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Abstract

Clusters of cyclical turning points in the coincident indicators help us identify and date Euro Area recessions and recoveries in the past several decades. In the U.S. and some other countries, composite indexes of coincident indicators (CEI) are used to date classical business cycle turning points; also indexes of leading indicators (LEI) are used to help in the difficult task of predicting these turning points. This paper reviews a selection of the available data for monthly and quarterly Euro Area coincident and leading indicators. From these data, we develop composite indexes using methods analogous to those tested in the U.S. CEI and LEI published by The Conference Board. We compare the resulting business cycle chronology with the existing alternatives and evaluate our selection of leading indicators in the context of how well they predict current economic activity and its major fluctuations for the Euro Area.

Key Words: Business Cycle; Indicators; Leading Index; Times Series; Forecasting

JEL Classification: E32; C52; C53; C22

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1. Introduction

In the United States, the Business Cycle Dating Committee of the National Bureau of Economic Research has long used as its primary tool for identifying and dating business cycles a monthly composite index of coincident economic indicators (CEI). This index combines industrial production, real personal income less transfer payments, nonfarm employment, and real manufacturing and trade sales. In Europe; the Centre of Economic Police Research (CEPR) has recently formed a committee to perform the analogous tasks. Its definition of a recession is very similar to that of the NBER's BCDC, except that it is cast in quarterly rather than monthly terms[2].

The Conference Board (TCB) is now regularly constructing and publishing monthly cyclical indicators and composite indexes, which together are instrumental in dating and analyzing business cycles in the United States. In the past decade, TCB has extended this research to several foreign countries, including France, Germany, Spain and the United Kingdom. Encouraged by the progress of this and other related work, we describe fully in this paper our new composite indexes of coincident and leading indicators for the Euro Area. In addition we discuss the descriptive and predictive performance of these new indicators and composite indexes in real time.

Both the availability and quality of the data for the Euro Area are limited, mainly because the cross-country differences in institutions and policies are substantial. These are the sources of the main difficulties faced in attempting to develop the new coincident and leading indexes.[3]

Dating business cycles is done best with composite indexes of coincident indicators which do not exist for the Euro Area as a whole prior to the early 1990s.[4,5] Our approach to develop

[2] See Emanuel Munch and Harald Uhlig, "Towards a Monthly Business Cycle Chronology for the Euro Area," SFB 649 Discussion Paper, University of Berlin, 2005. The authors prefer monthly to quarterly reference chronologies, and we do so, too.

[3] In their September 22, 2003 press release, the Center for Economic Policy Research (CEPR) business cycle dating committee says: "Although subject to common monetary policy since 1999, they [states within the Euro Area] even now have heterogeneous institutions and policies. Moreover, European statistics are of uneven quality, long time series are not available, and data definitions differ across countries and sources."

them has been to use Euro Area level data mainly from Eurostat[6] and European Central Bank (ECB) but also from some private sources as our primary sources. Despite serious data limitations, our review of the available high frequency indicators for the Euro Area yielded eight series that we consider to be good components of a leading index. In the selection of these series, we took the NBER approach to cyclical indicators and the set of components used by The Conference Board in its US and global leading indexes as models. We considered economic relevance as well as cyclical timing, conformity, consistency, and statistical adequacy as primary criteria for the choice of the components.

Section 2 has three tasks: It (1) presents the selected monthly and quarterly Euro Area coincident indicators, (2) identifies and dates the recent European recessions and recoveries, and (3) provides an evaluation of the evidence and comparison of the business cycle chronology developed in (2) with others. Section 3 discusses the composition and performance of the proposed Euro Area leading index using the chronology developed in section 2. It then turns to the real-time or current use aspects of the composite indexes and discusses problems of data availability and publication lags.[7] Section 4 concludes.

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[4] The Euro Area is defined in this paper as consisting of the twelve European countries that adopted the Euro as their single currency in circulation prior to 2007. France, Germany, and Italy are the largest, and together they account for just a little more than half of the aggregate economic activity in the area. The others are individually much smaller: Austria, Belgium, Finland, Greece, Ireland, Luxembourg, the Netherlands, Portugal and Spain. The Euro Area was created on January 1, 1999, and the Euro was adopted as a dominant currency by the states within the Euro Area on January 1, 2002. As of January 1, 2007, Slovenia adopted the Euro as its currency of exchange and became a full member of the Euro Area, while Cyprus and Malta became full members as of January 1, 2008. However, aggregated data for the Euro 12 countries are more readily available; hence the entries of Slovenia, Cyprus and Malta into the Euro Area are ignored in this paper. As three small countries, their effects on Euro Area business cycle dating are negligible.

[5] See Catherine Guillemineau with Jennifer Chao, "Business Cycle Indicators for the Euro Area." See especially Introduction and section 1, "Construction of Euro Area Aggregates."

[6] Eurostat, the official statistical agency for the European Union, has compiled some historical time series for the Euro Area as a whole. Eurostat aims to derive its historical statistics from actual data and comprehensive systems of comparable measures such as national income and product accounts for the euro countries. For each country, historical data in national currency units must be converted into data in common currency prior to aggregation across the Euro Area. The European Currency Unit (ECU) acted as an effective currency basket in times of variable exchange rates preceding the implementation of the euro and fixed exchange rates, prior to 2001 for Greece, and prior to 1999 for the other Euro Area states. Before its adoption as the dominant currency by the Euro Area countries, the euro, as constructed by OECD's statistical department, was a synthetic and virtual currency rather than an operating currency. Eurostat converts the historical country data using the prevailing exchange rates of the national currencies against the ECU. The converted national accounts series are then aggregated across the euro countries by simple summation.

[7] We describe and evaluate a procedure currently used with the US leading index. Earlier vesions of this procedure were discussed in McGuckin et. al. (2007) which addresses the problem of publication lags in the components of the composite indexes. See also Bouwman and Jacobs (2005).

2. Individual and Composite Coincident Indicators

Chart 1 refers to the index of industrial production, monthly, 1975-2007. The two largest declines in this index, from December 1979 to December 1982 and from November 1991 to July 1993, coincide almost exactly with two business recessions. (Here, and elsewhere, the matching specific-cycle peaks and troughs are marked by asterisks (*). The business cycle peaks and troughs are dated above the chart and connected by shaded columns, which denote the duration of each recession covered. The “extra” turning points that do not match the prevailing area recessions and recoveries are marked with little crosses (x).) The index of industrial production shows four extra cycles that were short and relatively shallow (Chart 1).

Chart 2 refers to Euro Area employment and covers the period since 1960. This series, reported quarterly, is shown in monthly form, linearly interpolated between center months of each successive quarter, after seasonal adjustment. Employment matched each of the three covered and dated business cycles of the area, but mostly with short leads at peaks and short lags at troughs (at one recession, in early 1980, employment had a rather lengthy lag). The decline of this series in 1964-68, shallow and irregular in its first thirty months, but relatively steep and smooth in the last eighteen months, suggests a possibility of a European recession at the time, but no other existing data confirm it. Chart 3 combines industrial production and employment into a monthly index, which leads at peaks in 1974 and 1992, coincides at the peak in 1980, and lags at troughs in 1975, 1982, and 1993 by fairly short intervals.

Chart 4 presents real gross domestic product (GDP) in monthly interpolated form over the period 1963-2006. This most comprehensive Euro Area output series was developed by combining country level data from OECD and Eurostat before 1995 and more complete Euro Area data after 1995 from Eurostat.[8] It shows two declines that start from specific-cycle peaks in August 1974 and February 1992, which match exactly the dates of the corresponding Euro Area recessions (business cycle peaks). The May 1975 date of the first

[8] See Catherine Guillemineau with Jennifer Chao, “Business Cycle Indicators for the Euro Area.” See especially Introduction and section 1, “Construction of Euro Area Aggregates.”

covered recovery (business cycle trough) is also exactly matched by the GDP. However, the recession of March 1980-November 1982, while the longest of the three shown by the indicators of industrial production and employment, fails to be supported by a cyclical decline in real GDP, which only declines briefly at the beginning and end of this episode but otherwise continues to increase, though more slowly (see chart). At the last recovery covered in July 1993, real GDP shows a lead of five months.

Chart 5 combines the Euro Area coincident indicators (industrial production and employment, see Chart 3) with real GDP converted to monthly terms (as shown in Chart 4). This is the broadest index series available to us and based on the most authoritative data. Hence, we would like to use it for dating the business cycle recessions and recoveries in the Euro Area. The three shaded areas in Chart 5 and the peak and trough dates at the top of the chart identify these business cycles in monthly terms.

3. The New Business Cycle Chronology for the Euro Area

3.1 The Task Ahead

The indicators presented and discussed in section 2.1 represent variables that are expected to have "roughly coincident" timing, that is, to exhibit specific-cycle peaks and troughs that cluster around business cycle downturns ("recessions") and upturns ("recoveries"), respectively[9]. Industrial production, nonfarm or total employment, and real gross domestic product (GDP) measure different aspects of aggregate economic activity, and as such are all important, though they also differ in coverage. It is such comprehensive coincident indicator series that have long been used to identify and date business cycles in national economies[10].

Combining the individual indicators into composite indexes and using the resulting evidence to trace the growth trends and date the major fluctuations in Europe's overall economic

[9] Technically, their average timing should fall between -3 and +3 months (- and + referring to leads and lags respectively).
[10] This is, indeed , the primary characteristic of the "indicator approach" developed in the first half of the 20th Century by the National Bureau of Economic Research.

activity, while a serious undertaking in itself, is by no means the whole of it. It will be just as important to evaluate the quality of both the inputs and the outputs of this analysis. How good are the available indicators? How close is their consensus? How well do the results stand up to alternatives?

3.2 How Representative is the Indicator Sample?

There is no Euro nation and the Euro Area is a heterogeneous conglomerate with a short history of its own, but a long prehistory as a region of important nation states with major linguistic, cultural, and economic differences. This is the basic reason why it has been so difficult to produce a really long and rich collection of statistical indicators for the Euro Area. The existing time series are comprehensive but short and limited to manufacturing and industrial production indexes (MP and IP), total employment in numbers working (EMP), and real GDP.

Many business cycle phases are short, so high-frequency data (long enough to qualify for a proper seasonal adjustment) are needed for their identification and analysis. IP and MP are monthly, while GDP and EMP are quarterly, hence less suitable for the task. On the other hand, GDP and the underlying national income and product accounts provide the most comprehensive as well as the most detailed data on the output of the area's economic activity. Some European experts concluded that quarterly reference dates based primarily on GDP are the best estimates that can be obtained here (see below in the CEPR chronology).

Table 1 is designed to help answer the question of how good the cyclical timing consensus is for the sample of the available statistical indicators of Euro Area aggregate economic activity. It lists, for each of these individual indicators and composite indexes, all measures of cyclical timing that count in this context. This includes the leads and lags at each of the six selected reference dates, their averages and standard deviations, and the numbers of extra turns and missed turns.

Manufacturing is known to be a particularly cyclical (and often volatile) sector of the economy. Table 1 (col. 1) lists four “extra” peaks and four “extra” troughs in industrial production (IP). This means four specific-cycle declines that do not correspond to general recessions (see the “x” turns in Chart 1, which mark these generally short but well articulated declines). IP does not miss any of the recessions it covers (note that it does not cover the 1974-75 recession). Where IP matches the reference turns, it does so with perfectly coincident timing. Total employment (col. 2) matches all turns of all three business cycles covered, but with sizable leads and lags. It starts in 1960 and shows clearly a lengthy cyclical decline in 1964-1967 (see Chart 2), but no other Euro Area indicator is available to corroborate this movement. Eurostat’s real GDP series, which starts in 1963, shows a strong rise in this period (chart 4), so the 1964-68 employment decline is, somewhat hesitantly, considered an “extra” movement.

When combined, the monthly production and employment series yield an index that supports the occurrence of three Euro Area recessions in the period since 1970 (see Table 1, column 3, and Chart 3). The evidence from real GDP deepens and widens the support for the first and third of these episodes in 1974/75 and 1992/93, but it shows no continuing decline, only a directionally mixed movement producing an overall slowdown, in the middle episode, 1980-82 (see Chart 4). Not only the basic Eurostat series, but also several real GDP estimates using different aggregation methods “miss” the 1980-82 recession (see Table 1, line 2, columns 4-9).

3.3 Lessons from Country Indicators and Area Details

The apparent disagreement between (1) IP plus EMP, which together indicate that a recession did prevail in 1980-82 across the Euro Area, and (2) GDP, which is more ambivalent about it, is unquestionably the single most difficult problem presented to us by the existing, creditable data. How is it to be resolved?

Empirical questions like this require a close and critical analysis of all relevant data, including, in this case, country as well as area indicators. A comprehensive analysis of industrial production, employment, real manufacturing sales, and real GDP data for Germany shows conclusively a consensus of cyclical declines in these series during the years 1980-82[11]. For France, a shorter recession in 1980-81 is similarly indicated by data on industrial production, nonfarm employment, personal consumption of durable goods (deflated), real household disposable income, real GDP, imports and wages and salaries. Chart 6 reproduces the TCB coincident indexes for France (1970-2006) and Germany (1965-2006) from the January 2007 Business Cycle Indicators. At this point, it is helpful to note that France and Germany together have accounted for slightly more than half of the Euro Area's aggregate economic activity throughout the period since 1995 for which Eurostat has quarterly aggregated GDP data available for the entire Euro Area.

The recent era was characterized by services growing faster and in a more stable fashion than goods throughout the world's market economies. GDP covers both goods and services, IP covers only goods; hence GDP shows stronger upward trends and weaker cyclical movements than IP. This helps explain some of the observed discrepancies that are at issue here. So, is a certain detail hidden by these discrepancies? It is worth noting that real GDP does itself show short but definite declines at the beginning and end of the 1980-82 phase. Its intervening movement has been weakly upward but longer, hence the overall pattern that looks more like a slowdown than a decline. But arguably, it was a time when forces of expansion and contraction were engaged in tight struggle. The positive factors may have had a stronger hand in shaping total output/real income (GDP) but the negative factors are seen as prevalent when goods production and total employment are given more weight (see charts 4 and 5; also charts 1 and 2).

In sum, our review of the data and the cyclical evolution of the coincident indicators suggest that the verdict of all these indicators clearly favors the outcome depicted in Chart 5: three Euro Area recessions during the last four decades, in 8/74-5/75, 3/80-11/82, and 2/92-7/93. As will be shown in the next section, the answer to the third question and the dating of the

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[11] See Jennifer Chao, Ataman Ozyildirim and Victor Zarnowitz, "Economic Growth and Fluctuations in Germany: Lessons from 2006 Benchmark Revisions," unpublished manuscript, The Conference Board, 2006.

Euro Area coincident index turns out to be fairly consistent with alternative chronologies developed elsewhere.

The longest of these recessions was also, strangely, the least widely diffused. During the 1980-1982 recession, GDP growth slowed but was not halted, whereas during the recessions of the 1970s and 1990s, Euro Area GDP declined. The three contractions lasted 9, 17, and 32 months, respectively. The first expansion covered, had a duration of 58 months, the second had a duration of 111 months, and the third, still ongoing, had lasted 155 months as of June 2007. This evidence is consistent with the hypothesis that business cycles are gradually moderating everywhere. (The United States data provide the strongest support for this thesis.)

The 1992-93 recession in the Euro Area was followed by an extraordinarily long expansion. Current observers perceived no end to it as of the spring of 2005[12]. Yet our monthly coincident index for Germany (including real GDP) shows a definite cyclical decline in the period from May 2001-August 2003, as shown in Chart 6. A probable reason why the Euro Area CEI shows no such decline during this period is that the European economy remained strong during the early years of this decade apart from the recession in Germany. France had a later, shorter, and milder recession in August 2002-June 2003, while Spain had no recession at all after 1993 (Chart 6). The coincident index constructed by combining industrial production, employment, and real GDP for the Euro Area as a whole shows greater strength than an alternative index constructed by combining national CEI's for Germany, France, and Spain (Chart 7). The (GE + FR + SP) index shows little growth but no decline in 2001-2003; the (IP + EMP + GDP) index shows somewhat more growth in the same period; and neither index suggests an area wide recession.

[12] Emanuel Munch and Harald Uhlig, "Towards a Monthly Business Cycle Chronology for the Euro Area," SFB 649 Discussion Paper, University of Berlin, 2005.

3.4 Comparison with Alternative Chronologies

Table 2 shows how the Euro Area business cycle chronology developed in this paper (column 1) compares with the dates reported by five independent authoritative European sources: (columns 2-6). CEPR, the Center for Economic and Policy Research, appointed a Business Cycle Dating Committee, loosely following the lead of the National Bureau of Economic Research in the United States. The CEPR chronology is quarterly but it is based on a broader range of indicators, not just on GDP. Using the center months of the turning point quarters of CEPR (column 2), we find a close correspondence with our own monthly dates (column 1). The numbers in parentheses listing the leads (-) and lags (+), in months, are three exact coincidences (0) and three short leads and lags between -3 and +1.

The dates that result when OECD aggregations of Euro Area data are used (in both its “single country” and “common currency” approaches) are not really another broadly based reference cycle of their own (and not actually claimed to be as such). Rather, they simply reflect the cyclical timing of the Euro Area’s GDP, and so agree fully with the corresponding entries for Eurostat GDP (which are not affected by the different aggregation methods). Only one of the four OECD dates, relating to the 1993 trough, differs from ours, so this comparison yields three coincidences (0) and one lead (-5; see columns 1 and 3). But one big difference is that the OECD interpretation of GDP data for that period does not recognize the 1980/82 recession.

Both the large working papers of the European Central Bank (FHM, column 4) and the study in methods of the Euro-zone data reconstruction (BDH-2001, column 5) recognize that a recession in the early 1980s did occur, but they put an end to it about two years earlier than we do, in early 1981 or even late 1980. Except for this episode, the timing discrepancies between their dates and ours are all relatively small. The reconstructed BDH data start in 1980, hence they do not cover the 1974-75 recessions (see the “n.a.” markings in column 5).

The history of the Euro Area is not only short but also full of structural changes and shocks with consequences difficult to assess. Backcasting and aggregating the national data to gain longer area-wide time series is beset by problems of statistical estimation. All this makes the task of constructing a reliable business cycle chronology for the Euro Area particularly novel and difficult. Hence, a careful and critical evaluation of the results is much needed, and itself hard to obtain. Our own close look at the indicator sample assembled and used here, lessons from country indicators and area detail, and comparison with alternative chronologies, disclose much common ground and relatively few significant discrepancies, which is generally encouraging.

4. Individual and Composite Leading Indicators

4.1 The Reviewed and the selected series

Table 3 shows a list of potential leading indicators we reviewed for this project. Most of the series are available from the mid-1980s on, but a few financial variables begin in the latter part of 1960s and 1970. These are monetary aggregates and interest rates, which probably reflects the easy availability and relatively straightforward aggregation of financial data. Table 3 also shows some series beginning only in the second half of the 1990s such as new orders for capital goods and housing permits. Starting the calculation of our LEI from 1987 ensures that at least half of the components are available in the first half of our sample.

The candidate series we propose to include in the LEI for the Euro Area are

1) Economic Sentiment Index (European Commission),
2) Index of Housing Permits Granted measured in square meters (Eurostat),
3) Index of Capital Goods New Orders (Eurostat),
4) Eurostoxx stock price index (Dow Jones),
5) European Central Bank (ECB) monetary aggregate (M2) for the Euro Area (deflated using a consumer price index), (Eurostat),
6) Interest rate spread constructed from interest rate data (ECB),
7) Eurozone Manufacturing Purchasing Managers' Index (NTCEconomics), and

8) Eurozone Service Sector Future Business Activity Expectations Index (NTCEconomics).[13]

The rest of this section presents a brief overview of the cyclical performance of the proposed leading index. In our evaluation of the candidates as well as the proposed LEI, we have relied on the Euro Area business cycle chronology developed above in section 2. The dates of EA business cycle peaks and troughs are listed above the charts and the corresponding recessions are marked by shaded columns.

Table 4 shows the cyclical timing of the selected leading indicators at peaks and troughs of the Euro Area turning points. Because of the fewness of the available observations, an accurate evaluation regarding the suitability of these components as leading indicators is very difficult. However, combining them according to the standard composite index methodology results in a composite index that appears to conform well to the cyclical fluctuations of the CEI and GDP in the Euro Area.

4.2 The Proposed Euro Area LEI in Two Versions

Chart 8 shows the coincident index combining industrial production and employment for the Euro Area which was discussed in section 2.[14] Two versions of the LEI are also plotted in Chart 8. The Euro Area leading economic index (LEI EA) begins in 1987 and therefore covers only the last of the three recessions identified since 1970 by Euro Area CEI and GDP. It shows one major contraction from July 1989 to July 1993, leading the Euro Area business

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[13] Among the other series we also considered as potential leading indicators were: The HWWA Commodities Price Index (The Hamburg Institute of International Economics, HWWA), the value of Euro Area exports, and the volume of oil imports of the Euro Area. But because of their shortcomings as cyclical indicators discussed below we decided not to use them in the LEI. For a brief review of all of the series considered see, Ozyildirim et. al. (2007).

[14] The specific cycle turning points in this series labeled CEI (IP+E), along with their counterparts in Euro Area real gross domestic product (GDP), are used to determine the chronology of Euro Area business cycles. The dates of EA business cycle peaks and troughs are listed above in Chart 8, and the corresponding recessions are marked by shaded columns.

cycle peak in February 1992 by 31 months and coinciding with the trough.[15] Also, this leading index had one large extra contraction from February 2000 to December 2001 during which a slowdown in the Euro Area activity is clearly indicated by CEI (IP+E) in the chart.

The LEI (EA) is only available for the last two decades. But the leading indicators for Germany, France, and Spain, published by The Conference Board, are available since 1965, 1970, and 1984, respectively. Chart 8 shows a composite index constructed as an average of the LEIs for Germany, France and Spain, with weights based on shares of real GDP for each of these three countries relative to the Euro Area GDP.[16] This index, LEI (FR+GE+SP), and the one for the Euro Area as a whole, LEI (EA), have moved in a closely parallel fashion over the period 1987-2007 which they both cover. Their high correlation is encouraging.[17]

Table 5 compares LEI (EA), the proposed Euro Area index with eight components, and LEI (FR+GE+SP), the weighted average index for three countries, with respect to their cyclical timing. They both have very long leads at the February 1992 business cycle peak and nearly coincident timing at the July 1993 trough. They have some common extra turns and no missed turns. The long leads at the peaks and the short leads or coincidences at the troughs are common to both indexes (which is a frequent timing pattern generally). We conclude that Table 5 confirms Chart 8 in showing that LEI (EA) and LEI (FR+GE+SP) have broadly similar cyclical properties and timing.

Will the more comprehensive leading index available for the Euro Area from 1987 on continue to track well the cyclical turning points and phases of EA in the future? Forecasting the performance of any such complex devise is hazardous. But the internally consistent and generally positive findings reported above support our cautious optimism.

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[15] Leads ahead of troughs are generally short or, in some cases, nonexistent. The Euro Area LEI presents an extreme example where the LEI trough coincides with the business cycle trough in July 1993. Following this trough, the index shows a very sharp and rapid recovery.

[16] The weighted average is constructed starting in 1970. The GDP of these three countries together comprise 64.5 percent of the Euro Area GDP. The LEI's are averaged by using real GDP shares in constant 2000 Euros as weights.

[17] In levels, the correlation coefficient between the two series is 0.95 and in log differences it is 0.62.

4.3 Euro Area LEI in Real Time: Making It More Timely

A close inspection of the monthly releases of our composite indexes makes it apparent that typically not all of their latest components are available concurrently at any given time. If we wait for the longest publication lags to pass so that all components are available, the new indexes will often arrive too late and be overtaken by more current developments. Thus, timely publication of the indexes may require having less than complete information on all of the index components.

McGuckin, Ozyildirim, and Zarnowitz (2007)[18] look at this tradeoff and discuss a procedure to make the US LEI more timely. That paper uses a simple imputation procedure to fill in the gaps in data availability with second order autoregressive forecasts of the missing variables. The authors argue that the disadvantages of the procedure are outweighed by the advantages of making the LEI available sooner. This is so because the forecasts are short-lived (they are replaced with actual values that become available within a few months) and relatively accurate (because their errors tend to offset each other). The paper provides empirical evidence that the LEIs that incorporate the new procedure gain significantly in timeliness (earlier publication). Although prompter, the new LEI retains a significant ability to forecast, out of sample, the growth of CEI, using real time (unrevised) data.

In this section, we look first at the possibility and effectiveness of using a similar imputation procedure in publishing the Euro Area LEI. Then, we ask how well our LEI performs in predicting the cyclical growth of its target, the Euro Area CEI, which itself is made more timely. How do the leading and coincident indexes with shorter publication lags differ from the actual indexes which become available later when all their components become available in revised form? We use out-of-sample forecasting exercises with the existing revised data in order to create "pseudo real-time" vintages, but leave the compilation of the real time unrevised data to future extension of this research.

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[18] Robert McGuckin, Ataman Ozyildirim and Victor Zarnowitz, "A More Timely and Useful Index of Leading Indicators," Journal of Business and Economic Statistics, January 2007.

We considered two possible publication schedules for the statistical agency's release of monthly LEI data.

Scenario one: Mid-month releases have two-month lags, e.g., the March index is published in mid-May.

Scenario two: End-of-month releases have one-month lags, e.g., the March index is published in late April.

Clearly, scenario two is more prompt than scenario one, but it results in less complete data.

For yield spread, money supply, the stock index, economic sentiment index, purchasing managers' index and business expectations index, all data are available. The index of new orders of capital goods index must be forecast one month ahead and the index of residential building permits must be forecast two months ahead. Hence, it turns out that the same amount of imputation needs to be done under either scenario for the LEI. In the case of the CEI, however, the two scenarios impose different forecasting requirements. For example, CEI for March produced in mid-May, will include IP and retail sales, but employment and manufacturing sales would have to be forecast. If the March CEI were produced instead in late April, IP and retail sales each would have to be predicted for March; manufacturing sales for February and March, and employment for December through March.[19] As shown by these examples, data for two of four components of CEI are available for release under the first scenario, while all four components would have to be forecast at least one month ahead under scenario two.

Before we discuss the out-of-sample forecasting performance of the LEI, we need to assess the extent of the forecast errors due to the imputations required by these scenarios. The

[19] Employment is a quarterly series that is released in the middle of the final month of a quarter. In using it for the CEI we transform it into a monthly series through linear interpolation. Therefore, under scenario 1 it must be forecast for 2 months ahead for production of the first month of a quarter, 3 months ahead for the second month of a quarter and four months ahead for the third month of a quarter. In contrast, because the most recent quarterly data won't have been released yet under scenario two, employment would be forecast for FIVE rather than TWO months ahead in the index production for the first month of a quarter.

assessment of the procedure to make the indexes more timely and the forecasting performance both require vintage datasets of the index components, the CEI, and the LEI. A vintage dataset has become the standard way to represent samples of real time data. These vintage datasets or real-time datasets are diagonal matrices where each column of a matrix adds one additional month of data; see for example, Diebold and Rudesbush , 1999)

Taking the revised historical data for the index components from 2007, we created pseudo-vintages of each variable for every month from 2002 through 2007. To do this, we split the sample of available data, which starts from 1987, into (1) an estimation sample 1987 -2001 and (2) an out of sample evaluation sample 2002-2007. Each of the pseudo-vintages have in common the sample of data for 1987-2001. Table 6 illustrates the structure of the dataset. The vintages are organized in a diagonal matrix, where the first column runs from 1987 to January 2002. Each consecutive column adds the next month's observation. Thus, the next pseudo-vintage (in the second column) consists of data through February 2002, and so on, until December 2007 (the last column). Hence, there are 72 (re-created) pseudo-vintages of component data in our dataset, each vintage starting in January 1987. This re-construction of the pseudo-vintages purposely ignores revisions of data as this allows us to focus only on the forecast errors caused by the procedure to make the indexes more timely.

As discussed above, under either scenario one or two some of the index components will not be available due to publication lags. The re-construction of the vintages takes these data gaps into account and approximates the publication lags that would have occurred had these data been published in real time. Thus, for the components which would have had missing observations at the end of the sample we implemented the same procedure to fill in for the missing observations.

These pseudo-vintages of component data are historical sequences available each successive month. They only differ near the end of each sample due to the different forecasting requirements, but are otherwise identical samples or nearly so. Each pseudo vintage of component data gives rise to a pseudo vintage of CEI or LEI data. Using these pseudo-vintages of components, we calculated corresponding vintages of LEIs and CEIs that would have been published in each of the 72 months between January 2002 and December 2007. Only the data available up to the last release month, and forecasts made with these data, are comprised in each pseudo-vintage of either index. Accordingly, each vintage is labeled by the month of the last release.

Chart 9 compares CEI in final revised form with CEI in pseudo real-time as derived from our vintage estimates under scenario one (Panel A) and under scenario two (Panel B). Each of the two pairs of series plotted displays an almost perfect positive correlation. This indicates that our imputations of missing data in the index components had in the end only very limited net effect.

The imputation procedure introduces some forecast errors, but these errors are fairly small. This can be inferred not only from the level comparisons in Chart 9 and 10 but also from the parallel comparisons of one-month and six-month changes in real time and final-revised CEI and LEI. The errors get larger in scenario two, which involves more forecasting, as expected.

For LEI, as well as CEI, comparisons of real time values with its revised values for each month in the sample 2002-2007 show that the imputation procedure used to make the indexes more timely does not cause a significant divergence from the revised values that are calculated at the end of 2007. In terms of levels, monthly percent changes, and six-month percent changes the real-time LEI and revised LEI are highly correlated in the sample shown in the charts below (2002-2007).

These findings suggest that the monthly publication of the composite indexes is unlikely to suffer from significant forecasting errors due to the imputation procedure and also that the forecasts made with these indexes and the interpretations of the cyclical dynamics in real time are not likely to be negatively affected to any large extent.

5. Forecasting the CEI with the LEI in Real Time

5.1 Forecast Models

We evaluate the forecasting power of the leading index by using a simple autoregressive equation as a benchmark and asking whether adding LEI to this model reduces out of sample forecast errors significantly. These assessments follow the previous approaches of Diebold and Rudebusch (1999) and McGuckin et. al. (2007) among others. The objective of these exercises is to determine whether forecasts of the final (historical) version of CEI, which incorporates all revisions, are improved when real-time LEI is added to the (already rather effective) autoregressive model.

Since both LEI and CEI have upward trends in levels, it is appropriate to use growth rates in these variables or to detrend them.[20] We worked with one-month ahead, three-month ahead and six-month ahead forecast horizons and tested the results. These horizons are commonly used by practitioners who forecast with high-frequency indicators. To be useful, LEI should be capable of anticipating changes in CEI over these near-term intervals.

Our benchmark models are simple autoregressions with specified lags of real time CEI. The alternative models use lags of real-time LEI, in addition to the lags of real-time CEI that constitute the benchmark models. Each of the 72 vintages in our dataset provides inputs for forecasts of CEI. Because the in-sample period ends in January 2002, the first forecast for the one month horizon is made for February 2002, while the first forecast for the six month horizon is made for July 2002[21].

All of our forecast models come in two sets, one estimated in six-month logarithmic differences for CEI and LEI, and the other in deviations from their own trends for the same

[20] For the US LEI, Camacho and Perez-Quiros (2002, pp. 62-63) note that 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.

[21] Therefore, a total of 71 forecasts are made for the one month horizon, 69 are made for the three month horizon, and 66 are made for the six month horizon.

variables. We use the Hodrick-Presscot trend with Ravn-Uhlig modification.[22] All of our models use pseudo real-time indexes on both the left hand side of the equation and the right hand side.[23]

The benchmark models are specified according to the formula:

$$CEI_t = \sum_{i=1}^{k} d_{1,i} CEI_{t-i} + e_{1,t}$$

where CEI_t denotes either detrended values of CEI or six month changes in natural logs of CEI. We start from the maximum lag k=6, but also consider two cases where the number of lags is chosen optimally for each model. The first of these works by selecting the number of lags that minimizes the Akaike Information Criterion (AIC). The second repeats the lag selection by using the Schwartz Information Criterion (SIC).

In the alternative models, we add lags of the pseudo real time LEI to the benchmark equation in the following way

$$CEI_t = \sum_{i=1}^{k} d_{1,i} CEI_{t-i} + \sum_{i=1}^{k} d_{2,i} LEI_{t-i} + e_{2,t}$$

where LEI_t denotes either detrended values of LEI or six month change in natural logs of LEI. Again, the number of lags, k, are either fixed at 6 lags or chosen optimally by minimizing the AIC and SIC[24].

---

[22] Detrending the composite indexes requires that an appropriate long term trend be estimated. In this we follow the guidance of Zarnowitz and Ozyildirim (2006) who compared different trend estimation methods used in the recent literature, such as Hodrick-Presscot and band pass filters, with the Phase Average Trend method used by the traditional NBER approach. They argue that if the smoothing parameters are chosen appropriately more sophisticated methods compare well with the PAT method for business cycle analysis. Specifically, they found that the Hodrick-Presscot trend estimated with a lambda parameter of 108,000 is almost identical with the PAT. Similarly, Ravn-Uhlig (2001) argue for a smoother trend, especially for higher frequency data. And this approach has already been incorporated into major statistics packages (i.e. Eviews 6.0). Thus, because of its appropriate trend estimation and computational ease, we have decided to use Ravn and Uhlig's modification of the Hodrick-Prescott trend.

[23] Though we have considered two production schedules for the coincident index, the results of the forecasting exercises are virtually identical whether scenario one or scenario two is used.

[24] For choosing the optimal lag in three month ahead forecast models the maximum lag we start from is k = 8. And for six month ahead forecast models the maximum lag is k = 11. To find the optimal lag, we follow a general to specific procedure by specifying the regression with a maximum number of lags, and reduce the number of lags until the information criterion is minimized.

These benchmark and alternative models are used to generate forecasts for three different forecast horizons: one-month ahead, three-month ahead and six-month ahead. For example, for the six-month ahead case, the benchmark model is specified as

$$CEI_t = \sum_{i=6}^{k} d_{1,i} CEI_{t-i} + e_{1,t}$$

And the alternative model is specified as

$$CEI_t = \sum_{i=6}^{k} d_{1,i} CEI_{t-i} + \sum_{i=6}^{k} d_{2,i} LEI_{t-i} + e_{2,t}$$

For each vintage in our sample we estimate all the fixed-lag and optimal-lag models and form the one, three and six-month ahead forecasts of CEI (in both detrended form and six-month log changes). Subtracting these forecasts from the corresponding revised values of CEI[25] gives us sequences of out-of-sample forecast errors for each model and horizon. We summarize these sequences for all models by an estimate of the root mean square error (RMSE). We also report the Mean Absolute Deviation (MAD) of the forecast errors.[26]

5.2 Findings

We find that RMSE and MAD of the alternative models are generally lower than the benchmark models, and that this improvement in forecast performance due to the inclusion of LEI is statistically significant as discussed below. Table 7 shows, in percentage terms, the reductions in the out-of-sample errors of our set of CEI forecasts that result from adding the LEI to the benchmark model. The reductions are reported in both the mean absolute deviation (MAD) and root mean squared error (RMSE). Table 7 shows the results for each of the two scenarios discussed above: in Panel A for Scenario 1, and in Panel B for scenario 2. When detrended values of the indexes are used to estimate the models the improvement in

[25] The revised CEI is obtained by calculating it using data from May 2008.

[26] Mean squared error is defined as $MSE = \sum_{t=1}^{n} e_t^2 / n$, where n is the number of out of sample forecasts and e_t refers to the out of sample forecast errors. Mean absolute deviation is defined as $MAD = \sum_{t=1}^{n} |e_t| / n$.

forecast performance is fairly high. Adding LEI to the forecast model leads to an improvement of about 5 percent in the one-month ahead horizon and the improvement is larger for three months ahead and six months ahead horizons Table 7 see cols. 1-2). For three months ahead forecasts the improvement from adding LEI is about 8 or 9 percent. For the six months ahead forecasts, the detrended data even show an improvement of about 14 to 16 percent (Table 7, see cols. 1, 2). The selection of the optimal number of lags by using AIC or SIC does not appear to have an adverse effect on this result.[27]

While the forecast models estimated with log changes still benefit from the inclusion of LEI, they show lower improvements in percent terms (Table 7 col. 3 and 4). The addition of LEI to the benchmark model results in an improvement between approximately 1.0 to 2.6 percent when forecasting one month ahead (see Table 7 col. 3 and 4). The gains increase to about 3.6 to 5.2 percent when forecasting three months ahead (Table 7 col. 3 and 4). However, increasing the horizon further deteriorates the forecasting ability, as might be expected, and forecasting six months ahead the improvement from the inclusion of LEI is about 4.2 to 4.6 percent, about the same as the three month ahead forecast improvement. In fact, if the number of lags is chosen optimally by information criteria either AIC or SIC, adding LEI to the forecast model is unable to beat the autoregressive forecast. This suggests that the forecast models estimated with log changes may not be able to properly account for the autocorrelation introduced by taking log changes over six month spans and it may be nearly impossible to improve on the autoregression of the CEI.

[27] Neither does the publication scenarios appear to change the results even though they have an effect on the pseudo real time CEI and LEI.

5.3 Significance Tests

Our tests compare models that are "nested," since one set is derived by adding a variable to another set. Therefore, standard tests such as the popular Diebold-Mariano (DM) test are not appropriate because under the null hypothesis of equal predictive ability, the limiting distribution of the DM test is not normal (see McCracken, 2000, and Clark and McCracken, 2001). Nonetheless we include the DM statistic and p-values in our chart because the DM test is widely used. The recent literature on significance tests for choosing between nested models provides some alternatives that could be used.[28] We looked at two of these: 1) CCS, developed by Chao, Corradi, and Swanson (2001), which has an χ^2 distribution with degrees of freedom equal to the number of extra explanatory variables[29], and 2) ENC-NEW, an alternative encompassing test statistic proposed by Clark and McCracken (2001), which has a nonstandard distribution. In the summary tables, we report results based on both tests as well as the DM test.[30] It is worth noting that one advantage of the CCS test over the ENC-NEW test is that it is applicable to all forecast horizons.[31]

Tables 8 and 9 mirror the format of Table 7 in reporting the relevant tests of statistical significance. Diebold-Mariano, ENC-NEW, and CCS test statistics and the associated p-values are reported for the publication scenarios one and two in Tables 8 and 9, respectively. These tables confirm that, for most of the forecast horizons considered, our findings on the

[28] For a review of these newly developed tests see Corradi and Swanson, 2003.
[29] This assumes that the parameter estimation error vanishes. See Corradi and Swanson, 2002, for a more general version of this test.
[30] In these tests, the null hypothesis is that the sequence of out of sample forecast errors from the benchmark autoregressive model is not different from that of the alternative model that includes the LEI.
[31] Therefore to extend the range of the available comparisons, we have calculated the ENC-NEW for all cases, even where it isn't strictly appropriate.

improvement in forecast performance due to the addition of LEI to the benchmark model are statistically significant.

We conclude that the addition of detrended LEI to the autoregressive benchmark models of detrended CEI leads to significant reductions in out of sample errors for forecasts of one-, three- and six-month ahead. Forecasts of log changes in the CEI also show an improvement when log changes of LEI are added to the benchmark model, but the results are less uniform for longer horizon forecasts. The improvements in forecasting performance are generally significant according to each of the three test statistics we have examined: the Diebold-Mariano, ENC-NEW, and CCS. Moreover, these improvements are comparable to the reductions in mean squared errors achieved in the real time forecasting exercises for the US indexes, as reported by Ozyildirim, McGuckin and Zarnowitz (2007).

6. Summary

In this paper we have reviewed a sizable collection of high frequency indicator data that are available for the Euro Area and selected those that had the best trend/cycle attributes. We then developed a business cycle chronology through the construction of a composite index of coincident indicators (CEI). Next, we developed a composite index of leading indicators (LEI) with the aim of predicting cyclical downturns and upturns represented by the CEI.

Finally, we have discussed the real time properties of the indexes, using an imputation procedure that makes the indexes more timely than otherwise possible, given the data publication lags. We find that this procedure, while introducing some forecast errors, has fairly small net effects on the composite indexes. We also presented our findings on the out-of-sample forecasting performance of the LEI, which suggest that the LEI can significantly improve on autoregressive benchmark models of the CEI.

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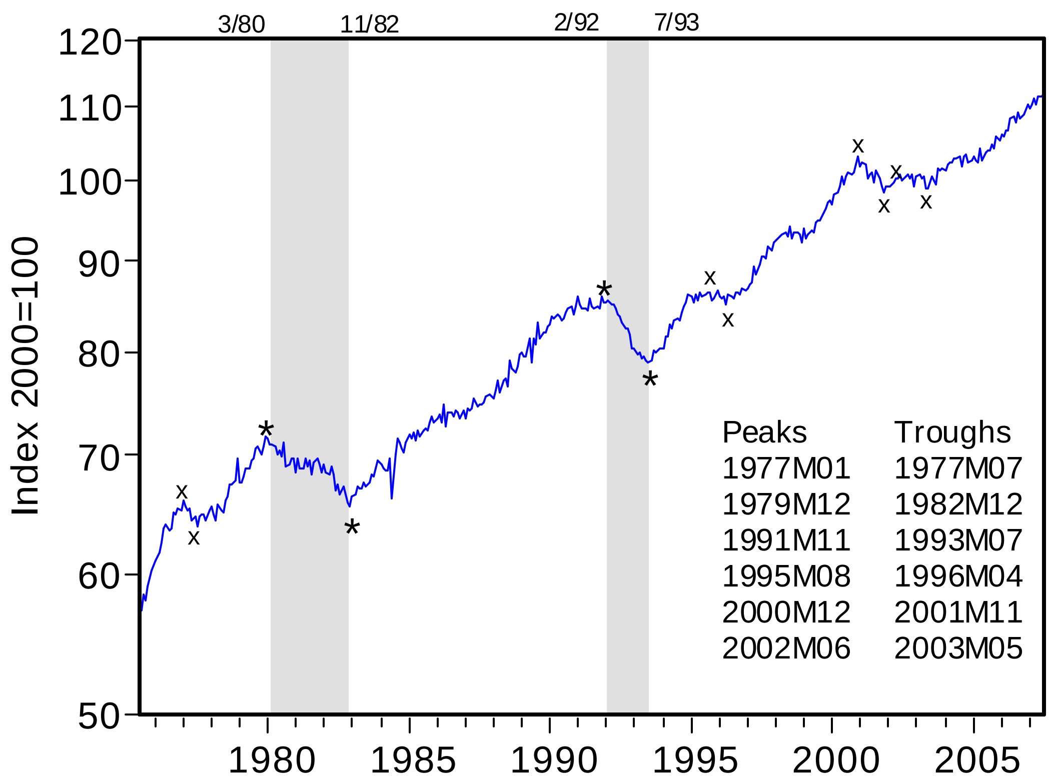
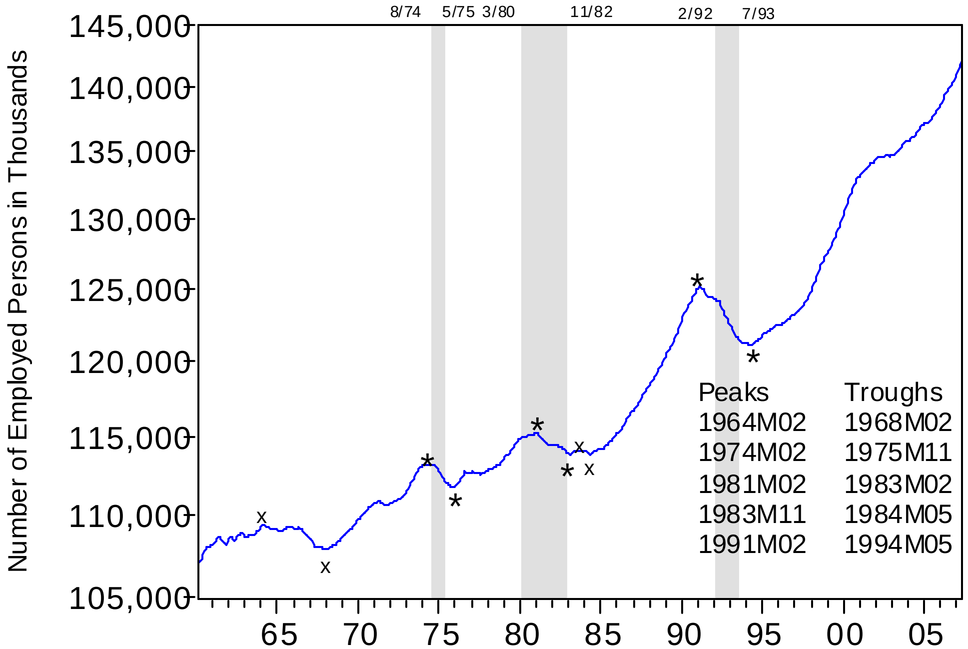
Chart 1
Index of Industrial Production for the Euro Area
1975-2007



Eurostat IP Series for EA from 1990-Present
Spliced with OECD series from 1975-1990

Chart 2
Euro Area Employment, 1960-2007
Monthly Series, Interpolated from Quarterly Data



Eurostat Euro Area employment for 12 countries since 1991.
Spliced with an aggregate of national Employment data
from Eurostat and OECD for 1960-1990

Chart 3
Euro Area Composite Index of Industrial Production and Employment
1960-2007
Sources, OECD, Eurostat, TCB

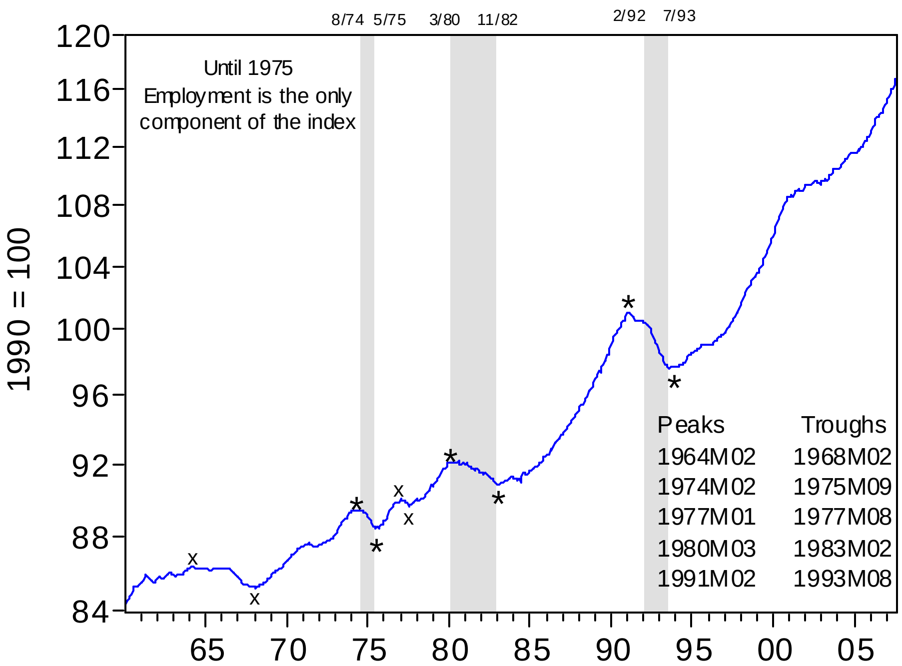
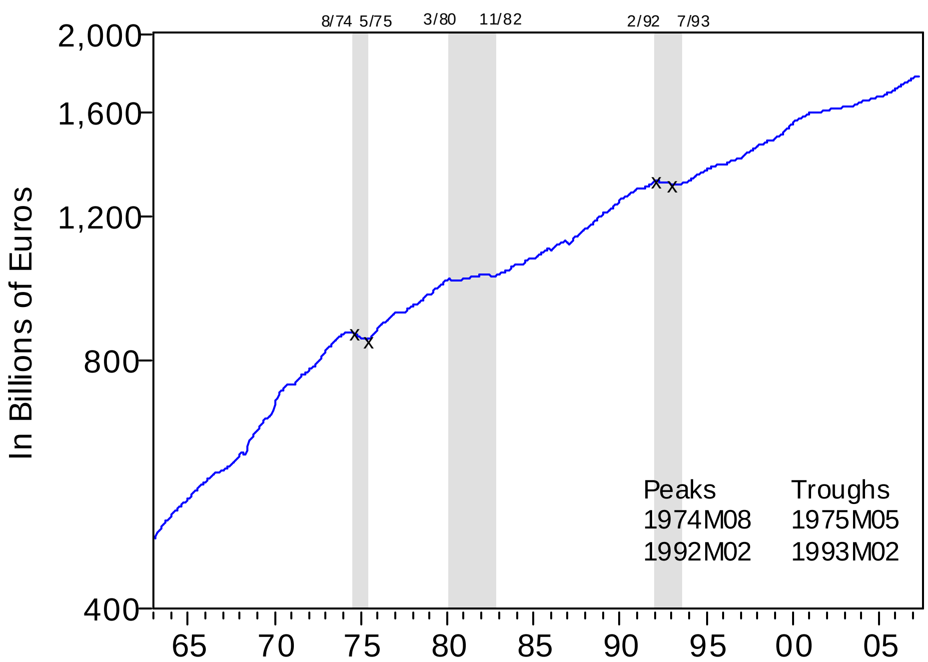


Chart 4
Euro Area Real Gross Domestic Product
1963-2007
Seasonally Adjusted, Constant Prices



Eurostat data for the Euro Area 12 countries since 1995 spliced with country level data from OECD and Eurostat combined to form aggregate for Euro Area prior to 1995.

Chart 5
Euro Area Coincident Economic Index (CEI) Including
Real GDP, Industrial Production and Employment
1970-2006

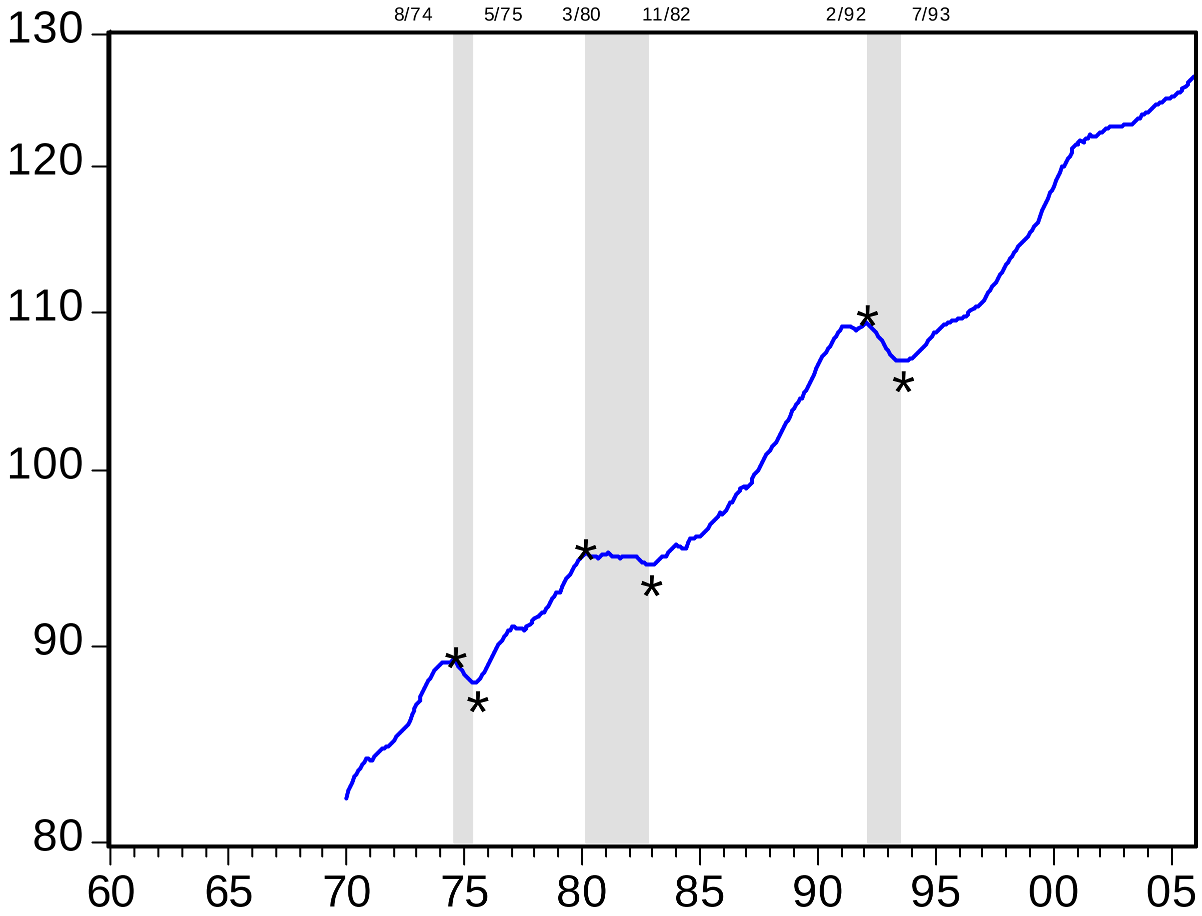
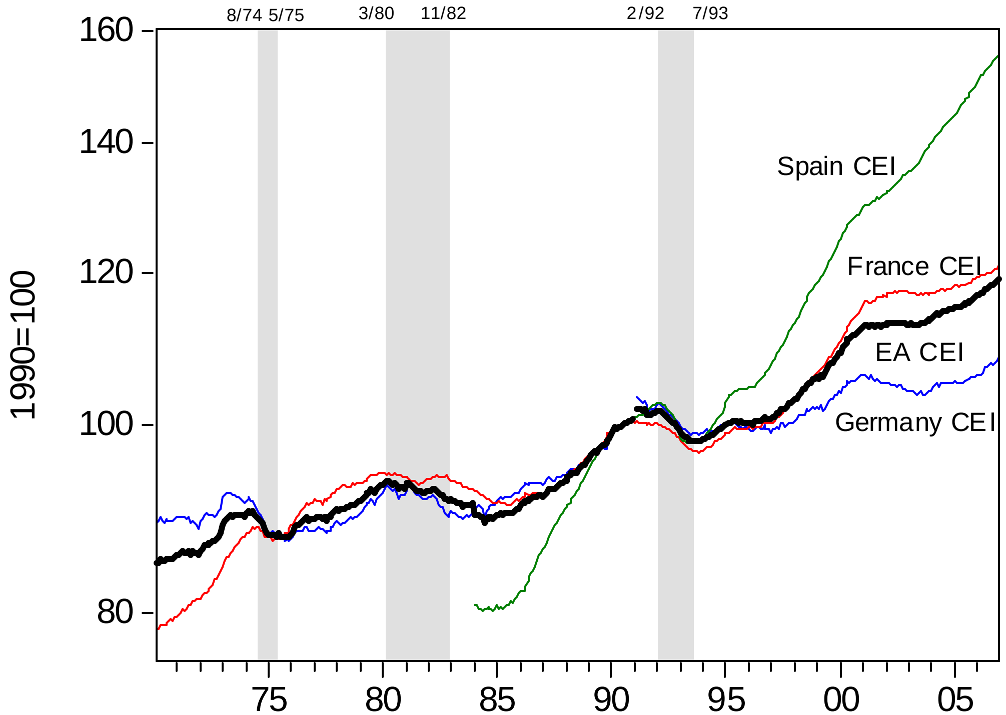


Table 1
Cyclical Timing of Selected Coincident Indicators of Euro Area Economic Activity 1974-2007

Line	Turning Points for Euro Area Business Cycles (Only those 1970-2005)	1 Industrial Production OECD	2 Employment Eurostat	3 Industrial Production and Employment Combined	4 GDP Using AWM Eurostat	5 GDP Using BDH Eurostat	6 GDP Using BDH and PPP Eurostat	7 GDP OECD Single Country Eurostat Data	8 GDP OECD Single Country Eurostat Data	9 GDP 1995 ESA	10 Overall Composite Index (IP, Employment and Real GDP)
	Timing at Business Cycle Peaks										
1	**Aug-74**	n.a.	-6	-7	0	0	-3	0	0	0	0
2	**Feb-80**	0	12	0	n.m.	n.m.	n.m.	n.m.	n.m.	n.m.	0
3	**Feb-92**	-1	-12	-13	0	0	0	0	0	0	0
4	**Extra Turns**	4	1	1	0	0	0	0	0	0	0
5	**Missed Turns**	0	0	0	1	1	1	1	1	1	0
6	**Mean**	-0.50	-2.00	-6.67	0.00	0.00	-1.50	0.00	0.00	0.00	0.00
7	**Median**	-0.50	-6.00	-7.00	0.00	0.00	-1.50	0.00	0.00	0.00	0.00
8	**St. Deviation**	0.58	12.49	6.51	0.00	0.00	1.73	0.00	0.00	0.00	0.00
	Timing at Business Cycle Troughs										
9	**May-75**	n.a.	6	4	0	0	0	0	0	0	0
10	**Nov-82**	0	3	4	n.m.	n.m.	n.m.	n.m.	n.m.	n.m.	0
11	**Jul-93**	0	7	6	-5	-5	-5	-5	-5	-5	0
12	**Extra Turns**	4	1	1	0	0	0	0	0	0	0
13	**Missed Turns**	0	0	0	1	1	1	1	1	1	0
14	**Mean**	0.00	5.33	4.67	-2.50	-2.50	-2.50	-2.50	-2.50	-2.50	0.00
15	**Median**	0.00	6.00	4.00	-2.50	-2.50	-2.50	-2.50	-2.50	-2.50	0.00
16	**St. Deviation**	0.00	2.08	1.15	2.89	2.89	2.89	2.89	2.89	2.89	0.00
	Combined Statistics										
17	**Mean**	-0.25	1.67	-1.00	-1.25	-1.25	-2.00	-1.25	-1.25	-1.25	0.00
18	**Median**	0.00	4.50	2.00	0.00	0.00	-1.50	0.00	0.00	0.00	0.00
19	**St. Deviation**	0.41	8.96	7.48	3.54	2.04	2.16	2.04	2.04	2.04	0.00

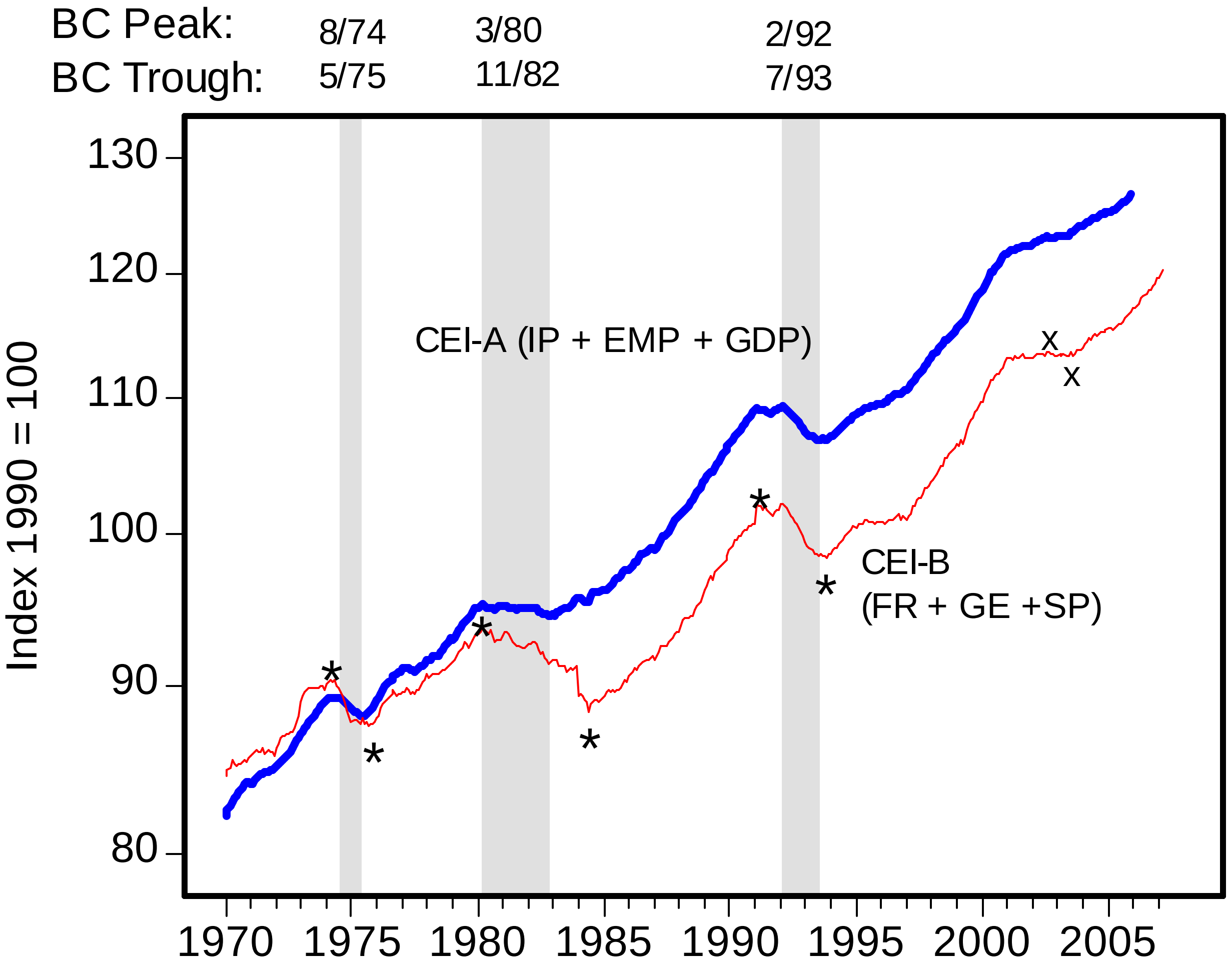
Note: Entries marked "-" denotes leads in months; entries unmarked denote lags in months; 0 represents coincidence. The entries in lines 4, 5, 12, and 13 are numbers of turning points; those in lines 6-8, 14-16, and 17-19 are summary statistics based on lines 1-3, 9-11, and the two sets combined, respectively, n.a. - not available (turn not covered by data). For the headings of the columns, see also Table 1. - Abbreviations: AWM (Area Wide Model), n.m. = not matched (missed turn).

Chart 6
Coincident Indexes for France, Germany, Spain and the Euro Area
1970-2006



Note: Shaded areas represent B.C. Recessions as determined by TCB based on CEI+GDP for Euro Area
Euro Area CEI is a weighted average of Spain, France and Germany CEI

Chart 7
Two Alternative Composite Indexes of Coincident Indicators
for the Euro Area, 1970-2006



CEI-A: Based on three area-wide aggregates: industrial production, employment and real GDP.
The business cycle recessions (shaded areas) are dated by TCB according to the turning points of this series as selected by the Bry-Boschan algorithm.
CEI-B: Based on TCB coincident indicators and real GDP for three countries: France, Germany, Spain
* denote turning points of CEI-B selected by the Bry-Boschan algorithm.

Table 2
Alternative Business Chronologies for the Euro Area, 1974-2007

Line	Business Cycle	TCB Indicators Approach[32]	CEPR Quarterly[33]	OECD Approaches[34]	FHM-AWM[35]	BDH-2001[36]
1	Peak	August 1974	Q3 1974 (0)	Aug. 1974 (0)	Aug. 1974 (0)	n.a.
2	Trough	May 1975	Q1 1975 (-3)	May 1975 (0)	Feb. 1975 (-3)	n.a.
3	Peak	March 1980	Q1 1980 (-1)	n.m.	Feb. 1980 (-1)	Feb 1980 (-1)
4	Trough	November 1982	Q3 1982 (0)	n.m.	Feb. 1981 (-21)	Oct. 1980 (-25)
5	Peak	February 1992	Q1 1992 (0)	Feb. 1992 (0)	Feb. 1992 (0)	May 1992 (+3)
6	Trough	July 1993	Q3 1993 (+1)	Feb. 1993 (-5)	Feb. 1993 (-5)	May 1993 (-2)

[32] Derived in the text and Table 2 above. TCB = The Conference Board
[33] See the September 2003 memo of the Business Cycle Dating Committee of CEPR (Centre for Economic Policy Reasearch)
[34] Refers to both the "single country" approach and the "common currency" approach, which produces identical dates. Chronology based on the cyclical timing of GDP, with different aggregation methods. (cf. Table 2).
[35] Fagan, Henry and Mestre Area Wide Model, also, Eurostat AWM method. See Catherine Guillemineau, August 2006, Tables 2 and 3.
[36] Beyer, Doornik and Hendry. Related to 1995 BDH method using ECU exchange rates. See Catherine Guillemineau, August 2006, Tables 2 and 3.

Chart 8
Comparison of Coincident Index (IP + E), Euro Area Leading Index and Weighted Average of France, Germany and Spain LEIs
1970-2007

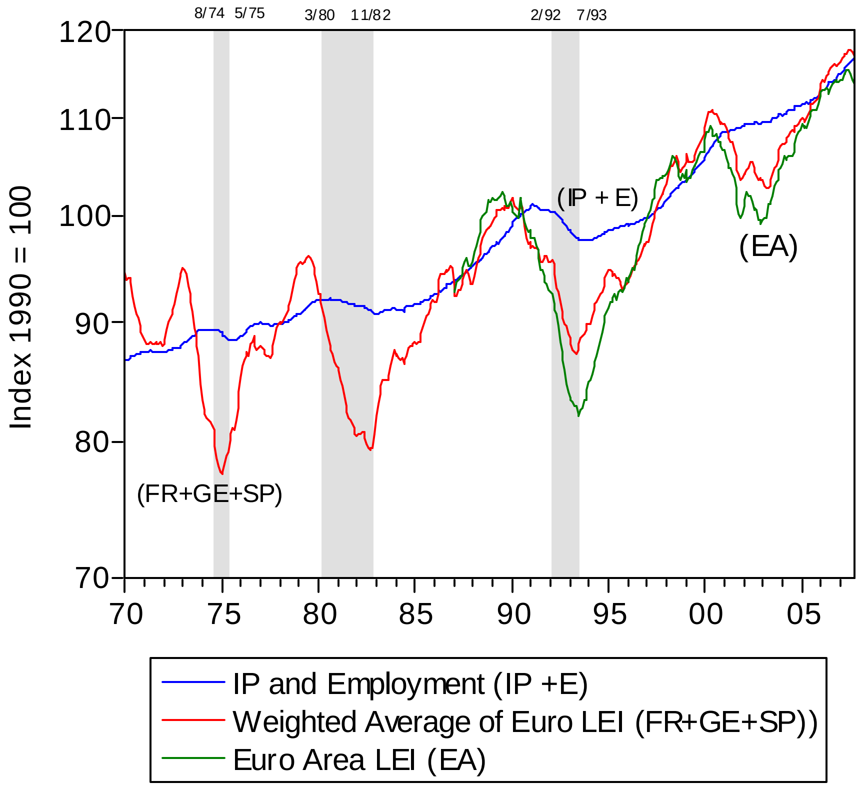


Table 3: List of Potential Leading Index Components for the Euro Area

Indicator:	Source:[37]	Beginning Date:[38]
Economic Sentiment Index	European Commission	1985
Index of Housing Permits Granted (sq. meters)	Eurostat	1995
Index of Capital Goods New Orders	Eurostat	1996
Eurostoxx stock price index	Dow Jones	1987
Real M2	ECB	1980
German 10 Year bond yield – 3 mo. Fibor yield	Bundesbank	Jan. 1965
10 Year ECB benchmark bond - 3M Euribor Rate	ECB	Jan. 1994
10 Year ECB benchmark bond - ECB Minimum Bid rate	ECB	Jul. 2000
Manufacturing Purchasing Managers' Index, PMI	NTC Economics	1998
Business Expectations for Services	NTC Economics	1998
HWWA Commodities Price Index	HWWI	1978
Index of Euro Area exports	Eurostat	1995
Oil Imports of the Euro Area	Eurostat	1990
Real M3	ECB	1970

[37] ECB = European Central Bank, NTC = NTC Economics, HWWI = Hamburg Institute of International Economics

[38] Available from the beginning date to present, unless indicated otherwise.

Table 4: Cyclical Timing for the Selected Components of the Euro LEI

Turning Points for Euro Area Business Cycles (Only those 1970-2005)	Money Supply M2 Since 1980	Cumulative Yield Spread* GE YS, Euribor YS, ECB Minimum Bid YS Since 1987	Economic Sentiment Index European Commission Since 1985	Eurostoxx Dow Jones Since 1987	Residential Building Permits Eurostat Index Since 1995	New Orders for Capital Goods Eurostat Index Since 1996	PMI Index (Manufaccturing) NTC Economics Since 1998	Business Expectations Index (Manufaccturing) NTC Economics Since 1998
Timing at Business Cycle Peaks								
Aug-74	NA	NA	NA	NA	NA	NA	NA	NA
Feb-80	9	NA	NA	NA	NA	NA	NA	NA
Feb-92	NM	-15	-31	-20	NA	NA	NA	NA
Extra Turns	1	1	5	3	2	1	4	3
Missed Turns	1	0	0	0	0	0	0	0
Mean	9.00	-15.00	-31.00	-20.00	-	-	-	-
Median	9.00	-15.00	-31.00	-20.00	-	-	-	-
St. Deviation	5.20	8.66	17.90	11.55	0.00	0.00	0.00	0.00
Timing at Business Cycle Troughs								
May-75	NA	NA	NA	NA	NA	NA	NA	NA
Nov-82	-13	NA	NA	NA	NA	NA	NA	NA
Jul-93	NM	6	0	-30	NA	NA	NA	NA
Extra Turns	1	1	5	3	2	1	4	3
Missed Turns	1	0	0	0	0	0	0	0
Mean	-13.00	6.00	0.00	-30.00	-	-	-	-
Median	-13.00	6.00	0.00	-30.00	-	-	-	-
St. Deviation	7.51	3.46	0.00	17.32	0.00	0.00	0.00	0.00
Combined Statistics								
Mean	-2.00	-4.50	-15.50	-25.00	-	-	-	-
Median	-2.00	-4.50	-15.50	-25.00	-	-	-	-
St. Deviation	7.03	7.04	12.66	13.29	0.00	0.00	0.00	0.00

NA: Data not available for component at the time of Euro Area peak or trough
NM: Peaks and troughs for component did not occur at or near time of the Euro Area peak or trough
*peaks and troughs found using combined version of yield spread cumulation.

Table 5: Cyclical Timing for the Euro LEI and Composite LEI

Turning Points for Euro Area Business Cycles (Only those 1970-2005)	LEI Standard Eight Components Since 1987	Composite LEI France, Spain, Germany Since 1970
Timing at Business Cycle Peaks		
Aug-74	NA	-19
Feb-80	NA	-8
Feb-92	-31	-25
Extra Turns	2	3
Missed Turns	0	0
Mean	-31.00	-17.33
Median	-31.00	-19.00
St. Deviation	17.90	8.62
Timing at Business Cycle Troughs		
May-75	NA	-4
Nov-82	NA	-2
Jul-93	0	-2
Extra Turns	2	4
Missed Turns	0	0
Mean	0.00	-2.67
Median	0.00	-2.00
St. Deviation	0.00	1.15
Combined Statistics		
Mean	-15.50	-10.00
Median	-15.50	-6.00
St. Deviation	12.66	9.74

NA: Data not available for index at the time of Euro Area peak or trough

NM: Peaks and troughs for index did not occur at or near time of the Euro Area peak or trough

Table 6: Pseudo Vintages of the Coincident Index (CEI), 2002 – 2007*

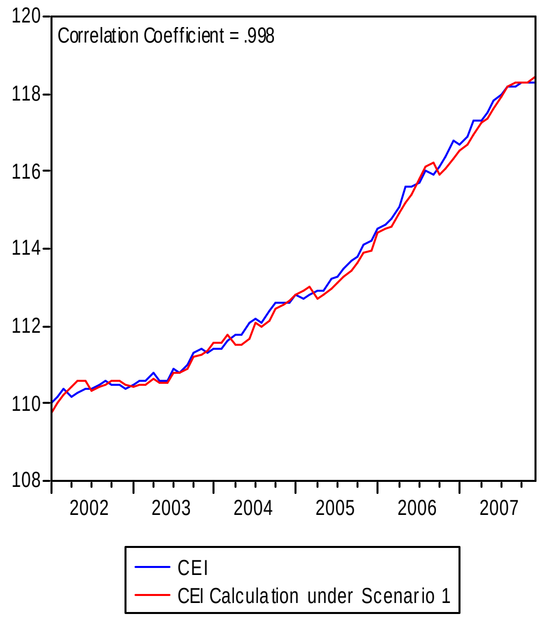
	January '02	February '02	March '02	April '02 – September '07	October '07	November '07	December '07
Vintage:	**CEI_1**	**CEI_2**	**CEI_3**	**CEI_4 - CEI_69**	**CEI_70**	**CEI_71**	**CEI_72**
Date	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
Jan-87	93.7	93.7	93.7	…	93.7	93.7	93.7
Feb-87	93.8	93.8	93.8	…	93.8	93.8	93.8
Mar-87	93.9	93.9	93.9	…	93.9	93.9	93.9
…	…	…	…	…	…	…	…
…	…	…	…	…	…	…	…
Oct-01	109.7	109.6	109.6	…	…	…	…
Nov-01	109.8	109.7	109.7	…	…	…	…
Dec-01	110.0	109.8	109.8	…	…	…	…
Jan-02	110.1	109.8	109.9	…	…	…	…
Feb-02	**---**	109.9	110.0	…	…	…	…
Mar-02	**---**	**---**	110.1	…	…	…	…
Apr-02	**---**	**---**	**---**	…	…	…	…
May-02	**---**	**---**	**---**	…	…	…	…
…	**---**	**---**	**---**	…	…	…	…
…	**---**	**---**	**---**	…	…	…	…
Jul-07	**---**	**---**	**---**	…	117.9	117.9	117.9
Aug-07	**---**	**---**	**---**	…	118.2	118.1	118.1
Sep-07	**---**	**---**	**---**	…	118.2	118.1	118.1
Oct-07	**---**	**---**	**---**	…	118.4	118.3	118.3
Nov-07	**---**	**---**	**---**	…	**---**	118.4	118.3
Dec-07	**---**	**---**	**---**	…	**---**	**---**	118.5

* Each consecutive column adds one more month's observation. The first pseudo vintage (Jan. '02 vintage) contains data from Jan. '87 to Jan. '02. The next pseudo vintage (in the second column) contains data through February 2002, and so on, until December 2007 (the last column). Hence, there are 72 pseudo vintages of component data in our dataset, each vintage starting in January 1987. In the table "…" denotes skipped rows and columns, and "---" denotes data unavailable to the real time forecaster beyond the end of the sample. By construction, the histories of each pseudo vintage for CEI and LEI are almost identical except for the last few months where data gaps in components have been filled in by forecasts.

Chart 9

Comparison of pseudo real-time CEI with revised CEI, monthly, levels: 2002-2007

Panel A **Panel B**



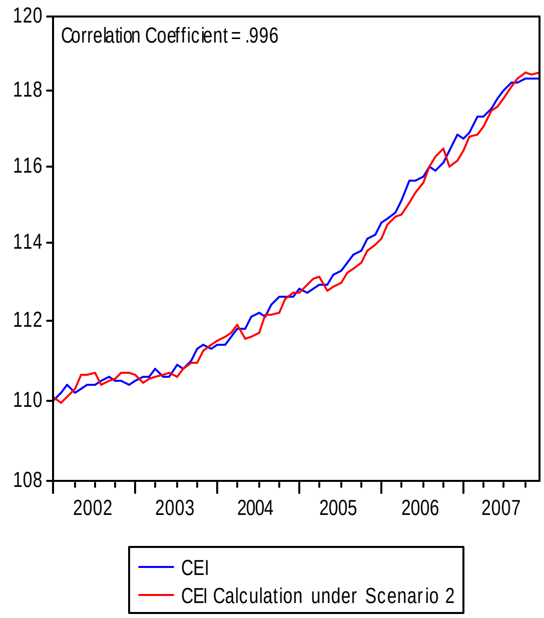


Chart 10

Comparison of pseudo real-time LEI with revised LEI, monthly, levels: 2002-2007

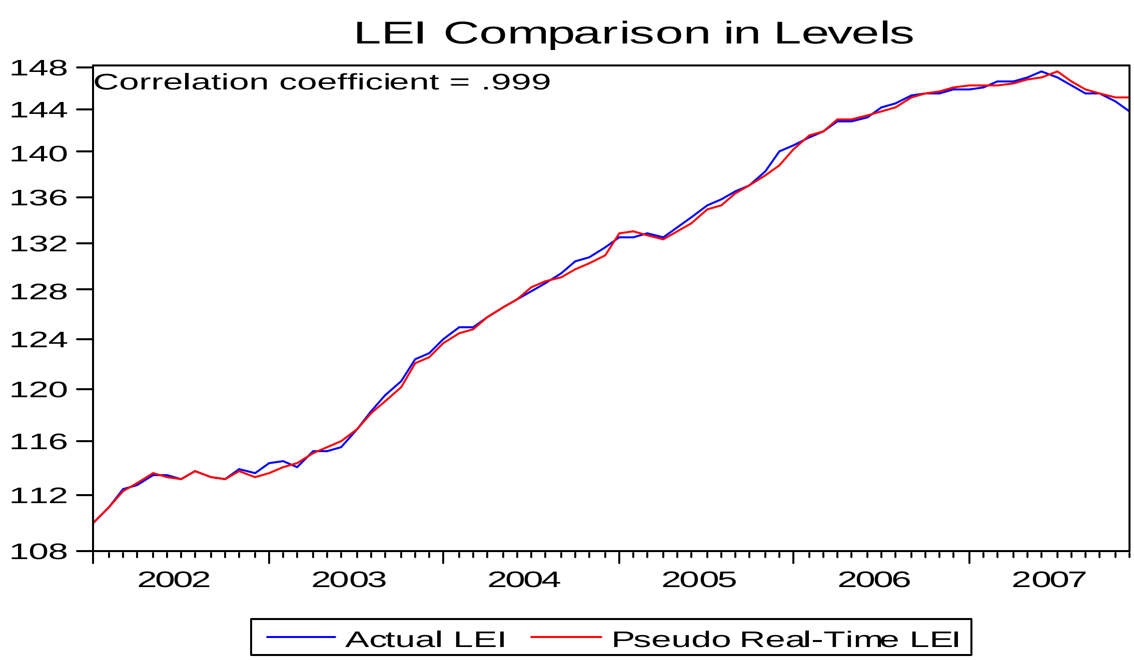


Table 7

Percent Improvements in Forecasting Performance when Alternative Models Are Used instead of Benchmark Models (2002-2007)

Panel A: Scenario One

	Deviation from Trend		Six-Month Log Differences	
Number of Lags	**MAD**	**RMSE**	**MAD**	**RMSE**
(1)	(2)	(3)	(4)	(5)
		One-Month Ahead Forecasts		
Fixed (6)	-4.667	-4.071	-2.585	-0.990
AIC	-4.468	-3.874	-2.585	-0.990
SIC	-3.573	-2.972	-2.585	-0.990
		Three-Month Ahead Forecasts		
Fixed (6)	-9.126	-8.082	-5.165	-4.174
AIC	-8.462	-7.483	-4.137	-3.580
SIC	-8.770	-7.898	-4.045	-3.731
		Six-Month Ahead Forecasts		
Fixed (6)	-14.481	-16.684	-4.586	-4.193
AIC	-15.948	-15.541	-0.137	0.130
SIC	-11.974	-13.831	1.069	0.557

Panel B: Scenario Two

	Deviation from Trend		Six-Month Log Differences	
Number of Lags	**MAD**	**RMSE**	**MAD**	**RMSE**
(1)	(2)	(3)	(4)	(5)
		One-Month Ahead Forecasts		
Fixed (6)	-4.647	-4.067	-1.929	-1.454
AIC	-4.569	-3.879	-1.929	-1.454
SIC	-3.552	-2.885	-1.929	-1.454
		Three-Month Ahead Forecasts		
Fixed (6)	-8.367	-8.089	-5.079	-4.223
AIC	-7.820	-7.577	-3.718	-3.473
SIC	-8.077	-7.874	-3.673	-3.638
		Six-Month Ahead Forecasts		
Fixed (6)	-15.963	-17.178	-4.389	-4.110
AIC	-14.548	-15.948	0.122	0.210
SIC	-12.616	-13.726	1.134	0.620

Notes: *Benchmark model denotes autoregression with CEI lags on the right-hand side.
Alternative model adds lags of LEI to the benchmark model.
The values in the table are 100*(RMSE from the benchmark model / the RMSE from the alternative mod
Negative values indicate a reduction in forecast errors in the alternative model and an improvement in forecast performance.

Table 8

Forecasting CEI with LEI: Summary of test statistics in forecast performance comparisons of the Benchmark and Alternative Models for Scenario 1 (2002-2007).

	Deviation from Trend			Six-Month Log Differences		
Number of Lags	**DM Statistic**	**ENC-NEW Statistic**	**CCS Statistic**	**DM Statistic**	**ENC-NEW Statistic**	**CCS Statistic**
(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
			One-Month Ahead Forecasts			
Fixed (6)	2.987	3.009	45.814	0.797	1.005	21.044
	(0.001)	**(0.012)**	**(0.000)**	**(0.213)**	**(0.429)**	**(0.002)**
AIC	3.261	2.851	41.784	0.797	1.005	21.044
	(0.001)	**(0.016)**	**(0.000)**	**(0.213)**	**(0.429)**	**(0.002)**
SIC	3.055	2.196	1.233	0.797	1.005	21.044
	(0.001)	**(0.054)**	**(0.267)**	**(0.213)**	**(0.429)**	**(0.002)**
			Three-Month Ahead Forecasts			
Fixed (6)	2.962	4.983	24.748	2.059	3.506	6.731
	(0.002)	**(0.000)**	**(0.000)**	**(0.020)**	**(0.005)**	**(0.081)**
AIC	2.906	4.626	47.469	1.812	2.994	11.611
	(0.002)	**(0.001)**	**(0.000)**	**(0.035)**	**(0.012)**	**(0.114)**
SIC	2.904	4.905	47.106	1.926	3.059	12.010
	(0.002)	**(0.000)**	**(0.000)**	**(0.027)**	**(0.011)**	**(0.100)**
			Six-Month Ahead Forecasts			
Fixed (6)	2.665	12.524	36.945	2.042	3.162	9.340
	(0.004)	**(0.000)**	**(0.000)**	**(0.021)**	**(0.009)**	**(0.155)**
AIC	2.640	11.778	40.178	-0.121	0.081	15.722
	(0.004)	**(0.000)**	**(0.000)**	**(0.452)**	**(0.998)**	**(0.028)**
SIC	2.405	10.785	36.665	-0.699	-0.234	21.635
	(0.008)	**(0.000)**	**(0.000)**	**(0.242)**	**(1.000)**	**(0.001)**

Notes: *Benchmark model denotes autoregression with CEI lags on the right-hand side.
Alternative model adds lags of LEI to the benchmark model.
Values in gray denote test statistics and values underneath report the p-value.
Bolded values under the test statistics in parentheses are p-values signifying the probability that the null hypothesis (that the benchmark and alternative models have equal predictive ability) is not rejected.

Table 9

Forecasting CEI with LEI: Summary of test statistics in forecast performance comparisons of the Benchmark and Alternative Models for Scenario 2 (2002-2007)

Number of Lags	DM Statistic	ENC-NEW Statistic	CCS Statistic	DM Statistic	ENC-NEW Statistic	CCS Statistic
(1)	(2)	(3)	(4)	(5)	(6)	(7)
			One-Month Ahead Forecasts			
Fixed (6)	2.975	3.014	45.637	1.621	1.206	21.851
	(0.001)	(0.012)	(0.000)	(0.052)	(0.315)	(0.001)
AIC	3.251	2.863	39.227	1.621	1.206	21.851
	(0.001)	(0.015)	(0.000)	(0.052)	(0.315)	(0.001)
SIC	3.051	2.140	2.128	1.621	1.206	21.851
	(0.001)	(0.060)	(0.145)	(0.052)	(0.315)	(0.001)
			Three-Month Ahead Forecasts			
Fixed (6)	2.989	4.962	24.751	2.294	3.412	7.195
	(0.001)	(0.000)	(0.000)	(0.011)	(0.005)	(0.066)
AIC	2.900	4.661	48.128	1.950	2.828	16.243
	(0.002)	(0.001)	(0.000)	(0.026)	(0.016)	(0.023)
SIC	2.908	4.864	47.843	2.076	2.909	16.844
	(0.002)	(0.000)	(0.000)	(0.019)	(0.014)	(0.018)
			Six-Month Ahead Forecasts			
Fixed (6)	2.640	13.019	37.097	1.952	3.116	9.669
	(0.004)	(0.000)	(0.000)	(0.025)	(0.009)	(0.139)
AIC	2.628	12.224	41.975	-0.194	0.028	16.621
	(0.004)	(0.000)	(0.000)	(0.423)	(1.000)	(0.020)
SIC	2.414	10.904	37.203	-0.775	-0.276	21.239
	(0.008)	(0.000)	(0.000)	(0.219)	(1.000)	(0.002)

Notes: *Benchmark model denotes autoregression with CEI lags on the right-hand side.
Alternative model adds lags of LEI to the benchmark model.
Values in gray denote test statistics and values underneath report the p-value.
Bolded values under the test statistics in parentheses are p-values signifying the probability that the null hypothesis (that the benchmark and alternative models have equal predictive ability) is not rejected.