Economics Program Working Paper Series

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Robert H. McGuckin
Ataman Ozyildirim

The Conference Board
June 2003

EPWP #03 - 04

THE CONFERENCE BOARD

Economics Program
845 Third Avenue
New York, NY 10022-6679
Tel. 212-759-0900
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Real-Time Tests of the Leading Economic Index: Do Changes in the Index Composition Matter?

Robert H. McGuckin and Ataman Ozyildirim†

Paper Prepared for Conference in Honor of Victor Zarnowitz

Organized by CIRET at RWI in Essen, FRG

June 27-28, 2003

Abstract

This paper reports real-time out-of-sample tests of the ability of the U.S. Index of Leading Economic Indicators (LEI) to forecast the economy using "composition-changing" or "as-published" versions of the LEI. It is an extension of recent work that focused on forecasts with a "composition-constant" LEI. The results demonstrate that the LEI helps forecasts and that compositional change in the LEI does not account for poor real-time out-of-sample forecast performance found in earlier work. Reviews of the historical record reinforce the findings.

Keywords: business cycle, indicators, leading index, times series, forecasting

JEL Classification: E32, C52, C53, C22

† We would like to thank Victor Zarnowitz for valuable comments and suggestions and for his inspiration that led us to study indicator approaches to business cycle analysis and forecasting. We would also like to thank Joey Bortfeld for excellent research assistance. All remaining errors are, of course, ours. The views expressed in this paper are those of the author(s) and do not necessarily represent those of The Conference Board. McGuckin: (212) 339-0303, robert.mcguckin@conference-board.org. Ozyildirim: (212) 339-0399, a.ozyildirim@conference-board.org.

1 Introduction

In an important paper, Diebold and Rudebusch (1991) find that the U.S. Index of Leading Economic Indicators (LEI) doesn't predict industrial production in real time out-of-sample tests. They find the opposite true for a post revision historical version of the index. Diebold and Rudebusch (1991) suggest that changes in composition of the LEI are the likely cause of its success in historical tests and its poor performance in out-of-sample real-time tests. They speculate that one reason the LEI fails as a forecast tool in real-time is that its components are chosen for their fit to historical changes in measures of economic activity. From this one might draw the implication that the components of the leading index are ad hoc in the sense they are chosen with an eye to improving in-sample forecasts of the aggregate economy and business cycle turning points. Thus, many have concluded that although the LEI fits historical description of the U.S. business cycles, its ability to track the economy on a current basis is absent or limited at best.

In sharp contrast, recent work (McGuckin, Ozyildirim and Zarnowitz (2003)) shows that the leading index improves real-time out-of-sample forecasts beyond what would obtain from a forecast based simply on an autoregressive model of the forecasted variable. This analysis differs from the Diebold and Rudebusch work in two substantive ways. First, the basic forecasting model involves predictions of short-term growth rates rather than monthly levels and first differences.

Second, unlike Diebold and Rudebusch, they conduct their analysis holding the composition of the LEI constant over the sample. Using real-time data for each of the ten components in the current set of leading indicators (see Business Cycle Indicators Handbook, 2001), puts the indexes on a strictly consistent and comparable basis over time. This procedure is appropriate when the purpose is, as it was in that research, to evaluate the gains from a new procedure designed to make the leading index timelier (i.e. more current). But constant-composition versions of the LEI have the disadvantage of being a reconstruction of history and this is not in the spirit of most real-time tests.

This paper examines composition changes in the LEI and their effects on the predictive ability of the leading index using the modeling framework from McGuckin, Ozyildirim and Zarnowitz (2003). Accordingly, we review the literature on how and why components of the LEI are chosen and changed and undertake an empirical analysis to compare forecasts using constant composition and changing composition (or “as–published”) vintages of the leading index focusing on periods when the index compositions were changed.

Drawing on early work by Zarnowitz (1992), recent work by Klein (1999a,b), and personal experience, we find little evidence that composition changes in the LEI are associated with ad hoc data fitting exercises. In fact, data availability, deteriorating data quality, and new research findings reflecting structural and policy changes appear to be the key factors involved in choosing indicators. Indeed, the composition of the LEI in terms of economics concepts or areas covered has remained fairly constant throughout its long history. Nonetheless, it is also true that indicator series are classified into those that lead, lag and are coincident with economic activity based largely on past performance in addition to economic theory. Thus, it is impossible to completely rule out the "correlation" hypothesis from the historical evidence.[1]

The available data also allow us to examine the historical record for the published LEI, which is based on different sets of indicators. This is what Diebold and Rudebusch did and we expand the analysis to 2002 using the same forecast models used in our earlier constant-composition work with Victor Zarnowitz. In contrast to our earlier work, allowing the composition to change provides a more direct real-time test of the indicators. We isolate the effect of changing composition on the forecasts by comparing the predictive ability of models using constant-composition LEI with those using changing-composition LEI.

While our approach involves different models than used by Diebold and Rudebusch (1991), the tests are more in the spirit of the indicator approach. Rather than estimating levels of industrial production from an autoregressive model with LEI terms appended, the tests are formulated in terms of growth in the LEI and the target variable, growth in an index of current economic conditions (the U.S. Index of Coincident Economic Indicators or current conditions index, CCI).

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[1] Note that the methodology by which the component indicators are aggregated into the composite index of leading indicators has generally remained constant over time, only undergoing occasional and minor modifications.

The CCI is a broader monthly measure of economic activity and of current economic conditions than IP (which it includes); it is more closely related to GDP than industrial production, and is what the LEI was designed to lead. Following the constant-composition work, we forecast 1, 3, and 6 months ahead, although we prefer forecasts of 3 and 6 months ahead, which is the range used by most practitioners who use indicators as a forecasting tool.

We find that the leading index significantly improves forecasts across a broad range of models and the gains are observed even when the composition of the index is allowed to change. Moreover, the pattern of the errors in our forecast models suggests, consistent with the experience of most practitioners, that the leading economic indexes are best used to predict the future direction of economic activity in combination with other related indexes such as a diffusion index. This is quite consistent with the results of Filardo (2002) who finds the LEI has predictive power in a model that uses a particular and often quoted rule to determine when the LEI signals a recession and a recovery. Extending this work to an "optimum" forecasting scheme will be the next step in our research program.

The paper is organized as follows. Section Two describes the method of constructing a composite leading index, and sets out its rationale. This section also discusses the coincident or current conditions index (CCI), which the leading index (LEI) is designed to predict, and how and why the composition of the indexes is changed.

Section Three describes the structure of the underlying data and the testing methodology. The purpose of the tests is to see how well the leading index predicts CCI across a wide range of forecast exercises. The equations or models and the procedures designed for testing the performance of the LEI are presented and discussed. The tests compare the historical leading index defined as the leading index calculated with the latest revised data (in pseudo real-time forecasting exercises), with "as-published" and "constant-composition." vintages of the leading indexes, in real-time out-of-sample forecasts:

Section Four reports our findings and Section Five offers discussion and places the results in the context of some other related findings in the literature. A concluding comment is in Section Six.

2. Construction of the Composite Leading and Coincident Index[2]

The leading index is widely used as a tool to forecast changes in the direction of aggregate economic activity and in particular business cycle turning points. The reference chronologies of the latter are determined historically by the National Bureau of Economic Research (NBER). In this task, NBER relies to a large extent on four principal coincident indicators: non-farm establishment employment, real personal income less transfers, real manufacturing and trade sales, and industrial production (IP). These same four indicators make up The Conference Board's Index of Coincident Economic Indicators or the current conditions index (CCI). Business cycle peaks and troughs are well approximated by the dates of peaks and troughs in the CCI.

2.1 The Coincident Index as a Measure of Current Economic Conditions

As illustrated in Chart 1, there is a very close correspondence between the timing of CCI and the chronology of U.S. expansions and contractions. Chart 1 also demonstrates that CCI and real GDP, which is the most comprehensive measure of U.S. output, are very closely associated. (Simple correlation between the two is 0.997 in levels and 0.804 in quarterly growth rates.) While highly correlated with real GDP, CCI has several advantages over GDP as a target measure for testing the new composite leading economic index.

One advantage of the CCI is that, unlike GDP, which is only available quarterly, it is available monthly.[3] Another advantage of CCI is that as an index it includes both the output and income side of the circular flow. While in equilibrium these should equal, in practice they can move in different directions during cyclical events. The four components of CCI, together, cover all economic activities that are important for business cycle analysis: Two series represent

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[2] The indicator approach is just one of many approaches to business cycle analysis. Introduced first by Mitchell and Burns (1938), it has been a major component of the NBER business cycle program and has proved useful over the years.

[3] Tests of how well LEI predicts GDP must first solve the problem of how to transform the two series to common frequencies. One would like to take advantage of the fact that the leading indicators are monthly, but interpolations of quarterly to monthly real GDP can affect the results, and not always harmlessly. In the absence of a reliable monthly GDP, we would prefer to work with quarterly LEI, although this transformation necessitates a considerable loss of information and is also not necessarily innocuous. Still, tests with GDP were supportive of the efficacy of the LEI approach in McGuckin, Ozyildirim and Zarnowitz (2003).

the production or output side of the circular flow, IP and manufacturing and trade sales, and two series represent the income or input side, non-farm employment and personal income.

Moreover, GDP is subject to long strings of revisions, which are often large; CCI is revised less, partly because the revisions of its components frequently offset each other. The linkage to the cyclical turning points is closer for CCI than GDP (see Zarnowitz, 2001).

The problems with using quarterly GDP are among the main reasons why many studies use IP as the target variable. But IP is only one of the components of CCI, and it directly covers a relatively small and declining part of the economy (manufacturing, mining, and electric and gas utilities).[4] Nevertheless, in our earlier work we reported, in addition to the results for CCI, tests based on the industrial production index. This provided a benchmark of the results for critics who argue that the leading index does not do well when based on real-time data. We see no need to repeat these tests here and we take the CCI as the measure of aggregate economy to be forecasted.

2.2 Construction of the Leading Economic Index

There is much variation among business cycles in duration and magnitude, causes and consequences. The contributions of specific factors differ over time. This helps to explain why composite indexes generally work better over time than do their individual components (different indicators selected for the best past performance). The leading index, for example, represents better the multi-causal, multi-factor nature of economic movements than does each of its components: the average workweek, initial claims for unemployment insurance, new investment commitments (orders, contracts, housing permits), real money supply, yield spread, stock prices, and consumer expectations. Chart 2 shows that the LEI leads the CCI at all business cycle peaks and troughs since 1959.

The monthly change in the LEI is the sum of the contributions from each component. As such, the index summarizes the cyclical movements of its various components.[5] The contributions of the individual components vary over time, depending on the characteristics of

[4] Since much of the output covered in IP is production of intermediate goods, the breadth of its coverage is wider than indicated by the industries included in this index.
[5] The component contributions are standardized to have equal volatility so that more volatile components do not influence the index disproportionately.

each cycle. The leading series themselves vary in timing, smoothness, currency, etc. The index gains from this diversification.[6]

2.3 Reasons for Changes in the Composition of the Indexes

The long history of the leading and coincident indexes has been punctuated from time to time by changes in the composition of these indexes and some of their technical properties. The reasons for these alterations lie mostly in changes in the availability and statistical quality of the underlying time series and occasionally in advances of the research on business cycles and the indicators. We find no support for the notion that changes in composition were made ex-post to increase the correlation with measures of aggregate economic activity.

The first list of leading indicators dates back to Mitchell and Burns (1938). This original list later underwent major revisions six times; these revisions are documented in Moore (1950), Moore (1961), Moore and Shiskin (1967), Zarnowitz and Boschan (1975), Hertzberg and Beckman (1989), and The Conference Board (2001). The U.S. Commerce Department also made other changes on a smaller scale from time to time such as the removal of a component in 1987.

The majority of these revisions in the components reflect improvements in the quality of statistics available at the time.[7] As new series of higher quality (better timeliness, more coverage, better statistical adequacy etc.) that measured the same concepts as an existing series became available, they were substituted for the original series. On a few occasions, series have been discontinued by the source agency and, unless good substitutes were available, they have been dropped from the list (e.g. index of net business formation discontinued in the 1970s). There are also occasional efforts to improve the index by removing or replacing a component that became unduly volatile or otherwise deteriorated. A good example is the index of sensitive materials prices that was included in LEI prior to the 1996 revision by The Conference Board.

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[6] Technical problems arise from this diversity and are discussed in our earlier work. (See McGuckin, Ozyildirim and Zarnowitz (2003)) In that paper we dealt intensively with procedures to make the LEI timelier. Here we do not use the timelier procedures, which are now a regular part of The Conference Board's Program. Rather all tests are done on a basis consistent with historical practice. That is, monthly indicators used in tests are consistent with published versions of the LEI.

[7] For comprehensive information on the structure and evolution of cyclical indicators and composite indexes, see Klein (1999a, b) and Zarnowitz (1992) chapters 10 and 11.

Producers of cyclical indicators must be sensitive to the effects of real changes in the economy's structure, institutions, and policies. Thus, new series have been added when accumulating evidence suggested strong cyclical performance ahead of recessions. A good example is the addition of real money supply to LEI in the 1973-75 review and benchmarking. Another is the addition of the yield spread by The Conference Board in 1996. This reflected research on the usefulness of this variable in forecasting and the recognition of the growing importance of Fed policy operations that worked through changes in short-term interest rates.

Yet, according to those involved in the operations, the NBER and the U.S. Bureau of Economic Analysis (BEA) conducted no formal fitting exercises to improve forecasting with LEI. During the last review of the composite indexes in 1996, The Conference Board compared the new indexes constructed in 1996 10 components with those using the 11 indicators they inherited from the Bureau of Economic Analysis.[8] The Conference Board also examined the relationships of the leading index with the coincident index and GDP on a historical basis. But the focus of these examinations was more on turning points and false signals – times when the LEI indicated a recession and only a slowdown materialized. In fact, the new and old indexes did not show any material differences with respect to NBER recession dates.[9]

Our experience indicates that the increased importance of monetary policy, the deterioration of the sensitive prices series, various adjustments to components of individual series by the statistical agencies, new and better series covering the same concept, and consistency with turning points are the key factors in the change. Nonetheless, while there is no evidence that fitting exercises were a key factor in the adoption of the new components, the new list of components did eliminate two false signals in the index. Surely, this would tend to improve the historical fit in the sense that movements in the LEI would more closely correlate with growth in GDP and the CCI, which are highly correlated themselves. Moreover, since new indicators are often closely related to the series they replace, the possibility of selection bias and overfitting issues cannot be dismissed out of hand. (See Sims (1994) where he makes this point in a review of Zarnowitz (1992). Thus, a key issue remains, does the LEI improve forecasts and how does it work in real-time out-of-sample tests?

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[8] See the discussion in the Handbook of Business Cycle Indicators (2001) at pages 58-60.

[9] The new index has shorter leads at the 1969, 1981, 1990 business cycle peaks, but longer leads at the 1961, 1970, 1975, and 1980 business cycle troughs. For the six recessions since 1959, the average lead at peaks fell from 12 to 9

3. Testing Methodology and Data

In order to assess the effect of composition changes on the ability of the LEI to forecast movements in the economy in real time we construct a series of forecasts using the same forecast model but different versions of the LEI. In all cases we use the following standard for our tests: LEI should improve on simple autoregressive forecasts for the monthly measure of aggregate activity, CCI.

Forecast regressions all have the same structure for each vintage of the data and version or composition of the LEI. The sequence of out of sample forecast errors from these regressions are summarized by an estimate of the mean square error (MSE)[10] based on differences between the forecast and the historical values of the corresponding actual growth rates in the target economy-wide aggregate. This procedure is repeated for a series of forecasting exercises that vary the forecast horizons (1,3, 6 months-ahead), spans over which growth is measured in the estimating equation (1,3,6, 9 months) and lags of the forecast variables (1,3, 6, 9).

The analysis involves two steps. We begin by replicating tests that use the LEI as published. This is what Diebold and Rudebusch (1991) did and we simply expand the period of examination to cover the last two recessions.

Second, we undertake forecasts with constant-composition LEIs for the 1989-2002 period using the latest composition introduced in 1996. We also develop constant composition forecasts for the same period but using the pre-1996 or 1989 composition. While one might like to look at additional compositions, this sample is sufficient for our purposes. As a practical matter, this is the only such comparison that is permitted by the (currently) available data.

Therefore, we undertake forecasting exercises for two subperiods during the 1989 to 2002 period, 1989-1996 and 1996-2002. The overall period includes two recessions and two very different LEI compositions. By directly comparing the historical and real–time forecasts of the composition-constant and the composition-varying indexes in these subperiods we are able to

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months and the average lead at troughs rose from 3 to 4 months. Differences in lead times of 1-2 months are generally considered insignificant if they appear to be random.

[10] $MSE = \frac{\sum_{t=1}^{n} e_t^2}{n}$, where n is the number of out of sample forecasts. Because e_t^2 are very small, we report MSEx10^5 in the tables.

control all factors --methodology, timing, etc. – that could affect forecast performance. This allows us to isolate the effect of the composition change in the LEI in 1996 and provides an indication of how well the older composition "works" in forecasts after 1996.

It also provides a comparison of the historical and real-time forecasts prior to the change in composition. If the effect of the change in composition was to improve the historical (ex-post fit) to the data, this should manifest itself in improved forecasts with the historical data. While one might argue that the gains would necessarily show up only for in-sample fitting exercises, the test we propose is in the spirit of the conjectures about the ad hoc adjustments that arise from the Diebold and Rudebusch results.

If the primary motivations for the composition change involved changing structure and better data and they were justified, then the composite index should better reflect the structure of the economy and be composed of better quality indicators. In turn, the real–time forecasts should improve. Again, there is a caveat since revisions to the data could offset real-time improvements in practice. In fact, there have been substantial revisions in many statistical series in the post-1996 period. This makes the real-time tests harder to pass. But in light of the composition constant, real-time, out-of-sample findings described earlier, we don't expect such data revisions to offset the improved index entirely.

3.1 Real-Time Data

This study extends to 2002 the vintages of as-published LEI collected by Diebold and Rudebusch initially for 1968-1988. The data available in December 1968 are called the "December 1968 vintage" and consist of a monthly sample covering the period January 1959 to October 1968. Each consecutive monthly vintage adds the next month's observation. Thus, the next vintage consists of the comparable data available in January 1969, covering the sample period January 1959 to November 1968, and so on, through August 2002, which is reported in the October 2002 vintage. Hence, there are 407 vintages of the as-published LEI in our dataset, each vintage starting in January 1959.

Each of the 407 vintages provides data for a forecast of the monthly change in CCI (or IP). The first out-of-sample forecast is for November 1968; the last is for September 2002. Thus, the sample period provides a series of 407 estimated regressions for each forecast model.

Each estimated model is based on observations starting in January 1959 and ending in the following successive months: October 1968, November1968,..., August 2002.[11]

In addition, constant-composition LEI vintages for 1989-2002 were reconstructed from business cycle indicators data which were first electronically archived in 1989 by the former Statistical Indicators Division of the U.S. Department of Commerce and later, since 1995, by The Conference Board. The data are organized the same way as the as-published vintages of LEI. There are 165 vintages from January 1989 to October 2002 and 165 corresponding sets of data that are used to create 165 series of the LEI, each starting in January 1959 and each using the 1996 composition of the LEI.[12] We also created another set of 165 series of the LEI, each starting in January 1959, but using the 1989 composition of the LEI.

We use real-time data for LEI so as to reproduce fairly the actual forecasting situation. Each vintage series of the LEI gives rise to an out of sample forecast using one of the models described below. The forecast is then compared to the actual realization of the dependent variable to construct the out of sample forecast error. Doing this for each vintage and for each model generates a sequence of forecast errors for that model.

It's worth noting that for CCI we use historical data so this target variable remains the same over all vintages and forecast models. Here we follow the common practice requiring the forecaster to use preliminary estimates to predict data incorporating future revisions in the target variable. This allows a comparison of our results to those of other studies that pursue the same strategy.[13]

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[11] The formal and general representation of such a data structure as laid out in Diebold and Rudebusch (1991) is a matrix with 1...s columns, one for each successive vintage, and with 1...r rows, one for each successive period covered by the data available within each vintage. Here LEI_{rs} is the value of the leading index, which covers month r and which has been published in month s.

[12] Since the published indexes rely on different base years and, more importantly, the standardization factors are not the same, we recalculate the "published" indexes for these exercises. The differences in the recalculated "real-time" indexes are very small and show virtually no differences in cyclical behavior.

[13] See in particular Diebold and Rudebusch (1991). The revised data are believed to be closer to the truth. However, the use of revised data in lagged values of the dependent variable gives the autoregressive element an advantage vis-à-vis the contribution of the leading index term which is based on preliminary data. Assessments of the forecasts thus mix forecasting and measurement errors. This approach makes it more difficult for the LEI to improve the forecast.

3.3 The Forecast Models[14]

The forecast regression models are specified in changes in natural logarithms for both the coincident index and the leading indexes. This is done in order to avoid spuriously high correlations due to common trends that obtain in the levels of the indexes. As noted by Camacho and Perez-Quiros (2002, pp. 62-63), the augmented Dickey-Fuller test cannot reject the null hypothesis of a unit root in the levels of the LEI series but is consistent with stationarity of log differences of LEI. Given the trend in the LEI and the even stronger trend in CCI, the use of the change model is appropriate. But the monthly changes in CCI are quite volatile and those in LEI even more so. Further, the LEI leads the CCI by a considerably longer period than one month, even on average, and the lead is particularly long near the peak. This suggests that some coordinated extensions of the forecast horizons and numbers and spans of the growth rates used are appropriate, but we opted for a broad range of simple specifications so as to avoid any risks of data or model mining.

Let $\Delta_j CCI_t$ denote the growth rate over the past j months ending in month t. The span j is allowed to vary from one to 3, 6, and 9 months. To provide a standard for evaluating the forecasting power of the leading index, a simple autoregressive equation is used in which $\Delta_j CCI_t$ is related to its own lags, $\Delta_j CCI_{t-1}$ to $\Delta_j CCI_{t-k}$, with the number of lagged terms, k, varying from one to 3, 6, and 9.

$$\Delta_j CCI_t = \alpha_1 + \sum_{i=1}^{k} \beta_{1,i} \Delta_j CCI_{t-i-p+1} + \varepsilon_{1,t} \begin{cases} k, j = 1,3,6,9 \\ p = 1,4,7 \end{cases} \qquad \text{Eq. (1)}$$

Then we add lags of the leading index to this equation and ask whether this reduces out-of-sample forecast errors relative to those from Equation (1). Equation (2) adds lags of the leading index to the benchmark Eq. (1):

$$\Delta_j CCI_t = \alpha_2 + \sum_{i=1}^{k} \beta_{2,i} \Delta_j CCI_{t-i-p+1} + \sum_{i=1}^{k} \delta_{2,i} \Delta_j LEI_{t-i-p+} + \varepsilon_{2,t} \begin{cases} k, j = 1,3,6,9 \\ p = 1,4,7 \end{cases} \qquad \text{Eq. (2)}$$

This gives 16 different combinations of the spans of growth rates (j) and number of lags (k) for each of the above three models. We repeat the same exercise for forecasts three and six

[14] This section closely follows the discussion in McGuckin, Ozyildirim, and Zarnowitz (2003) where the model and approach were first introduced.

months ahead (p = 4 and p = 7). This provides us with 48 forecast exercises classified by three factors: the length of forecast horizon, the number of the lagged explanatory terms, and transformation of the data (span of the growth rates).

No effort was made to optimize the predictive regression specifications.[15] Rather, we tried to get a sufficiently comprehensive and diverse picture of what the leading indexes can contribute, even under relatively unfavorable conditions. This approach – looking at a broad and symmetric set of models – was modified in one way: Only results for models for which the span of growth in the variables in the model is greater than or equal to the forecast horizon are reported. Longer forecasts are not well served by short growth rates. Thus, the empirical results are based on 36 forecasts for each period and LEI definition.

4. Empirical Findings

Our empirical results are all summarized in Table 1, which covers 7 sets of forecasts, 3 with the as-published LEIs for the 1968-2002 period and two subperiods, and 4 more using constant-composition LEIs. The constant-composition LEIs cover forecasts for the entire period for which we have data, 1989-2002, and the subperiod 1989-1996. This subperiod covers the 7 years directly prior to the latest composition change and includes 1.5 years before the 1990-91 recession and 6 years after.[16]

Table 1 shows the average MSE for all 36 forecast models in its period/LEI composition class. It also includes the number of forecast models where the inclusion of the LEI in the model fails to reduce the MSE. It is worth noting that all forecast errors are in line with our earlier work and similar across all versions of the LEI. The longer the forecast horizon, the larger the errors and the more explanatory (lagged) terms, the smaller generally are the MSEs. We also observe, as in our earlier work, that MSEs generally increase with the span in months over which the growth rates are calculated for each forecast horizon and lags.[17]

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[15] For example, selection of the optimal number of lags through the use of an information criterion, such as the Akaike Information Criterion, would be expected to improve the forecasts from these models.

[16] The post 1996 period only covers 5 years and over two of those involve recession and recovery following a very strong expansion so it is not a useful subperiod for examination separately.

[17] Such rises in the errors may seem alarming, but in fact it is not and has an easy explanation. The longer its span (j), the larger is the growth rate $\Delta_j CCI_t$ reflecting the economy's upward trend. The means of Δ_1, Δ_3, Δ_6, and Δ_9 for our dependent variable are 0.0022, 0.0066, 0.0132, and 0.0198, respectively. Thus, $\Delta_j CCI$ grows a little faster in size than in length, e.g., Δ_6, is 6 times Δ_1 and Δ_9 is 9 times Δ_1. This is a faster progression than that of the

The specific results for all forecasts and models are reported in the Appendix where tables, A1-A7, give the MSEs for each forecast model. There is one table for each of the 7-period/LEI combinations reported in Table 1. The tables report the mean square errors (MSE) for 36 forecast exercises, 16 for one-month ahead, 12 for 3-month ahead, and 8 for 6- month-ahead forecasts. Each table includes one, three, and six month ahead autoregressive forecasts of changes in CCI (column 4), and the same forecasts when lagged changes in LEI are added to the model (the historical and real time LEI in columns 5 and 6, respectively). This covers all possible models where the span of the forecast variables is greater than or equal to the forecast horizon.

4.1 Published or Composition Changing Indexes

The first row of Table 1 reports the results for all available vintages of the as-published LEI. The equations with the historical index reduce the MSE's from those obtained in the baseline autoregressions in all 36 cases (col. 4). On average, the MSEs from the benchmark model (8.034) fall to 5.304, about a 34 percent drop, when the historical index is added to the forecast equation (compare cols. 1 and 2). The equations with the as-published or real-time LEI reduce the MSE's in all cases except 3 (col. 5). On average, the MSE from equations including lags of the real time LEI is 7.386 (col. 3), an 8 percent reduction over the benchmark model.

The second row of Table 1 reports the out-of-sample forecast period from November 1968 to December 1988, which corresponds to the sample that was available to Diebold and Rudebusch (1991). In this shorter period, which does not include the LEI based on the 1989 and 1996 definitions, the MSEs are generally higher for all models. Again, the equations with the historical index reduce the MSE's in all 36 cases (col. 4), on average from 10.035 to 6.884 (a reduction of 31 percent). The equations with the as-published LEI reduce the MSE's in all cases except 7 (col. 5), on average from 10.935 to 10.106 (a reduction of 7 percent).

Turning to the period post the Diebold and Rudebusch work, the third row reports the findings for the forecast period January 1989 to October 2002. This short period covers the two most recent recessions and both 1989 and 1996 compositions. Both equations with the historical index and those with the as-published LEI reduce the MSEs in all cases except 2 (cols. 4 and 5),

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corresponding MSE's. Hence the errors actually tend to <u>decrease</u> in relative terms, while <u>increasing</u> in absolute terms.

with reductions of 20 and 10 percent respectively for the historical index and the real time index (compare cols. 1, 2, and 3).

These results provide strong empirical support for the proposition that the efficacy of the LEI as a forecasting tool is not affected by changes in its composition. While the revised or historical LEI exhibits smaller MSEs in the pseudo real-time forecasting exercises, the LEI still performs well in the real time out of sample forecasts. Even with the as-published vintages of LEI, out of sample forecast errors tend to be smaller than the forecast errors of an autoregressive model of the growth in CCI.

The lack of predictive ability of the LEI in real time observed by Diebold and Rudebusch stands in sharp contrast to these results.[18] The most likely explanation of why our results differ is that we used different forecasting models. The forecast models estimated by Diebold and Rudebusch were in monthly levels and first differences, whereas, we employ short-term growth rates. (We defer a more detailed discussion to the last part of the paper.)

4.2 Indexes with Constant Composition

We examined two versions of the constant-composition LEI; one using the 1989 list of components and the other using the 1996 list of components. As described above, vintages of these two versions of the LEI were constructed using the real time data for the underlying components from 1989 to 2002.

The fourth and fifth rows of Table 1 report the results for the 1989-1996 period for both definitions of the index. We see the same pattern of reduced errors when the LEI is added to the forecast models. In this period, the real time LEI only fails to reduce forecast errors in 2 out of 36 equations with the 1989 composition of the index, and in 4 out of 36 cases with the 1996 composition (col. 5). In both cases, the forecast errors decrease with the historical index in all equations except one (col. 4). On average, adding the historical index to the benchmark equation reduces the forecast errors about 27 percent with the 1989 composition and 21 percent with the 1996 composition (compare cols. 1 and 2). Again on average, adding the real time index reduces

[18] Moreover, while not reported here, we are able to replicate the negative real-time results found in Diebold and Rudebusch (1991) for the extended sample.

the forecast errors somewhat less, about 16 percent with the 89 composition and 17 percent with the 1996 composition (compare cols. 1 and 3), but the gains in forecast accuracy are substantial.

Extending the out of sample forecast period to 2002 (see rows 6 and 7, Table 1) does not change these results for the historical index. The forecasts improve in virtually all cases and there are substantial declines in MSE (col. 1 compared to col. 2). As observed above, the forecast errors of the models that use the real time LEI (both 1989 and 1996 compositions in col. 3) are higher than those with the historical index, but much more so for the 1989 composition than the 1996 composition. In fact, adding the 1989-composition version of the LEI to the forecast models fails to improve on the benchmark model (row 6, col. 3) and for 18 out of 36 cases (col. 5) the addition of the real-time LEI worsens the forecasts relative to the benchmark autoregressive model of growth in CCI.

In contrast, the failure rate for the 1996 composition of the LEI is only 6 out of 36 forecasts and the average MSE is substantially less than the benchmark model (12%) (row 7, col. 3). This suggests that the 1996-composition change involved improved real-time performance rather than better historical fit.

5. Discussion

The analysis shows, using real time out-of-sample evaluation methods, that the index of leading indicators provides useful forecasting information. It reduces errors for both historical and real-time out of sample forecasts of growth in CCI. This strongly suggests that the LEI is useful ex-ante as a forecasting tool to determine the near term (up to 6 months) direction of aggregate economic activity.

The historical leading index like the target historical coincident index (CCI) is essentially free of revision (measurement) errors. It is thus not surprising that the errors are larger for its real-time counterpart, which is preliminary with its latest values subject to revisions. Nonetheless, the addition of real time vintages of the LEI as published since 1968, reduces the forecast errors systematically. This contradicts the empirical evidence from studies that find fault with the ex ante performance of the composite index of leading economic indicators. Our findings are consistent with several recent studies that use different modeling approaches (Filardo (2002), Camacho and Perez-Quiros (2002), and Hamilton and Perez-Quiros (1996)).

We speculated in our earlier paper that the poor real time performance found by some researchers might have been because the leading index was not as up-to-date as some financial indicators. The old procedures for calculating the index left out the most recent financial data. In our earlier paper we described and evaluated a simple procedure to use all available data more efficiently and make the composite indexes more timely. Notwithstanding the fact that the timelier LEI improved forecasts, the difference in performance of the historical and real-time indexes could not be traced to the less timely procedure.

So the difference in the results appears to be rest squarely on the difference between the forecast models. In turn, this raises the basic issue: How are the indicators used to make predictions? As noted earlier, one of the few papers to focus on "typical" rules for use of the indicators also finds that they work in real-time (Filardo (2002). And our choice of model was predicated on the notion that lagged short-term growth rates of 3 to 9 months in the LEI were the appropriate exogenous variables to include in the forecast model.

Thus, a key issue with the LEI is how to use it in forecasting exercises. This has always been something of an art form and practitioners often argue that the LEI, by itself, is not sufficient for prediction. But they usually never tell us exactly how to use it in forecasting. We currently have a deeper investigation of the problem of how to use the indicators underway with the idea of developing more specific and robust forecasting procedures based on the indicator approach. But in the light of our results to date, we conclude that the view of the composite index approach as a useful tool for predicting and assessing business cycles is still a very viable hypothesis.

6. Concluding Comments

In conclusion, we find that the alleged failure of the LEI in real-time forecasts is not associated with the changing composition of the LEI. The results reported here suggest strongly that it is the forecast model and what the target of the forecast is that are the key to the disparate findings in the literature. Moreover, and more importantly, the index generally performs well in forecasts of growth in economic activity. This is not unexpected since the index is a comprehensive and diversified composite of key indicator variables selected for their logical and empirical leading characteristics.

We think the kinds of models we use here are much closer to the "right" models than the levels or first difference models used in earlier research. Nonetheless, it is clear that the index itself, while useful in growth forecasts, could be improved for forecasting near turning points. But this is why generations of practitioners have used the diffusion indexes and related "rules" in their analysis and forecasts. Hence, it is important to extend the research and develop a more systematic and reproducible vision for using the indicators in forecasts.

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Table 1: Summary of Forecast Results

	Period and LEI Composition		Mean MSE of 36 Forecast Equations			Number of Models out of 36 (total per line) where LEI Failed to Reduce MSE	
			CCI Only	CCI and Historical LEI	CCI and Real Time LEI	CCI and Historical LEI	CCI and Real Time LEI
	Composition Changing Period		(1)	(2)	(3)	(4)	(5)
1	1968-2002	As-published	8.034	5.308	7.386	0	3
2	1968-1988	As-published	10.935	6.884	10.106	0	7
3	1989-2002	As-published	3.723	2.968	3.342	2	2
	Composition Constant						
	1989-1996						
4		89 composition	4.472	3.270	3.749	1	2
5		96 composition	4.501	3.555	3.716	1	4
	1989-2002						
6		89 composition	3.705	3.184	3.778	1	18
7		96 composition	3.740	3.193	3.303	2	6

APPENDIX

Table A1 reports the details on the forecast models summarized in the first row of Table 1. All equations that include the historical LEI reduce the MSEs relative to the benchmark model of growth in CCI. The equations with the as-published or real-time LEI reduce the MSE's in all 36 cases except 3 (col. 6). Two exceptions are one- and six- month ahead forecasts using 6-month growth rates and 9 lags on the right hand side. The third exception is the one-month ahead forecast using first differences and one lag on the right hand side.

The MSEs reported in Table A2 look at the forecast errors in the same period covered in the Diebold and Rudebusch study. Again, all 36 equations that include the historical LEI reduce the MSEs. The equations with the as-published LEI reduce the MSE's in all cases except 6 (col. 6). In addition to the three exceptions above, the exceptions are one-month ahead forecasts of 6-month growth rates using 9 lags and six-month ahead forecasts of 9-month growth rates using 6 and 9 lags.

We report the findings for the period after the Diebold and Rudebusch work (January 1989 to October 2002) in Table A3. This short period includes both the 1989 and the 1996 compositions and covers the two most recent recessions. Both equations with the historical index and those with the as-published LEI reduce the MSEs in all 36 cases except 2 (cols. 5 and 6). The two exceptions in both columns are one-month and three-month ahead forecasts using one lag.

The results for the forecasting exercises summarized on rows 4 and 5 of Table 1 are reported in Tables A4 and A5. In general, the same pattern holds. There are few exceptions to the observation that adding LEI, whether in its historical form or in real-time, reduces MSE relative to the benchmark. The results for the historical LEI, in general, have fewer exceptions.

Table A6 reports the detailed results for the forecasting exercises where the1989 composition of LEI is held constant over the period 1989-2002 and Table A7 reports the results where the 1996 composition is held constant over the same period. While the results for the historical LEI are similar, there is a marked difference for the real-time versions of the LEI. The equations using the real-time LEI with the 1989 composition has three times as many failures to improve over the benchmark model as the equations that include the 1996 definition (18 failures using the former versus 6 using the latter).

Table A1: LEI as-published Dec.1968 – Oct. 2002
Out-of Sample Forecasts of Growth in the Current Conditions Index:
Contribution of Autoregression and the Leading Index

Line	Span of Months over which Growth Rate is Calculated (j)	Number of Lags of Growth Rates of CCI, LI (1 to k)	Mean Square Errors (MSE) for Model with Lagged Terms in: CCI only	CCI and LI (historical index)	CCI and LI (real-time)
(1)	(2)	(3)	(4)	(5)	(6)
			One Month Ahead Forecasts		
1	1	1	1.122	1.118	1.149*
2	1	3	1.040	0.989	0.990
3	1	6	1.056	0.989	1.043
4	1	9	1.063	0.963	1.029
5	3	1	1.711	1.484	1.548
6	3	3	1.617	1.567	1.581
7	3	6	1.410	1.270	1.376
8	3	9	1.314	1.167	1.252
9	6	1	2.211	1.668	1.860
10	6	3	1.977	1.739	1.856
11	6	6	1.991	1.719	1.915
12	6	9	1.450	1.286	1.461*
13	9	1	2.274	1.590	1.800
14	9	3	2.001	1.657	1.774
15	9	6	1.943	1.693	1.759
16	9	9	1.952	1.696	1.775
			Three Month Ahead Forecasts		
17	3	1	5.629	4.592	5.097
18	3	3	5.631	4.621	5.146
19	3	6	5.584	4.070	5.037
20	3	9	5.489	3.893	4.946
21	6	1	9.590	5.960	7.810
22	6	3	8.437	6.204	7.859
23	6	6	7.729	4.995	6.801
24	6	9	6.620	4.848	6.507
25	9	1	10.701	5.157	7.567
26	9	3	7.927	5.297	6.650
27	9	6	7.561	5.360	6.835
28	9	9	7.423	5.226	7.116
			Six Month Ahead Forecasts		
29	6	1	19.546	13.564	18.352
30	6	3	19.796	12.691	18.319
31	6	6	19.736	12.479	18.501
32	6	9	19.290	13.169	19.770*
33	9	1	28.904	14.452	23.652
34	9	3	22.748	14.092	21.358
35	9	6	22.107	13.695	21.834
36	9	9	22.637	14.121	22.573

Note: The *'s denote the cases where the models with lagged LEI terms are less accurate than the autoregressive model, that is, where the entries in columns 5 and 6 are smaller than the corresponding entries in column 4.

Table A2: LEI as-published Dec.1968 – Dec. 1988
Out-of Sample Forecasts of Growth in the Current Conditions Index:
Contribution of Autoregression and the Leading Index

Line	Span of Months over which Growth Rate is Calculated (j)	Number of Lags of Growth Rates of CCI, LI (1 to k)	Mean Square Errors (MSE) for Model with Lagged Terms in		
			CCI only	CCI and LI (historical index)	CCI and LI (real-time)
(1)	(2)	(3)	(4)	(5)	(6)
				One Month Ahead Forecasts	
1	1	1	1.301	1.282	1.340*
2	1	3	1.242	1.169	1.177
3	1	6	1.257	1.175	1.263*
4	1	9	1.264	1.136	1.249
5	3	1	2.169	1.791	1.893
6	3	3	1.980	1.912	1.939
7	3	6	1.726	1.524	1.689
8	3	9	1.564	1.365	1.499
9	6	1	2.905	2.072	2.361
10	6	3	2.448	2.150	2.328
11	6	6	2.433	2.061	2.374
12	6	9	1.811	1.596	1.882*
13	9	1	2.811	1.784	2.099
14	9	3	2.321	1.885	2.046
15	9	6	2.204	1.924	2.007
16	9	9	2.213	1.937	2.060
				Three Month Ahead Forecasts	
17	3	1	7.812	6.054	6.848
18	3	3	7.699	6.165	6.943
19	3	6	7.651	5.384	6.847
20	3	9	7.500	5.210	6.776
21	6	1	13.716	8.089	10.860
22	6	3	11.883	8.569	11.052
23	6	6	10.960	6.725	9.515
24	6	9	9.156	6.593	9.149
25	9	1	14.781	6.502	10.102
26	9	3	10.286	6.743	8.707
27	9	6	9.782	6.847	9.014
28	9	9	9.789	6.746	9.729
				Six Month Ahead Forecasts	
29	6	1	27.166	17.742	25.311
30	6	3	27.580	16.530	25.210
31	6	6	27.538	16.452	25.801
32	6	9	26.601	17.641	28.048*
33	9	1	40.431	18.560	32.874
34	9	3	30.897	18.305	29.405
35	9	6	29.976	17.806	30.578*
36	9	9	30.802	18.409	31.855*

Note: The *'s denote the cases where the models with lagged LEI terms are less accurate than the autoregressive model, that is, where the entries in columns 5 and 6 are smaller than the corresponding entries in column 4.

Table A3: LEI as-published Jan. 1989- Oct.2002
Out-of Sample Forecasts of Growth in the Current Conditions Index:
Contribution of Autoregression and the Leading Index

Line	Span of Months over which Growth Rate is Calculated (j)	Number of Lags of Growth Rates of CCI, LI (1 to k)	Mean Square Errors (MSE) for Model with Lagged Terms in: CCI only	CCI and LI (historical index)	CCI and LI (real-time)
(1)	(2)	(3)	(4)	(5)	(6)
			One Month Ahead Forecasts		
1	1	1	0.863	0.881*	0.872*
2	1	3	0.747	0.727	0.718
3	1	6	0.764	0.719	0.723
4	1	9	0.772	0.710	0.710
5	3	1	1.046	1.040	1.046
6	3	3	1.089	1.067	1.063
7	3	6	0.952	0.902	0.922
8	3	9	0.949	0.879	0.894
9	6	1	1.204	1.082	1.133
10	6	3	1.294	1.141	1.171
11	6	6	1.348	1.221	1.248
12	6	9	0.925	0.836	0.849
13	9	1	1.494	1.307	1.368
14	9	3	1.536	1.325	1.379
15	9	6	1.562	1.357	1.398
16	9	9	1.571	1.346	1.361
			Three Month Ahead Forecasts		
17	3	1	2.421	2.443*	2.522*
18	3	3	2.592	2.351	2.506
19	3	6	2.546	2.140	2.378
20	3	9	2.534	1.957	2.256
21	6	1	3.528	2.832	3.327
22	6	3	3.373	2.728	3.168
23	6	6	2.981	2.454	2.812
24	6	9	2.895	2.283	2.626
25	9	1	4.706	3.181	3.841
26	9	3	4.461	3.172	3.627
27	9	6	4.298	3.176	3.634
28	9	9	3.945	2.991	3.276
			Six Month Ahead Forecasts		
29	6	1	8.140	7.311	7.935
30	6	3	8.143	6.945	8.002
31	6	6	8.058	6.532	7.575
32	6	9	8.345	6.475	7.377
33	9	1	11.649	8.304	9.847
34	9	3	10.549	7.786	9.311
35	9	6	10.328	7.541	8.745
36	9	9	10.415	7.702	8.678

Note: The *'s denote the cases where the models with lagged LEI terms are less accurate than the autoregressive model, that is, where the entries in columns 5 and 6 are smaller than the corresponding entries in column 4.

Table A4: LEI with '89 Definition Jan. 1989- Dec. 1996
Out-of Sample Forecasts of Growth in the Current Conditions Index:
Contribution of Autoregression and the Leading Index

Line	Span of Months over which Growth Rate is Calculated (j)	Number of Lags of Growth Rates of CCI, LI (1 to k)	Mean Square Errors (MSE) for Model with Lagged Terms in		
			CCI only	CCI and LI (historical index)	CCI and LI (real-time)
(1)	(2)	(3)	(4)	(5)	(6)
			One Month Ahead Forecasts		
1	1	1	1.207	1.236*	1.228*
2	1	3	1.063	1.020	0.999
3	1	6	1.084	1.001	1.019
4	1	9	1.095	0.984	0.989
5	3	1	1.536	1.531	1.526
6	3	3	1.566	1.514	1.498
7	3	6	1.360	1.258	1.301
8	3	9	1.353	1.226	1.253
9	6	1	1.670	1.476	1.558
10	6	3	1.819	1.564	1.601
11	6	6	1.910	1.674	1.714
12	6	9	1.253	1.106	1.131
13	9	1	2.041	1.806	1.889
14	9	3	2.169	1.818	1.879
15	9	6	2.247	1.851	1.894
16	9	9	2.269	1.849	1.861
			Three Month Ahead Forecasts		
17	3	1	3.053	2.871	2.905
18	3	3	3.332	2.790	2.943
19	3	6	3.280	2.512	2.841
20	3	9	3.358	2.261	2.641
21	6	1	4.327	3.218	3.971
22	6	3	4.221	3.081	3.743
23	6	6	3.700	2.754	3.264
24	6	9	3.704	2.527	3.039
25	9	1	5.621	3.648	4.553
26	9	3	5.952	3.669	4.207
27	9	6	5.890	3.749	4.311
28	9	9	5.329	3.386	3.618
			Six Month Ahead Forecasts		
29	6	1	8.654	7.873	8.716*
30	6	3	8.787	7.082	8.508
31	6	6	8.814	6.603	7.990
32	6	9	9.601	6.300	7.405
33	9	1	11.815	8.416	10.583
34	9	3	11.944	7.638	9.668
35	9	6	11.909	7.195	8.500
36	9	9	12.056	7.245	8.217

Note: The *'s denote the cases where the models with lagged LEI terms are less accurate than the autoregressive model, that is, where the entries in columns 5 and 6 are smaller than the corresponding entries in column 4.

Table A5: LEI with '96 Definition Jan. 1989- Dec. 1996
Out-of Sample Forecasts of Growth in the Current Conditions Index:
Contribution of Autoregression and the Leading Index

Line	Span of Months over which Growth Rate is Calculated (j)	Number of Lags of Growth Rates of CCI, LI (1 to k)	Mean Square Errors (MSE) for Model with Lagged Terms in		
			CCI only	CCI and LI (historical index)	CCI and LI (real-time)
(1)	(2)	(3)	(4)	(5)	(6)
				One Month Ahead Forecasts	
1	1	1	1.211	1.226*	1.212*
2	1	3	1.065	1.032	1.036
3	1	6	1.086	0.991	1.004
4	1	9	1.096	0.982	0.984
5	3	1	1.532	1.496	1.539*
6	3	3	1.565	1.519	1.546
7	3	6	1.362	1.248	1.290
8	3	9	1.356	1.227	1.244
9	6	1	1.680	1.495	1.526
10	6	3	1.834	1.623	1.639
11	6	6	1.922	1.677	1.730
12	6	9	1.256	1.106	1.125
13	9	1	2.055	1.834	1.850
14	9	3	2.184	1.890	1.886
15	9	6	2.258	1.913	1.884
16	9	9	2.281	1.888	1.825
				Three Month Ahead Forecasts	
17	3	1	3.053	2.886	3.073*
18	3	3	3.336	2.873	3.083
19	3	6	3.283	2.654	2.858
20	3	9	3.364	2.387	2.591
21	6	1	4.359	3.499	3.871
22	6	3	4.264	3.346	3.731
23	6	6	3.727	2.978	3.263
24	6	9	3.696	2.646	2.840
25	9	1	5.663	4.073	4.268
26	9	3	5.998	4.018	4.231
27	9	6	5.930	4.050	4.264
28	9	9	5.371	3.535	3.678
				Six Month Ahead Forecasts	
29	6	1	8.716	8.526	9.083*
30	6	3	8.849	7.893	8.674
31	6	6	8.875	7.483	8.031
32	6	9	9.669	7.174	7.294
33	9	1	11.923	9.922	9.993
34	9	3	12.040	8.716	9.101
35	9	6	12.022	8.212	8.370
36	9	9	12.165	7.968	8.167

Note: The *'s denote the cases where the models with lagged LEI terms are less accurate than the autoregressive model, that is, where the entries in columns 5 and 6 are smaller than the corresponding entries in column 4.

Table A6: LEI with '89 Definition Jan. 1989- Oct.2002
Out-of Sample Forecasts of Growth in the Current Conditions Index:
Contribution of Autoregression and the Leading Index

Line	Span of Months over which Growth Rate is Calculated (j)	Number of Lags of Growth Rates of CCI, LI (1 to k)	Mean Square Errors (MSE) for Model with Lagged Terms in		
			CCI only	**CCI and LI** (historical index)	**CCI and LI** (real-time)
(1)	(2)	(3)	(4)	(5)	(6)
				One Month Ahead Forecasts	
1	1	1	0.858	0.860*	0.926*
2	1	3	0.743	0.711	0.732
3	1	6	0.760	0.713	0.753
4	1	9	0.768	0.714	0.746
5	3	1	1.043	1.013	1.141*
6	3	3	1.087	1.056	1.076
7	3	6	0.948	0.891	0.966*
8	3	9	0.944	0.869	0.953*
9	6	1	1.197	1.091	1.199*
10	6	3	1.286	1.156	1.181
11	6	6	1.340	1.236	1.280
12	6	9	0.924	0.843	0.906
13	9	1	1.486	1.317	1.423
14	9	3	1.528	1.338	1.389
15	9	6	1.554	1.376	1.402
16	9	9	1.562	1.369	1.371
				Three Month Ahead Forecasts	
17	3	1	2.426	2.395	2.740*
18	3	3	2.595	2.370	2.677*
19	3	6	2.548	2.276	2.789*
20	3	9	2.535	2.061	2.928*
21	6	1	3.516	3.089	3.440
22	6	3	3.357	2.939	3.352
23	6	6	2.974	2.631	3.192*
24	6	9	2.905	2.440	3.148*
25	9	1	4.687	3.584	4.048
26	9	3	4.443	3.356	3.911
27	9	6	4.282	3.383	3.983
28	9	9	3.928	3.069	3.746
				Six Month Ahead Forecasts	
29	6	1	8.090	7.696	8.099*
30	6	3	8.093	7.542	9.108*
31	6	6	8.009	7.198	8.754*
32	6	9	8.298	7.137	9.252*
33	9	1	11.578	9.652	10.298
34	9	3	10.485	8.570	11.264*
35	9	6	10.266	8.275	10.979*
36	9	9	10.353	8.395	10.841*

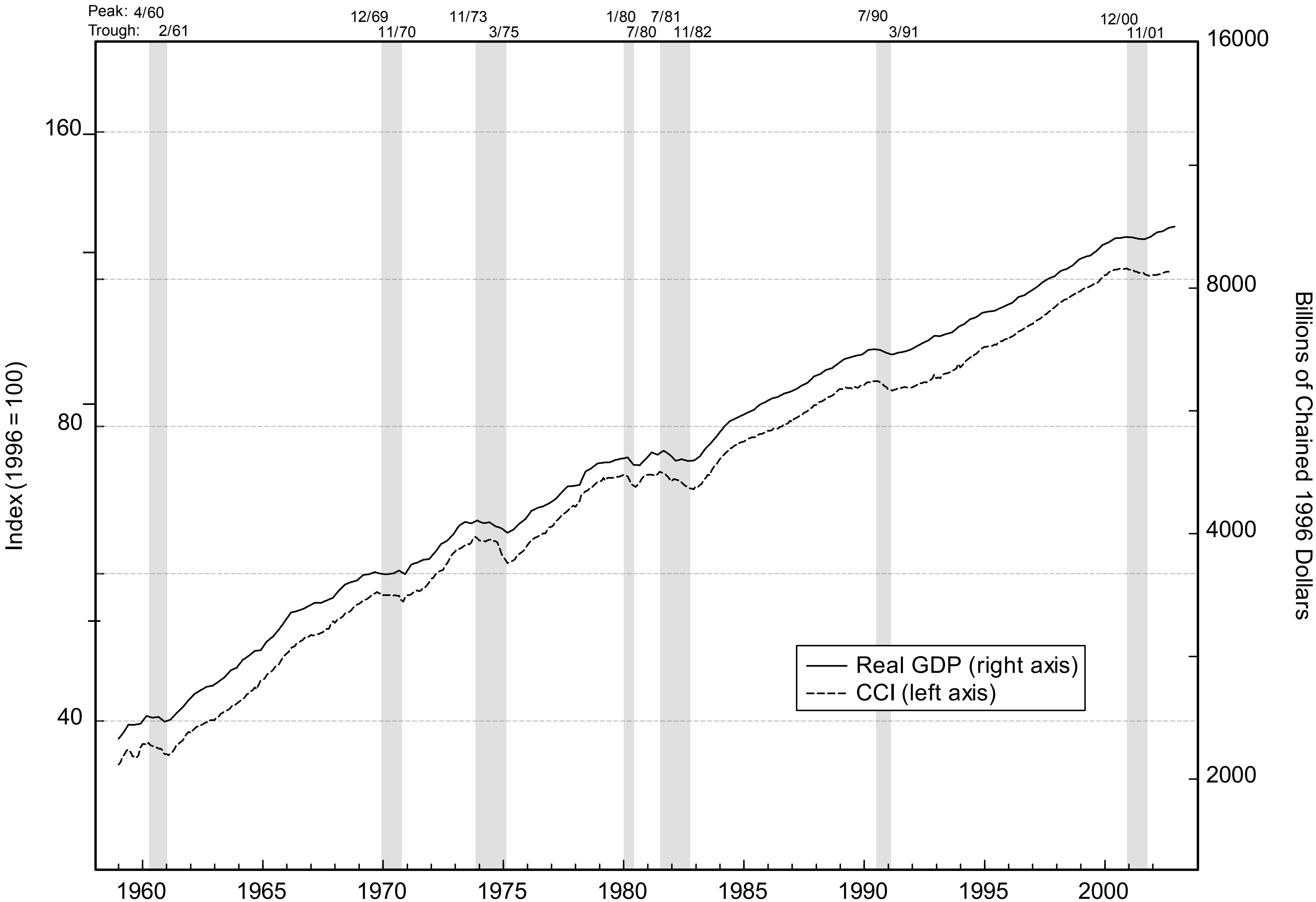
Note: The *'s denote the cases where the models with lagged LEI terms are less accurate than the autoregressive model, that is, where the entries in columns 5 and 6 are smaller than the corresponding entries in column 4.

Table A7 LEI with '96 Definition Jan. 1989- Oct.2002
Out-of Sample Forecasts of Growth in the Current Conditions Index:
Contribution of Autoregression and the Leading Index

Line	Span of Months over which Growth Rate is Calculated (j)	Number of Lags of Growth Rates of CCI, LI (1 to k)	Mean Square Errors (MSE) for Model with Lagged Terms in		
			CCI only	CCI and LI (historical index)	CCI and LI (real-time)
(1)	(2)	(3)	(4)	(5)	(6)
			One Month Ahead Forecasts		
1	1	1	0.863	0.873[x]	0.877[x]
2	1	3	0.747	0.732	0.752[x]
3	1	6	0.764	0.719	0.733
4	1	9	0.770	0.713	0.723
5	3	1	1.044	1.022	1.063[x]
6	3	3	1.090	1.074	1.104[x]
7	3	6	0.953	0.904	0.939
8	3	9	0.949	0.882	0.907
9	6	1	1.207	1.099	1.133
10	6	3	1.299	1.180	1.202
11	6	6	1.351	1.235	1.282
12	6	9	0.929	0.850	0.879
13	9	1	1.500	1.333	1.361
14	9	3	1.543	1.369	1.386
15	9	6	1.566	1.397	1.388
16	9	9	1.574	1.369	1.339
				Three Month Ahead Forecasts	
17	3	1	2.436	2.486[x]	2.663[x]
18	3	3	2.608	2.440	2.629[x]
19	3	6	2.561	2.281	2.459
20	3	9	2.549	2.088	2.272
21	6	1	3.549	3.058	3.283
22	6	3	3.393	2.942	3.188
23	6	6	2.999	2.675	2.868
24	6	9	2.913	2.430	2.592
25	9	1	4.734	3.517	3.696
26	9	3	4.488	3.435	3.642
27	9	6	4.321	3.398	3.600
28	9	9	3.968	3.174	3.333
				Six Month Ahead Forecasts	
29	6	1	8.172	7.768	8.039
30	6	3	8.174	7.537	7.904
31	6	6	8.088	7.182	7.422
32	6	9	8.381	7.124	7.164
33	9	1	11.713	9.385	9.362
34	9	3	10.598	8.585	8.811
35	9	6	10.387	8.336	8.457
36	9	9	10.473	8.369	8.462

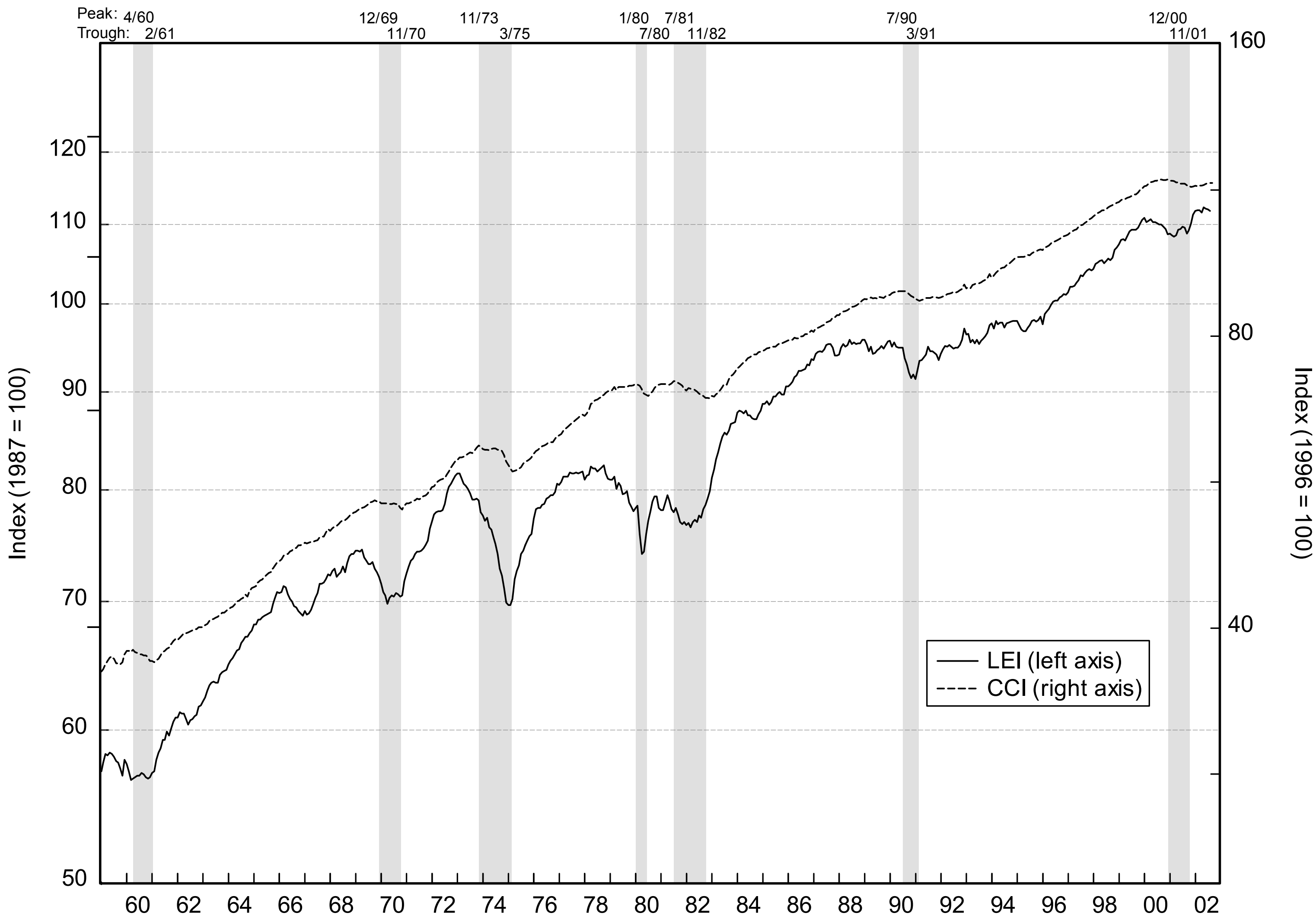
Note: The *'s denote the cases where the models with lagged LEI terms are less accurate than the autoregressive model, that is, where the entries in columns 5 and 6 are smaller than the corresponding entries in column 4.

Chart 1: U.S. Current Conditions Index (CCI) and Real GDP
January 1959 - August 2002



The shaded areas represent U.S. business cycle recessions as dated by the National Bureau of Economic Research.
The latest shading relates to the recession of 2001 and is dated according to the cyclical contraction of the CCI.

Chart 2: U.S. Index of Leading Economic Indicators (LEI) and Current Conditions Index (CCI)
January 1959 - August 2002



The shaded areas represent U.S. business cycle recessions as dated by the National Bureau of Economic Research. The latest shading relates to the recession of 2001 and is dated according to the cyclical contraction of the CCI. The LEI shown is the Oct. 2002 vintage.