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Chapter 4

Sequential Signals of Recession and Recovery

Victor Zarnowitz and Geoffrey H. Moore*

Early and confirming signals of business cycle peaks and troughs are produced sequentially on a current basis by a system of monitoring smoothed rates of change in the composite indexes of leading and coincident indicators. Evidence is offered that the system would have identified each of the peaks and troughs of U.S. business cycles since 1949 without undue delays and false alarms. Countercyclical policies activated and deactivated by such signals would have desirable timing properties.

COUNTERCYCLICAL POLICY TRIGGERS: THE PROBLEM AND ITS SETTING

This chapter describes a sequential procedure for identifying the beginning and ending dates of business cycle recessions as promptly and accurately as practicable. Its origin lies in a study undertaken for

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the Economic Development Administration (EDA), U.S. Department of Commerce, which deals with the problem of designing and testing an efficient trigger formula for public works expenditures with the aid of a system of cyclical indicators. However, the proposed approach can be applied much more broadly to any temporary countercyclical policy program on the national level.

Federal policy programs of job creation through public works or public service employment have been repeatedly called *countercyclical* without in fact being so. Most such programs came into effect much too late to counter the cyclical *rises* in the national unemployment rate (which, of course, does not necessarily preclude their being appropriate for other reasons, e.g., because of relatively high *levels* of unemployment in the intended impact areas). In fact, public works programs were not enacted until nine to nineteen months after the cyclical decline in output had been reversed and that in employment nearly completed.[1] For the public service employment programs, the legislative and administrative lags have been considerably shorter, but not sufficiently so to produce significant countercyclical effects.[2] Moreover, no provision was made in any of the programs for effective cutoff dates related to signals of the progress of the recovery. In sum, the overall lags involved were such that the funds, instead of being spent to combat unemployment during recesssions, were actually spent when the expansion of the national economy was already well under way.

The tardiness of policies designed to stimulate employment not only reduces their intended stabilizing (antirecession) effects but also induces some unintended destabilizing effects. Government expenditures are likely to contribute more to excess demand and inflationary pressures during a business expansion than during a business contraction. Ill-timed fiscal and monetary policies can, of course, have similar effects.

The success of any discretionary countercyclical policy action depends critically on its timeliness; in addition, it must also have a sufficient degree of flexibility. However, the accuracy of economic forecasts tends to deteriorate as the forecast span lengthens and is generally not adequate for predictions looking as far ahead as a year or more. But shorter predictions of slowdowns and recessions, based on the actual record of cyclical indicators with early timing characteristics rather than on forecasts of such series, can be shown to provide useful first-alert signals which, when combined with confirmatory signals from measures of aggregate economic activity, are capable of producing a timely and reliable "triggering" mechanism.

The main problem with recent public works programs as well as other policies intended to be countercyclical lies in the long lags with which they are initiated and terminated. Most of the total delay is accounted for by the recognition, legislative, and administrative lags—which would be eliminated if the programs were effectively triggered at the onset and at the end of a recession.[3] As noted, the time between the allocation of funds and the employment of half the workers to be employed is approximately six to twelve months, which is not unduly long, given the duration of high unemployment created by recent recessions. The solution, then, lies primarily in making the policy action timely by tying it to certain prespecified indicator values which reliably signal the beginning and end of a recession. The required flexibility can be obtained by advance preparation of a backlog of useful projects to be mobilized progressively according to schedules related to a sequence of increasingly reliable signals.[4]

This study relates only to the problem of optimal *timing* of public employment policies in the context of cyclical movements in the U.S. economy as a whole. It is recognized that the effectiveness of the programs depends also on their size, financing, organization, and still other factors (such as any displacement and spillover effects), but these matters lie outside the scope of the present chapter.

The plan of the procedure consists in identifying certain signals from suitably smoothed rates of change in composite indexes of cyclical indicators, which normally occur in a predetermined sequence. The possibility of false alarms is reduced by using turning points first in the leading and then in the confirming indicators. Actions based upon the initial turning points should be of a limited and reversible nature, involving relatively small commitments of funds. When the initial points have been confirmed by the subsequent turning points, more definitive and substantial actions should be taken. The signals devised in this plan refer directly to business cycles as defined and dated by NBER, but they also make use of the concept of growth cycles, that is, alternating periods of above-average and below-average rates of growth in aggregate economic activity. Since a growth slowdown preceded each recent recession, signals of the former give some advance warning of business cycle peaks. At troughs, leads of this type are typically fewer and much shorter, but if the signals are somewhat late they are also less scattered and often easier to read.

In what follows, the rationale of the proposed strategy for using the cyclical indicators is outlined; the concept of the growth cycle and its relationship to the business cycle is explained; the procedures used and the results obtained thus far are presented and assessed; and some perspective is provided on the needs and the promise of further work.

CONCEPTS AND PROCEDURES

The proper objective of countercyclical policy programs is to reduce the number of cyclically unemployed at times of overall slowdowns and recessions. This might seem to indicate that the policies should be initiated (discontinued) when the national unemployment rate rises above (falls below) some specified "high" level for some sufficiently long time. Indeed, triggering formulas based on unemployment statistics have received much attention in recent programs of direct employment stimulation by fiscal means. But here, as elsewhere, policy targets should not be confused with policy indicators. While the behavior of total unemployment is strongly influenced by business cycles, it is very difficult to separate the cyclical component of unemployment from the other components—frictional, structural, and institutional. The use of high-unemployment trigger formulas will inevitably cause the programs to be badly mistimed, that is, to lag behind recessions and be active during expansions when unemployment may be relatively high for reasons other than cyclical declines or deficiencies in aggregate demand.

An analysis of a variety of labor market indicators shows that they are strongly affected by cyclical changes in the economy, but also that most of them are either too sluggish or too irregular in their timing to produce useful signals for our present purposes. However, one promising option is being explored in another study. This consists of combining several leading and trendless labor turnover series.[5]

The best of the options for a trigger formula, as currently considered, is a plan based on a comprehensive coverage of leading and confirming indicators of business expansions and contractions. There is ample evidence from a long series of studies that important and persistent timing sequences exist among series in each of the areas viewed as critical in business cycle theories. The following tabulation illustrates this in a general and selective way.[6]

Some of the main factors in business cycle theories:	Evidence from time series for the corresponding variables:
1. Interaction between investment and final demand, or between the investment and savings functions.	Large cyclical movements in business investment commitments (order, contracts) lead total output and employment; smaller movements in investment expenditures coincide or lag.

2. 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, with typically early cyclical timing; market interest rates coincide or lag.
3. Changes in price/cost relations, in the diffusion, margins, and totals of profits, and in business expectations.	The profit variables all show large and unusually early cyclical movements, and so do stock price indexes. Unit labor costs contribute to this result by rising rapidly prior to and just after a business peak and falling prior to and just after a trough.

More specifically, series that represent early stages of production and investment processes (new orders for durable goods, housing starts, or permits) lead series that represent late stages (finished output, investment expenditures). Under uncertainty, less binding decisions are taken first. For example, hours of work are lengthened (shortened) before the work force is altered by new hirings (layoffs). Other timing sequences reflect important stock-flow relationships involving the demand for and supply of output of goods and services, as influenced by changes in business fixed capital and inventories, money and credit.

For well-supported theoretical reasons, a selected group of indicators representing a whole set of these relationships has much greater predictive value over time than any of the individual indicators.[7] This insight led to the construction of composite indexes of leading, coincident, and lagging indicators which indeed, as a rule, outperform the individual indicators. These indexes incorporate series that represent different economic processes but have similar cyclical timing. The best indicators from each economic-process group are selected by means of a detailed scoring procedure incorporating several major criteria (economic significance, statistical adequacy, consistency of timing and conformity to the cyclical movements of the economy at large, smoothness, and currency). For each timing category (say, the leading series), the chosen indicators are combined into an index with weights provided by their overall performance scores.[8]

Our procedure uses the data from the leading and coincident composite indexes published by the U.S. Department of Commerce in *Business Conditions Digest (BCD)* each month. Cyclical peaks in the leading index often occurred early in the low-growth phases and anticipated the beginning dates of recessions by variable but, on the average, rather long intervals, whereas the troughs in the index led the beginning dates of recoveries by quite short intervals. Reliable signals from the indexes proper, when we take into account the need for some smoothing and confirmation, would occasionally be too tardy for the purpose on hand. To obtain more timely and dependable indications, we found it advisable to use rates of change in the composite indexes with the aid of simple smoothing and decision rules.[9]

One such rule that turned out to be effective is that of taking the ratio of the current month's index to the average of the twelve preceding months and expressing the resulting percentage change at a compound annual rate.[10] This is a smoothed six-month rate, which involves the same loss of lead time as an ordinary six-month change (where the current month is compared with the single month's figure six months earlier). The two are affected in the same way by any special factors that pertain to the current month, but the ratio that uses the twelve-month centered moving average in the denominator is for this reason much less subject to erratic fluctuations than the ordinary rate of change over six-month moving periods.[11]

Each of the composite indexes published in *BCD* contains a "target trend" of 3.3 percent per year (0.272 percent per month). The purpose is to make the long-run trend in each index the same and equal to the trend rate of growth in the economy as a whole from 1948 to 1975, so that any differences in the behavior of the indexes are due to short-run factors.[12] Accordingly, the average value of the annualized rate-of-change series derived from the indexes over a long period is in each case approximately 3.3 percent. Thus, when the six-month smoothed rates of change described in the preceding paragraph are less than 3.3 percent, this means that the underlying index is rising at less than its long-term average rate. In the case of the leading index, this is an indication that a declining phase of the growth cycle is approaching; in the case of the coincident index, that it is probably under way. Likewise, when the annual rates of change come to exceed 3.3 percent, this means that an upswing in the growth cycle may be starting.

Growth cycles represent an important but not very familiar phenomenon which may require some additional explanation. They are movements in aggregate economic activity defined by the consensus of fluctuations in comprehensive indicators adjusted for their long-term trends. They are thus composed of specific cycles in the *deviations from trend* of time series representing output, income, trade, employment, and many other economic processes, and they differ from business cycles in that the latter are defined by the consensus of fluctuations in the *levels* of the same collection of comprehensive economic indicators (see Chapter 5).

A business cycle always involves at least one growth cycle, since in a contraction the short-term growth rate, being negative, is necessarily less than the long-term growth rate (which for an expanding economy is, of course, always positive—reflecting the growth of total resources and their productivity). A business cycle will involve more than one growth cycle on those occasions when its expansion contains one or more protracted low-growth phases (periods when the short-term growth rate, while remaining positive, falls below the trend rate for a year or so).[13] Consequently, there are some "extra" growth cycles in addition to those which stand in a one-to-one correspondence with business cycles. Since 1945 the U.S. economy has passed through seven recessions—the latest in the first half of 1980—and it has also witnessed three periods of below-average growth rate that did not encompass recessions.

Each of the seven expansions of the 1945-1979 period decelerated before peaking and ending in a contraction; in other words, each of the recessions was preceded by a phase of positive but below-normal economic growth. The lags of business cycle peaks behind the starting dates of the low-growth phases lengthened substantially over this period, from two to six months for the first four of the peaks, which occurred in 1948-1960, to eight to thirteen months for the last three, which have occurred since 1969. This development reflects several interrelated trends in an economy with an expanding government, intensified inflation, increasing role of services versus goods in national employment, and reduced rates of private investment and productivity.

Whereas the growth cycle peaks led the business cycle peaks, the growth cycle troughs (marking the transition from low- to high-growth phases) usually occurred at about the same time as the business cycle troughs. Occasionally, as in 1954, a growth cycle trough would follow a business cycle trough, that is, the recovery would start slowly, with the overall growth rate not getting up to the average level until some months later.

The NBER reference chronologies for growth cycles and business cycles, on which the above statements are based, are presented in the first two columns of Tables 4-1 and 4-2 for the peaks and troughs, respectively. These lists of dates have been established by a close examination of time series of levels and deviations from trend for a broad set of comprehensive indicators of real economic activity.[14] It should be noted that the expansions of recent business cycles varied

Table 4-1. Three Signals of Recession: Timing at Business Cycle Peaks.

Growth Cycle Peak	Business Cycle Peak	First Signal ($L < 3.3$; $C > 0$)	Second Signal ($L < 0$; $C < 3.3$)	Third Signal ($L < 0$; $C < 0$)	Lead (-) or Lag (+), in Months, at Business Cycle Peaks: First Signal	Second Signal	Third Signal
7/48	11/48	N.A.	N.A.	N.A.	—	—	—
3/51	None	2/51	7/51	—	—	—	—
3/53	7/53	6/53	8/53	9/53	-1	+1	+2
2/57	8/57	12/55	1/57	8/57	-20	-7	0
2/60	4/60	8/59	5/60	8/60	-8	+1	+4
5/62	None	5/62	—	—	—	—	—
6/66	None	6/66	2/67	—	—	—	—
3/69	12/69	6/69	11/69	1/70	-6	-1	+1
3/73	11/73	7/73	12/73	2/74	-4	+1	+3
12/78	1/80	7/78	6/79	10/79	-18	-7	-3
Average	—	—	—	—	-10	-2	+1

Note: For full definitions of signals, see text. The following are regarded as false signals of a business cycle peak in constructing this table. First signal: a decline in the leading index rate below 3.3 percent in July 1977. Second signal: a decline in the coincident index rate below 3.3 percent in May-September 1956. October-November 1959, and April 1979. Third signal: a decline in the coincident index rate below zero in July 1956 and October-November 1959.

Table 4-2. Three Signals of Recovery: Timing at Business Cycle Troughs.

Growth Cycle Trough	Business Cycle Trough	First Signal ($L > 0$; $C < 0$)	Second Signal ($L > 3.3$; $C > 0$)	Third Signal ($L > 3.3$; $C > 3.3$)	Lead (-) or Lag (+), in Months, at Business Cycle Troughs: First Signal	Second Signal	Third Signal
10/49	10/49	8/49	1/50	3/50	-2	+3	+5
8/54	5/54	5/54	11/54	12/54	-0	+6	+7
4/58	4/58	5/58	9/58	11/58	+1	+5	+7
2/61	2/61	2/61	6/61	8/61	0	+4	+6
11/70	11/70	11/70	4/71	11/71	0	+5	+12
3/75	3/75	6/75	9/75	11/75	+3	+6	+8
7/80	7/80	9/80	12/80	2/81	+2	+5	+7
Average	—	—	—	—	+1	+5	+7

Note: For full definitions of signals, see text.

greatly in length but averaged about fifty months, that is, about 4.5 times the mean duration of the contractions. In contrast, the growth cycles that emerge after elimination of the secular upward trend are nearly symmetrical, with high- and low-growth phases averaging twenty and eighteen months. Such regularities are attractive to business-conditions analysts and increasingly recognized. Certainly, it is much easier to recognize a developing slowdown than to pinpoint the date of a future downturn, and this strong presumption is well supported by lessons from recent forecasts. Since most low-growth periods do end as recessions, the concept and measurement of growth cycles can help provide some advance warning of business cycle peaks. Even though a slowdown may not evolve into a recession, its recognition gives time for precautionary action. Similarly, it is more important to stop antirecession action when a rapid recovery is under way than when a recovery is proceeding slowly.

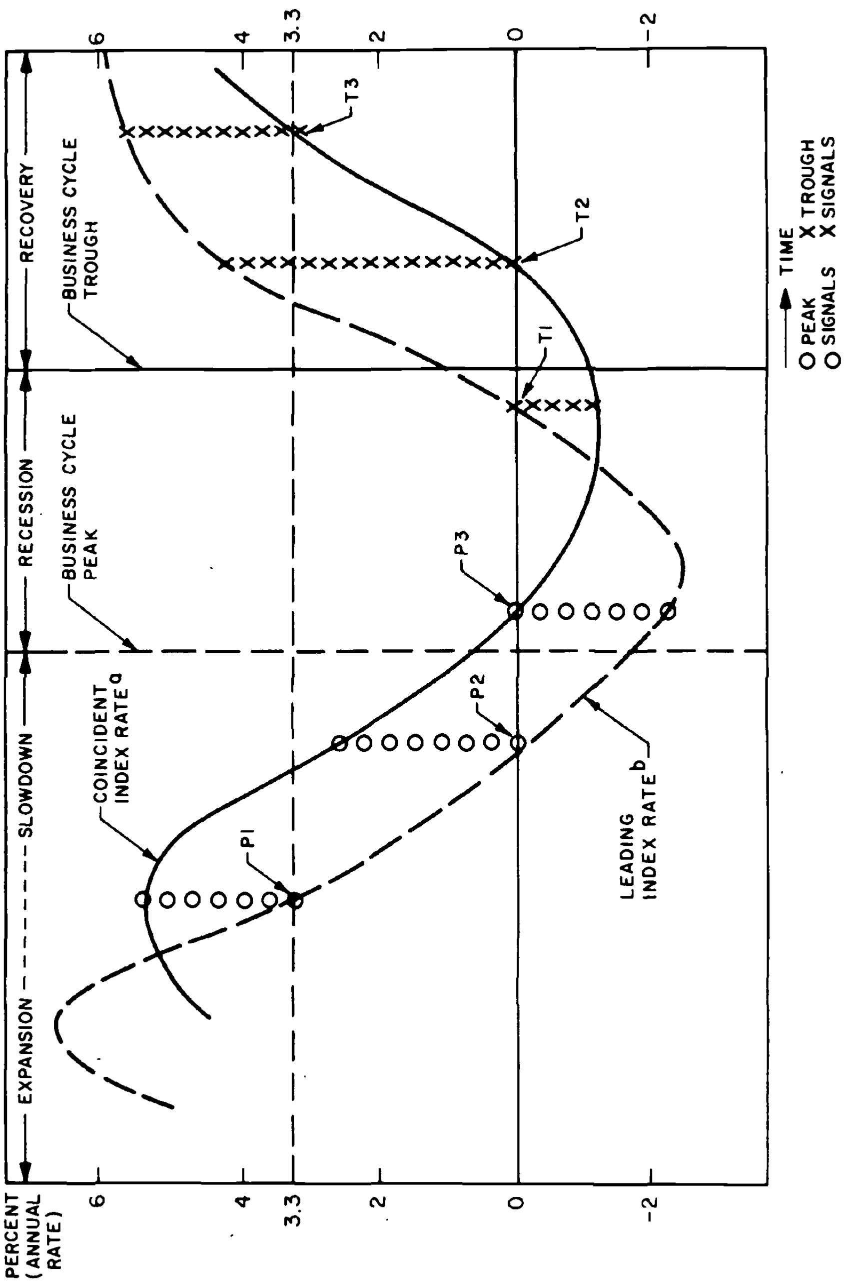
THE RESULTS: A SIGNALING SYSTEM AND ITS EX-POST RECORD

The cyclical movements in the leading index tend to occur earlier than those in the coincident index. Figure 4-1 shows, in a hypothetical diagram, the smoothed rates of growth in the two series, which for simplicity will be called the "leading index rate" (L) and the "coincident index rate" (C).[15] Among the earliest signs that an ongoing expansion may start to decelerate is a decline in the leading index rate. This development is more decisively indicated when a sustained decline of the growth rate in the leading index puts it below the average 3.3 percent line. A similar decline in the coincident index rate, which would normally occur later, confirms the onset of a general slowdown (low-growth phase) and suggests an increased possibility of a business cycle recession. If the leading index rate then falls below zero and the coincident index rate falls below 3.3 percent (not necessarily in this order), the probability of recession is heightened. Finally, if the coincident index rate follows the leading index rate by turning negative, chances are high indeed that the slowdown is being succeeded by an actual decline in overall economic activity, that is, a recession.

The expected sequence of signals at business cycle peaks, then, is when each of the following conditions is first observed:

- First signal ($P1$): The leading index rate falls below 3.3 percent, while the coincident index rate is positive ($L < 3.3$; $C > 0$).

Figure 4-1. Sequential Signals of Recession and Recovery: A Schematic Diagram.



- Second signal ($P2$): The leading index rate becomes negative, and the coincident index rate falls below 3.3 percent ($L < 0$; $C < 3.3$).
- Third signal ($P3$): Both the leading index rate and the coincident rate become negative ($L < 0$; $C < 0$).

In Figure 4-1, the vertical links between the two curves remind us that these signals involve prespecified positions or changes in both index rates. The business cycle peak is expected to occur in the vicinity of $P3$, that is, no more than a few months earlier or later than that signal.

This system of signals would have identified each of the six business cycle peaks from 1953 to 1980 (we do not have sufficient data available to check the 1948 peak). The average lead at business cycle peaks was nearly ten months for the first signal, two months for the second signal. The third signal lagged the peak by an average of one month. As shown in Table 4-1, the variation of the individual leads or lags around these averages was considerable, with long advance warnings before the 1957 and 1980 peaks, very short leads and lags in 1953, and intermediate situations in the remaining cases. However, sizable leads prevailed for the first signal, and even the third signal involved no long lags. It is important, too, that the sequence of the signals was maintained in each of the episodes covered.

The first two signals also identified two of the three growth cycle slowdowns that did not become business cycle recessions (the first signal alone identified all three), but the third signal ruled out each of these instances. In addition, the system produced four "false warnings" that were not associated with either slowdowns or recessions, but none of these would have done real harm. Of these cases (listed in Table 4-1), two were single-month declines that related to the first or second signal only and were ruled out by the third. The other two were caused by the major steel strikes in 1956 and 1959 and would have been recognized as such at the time.[16]

At the latest business cycle peak, which on June 3, 1980 was identified by the NBER as January 1980, the timing of the signals was as follows: first signal, July 1978, a lead of eighteen months; second signal, June 1979, a lead of seven months; and third signal, October 1979, a lead of three months.

In this instance the third signal, where both the leading and coincident index six-month rates were negative for the first time, was interrupted in December 1979-January 1980, when the coincident rate turned positive for two months. In February 1980, it became negative again and remained negative through May. Hence the third signal either gave an advance warning three months before the January 1980 peak or a delayed warning one month after the peak.

In interpreting these results, one must allow for the fact that data are not available instantaneously. The indexes are published initially by the Commerce Department toward the end of the month following the month to which they refer. For example, the May indexes were released June 30. Hence, in terms of availability, the dates in Table 4-1 should be placed at least one month later.

At business cycle troughs, the signals we have selected are slightly different, occurring when each of the following conditions is first observed:

- First signal ($T1$): The leading index rate rises above zero, while the coincident index rate is negative ($L > 0$; $C < 0$). This means that the first signal of a trough must follow the third signal of a peak.
- Second signal ($T2$): The leading index rate rises above 3.3 percent, and the coincident index rate rises above zero ($L > 3.3$; $C > 0$).
- Third signal ($T3$): Both the leading index rate and the coincident index rate exceed 3.3 percent ($L > 3.3$; $C > 3.3$).

These signals identified the end of each of the seven business cycle recessions between 1949 and 1980, though with more of a lag than was true of the peak signals. The average timing of the three signals at the seven business cycle troughs is as follows: first signal, one month lag; second signal, five-month lag; and third signal, seven-month lag. The variation around these averages from one cycle to another is shown in Table 4-2. There were no false signals of recovery in any instance in which the preceding business cycle peak had already been identified by the three peak signals.

The lags of the signals at troughs are acceptable because at the beginning of recovery the level of activity is low (unemployment is at its cyclical peak levels), so that a program of public works expenditures may still be appropriate if it is tapering off and is discontinued after a brief period. While the third signal lags at business cycle troughs by seven months on average, most of the cyclical expansion is yet to come. In fact, in none of the seven instances would aggregate economic activity as measured by the coincident index have regained its previous peak level by the time the third signal was reached.[17]

Hence the seven-month lag means that recovery is well under way and not likely to be aborted but has not reached a point where capacity utilization has become a problem.

Figure 4-2 displays the behavior of the six-month smoothed rates of change in the leading index and in the coincident index relative to the business cycle peak and trough dates. The crossings of the 3.3 percent trend line and of the zero baseline—which underlie the signals of these dates as listed in Tables 4-1 and 4-2—are identified. This allows a visual assessment of the workings of the procedure.

One way to evaluate the set of signals here is to count the number of months during business recessions when the signals would have operated in the appropriate way—and likewise during business expansions. Table 4-3 does this for the third signal and shows that it operated in the correct direction nearly 85 percent of the time between 1949 and 1980. The signal of recession was "on" for about 8.5 years, compared with a total of about five years accounted for by the six recessions covered (since 1953). The record shows that these errors were heavily concentrated at the beginning of expansions and (to a lesser extent) at the beginning of recessions. The recession signal was always "off" before the economy recovered to its previous peak level (see text and note 17). In terms of public works expenditures, these are the most tolerable types of error. A brief delay in turning them off at the beginning of an expansion means that they will be concentrated during a part of the business cycle when economic activity is most depressed and inflationary pressures are apt to be receding.

This record is very different from the actual performance of public works expenditures in the past, where a major problem has been that they have been concentrated in periods of high activity rather than low. The set of signals described in this chapter should make possible a significant improvement on past performance in this respect.

Another kind of test is to see how the system works on similar data for other countries. The leading and coincident indexes currently compiled by the Center for International Business Cycle Research for six other countries provide the means for such a test. It is not, however, possible to compare the signals with business cycle peaks and troughs, because most countries do not have such chronologies. However, chronologies of growth cycles have been established by the Center. For an initial test we have selected one period, 1973-1976, when every country experienced not only a slowdown but also a recession. The results can be briefly summarized.

1. In each of the six countries (Canada, the United Kingdom, West Germany, France, Italy, and Japan), the three signals of peaks

Figure 4-2. Six-Month Smoothed Rates of Change in the Leading Index and in the Coincident Index. (*A, the leading index rate. B, the coincident index rate.*)

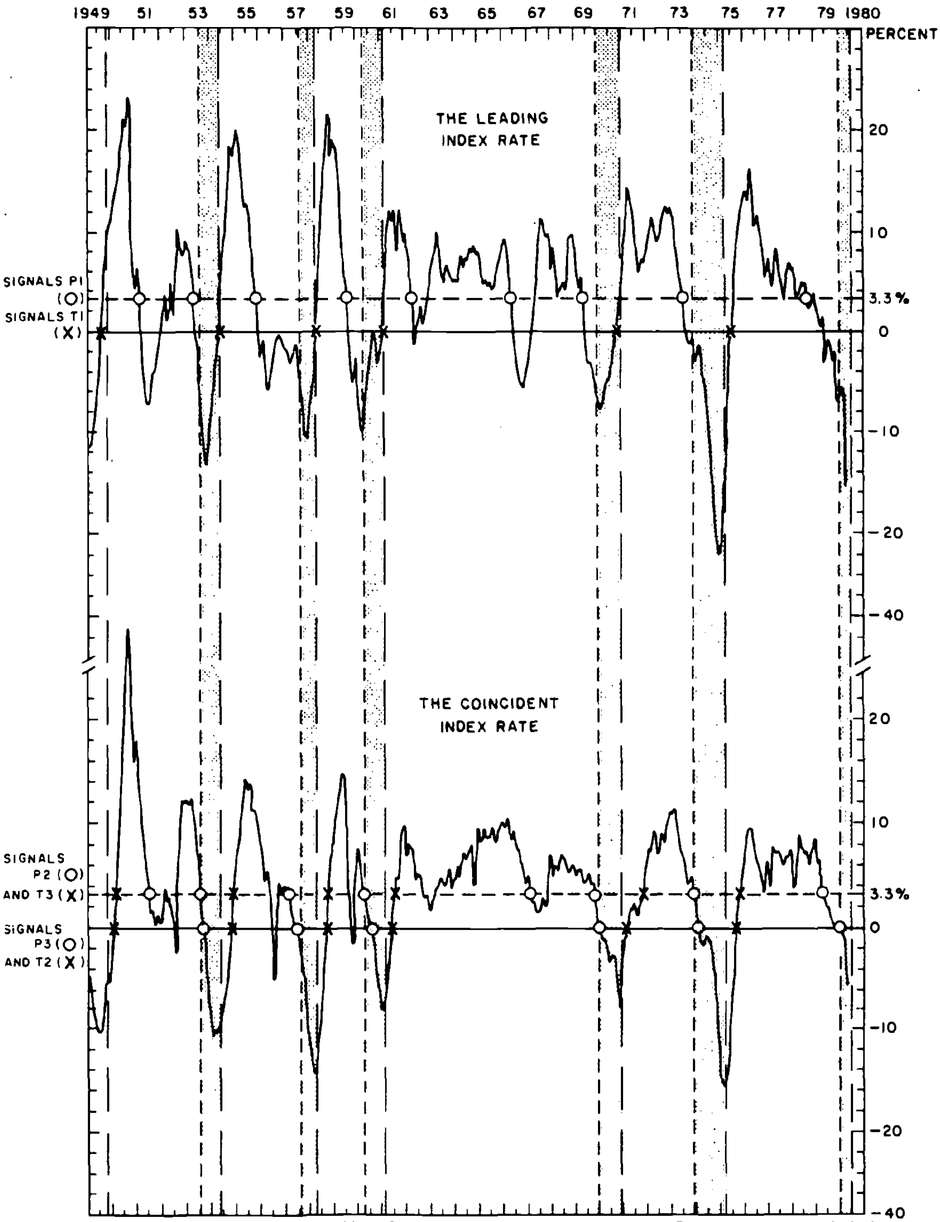


Table 4-3. Countercyclical Record of the Third Signal.

A. Business Cycle Recessions

Business Cycle		Third Signal		Months of Recession				% of Total		
						Third Signal Incorrect			Third Signal Incorrect	
Peak (1)	Trough (2)	Peak (3)	Trough (4)	Total (5)	Third Signal Correct (6)	at Beginning (7)	at End (8)	Third Signal Correct (9)	at Beginning (10)	at End (11)
11/48	10/49	n.a.	n.a.	11	—	—	—	—	—	—
7/53	5/54	9/53	12/54	10	8	2	0	80	20	0
8/57	4/58	8/57	11/58	8	8	0	0	100	0	0
4/60	2/61	8/60	8/61	10	6	4	0	60	40	0
12/69	11/70	1/70	11/71	11	10	1	0	91	9	0
11/73	3/75	2/74	11/75	16	13	3	0	81	19	0
1/80	7/80	10/79	2/81	6	6	0	0	100	0	0
Total				61[a]	51	10	0	84	15	0

B. Business Cycle Expansions

Business Cycle		Third Signal		Months of Expansion				% of Total		
						Third Signal Incorrect			Third Signal Incorrect	
Trough (1)	Peak (2)	Trough (3)	Peak (4)	Total (5)	Third Signal Correct (6)	at Beginning (7)	at End (8)	Third Signal Correct (9)	at Beginning (10)	at End (11)
10/49	7/53	3/50	9/53	45	40	5	0	89	11	0
5/54	8/57	12/54	8/57	39	32	7	0	82	18	0
4/58	4/60	11/58	8/60	24	17	7	0	71	29	0
2/61	12/69	8/61	1/70	106	100	6	0	94	6	0
11/70	11/73	11/71	2/74	36	24	12	0	67	33	0
3/75	1/80	11/75	10/79	58	47	8	3	81	14	5
Total				308	260	45	3	84	15	1

C. Business Cycle Recessions and Expansions

	Cols. 5	Cols. 6	Cols. 7	Cols. 8	Cols. 9	Cols. 10	Cols. 11
Total	369	311	55	3	84	15	1

Note: Column 5 is the interval between the dates in columns 1 and 2. Column 6 is the interval between the dates in columns 3 and 2. Column 7 is the interval between the dates in columns 1 and 3. Column 8 is the interval (if any) from the date in column 4 to that in column 2. The false signals in 1956 and 1959 listed in the note to Table 4-1, which were associated with strikes, are ignored in this table.

[a] Exluding 1948-1949.

occurred in the expected sequence during 1973-1974, and the three signals of troughs did likewise during 1975-1976.

2. At the growth cycle peak in each country, the lag of the first signal, averaged across the six countries, was two months, while the second and third signals lagged by an average of five and six months, respectively. At the growth cycle trough, the average lags for the six countries were zero, six, and eight months, respectively.

3. The system produced no false signals in any country during 1973-1976, but in Japan the third signal of a trough was subject to unusual delay. In this set of indexes, the "target-trend" growth rate for each country is equal to the rate of growth in its real GNP during 1966-1976. For Japan, this is 7.8 percent per year. The coincident index rate did not reach that level until 1979 and then only briefly, even though a growth cycle trough was recognized in March 1975. Growth in Japan has, of course, slowed since the 1973 oil crisis. The growth cycle chronology allows for this change in trend, but the criterion used in the third signal does not. This points to one of the potential problems with the target-trend aspect of the signal system, although Japan was the only country where it had a significant effect.

In general, the results of this test on data for other countries correspond well with those for the United States. At peaks the lags are longer than those shown for the United States in Table 4-1, but this is because growth cycle peaks (used in six countries) precede business cycle peaks. At troughs, where growth cycle and business cycle turns usually coincide, the lags for the six countries are nearly the same as those for the United States. As additional experience is gained, for example, in applying the system on a current basis, we shall be in a better position to appraise its virtues and limitations.

MODIFYING THE SYSTEM FOR USE WITH CURRENT DATA

An important limitation of the foregoing tests is that they use historical, not current, data. The index series are based on the best information available at the present time, that is, on figures which, for all but a few of the most recent months, have undergone several revisions. In actual practice, business analysts and forecasters cannot work with these data since they cannot afford the long delays entailed in waiting for the revisions to be completed. Realistically, the choice they have is restricted to using either the preliminary data, which involve the least delay but also are the least accurate, or the first revised data, which add another month to the lag of the indexes behind the events but improve the quality of the information.[18]

Table 4-4 compares the monthly values of the leading index rate and the coincident index rate as they appeared in preliminary data and in first revised data. These series begin in October 1976 because consistent information of this type is not available for the earlier years.[19]

The leading index rate based on preliminary data (L_p) dipped below the 3.3 percent level intermittently for a total of eight months between February 1977 and August 1978. These declines were generally short and shallow, but, under the strict application of the rules stated above, each of these months is associated with a false signal, identified in the table by the symbol (*P*1) (see columns 1 and 3). Only in November 1978 did the series L_p begin signaling the recession consistently, by falling and staying below 3.3 percent (and soon thereafter below 0 percent). Accordingly, it is in that month that a true signal of the peak, denoted as *P*1, is shown in the table for the first time (the first appearance of a true signal is marked with an asterisk). The *P*1 signal was reported in each of the five following months.

The coincident index rate based on preliminary data (C_p) declined below 3.3 percent in May 1979 and remained below that level until after the 1980 recession, thus yielding (together with the leading index rate) a true second signal of the peak, *P*2 (see columns 2 and 3). However, C_p slipped intermittently below zero in four months between August 1979 and January 1980, producing false third signals of the peak (*P*3). The true third signal, *P*3, is first dated March 1980; it stayed on for six months, through August 1980.

When first revised data are used for the leading index rate (L_r) and the coincident index rate (C_r), the frequency of false signals is drastically reduced. The series L_r shows four months of false first signals (*P*1) between January 1977 and August 1978 (columns 5, 7). This compares with eight such months in the preliminary series L_p (see columns 3 and 7). According to the series C_r, the true second signal *P*2* occurred for the first time in April 1979 and stayed on for six consecutive months (columns 6, 7). When one allows for the longer information lag due to the revision, this timing is effectively the same as that of the preliminary series C_p (see columns 3 and 7). There are no false signals of the *P*2 type in either C_r or C_p. Further, the use of C_r would result in fewer and less confusing false signals of the *P*3 type than use of C_p would. Finally, the revised data gave the third true signal of the peak, *P*3, for the first time in February 1980 and

Table 4-4. Sequential Signals of Recession and Recovery, Two Variants, Applied to Preliminary and Revised Data, 1976-1981.

Year and Month	*Preliminary Data*[a]				*First Revised Data*[b]			
			Signals of Business Cycle Turns				*Signals of Business Cycle Turns*	
	Leading Index Rate (L_p) *(1)*	*Coincident Index Rate* (C_p) *(2)*	*Level Signals*[c] *(3)*	*Band Signals*[c] *(4)*	*Leading Index Rate* (L_r) *(5)*	*Coincident Index Rate* (C_r) *(6)*	*Level Signals*[c] *(7)*	*Band Signals*[c] *(8)*
1976								
October	4.1	2.7	—	—	4.5	2.8	—	—
November	5.5	4.0	—	—	6.1	4.2	—	—
December	8.2	5.2	—	—	7.3	5.7	—	—
1977								
January	3.6	4.0	—	—	3.1	3.4	(*P*1)	—
February	3.1	4.3	(*P*1)	—	3.7	4.9	—	—
March	5.6	7.3	—	—	6.4	7.9	—	—
April	6.5	8.4	—	—	6.5	7.6	—	—
May	5.3	8.2	—	—	5.0	8.2	—	—
June	3.1	8.1	(*P*1)	—	3.8	7.3	—	—
July	2.9	7.2	(*P*1)	—	3.8	7.0	—	—
August	4.7	5.8	—	—	5.5	5.5	—	—
September	5.4	6.3	—	—	6.0	6.0	—	—
October	6.4	6.3	—	—	7.3	6.4	—	—
November	5.8	6.8	—	—	6.3	5.8	—	—
December	6.9	6.4	—	—	7.0	7.1	—	—
1978								
January	2.4	5.5	(*P*1)	—	3.6	3.7	—	—
February	2.7	4.3	(*P*1)	—	4.0	3.7	—	—
March	3.0	6.1	(*P*1)	—	3.2	6.3	(*P*1)	—
April	3.7	8.3	—	—	5.2	8.6	—	—
May	4.2	7.9	—	—	4.2	7.5	—	—
June	4.2	7.3	—	—	4.8	7.3	—	—
July	2.5	7.7	(*P*1)	—	2.0	7.0	(*P*1)	*P*1*
August	2.9	6.2	(*P*1)	—	2.9	7.0	(*P*1)	*P*1
September	4.0	5.7	—	—	4.3	6.1	—	*P*1
October	4.5	6.7	—	—	3.7	7.2	—	*P*1
November	1.9	8.0	*P*1*	*P*1*	2.4	7.8	*P*1*	*P*1
December	1.1	7.9	*P*1	*P*1	1.8	8.0	*P*1	*P*1

1979								
January	-.7	6.8	*P*1	*P*1	2.9	6.0	*P*1	*P*1
February	.1	5.2	*P*1	*P*1	1.0	4.8	*P*1	*P*1
March	-.3	4.7	*P*1	*P*1	1.6	6.1	*P*1	*P*1
April	-5.0	3.3	*P*1	*P*1	-2.6	2.0	*P*2*	*P*2*
May	-1.8	.9	*P*2*	*P*2*	-2.0	3.0	*P*2	*P*2
June	-2.2	1.4	*P*2	*P*2	-3.2	2.0	*P*2	*P*2
July	-3.6	1.3	*P*2	*P*2	-3.7	1.3	*P*2	*P*2
August	-3.5	-.9	(*P*3)	*P*2	-2.3	.4	*P*2	*P*2
September	-.7	-.1	(*P*3)	*P*2	-2.1	.3	*P*2	*P*2
October	-3.5	.5	—	*P*2	-4.0	-.4	(*P*3)	*P*2
November	-5.8	-.2	(*P*3)	*P*2	-5.4	-.5	(*P*3)	*P*2
December	-4.8	.2	—	*P*2	-6.3	-.2	(*P*3)	*P*2
1980								
January	-6.7	-.9	(*P*3)	*P*2	-6.5	.8	—	*P*2
February	-6.1	.1	—	*P*2	-6.0	-.4	*P*3*	*P*2
March	-9.8	-2.2	*P*3*	*P*3*	-8.4	-2.5	*P*3	*P*3*
April	-15.3	-5.5	*P*3	*P*3	-15.0	-5.6	*P*3	*P*3
May	-17.3	7.9	*P*3	*P*3	-17.0	-8.5	*P*3	*P*3
June	-11.3	-10.7	*P*3	*P*3	-13.4	-10.1	*P*3	*P*3
July	-4.2	-11.4	*P*3	*P*3	-6.8	-9.3	*P*3	*P*3
August	-2.2	-8.0	*P*3	*P*3	-2.5	-8.5	*P*3	*P*3
September	3.0	-7.2	*T*1*	*T*1*	4.7	-5.0	*T*1*	*T*1*
October	7.1	-2.4	*T*1	*T*1	6.9	-1.9	*T*1	*T*1
November	9.5	.2	*T*2*	*T*1	9.5	-.1	*T*1	*T*1
December	7.7	1.5	*T*2	*T*2*	7.1	1.7	*T*2*	*T*2*
1981								
January	6.0	3.0	*T*2	*T*2	7.4	2.6	*T*2	*T*2
February	6.2	2.3	*T*2	*T*2	4.8	3.5	*T*3*	*T*2
March	7.4	3.9	*T*3*	*T*2	8.7	4.7	*T*3	*T*3*
April	8.6	4.7	*T*3*	*T*3*	7.7	3.5	*T*3	*T*3
May	2.7	3.3	(*P*1)[d]	*T*3	—	—	—	—

[a] Based on the first published BCD figures (with a publication lag of one month).

[b] Based on the second published BCD figures (with a publication lag of two months).

[c] The symbols are those used in the text, e.g., *P*1 denotes the first signal for peaks, *T*2 the second signal for troughs, etc. The false signals are in parentheses, e.g., (*P*1) or (*T*2), the true signals are not. The first time a true signal appears it is marked by an asterisk, e.g., *P*1* or *T*2*. For the explanation of the systems of level signals and band signals, see text.

[d] The level of L_p in May 1981 (2.7 percent) represents a first peak signal (*P*1) which may or may not prove to be a false signal. Subsequent data as of September 1981 show a *P*1 signal in June 1981 and a *P*2 signal in August 1981, but no *P*3 signal.

repeated it in each of the six ensuing months. This is again equivalent to the timing of the corresponding signal in the preliminary data (March-August 1980). The NBER designated January 1980 as the business cycle peak on June 3, 1980.[20]

The trough of the 1980 recession occurred in July 1980, according to a recent finding by the NBER (July 8, 1981). Our first, second, and third trough signals are dated September and November 1980 and March 1981, respectively, according to the preliminary data, and September and December 1980 and February 1981 according to the revised data. The lags involved, two to nine months, are similar to those observed in recent recoveries (see Table 4-2 and text).

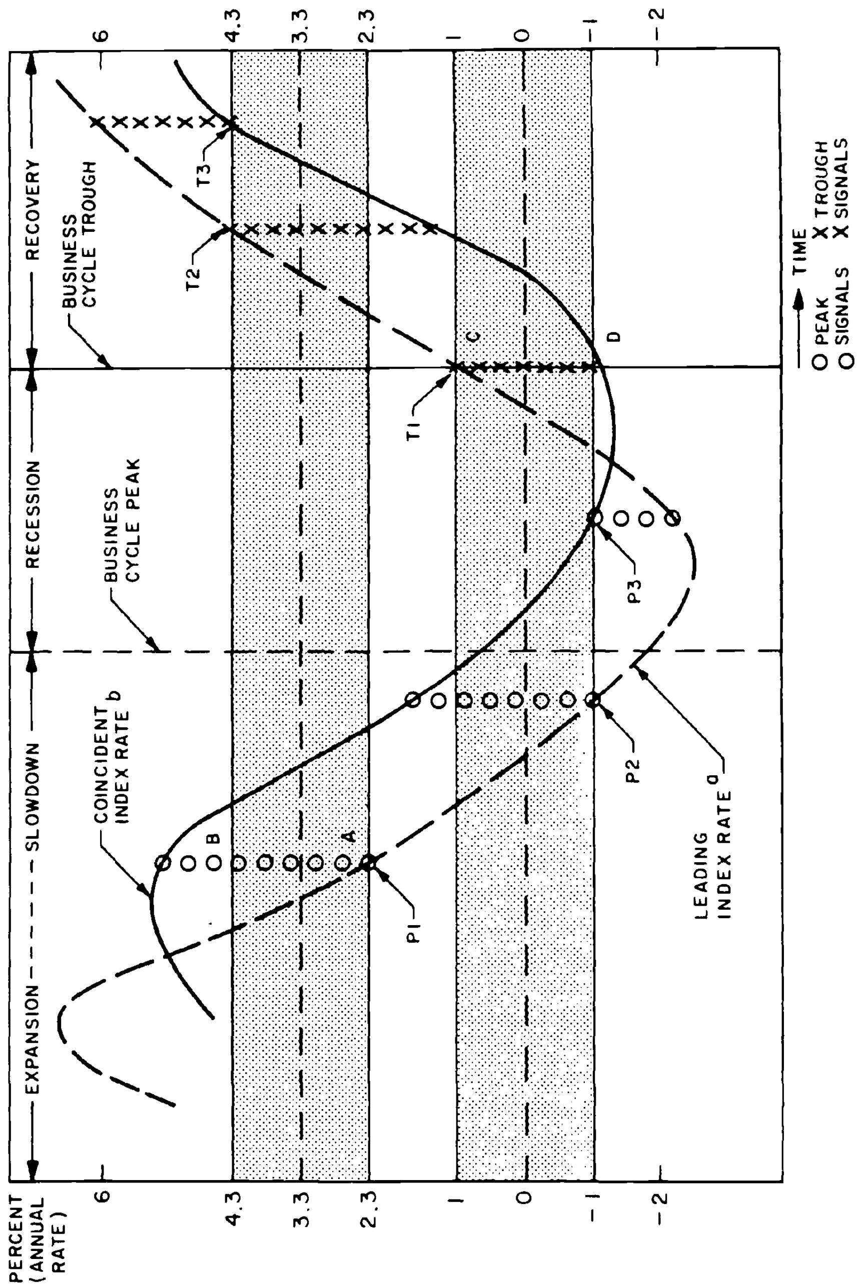
Let us sum up the results obtained at this point: The simple device of using the first revised instead of the preliminary indexes turns out to be rather effective in dealing with the problem of false signals (as exemplified by the data relating to the January 1980 peak). But another approach appears to work better still. It consists in redefining the signaling system by using bands of ± 1.0 percent around the critical levels of 3.3 percent and 0 percent. This would approximately allow for the dispersion of the values of the random components of the composite indexes.[21]

Figure 4-3 shows how the "band approach" would work by means of a schematic diagram analogous to Figure 4-1 (which applies to the level approach used up to this point). Here the first signal of the peak, assuming the coincident index rate is above zero, occurs when the leading index rate declines across the band 3.3 percent ± 1.0 percent. If, after that happened, the leading rate rose again but stayed within the band (at points like *A* in Figure 4-3, for example), the signal would not be invalidated; for the signal to be revealed as false, the leading index rate would have to rise above the band (e.g., to point *B*). The second peak signal occurs when the leading rate falls below the band 0 percent ± 1.0 percent, and the coincident rate falls below the band 3.3 percent ± 1.0 percent. The third peak signal is given when the coincident rate falls below the band 0 percent ± 1.0 percent, while the leading rate remains below zero. The criterion defining false signals is everywhere the same: Backing up *into* the band does not invalidate the previous signal; reverse crossing *through* the band does.

The expected sequence of signals at business cycle peaks, then, is when each of the following signals is first observed:

- First signal (*P*1): The leading index rate falls below 2.3 percent; the coincident index rate will usually be higher than 2.3 percent, but we require only that it be nonnegative ($L < 2.3$; $C \geqslant 0$).

Figure 4–3. Sequential Signals of Recession and Recovery: The Band Approach.



- Second signal (*P2*): The leading index rate falls below−1.0 percent and the coincident rate falls below 2.3 percent ($L < -1.0$; $C < 2.3$).
- Third signal (*P3*): The coincident index rate falls below -1.0 percent, while the leading index rate is still negative ($L < 0$; $C < -1.0$).

At business cycle troughs, the first signal occurs when the leading index rate rises across the band 0 percent ± 1.0 percent while the coincident rate remains below that band. If, thereafter, the leading rate falls back within the band (say, to point *C*), the signal continues to apply; if it falls below the band (say, to point *D*), the signal is taken to be false. The second trough signal is given when the leading rate rises across the band 3.3 percent ± 1.0 percent and the coincident rate rises across the band 0 percent ± 1.0 percent. The third signal occurs when both rates rise above the band 3.3 percent ± 1.0 percent. Again, the criterion for distinguishing false from true signals remains as defined above.

To sum up, the expected sequence of signals at business cycle troughs is given by the first occurrence of the following:

- First signal (*T1*): The leading index rate rises above 1.0 percent while the coincident index rate is less than 1.0 percent ($L > 1.0$; $C < 1.0$). A *T1* must follow a *P3*.
- Second signal (*T2*): The leading index rate rises above 4.3 percent and the coincident index rate rises above 1.0 percent ($L > 4.3$; $C > 1.0$).
- Third signal (*T3*): Both the leading index rate and the coincident index rate rise above 4.3 percent ($L > 4.3$; $C > 4.3$).

To be reasonably successful, the band approach requires that (1) the proportions of observations that fall into the two bands be small for both index rates, *L* and *C*; and (2) the reverse crossings through the bands be very infrequent for both series. Unless the first condition applies, either *L* or *C* or both may meander within the bands, with the effect of delaying and perhaps obscuring the signals. Unless the second condition applies, false signals will present a problem.

Fortunately, the evidence suggests that the two requirements are likely to be met by the data. As shown in Table 4-5, less than 7 percent of the observations for the leading index rate fell in the band 3.3 percent ± 1.0 percent and about 6 percent fell in the band 0 percent ± 1.0 percent. For the coincident index rate, the corresponding

Table 4-5. Frequency Distributions of Monthly Observations on Six-Month Smoothed Rates of Change in the Leading Index and in the Coincident Index, 1948-1981.

	Frequency of Observations							
	Leading Index Rate (L)				*Coincident Index Rate (C)*			
Class Interval (% Points)	*N* *(1)*		*%* *(2)*		*N* *(3)*		*%* *(4)*	
4.4 and over	199		51.4		195		50.4	
3.4-4.3	13	26	3.4	6.7	24	48	6.2	12.4
2.4-3.3	13		3.4		24		6.2	
1.1-2.3	16		4.1		29		7.5	
.1-1.0	9	23	2.3	5.9	14	33	3.6	8.5
-1.0-0.0	14		3.6		19		4.9	
-1.1 and under	123		31.8		82		21.2	
Total	387		100.0		387		100.0	

Note: The measures in this table refer to the series plotted in Figure 4-2A (for *L*) and Figure 4-2B (for *C*). The series are based on the composite indexes published in U.S. Department of Commerce, Bureau of Economic Analysis, *Business Conditions Digest* (BDC) 1979.

percentages are somewhat larger but still moderate: a little over 12 percent and 8 percent, respectively. Thus, the *L* series was outside of the two bands 87 percent of the time, and the *C* series was outside of the same bands 79 percent of the time.

Returning to Table 4-4, let us inspect columns 4 and 8, which register the signals produced by the band approach for the preliminary and first revised data, respectively. There are no false signals at all in either set; that is, no reverse crossings of the bands occurred during this period of more than four years. This is a major advantage of using the band signals rather than level signals (cf. column 4 with 3, and column 8 with 7). There is no significant advantage to applying the band approach to the first revised data rather than the preliminary data (cf. columns 4 and 8).

The timing of the band signals is in most cases identical with the timing of the corresponding level signals, as shown in Table 4-6. Hence this method, like the use of revised data, would cause no additional delay in the signals associated with the last recession and recovery. We conclude that the proposed procedure offers a promising way of dealing with the difficult and important problem of false signals on a current basis.

It is somewhat surprising that the band signals do not show more of a lag relative to the level signals, since the two approaches differ in a way that would seem to suggest the presence of such lags (cf. Fig-

Table 4-6. Timing of the Signals of Peaks and Troughs, Two Variants, Preliminary and First Revised Data, 1976-1981.

	Preliminary Data				First Revised Data			
	Level Signals		Band Signals		Level Signals		Band Signals	
Type of Signal	Date (1)	Lead (-) or Lag (+) (2)	Date (3)	Lead (-) or Lag (+) (4)	Date (5)	Lead (-) or Lag (+) (6)	Date (7)	Lead (-) or Lag (+) (8)
	Business Cycle Peak Signals							
P1*	Nov. 1978	-14	Nov. 1978	-14	July 1978	-18	Nov. 1978	-14
P2*	May 1979	-8	May 1979	-8	April 1979	-9	April 1979	-9
P3*	March 1980	+2	March 1980	+2	Feb. 1980	+1	March 1980	+2
	Business Cycle Trough Signals							
T1*	Sept. 1980	+2	Sept. 1980	+2	Sept. 1980	+2	Sept. 1980	+2
T2*	Nov. 1980	+4	Dec. 1980	+5	Dec. 1980	+5	Dec. 1980	+5
T3*	March 1981	+8	April 1981	+9	Feb. 1981	+7	March 1981	+8

Note: All leads and lags are in months. For the peak signals, they are measured from the NBER reference date for the business cycle peak: January 1980. For the trough signals, they are measured from the NBER reference date of July 1980 (see text and note 20). On the symbols for the types of peak and trough signals and the underlying data, see Table 4-4.

ures 4-1 and 4-2). As a last test available to us, we have therefore applied the band approach to the historical data extending back to 1948. The results are presented in Tables 4-7 and 4-8, which may be compared with Tables 4-1 and 4-2, respectively. The mean timing of the three band signals at business cycle peaks is -8, -3, and +3 months, a slight overall delay relative to the corresponding measures for the level signals (-10, -2, and +1). At troughs, the average leads or lags of the two sets of signals are virtually identical.

It should also be noted that sequences of all three peak signals appear in Table 4-7 only in connection with business cycle recessions, not growth cycle slowdowns. The latter are associated either with first and second signals (as in 1951) or with the first signal only (as in 1962 and 1966). The absence of the *P*3 signal in each of these instances also rules out any trough signals in the years 1952, 1963, and 1967. In all these respects, there is a basic similarity between the band signals of Tables 4-7 and 4-8 and the level signals of Tables 4-1 and 4-2. The main difference is the absence of false signals, which constitutes a substantial advantage of the band approach.

THE TIMING OF THE SIGNALS AND INFLATION

Ideally, countercyclical policies should be timed so as to also have some stabilizing effects on prices in general. If the price level increased in business expansions and decreased in business contractions, the two aims of policy, far from being in any way inconsistent, would actually be complementary. In the 1940s and earlier, the comprehensive price indexes did tend to fluctuate with the business cycle. In the recent era of persistent inflation, the general level of prices of goods and services no longer shows any comparable degree of downward flexibility. Thus, as shown in Figure 4-4, the six-month smoothed rate of change in the consumer price index (to be called, for simplicity, the CPI rate) became negative in 1949-1950 and 1954-1955, during and immediately after the first two business cycle contractions of the post-World War II period; but it stayed positive during each of the five recessions that occurred in the following quarter-century.

However, despite the upward trend in inflation since the mid-1960s, the CPI rate continued to show a cyclical pattern. The only significant declines in this (and other) measures of inflation occurred during recessions or, increasingly, in the early recovery phases (Figure 4-4). Inflation decelerated sharply on most of these occasions,

Table 4-7. Three Signals of Recession: Timing at Business Cycle Peaks—The Band Approach, 1948-1980.

Growth Cycle Peak	*Business Cycle Peak*	*First Signal ($L < 2.3$; $C > 0$)*	*Second Signal ($L < -1.0$; $C < 2.3$)*	*Third Signal ($L < 0$; $C < -1.0$)*	*Lead (-) or Lag (+), in Months, at Business Cycle Peaks*		
					First Signal	*Second Signal*	*Third Signal*
7/48	11/48	N. A.	N. A.	N. A.	—	—	—
3/51	None	3/51	7/51	—	—	—	—
3/53	7/53	6/53	8/53	9/53	-1	+1	+2
2/57	8/57	1/56	7/56	9/57	-19	-13	+1
2/60	4/60	9/59	6/60	9/60	-7	+2	+5
5/62	None	5/62	—	—	—	—	—
6/66	None	6/66	—	—	—	—	—
3/69	12/69	6/69	11/69	4/70	-6	-1	+4
3/73	11/73	8/73	1/74	3/74	-3	+2	+4
12/78	1/80	11/78	5/79	3/80	-14	-8	+2
Average	—	—	—	—	-8	-3	+3

Note: For full definitions of the signals, see text. Revised data are used prior to October 1976, preliminary data since then.

Table 4-8. Three Signals of Recovery: Timing at Business Cycle Troughs—the Band Approach, 1949-1981.

Growth Cycle Trough	*Business Cycle Trough*	*First Signal ($L > 1.0$; $C < 1.0$)*	*Second Signal ($L > 4.3$; $C > 1.0$)*	*Third Signal ($L > 4.3$; $C > 4.3$)*	*Lead (-) or Lag (+), in Months, at Business Cycle Peaks*		
					First Signal	*Second Signal*	*Third Signal*
10/49	10/49	8/49	1/50	3/50	-2	+3	+5
8/54	5/54	5/54	11/54	12/54	0	+6	+7
4/58	4/58	6/58	10/58	11/58	+2	+6	+7
2/61	2/61	3/61	6/61	8/61	+1	+4	+6
11/70	11/70	11/70	5/71	12/71	0	+6	+13
3/75	3/75	6/75	9/75	11/75	+3	+6	+8
7/80	7/80	9/80	12/80	4/81	+2	+5	+9
Average	—	—	—	—	+1	+5	+8

Note: For full definitions of the signals, see text. Revised data are used prior to October 1976, preliminary data since then.

Figure 4-4. Rate of Inflation (CPI) and Business Cycles. (*Dotted areas are business cycle recessions as determined by the NBER. The CPI rate is the "six-month smoothed percentage change at annual rate" as determined from the ratio of the current month's index to the average index for the twelve preceding months.*)

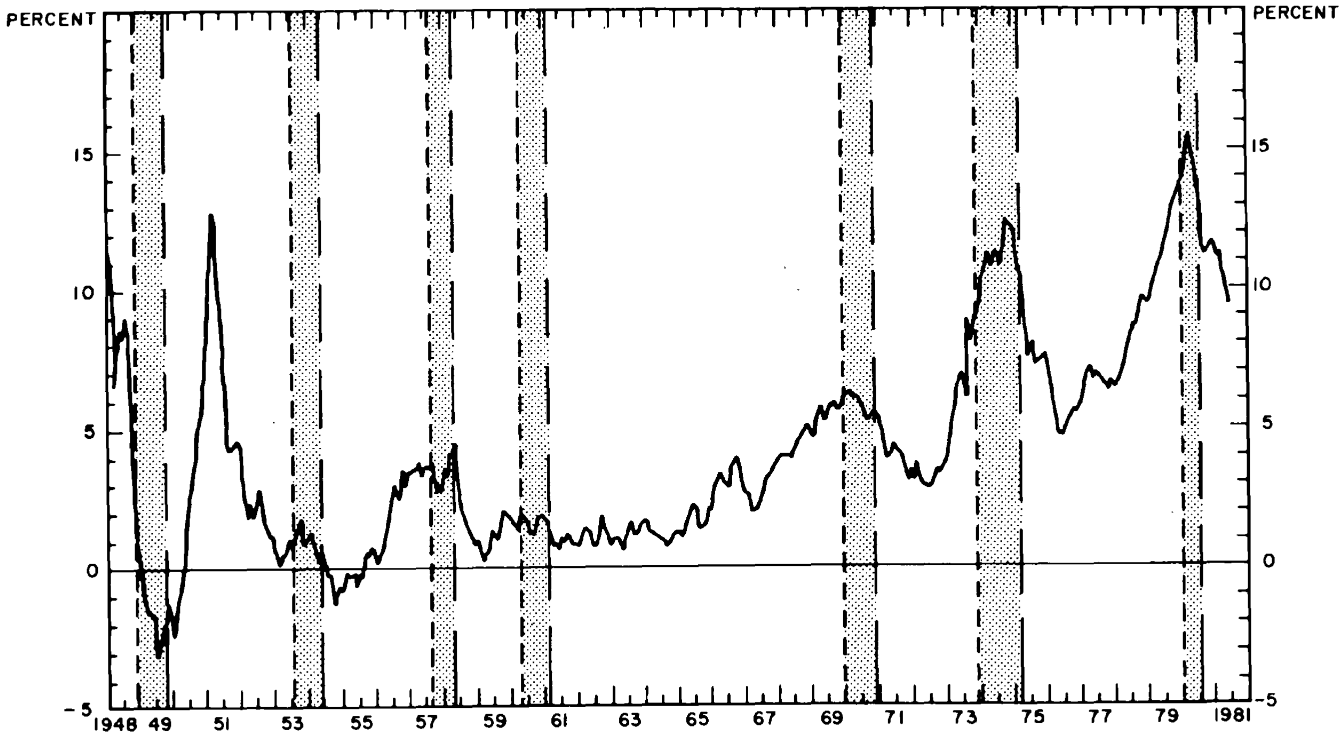
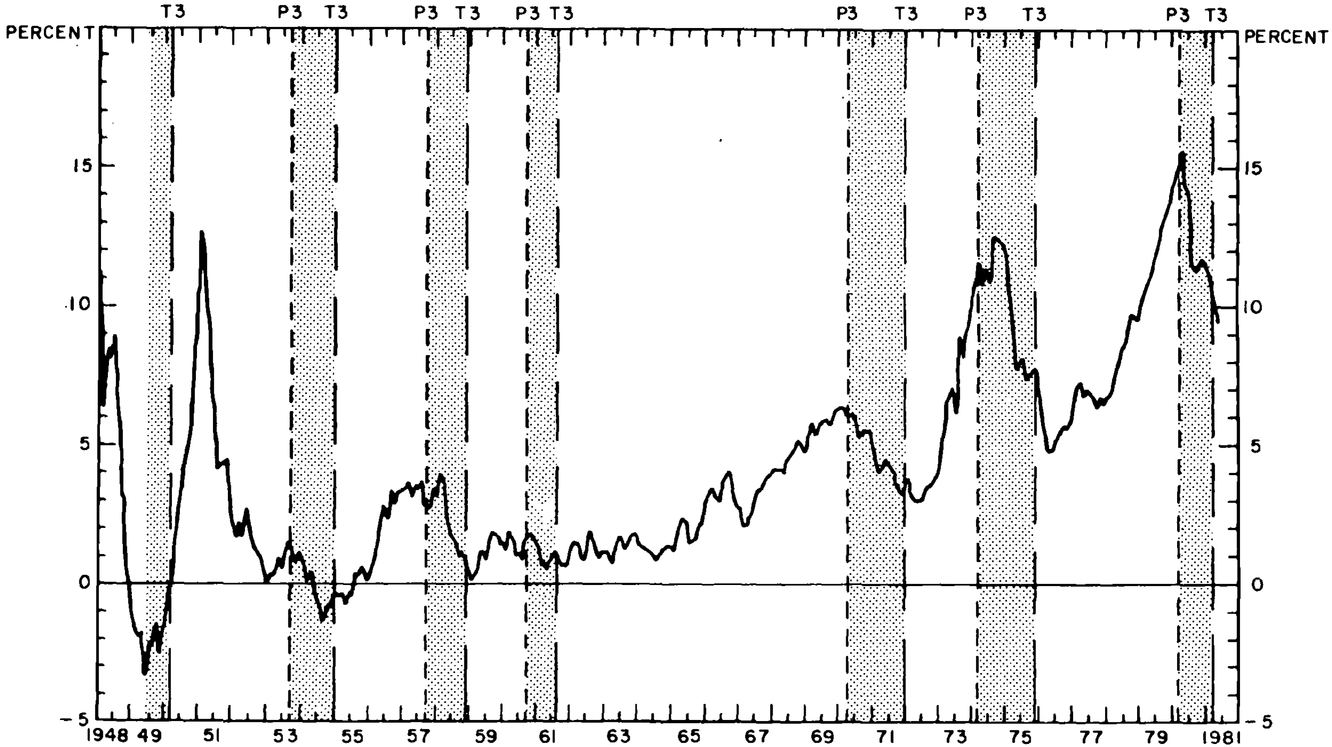


Figure 4-5. Rate of Inflation (CPI) and Third Signals of Peaks and Troughs. (*Dotted areas are business cycle recessions as indicated by the third signal for peaks (P3) and troughs (T3), using the band approach. The CPI rate is as in Figure 4-4.*)



as in 1958-1959, 1970-1972, 1974-1976, and 1980-1981; unfortunately, the accelerations during the expansions in 1968-1969, 1972-1974, nd 1976-1979 were larger yet.[22] This suggests that, in order not to aggravate inflation, countercyclical policies ought to be strictly confined to periods of business cycle contraction and early recovery when the upward pressures on the price level typically abate. They should not be initiated before the expansion tapers off and should be discontinued well before the next expansion heats up.

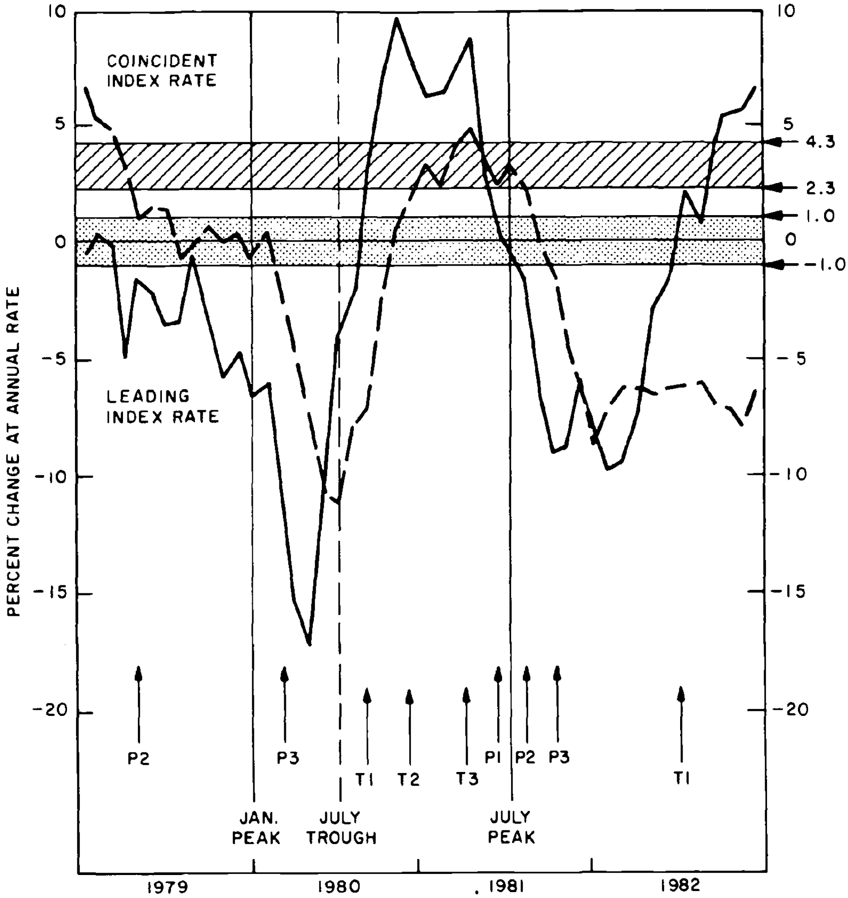
Our system of sequential signals is consistent with these precepts. If countercyclical policies were not significantly activated until the third peak signal, *P*3, and were fully deactivated by the third trough signal, *T*3, the relation to the inflation rate would be as shown in Figure 4-5. Each of the time intervals between *P*3 and *T*3 (indicated by the broken vertical lines bounding the dotted areas) corresponded closely to a phase of decline in the CPI rate. In the first two cycles, the off (*T*3) signals more or less coincided with the local inflation troughs as represented by the minima of the CPI rate; since 1958, they have preceded the low points of inflation by several months on each occasion. Hence the use of the signaling system would produce counterinflationary as well as countercyclical timing of discretionary economic policies.

AN UPDATE OF THE SEQUENTIAL SIGNALING SYSTEM

The recent record of the signals, using the "band approach" described above, is displayed in Figure 4-6. At the 1981 peak the first signal came in June 1981, the second in August, and the third in October. The business cycle peak, as designated later by the National Bureau, was July 1981. Hence the first signal led the peak by one month, the second lagged by one month, and the third lagged by three months. The first signal did not give as early a warning as on most past occasions, and all three signals were more tightly concentrated than usual.

The first subsequent signal of a trough came in July 1982, when the growth rate for the leading index reached 1.9 percent, after having been negative during the preceding twelve months. In August the growth rate dipped to 0.7 percent, but since this was still within the -1.0 to +1.0 percent band, the signal was not reversed. In September the growth rate rose to 3.9 percent, and it climbed higher in October, November, and December, the latest month as of this writing. Meanwhile, the coincident index growth rate remained negative, so the second trough signal had not arrived by December. As of the end of

Figure 4-6. Recession and Recovery: Sequential Signals.



1982, therefore, confirmation that a recovery was underway, as provided by the second and third signals, was still lacking.

NOTES TO CHAPTER 4

1. Thus the Accelerated Public Works Program was enacted in September 1962, that is, nineteen months after the end of the 1960-1961 business cycle contraction as dated by the NBER. For the Public Works Impact Program (August 1971), the lag behind the trough of the 1969-1970 recession was nine months. The enactment of the Local Public Works Program in July 1976 followed by sixteen months the NBER reference date for the end of the 1973-1975 contraction.

2. The Public Employment Program was created by the Emergency Employment Act in July 1971, eight months into the recovery from the 1969-1970 recession. The Comprehensive Employment and Training Act (Title VI) was enacted in December 1974—thirteen months after the business cycle peak, but three months before the trough as dated by NBER. It is estimated that about six months elapsed between the allocation of funds and the employment of half the number of workers (half the direct jobs to be created) under these programs. The lags with which the policies take effect are, on the average, longer for public works, where the half-life is of the order of one year. (See Vernez and Vaughan 1978: 48-59).

3. While it is true that some public works (new large projects) have long implementation lags, others (renovations and small new projects) take much less time to complete. Public employment service programs have relatively short outside lags, with the best results showing 60 percent to 70 percent of the peak number of jobs filled in six months, as shown for EEA in 1971-1972 and CETA VI in 1974-1975 by Vernez and Vaughan (1978: 56).

4. Note the following passage from an early, authoritative document: "Within limits, expenditures for public works can be timed to serve the interests of stability, but only if a reservoir of engineering studies and blueprints for specific projects has been prepared well in advance of need" (Council of Economic Advisers 1954: 123).

5. The composite index of "marginal employment adjustments" compiled by the Bureau of Economic Analysis (BEA) of the U.S. Department of Commerce includes the average workweek, accession rate, and layoff rate (all in manufacturing) and the average initial claims on state unemployment insurance. Two of these series (the workweek and the layoff rate) are components of the BEA index of twelve leading indicators used in the procedure described in the text below. For a modified version of the employment adjustment index, see Chapter 22, below.

6. This is of necessity but a starkly condensed list which groups together several types of explanations, e.g., (1) includes accelerator-multiplier models, hypotheses stressing autonomous investment, disturbances, lags, innovations, etc.; (2) covers both the older theories that assign a central role to fluctuations in bank credit and interest rates and the current monetarist theories; and (3) refers to the roles of cost-price imbalances, volatility of prospective rates of return, and expectational errors. Nor is this tabulation in any sense exhaustive. For an overview of business cycle literature with references, see Zarnowitz 1972: 1-38. For a bibliography of indicator studies, see Zarnowitz 1972 and Chapter 21, below.

7. Careful observation led to an acceptable working definition of business cycles as a recurrent but not periodic sequence of cumulative expansions and contractions that spread unevenly over the myriad of processes and participants that constitute a market economy yet are sufficiently synchronized to show up as fluctuations in the overall aggregates of real income, output, employment, and trade. The historical movements display certain well-established and important (but far from immutable) regularities along with many unique features of the individual processes and cycles. There are plausible hypotheses that are not nec-

essarily mutually exclusive, but there is no unified theory that has succeeded in explaining all that seems essential about business cycles. Thus, prediction cannot reliably depend on any single presumptive chain of cause and effect. The composition of factors that influence the course of the economy can and does vary from one business cycle to another, so some indicators may work better in one environment, others in a different environment. To increase the chances of getting true signals, it is therefore advisable to construct indexes from data of historically tested usefulness, with diversified economic coverage. It is also important and helpful that, in such indexes, much of the independent measurement error and other noise in the included series are smoothed out.

8. The series are also subjected to a standardization procedure designed to put them on an equal basis and to prevent the more volatile series from dominating the index. Further, trend adjustments are used, as noted later in this chapter. For detail on the construction, record, and predictive value of the composite indexes of cyclical indicators, see Zarnowitz and Boschan 1975a, b; U.S. Department of Commerce, Bureau of Economic Analysis 1977; Vaccara and Zarnowitz 1978: 41-50, 1979; and Chapters 24 and 25 below.

9. Another technique with a good claim to be considered is the use of trend-adjusted indexes, again after smoothing. But trend estimation is often difficult and uncertain, especially near the end of a series, and this is precisely where attention must be focused in a signaling system.

10. This is done by raising the ratio to the 12/6.5 power (the average of the twelve preceding months is located 6.5 months before the current month).

11. In fact, the smoothed six-month change at annual rate was found to compare favorably with a simple twelve-month change, the popular "same month year ago" comparisons. The latter series, while slightly smoother, lagged behind the former by one or two months at nearly every turn.

12. Specifically, the trends are made equal to the average of the long-term trends in the four components of the index of roughly coincident indicators (number of employees on nonagricultural payrolls; index of industrial production; personal income less transfer payments in constant dollars; manufacturing and trade sales in constant dollars). For each of these monthly series, a loglinear trend is computed by converting the percentage change from the centered initial cycle average (1949-1954) to the centered terminal cycle average (1970-1975) into a monthly rate by the compound interest formula. (For further details, see U.S. Department of Commerce, Bureau of Economic Analysis 1977: 74-76, 1979: 157.) The target trend will be reestimated each time a new trough-to-trough cycle is completed in the four coincident indicators. Frequent updating of the target trend rate is not practicable, but this should not cause any serious errors because the change in the secular trend of the economy is gradual and small in the short run.

13. Theoretically, business cycle contractions could likewise be interrupted by high-growth phases, but there are no instances of this sort in recent history, and none would be expected in times when all recessions are relatively short. In the seven completed business cycles of the post-World War II period (1945-1980), the contractions ranged in length from six to sixteen months and averaged ten months.

14. The series represent aggregate output, employment and unemployment, income, and sales; all are in constant dollars or physical units or quantity index numbers. The trends are estimated by interpolation between segments determined with the aid of ratios to long (seventy-five-month or twenty-five-quarter) centered moving averages; they are estimated so as to cut through and contain no significant elements of the short cyclical movements in the series. Various composite and diffusion indexes based on the same set of indicators are used as well. (For further detail and applications, see Zarnowitz and Boschan 1977: 34-38; Zarnowitz and Moore 1977.)

15. The rates of growth actually used in this chapter are smoothed six-month changes in annualized form, as described in the text. Of course, these indexes, like any others built from real economic indicators, contain much "noise," short erratic movements, which are entirely disregarded in Figure 4-1.

16. The coincident index rate was below 3.3 percent for five months in 1956 and was negative in one month. In 1959, it was below 3.3 percent (and negative) for two months.

17. The following tabulation compares the lags of the third signal with those involved in the recovery of the coincident index to its previous peak level (in the 1980-81 recovery the index did not regain its peak level):

Business Cycle Trough	*Lag of Third Signal (months)*	*Lag of Recovery in the Coincident Index (months)*
Oct. 1949	5	8
May 1954	7	12
April 1958	7	13
Feb. 1961	6	9
Nov. 1970	12	13
March 1975	8	24
Average	8	13

18. The main reason for the large revisions in the preliminary index is that it is constructed from only ten of the twelve components. The figures for the two components (net business formation and net change in inventories on hand and on order in 1972 dollars) are not yet available. These figures are added to the index one month later in the first revision (however, lately the figures for the net business formation have lagged two months). The preliminary coincident index is based on three of the four components (the figures for manufacturing and trade sales in 1972 dollars are added one month later in the first revision).

19. The content and method of constructing the composite indexes of cyclical indicators were altered in several aspects by the compiling agency in 1976. (See U.S. Department of Commerce, Bureau of Economic Analysis 1977, for more information.)

20. See Zarnowitz and Moore 1981.

21. The standard deviation of the irregular component of the leading index rate is 0.91 percent; the corresponding statistic for the coincident index rate is 1.00 percent.

22. During much of the 1973-1974 recession (through September 1974), the CPI rate continued on an upward course, largely reflecting the earlier "supply shocks" of sharp rises in prices of imported oil and other materials. Such a long and large increase in the inflation rate during a period of business contraction was then, and still is, unique in U.S. business cycle history.

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