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III Indicators

10 Cyclical Indicators: Structure, Significance, and Uses

10.1 Roughly Coincident Indicators and the Dating of Business Cycles

Economic indicators, as a general category, are descriptive and anticipatory data used as tools for business conditions analysis and forecasting.[1] There are potentially as many subsets of indicators in this sense as there are different targets at which they can be directed. For example, some indicators may relate to employment; others to inflation.

This brings to mind the uses of such time series as lagged explanatory variables in econometric models and regression equations. But there is a different, established meaning to what is often called the "indicator approach." This is a system of data and procedures designed to monitor, signal, and confirm cyclical changes, especially turning points, in the economy at large. The series that serve this purpose are selected for being comprehensive and systematically related to business cycles and are known as *cyclical indicators*.

Business cycles are recurrent sequences of alternating phases of expansion and contraction that involve a great number of diverse economic processes and show up as distinct fluctuations in comprehensive series on production, employment, income, and trade—aspects of aggregate economic activity. The end of each expansion is marked by a cluster of peaks in such series; the end of each contraction, by a cluster of troughs. Analysts at the National Bureau of Economic Research (NBER) base the dating of business cycle peaks and troughs on the identification and analysis of such clusters, that is, the consensus of the corresponding turning points in the principal *coincident indicators*.. This is done because (1) the comovement of the indicators is itself an essential characteristic of the business cycle; (2) no single adequate measure of aggregate economic activity is available in a consistent form for a long historical

1. This section draws in part on Zarnowitz and Moore 1977, p. 476–507. It is also based in part on Zarnowitz 1987, as are some other sections of this chapter.

period; and (3) economic statistics generally are subject to error, so that the evidence from a number of independently compiled indicators tends to be more reliable than the evidence from any individual series. The NBER reference chronologies of business cycle peaks and troughs (Burns and Mitchell 1946, ch. 4; Moore 1961, chs. 5 and 6; Zarnowitz and Moore 1977, 1981; Moore and Zarnowitz 1986) are widely used in academic as well as current business research.

Figure 10.1 illustrates the process of dating business cycles with the aid of 12 indicators in real terms for 1972–76. This period was one of a slowing expansion, a mild downturn followed by an accelerating contraction, an abrupt upturn, and more gradual recovery. It was complicated by an unanticipated rise in inflation following highly stimulative monetary and fiscal policies of 1971–72; exogenous increases in prices of raw materials and agricultural products during 1973; and the oil embargo and huge hikes in energy costs in 1973:4 and 1974:1. Real retail sales peaked as early as March 1973, industrial production in June 1974, employee-hours in nonagricultural establishments as late as October 1974. Despite this considerable scatter of dates, there was a definite concentration of peaks in the series on output, real income and sales, and inverted unemployment around November 1973 and 1973:4 (the x's denote the specific-cycle turns on the chart).

The troughs in the specific cycles for the twelve series show less of a scatter, but here too retail sales in constant dollars turned up early (November 1974) and employment late (June 1975). The other ten series all reached their local minima in March 1975 or 1975:1.

Aspects of general economic activity admit of different measurements, and their alternative statistical representations contain largely unknown data errors. For these reasons, evidence from two or more closely related or partly overlapping series is considered in deciding on when recessions began and ended.

No aggregates in current dollars are shown in the figures presented here but the original work on dating the contraction of 1973–75 included an examination of seven such series (GNP, final sales, value of goods output, personal income, retail sales, manufacturing and trade sales, and wages and salaries in manufacturing, mining, and construction; see Zarnowitz and Moore 1977). The nominal totals represent the original form in which many economic transactions take place and are motivated and recorded. In times of stable prices or cyclical alternation of inflation and deflation, such series would show distinct rises and declines in levels and be given much weight in the process of dating business cycles. However, in times of continuing strong inflation the current-dollar aggregates often do not decline at all in recessions.[2] The deflated series

2. For example, of the seven series listed at the beginning of this paragraph, only the last two had specific-cycle contractions at any time in the period covered (and brief and shallow at that, corresponding to the last and worst part of the contraction in late 1974 and early 1975). See Zarnowitz and Moore 1977, p. 479 and 482 for charts of the levels and deviations from trend for the nominal indicators in 1972–76.

and indexes of physical volume are then given decisive weight as representing more closely what is commonly understood by "recession" and "recovery." When trend adjusted, however, the nominal indicators commonly show significant declines that indicate their participation in growth cycles.

The choice of November 1973 for the business cycle peak and March 1975 for the business cycle trough was ultimately based on judgmentally weighted evidence from the series displayed in figure 10.1. It is confirmed by the composite index shown on figure 10.2, which covers eleven real indicators.[3]

A diffusion index based on the same series shows in cumulated form the excess of the percentage of indicators expanding over the percentage contracting, using cyclical peaks and troughs to define these phases. As plotted on figure 10.2, this index reached a high plateau in November 1973 and drifted neither upward nor downward for about a year thereafter (meaning that about half of its components were expanding and half contracting). This series, which summarizes the underlying data in a complementary but less informative way, is only in a very broad sense consistent with the choice of the November 1973 peak but supports strongly the March 1975 trough date.

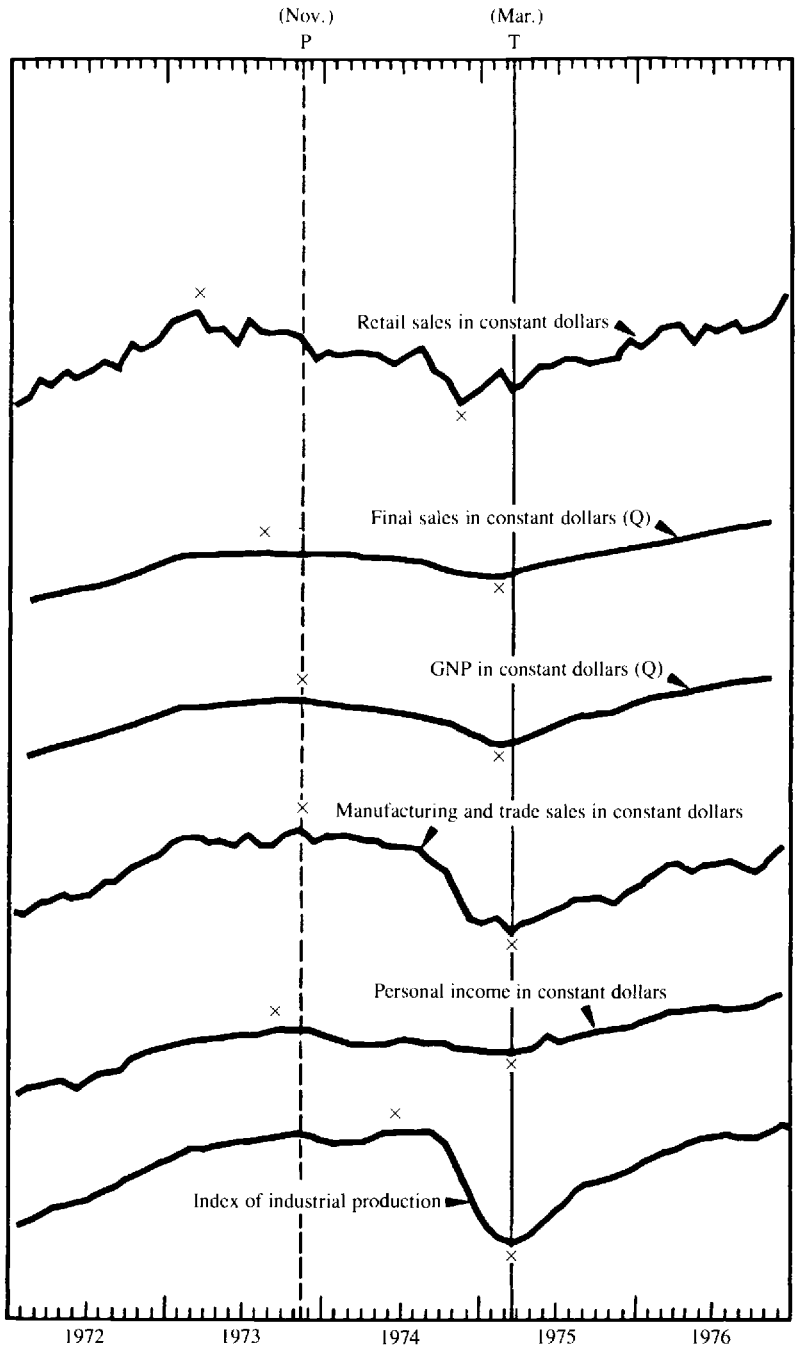
How prompt and confident the determination of a business cycle peak or trough can be depends on how close the consensus of the corresponding specific-cycle turn is. When the latter are widely dispersed, as in the case of the 1973–74 peaks, the dating is difficult and must not be rushed; when they are not, as in the case of the 1975 troughs, the recognition that a new phase of the cycle has begun is relatively easy and quick. Gradual downturns and sharp upturns characterized several postwar business cycles, whereas the opposite was true of the major interwar cycle, where the declines took much less time to start than to end.

In sum, this example demonstrates one important use of the cyclical indicators, namely, the identification and dating of business contractions and slowdowns. The construction of the historical reference cycle chronologies at NBER was always based on a similar detailed inspection of the available data, mainly for those indicators considered to have "roughly coincident" timing. (Of course, the statistical information for the more distant past has been much more limited.) The January 1980 business cycle peak was the first determined by a formally constituted NBER Committee on Business Cycle Dating convened on June 3, 1980 (for a report, see Zarnowitz and Moore 1981).

10.2 Growth Cycles and Business Cycles

Figure 10.3 presents the turning points in the corresponding trend-adjusted series used to date growth cycles. The specific-cycle peaks in these data fall

3. These are the same series as in figure 10.1, except that the rate of unemployment is omitted (the number of unemployed is retained). Composite indexes are computed by standardizing the monthly percentage changes in the component series so as to prevent the more volatile series from dominating the index; averaging the standardized changes for each successive month; and cumulating the results into a monthly index.


(Nov.)
P
(Mar.)
T
Retail sales in constant dollars
Final sales in constant dollars (Q)
GNP in constant dollars (Q)
Manufacturing and trade sales in constant dollars
Personal income in constant dollars
Index of industrial production
1972
1973
1974
1975
1976

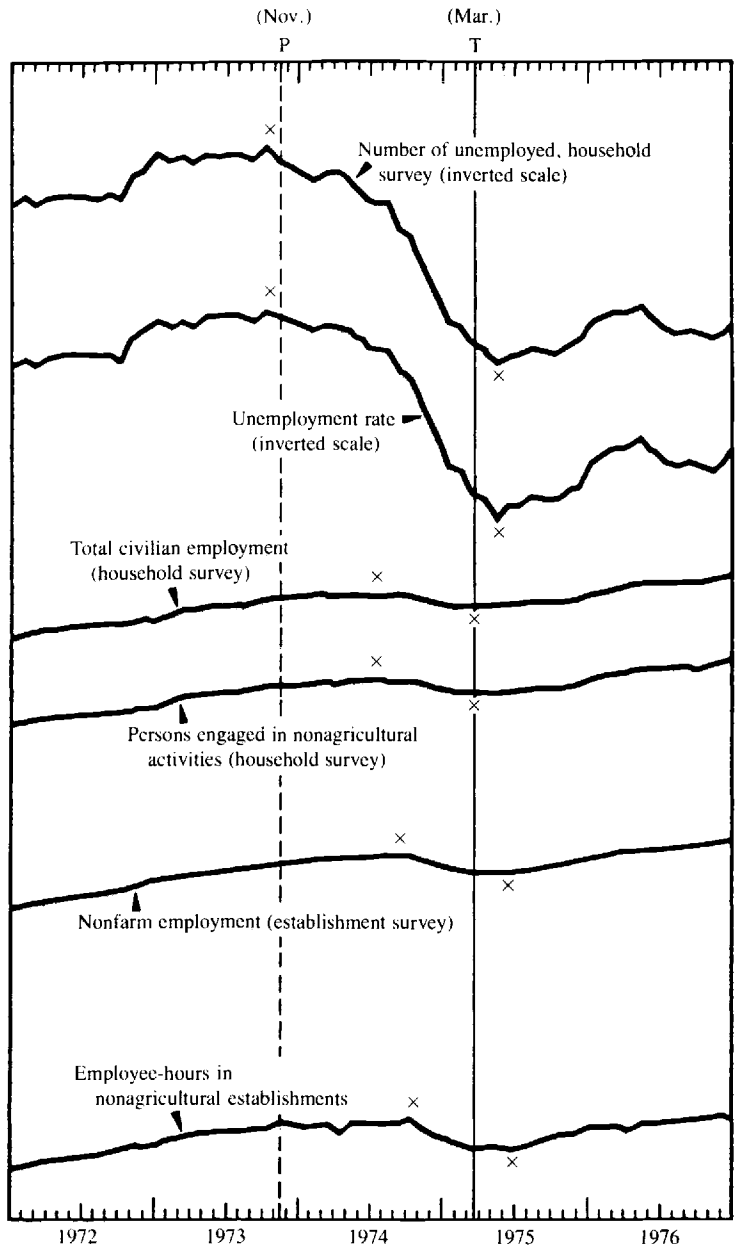


Fig. 10.1 Selected measures of aggregate economic activity, levels, 1972–76
Note: The *x*'s denote specific-cycle turns.

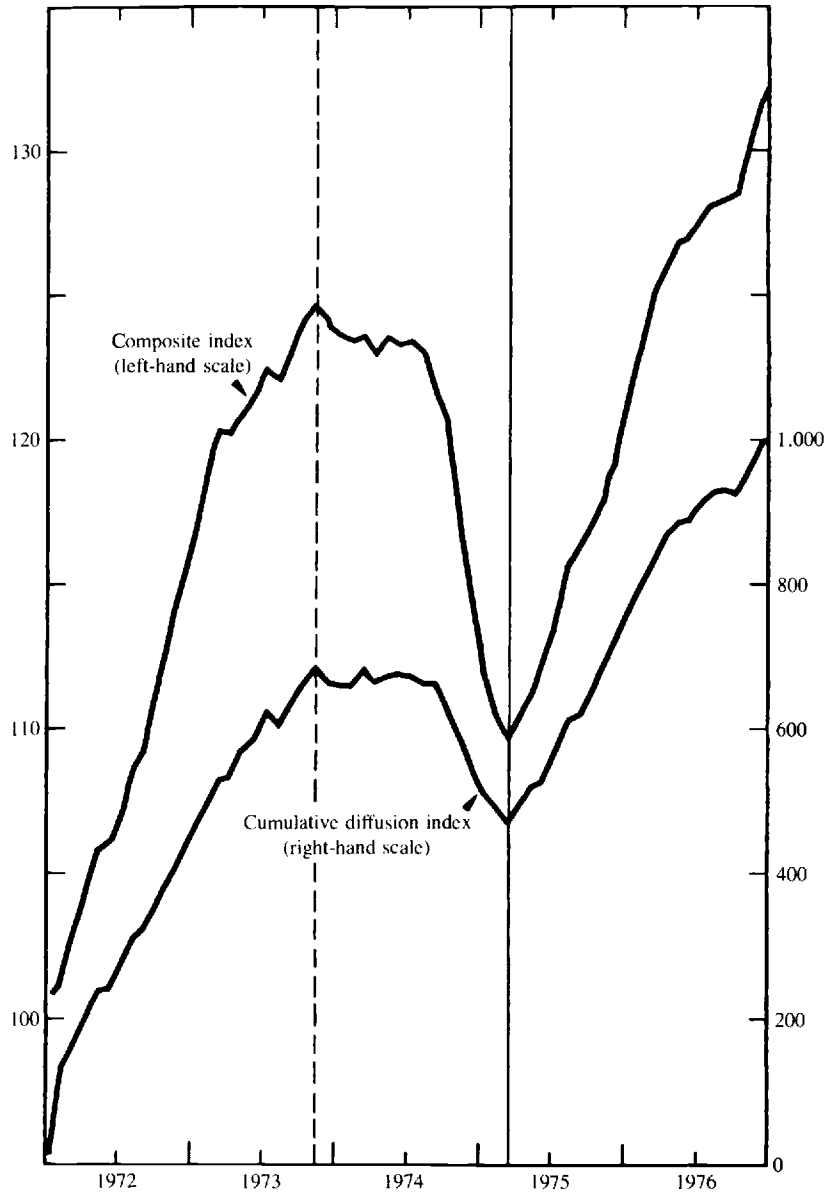


Fig. 10.2 Composite index and cumulative diffusion index of original data, 11 real series, 1972–76

into two groups: 1973:1 or March for GNP, sales, and personal income in constant dollars; and September–November 1973 for industrial production and the employment and unemployment series. As the slowdown preceded the recession, most of the peaks in the detrended indicators occurred earlier than their counterparts in the original series. In contrast, the trough dates were generally unaffected by the trend adjustments, which is typically the case when the upturn is well articulated. When the recovery starts slowly, the troughs in the detrended series tend to lag behind the corresponding troughs in the unadjusted series.

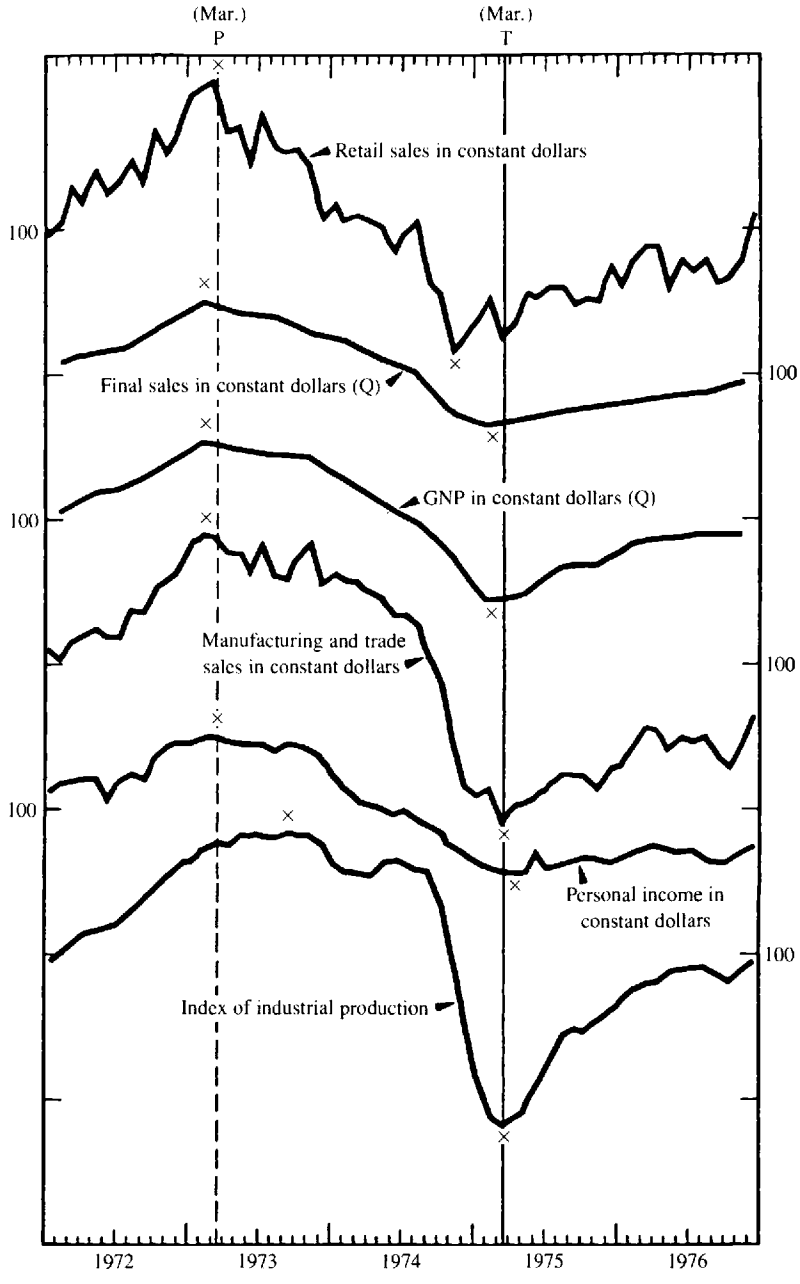
Figure 10.4 shows that the composite index based on the deviations from trend of the eleven real indicators reached a peak in March 1973 and varied only a little during the next nine months. This marks the peak of the growth cycle, that is, the beginning of the 1973 slowdown that turned into a recession near the end of the year. The index clearly stopped falling and started rising in March 1975, the date of the trough in both the business cycle and the growth cycle. The corresponding cumulative diffusion index in the lower part of figure 10.4 provides roughly consistent evidence.

Each of the seven recessions of 1948–80 was preceded by a phase of positive but below-average growth, but these slowdowns lengthened from 2–6 months for the first four of the peaks to 8–13 months for the last three. The long slowdowns marked the ends of the expansions of 1961–69, 1970–73, and 1975–80, and were related to intensified inflation and price shocks, government interventions, reduced rates of private investment and productivity, and the increasing role of service employment. Only the short and weak expansion of 1980–81 ended without any significant slowdown.

If long slowdowns always ended in recessions, they would be very helpful to those engaged in predicting (as distinct from dating) business cycle peaks. But some growth cycle declines interrupt rather than disrupt business cycle expansion (as discussed in chapters 6 and 7). It turns out to be particularly hard to distinguish between these two types of slowdown on a current or timely basis.

10.3 Timing of Specific Cycles: Leading and Lagging Indicators

Differences among business cycles are naturally reflected in the behavior of cyclical indicators. In a growing economy expansions must be on average larger than contractions in terms of output, employment, etc., and they are also likely to be longer. The individual cycles and their phases, however, vary greatly in duration and amplitude. These differences are systematically related to the scope or diffusion of cyclical movements among different units of observation (e.g., activities, regions, industries). Vigorous expansions are generally more widespread than weak expansions; severe contractions are more widespread than mild contractions. Consider diffusion indexes, that is, time series showing the percentage of components in a given aggregate that are


(Mar.)
P
(Mar.)
T
Retail sales in constant dollars
100
Final sales in constant dollars (Q)
100
GNP in constant dollars (Q)
100
Manufacturing and trade
sales in constant dollars
100
100
Personal income in
constant dollars
Index of industrial production
100
1972
1973
1974
1975
1976

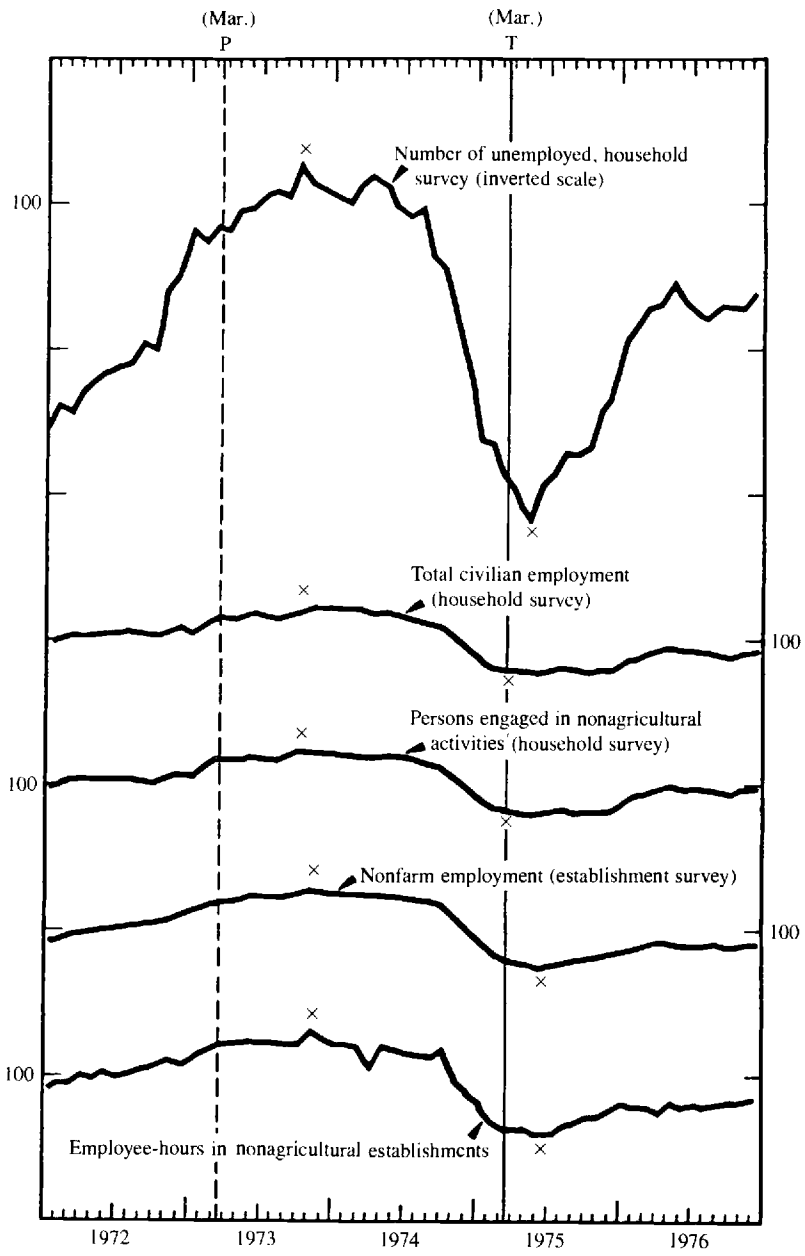


Fig. 10.3 Selected measures of aggregate economic activity, deviations from trend, 1972–76

Note: The *x*'s denote specific-cycle turns.

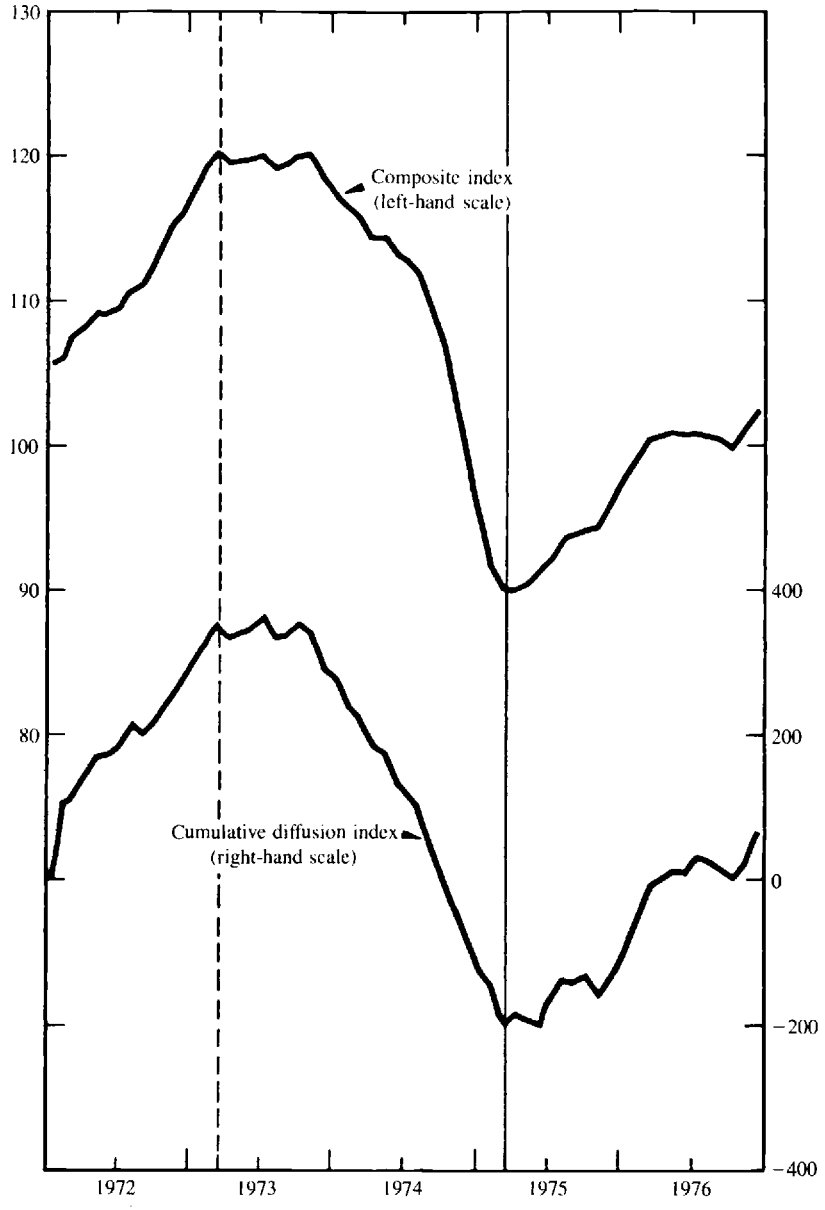


Fig. 10.4 Composite index and cumulative diffusion index of deviations from trend, 11 real series, 1972–76

rising in each successive unit period. Such indexes are correlated with the rates of change in, and tend to lead the levels of, the corresponding aggregates. Information about the direction of the change, hence surveys designed to produce timely diffusion measures on actual or expected sales, prices, profits, etc., are popular in many countries.

As observed across a wide spectrum of variables, the specific cycles differ greatly and in part systematically. What matters particularly in the present context is the characteristic variation of cyclical indicators with respect to their relative *timing*. Thus many economic time series, called *leading indicators*, tend to reach their turning points *before* the corresponding business cycle turns. There are also many series that tend to reach their turning points *after* the peaks and troughs in the business cycle, and they are the *lagging indicators*.

The leading series represent largely flow and price variables that are highly sensitive to the overall cyclical influences but also to shorter random disturbances; hence they show large cyclical rises and declines but also high volatility. Coincident series such as those shown in figure 10.1 have cyclical movements that generally come closer to one-to-one correspondence with business expansions and contractions, and are much smoother. At the same time, the fluctuations in the approximately coincident indicators tend to be smaller than those in the more responsive leaders. Lagging indicators include some massive stock variables which move cyclically much less yet and are extremely smooth.

The tripartition according to timing is not exhaustive and not always so simple. Apart from series that do not conform to business cycles at all or have irregular timing, there are some that have mixed timing (e.g., lead at peaks and lag at troughs, or vice versa).

Gradual changes in timing also appear in some variables, reflecting the effects of structural or institutional changes. For example, the index of industrial production lagged at most of the business cycle peaks in 1920–37 but led at most of the peaks in 1948–81. Although short intervals prevailed among these observations in both periods, the timing of production was more nearly coincident in the interwar than in the postwar cycles. This may be due to the decline of the share in employment of the sectors covered by this index (manufacturing, mining, and electric and gas utilities). Against the backdrop of the rising size and weight of broadly defined services, it is now possible for the index of industrial production to turn down without pulling the rest of the economy promptly into a recession. Employment in goods-producing industries actually declined in 1967 and 1985–86, years of continued expansion. Total nonfarm employment now tends to have more short lags and fewer short leads and coincidences compared with its historical timing at business cycle turns. This is likely to be attributable to the rising trend and weight of overhead labor and service jobs.

10.4 Alternative Interpretations and Uses of Lagging Indicators

A large majority of indicators show positive conformity to business cycles, that is, they tend to increase in expansions and decrease in contractions subject to leads or lags that are small in comparison to the durations of their cyclical movements. Some indicators, such as the rates of unemployment, delinquent loans, and business failures, show inverse conformity by typically increasing in contractions and decreasing in expansions. Their timing is measured on an inverted basis by matching their specific-cycle peaks (troughs) with business cycle troughs (peaks).

Some series, such as those on the monetary growth rates, have very long leads when treated on the positive basis and shorter lags when treated on the inverted basis. The influence from money to business would argue for the former interpretation (downturns in monetary growth cause recessions; upturns cause recoveries); the influence from business to money may favor the latter interpretation (e.g., recessions cause increases, and recoveries cause decreases, in the currency and reserve ratios). Theory does not make the choice very easy, since it is agreed that the influences run both ways. The finding that the dispersion of the timing comparisons is less when computed on the positive plan supports the matching of like turns used in the early monetarist studies (see Friedman 1964, pp. 14–15).

Alternative interpretations also apply to another set of important cyclical relations. When treated on an inverted basis, the principal lagging indicators become long leaders. Interest rates usually rise early in business contractions but decline later as pressures of the demand for credit ease and banks acquire more reserves. But these declines signal reductions in the cost of credit, which stimulate borrowing for more real investment and future production; in this sense, they can be linked, with leads, to the next business revival, which they are helping to bring about. The interest rates tend to decline through the early recovery stages of expansion, and the later they turn up as a result of tighter credit supply, the longer the expansion is likely to last (Cagan 1969). Long records support the inference that bond yields lag and bond prices (approximately, inverted yields) lead at both peaks and troughs in aggregate economic activity.

Other lagging series, like interest rates, also measure or reflect the costs of doing business: unit labor cost, inventories carried in manufacturing and trade, and business loans outstanding. The costs of inputs of labor, materials, and capital will rise eventually during expansions as more and more industries get to operate close to full-capacity utilization and higher. A large increase in such costs relative to the levels of actual and expected prices would have strong deterrent effects on new orders and contracts, credit extensions, etc. This mechanism can produce a deteriorating "profit squeeze," depress business confidence and new investment, and be instrumental in bringing on a slowdown or even a recession. Conversely, declines in the overall level of

financial, production, and inventory costs during contractions improve the actual and expected profit margins and pave the way for an upturn in the leading and, later, the coincident indicators of general economic activity.

In fact, turning points in the lagging series occur before the opposite turning points in the leading series on average and with great regularity. The median troughs of a group of 30 lagging series led the median peaks of a group of 75 leading series in anticipation of each of the fifteen business cycle downturns between 1887 and 1937. The median peaks of the laggers led the median troughs of the leaders thirteen times (and coincided twice) ahead of each of the fifteen business cycle upturns between 1888 and 1938. The average leads were 12 months at peaks of the leaders and 7 months at troughs. Analogous comparisons based on twelve leading and six lagging indicators for 1949–82 produce seven leads in as many observations at peaks and seven leads out of eight observations at troughs (one coincidence). Here the means are −16 and −4 months respectively. The dispersions of the individual timing comparisons around these averages are large mainly because of a few outliers.[4]

Table 10.1 presents for the same groups of indicators a summary of timing at business cycle turns (rather than relative to each other). The entries in columns 1, 3, and 5 make clear that the inverted laggers provide the earliest signals of both peaks and troughs, followed by the leaders, and eventually confirmed by the laggers (the coincident series are not included). The leads tend to be longer at peaks than at troughs, particularly so for the first group and in the postwar period, when expansions increased and contractions decreased greatly in duration. The lags tend to be longer at troughs than at peaks in the same period.

10.5 Differences and Shifts in Timing at Peaks and Troughs

According to a count based on 103 series with long records, leads and lags were equally frequent at peaks of the pre-1919 business cycles, whereas at troughs leads were twice as frequent as lags. In 1919–38, the ratio of leads to lags was approximately 5 to 4 at both peaks and troughs. In a very comprehensive sample of 188 series for 1948–70, leads outnumbered lags by more than 7 to 2, but the two categories were almost in balance at troughs (see table 10.2, lines 1–3).

Differences between the pre-1939 sample and the post-1947 sample cannot explain the observed shifts in timing. Thus a set of 40 long series that extend through 1970 gives very similar results (lines 4–5). Moreover, a subset of 28 series that cover five business cycles in 1920–38 and five in 1948–70 provides

4. Omitting one very long lead associated with the business downturn of 1937 reduces the mean for the early observations at peaks from −12 to −10 and the standard deviation from 11 to 4. Omitting another unusually long lead associated with the revival of 1933 reduces the mean lead for the early observations at troughs from −7 to −5 and the standard deviation from 9 to 4. The postwar comparisons include smaller outliers associated with the peaks of 1953 and 1980.

Table 10.1 **Leads and Lags of Groups of Cyclical Indicators, Means and Standard Deviations, 1885–1982 and Subperiods**

Type of Turn and Group	1885–1919[a] Mean (1)	1885–1919[a] S.D. (2)	1948–82[b] Mean (3)	1948–82[b] S.D. (4)	1885–1982[c] Mean (5)	1885–1982[c] S.D. (6)
Leads (−) or Lags (+) at Peaks						
Median trough, lagging[d]	−17	11	−26	12	−20	12
Median peak, leading	−5	4	−10	6	−7	5
Median peak, lagging	+6	4	+5	3	+5	4
Leads (−) or Lags (+) at Troughs						
Median peak, lagging[e]	−13	9	−7	3	−11	8
Median trough, leading	−6	3	−3	2	−5	3
Median trough, lagging	+7	5	+10	5	+7	5

Sources: 1885–1938: Moore 1950, table 11, based on 75 leading and 30 lagging series. 1948–82: BCD, October 1977, app. F and subsequent issues, based on 12 leading and 6 lagging series. For a list of all observations used (leads and lags at the individual business cycle turns), see Zarnowitz and Moore 1986, tables 9.15 and 9.16.

Note: S.D. = standard deviation.

[a]Covers 14 business cycle peaks in 1887–1913 and 1920–37 (August 1918 omitted) and 14 business cycle troughs in 1885–1914 and 1919–38 (April 1919 omitted).

[b]Covers 8 business cycle peak in 1948–81 and 8 business cycle troughs in 1949–82.

[c]Covers 22 business cycle peaks and 22 business cycle troughs.

[d]Data for the November 1948 peak not available.

[e]Data for the May 1885 trough not available.

confirming evidence (lines 6–7). The latter sample also shows that leads at peaks grew much longer in the postwar as compared with the interwar cycles, and lags at peaks grew shorter. The differences are much smaller for the comparisons at troughs, where both the leads and the lags became moderately smaller (see the last two lines in table 10.2).

The NBER reference cycle chronology has been subjected to several reviews, most recently in Moore and Zarnowitz 1986 (see also chapter 7). It is unlikely to contain errors sufficiently large and systematic to be responsible for the above-noted asymmetries and shifts in the distributions of the cyclical timing comparisons.[5]

What then can explain these observations? It is possible for strong upward trends to skew the timing of many indicators toward lags at peaks and leads at troughs. The differences between the measures for the pre-1919 and 1919–38 cycles are consistent with this simple hypothesis, because the interwar period as a whole was marked by reduced upward trends (less real growth and more deflation). But the distributions shifted even further toward leads at peaks and lags at troughs in 1948–70, despite the higher growth and inflation trends then

5. For early discussions of this point, see Moore 1961, ch. 7, esp. pp. 222–25; and Mitchell 1951, pp. 73–75.

Table 10.2 **Distributions of Leads and Lags at Business Cycle Peaks and Troughs in Prewar, Interwar, and Postwar Periods**

Period	Time Series (no.) (1)	Timing Observations (no.) (2)	Business Cycle Peaks			Business Cycle Troughs		
			Leads (%) (3)	Coincidences (%) (4)	Lags (%) (5)	Leads (%) (6)	Coincidences (%) (7)	Lags (%) (8)
			A. Nonmatching Samples					
Before 1919	103	1,263	46	9	46	62	8	30
1919–38	103	919	50	12	38	46	19	36
1948–70	188	1,442	75	7	20	36	21	43
			B. Matching Samples					
Before 1939	40	562	48	11	40	55	12	32
1948–70	40	343	72	8	20	43	19	38
1920–38	28	259	55	11	34	45	17	38
1948–70	28	236	73	8	19	43	16	41

Addendum: Mean Lead (−) or Lag (+), in Months

	All Observations		Leads at Peaks	Lags at Peaks	Leads at Troughs	Lags at Troughs
	Peaks	Troughs				
1920–38	−2.0	+1.1	−6.8	+5.0	−6.0	+9.7
1948–70	−7.5	+1.0	−11.0	+3.1	−4.4	+7.2

Note: In some lines, the entries for leads, coincidences, and lags in cols. 3–5 or 6–8 fail to add up exactly to 100 due to rounding. Each of the 103 series used in lines 1 and 2 has a record beginning before 1919 and extending through 1938 and has been accepted for cyclical conformity and timing in either the full period covered or 1919–38. This sample was examined in Moore 1950 (reprinted in Moore 1961, pp. 222–25). The sample of 188 series (line 3) includes all indicators evaluated in the 1972–75 Bureau of Economic Analysis (BEA) review. The sample of 40 series (lines 4 and 5) is a subset of the longest series from the same BEA collection (10 start in 1857–89, 24 in 1907–21, and 6 in 1926–29). The sample of 28 series (lines 7–9) is a subset of the previous one that covers 5 peaks and 5 troughs of business cycles in 1920–38 and an equal number of turns of either type in 1948–70.

prevailing (cf. lines 1–3 in the table). This is contrary to the hypothesized trend effects.

The most likely explanation of the contrast between the interwar and the postwar distributions of the measures of timing at peaks and troughs derives from the reasons for the moderation of business cycles (chapter 3). Structural, institutional, and policy changes tended to support the forces of expansion and counteract those of contraction. The economy grew more responsive to the former and more resistant to the latter. Hence recessions, once recognized as such, were not permitted to endure and deepen but ended in relatively concentrated and symmetrical upturns. Expansions survived weaknesses in the cyclically sensitive sectors more easily than before; and when such slowdowns did worsen and spread so as to bring about a decline in aggregate activity, the process was now often much more protracted than it used to be. The slowdowns that preceded the business cycle peaks were accompanied by

many leads in sensitive indicators and generally much dispersion of the specific-cycle peaks.[6]

Expansions were much longer and contractions much shorter in 1948–70 than in 1920–38, and this probably helps explain the differences in the average size of leads and lags between the two periods, as shown in the last section of table 10.2. The hypothesis is that the lags at initial troughs and the leads at terminal peaks tend to increase with the length of expansions, whereas the lags at initial peaks and the leads at terminal troughs increase with the length of contractions. This implies that cyclical timing relations are more stable in terms of business cycle time than in terms of calendar time (see chapter 6, sec. 6.3).

The evidence from the data used in table 10.1 and from the phase durations in peacetime business cycles of 1887–1982 is on the whole consistent with the above hypothesis. The correlations between the durations of business expansions on the one hand and the leads and lags internal to the corresponding expansions on the other are all positive, and half of them are quite high (table 10.3, lines 1–4). The analogous correlations with business contractions are also positive (except one that is effectively zero), but most are smaller (lines 5–8). This presumably reflects the fact that many contractions were similar in being short, particularly in the postwar period, and the same applies to the recent average leads at troughs. With more observations of greater variety, it seems plausible that the hypothesis would receive stronger support.[7]

There is also related evidence that the lengths of the leads or lags at successive turning points are positively correlated (Zarnowitz and Moore 1986, pp. 565, 568–71). These correlations refer directly to the intervals between the turns in the indicator series and make no use of the business cycle chronology. They too apply as well to comparisons between opposite turns as to those between like turns. All of this is certainly consistent with the idea that cyclical influences run from lagging to leading indicators as well as in the opposite direction. As detailed in the next two sections, these dynamic interactions form an integral part of business cycles, helping to shape and being themselves shaped by the movement of aggregate economic activity (coincident indicators).

6. It is well to observe that this prevalence of flat downturns and sharp upturns is the direct opposite of the asymmetry noted for the pre-1939 sample of indicators, which was attributed by Mitchell (1951, p. 75) "mainly to a difference between peaks and troughs in the average character of the arrays of specific-cycle timing dates. . . . At the peaks these arrays are on the average relatively compact and symmetrical; at the troughs the arrays are more dispersed and skewed toward leads."

7. Consider a diversified collection of indicators, all extending over the same stretch of time, which includes an equal number of business expansions and contractions. The number of specific-cycle turns that match business cycle turns (peaks and troughs combined) is about equally divided between business expansions and contractions. If contractions are short and expansions long, for example, the density of the turns in the series and their proximity to the business cycle turns should on the average be greater in contractions than in expansions.

Table 10.3 **Correlations between Leads and Lags of Groups of Indicators and Durations of Business Cycle Phases, 1885–1982 and Subperiods**

Line	Statistic[a]	Correlation Coefficients (r) 1885–1938 (1)	1948–82 (2)	1885–1982 (3)
	A. With Durations of Business Expansions[b]			
1	Leads at peaks of MdT-Lg	+.87	+.97	+.89
2	Leads of MdT-Lg relative to MdP-L	+.78	+.95	+.51
3	Leads at peaks of MdP-L	+.50	+.51	+.57
4	Lags at initial troughs of MdT-Lg	+.12	+.82	+.41
	B. With Durations of Business Contractions[c]			
5	Leads at troughs of MdP-Lg	+.90	+.43	+.88
6	Leads of MdP-Lg relative to MdT-L	+.82	+.60	+.75
7	Leads at troughs of MdT-L	+.21	−.01	+.37
8	Lags at initial peaks of MdT-Lg	+.19	+.64	+.26

Sources: See table 10.1

[a]Abbreviations: Md, median; T, trough; P, peak; Lg, lagging group; L, leading group. For example, line 1 refers to "median trough, lagging group."

[b]Number of observations per entry in cols. 1, 2, and 3 is 14, 5, and 19, respectively.

[c]Number of observations per entry in cols. 1, 2, and 3 is 14, 6, and 20, respectively.

10.6 Economic Process and Cyclical Timing

Business cycle indicators have been selected, analyzed, and reviewed in a long series of comprehensive and detailed studies (Mitchell and Burns 1938; Moore 1950, 1961; Shiskin 1961a; Moore and Shiskin 1967; Zarnowitz and Boschan 1975a, 1975b). The results include a cross-classification of all individual indicators by types of economic process and characteristic timing in recessions and recoveries.

Table 10.4 summarizes this material for the 112 series included in the section on "Cyclical Indicators" in *Business Conditions Digest* (*BCD*), a monthly report of the Bureau of Economic Analysis (BEA) in the U.S. Department of Commerce.[8] The indicators are divided into seven groups representing major economic processes and into more than thirty smaller subgroups. For each of the latter, part A (B) of the table lists the median leads or lags at business cycle peaks (troughs) of 1948–80.

The proportions of leaders, coinciders, and laggers are 57%, 22%, and 21% at peaks and 44%, 20%, and 36% at troughs, respectively. More series anticipated recessions than recoveries in this representative collection of post-

8. *BCD* (called *Business Cycle Developments* before 1968) began publication in 1961 and was discontinued in March 1990. From April 1990 on, data and charts on business cycle indicators are published in a new section of *Survey of Current Business*, another monthly report by the BEA.

Table 10.4 **Cross-classification of Indicators by Economic Process and Cyclical Timing**

Economic Process	Leading (L) (no. of series)	Median Lead (−) or Lag (+) (mo.)	Roughly Coincident (RC) (no. of series)	Median Lead (−) or Lag (+) (mo.)	Lagging (Lg) (no. of series)	Median Lead (−) or Lag (+) (mo.)
			A. At Seven Business Cycle Peaks, 1948–80[a]			
I. Employment & unemployment (15 series)	Marginal employment adjustments (3)	−11 to −13	Comprehensive employment (5)	0 to −3	Unemployment, long-term & average duration (2)	0, +1
	Job vacancies (2)	−7, −9				
	Comprehensive unemployment (3)	−3 to −5				
II. Production & income (10 series)	Capacity utilization (2)	−6 to −11	Comprehensive output & income (4)	0 to −3		
			Industrial production (4)	0 to −3		
III. Consumption, trade, orders, & deliveries (13 series)	New & unfilled orders (4)	−5.5 to −12	Consumption & trade (4)	0 to −3		
	Change in unfilled orders, vendor performance (2)	−6, −11				
	Consumer sentiment, car buying, real retail sales (3)	−5.5 to −12				
IV. Fixed capital investment (18 series)	Formation of business enterprises (2)	−10, −13	Business investment expenditures (6)	−2.5 to +1		
	Residential construction (3)	−10 to −13				
	Business investment commitments (7)	−2 to −9				
V. Inventories & inventory investment (9 series)	Change in inventories (4)	−4 to −11			Manufacturing & trade inventories (4)	+3 to +8
	Materials & supplies on hand & on order (1)	−2				
VI. Prices, costs, & profits (19 series)	Stock prices (1)	−9.5			Unit labor costs (4)	+5 to +10
	Sensitive commodity prices (3)	−5 to −10			Labor share (1)	+10
	Profits & profit margins (8)	−6 to −24.5				
	Cash flows (2)	−6, −6				

VII. Money and credit (28 series)	Changes in money & liquid assets (3)	−7 to −20	Velocity of money (2)	0, +0.5	Interest rates:	
	Real money balances (2)	−11, −16			On market securities (6)	+1 to +2
	Credit flows (5)	−9 to −11			Charged by banks (2)	+3.5, +4
	Credit difficulties (2)	−9, −14			Private debt outstanding (4)	+1 to +4
	Bank reserves (2)	−3, −4.5				
Total: 112 series	64 series		25 series		23 series	
			B. At Seven Business Cycle Troughs, 1949–80[b]			
I. Employment & unemployment (15 series)	Marginal employment adjustments (3)	0 to −1	Comprehensive employment (4)	0 to 0	Job vacancies (2)	+1, +2
					Employment population ratio (1)	+3
			Insured unemployment rate (1)	0	Comprehensive unemployment (2)	+3, +3
					Unemployment: long-term & average duration (2)	+5, +8
II. Production & income (10 series)	Industrial production (nondurable manufactures) (1)	−1	Comprehensive output & income (4)	0 to 2		
			Industrial production (3)	0 to 0		
			Capacity utilization (2)	0 to +1		
III. Consumption, trade, orders, & deliveries (13 series)	New orders, change in unfilled orders (4)	−1 to −3	Manufacturing & trade sales (2)	0, −1	Unfilled orders (1)	+2
	Vendor performance (1)	−4	Car buying (1)	0		
	Production of consumer goods, retail sales (3)	−1 to −3				
	Consumer sentiment index (1)	−2				
IV. Fixed capital investment (18 series)	Formation of business enterprises (2)	−1, −1.5	Nonresidential fixed investment, total, equipment (2)	0, 0	Output of business equipment (1)	+1
	Contracts & orders, plant and equipment (4)	−1 to −2			Construction contracts, BIC (1)	+2
	Residential construction (3)	−2 to −3			Nonresidential fixed investment, structures (1)	+3
					Capital appropriations, BIC (2)	+1, +5
					Business investment expenditures (2)	+4, +4

(*continued*)

Table 10.4 **Continued**

Economic Process	Leading (L) (no. of series)	Median Lead (−) or Lag (+) (mo.)	Roughly Coincident (RC) (no. of series)	Median Lead (−) or Lag (+) (mo.)	Lagging (Lg) (no. of series)	Median Lead (−) or Lag (+) (mo.)
V. Inventories & inventory investment (9 series)	Change in inventories (4)	−1 to −5.5			Inventories on hand & on order (5)	+3 to +13
VI. Prices, costs, & profits (19 series)	Stock prices (1)	−4	Profits with inventory valuation & capital consumption adjustments (3)	0 to 0	Unit labor costs (4)	+9 to +13
	Sensitive commodity prices (3)	−1 to −7			Labor share (1)	+13
	Profits & profit margins (5)	−2 to −4				
	Cash flows (2)	−2, −2				
VII. Money and Credit (28 series)	Changes in money & liquid assets (3)	−3 to −9	Velocity of money (GNP/M1) (1)	−1.5	Velocity of money, PI/M2 (1)	+12.5
	Real money balances (2)	−3, −4			Bank reserves (2)	+2.5, +5
	Credit flows (5)	−1 to −3			Outstanding debt (4)	+2.5 to +7
	Credit difficulties (2)	0, −2			Interest rates (8)	+2 to +16
Total: 112 series	49 series		23 series		40 series	

Source: U.S. Department of Commerce, Bureau of Economic Analysis, *Handbook of Cyclical Indicators: A Supplement to the Business Conditions Digest* (1984), table 8, pp. 172–73.

[a]November 1948, July 1953, August 1957, April 1960, December 1969, November 1973, January 1980.

[b]October 1949, May 1954, April 1958, February 1961, November 1970, March 1975, July 1980.

war indicators. Moreover, the average leads were in general markedly longer at downturns than at upturns. The opposite applies to the lags, which tended to be both fewer and shorter at peaks.

The general conspectus of timing relationships that are typical of business cycles was introduced in chapter 2 (see table 2.4 and text); table 10.4 extends and quantifies that schematic representation. Read horizontally, the table shows the within-process sequences: for example, marginal employment adjustments (average workweek, overtime hours, claims for unemployment insurance) led at business cycle peaks by long intervals, job vacancies by intermediate intervals, and unemployment by short intervals; comprehensive employment had roughly coincident timing; and long-term unemployment and average duration of unemployment lagged. At troughs, the sequence was somewhat different in that job vacancies and most unemployment series lagged. Read vertically, the table shows which variables in different economic-process groups had similar timing. To illustrate, marginal employment adjustments, new orders for consumer goods, business investment commitments (new appropriations, orders and contracts for capital goods), change in inventories, stock prices, corporate profits, and money change and credit flows, all led at both peaks and troughs.

Series on job vacancies and unemployment (inverted) illustrate the mixed category of leads at peaks and lags at troughs. This is because employment typically rises slowly in both the initial and the late stages of a business expansion, whereas the labor force grows at a fairly steady pace.[9] Capacity utilization rates exemplify series that lead at peaks and coincide at troughs, presumably again reflecting the recent patterns of flat downturns and sharp upturns.

Most indicators, however, tend to either lead at both types of turn or be roughly coincident or lag at both. The identities of the leaders, coinciders, and laggers remain unchanged over long stretches of time, as documented by repeated reviews of their performance. That is, the medians in table 10.4 are generally quite representative in the sense that leads prevail heavily for the series listed on the left, rough coincidences (including leads and lags of 3 months or less) for the series listed in the middle, and lags for the series listed on the right. But it should be noted that this qualitative continuity coexists with a good deal of variation in the *magnitudes* of the *individual* leads (lags) recorded over time for a particular leading (lagging) indicator.

Table 10.5 lists the medians and ranges of the leads and lags for the same groups of indicators at the 1981 peak and the 1982 trough of the severe recession that issued in the long expansion of the past decade. Comparisons of the corresponding entries in this table and table 10.4 confirm that the timing classifications established some time ago in the *BCD* generally held up well. As

9. The reasons why employment recovers relatively slowly lie in the initial uncertainties about the prospects for an enduring expansion and the concurrent rises in the average workweek and labor productivity. The reasons why employment grows less in late than in midexpansion stages lie in demand slowdowns or supply constraints or both.

Table 10.5 Timing of Groups of Indicators in the Recession and Recovery of 1981–83

Line (1)	Group (no. of series) (2)	Median Lead (−) or Lag (+) (mo.) Business Cycle Peak: July 1981 (3)	Business Cycle Trough: November 1982 (4)
	I. Employment and Unemployment (15 series)		
1	Marginal employment adjustments (3)	−6 (−3 to −7)	−2 (+1 to −2)
2	Job vacancies (2)	−8 (same)	−2 (same)
3	Comprehensive employment (5)	0 (0 to −7)	+2 (0 to +4)
4	Comprehensive unemployment (3)	0 (0 to +1)	+1 (0 to +1)
5	Average duration & long-term unemployment (2)	+3 (+1, +5)	+5 (+1, +9)
	II. Production and Income (10)		
6	Capacity utilization (2)	−3.5 (−2, −5)	0 (same)
7	Comprehensive output & income (4)	+1 (−1 to +2)	−0.5 (0 to −3)
8	Industrial production (4)	+ 0.5 (0 to +1)	0 (0 to −6)
	III. Consumption, Trade, Orders, and Deliveries (13)		
9	Change in unfilled orders; vendor performance; retail sales (4)	−3.5 (+1 to −7)	−7.5 (−3 to −10)
10	New orders (3)	−2 (same)	−1 (same)
11	Unfilled orders; production of consumer goods (2)	0 (same)	0 (same)
12	Manufacturing & trade sales (2)	0 (−1, +1)	−1 (same)
13	Index of consumer sentiment; car buying (2)	+1 (same)	−10 (−8, −12)
	IV. Fixed Capital Investment (18)		
14	Formation of business enterprises (2)	−2 (−1, −3)	−3 (−2, −4)
15	Business investment commitments (5)	−3 (−3 to −8)	−3 (+1 to −3)
16	Capital appropriations (2)	0 (−2, +2)	+ 0.5 (−3, +4)
17	Business investment expenditures (6)	−2.5 (0 to −4)	+3 (0 to +6)
18	Residential construction (3)	−10 (−8 to −10)	−12 (−9 to −13)
	V. Inventories and Inventory Investment (9)		
19	Inventory investment (4)	−0.5 (+1 to −2)	0 (0 to −5)
20	Inventories on hand & on order (5)	+4 (0 to +6)	+7 (+1 to +8)
	VI. Prices, Costs, and Profits (19)		
21	Sensitive commodity prices & stock prices (4)	−9.5 (−8 to −12)	−9 (+1 to −14)
22	Corporate profits & margins after taxes (4)	−5 (−2 to −8)	+3 (0 to +3)
23	Same with inventory valuation and capital consumption adjustments; price/unit labor costs ratio (4)	+4 (+1 to +4)	−9 (0 to −9)
24	Corporate cash flows (2)	−0.5 (+4, −5)	−9 (same)
25	Unit labor costs & labor share (5)	+16 (+10 to +19)	+12 (+9 to +20)
	VII. Money and Credit (28)		
26	Changes in money supply & liquid assets (3)	−11 (−6 to −13)	−9 (0 to −14)

Table 10.5 Continued

Line (1)	Group (no. of series) (2)	Median Lead (−) or Lag (+) (mo.) Business Cycle Peak: July 1981 (3)	Business Cycle Trough: November 1982 (4)
27	Real money supply (2)	n.t.	−17.5 (−13, −22)
28	Velocity of money (2)	+1 (same)	+8.5 (+8, +9)
29	Credit flows—change in debts (5)	−2 (+6 to −9)	−1 (+1 to −9)
30	Credit difficulties (2)	n.t.	n.t.
31	Bank reserves (2)	n.t.	n.t.
32	Interest rates (8)	+1.5 (−2 to +2)	+5 (+2 to +8)
33	Outstanding debt (4)	+14 (same)	+8.5 (+8, +11)

Note: The entries in cols. 3 and 4 are medians of leads and lags for the groups of indicators listed in col. 2 and (in parentheses) the ranges of the corresponding observations for the individual series in each group. Where the group consists of two series only, both observations are listed. Where all observations for the group are identical, the designation is "(same)." Where no timing comparisons can be made for any series in the group, the entry reads "n.t." (no specific turning points matching the 1981 business cycle peak or the 1982 business cycle trough). For the identification of the source and the series covered, see table 10.4.

would be expected, however, there were individual abberations. The downturn in July 1981 occurred abruptly, cutting short a recovery that began only a year earlier. Because there was no slowdown, some series that typically lead at peaks were tardy this time: the index of consumer sentiment, consumer expenditures on automobiles, and change in business inventories. At the November 1982 trough, job vacancies had a short lead instead of the usual lag, and business investment and profits turned upward late instead of close to the reference date.

10.7 How the Indicators Performed before and after World War II

The first list of indicators of both revivals and recoveries, based on data available through 1938, appeared in Moore 1950. Later Moore (1979) compared the historical timing record of these series in periods of varying lengths between 1860 and 1938 (mostly interwar years) with the record of the same series or their current equivalents in 1948–75. This is a rather demanding test of the postsample performance for the indicators, considering the many profound differences between the U.S. economy before 1938 and after 1948.

Table 10.6 is a summary of the main findings from Moore 1979. Of the 21 indicators originally selected in 1950, 15 continued to be carried in the *BCD* through 1979. The other six were replaced by related series available from the same source. For three leading indicators and one lagging, the substitutes are very close; for the two coincident indicators, much less so (see the notes to

Table 10.6 **Prior and Subsequent Performance of Three Groups of Indicators Selected and Classified in 1950**

	At Business Cycle Peaks			At Business Cycle Troughs		
	Leading[a]	Roughly Coincident[b]	Lagging[c]	Leading[a]	Roughly Coincident[b]	Lagging[c]
	Average Lead (−) or Lag (+), in Months					
Through 1938	−6	0	+5	−5	−2	+3
1948–75	−12	−2	+3	−2	+1	+4
	Percentage of Timing Comparisons in Appropriate Class					
Through 1938	80	72	88	81	67	72
1948–75	89	60	68	71	84	73

Source: Moore 1979, pp. 408–9 (reprinted in Moore 1983, ch. 24, pp. 376–77).

[a]The leading group includes eight series: liabilities of business failures; Dow-Jones index of industrial common stock prices (S&P 500 index in 1948–75); new orders, durable goods, value; residential building contracts, floorspace (new building permits, private housing units, number in 1948–75); commercial and industrial building contracts, floorspace; average workweek, manufacturing; new incorporations, number; wholesale price index, 28 basic commodities (industrial materials price index, 13 commodities in 1948–75).

[b]The roughly coincident group includes eight series: employment in nonagricultural establishments; persons unemployed, number; corporate profits after taxes; bank debits outside New York (manufacturing and trade sales, value, in 1948–75); freight car loadings (value of goods output, 1972 dollars, in 1948–75); industrial production index; gross national product, value; wholesale price index, industrial commodities.

[c]The lagging group includes five series: personal income, value; retail sales, value; consumer installment debt, value; bank rates on business loans; manufacturers' inventories, book value (manufacturing and trade inventories, book value, in 1948–75).

the table for details). To simplify and save space, only the overall group averages are shown here, but the underlying observations at individual turns are on the whole consistent with the conclusion that the postwar data tend to support the choices and classifications made 30 years earlier on the strength of the pre-1938 information.

In particular, it is clear that the leaders as a group continued to lead, though by longer intervals at peaks and shorter ones at troughs. The laggers continued to lag. Among the 1948–75 timing comparisons for the series designated as leading indicators in 1950, the relative frequency of leads increased moderately at peaks and decreased at troughs. The lagging indicators performed worse at peaks but equally well at troughs in the postwar as compared with the pre-1938 sample period.

10.8 How to Explain the Cyclical Sequences

There are good reasons to expect the observed cyclical timing sequences to persist, as they indeed do. To a large extent, established procedures and tech-

nologies determine which series move early and which late relative to each other. For example, before funds for new capital projects are disbursed, they must be appropriated; before plants are built, construction contracts are placed; before equipment is paid for and installed, it must be ordered; before expenditures on residential investment are recorded, building permits are taken out and housing starts are counted.

Moreover, new investment commitments come close to representing investment planning on the demand side, and payments for capital goods and their production, delivery, or installation represent more nearly investment realizations on the supply side. Where substantial gestation lags intervene, the distinction is important. Thus, according to the theory of desired stock-flow adjustments, planned investment should lead total output, including consumption as well as (realized) investment. The flexible accelerator theory also applies to inventories, where it suggests that inventory investment tends to lead sales and that the ratio of manufacturing and trade inventories to the corresponding sales lags.

Additional explanations derive from monetary and financial arrangements. The rate of change in business and consumer credit outstanding leads because new loans serve to finance investment in processes that are themselves leading (in inventories, housing, and consumer durables; also in plant and equipment, where the loans are taken out early in the process). Here too, there are timing sequences that reflect stock-flow relationships: net increments lead; totals lag. Credit flows have large early movements, but debt aggregates are smooth and sluggish. Money growth rates are very volatile but tend to lead by variable, though mostly long, intervals. Monetary aggregates themselves are dominated by upward trends and show persistent declines only in cycles with severe contractions. However, real money balances, such as the broadly defined money supply M2 deflated by a consumer price index, declined well ahead of several recent peaks in total output and employment and rose well ahead of troughs. That is, in late stages of expansion (contraction) money increased less (more) than prices. Here both endogenous and exogenous elements are important; notably, changes in the nominal money stock depend on the policy-controlled changes in the monetary base.

Interest rates (much influenced by the actual and expected changes in money, credit, and prices) tend to lag. This does not mean that they are to be viewed as only a result, not a cause, of the economy's cyclical course and future: they are both. Changes in the level and structure of interest rates are important codeterminants, along with risk premiums, of discount factors and stock returns, cost of finance, and investment opportunities. Expectations of changes in the price level vary across the economy and over time, and interest rates adjust to these changes, in ways that are not directly or reliably observable, let alone predictable. Nominal rates play an important role in the interactions of money demand and supply. Therefore, nominal rates matter at least as much as real rates in business cycle developments.

Cost-price-productivity-profit linkages give rise to other cyclical sequences. Changes in prices of sensitive materials precede changes in producer and consumer prices. Changes in labor productivity (output per hour) lead; changes in unit labor cost lag. As a result of these tendencies connected with cyclical movements in sales and the rates of utilization of labor and capital, profit margins and totals show early and large fluctuations. (For further discussion of the subjects of this and the preceding paragraph, see chapters 2, 3, and 4.)

Stock prices track and anticipate the broad movements of corporate earnings (leading) and interest rates (lagging) and relate positively to the former, inversely to the latter. This helps explain the cyclicality and early timing of broadly based indexes of common stock prices. Long records of such indexes, in the United States and abroad, document that bear markets tend to begin well before business contractions and bull markets well before expansions. But the indexes also show additional, sizable movements because stock prices are apparently quite sensitive to noncyclical short-term influences or shocks as well.

Some timing relations reflect directly the changing state of the economy. Thus delivery periods get progressively longer just before and during recoveries and especially in booms, when orders back up and strain the capacity to produce; and they get progressively shorter when an expansion slows down and a contraction develops. This explains the leads of vendor performance (percentage of companies receiving slower deliveries). The early timing of the change in unfilled orders can be explained similarly. The ratio of unfilled orders to sales measures roughly the number of months it would take for the backlog of work to be eliminated at the current levels of activity. When expansions slow gradually, as they did on several recent occasions, these indicators peak early along with the capacity utilization rates. This helps account for the long leads at the corresponding business downturns of other series, too, notably indexes of consumer expectations, new orders for consumer goods and materials, and contracts and orders for plant and equipment.

Last but not least, there is a simple rationale for the sequences among the labor market series. Changes in hours are less binding than changes in the number employed, so the average workweek in manufacturing leads because it is altered early in response to uncertain signs of shifts in the demand for output. Initial claims for unemployment insurance change slightly ahead of the overall unemployment rate, whereas long-term unemployment and the jobless rate among persons unemployed 15 weeks and over lag behind. People with the least qualifications and weakest attachments to the labor force lose jobs early and gain jobs late whenever the economy slows and declines.

10.9 Significance in Macro and Micro Theories

The existence of regular timing sequences among economic time series is necessary but not sufficient to demonstrate that some indicators are likely to lead, others to have approximately coincident timing, and still others to lag at *business cycle turns*. What is needed in addition is (1) that the movements involved have cyclical dimensions with respect to duration and amplitudes and (2) that the coincident indicators, which include the aggregates of input and output as implied by the definition of business cycles, occupy central positions in many of the sequences. Both requirements are amply satisfied, as already demonstrated by our measures.

The indicators in current use play important roles in many areas viewed as critical in business cycle theories. This is illustrated in table 10.7, which is based on a long series of studies (for references, see chapters 2 and 5 and Moore 1983, pp. 347–51).

The literature on business cycles, though rich in ingenious hypotheses of varying plausibility and compatibility, produced no unified theory (chapter 2).

Table 10.7 Business Cycle Theories and Indicator Sequences: A Conspectus

Theories or Models	Some Main Factors	Evidence from Time Series
Accelerator-multiplier models; hypotheses on autonomous investment, innovations, and gestation lags	Interaction between investment, final demand, and savings	Large cyclical movements in business investment commitments (orders, contracts) lead total output and employment; smaller movements in investment realizations (shipments, outlays) coincide or lag
Inventory investment models	Stock adjustments in response to sales changes and their effects on production	Inventory investment tends to lead; its declines during mild recessions are large relative to those in final sales
Old monetary overinvestment and current monetarist theories	Changes in the supply of money, bank credit, interest rates, and the burden of private debt	Money and credit flows (rates of change) are highly sensitive, early leaders; velocity, market rates of interest, and credit outstanding coincide or lag
Hypotheses of cost-price imbalances, volatility of prospective rates of return, and expectational errors	Changes in costs and prices, in the diffusion, margins, and totals of profits, and in business expectations	Profit variables and stock price indexes are sensitive early leaders; unit labor costs lag

Source: See references in text.

There is evidence in support of a number of different models that focus on period-specific or sector-specific aspects of the economy's motion. Monocausal theories may help explain some episodes but are invalidated by long experience.

Some more or less formal models have been developed recently to explain why some of the leading indicators lead. Popkin (1984, 1990) stresses the importance of intermediate transactions between producing units rather than with final purchasers, and of the production of goods rather than services. He argues that the latter are only weakly cyclical; it is the goods-producing industries, mainly manufacturing, that are most sensitive to business cycles. Therefore, manufacturing is and should be strongly represented on the list of principal leading indicators used in composite indexes. The series concerned include new orders for consumer goods and materials, contracts and orders for plant and equipment, the average workweek of production workers in manufacturing, vendor performance, change in manufacturing inventories on hand and on order, and the percentage change in sensitive materials prices. All of these, except the last one, are in real terms. Popkin builds, estimates, and simulates a quarterly log-linear model linking final demand (sales) with intermediate manufactures. Retailers place orders for finished goods, whose producers react by changing unfilled orders and/or inventories and/or output. These adjustments determine the profit margins over costs of labor and materials and, hence, output prices, given the wages and material prices paid. The results show that the amplitudes of cyclical fluctuations transmitted from final sales are systematically greater for the manufacturers of materials than for the manufacturers of finished products, and greater for the latter than for the retailers. The magnification appears in ratios of cyclical to control solutions of the model for outputs, inventories, new orders, and prices. The analysis recalls earlier studies of vertical (interstage) transmission of demand movements through changes in new and unfilled orders and inventories (Zarnowitz 1962, 1973; Mack 1967; Childs 1967).

A model of the short-run behavior of a firm that attempts to minimize the costs of meeting expected demand is shown by de Leeuw (1991) to be consistent with the relative timing and amplitudes of new orders, output, shipments, employment, average hours, and changes in unfilled orders and inventories—under many but not all conditions. The outcomes of model simulations depend on whether production is to order or to stock; on whether the initiating disturbances occur in actual or expected demand or productivity; and on whether the expectations are formed adaptively or on the assumption of perfect foresight. Tests based on regressions of alternative measures of output growth on lagged values of employment growth, changes in inventories and unfilled orders, and alternative proxies for expected demand are found to be on the whole encouraging.

According to de Leeuw (1989), it is possible that business cycles reflect to

a large extent movements in certain fundamental forces ("prime movers") such as "monetary and fiscal policies, regulatory decisions, foreign economic developments, demographic shifts, new technologies, droughts or bumper crops, and a few others" (p. 23). Yet few prime movers are included in the lists of principal leading indicators for the United States and other countries.[10] After considering several possible reasons and remedies for this, de Leeuw develops a "prime-mover–based" leading index by means of a regression of output on M2, cyclically adjusted federal expenditures, exports, relative import prices, inflation, and the GNP gap (where the first two of the variables listed are taken as first differences in logs, and the next three as second differences to proxy for unexpected changes). An index obtained by transformation of the values produced by the above regression declined only slightly and irregularly in 1955–57 and 1968–69, leading by long intervals but not distinctly at the 1957 and 1970 peaks in the coincident index; its movement was essentially trendless and random in the 1950s and dominated by a rising trend in the 1960s. In 1970–88 this index of prime movers acquired more cyclicality and definitely declined in 1973–74 and 1978–81, with long leads at the peaks of 1973 and 1980. It skipped the recessions of 1953–54 and 1960 and failed to signal the 1981 peak (see de Leeuw 1989, chart 2).

The performance of this construct as a leading indicator is relatively weak, in my view. Moreover, de Leeuw's results are not surprising. As noted in chapter 3, the effects of fiscal policy on aggregate economic activity have not been particularly consistent. Also, our vector autoregressive model estimates in chapter 12 confirm that fiscal variables contribute little to the determination of changes in real GNP in the presence of several much more powerful variables, notably an index of selected leading indicators. Monetary policy had stronger effects but also lacked consistency and contained important endogenous components. In the 1980s the volatility of growth rates increased for all monetary aggregates, and their performance as cyclical indicators deteriorated (see Cagan 1990). Deflation helps and M2 is still a relatively good choice among the monetary series (as is the monetary base, according to Cagan). But other areas produce better leading indicators (e.g., in real investment, credit, sensitive prices).

10. The U.S. composite index of leading indicators contains one series classified by de Leeuw as a prime mover, namely, the deflated money supply. The Organization for Economic Cooperation and Development (OECD) has identified leading indicators in 21 countries, and out of 180 such series 36, or 20%, are designated prime movers in de Leeuw 1989, table 1. (These include 18 money supply series, 8 export series, 8 terms-of-trade series, and 2 leading indicators for neighboring countries.) Of the leading indicators for 10 countries as selected at Columbia University's Center for International Business Cycle Research (CIBCR), only 3% are so designated. The CIBCR indicators are by design generally similar to those chosen for the United States in the NBER and BEA studies (P. A. Klein and Moore 1985); the OECD indicators deviate more from the U.S. selections. It should be noted that both the OECD and the CIBCR international indicators refer directly to growth cycles rather than business cycles.

Enough has been said on the reasons for the observed behavior of the indicators and their links to micro and business cycle theories to weaken if not disprove the charge of "measurement without theory." If the reasons are simple, so much the better.

10.10 Modeling with Cyclical Indicators

The development of modern macroeconomic models was closely related to the idea of interdependence among the major components of aggregate income and output. Correspondingly, the econometric implementation of these models was closely related to the development and structure of national income and product accounts (NIPA). The builders of macroeconometric models drew heavily on the NIPA data, first in annual and later in quarterly form. Also, the models soon acquired a Keynesian orientation, which meant a shift from the direct interest in business cycles (which dominated at the beginning: Tinbergen 1938–39) to a preoccupation with the determinants of levels of aggregate output and employment in the short run.

In contrast, the development of the indicators was from the beginning motivated by the need for timely detection or prediction of business cycle turning points (the first one was the revival from the slump of 1937–38; see Mitchell and Burns 1938). The objective being the analysis of current business conditions and the forecasting, recognition, measurement, and appraisal of recessions and recoveries, the approach uses mainly monthly, and to a lesser extent quarterly, times series. The indicators are generally endogenous variables (not exogenous "prime movers"); that is, they influence the economy and are influenced by it. The traditional NBER approach, with its emphasis on the dichotomies of contraction and expansion, peak and trough, seems to lend more support to endogenous and nonlinear theories than to exogenous and linear theories of the business cycle. On the other hand, most macromodels are not fundamentally nonlinear and rely heavily on outside forces and shocks to account for the very existence of business cycles (chapters 6 and 9).

The evolution of macroeconomics led to progressively less dependence of both the theoretical and the econometric models on the early Keynesian ideas and progressively more dependence on principles of optimization and market clearing. The theory underlying the system of cyclical indicators is largely of a different type, namely, the dynamics of plans and expectations under uncertainty and of institutional and physical constraints in processes of production and investment.

All these differences of objective, concept, data, and method make it difficult to combine cyclical indicators and econometric models in some comprehensive and systematic way. Yet the two approaches are complementary in important respects. The indicators are indispensable for the analysis of the current course and near future of the economy. As such the required data need to be systematically collected, monitored, and processed into appropriate

composite indexes (the latter will be discussed in chapter 11). For years now this task has been performed by the Commerce Department (BEA), which amounts to a de facto endorsement of the indicator methodology by the federal government.[11] The active macroeconometric models, which have meanwhile grown greatly in size and complexity, are not well equipped to track the current developments and forecast or at least recognize promptly the key business cycle events. But they are designed to make quantitative quarterly and/or annual forecasts from sets of estimated economic relationships, and indeed this is increasingly their main function. In actual practice, there are probably few professional forecasters with macromodels, and few experienced users of quantitative forecasts who would ignore the signals from indicators.[12]

Some leading indicators are regularly included in large econometric models. For example, vendor performance acts as an important determinant of industrial prices and inventory investment in the Data Resources, Inc. (DRI), model (Eckstein 1983). Housing starts are related to the variables governing the demand for housing services, the stock of housing, and cost and availability of mortgage financing; then residential construction is estimated as a moving average of starts. Contracts and orders for plant and equipment could be treated similarly but are not (more attention is paid to survey data on investment intentions). The labor input in the production function is represented by the product of employment and the average hours worked. The distinction between the fast short-run adjustment of weekly hours and the slower adjustment of the number of workers is made in one version of the Wharton model (L. R. Klein 1990). The demand functions for money and other financial assets generally follow the modern portfolio theory, but with many elaborations in the large-scale models, and the monetary base or unborrowed reserves are treated as an exogenous variable subject to control by the Federal Reserve. Price indexes for raw and intermediate industrial materials play an important role but as early indicators of inflation rather than changes in real activity.

It is clear that these uses of the leaders, though important, are quite different from those made of the same variables in the indicator approach. They are more indirect, partial, and limited. The interdependence of timing, stressed in the indicator system, receives no special consideration in the models. There is aggregation by time, because it is still difficult to construct monthly models, and the lag specifications are often crude.

Yet some model builders report making intensive use of monthly indicator data. As discussed by L. R. Klein (1990, pp. 104–5), the recent "Pennsylvania approach" is as follows. Selected monthly series, including many cyclical indicators, leading and others, are estimated and extrapolated by means of formal time-series models (e.g., ARIMA, VAR). Averaged into quarterly val-

11. Many state governments and foreign countries have followed the United States in compiling their own leading indicators and indexes.

12. Incidentally, the same applies to the makers and users of "judgmental" forecasts. For more on these matters, see chapters 13, 14 and 18.

ues, they are then used to project many GNP components for the current quarter and one quarter ahead. Constant-term adjustments, or "add-factors," are applied to the results obtained from the model equations to make them agree reasonably well with the indicator-based estimates. Longer solutions are produced by simulation techniques with the add-factors retained in the model. This method permits a combination of high- and lower-frequency magnitudes calculated, respectively, from the monthly indicators and the quarterly model.

Small forecasting models that incorporate selected leading indicators along with third-order autoregressions and that use pooled international data have been found to generate relatively accurate and efficient predictions of annual and quarterly growth rates of real output for eight European countries and the United States (Garcia-Ferrer et al. 1987). Such forecasts, while much more limited in scope than those produced by elaborate international efforts using large econometric models, are also much less costly yet quite competitive in quality. The leading indicators used include real stock returns and growth rates in money supply for each country and all countries combined.[13]

10.11 Conclusion and Brief Preview of Part III

This chapter has been concerned mainly with the systematic aspects of cyclical indicators and their analytical characteristics and functions. But the principal uses of the indicators are in forecasting. Here it becomes essential to construct the composite indexes of leading, coincident, and lagging indicators from preselected series. Such indexes, and particularly those designed to lead, can be built, applied, and assessed in various ways. They are the subject of chapter 11.

It remains to offer some concluding and forward-looking remarks. When used collectively, the indicators provide over the course of business cycles a revolving flow of signals. Shallow and spotty declines in the leading series provide only weak and uncertain warnings; a run of several large declines increases the risk of a general and serious slowdown or recession. The latter may suggest some stabilizing policy actions that, if effective, could falsify the warning. The coincident indicators confirm or invalidate the expectations based on the behavior of the leaders and any related policy decisions. The lagging indicators provide further checks on the previously derived inferences, in particular on any early designation of the timing of a business cycle term. Moreover, for reasons stated earlier (sec. 10.4), they also act as predictors when used in inverted form.

Macroeconomic forecasting, which the indicator system is designed to aid, must be essentially consistent with the ascertained regularities of business fluctuations. Some of these "stylized facts" may be difficult to reconcile with

13. It is interesting to note that to my knowledge, the large models generally do not include indexes of stock prices or returns.

the preconceptions of the general-equilibrium theory, but this does not diminish the value of the indicator analysis. The real problems with the indicators are mainly practical. Large amounts of random noise, large revisions of originally published figures, and short lead times (which occur mostly at troughs of short recessions) detract from the usefulness of some leading series. Those irregular variations and data errors in its components that are independent tend to cancel out in the leading index, which is therefore relatively smooth. As a result, the problem of extra turns or false warnings is reduced, but it is not eliminated.

Chapter 11 will discuss why and how the composite indexes are constructed and used and with what results, as assessed by repeated tests. Chapter 12 examines the role of a combination of leading indicators in the framework of a simple VAR model that also includes total output, monetary and fiscal variables, and interest and inflation rates.