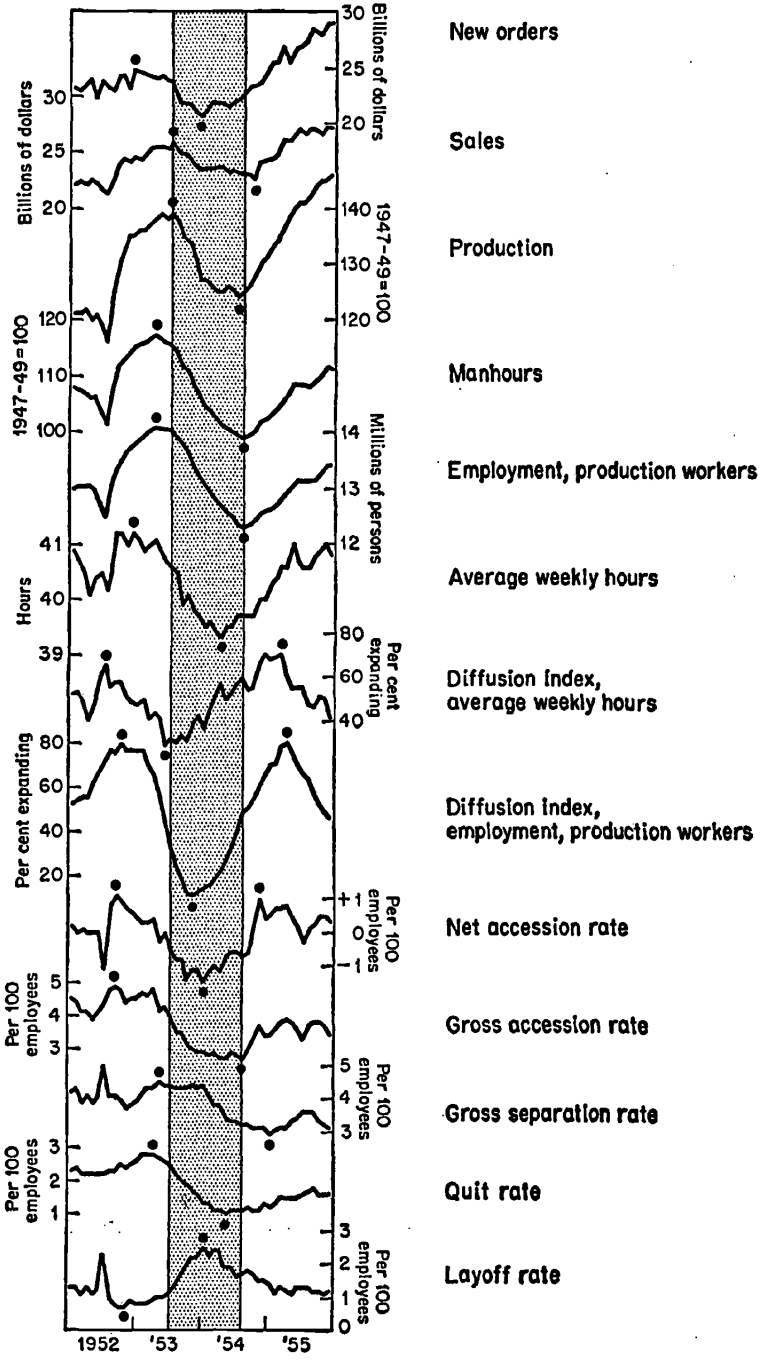
[20] Though this may seem plausible, it would not have been surprising if we had found that most lay-offs occurred shortly after the business cycle peak and if they were at their minimum shortly after troughs. As it is, inverse conformity with a substantial lead is the rule.

[21] The findings suggest the usefulness of accession and lay-off rates as economic indicators — a subject which cannot be considered within the scope of this paper.

Chart 11
Labor Input and Related Variables, All Manufacturing, 1952-1955



For explanation of shaded areas and dots, see Chart 8.

Table 11

Sequence of Cyclical Turns in Weekly Hours and Related Variables, at the July 1953 Peak and the August 1954 Trough, Manufacturing

Specific Peaks	*Timing*[a]	*Activity*	*Specific Troughs*	*Timing*[a]	*Activity*
July 1952	−12	diffusion index of average hours	June 1953	−14	diffusion index of average hours
Sept. 1952	−10	gross accession rate net accession rate	Nov. 1953	− 9	diffusion index of employment
			Dec. 1953	− 8	new orders
Oct. 1952	− 9	diffusion index of employment	Jan. 1954	− 7	net accession rate lay-off rate (on inverted basis)
Nov. 1952	− 8	lay-off rate (on inverted basis)			
Dec. 1952	− 7	average hours new orders	Apr. 1954	− 4	average hours
			May 1954	− 3	quit rate
Apr. 1953	− 3	quit rate employment manhours	July 1954	− 1	production
			Aug. 1954	0	gross accession rate employment manhours
May 1953	− 2	gross separation rate			
July 1953	0	sales production	Oct. 1954	+ 2	sales
			Feb. 1955	+ 6	gross separation rate

[a]Lead (−) or lag (+) in months, relative to business cycle turns.

A TYPICAL SEQUENCE OF TURNING POINTS

Let us see whether our analysis to this point permits us to interpret what happens to average weekly hours, employment, manhours and related economic activities at given cyclical turns. We choose as an example the peak and trough marking the contraction of 1953-54. It is understood that sequences of turning points vary with historical circumstances. However, the typical behavior of economic activities might, under ordinary conditions, be expected to be discernible within the historically unique patterns. In any event, the typical behavior should provide some standard against which to evaluate the actual behavior during a given cycle. The relevant series are depicted on Chart 11 and their cyclical turning points are listed in chronological order in Table 11.

The Business Cycle Peak of July 1953

Among these series, the earliest indication of an impending cyclical contraction came from the activity that is in the center of the present inquiry: average weekly hours. As early as July 1952, that is, a full year before the business cycle turn in 1953, the percentage of industries experiencing a lengthening of the workweek began to fall. This figure reached 65 per cent in July; after that date it continued to decline (with the exception of one month) until, in December 1952, more than half the included manufacturing industries showed a shortening of the workweek. It took more than a year until this trend was reversed. Let us note that this early turn occurred in the diffusion of average weekly hours rather than in their level. It signified a slackening of the expansion, but not yet any actual decline of hours.

The next activity to turn was the gross accession rate, which reached a peak in September 1952. Business firms became more cautious in their hiring,[22] and did not necessarily replace quitting workers (the quit rate continued to rise for many months). The reduction in the hiring rate, in combination with a virtually stable level of total separations, forced a decline of the net accession rate. That is, net additions to employment became smaller. The net change stayed positive for seven more months; thereafter it showed negative values for the whole of the business contraction. We shall soon see how the various major components of the rate contributed to this result.

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[22] The decline in the hiring rate might also be affected, however, by the increasing tightness of the labor market (which makes hiring difficult) and by the rising levels of employment (which increase the denominator and thus decrease the value of the hiring ratio).

The decline in net accessions meant merely that the additions to the work force now became smaller. As long as net accession remained positive, employment continued to rise. But the decreasing size of net additions meant a declining rate of growth in employment, a development that can be verified from Chart 11. The greater caution of management was reflected in a decline in the per cent of industries showing expanding employment: the diffusion index reaches its peak in October. Also, the next turn experienced by our labor market indicators was an upturn in the lay-off rate, in November 1952. This turn must be regarded as highly significant. From November on for more than a year business firms increased almost every month the number of workers involuntarily separated from their jobs.

Up to this point we have found only reversals in rates of growth or in diffusion indexes. In December 1952 we witness the first actual downturn in the level of a labor input measure: in average weekly hours. The decline was mild at first, but soon gained momentum and led eventually to a reduction of the average workweek by about two hours. The peak in average weekly hours occurred in the same months in which the number of industries with declining hours exceeded, for the first time, the number with expanding hours. It is reasonable to expect this proximity of events, but actual coincidence is not inevitable.

In the same month, December 1952, new orders reached their highest level, with a lead of 7 months over the business cycle peak. Such a lead of new orders is not surprising—we know empirically that they tend to lead business reversals; and they may be expected, on general economic grounds, to precede business cycle peaks. Can anything be said about the relation between the decline in new orders and the contraction of the average workweek from their December peaks? Businessmen are generally aware of changes in shipments and backlogs (which add up to new orders). Many had undoubtedly already experienced declines in new orders. They might well have reacted to a deterioration of demand conditions with general economy measures including reduction of labor input, particularly overtime hours. Not much lead is required for such response. In fact the proportion of workers working more than 41, and more than 48 hours, reached peaks in the same month (see Chart 4).

During the first quarter of 1953 none of the series showed any peaks, but in the second quarter we find increasing signs of contraction in the labor market. Voluntary quitting decreases—presumably as a result of dwindling employment opportunities and the greater caution of workers in leaving their jobs. It is interesting to note that for a while the reduced voluntary quitting just about balanced the mounting lay-offs, with the

effect of roughly stabilizing gross separations from April to the end of the year. It was the rapid decline of hiring that forced the net accession rate below zero and led to a decline of employment after April 1953.

Employment, with its large cyclical swings, clearly dominated the fluctuations of labor input. Thus, in spite of the prior decline in the length of the workweek, total manhours of production workers reached a peak in April, together with employment. Although under the impact of downward changes in both employment and average weekly hours the decline in manhours was fairly rapid, it was not, for a while, reflected in declines of output—presumably because of the existence of goods in process, the need to replenish essential stocks, a tightening of managerial controls and perhaps somewhat greater exertion on the part of the work force.

In July 1953, that is, coincident with the peak of general business conditions, production and sales reached their apex. In terms of historical experience the behavior of these two activities ran true to form. Some labor market activities, such as wage rates, typically lag behind business cycle turns, but none of these is included among the variables on which the present description is based.

The Business Cycle Trough of August 1954

From July 1953 to August 1954, the economy of the United States experienced a general contraction—a mild one, if measured against the cycles of the interwar period, yet one that decreased production worker employment in manufacturing by about 13 per cent.

Long before the low point of this contraction was reached, the first signs of recovery in labor input factors appeared. Some of these emerged, in fact, before general business conditions had even reached their preceding peak! Again, one of the first indications of revival can be found in average weekly hours. As early as June 1953, one month before the business cycle peak, the percentage of industries showing an expansion in the average workweek began to increase. In June, the workweek was lengthening for less than 30 per cent of the major manufacturing industries; after this month the percentage began to rise, first haltingly but soon more rapidly. Also the next turn for the better appeared in the structure rather than in the level of an economic activity: after November 1953 the number and per cent of industries showing an increase in production worker employment began to grow. In Chart 11, which shows a six-month moving average through these percentages, the upswing is well defined and uninterrupted—a development related to a deceleration in the decline of aggregate employment but not as readily apparent from the employment series graphed.

The next activity to turn up was new orders, which reached its low mark in December 1953. The upturn of new orders preceded the business cycle recovery in August 1954 by eight months and ushered in a variety of developments in labor input, to which we now turn.

In January 1954, the lay-off peak was reached; after this date, the percentage of workers involuntarily separated from their jobs began to fall. In conjunction with a continued decrease in voluntary quits, this led to a marked decline of gross separations, which had maintained a high level for about three-quarters of a year. The gross accession rate on the other hand maintained, with minor exceptions, a low flat-bottom plateau. The combination of markedly reduced separations and almost stabilized hiring led to an upturn in the net accession rate after January. The rate stayed negative, however, throughout the remainder of the business contraction and thus led to a deceleration but not to a reversal of the decline in production worker employment.

The first activity to show a rise in level is again the average workweek. We shall later consider in detail facts that may explain why businessmen prefer to manipulate labor input (during periods of uncertainty) by expanding and contracting average weekly hours rather than employment. It is enough to say here that this preference was again expressed in the sequence of turning points near the 1954 trough.

While we have found that voluntary quit rates generally lag business cycle troughs, at the 1954 trough, by contrast, quit rates rose as early as May 1954, several months before the turn in general business conditions. One might point to the mildness of the contraction for a general explanation of this behavior. But the charted record is more revealing. Although a trough was reached in May 1954, voluntary quits stayed on a very low level throughout most of 1954 and began to rise significantly only during the next year when the expansion became certain and vigorous.

In the months of July and August, approximately coincident with the revival of general business conditions, production, employment and manhours reached a trough. The domination of manhours by employment is again confirmed by this record. Sales of manufactured goods reached a trough two months later, in October. Cyclical turns of this series usually coincide with those of business cycles; a deviation by as little as two months is however well within the range of historical precedent.

The last activity on our list to turn up is the gross separation rate. Its trough in February 1955 occurred six months after the revival in general business conditions. The lag of gross separation rates at business troughs has been described earlier as a common historical phenomenon. The turn occurs usually when, early in the expansion, the gradually rising quit rate

offsets the gradually declining lay-off rate. This development during the recovery from the 1954 business cycle trough is clearly apparent in Chart 11.

For the activities analyzed, the sequence of turning points during the 1953-54 business contraction proved to be fairly typical. Hence the findings of the general analysis could readily be used for the interpretation of labor market changes during those years.

THE NEED FOR STRUCTURAL DETAIL

Analysis of averages or diffusion indexes of weekly hours for large industrial segments such as All Manufacturing or All Nonagricultural Industries has obvious limitations. We cannot judge whether the broad overall measures are fortuitous results of widely variegated behavior or whether they are "typical" for most components.

There exist, in principle, several ways by which to analyze the changes in average weekly hours in detail, even within the limits of existing statistics. The NICB data, for instance, permit us to distinguish different skill and sex groups in All Manufacturing as well as in each industry.

Table 12

Weekly Hours, by Skill and Sex Groups, All Manufacturing, 1921-1941

Lead (−), *Lag* (+), *or Coincidence* (0) *at Business Cycle Turns, in Months*

	MALE			FEMALE
Business Cycle Turns	*Total*	*Skilled and Semiskilled*	*Unskilled*	*Total*
T July 1921	− 5	− 5	− 5	− 7
P May 1923	− 6	− 6	− 6	− 1
T July 1924	0	0	− 1	0
P Oct. 1926	−10	−11	−10	−21
T Nov. 1927	− 2	− 1	− 1	+ 5
P July 1929	+ 1	+ 1	− 6	+ 2
T Mar. 1933	− 8	− 8	0	− 9
P May 1937	− 2	− 2	− 3	0
T June 1938	− 5	− 5	− 5	− 5
Averages				
All Peaks	− 4.2	− 4.5	− 6.2	− 5.0
All Troughs	− 4.0	− 3.8	− 2.4	− 3.2
All Turns	− 4.1	− 4.1	− 4.1	− 4.0

Based on NICB data.

The BLS data can be analyzed by state and even smaller geographical areas, as well as in fine industrial detail.

Let us briefly survey the promise offered by various ways of analyzing structural detail. For example, average weekly hours of skilled workers may differ from those of unskilled in cyclical timing because the proportion of piece work in the two groups is different. Whatever the cyclical differences in the behavior of hours for skilled and unskilled, none is apparent in the timing measures. On the average weekly hours of both skilled and unskilled workers show a lead of four months (see Table 12). It is true that there are differences between skilled and unskilled if the average timing of hours is measured separately for peaks and troughs. However, these differences, in both cases, are the result of an extreme observation at a single turning point; they do not reflect any characteristic distinction between the timing behavior of hours of skilled and unskilled workers. Similarly, the timing of average hours for men and for women does not exhibit any marked differences. According to Table 12, the average lead in each case is four months; and the small differences which can be observed at peaks and at troughs lack systematic character. We therefore decided to abandon the skill-sex classification as a basis for more detailed analysis.

How about regional detail? Examination of average hours of manufeaturing production workers in two states, New Jersey and New York, showed that the timing of the state data was basically similar to that of the national series. While the sequence was not always the same at each business cycle turn, the state measures showed no systematic differences from the national indexes. State and other regional detail on hours might be useful in testing the degree to which characteristics observed on the national level have indicator value in smaller areas, and *vice versa.* Earlier in this paper, state data were used as components of diffusion indexes, measuring the extent to which given changes in hours penetrate the geographical subdivisions of the country. However, since the original data were not individually adjusted for seasonal variations, the observations on timing referred only to simple and cumulative diffusion indexes. Regional data would also be valuable if further broken down by industry, since industrial composition may provide clues to differential behavior among states. However, we have not ventured into the detail provided by the regional and industrial cross-classification of average hours data available, with increasing coverage, since 1947. Such effort would be justified only if the timing of average weekly hours showed persistent industry-specific characteristics. In the next two sections, we shall explore

this possibility by examining industry detail, within both manufacturing and nonmanufacturing industries.

Certain problems may require an even more detailed breakdown than a regional and industrial cross-classification. Some investigation of the timing of weekly hours and employment in individual manufacturing plants is presented in Section V.