By FRANK de LEEUW

Leading Indicators and the "Prime Mover" View

THE "prime mover" view of a country's economy holds that fluctuations in economic activity reflect, to an important extent, movements in certain fundamental forces. These forces, or prime movers, include monetary and fiscal policies, regulatory decisions, foreign economic developments, demographic shifts, new technologies, droughts or bumper crops, and a few others.

The prime mover view is a broad framework with many variants. Keynesians, monetarists, and supply-siders, for example, all use the framework, although they disagree sharply about the relative importance of various prime movers and about exactly how prime movers affect economic behavior. Some variant of the prime mover view implicitly underlies many statements before the economic committees of the Congress, reports to boards of directors on the economic outlook, projections of econometric models, and theories of business cycles.

If the prime mover view is valid, then measures of prime movers ought to make highly useful leading indicators of economic activity. Statistical measures of monetary and fiscal policies, foreign economic developments, and other prime movers ought to foreshadow overall economic changes, unless their impacts are extremely speedy or highly complex.

In fact, indexes of leading indicators use very few prime movers. The 11 components of the U.S. composite index of leading indicators include only 1—the deflated money supply. Indexes for other countries similarly have little representation of prime movers. Most indicators measure either (1) an **early stage** of a production sequence, such

as new orders or permits; (2) a dimension of activity that is **rapidly responsive** to changes in the economic environment, such as average weekly hours or profits; or (3) a market value that is highly **expectation sensitive**, such as stock prices or commodity prices.

It is possible to explain the good performance of these commonly used indicators by theories of the dynamic behavior of a cost-minimizing firm.[1] The prime mover view, however, is not at all inconsistent with these theories; it simply holds that prime movers are major underlying causes of changes, for example, in new orders or profits. If the prime mover view is valid, indicators that measure prime movers could provide even earlier clues to changes in economic activity than the variables that usually appear on lists of leading indicators.

Why, then, are prime movers largely absent from lists of leading indicators? Possibly the prime mover view, in spite of its popularity, is wrong or incomplete. Possibly statistical measures of prime movers have major shortcomings. Possibly there is some technical flaw in the method of selecting leading indicators.

This paper is in three major sections. The first section summarizes the composition of composite indexes of leading indicators for 21 countries, based on the work of the Organisation for Economic Co-operation and Development (OECD). The second section discusses eight possible reasons why prime movers seldom appear on lists of leading indicators. Some of the reasons, if true, are valid reasons why prime movers should be absent from such lists. Other reasons are defects in the way prime movers are measured. The discussion of these

reasons suggests remedies for these defects that might improve the performance of prime movers as leading indicators.

The third section reports on using some of these remedies to construct an experimental prime-mover-based leading index for the United States. The results from using the index suggest that there is substantial scope for improving the representation of prime movers in compilations of leading indicators.

The Composition of OECD Indexes of Leading Indicators

The OECD has identified leading indicators in many countries by using procedures similar to the ones developed in the United States. The results are useful for exploring the representation of prime movers among leading indicators. Table 1 shows, for each of 21 countries, the number of index components in each of 5 categories: Early stage indicators, rapidly responsive indicators, expectation-sensitive indicators, prime movers, and other indicators.

These categories, which represent different rationales for leads, are useful for understanding the underpinnings of leading indicators. For many indicators, however, placement in more than one category could be defended; the entries in the table represent primary classifications only. For this and other reasons, the table provides no more than rough indications of the importance of the five categories.

For the 21 countries as a whole, prime mover components include 18 money supply series, 8 export series, 8 terms of trade series, and 2 leading indexes for neighboring countries. These series represent only 20 percent of the

1. Frank de Leeuw, "Toward a Theory of Leading Indicators," in *Leading Economic Indicators: New Approaches and Forecasting Methods*, ed. Kajal Lahiri and Geoffrey Moore (Cambridge, United Kingdom: Cambridge University Press, 1989). Forthcoming.

total number of components.[2] Prime mover components are greatly outnumbered by components representing other rationales.

Reasons for the Low Representation of Prime Movers and Some Remedies

This section lists eight possible reasons why prime movers might fail to appear in compilations of leading indicators. Some reasons are problems relating to the theoretical connections between prime movers and economic activity; others are problems in the procedure for selecting leading indicators; still others are problems related to the adequacies of available time series.

For some of the problems, there are no easy remedies. For example, if no data are available for a prime mover, then it cannot be used as a leading indicator, short of the lengthy process of developing new data that cover a substantial time period. For some of the problems, there are easier remedies. For example, if the unexpected, but not the expected, movements in a prime mover influence economic activity, then it may be possible to extract an approximate measure of the unexpected movements from the measure of the prime mover.

1. Some prime movers may not influence economic activity

In part, this is a semantic problem. The definition of prime movers could be restricted to those forces that have a discernible impact on economic activity. Then there would be no such thing as a prime mover that does not influence economic activity.

Based on such a definition, however, we could never be sure whether a specific variable was a prime mover or not. Some empirical tests would indicate that it was a prime mover; others, that

Table 1.—Components of OECD Leading Indexes by Type of Rationale

[Number of indicators]

Country	Early stage indicators[1]	Rapidly responsive indicators[2]	Expectation-sensitive indicators[3]	Prime movers[4]	Other indicators[5]
Australia	2		3	2	1
Canada	2	4	2	2	2
France		1	3	2	
Germany, Federal Republic of	3	1	2	1	2
Italy	2	1	1	2	1
Japan		3	2	2	4
United Kingdom	1	3	2		4
United States	3		2	1	3
Austria	2		1	2	1
Belgium	2		2	1	2
Denmark	2		2	2	3
Finland	1	1	3	3	2
Greece	1		2	2	4
Ireland	1	2	1	2	3
Netherlands	2	1	2	3	3
Norway		2	3	3	3
Portugal	2	1		1	2
Spain	2	1	2		2
Sweden	3	2	1	2	4
Switzerland	1	1	2	2	1
Yugoslavia	1			1	2
Total:					
Number	33	24	38	36	49
Percent	18	13	21	20	27

1. Includes new orders (amounts and tendency surveys), unfilled orders, construction approvals and starts, new company formation, and vacancies.
2. Includes average hours, profits, inventory change and level (amounts and tendency surveys), and bottlenecks (tendency surveys).
3. Includes stock prices, changes in raw materials prices, tendency surveys of expected production and expectations about the economic situation.
4. Includes money, deposits, exports, terms of trade, and composite indexes for foreign countries.
5. Includes production series, retail sales, motor vehicle registrations, claims for unemployment insurance, layoffs and new hires, price indexes, unit labor costs, credit ratios, interest rates, foreign exchange holdings, foreign trade balances, surveys of stocks, and employment.

NOTE.—The OECD leading indexes are described in Organisation for Economic Co-operation and Development, *OECD Leading Indicators and Business Cycles in Member Countries, 1960–1985*, Sources and Methods No. 39, January 1987. The author classified the components of the leading indexes using information from this study.

it was not. A more useful definition of a prime mover, therefore, is any fundamental force that, according to a well-articulated theory, influences economic activity. Based on this definition—the one adopted in this paper—most experts will at least agree on a core list of potential prime movers, and empirical macroeconomists can concentrate on assessing the impact of specific prime movers.

During the 1960's and 1970's, empirical macroeconomists did attempt to assess two prime movers—monetary policy and fiscal policy—by conducting extensive empirical tests of the relation of GNP changes to measures of these two policies. Measures of monetary policy turned out to have a significant influence on economic activity in most of these tests, while measures of fiscal policy had a much more mixed record. Some participants in the debate concluded that fiscal policy is an unimportant prime mover. Other participants in the debate criticized the tests.[3]

During the 1970's, an important criticism was that economic activity

influences policy variables, in addition to being influenced by them (this criticism is discussed in point 2 below). More recently, some macroeconomists have emphasized the distinction between **expected** and **unexpected** changes in policy.[4] They would, presumably, criticize tests of the kind that were common 20 years ago on the grounds that expected changes in policy may have very little influence on economic activity, whereas unexpected changes in policy may have a substantial influence.

The expected-unexpected distinction suggests that policy variables might be absent from leading indicators, not because they contain no information about future economic activity, but because tests have not focused on the component of them that leads—the unexpected component. There is no fully satisfactory method of separating monetary or fiscal policy variables into expected and unexpected components, but there are crude methods that may do a serviceable job. Applying these crude methods might improve the performance of some prime movers as leading indicators.

2. Columbia University's Center for International Business Cycle Research, under Geoffrey Moore's leadership, publishes indexes of leading indicators each month for 10 industrial countries—the first 8 countries presented in table 1 plus Taiwan and Korea. Prime movers have even less representation in these indexes than in the OECD indexes; they account for only 3 percent of the total number of components. This low representation is not the result of testing and rejecting prime mover series, however; it is the result of initially selecting components for these indexes that replicated the components of the U.S. composite index, which includes only one prime mover series.

3. For a recent review of this debate, see Karl Brunner, "Fiscal Policy in Macro Theory: A Survey and Evaluation," in *The Monetary versus Fiscal Policy Debate*, ed. R.W. Hafer (Totowa, NJ: Rowman and Allanheid, 1986), 33–116; Alan S. Blinder, "Ruminations on Karl Brunner's Reflections," *Debate*, 117–126; and Robert J. Gordon, "Comment," *Debate*, 127–136.

4. Robert E. Lucas, Jr., "Econometric Policy Evaluation: A Critique," in *Carnegie-Rochester Series in Public Policy*, vol. 1, ed. K. Brunner and A.H. Meltzer (New York: North Holland, 1976), 19–46.

2. *Economic activity may influence the behavior of prime movers*

If a prime mover is itself influenced by economic activity, then it may not make a good leading indicator. For example, if policymakers varied tax rates so as to reduce, but not to eliminate, fluctuations in economic activity, then tax policy would tend to be expansionary when the economy is contracting and contractionary when the economy is expanding. Goldfeld and Blinder show that the estimated impact of such a policy may well be biased toward zero in regression tests.[5] The policy appears to have little impact because two-way interaction invalidates simple tests.

The possible dependence of prime movers on economic activity poses a major challenge to the prime mover view. If monetary policy, for example, could be explained largely as a sequence of predictable reactions to recent economic developments, then there would be no reason to think of monetary policy as different from consumption decisions, wage determination, or some other component of economic behavior. A leading index based on prime movers would have no special appeal.

In fact, monetary policy is surely more than simply a sequence of predictable reactions. The answer to the challenge that predictable policy reactions pose is to try to measure the **endogenous** component (the component influenced by current economic activity) of a prime mover and subtract it from the total. The remaining **exogenous** component—often referred to as the "innovation"—should be suitable for testing in conventional ways and for inclusion in a leading index.

A well-known example of this approach is the separation of Federal Government receipts and expenditures into a cyclical portion and a cyclically adjusted, or high-employment, portion. Separating endogenous responses from innovations, however, need not be restricted to policy variables. Any variable that is not a definitional identity may at times have important innovations. The search for prime movers should involve both removing endogenous influences from policy variables

and trying to detect innovations in other variables.[6]

3. *Prime movers may generate repeating cycles*

Theories of business cycles often leave open the possibility that a maintained shock to the economy—for example, a change in the rate of growth of the money supply—will produce continuing cycles in economic activity, rather than a single cycle or movement.[7] If economies actually behave in this way, then it may be difficult or impossible to relate a change in economic activity to its underlying prime mover cause, because the cause could have occurred many years ago.

Econometric models of the economy suggest that repeating cycles are not a serious problem. For the DRI model, Eckstein states that, in response to a typical disturbance, "the stock-flow adjustment processes do create a second cycle, but of much smaller magnitude, usually less than one-third as large as the original cycle."[8] Unpublished simulations of the BEA econometric model display similarly heavy damping.

4. *Binary comparisons may mask some indicators*

Standard procedures for selecting leading indicators rely totally on binary comparisons. Researchers classify each time series as leading, coincident, lagging, or unclassified by comparing its turning points with the turning points in aggregate activity. If the weighted sum, or the ratio, of two series makes an excellent indicator but each series separately does not, researchers would detect this fact only if they happen to define the sum, or the ratio, of the two series as a separate series to be tested.

It is possible that potential leading indicators—and especially prime movers—go undetected because of these procedures. It would hardly be surprising if monetary policy were the cause of some movements in economic activity, changing terms of trade were the cause of others, and tax policy were the cause of still others. If that were the case, it could easily happen that

these three prime movers individually would be "unclassified" using the standard procedures.

The solution to this problem is to use multivariate, rather than bivariate, analysis. Multiple regression is the best known, but not the only, multivariate technique available. It does not easily lend itself to the emphasis on turning points that has characterized leading indicator research, but that is not necessarily a drawback.

5. *Emphasis on turning points may mask some indicators*

Under standard procedures for selecting leading indicators, the central requirement for a series to be classified as leading is that it shows turning points that lead turning points in aggregate economic activity. Without this turning-point relationship, a series will not be classified as leading even if it provides an excellent indicator of future slowdowns or accelerations. Furthermore, with this turning-point relationship, a series is likely to be classified as leading even if it has other, "false" turning points.

This heavy emphasis on turning points in aggregate economic activity is controversial. Indicators of the strength of expansions or contractions as well as of turning points would surely be useful. The emphasis on turning points probably stems from the limitations of time-series techniques that were available 40 years ago, limitations that modern time-series analysis and computers have largely overcome.

This emphasis on turning points may not be more relevant to prime movers than to other indicators. Whether it is or not, experimentation with other procedures—for example, multiple regression—seems worth pursuing.

6. *Some prime movers may be reflected in other leading indicators*

The classification of leading indicators into prime movers and other categories is crude, as has been noted. It is possible that the low representation of prime movers in lists of leading indicators is partly a matter of misclassification.

Concretely, some of the movements in early-stage variables may reflect changes in prime movers. New orders for equipment or for durable goods, for example, include new orders for exports and new orders for government

5. Stephen M. Goldfeld and Alan S. Blinder, "Some Implications of Endogenous Stabilization Policy," *Brookings Papers on Economic Activity* 3 (1972): 597–613.

6. For an influential development of these ideas, see Christopher A. Sims, "Macroeconomics and Reality," *Econometrica* 48 (January 1980): 1–49.

7. See R.G.D. Allen, *Mathematical Economics*, 2nd ed., chs. 7 and 8 (New York: Macmillan Co., 1960).

8. Otto Eckstein, *The DRI Model of the U.S. Economy* (New York: McGraw-Hill, 1983), 51–52.

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purchase. Construction permits or contracts may also include construction for government use—even when (as in the United States) they exclude construction that government agencies themselves undertake.

7. Data for some prime movers may not be available by month

Potentially useful leading indicators may be missed because data for them are not available or because they are available only for years or quarters. With few exceptions, candidates for leading indicator indexes have had to meet the requirement of availability for each month. Government-sector indicators—to cite one example of this problem—may be missed because most countries publish government-sector variables in detail only by quarter.

This study does not restrict itself to monthly series, because its purpose is to explore new ideas rather than to produce a monthly indicator. Accordingly, the empirical section of the study uses quarterly, rather than monthly, data. For quarterly series that appear to be useful leading indicators, it may be possible to devise serviceable monthly series by using available monthly indicators together with interpolation techniques.

8. Data for some prime movers may measure late stages in a production cycle

A final possibility is that the available data for some prime movers may measure changes in production or demand at late stages, long after the impact on economic activity has begun. If measures of early stages of production or demand were available for these prime movers, they might be classified as leading indicators; however, measures may be available only for a stage at which the lead has disappeared.

In the United States, for example, the national income and product accounts (NIPA's) measure Federal Government purchases of goods at the time of delivery. For goods with a long production period, orders and progress payments have been influencing markets for some time before the purchases appear in the NIPA's. A desirable solution would be to develop measures of these prime movers at earlier stages of the order-production-payment process.

A summary of proposed remedies

To conclude this section, it is useful to summarize the remedies that could overcome some (but not all) of the problems that underlie the failure of prime movers to be represented in indexes of leading indicators. The number in parentheses following each remedy refers to the reason, in the preceding listing, under which the remedy is discussed.

- Separate the changes in a prime mover into expected and unexpected components (1);
- Separate the changes in a prime mover into exogenous (innovations) and endogenous components (2);
- Use multivariate comparisons in selecting indicators (4, 5);
- Use quarterly data when monthly data are unavailable (7); and
- Develop measures of prime movers at early stages of the order-production-payment process (8).

A Prime-Mover-Based Leading Index

This section will show how using some of the proposed remedies can improve the performance of prime movers as leading indicators. The section begins with a list of some widely used prime movers. Because many of these prime movers initially affect current-dollar income, the section then discusses how to relate them to fluctuations in real activity. Next, it describes the application of some of the remedies to the variables representing prime movers. The section concludes by presenting a tentative, quarterly leading index based on prime movers.

Some prime movers

Monetary and fiscal policies are the prime movers that have received the most attention. There are three competing time series used to represent monetary policy: The monetary base, or currency plus reserves adjusted for reserve requirement changes; M1, or currency plus checkable deposits; and M2, or M1 plus small-denomination time and savings deposits and certain other highly negotiable assets. The preliminary empirical work in this study tested each of these three series. Because M2 consistently gave better

results than the others, the equation reported later in this section uses M2.

For fiscal policy, the familiar problem of the dependence of Government receipts, expenditures, and debt on current economic activity has an equally familiar solution—the deduction of estimated cyclical effects from the actual figures. The study therefore utilized BEA's cyclically adjusted Federal expenditures, receipts, and debt.[9] The equation reported later in this section uses only cyclically adjusted expenditures, because that is the only one of the three measures that yielded statistically significant results.

The study also tested a measure of defense activity at an early stage relative to activity at a later stage. The measure—new orders for defense products relative to shipments of defense products—is available beginning in 1968. Even after various methods of smoothing, it did not prove significant in any regression tests, and it is not discussed further.

To represent the impact of foreign economic developments on the U.S. economy, preliminary work utilized both transactions measures and price measures. The transactions measures were total U.S. exports, exports of goods, and exports of services. The price measures were the ratio of a crude petroleum price index to the U.S. producer price index and the ratio of a fixed-weighted price index for imports relative to one for GNP. Two of these proved statistically related to economic activity: Total exports and the relative price of imports.

For various reasons, the preliminary work did not include any other prime movers. One candidate, regulatory decisions, is difficult to capture in one or two time series. Two others, major strikes and farm supply shocks, rarely affect aggregate activity and probably do so with very short lags. As for demographic shifts and technological change, it is at least plausible to suppose that they affect longrun growth more than shortrun fluctuations—but this proposition is a matter of controversy among macroeconomists. More careful and complete empirical work should certainly test these, and perhaps other, prime movers.

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9. Estimates based on a middle-expansion GNP trend were used through the second quarter of 1974. Estimates based on a GNP trend corresponding to a 6-percent unemployment rate—the only estimates published currently—were used starting in the third quarter of 1974, a quarter in which the middle-expansion unemployment rate trend was 6 percent.

Nominal income and real activity

A number of prime movers—for example, monetary aggregates, Federal expenditures, and exports—have their initial impact on nominal, or current-dollar, income. Because the focus of this study is on real economic activity, it is necessary to transform these prime movers into indicators of real activity.

One approach is to deflate them using a broadly based price index. That is the way the official U.S. index of leading indicators handles its one prime mover component—the deflated money supply (M2). The obvious way to convert a nominal variable to a real one is to deflate it; however, applying deflation to a nominal leading indicator implies that price changes affect real economic activity with the same time pattern as changes in the nominal prime mover, but with the opposite sign. There is, unfortunately, no reason to expect such symmetry.

A less restrictive, and therefore preferable, approach to the relation between nominal and real activity begins with the assumption that the excess of actual inflation above some normal or expected level is related to the recent gap between actual output and trend, or potential, output.

The mathematical representation of this assumption is

$$(1) \quad DP = DP^e + a(Y-Y^t)_l,$$

where DP is the actual inflation rate; DP^e is the expected inflation rate, often represented by lagged actual inflation rates; $Y-Y^t$ is actual minus trend output; and the subscript l indicates a recent time period or periods. The rate of change of nominal income, by definition, is equal to the sum of rates of change of prices and of real income:

$$(2) \quad DY\$ = DP + DY,$$

where $DY\$$ and DY are rates of change of nominal and real income, respectively.

Solving for DY gives

$$(3) \quad DY = DY\$ - DP^e - a(Y-Y^t)_l.$$

Equation (3) suggests a relationship between the growth of real income and three sets of variables: (i) Those that influence nominal income change ($DY\$$), (ii) the expected inflation rate (DP^e), and (iii) recent actual output minus trend output ($Y-Y^t$). Incorporating variables (ii) and (iii) in a multivariate

analysis is a more satisfactory way of dealing with nominal-real interaction than simply deflating nominal prime movers.

The preliminary empirical work, therefore, utilized multiple regressions of the general form

$$(4) \quad DY = b_1 DPM1_{l1} + b_2 DPM2_{l2} + \cdots + b_3 DP_{l3} + b_4(Y-Y^t)_{l4},$$

where DY is the growth rate of real GNP, $DPM1_{l1}$ and $DPM2_{l2}$ represent lagged values of rates of change in prime movers transformed in appropriate ways, DP_{l3} represents lagged values of rates of change in a general price index, and $(Y-Y^t)_{l4}$ represents lagged values of actual minus trend output.

Applying some of the remedies

Two of the remedies proposed for improving the performance of prime movers as leading indicators are using multivariate, rather than bivariate, analysis and using quarterly data where monthly data are not available. The empirical work in this study implements these remedies by using multiple regression analysis of quarterly (seasonally adjusted) data.

Another remedy is separating changes in a prime mover into expected and unexpected components. The present study used, as a simple expedient, second differences as a proxy for unexpected changes. For monetary aggregates, actual changes consistently gave better results than any more complex transformations; however, for the other prime movers, second differences gave significant results, while actual changes or actual changes less second differences did not.

Two other remedies are separating the changes in a prime mover into exogenous and endogenous components and developing a measure of a prime mover at an early stage of the order-production-payment process. To separate exogenous from endogenous components, the study used cyclically adjusted, rather than actual, Federal receipts and expenditures. To measure prime movers at early stages, the study tested (unsuccessfully) ratios of orders to shipments for defense products.

This summary of remedies should make clear that this study has not exhausted the possibilities. The results are nevertheless promising enough to suggest that prime movers may be strong candidates for an improved

leading index. Further work is clearly feasible and could have a substantial payoff.

Developing a prime-mover-based leading index

This study reports only the final equation used to develop a prime-mover-based leading index. A number of alternative equations gave roughly similar, but not quite as close-fitting, results. For this preliminary exploration, it does not seem useful to report these equations.

The best fitting equation of those tested is

$$(5) \quad DY =$$
$$0.0046 + 0.517 DM2_3 +$$
$$(2.2) \qquad (4.4)$$

$$0.229 DDCAE_3 + 0.091 DDEXP_3 -$$
$$(2.8) \qquad\qquad (2.0)$$

$$0.300 DDPREL_3 - 0.781 DPY_6 -$$
$$(-2.2) \qquad\qquad (-5.5)$$

$$0.045 GAP_6$$
$$(-1.6)$$

period of fit: 1953:I–1986:IV
$$R^2 = 0.301, D-W = 1.9.$$

The numbers in parentheses are t-ratios. The subscript 3 refers to averages of values for quarters $t-1$, $t-2$, and $t-3$. The subscript 6 refers to averages of values for quarters $t-1$ through $t-6$. Other averages did not fit as well as these three- and six-quarter averages. See the box for definitions and sources for the variables.

Equation (5) has several notable features. Its coefficients and significance levels are higher for the money and inflation variables, $DM2$ and DPY, than for the other variables. This result is consistent with many of the equations testing the relation of GNP to monetary and fiscal policies in the 1960's and 1970's. Unlike many of those equations, however, the coefficient of M2 in equation (5) is far below 1.0—perhaps because of the velocity changes in the 1980's.

The value of R^2 is low, perhaps because prime movers do not affect many of the forces that cause quarter-to-quarter changes in GNP growth rates

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CHART 2

An Index of Prime Movers Compared With the U.S. Composite Indexes of Leading and Coincident Indicators
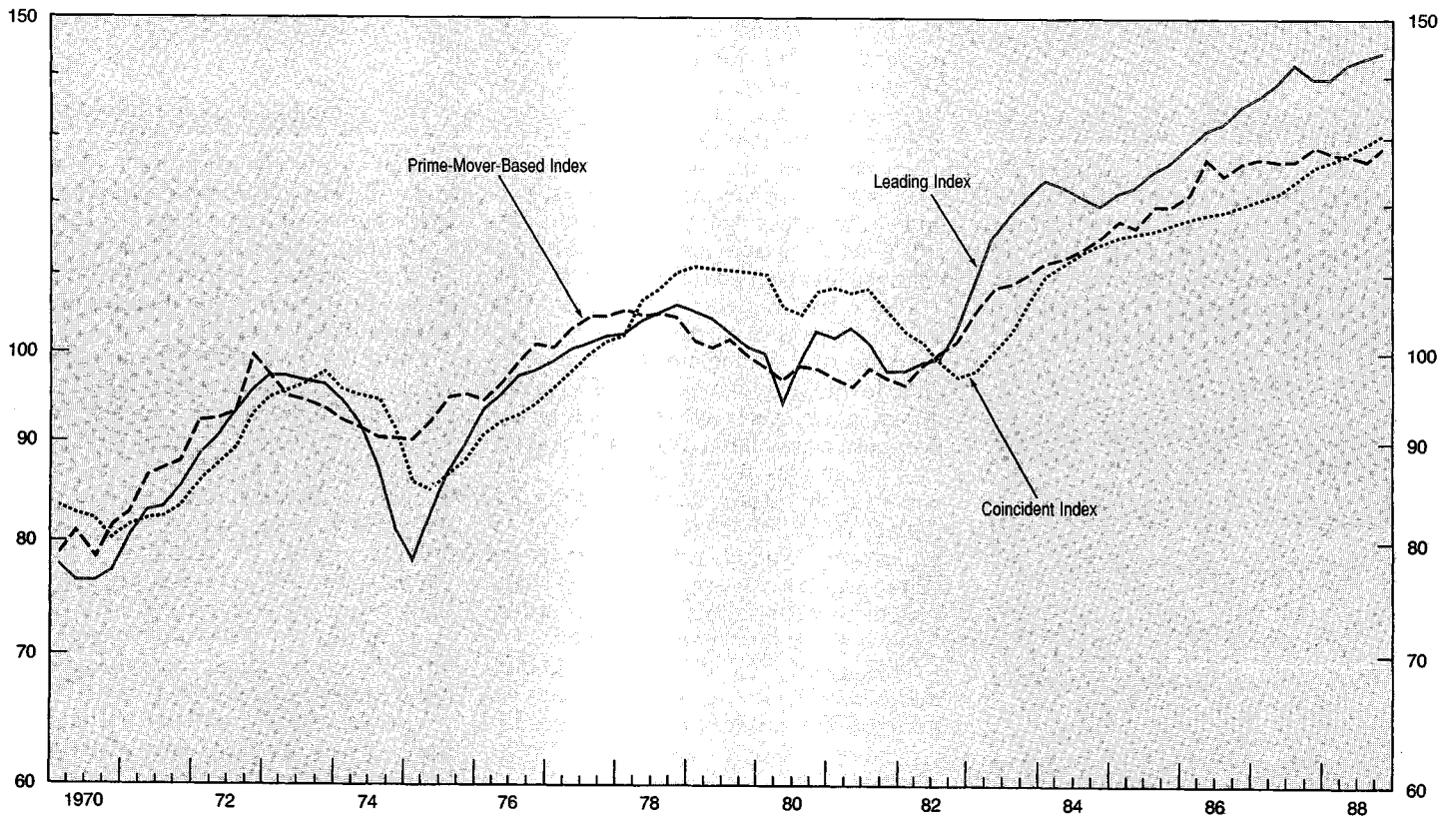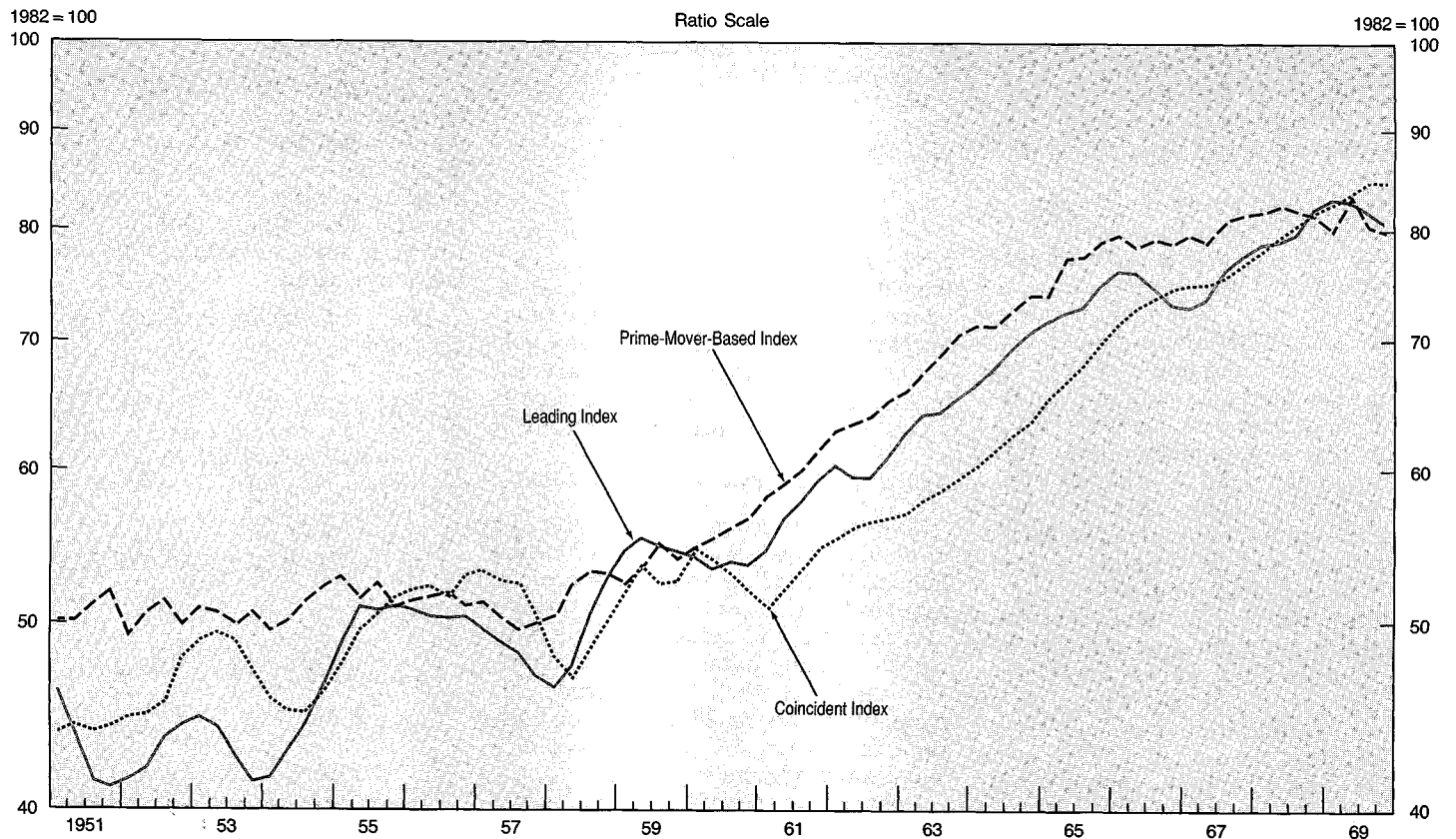
U.S. Department of Commerce, Bureau of Economic Analysis

Definitions and Sources for the Variables in Equation (5)

Variable	Definition	Source
DY	Change in the natural log of real GNP	BEA, table 1.2
DM2	Change in the natural log of M2	Federal Reserve Board, 1959–88; BEA, pre-1959
DDCAE	Second difference in the natural log of cyclically adjusted Federal expenditures.	BEA, March 1986 and March 1988 SURVEY OF CURRENT BUSINESS; pre-1955, author
DDEXP	Second difference in the natural log of U.S. exports, national accounts basis.	BEA, table 4.1
DDPREL	Second difference in the natural log of an index of relative import prices.	BEA, table 7.1, ratio of import prices to GNP prices
DPY	Change in the natural log of the fixed-weighted price index for GNP.	BEA, table 7.1
GAP	Natural log of real GNP less natural log of trend GNP.	BEA, table 1.2 and sources for DDCAE

NOTE.—References are to national income and product accounts tables published in the SURVEY OF CURRENT BUSINESS and its supplements, unless otherwise indicated.

The performance of the prime-mover-based leading index

Chart 2 compares the prime-mover-based index and the official U.S. composite leading and coincident indexes. The following are some of the more noteworthy features of the chart:

- The prime-mover-based index, like the leading index, unquestionably leads the coincident index;
- The average lead of the prime-mover-based index is at least as long as that of the leading index;
- The prime-mover-based index does not have the pronounced false leads that the leading index displays in 1967 and 1984; and
- The prime-mover-based index has more irregular quarter-to-quarter swings than do the composite indexes.

(including measurement errors). Serial correlation of the residuals from the equation, however, is not a problem; this suggests that the equation may be a better guide to changes over several quarters than to changes from one quarter to the next.

Predicted values from equation (5) form the basis for a prime-mover-based leading index. There are three main differences between the predicted values and the desired index. First, the measure of economic activity—real GNP—used in equation (5) differs in level and in amplitude of change from the indexes of leading and coincident indicators with which it is desirable to compare the new prime-mover-based index. Second, the predicted values refer to quarterly changes, whereas a leading index should refer to levels. Third, the predicted values are based on distributed lags of the explanatory variables, whereas a leading index uses current values of those variables.

Because of these differences, a prime-mover-based index requires transformation of the predicted values from equation (5). The equation of transformation is

$$(6) \quad PMI_t = PMI_{t-1} \times Exp\{4.0 DYPRED_t + 0.003\} ,$$

where PMI_t is the index for quarter t, PMI_{t-1} is the index for quarter $t-1$, Exp denotes exponentiation, and $DYPRED_t$ is the predicted value from equation (5) based on current rather than lagged values for all variables.

The two coefficients in equation (6) are the result of trial and error. They were set so as to match, approximately, the cyclical amplitude and average growth rate of the official U.S. leading index. The first coefficient (4.0) mainly affects cyclical amplitude, and the second coefficient (0.003) mainly affects average growth rate.

In conclusion, it is important to reiterate the tentative character of the prime-mover-based index. The index fails to implement a number of suggestions that may prove useful—for example, the representation of other prime movers and alternative techniques for trying to measure expected and unexpected, or endogenous and exogenous, components of prime movers. Chart 2 is based entirely on the latest revised estimates of all variables, and it includes only a few years outside of the period of fit of equation (5). It would not be at all surprising for the forecasting performance of equation (5) to be worse than its performance in the bottom panel of chart 2.

In spite of these shortcomings, the new index and the work leading up to it strongly suggest that much can be done to improve the representation of prime movers in indexes of leading indicators. In any attempt to bring economic theories and leading indicators closer together, further investigation of prime movers should play a major role.