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THE EURO AREA-WIDE LEADING INDICATOR (ALI)

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by Gabe de Bondt[2]

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In 2010 all ECB publications feature a motif taken from the €500 banknote.

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Abstract

This study develops a new monthly euro Area-wide Leading Indicator (ALI) for the euro area business cycle. It derives the composite ALI by applying a deviation cycle methodology with a one-sided band pass filter and choosing nine leading series. Our main findings are that i) the applied monthly reference business cycle indicator (BCI) derived from industrial production excluding construction is close to identical to the real GDP cycle, ii) the ALI reliably leads the BCI by 6 months and iii) the longer leading components of the ALI are good predictors of the ALI and therefore the BCI up to almost a year ahead and satisfactory predictors by up to 2 years ahead. A real-time analysis for predicting the euro business cycle during the 2008/2009 recession and following recovery confirms these findings.

JEL classification: E32

Keywords: Leading indicator; Business cycle; Deviation cycle; Real-time analysis; Euro Area

Non-technical summary

The challenge of early detection of business cycle turning points has rarely been more topical than recently. The recent recession has been one of the sharpest and globally widest-spread crisis since industrialised economies started to collect economic data. In line with this, more than sixty years after Burns and Mitchell's (1946) seminal work, the interest in business cycle analysis and forecasting, though having been continually high, has increased even further.

Many business cycle indicators have been developed since Burns and Mitchell's early work, also for the euro area. Over the past few decades a whole class of new "model based" business cycle indicators has emerged which are generally either derived from dynamic factor models or Markov switching models. The class of these "model based" business cycle indicators complements that of the "non-model based" indicators like those of the OECD, which extract and combine the business cycle signals from a number of pre-selected series and have meanwhile a long tradition. While the "model based" indicators are more appealing from an econometric point of view, the "non-model based" indicators feature by their simplicity and good performance. A comparison of indicators from both classes for the US in fact shows that the simpler "non-model based" indicators performed best in this practical application (Marcellino (2006)). For the euro area, however, experiences with the traditional "non-model based" business cycle leading indicators that focus directly on the aggregate of the euro area economy are still very limited so far.

This study develops a new monthly euro Area-wide Leading Indicator (ALI) for the euro area business cycle which can be subsumed to the class of the traditional "non-model based" indicators and is based on aggregate euro area wide data, i.e. it focuses directly on the entity of the euro area economy. The ALI is based on the concept of deviation cycles, i.e. cyclical fluctuations in the deviations of overall economic activity around its long-term trend. The cyclical component of the series is determined by applying a one-sided band pass filter. A one-sided or asymmetric filter is only based on past observations and therefore insensitive to new observations. It has thus the advantage that it can be used to obtain real-time estimates of the cyclical component. The ALI is derived as a composite index of nine leading series which are carefully selected from a large pool of data and have shown a strong and stable leading correlation with the euro area business cycle. Moreover, emphasis is put on ensuring a broad economic mixture of the leading series to guarantee that information from different parts of the economy and different data sources is exploited which should also help in enhancing the robustness of the indicator. The ALI is a un-weighted average of the included leading series: ten-year government bond yield, stock price, US unemployment rate, real M1, German ifo expectations indicator, building permits granted, consumer confidence, economic sentiment, and PMI new orders-stocks ratio.

The three main findings of the study can be summarised as follows. First, our reference series for the euro area business cycle, i.e. the cyclical standardised deviation from trend of industrial production excluding construction derived from a one-sided band pass filter, closely matches the real GDP cycle. Our BCI can thus be viewed as a monthly tracer of the real GDP cycle. Second, the ALI reliably leads the BCI by 6 months. Third, the longer leading components of the ALI are good predictors of the ALI and therefore the BCI by up to almost a year ahead and satisfactory predictors by up to 2 years ahead. A real-time analysis for predicting the future developments of the euro area business cycle up to 2 years ahead during the 2008/2009 recession and following recovery confirms these findings. It also shows that the ALI is revised much less than the BCI, which is another favourable property of the ALI in real-time use. Moreover, it suggests that the ALI provided during this period somewhat more reliable turning point signals than the only comparable regularly published leading indicator that was available over the whole of this period, the OECD Composite Leading Indicator (CLI) for the euro area. The latter is derived as an aggregate of the OECD CLIs for euro area countries, while the second regularly published indicator for the euro area from the Conference Board was launched too late for this comparison (in January 2009).

All in all, our findings imply that the BCI is an important new monthly device for tracking cyclical developments in euro area real GDP at an early stage and the ALI for signalling in an accurate way the future direction of the euro area business cycle, in particular, up to 10 months ahead.

1 Introduction

The challenge of early detection of business cycle turning points has rarely been more topical than recently. The recent recession has been one of the sharpest and globally widest-spread crisis since industrialised economies started to collect economic data. In line with this, more than sixty years after Burns and Mitchell's (1946) seminal work, the interest in business cycle analysis and forecasting, though having been continually high, has increased even further.

A multitude of business cycle indictors has been developed since Burns and Mitchell's early work, also for the euro area. Over the past few decades a whole class of new "model based" business cycle indicators has emerged (Marcellino (2006)). These indicators are generally either derived from dynamic factor models or Markov switching models and there are also combinations of the two.[1] In dynamic factor models the business cycle is generally represented by the common component of the included series. Applications for the euro area are the regularly published monthly coincident business cycle indicator "Eurocoin" (Altissimo et al. (2001)) and the so-called "New Eurocoin" which is designed to track medium to long-run GDP growth (Altissimo et al. (2007)) both of which are based on the dynamic factor model by Forni et al. (2000, 2001 and 2005). Dynamic factor models have, in addition, been widely applied also for short-term GDP forecasting thereby complementing the class of bridge equation models.[2] Markov switching models help to gain insights into the business cycle situation by proving probabilities for the different business cycle stages. For the euro area such models have been developed e.g. by Artis, Krolzig and Toro (2004) and Anas, Billio, Ferrara and Lo Duca (2007).

The class of "model based" business cycle indicators complements that of "non-model based" indicators. These indicators have meanwhile a long tradition and include well known

[1] Dynamic factor models go back to Gewecke (1977) and Sargent and Sims (1977) and have become well known in business cycle analysis particularly following the work of Stock and Watson (1989, 1991, 1992). Markov switching models were proposed by Hamilton (1989) and extended to the multivariate case by Krolzig (1997). Combinations of Markov switching models with factors models were suggested by Diebold and Rudebusch (1996) and Kim and Nelson (1998).

[2] Concerning short-term forecasting with dynamic factor models see e.g. Marcellino, Stock and Watson (2003), Giannone, Reichlin and Small (2006), Banbura and Rünstler (2007), Angelini et al. (2008), Angelini, Banbura and Rünstler (2008) and Camacho and Perez-Quiros (2008) and for bridge equation models e.g. Parigi and Schlitzer (1995), Baffigli, Golinelli and Parigi (2002), Rünstler and Sédillot (2003), Diron (2008) and Hahn and Skudelny (2008).

composite coincident and leading business cycle indicators from institutions like the OECD and The Conference Board, which have been regularly published over several decades and are widely applied by business cycle analysts in their assessments of the conjunctural outlook for a large number of countries. These indicators extract the business cycle signals from a number of pre-selected series which are usually combined by relatively simple weighting schemes. While the "model based" indicators are more appealing from an econometric point of view as they are embedded in an encompassing statistical framework, the "non-model based" indicators feature by their simplicity and good performance. A comparison of indicators from both classes for the US in fact shows that the simpler "non-model based" indicators perform best in a practical application (Marcellino (2006)).

For the euro area, it is nevertheless to say that also more than one decade after the introduction of the euro and the common monetary policy in the countries forming the euro area, experiences with the traditional "non-model based" business cycle leading indicators that focus directly on the aggregate of the euro area economy are still very limited. Traditional business cycle indicators for the euro area are currently regularly released by the OECD and the Conference Board. The OECD (Gyomai and Guidetti (2008)), however, does not yet provide a direct business cycle leading indicator for the euro area, i.e. an indicator that focuses on the aggregate euro area economy based on euro area-wide data. Instead, it derives its euro area indicator indirectly as a weighted average of the indicators it traditionally compiles for the OECD members among the euro area countries (these are 13 out of the 16 euro area countries). In 2001, Arnaud and Hong (2001) explored the possibility of a direct OECD business cycle leading indicator for the euro area economy but rejected the idea given the scarcity and deficiencies of the euro area-wide data while acknowledging that with progressing European integration the focus on an area-wide leading indicator seems more plausible. Major problems at that time were seen in the availability of euro area series with appropriate time series length, the state of harmonisation across the country data they were based on and the release timeliness. The Conference Board (Ozyildirim et al.(2010)), by contrast, has meanwhile developed a euro area business cycle leading indicator based on area-wide data taking account of the significant improvements in the data situation for the euro area since then. The experience with this indicator is, however, still limited given that it was just launched about a year ago in January 2009. Traditional leading indicators for the euro area business cycle based on area-wide data were recently also developed by Rua and

Nunes (2005) affiliated to Banco de Portugal and by two economists from De Nederlandsche Bank (DNB) (van der Veer and de Winter (2009)), which followed the methodology of den Reijer (2006 and 2007), but these indicators are not regular released for the euro area so that it is difficult to gauge their performance in real-time.

Common to these leading indicators from all institutions is that they are compounds of a small bundle of economic series for which leading indicator properties concerning the business cycle have been observed, though the concrete selection of indicators naturally differs also on account of the country perspective of the OECD and the euro area perspective of the others. The selected small number of leading series is usually identified a priori by some rather heuristic criteria. A further communality of the composite leading indicators from the OECD, The Conference Board and DNB is the bundling of the selected indicators based on equal weights while implicitly due to prior normalisation of the indicators inverse weighting according to the standard deviations of the series is implemented. The indirect euro area OECD indicator then additionally adds up the so derived country indicators taking into account their respective GDP weights. Rua and Nunes (2005), by contrast, use principal components to weight the indicators.

There are, however, also a number of somewhat larger methodological deviations between the leading indicators from the different institutions. Such differences refer to the treatment of the series prior to their inclusion in the composite indicator. Whereas the selected series are included without further adjustments in the Conference Board indicator, the indicators from the OECD, DNB and Rua and Nunes (2005) contain the cyclical components of the selected series. In the indicators from the OECD, DNB and Rua and Nunes (2005) the selected series are, furthermore, shifted in time or grouped according to their respective leads to align their lead times, while this is not the case in the Conference Board indicator. The OECD, DNB and Rua and Nunes (2005) indicators, moreover, end at the lead where all included components are available, while in the Conference Board indicator series that are published later than others are forecast with autoregressive models.

In this paper we develop a new monthly euro Area-wide business cycle Leading Indicator (ALI) which can be subsumed to the class of the traditional "non-model based" indicators and focuses directly on the entity of the euro area economy. Given the common currency and the single monetary policy with a focus on the whole euro area economy it appears most consistent to also approach the euro area business cycle and construct the corresponding leading indicator with the same euro-area wide perspective. The ALI is based on the concept of deviation cycles, i.e. cyclical fluctuations in the deviations of overall economic activity from its long-term trend. In line with the above discussed other traditional indicators, the ALI is composed of a number of leading series. These are carefully selected in a general to specific selection process from a large pool of data whereby particular emphasis is put on ensuring a good mixture of leading series to guarantee that information from different parts of the economy and data sources is exploited and enhance the robustness of the indicator. In terms of methodology our indicator is closest to the approaches taken by the OECD, DNB and Rua and Nunes (2005). This relates, in particular, to the focus on the cyclical part of the movements of the series, which should help to better distinguish cyclical signals from both short-term volatility and trend developments. A one-sided band pass filter is selected which reduces revisions of the indicator to those of potentially revised components and helps to achieve clear turning point signals in real-time use. We, moreover, explore at which costs in terms of loss of reliability the lead times of the indicator can be extended further also relative to those of the other institutions. In the pursuit of increasing this horizon, we focus on the information which is in fact available and avoid mixing "real" signals from the available leading series with potential forecast errors in predicting the still missing ones.

Our final aim is to employ the tool of the leading indicator in the conjunctural analysis and forecast process of the euro area economy. Macroeconomic forecasts often extend over a horizon of around two years, but short-term forecasting models have proved reliable tools only over much shorter horizons of up to about one quarter ahead and may therefore only be useful in getting the starting points of the macroeconomic forecast right. Leading indicators, though qualitative in nature in contrast to the earlier mentioned short-term forecasting models, should help in setting the path over the remaining horizon. Also the ALI is designed to be informative only about the future direction of economic activity and not for quantitative forecasts. This notwithstanding, studies show that the OECD leading indicators can be useful for quantitative forecasting (Camba-Mendez et al. (1999) and Fichtner et al. (2009)). As ex post analysis of the indicator may not reveal its true performance given that it may be subject to revisions, we finally conduct a real-time analysis of its developments over the past few years and explore whether, and if so when, the indicator correctly predicted the turning points of the 2008/09 recession and following recovery.

The structure of the rest of the paper is as follows. Section 2 explains the details of the methodology applied to derive the euro area-wide leading indicator ALI as well as a reference business cycle indicator which is used as benchmark to assess the performance of the leading indicator. Section 3 presents the empirical results. In this section, first the selected reference business cycle indicator is presented. Thereafter, the ALI is derived and its performance in tracking and leading the reference cycle is explored. Next, leading indicators with longer leads are developed and their performance and reliability are examined. Section 4 explores the performance and ability of the leading indicators to predict the turning points of the 2008/09 recession and following recovery in a real-time analysis. Section 5 concludes.

2 Methodology

2.1 Reference business cycle indicator

The prerequisite for the development of a leading indicator for the business cycle is the availability of a reference business cycle indicator which serves as a benchmark for the leading indicator. The construction of this business cycle indicator strongly depends on the definition of the business cycle that is applied. The literature traditionally distinguishes between two main definitions of the business cycle. In the earliest definition of the business cycle, the so called classical cycle, the business cycle was defined in terms of the level of GDP (see Burns and Mitchell (1946)). In this framework business cycle turning points mark changes between periods of expansions and contractions in GDP. Expansions start when GDP has reached a trough and end at the following peak and vice versa for recessions. The more recent literature (see, among others, Zarnowitz and Ozyildirim (2006)) puts a stronger focus on the so called deviation or growth cycle, where the business cycles is defined in terms of the cyclical movement of overall economic activity around its long-run trend. This definition allows to distinguishing between periods of above and below trend growth and turning points in the series determine, according to this framework, changes in the strength of GDP growth relative to trend growth. Occasionally, also a third definition of the business cycle, the acceleration cycle, is put forward. This refers to increases and decreases in the growth rate of overall economic activity and turning points indicate a change from acceleration in growth to deceleration or vice versa. In this paper we apply the most widely-used concept of the deviation cycle to define the euro area business cycle indicator.

Two main issues have to be addressed in order to implement the business cycle indicator corresponding to the concept of the deviation cycle. The first is a decision on the variable that should form the basis for the indicator. In line with the notion of the business cycle reflecting economy-wide fluctuations, the reference business cycle variable also known as coincident index should ideally be an encompassing indicator of activity across the economy. This predestines GDP as the variable underlying the business cycle. The NBER Business Cycle Committee for instance views real GDP as the single best measure of aggregate economic activity. Data on GDP are, however, only available at quarterly frequency and with substantial publication lags. If we would observe real GDP promptly on a monthly basis, then we would not need a coincident index as a proxy for monthly real GDP (Mariano and Murasawa (2010)). Rua and Nunes (2005), nevertheless, use GDP to construct their reference business cycle series. The DNB, by contrast, uses a composite reference index consisting of the monthly and more timely available data on industrial production, retail sales and unemployment and the Conference Board Coincident Economic Index measure of current overall economic activity is based on industrial production, retail trade, employment, and manufacturing turnover. The OECD focuses only on total industrial production as reference series. Although industrial activity accounts only for a relatively small share of total value added in the euro area, its high cyclicality and strong co-movement with GDP make it a very good candidate for a more timely available business cycle indicator. Different to the OECD our preferred indicator is, however, not the total production index but industrial production excluding construction as construction activity is known to follow the cycle and the overall industrial production index including construction for the euro area is, in addition, released with a somewhat longer reporting lag and its backdata are shorter than those for the index excluding construction which is available from 1960 onwards.

Comparing our reference variable with those of the other institutions, the inclusion of the generally lagging labour market variables and the construction sector in the other indicators should imply that the reference business cycle indicators of these institutions are likely to be lagging relative to our selected business cycle indicator. This implies that even if our ALI indicator would show the same measured lead time with respect to our business cycle indicator as those of these institutions to theirs, it might exceed the actual leading indicator properties of the indicators of these institutions. The OECD indicated a lead time of its indicator to its reference series by between 6 and 9 months, the DNB indicator leads by 9 months and the leading indicator properties of the Conference Board indicator seem of broadly comparable length. Rua and Nunes (2005) develop leading indicators for 2 and 4 quarters respectively.

The second decision to take in deriving a reference business cycle indicator based on the deviation cycle is the choice of the statistical filter to extract the cyclical component of the selected variable. The cycle extraction is a crucial step in the construction of a composite leading indicator, because co-movements and similarities in patterns between the reference series and individual leading series are evaluated between filtered versions of these series. One issue to pay particular attention to is the end-point problem. This problem arises because the addition of new observations may change the filtered values of previous observations. It is therefore important to have an understanding of the sensitivity of the filter to new observations. Filters using a symmetrical or two-sided weighting scheme usually expand the routine with an extrapolation method in order to prevent that observations at the end of the series are lost. It is therefore not surprising that the addition of new actual observations can bring about (substantial) revisions to past data, because the filtered values depend in part on artificial observations. In contrast, asymmetrical or one-sided filters use only the available past observations for the calculations of the filtered values and thereby avoid extrapolation completely. Notwithstanding these differences in a technical and/or theoretical sense, the applied macroeconomic literature shows that the generated filtered series usually do not differ much ex post (Zarnowitz and Ozyildirim (2006)). This may be very different in real-time use though.

The most commonly applied cycle estimation methods are the Phase-Average trend (PAT), Hodrick-Prescott (1997) (HP), and band pass filter methodologies. The PAT filter has been developed by the National Bureau for Economic Research (NBER) in the United States and was up to recently used as filtering method by the OECD. This method has, however, the disadvantage that it needs a manual turning point insertion, making the filtering a rather subjective exercise. A more transparent and flexible filter method is the two-sided HP-approach. The HP-filter only eliminates the low frequencies (underlying trend) from a time series. The relationship between the variances of the trend component and the cyclical component, represented by the parameter λ, plays a key role in the HP-filter. The parameter λ determines the curve of the trend component. In case λ=0, there is no difference between the trend component and the original series. As λ approaches infinity, the trend-based component begins to appear as a linear trend. With a very high λ the HP filter produces growth cycles quite similar to the PAT. Band-pass filters are linear moving averages which leave cyclical fluctuations in tact while filtering out not only low frequencies (underlying trend), as is done by the HP-approach, but also the high frequencies (short-run noisy fluctuations). The resulting series are therefore relatively smooth, which allows for clear signals with well-articulated turning points. Commonly applied band-pass filters are from Baxter and King (1999) (BK-filter) and Christiano and Fitzgerald (2003) (CF-filter). Both of these filters share the same basic principles, but for the CF filter also a one-sided version, the so called CF random walk filter, exists. This one-sided filter makes use of the full sample, even at the beginning and end of the time series and Christiano and Fitzgerald (2003) argue that the phase effect of asymmetric filters is less serious than previously assumed. It is designed to work well on a larger class of times series than the BK-filter, and converges in the long run to the optimal filter.[3] Given these properties we choose the CF random walk filter for our business cycle and leading indicators. The choice of the asymmetric CF-filter is broadly in line with recent practice in policy institutions and the literature. Rua and Nunes (2005) apply the same filter. The Dutch Central Planning Bureau (see Kranendonk et al. (2004)) has switched from the PAT-filter to the CF-filter, whereas the OECD (see Nilsson and Gyomai (2009)) has replaced the PAT methodology by a double HP-filter (one HP-filter for the low frequency and one for the high frequency) with a 12-120 month filter band specification as they find a better turning point signal stability compared to the CF-filter. Our real-time analysis for the crisis period as presented in Section 4, however, shows that the turning points based on CF-filter are also very stable.

Applying the CF random walk filter, the cyclical component c_t of the raw data x_t is calculated as indicated in equation (1) with a period of oscillation between p_l and p_u where $2 \leq p_l < p_u < \infty$

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[3] Kranendonk et al. (2004) show, based on graphical and quantitative analyses for Dutch economic series, that the HP-filter is more sensitive to the end values than band pass filters and that of the two analysed band pass filters, the CF-filter performs better than the BK-filter. Nilsson and Gyomai (2009) argue to "use the CF-filter if you are sensitive to cumulative revisions" which is the case for our reference series. For example, the absolute average difference between the latest value and first release divided by the number of observations in the monthly growth rate in industrial production excluding construction over the period January 2003 – September 2009 amounted to a non-negligible 0.6 percentage points. The revisions ranged between -3.7 and 2.5. The initial estimates of a cyclical value are the closest to the final cyclical value with the CF-filter.

$$c_t = B_0 x_t + B_1 x_{t+1} + \ldots + B_{T-1-t} x_{T-1} + \widetilde{B}_{T-t} x_T + \ldots + B_1 x_{t-1} + \ldots + B_{t-2} x_2 + \widetilde{B}_{t-1} x_1 \quad (1)$$

for t = 3, 4, …, T-2, with

$$B_j = \frac{\sin(jb) - \sin(ja)}{\pi j}, \quad j >= 1 \quad (2)$$

$$B_0 = \frac{b-a}{\pi}, \quad a = \frac{2\pi}{p_u}, \quad b = \frac{2\pi}{p_l}.$$

$$\widetilde{B}_{T-t} = -\frac{1}{2} B_0 - \sum_{j=1}^{T-t-1} B_j, \qquad for \quad t = 3, \ldots, T-2$$

The formulas for c_t when t=2 and T-1 are simple linear functions of the B_j's. The formula of c_T as indicated in equation (3) is also of interest in circumstances when an estimate of c_T is required in real time

$$c_T = (\frac{1}{2} B_0) x_T + B_1 x_{T-1} + \ldots + B_{T-2} x_2 + \widetilde{B}_{T-1} x_1 \quad (3)$$

with

$$\widetilde{B}_{T-1} = -\frac{1}{2} B_0 - \sum_{j=1}^{T-2} B_j \quad . \quad (4)$$

Using the one-sided CF band pass filter to isolate business cycle frequencies requires an a priori specification of the minimum and maximum duration of a business cycle. Following Agresti and Mojon (2003), we employ an upper bound of 10 years for the euro area. The maximum length of the cycle of ten years is consistent with the euro area experience of four recession over the past forty years. The minimum length of the cycle is set to two years, aiming to filter out the minor cycles in addition to the seasonal ones. CF formulas assume that there is no drift in the random walk. If there is a drift in the raw data, it has to be removed prior to the analysis. In practical terms, this implies that for I(1) or trending series the drift has been eliminated and that I(0) or non-trending series have been demeaned. Prior to the filterting for all I(1) series we take the natural logarithm. Moreover, if the trend of the raw data can become close to zero we have added a constant in order to avoid dividing by zero in our calculations for the percentage deviation from trend.

2.2 Area-wide Leading Indicator (ALI)

The first step in the construction of the ALI consists in the selection of a set of variables that are most suitable to provide leading information on the reference business cycle. To that aim a list of potentially useful variables has been collected of which the best ones are included in the ALI. Prior to the selection process all series are filtered in the same way as the reference business cycle indicator to extract their cyclical components. The series are also standardised to adjust their fluctuations to a comparable magnitude. This standardisation into a similar unit is done by subtracting from the filtered series, expressed as a percentage deviation from trend, its sample mean and dividing it by its standard deviation (hereafter referred to as standardised percentage deviation from trend).

Three criteria are applied in a general-to-specific selection process to get the best leading series (LS^*) for a required lead time of at least five months. We choose a lead time of at least 5 months, which often corresponds to an effective lead time of 6 months, because we want our indicator to be informative for the horizon that goes beyond that of the short-term forecasting models. The effective lead time takes into account the relative publication lags/leads of the variables with respect to the chosen business cycle variable. Similar to den Reijer (2007), in a sequential selection process candidate leading series (LS) are sequentially removed from a full candidate set of leading series when they don't fulfil the criterion function, as expressed in equation (5), with ϱ the correlation coefficient, and l (l^*) the (optimal) lead horizon.

$$LS^* = \arg\left\{ \rho(BCI_t, LS_{t-l}) \geq 0.6 \wedge l^* \geq 5 \text{ and stable} \wedge LS_i^* \neq LS_j^* \text{ economically} \right\} \qquad (5)$$

Of the three criteria the first two are statistical criteria based on a dynamic correlation analysis and the third criterion is more of an economic nature taking expert knowledge into account. Assuming the requested lead of at least 5 months, the first criterion postulates that the appropriate series have to lead the reference business cycle well as measured by a correlation between the series and the BCI of at least 0.6. The second selection criterion imposes that among the remaining series the optimal lead time has to match the required lead time of at least 5 months and that this lead relation is stable over time. The optimal lead time refers to the lead at which the potential leading series has the highest correlation with the reference business cycle indicator. The stability is assessed by conducting the dynamic correlation analysis between the potential leading series and the business cycle indicator over different sample periods. The third and final selection criterion consists in ensuring a broad-based economic mixture of different kinds of variables in the ALI. This is to guarantee that the different parts of the economy both from an industry and expenditure component perspective are appropriately represented in the indicator and that the available information from different data sources is exploited in the leading indicator which should contribute to enhancing the robustness of the indicator.

In the second step the selected best performing leading series have to be combined appropriately to form the ALI. To that aim the series are first shifted according to their average lead times with respect to the business cycle indicator and then weighted together to the ALI. The literature proposes different weighting schemes derived from principal components, regression analysis, correlation coefficients or simple averages of the series. Pros and cons may be put forward concerning all of these decisions. Weighting by principal components for instance does not take into account the relationship of the series with the business cycle indicator, weights from regressions may only be applied when the series are independent and correlations may change over time. We decided in favour of weighting by simple averages over the indicators, i.e. equal weights. This weighting scheme features by its simplicity and robustness as it does not introduce revisions to the leading indicator. At the same time simple averaging does not deviate too much from the weighting schemes based on principal components or correlations as all of the selected series have to display a sufficiently high degree of co-movement with the business cycle.

In a final step once the ALI is constructed we explore whether and at what costs in terms of reliability the leading indicator properties of the ALI can be improved further by dropping series with shorter lead times and creating so called longer-term ALIs.

3 Empirical results

3.1 Reference business cycle indicator

As discussed above our reference business cycle indicator (BCI) for the deviation cycle is based on industrial production excluding construction data and the cyclical component of this index is derived by the random walk CF band pass filter. Chart 1 compares the BCI based on quarterly industrial production excluding construction with that based on real GDP. It shows a very strong co-movement of the two series with basically identical turning points. Larger deviations are only visible in the amplitude of the fluctuations which are higher for the BCI based on industrial production excluding construction in line with the stronger cyclicality of industrial activity than overall economic activity. Once the two series are normalised, which is part of the procedure to adjust the BCI and ALI to a comparable scale, the differences between the two BCIs become very minor also in terms of the amplitude of the cycle (see Chart 2). The correlation between the two BCIs amounts to 0.96 since 1970 and to 0.97 since 1999. This provides strong support for the choice of the timelier available BCI based on industrial production data. Chart 2, moreover, highlights that the sharp cyclical downturns of the BCI match very well with the periods of the four euro area recessions (1974/75, 1980 to 1982, 1992/93 and 2008/09) and the slow growth period (2003) identified by the CEPR for the period since 1970 which also underlines the general functioning of the indicator. The CEPR business cycle dating, admittedly, in contrast to the BCI refers to the classical business cycle definition. This comparison is, however, nevertheless useful as the CEPR dating is probably the most widely used reference business cycle dating for the euro area and there is a close link between the classical and deviation cycle periods with e.g. classical recessions naturally always representing a subset of (the most severe) deviation cycle recessions (see also Marcellino (2006)).

Chart 1: Comparison of the business cycle indicators based on industrial production excluding construction and real GDP

(percentage deviation from trend, quarterly data)

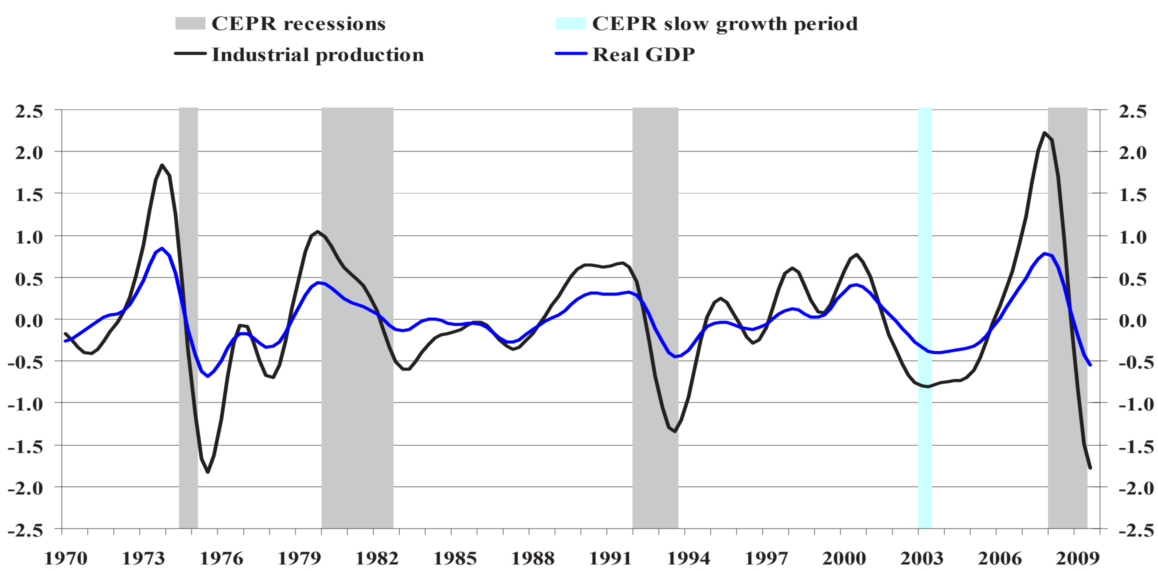
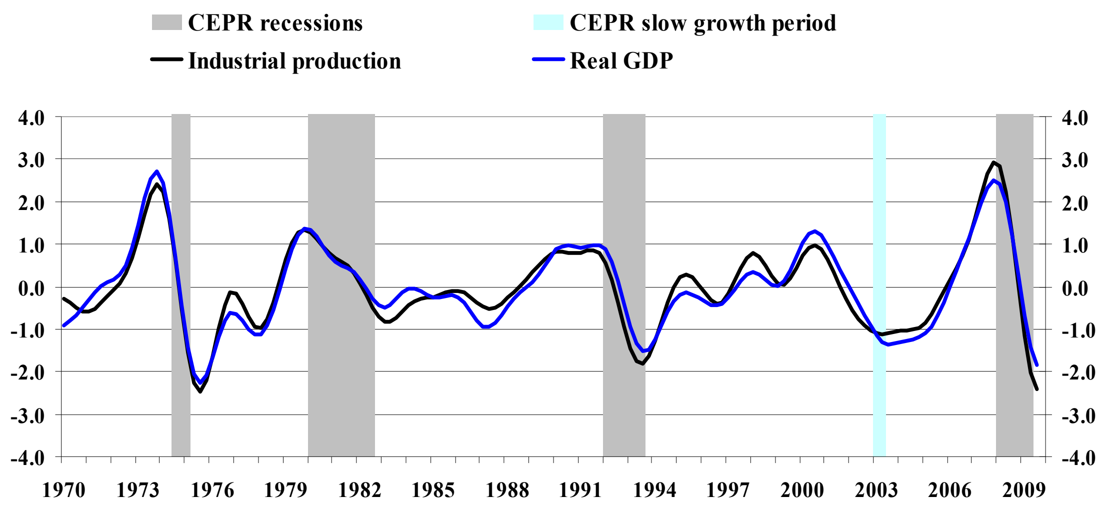


Chart 2: Comparison of the normalised business cycle indicators based on industrial production excluding construction and real GDP

(standardised percentage deviation from trend, quarterly data)



3.2 Area-wide Leading Indicator (ALI)

3.2.1 Derivation of the ALI

A large number of series from different sources were considered for potential inclusion in the ALI. The set of series includes monetary transmission mechanism variables, financial market variables, various kinds of other "hard" data, and survey indicators. Table 1 provides a full list of these series and summarises the outcome of the selection process based on the above explained three criteria. In the table the series are grouped based on their longest available sample period whereby sample periods starting in 1960, 1970, 1980, 1985 and 1999 are distinguished. The sample periods always end in 2007 in order to avoid that our selection is affected by the 2008/2009 crisis period. As the stability of the lead relation can be best assessed with long time series the selection process is started with the series beginning in 1960. The series are subsequently ranked according to their correlation coefficient (ϱ) with the business cycle indicator for a lead time of at least five months. The columns C1 to C3 indicate the series' compliance with the requested three criteria. In the columns further to the right the corresponding correlation coefficients are also reported for shorter sample periods, starting in 1970, 1980, 1990 and 1999 together with the optimal lead times for the various sample periods. The final column provides more detailed comments on the selection decisions.

Table 1: Overview general-to-specific selection procedure of leading series

1960-2007	C1	C2	C3	ρ, sample starting in					Optimal lead, sample starting in					Comments
	ρ			1960	1970	1980	1990	1999	1960	1970	1980	1990	1999	
Stock price index (real)	0.71	+	-	0.71	0.70	0.61	0.70	0.87	7	7	6	4	5	Nominal stock price index more timely available
German/euro area ten-year government bond yield (nominal, inverted)	**0.71**	+	+	**0.71**	**0.70**	**0.65**	**0.69**	**0.78**	**22**	**23**	**27**	**26**	**23**	**Captures long-term risk-free rate (24 month lead)**
Stock price index (nominal)	**0.69**	+	+	**0.69**	**0.70**	**0.60**	**0.70**	**0.87**	**7**	**7**	**6**	**4**	**5**	**Captures equity market (6 month lead)**
US unemployment rate (inverted)	**0.68**	+	+	**0.68**	**0.74**	**0.73**	**0.74**	**0.82**	**5**	**4**	**8**	**8**	**5**	**Captures US labour market (5 month lead)**
PPI manufacturing (inverted)	0.65	-		0.65	0.62	0.41	0.41	0.48	14	13	34	33	35	No stable lead relation
HICP (inverted)	0.60	-		0.60	0.63	0.39	0.49	0.54	7	6	10	10	8	No stable lead relation
US industrial production	0.60	-		0.63	0.72	0.67	0.72	0.85	3	3	6	4	3	Optimal lead time is too short
German/euro area three-month treasury bill rate (nominal, inverted)	0.59	-		0.59	0.54	0.57	0.54	0.57	22	22	36	36	36	No stable lead relation
OECD US composite leading indicator	0.49			0.49	0.53	0.30	0.32	0.65	10	10	13	13	9	Correlation is too low
Weekly hours worked in US manufacturing	0.49			0.49	0.56	0.39	0.39	0.71	8	9	13	13	9	Correlation is too low
Oil price (Brent crude in $, inverted)	0.43			0.43	0.44	0.57	0.55	0.57	36	36	36	36	36	Correlation is too low
German/euro area corporate bond spread (inverted)	0.38			0.38	0.47	0.55	0.61	0.62	10	12	12	11	27	Correlation is too low
PMI US	0.31			0.31	0.35	0.43	0.59	0.62	10	10	35	36	32	Correlation is too low
Oil price (Brent crude in $)	0.21			0.21	0.19	0.46	0.44	0.42	0	0	0	0	0	Correlation is too low
German/euro area ten-year government bond yield (real)	0.21			0.21	0.20	0.22	0.38	0.51	36	36	7	7	36	Correlation is too low
German/euro area three-month treasury bill rate (real)	0.12			0.12	0.12	0.48	0.70	0.81	0	0	0	2	3	Correlation is too low
1970-2007														
M1 (real)	**0.81**	+	+		**0.81**	**0.73**	**0.74**	**0.80**		**10**	**12**	**11**	**12**	**Captures transaction motive for holding money (11 months lead)**
M1 (nominal)	0.81	+	-		0.81	0.72	0.75	0.82		12	11	11	13	Prefer real M1 due to stronger theoretical link to the real business cycle
German IFO (business expectations)	**0.61**	+	+		**0.61**	**0.53**	**0.79**	**0.79**		**11**	**8**	**7**	**7**	**Long backward avalaible survey indicator (8 months lead)**
Ten-year government bond yield (nominal, inverted)	0.59	+	-		0.59	0.58	0.62	0.80		20	26	25	23	Covered by German/euro area ten-year government bond yield
Two-year government bond yield (nominal, inverted)	0.58	+	-		0.58	0.59	0.55	0.63		25	36	36	35	Covered by German/euro area ten-year government bond yield
Five-year government bond yield (nominal, inverted)	0.56	+	-		0.56	0.59	0.60	0.70		23	28	28	28	Covered by German/euro area ten-year government bond yield
Spread between ten-year and two-year government bond yield	0.45				0.45	0.50	0.49	0.61		30	36	36	36	Correlation is too low
Ten-year government bond yield (real)	0.36				0.36	0.12	0.17	0.14		8	36	3	5	Correlation is too low
1980-2007														
MFI loans flow (nominal)	0.73	-				0.73	0.72	0.83			0	0	0	Optimal lead time is too short
MFI loans flow (real)	0.72	-				0.72	0.72	0.84			0	0	0	Optimal lead time is too short
Building permits	**0.69**	+	+			**0.69**	**0.74**	**0.89**			**13**	**13**	**11**	**Captures housing market (13 months lead)**
Sectoral stock price index (nominal): basic materials	0.68	-				0.68	0.74	0.82			3	3	0	Optimal lead time is too short
Raw material prices in EUR, industrial HWWA index	0.65	-				0.65	0.72	0.75			4	2	0	Optimal lead time is too short
Earnings	0.61	-				0.61	0.71	0.69			0	0	0	Optimal lead time is too short
Sectoral stock price index (nominal): industrials	0.60	-				0.60	0.74	0.85			3	4	3	Optimal lead time is too short
Sectoral dividend yield (inverted): industrials	0.58	+	-			0.58	0.69	0.76			6	5	6	Covered by the broad total stock price index
Sectoral dividend yield (inverted): basic materials	0.56	+	-			0.56	0.61	0.83			9	7	2	Covered by the broad total stock price index
Dividend yield (inverted)	0.56	+	-			0.56	0.65	0.83			8	8	5	Covered by the broad total stock price index
Raw material prices in EUR, total excluding energy HWWA index	0.51					0.51	0.62	0.59			4	2	0	Correlation is too low
Sectoral price/earnings ratio: utilities	0.48					0.48	0.58	0.90			4	5	2	Correlation is too low
Raw material prices in EUR, total HWWA index	0.40					0.40	0.44	0.42			0	0	0	Correlation is too low
Baltic dry index	0.34					0.34	0.30	0.21			1	0	0	Correlation is too low
Raw material prices in EUR, energy HWWA index	0.32					0.32	0.47	0.37			0	0	0	Correlation is too low
Price/earnings ratio	0.28					0.28	0.44	0.86			12	11	8	Correlation is too low
MFI loans outstanding amounts (nominal)	0.15					0.15	0.20	0.42			0	0	0	Correlation is too low
MFI loans outstanding amounts (real)	0.06					0.06	0.13	0.35			0	0	0	Correlation is too low

Table 1: Overview general-to-specific selection procedure of leading series (continued)

1985-2007 [2]										
Industrial confidence indicator consumer goods	0.85	-		0.85	0.83	0.89	3	3	3	Optimal lead time is too short
Economic sentiment indicator	**0.83**	+	+	**0.83**	**0.83**	**0.88**	**5**	**4**	**4**	**Broad-based composite confidence indicator (5 months lead)**
Assessment of order-book levels from industry survey	0.79	-		0.79	0.77	0.83	3	2	2	Optimal lead time is too short
Major purchases over next 12 months from consumer survey	0.79	+	-	0.79	0.79	0.90	5	4	7	Covered by broad-based consumer confidence indicator
Industrial confidence indicator capital goods	0.78	-		0.78	0.76	0.77	3	2	2	Optimal lead time is too short
Industrial confidence indicator	0.78	-		0.78	0.76	0.81	4	3	3	Optimal lead time is too short
Employment expectations for the months ahead from industry survey	0.77	-		0.77	0.76	0.80	1	1	0	Optimal lead time is too short
Business climate indicator	0.77	-		0.77	0.75	0.81	3	3	2	Optimal lead time is too short
Production expectations for the months ahead from industry survey	0.76	+	-	0.76	0.73	0.75	5	4	4	Covered by the longer backward available ifo business expectations
Consumer confidence indicator	**0.76**	+	+	**0.76**	**0.79**	**0.91**	**5**	**4**	**4**	**Broad-based composite consumer survey indicator (5 month lead)**
Retail confidence indicator	0.75	-		0.75	0.88	0.88	3	3	3	Optimal lead time is too short
Unemployment expectations over next 12 months from consumer survey (inverted)	0.75	-		0.75	0.75	0.85	1	1	1	Optimal lead time is too short
Financial situation over next 12 months from consumer survey	0.75	+	-	0.75	0.76	0.89	5	4	5	Covered by broad-based consumer confidence indicator
Industrial confidence indicator intermediate goods	0.74	+	-	0.74	0.72	0.80	5	5	5	Covered by broad-based economic sentiment indicator
Assessment of export-order book levels from industry survey	0.73	-		0.73	0.71	0.77	3	3	2	Optimal lead time is too short
Savings over next 12 months from consumer survey	0.73	+	-	0.73	0.79	0.85	2	2	4	Optimal lead time is too short
Expected business situation from retail trade survey	0.71	+	-	0.71	0.78	0.81	6	6	3	Covered by broad-based sentiment indicator
Assessment of stocks of finished products from industry survey	0.71	+	-	0.71	0.71	0.72	5	4	5	Covered by PMI new orders-stocks ratio
General economic situation over next 12 months from consumer survey	0.69	+	-	0.69	0.69	0.89	5	4	4	Covered by broad-based consumer confidence indicator
Twelve-month forward earnings revisions ratio	0.67	+	-	0.67	0.65	0.75	8	8	12	Covered by nominal stock price index
Construction confidence indicator	0.59	-		0.59	0.70	0.87	3	3	4	Optimal lead time is too short
Construction order books	0.58	-		0.58	0.72	0.85	2	2	4	Optimal lead time is too short
New passenger car registrations	0.58	-			0.58	0.83		0	7	Optimal lead time is too short
Three-month Euribor (nominal, inverted)	0.57	+	-		0.57	0.63		34	33	Covered by German/euro area ten-yea government bond yield
German ZEW (expectations)	0.53				0.53	0.46		13	35	Correlation is too low
Three-month Euribor (real, inverted)	0.51				0.51	0.59		36	33	Correlation is too low
Price trends over next 12 months from consumer survey	0.36			0.36	0.40	0.54	0	0	0	Correlation is too low
Three-month Euribor (real)	0.34				0.34	0.55		0	0	Correlation is too low
Spread between ten-year government bond and three-month Euribor	0.33				0.33	0.59		36	36	Correlation is too low
1999-2007										
PMI manufacturing consumer goods	0.89	?	-			0.89			5	Covered by ifo indictaor and economic sentiment indictaor
PMI services new business	0.86	?	-			0.86			7	Covered by economic sentiment and consumer confidence indicators
Services expectations	0.85	-				0.85			3	Optimal lead time is too short
PMI composite output	0.85	?	-			0.85			7	Covered by economic sentiment indicator
PMI composite new business	0.85	?	-			0.85			7	Covered by economic sentiment indicator
Services confidence indicator	0.83	-				0.83			4	Optimal lead time is too short
PMI manufacturing output	0.82	?	-			0.82			6	Covered by ifo indictaor and economic sentiment indictaor
PMI manufacturing intermediate goods	0.81	?	-			0.81			7	Covered by ifo indictaor and economic sentiment indictaor
Retail sales	0.81	-				0.81			0	Optimal lead time is too short
PMI manufacturing	0.80	?	-			0.80			6	Covered by ifo indictaor and economic sentiment indictaor
PMI manufacturing new orders	0.80	?	-			0.80			7	Covered by ifo indictaor and economic sentiment indictaor
PMI services business expectations	0.79	?	-			0.79			8	Covered by economic sentiment and consumer confidence indicators
PMI manufacturing capital goods	0.79	?	-			0.79			5	Covered by ifo indictaor and economic sentiment indictaor
PMI manufacturing new orders-stocks ratio	**0.77**	**?**	+			**0.77**			**9**	**Captures inventory cycle (9 month lead)**
New orders, capital goods	0.75	-				0.75			0	Optimal lead time is too short
New orders, excluding ships, railway and aerospace equipment	0.74	-				0.74			0	Optimal lead time is too short
New orders	0.67	-				0.67			0	Optimal lead time is too short
PMI global	0.62	?	-			0.62			13	Covered by the US unemployment rate
PMI manufacturing extra euro area	0.48	?	-			0.48			20	Correlation is too low

Note: Bold denotes the leading series which are included in the ALI.

[1] EC survey indicators start at 1985.

[2] Earnings revisions ratio, new passenger car registrations/three-month Euribor and German ZEW start at December 1987, January 1990, and December 1991, respectively.

C1 refers to selection criterion 1. It postulates that the appropriate series have to have a correlation with the BCI of at least 0.6 for the requested lead of at least 5 months.

C2 refers to selection criterion 2. It requests that the optimal lead time has to fulfil the assumption of a lead time of at least 5 months and that this lead relation is stable over time.

C3 refers to selection criterion 3. It ensures a broad-based economic mixture of different kinds of variables in the ALI.

Looking at the time series available from 1960, about half of the series show a correlation equal or higher than 0.6 and thus fulfil our first selection criterion. The optimal lead time turns out to be only long enough and stable for the nominal German/euro area ten-year government bond yield, the real and nominal stock price index and the US unemployment rate. We prefer the nominal instead of real stock price index, because the stock price index is in nominal terms immediately available, whereas this is not the case when deflated by the HICP index. The latter thus reduces the effective lead time by one month. Of these indicators the longest lead of about two years (approximated at 24 months) is found for the long-term government bond yield. The stock price index and the US unemployment rate show somewhat shorter but still satisfactory leading indicator properties of 6 and 5 months respectively. As the three indicators are also economically representative of different aspects of the economy we include all of them in the ALI. Charts A.1 to A.3 in the Appendix confirm the quite good co-movement and leading indicator properties of the three series with the BCI respectively.

Economically, the nominal long-term interest rate, before 1999 the German one as most reliable measure of the risk-free long-term interest rate, reflects the bond market investors' view about economic growth as well as inflation over the next ten years. Under the assumption that long-term inflation expectations are well-anchored, the cyclical component of the long-term interest rate reflects mostly changes in the long-term economic outlook. Stock prices are also among the leading series of the OECD, Confidence Board and DNB leading indicators. The present-value model for the share price implies especially a forward looking role for the stock market. Higher stock prices reflect an increase in the discounted expected future dividends and earnings, providing potential useful information about future economic growth (Andersson and D'Agostino (2008) and de Bondt (2009)). Stock prices also play an active role for the economy through various channels. Higher stock prices provide an extra stimulus for households and firms that own directly or indirectly shares via positive wealth effects. Even if one does not own shares, the stock market is seen as a general measure for the state of the economy through which stock prices affect the real economy via the confidence of households and firms and to the uncertainty they have about their future economic situation. Investment also benefits from higher stock prices via lower capital costs. Firms with a stock exchange notation can finance investment cheaper because they can issue new shares. Higher stock prices also reflect an increase in the expected profits and thus in the ultimately available sources of internal finance for investment. This financing channel plays especially a role when external finance is not or only against (too) high cost available. Higher stock prices also improve the financial position of households and firms, allowing them to borrow easier and cheaper. The US unemployment rate is important as a proxy for the state of the external environment for the euro area. The US unemployment rate cycle, which is known to be strongly countercyclical (Stock and Watson (1999)), is found to be a more useful leading series for the euro area business cycle than the cycle in US industrial production, hours worked in US manufacturing and the US OECD leading indicator. For the euro area business cycle it appears to be essential that fluctuations in US economic activity are reflected in the unemployment rate.

Table 2 shows the correlations of the leading indicator composed of these three series (all appropriately shifted by their respective lead times and combined by simple averaging) with the BCI for different sample periods. The combined three-series-leading indicator has a higher correlation with the BCI than any of the individual series of about 0.8 for most sample periods which even rises further to 0.9 for the most recent sample starting in 1999.

We continue the selection process of series for the ALI with indicators starting in 1970. All series, with the exception of two, fulfil the first two selection criterions. Among the various government bond yields, the above discussed longer backward available ten-year German/euro area government bond yield is preferred, because it shows a somewhat higher correlation and has a stronger theoretical link to the long-term risk free interest rate. As regards M1, we prefer real instead of nominal M1 due to its stronger theoretical link to the real business cycle. The cyclical behaviour of money has a long tradition. Friedman and Schwartz (1963) show that the stock of money displays a consistent cyclical behaviour which is closely related to the cyclical behaviour of the economy at large. It is therefore no surprise that money is typically in the set of leading series. Arguments why money may provide useful information about the business cycle relate to traditional real balance effects and money as proxy for a whole range of relative prices of assets (Brand et al. (2004)). Another series we include in the ALI is the German ifo expectations index. Its leading properties for the euro area business cycle is probably largely due to Germany's considerable importance as a motor for the euro area economy given its size and the high share of the manufacturing sector in value added in Germany compared to other euro area countries. Senior managers in more than 7,000 businesses in German industry and trade are asked to give their business expectations for the six months ahead. The expectation component of the German ifo indicator also appears among a set of 130 indicators to be the best predictor for euro area real GDP growth selected by the DNB (DNB, 2008). It is thus no surprise that a new release of the German ifo indicator typically get a strong attention in the financial press and by financial market participants (Andersson et al. (2009)). Real M1 and the German ifo index are with a lead of 11 and 8 months, respectively, included in the ALI (see Charts A.4 and A.5). The correlation analysis of the composite leading indicator extended by these two series with the BCI in Table 2 shows that the inclusion of these additional two variables increases the correlations of the indicator with the BCI relative to the previous composite indicator over all sample periods except a slight deterioration over the shorter sample starting in 1999.

Considering indicators starting in 1980, we find that building permits, referring to all residential buildings, are most promising in view of their long lead time of 13 months with a reasonably high correlation of 0.7 and representing a part of the economy not yet represented in the ALI (see Chart A.6). Building permits granted are also part of the set of leading series as used by the OECD, Conference Board and DNB. They signal the future direction of the housing market and residential investment, which are important for the business cycle (Leamer (2007)). We therefore include building permits to our set of leading series. This addition results in a marginal improvement in the correlation with the BCI (see Table 2). The other series show a correlation that is too low or an optimal lead time that is too short, whereas the leading performance of the reported (sectoral) stock market-related variables are similar or lower than that of the already discussed total stock price index. The latter is therefore preferred and appears favourable also due to its broader economic coverage.

Analysing survey opinion indicators which are available from 1985 onwards for the euro area, there is a bunch of survey indicators with high correlations and sufficiently long and stable optimal leads. Among the survey indicators we pick the two with the best combinations of these two criteria and which help to broaden the economic coverage of the leading indicator even further. These are the consumer confidence indicator (CCI) and the economic sentiment indicator (ESI) with correlations of around 0.8 and a lead of 5 months (see Charts A.7 and A.8). Both indicators are published by the European Commission on the last working day of each reference month and have the advantage of a large survey sample and EU-wide standardisation of the survey method. Opinion surveys attract media and policymakers interest primarily because they contain timely information for yet-to-be published official statistics. We choose the CCI because private consumption is the largest component of GDP and the confidence among consumers are therefore expected to matter for aggregate economic activity (Ludvigson (2004)). The ESI composite indicator aggregates five confidence surveys for the following sectors: industry (weight 40%), services (30%), consumers (20%), construction (5%) and retail trade (5%). In terms of forecast ability for economic activity, the ESI, albeit constructed in a rather ad hoc way, is similar to more flexible weighting schemes (Gelper and Croux (2010)). Extending the combined leading indicator by these two series increases the correlations with the BCI even further over all available sample periods (see Table 2).

We, finally, look for series starting in 1999 though this sample is viewed as being too short to asses the stability of the lead relation. The series starting in 1999 include particularly indices from the Purchasing Managers' Survey (PMI), which are popular due to its international comparability. The PMI manufacturing new orders to stocks ratio is chosen to be included in the composite indicator, because this ratio is affected by new orders and inventories which were both not yet covered by the other so far selected series for the composite indicator. This ratio has a high correlation (around 0.8) and longer lead (9 months) on the BCI than most other PMI indices (see Chart A.9). The comparatively long lead of the orders-inventory ratio can be explained by the fact that orders received can be expected to appear subsequently in production, taking into account the de- or restocking of finished goods which takes place at the same time. Table 2 shows that including this PMI series does not change the correlation of the composite indicator in the sample starting in 1999. This series should, however, help to strengthen the performance and robustness of the composite leading indicator for longer lead periods, as it is among the selected indicators with longer leading indicator properties.

Table 2: Correlations between composite leading indicators and business cycle indicator

Composite leading series	Sample period				
	1960-2007	1970-2007	1980-2007	1985-2007	1999-2007
Ten-year government bond yield & stock price & US unemployment rate	0.82	0.83	0.81	0.79	0.92
Additional real M1 & German ifo expectations		0.89	0.85	0.85	0.91
Additional building permits			0.85	0.86	0.92
Additional consumer confidence & economic sentiment indicator				0.88	0.93
Additional PMI manufacturing new orders-stocks ratio					0.93

Note: Correlations are calculated from standardised cyclical deviation from trend according to CF-filter.

Table 3 provides an overview of the indicators selected for the ALI together with their leads, publication lags and effective leads, i.e. the leads corrected for the relative publication lag of the indicator with respect to the BCI based on industrial production excluding construction. It illustrates that of the selected leading series the cyclical component of the US unemployment rate, consumer confidence and the economic sentiment indicator have the shortest lead time of 5 months, followed by the stock price index with 6 months. The German IFO expectations (8 months), the PMI manufacturing orders-stocks ratio (9 months), M1 (11 months) and building permits (13 months) form the middle group of longer lead times of up to about a year, while the ten-year government bond yield has the by far longest lead of 24 months. For the effective lead time of an indicator, however, also its release timeliness and that of the benchmark series plays a role. Our aim is to compute the ALI in the middle of each month directly after the data release of industrial production excluding construction. When measured at that time of the month, the publication delay of industrial production excluding construction amounts to two months. For most leading series the publication delay at that time of the month is just one month, i.e. their effective lead exceeds the computed lead on the BCI by one month. Financial market data relate to the monthly averages of daily data, which are thus immediately available at the start of the next month. According to our mid-month computation they then have a publication lag of 1 month. On account of its 2 months publication lag when measured mid-month for M1 the effective lead equals the computed lead, while for building permits, for which no official release day is defined but which are usually published with a significant lag of around five months after the reference period, the effective lead is reduced significantly to 10 months. Overall, therefore taking into account all of the selected indicators the lead and effective lead of the ALI on the BCI amounts to 5 and 6 months, respectively.

Table 3: Leads, publication lags and effective leads of the cyclical components of the indicators included in the ALI with the BCI *(in months)*

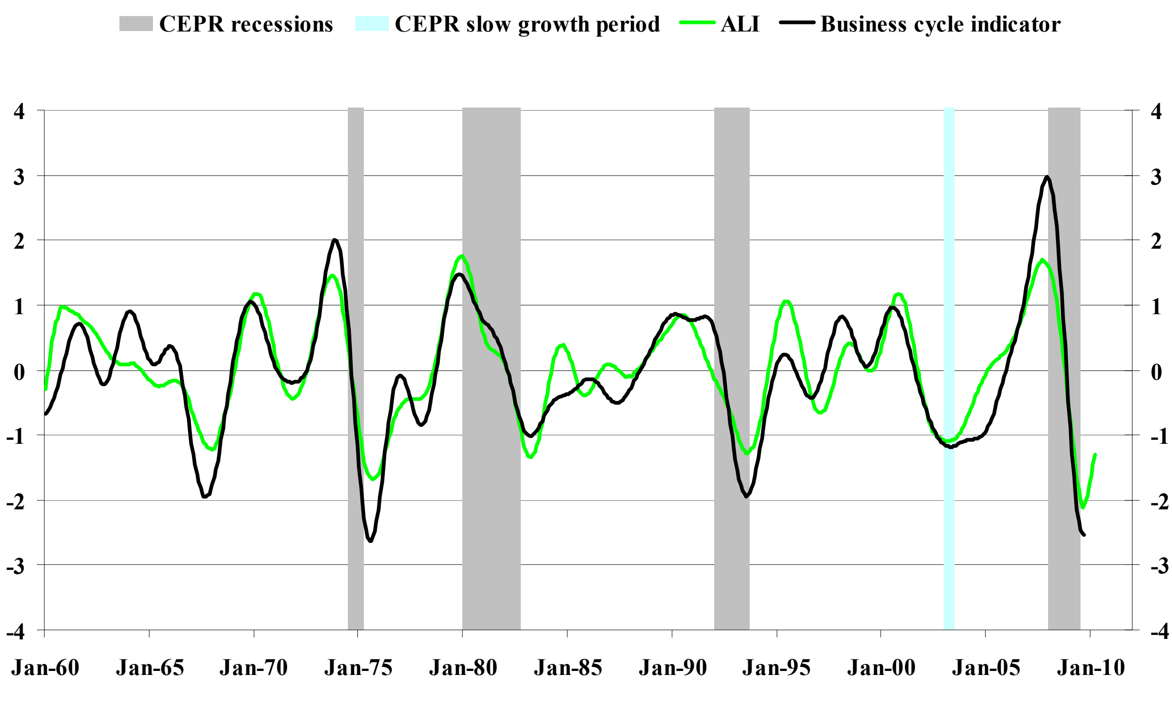
	Lead on BCI	Publication lag	Effective lead BCI
Ten-year government bond yield	24	1	25
Stock price index	6	1	7
US unemployment rate	5	1	6
Real monetary aggregate M1	11	2	11
German ifo expectations	8	1	9
Building permits	13	5	10
Consumer confidence	5	1	6
Economic sentiment indicator	5	1	6
PMI manufacturing new orders-stocks ratio	9	1	10
Industrial production excluding construction	-	2	-

3.2.2 What does the ALI tell us about future activity?

Chart 3 shows the development of the ALI together with the BCI where the ALI is shifted by the five months it leads the BCI. The comparison underlines the good co-movement of the two series and the good and stable leading indicator properties of the ALI. The ALI indicates clear cyclical turning points for the start and end of all of the euro area recession periods identified by the CEPR for the period since 1970. It, moreover, points to a further sharp euro area downturn around 1967 in line with a steep decline in the BCI at that time and also identifies correctly the slow growth period in the euro area around 2003 highlighted by the CEPR. The historical evidence seems to suggest that a fall of the ALI below the minus one standard deviation threshold is a serious indication of an upcoming recession. Concerning the most recent recession the ALI indicates a cyclical turning point before the recession for September 2007 and a turning point towards recovery for August 2009. While the ALI has improved further since then (Chart 3 includes data for the ALI up to March 2010) the BCI, which extends to September 2009, in line with the indications from the ALI appears to have just reached its trough around August and September where it was about flat.

Chart 3: The business cycle indicator and Area-wide Leading business cycle Indicator (ALI)

(standardised percentage deviation from trend)

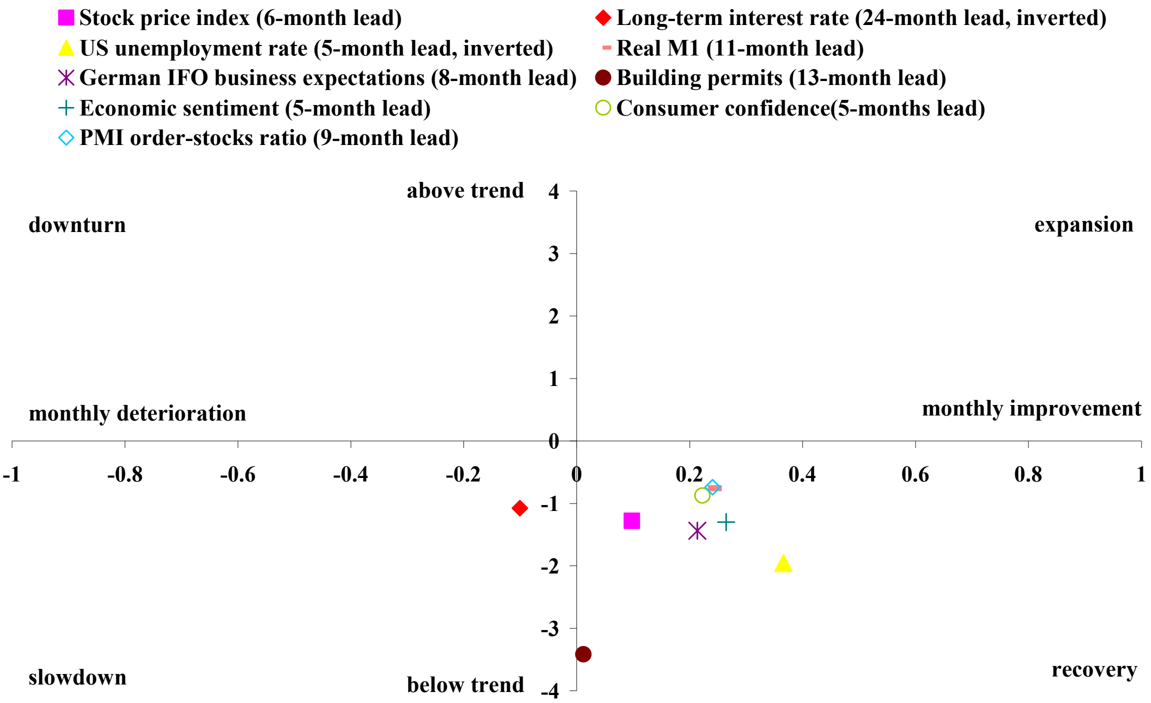


Note: The CEPR recession dating is based on real GDP and starts only in 1970. Two out of the three largest euro area countries for which recession dates are available for the 1960s had a recession in that decade as well.

An overview of the developments across the nine leading components underlying the ALI is provided by the ALI business cycle tracer (see Chart 4). The ALI business cycle tracer reviews the levels and monthly changes of the nine components at a point in time. It highlights that the majority of the components projected a further cyclical improvement for March 2010, but signal a level of activity still significantly (one standard deviation or more) below the trend. Eight out of the nine leading series indicated a recovery stage of the business cycle for March 2010. Noteworthy is that the business cycle signal for March 2010 derived from the level of and the change in the cyclical components of M1, consumer confidence and the PMI orders-inventory ratio were almost identical, despite their different nature. One leading component, the ten-year government bond yield, was in the slowdown quadrant of the business cycle tracer.

Chart 4: The ALI business cycle tracer for March 2010

(standardised percentage deviation from trend)



Note: Following the OECD terminology four subsequent business cycle phases are distinguished: i) downturn: above trend and deteriorating; ii) slowdown: below trend and deteriorating; iii) recovery: below trend and improving and iv) expansion: above trend and improving.

3.2.3 Longer leading ALIs

The composite ALI indicator leads the BCI by five months, but a number of its components showed significantly longer lead periods. This raises the question as to at what costs in terms of the reliability of the composite leading indicator the lead time of the ALI can be increased by dropping components with shorter lead periods. We explore this issue by stepwise dropping the components with the shortest lead periods from the ALI to construct a set of so-called longer-term ALIs of which we call the one with the longest lead the long-term ALI (see Table 4). Accordingly, in a first step the ALI is reduced by the three indicators with a lead of 5 months (consumer confidence, economic sentiment indicator, US unemployment rate) to the longer term ALI 1 with a lead of 6 months. The longer-term ALI is constructed by adding to the ALI the un-weighted average changes in the remaining leading series. Further reducing the indicator by stock prices increases its lead to 8 months (longer term-ALI 2) and by the ifo expectations to 9 months (longer term ALI 3). Dropping additionally building permits and PMI manufacturing order-stocks ratio extends the lead to 11 months (longer term ALI 4) and excluding M1 leaves the indicator with the variable ten-year government bond yield with a lead of 24 months (long-term ALI).

Table 4: Leads and effective leads of ALI and long(er)-term ALIs and regressions of ALI and BCI on long(er)-term ALIs

Leading indicator	Leading series	Lead on BCI in months	Effective lead in months	Regression of ALI on long(er)-term ALI		Regression of BCI on long(er)-term ALI	
				Adjusted R^2	S.E.	Adjusted R^2	S.E.
ALI	All nine	5	6			0.879	0.348
Longer term ALI 1	Six, ALI without US unemployment rate, consumer confidence and economic sentiment	6	7	0.991	0.087	0.847	0.392
Longer term ALI 2	Five, Longer term ALI 1 without stock price index	8	9	0.981	0.128	0.806	0.440
Longer term ALI 3	Four, Longer term ALI 2 without German ifo expectations	9	10	0.973	0.153	0.795	0.453
Longer term ALI 4	Two, Longer term ALI 3 without building permits and PMI orders-stocks ratio	11	11	0.877	0.327	0.703	0.545
Long-term ALI	One, Longer term ALI 4 without M1	24	25	0.787	0.431	0.656	0.587

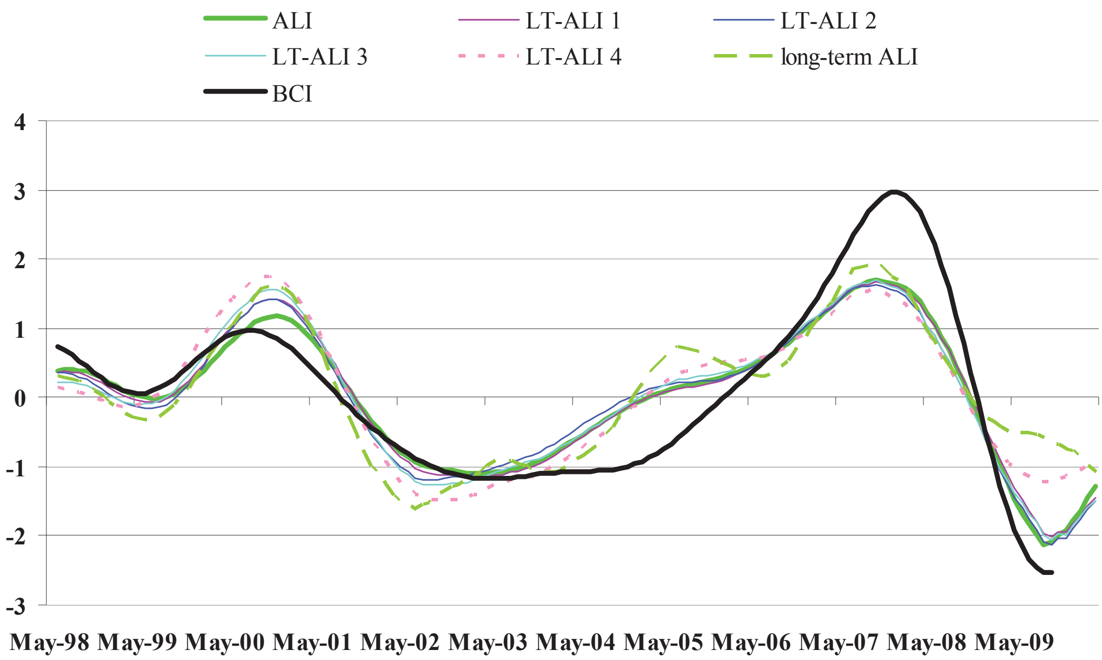
Note: The sample period of the regressions start in May 1998 (first month for which all leading series are available) and ends in March 2010 for the ALI regressions and September 2009 for the BCI regressions. S.E. refers to standard error of regression.

Regressions of the ALI on the long(er)-term ALIs should provide some insights concerning the predictive performance of the long(er)-term ALIs with regard to development of the ALI and correspondingly the BCI. The adjusted R-squared and standard errors of these regressions suggest that the predictive performance of the longer term ALIs 1 to 3 (i.e. up to the indicator reduced to four components) seems to be quite good and in fact very similar (see final four columns in Table 4). A somewhat larger drop in performance is recorded for the longer-term ALI 4 and the statistics deteriorate substantially further for the long-term ALI. It is thus important to keep in mind that the uncertainty around the ALIs in accurately predicting the business cycle increases the less leading series are considered. While it rises relatively modestly up to the longer-term ALI 3, the uncertainty, as measured by the standard error of regression, is for longer term ALI 4 and the long-term ALI about half to two-third larger than for the effectively 6-month leading ALI.

These observations are also confirmed when comparing the developments of the ALI and long(er)-term ALIs over the past decade (see Chart 5). The longer-term ALIs 1 to 3 move very closely with the ALI, while somewhat larger deviations are visible for the longer-term ALI 4 and even further deviations for the long-term ALI. This suggests that gradually extending the ALI indicator beyond its 5 months lead (6 months effective lead) to the longer-term ALI 3, which is based on the four components ten-year government bonds, real M1, building permits and PMI manufacturing order-stocks ratio, should provide reliable information concerning the further movements of the ALI and extends the leading indicator properties with regard to the BCI to 9 months (10 months effective lead). Extensions beyond that horizon become less reliable, but might still be informative once this deficiency is appropriately taken into account when interpreting the data.

Chart 5: Comparison of the ALI with the long(er)-term ALIs

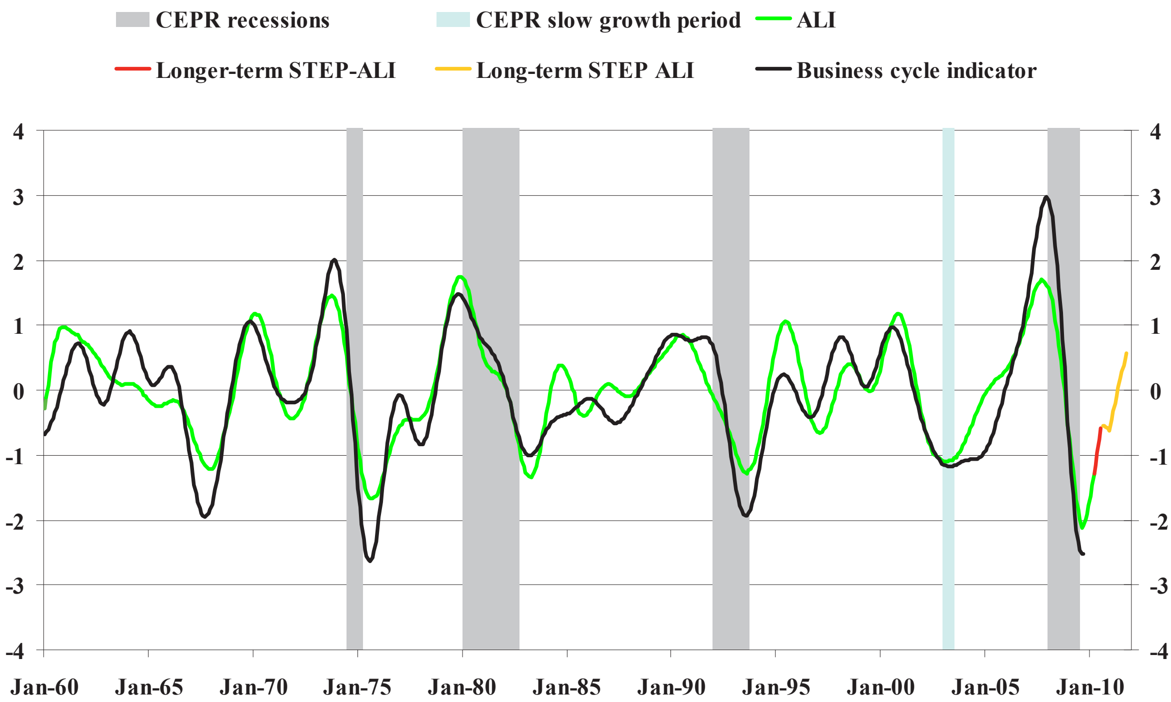
(standardised percentage deviation from trend)



Given these findings we construct a so-called STEP-ALI indicator which covers the whole leading horizon of components of the ALI (i.e. leads up to 24 months and effective leads up to 25 months) and where components are stepwise dropped when the horizon exceeds their respective leading indicator properties. This indicator is thus based on the complete set of variables in the ALI up to a lead of 5 months. Thereafter indicators are gradually taken out according to their leads until the indicator includes only the long-term interest rate for the lead period beyond 13 months. The above identified three stages of reliability (complete ALI, up to longer-term ALI 3, up to long-term ALI) are appropriately marked by the different colours in the STEP-ALI (see Chart 6). The information based on the complete ALI is depicted in green (5 (6) months (effective) lead) (denoted ALI), the indications from the longer-term ALIs up to the still very reliable longer-term ALI 3 is shown in red (9 (10) months (effective) lead) (defined as longer-term ALI) and the further extended somewhat less reliable signals up to the long-term ALI (24 (25) months (effective) lead) are shown in orange (defined as long-term ALI). The longer-term and long-term STEP-ALI in Chart 6 are linked to the ALI by adding to the ALI the un-weighted monthly changes in the longer leading series. Chart A.10 in the Appendix plots the historical series for the longer-term STEP-ALI (represented by longer-term ALI 3) and Chart A.1 for the long-term STEP-ALI (represented by long-term ALI), given that this is the ten-year government bond yield.

Chart 6: The business cycle indicator and the STEP-ALI

(standardised percentage deviation from trend)



Note: STEP-ALI refers to ALI, effectively leading up to 6 months, gradually extended to the longer-term ALI 3 effectively leading up to 10 months (denoted longer-term STEP-ALI), and further gradually extended to the long-term STEP-ALI, effectively leading up to 25 months. The CEPR recession dating is based on real GDP and starts only in 1970. Two out of the three largest euro area countries for which recession dates are available for the 1960s had in addition one recession in that decade.

4 Real-time analysis around the crisis

4.1 ALI's predictions of the 2008/09 recession and recovery

In the above ex post analysis the ALI has proved a reliable leading indicator for the euro area business cycle. The even more important question, however, is to what extent these characteristics of the ALI apply also in real-time. If the ALI were subject to larger revisions, despite its good ex post performance, it might not have provided reliable signals in real time and its leading indicator properties might likewise be an artificial ex post characteristic. As earlier mentioned, the applied one-sided CF-filter does not introduce revisions to the filtered series. Revisions of the ALI, therefore, solely result from revisions in the included data. Of the nine series included in the ALI only three are subject to revisions (building permits, the monetary aggregate M1 and the US unemployment rate) which should provide some limit to the magnitude of revisions of the ALI.

To fully answer the question on the real-time performance of the ALI we explore its ability to predict the growth cycle turning points of the latest recession and recovery based on the information that was available at that time. Such a real-time exercise with a forecast horizon beyond 6 months is, to the best of our knowledge, for the first time performed for the euro area. It extends earlier work by Diron (2008), which presents a real-time analysis of forecast for euro area real GDP growth up to two quarters. For the real-time analysis we take into account the pattern of data availability for all indicators and the state of revision of the three leading series subject to revisions and of the reference series as they were available in the respective past points in time. The period considered for the real-time analysis is 2007 to 2009. Over that period we compute one real-time data point for the ALI for each quarter, which always refers to the mid-month of the quarter, i.e. the considered months are February, May, August and November. The analysis replicates the information stand that was available mid of these months when euro area industrial production was released based on which the real-time BCI is computed as reference series for the real-time ALI.

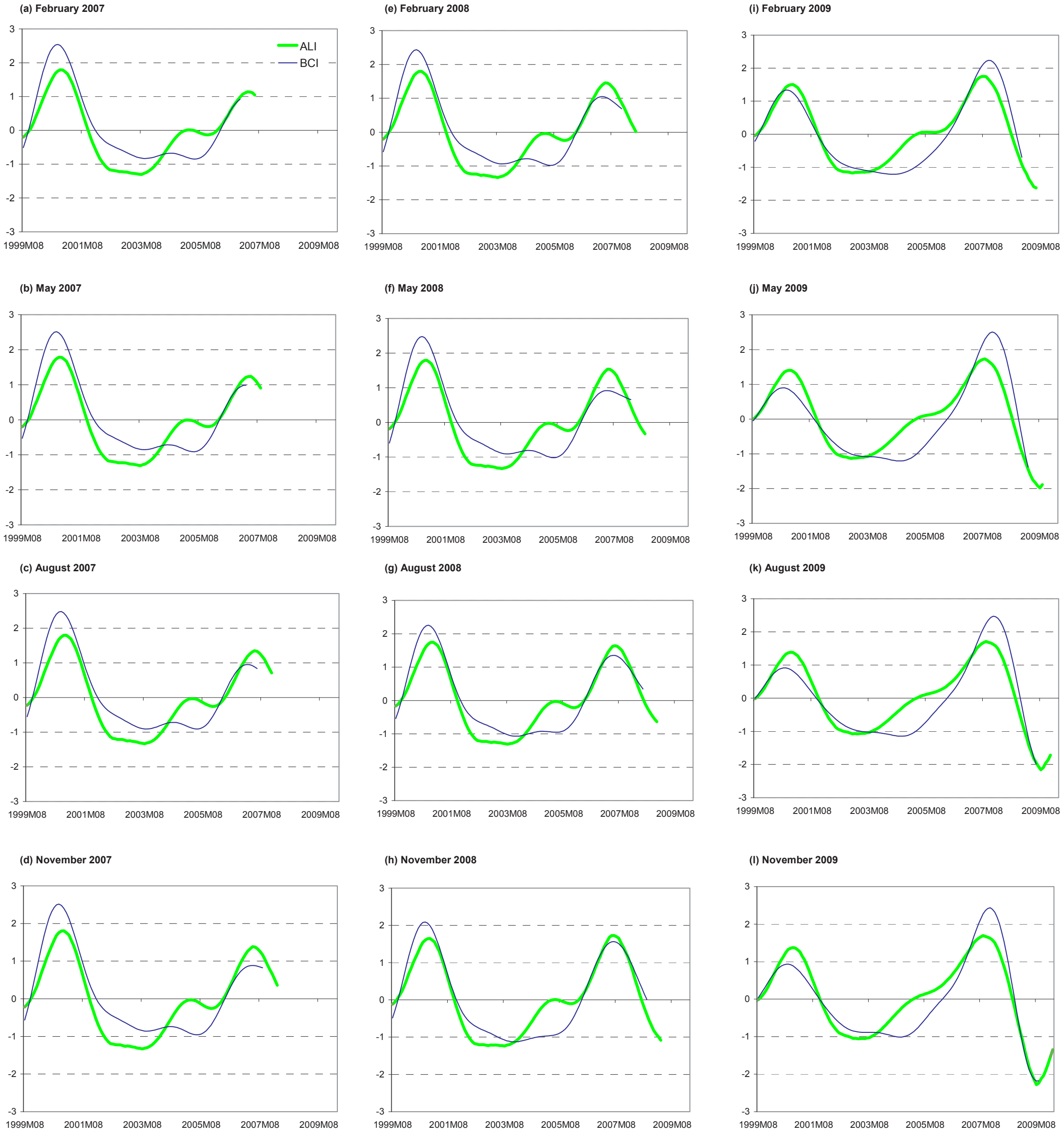
Charts 7 (a) to (l) show the real-time developments of the ALI and BCI for the four points in time in the years 2007 to 2009 respectively where the ALI is again shifted by the 5 months it leads the BCI. Chart 7 (a) highlights that in February 2007 the ALI predicted an upcoming turning point for the growth cycle. This signal remained without revisions in the following quarters and the indicated downturn got continually stronger over time. In February 2008 the ALI predicted that activity will reach the edge of falling below trend (Chart 7 (e)). The downward movement of the ALI below trend continued in the following quarters until clear signs of a growth cycle turning point to recovery appeared in May 2009. This signal again got continually stronger in the following quarters without much revision.

In line with the identified 6-month effective lead of the ALI the BCI displayed a turning point half a year after the ALI in August 2007. It reached the threshold to below trend growth in November 2008 and continued its falls until November 2009, where a first sign of a cyclical turning point in the growth cycle became evident in the BCI. For both of these events the lead of the ALI was even somewhat longer than the identified 6-month period.

Overall, the real-time analysis confirms the reliability and leading properties of the ALI. The ALI provided clear and unrevised signals of the growth cycle turning points which appeared well ahead of the same signals in the BCI. There appear to have been some smaller backward shifts in the timing of the turning point prior to the recession over time but these are also evident and appear to have been even somewhat stronger in the BCI. Also more generally the BCI seems to display larger revisions than the ALI. This is visible for instance in the larger changes in the amplitude of the BCI at the peak prior to the recession and is also in line with the construction of the two indicators as only one third of the series included in the ALI may be revised while the full information underlying the BCI (industrial production excluding construction) is subject to revisions, which are occasionally also of larger magnitude and may affect significant parts of the back data.

Chart 7: Real-time development of ALI and BCI over the period 2007 to 2009

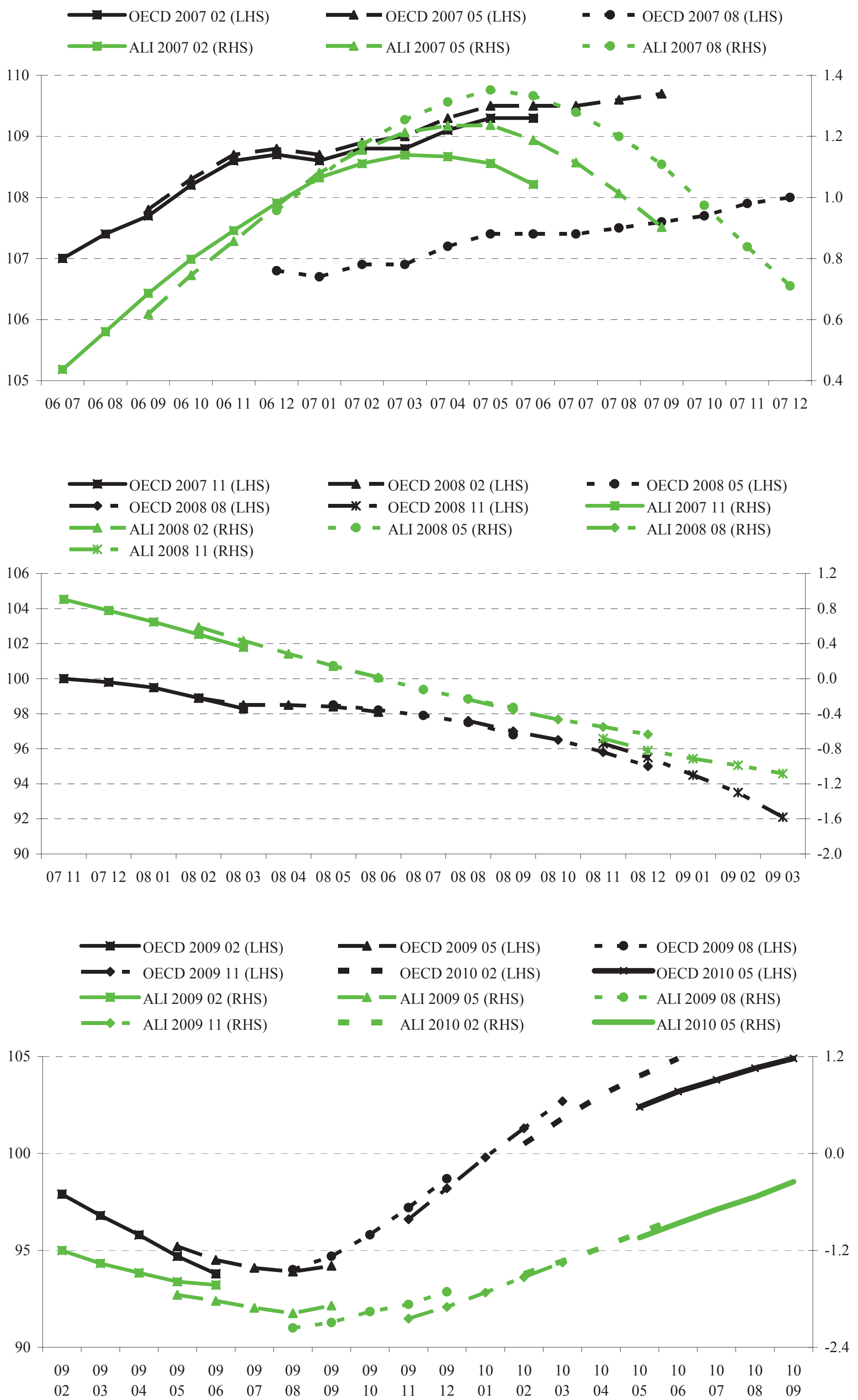
(standardised percentage deviation from trend)



4.2 Comparison of ALI's predictions with those of the OECD composite leading indicator

Do the signals of the ALI differ from those of the published and real-time available euro area OECD composite leading indicator (CLI)? Both 6-month leading indicators provided over the period considered generally similar signals (see Chart 8). But there are also some striking differences. Chart 8 (a) shows that the ALI already indicated a forthcoming downturn in February 2007 and confirmed this picture also in May and August 2007, whereas this is not the case for the OECD CLI. The real-time available OECD press release reports for this period, however, only the trend restored composite leading indicator for the euro area, making a fair comparison difficult. Chart 8 (b) shows that both leading indicators projected a slowdown in the period between November 2007 and November 2008. The OECD CLI signalled, however, in particular in February 2008 a less pessimistic economic outlook compared to that according to the ALI. The OECD CLI flattened in February 2008, whereas the ALI continued to show a sharp decline. Chart 8 (c) shows that in line with the ALI the OECD CLI detected signs of a turning point in May 2009, albeit a bit less pronounced than the ALI, and confirmed these signals thereafter. In November 2009 the OECD CLI was, however, not only upward sloping, as was the ALI, but also already above trend growth. The OECD CLI signalled in November 2009 thus for the euro area an expansion early 2010, whereas the ALI indicated an ongoing recovery. The November 2009 OECD press release states that the observed expansion signal should be interpreted with caution. The expected improvement in economic activity relative to long-term potential levels can be partly attributed to a decrease in the estimated long-term potential level and not solely an improvement in economic activity itself. All in all, the ALI seems to have provided during the period considered somewhat more reliable signals of turning points in the euro area business cycle 6 months ahead than the OECD CLI.

Chart 8: Real-time comparison between ALI and OECD composite leading indicator over the period 2007 to 2009 *(left-hand scale (LHS): (a) trend restored, (b) amplitude adjusted ratio to trend, (c) amplitude adjusted ratio to trend, new methodology; right-hand scale (RHS): standardised percentage deviation from trend)*



Source: OECD Press Releases and authors calculations.

4.3 Long(er)-term ALI's predictions of the recession and recovery

Given the very good performance of the ALI in real time, it is interesting to see whether also the STEP-ALIs (i.e. the ALI plus the longer-term ALI and the long-term ALI) based on subsets of the leading components of the ALI with longer lead times provide reliable signals for the developments in the ALI and BCI in real-time and have therefore predicted the 2008/09 recession and recovery even earlier.

We start the extended real-time analysis with the STEP-ALI that extends up to the longer-term ALI which has proved a very reliable leading indicator for the ALI in the ex post analysis. Charts 9(a) to (l) show that this indicator provided even clearer signals of an upcoming turning point in the growth cycle already in February 2007 than the ALI. Signals of below trend growth are provided already in November 2007 and the first clear indications that a growth cycle turning point towards recovery may be reached are visible already in February 2009. Overall, Charts 9(a) to (l) indicate that the longer-term ALI provided very good and reliable real-time information on the future developments in the ALI and BCI. It further extends the lead of the ALI by 4 months to almost a year and does similarly to the ALI not seem to be revised visibly.

We, finally, explore the real-time performance of the STEP-ALI that extends to the long-term ALI, i.e. the longest possible lead available in the included series (an effective lead of 25 months). We include for each of the lead periods as many of the indicators of the ALI as are available for that lead such that for the effective lead time between 11 and 25 months the leading indicator relies only on the ten-year government bond yield. Charts 10 (a) to (l) display the real-time development of this indicator together with those of the ALI, longer-term ALI and BCI.

Chart 9: Real-time development of longer-term STEP-ALI (effective lead of 10 months on BCI) and BCI over the period 2007 to 2009

(standardised percentage deviation from trend)

Chart 10: Real-time development of long-term STEP-ALI (lead of 24 months on BCI) and BCI over the period 2007 to 2009

(standardised percentage deviation from trend)

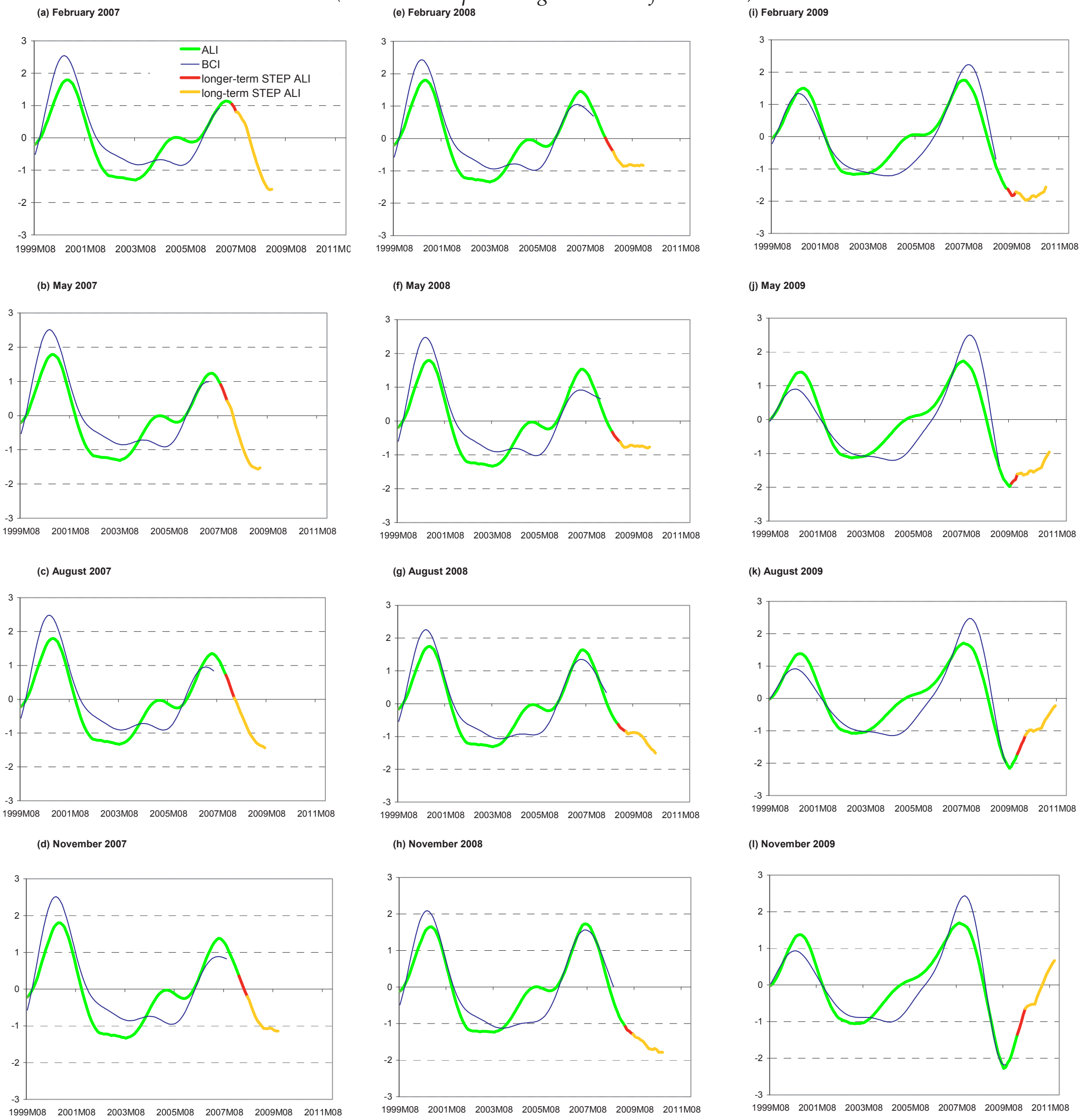


Chart 10(a) shows that the long-term ALI already predicted in February 2007 a sharp downturn far below trend growth for the period up to March 2009. In May 2007 it provided first signals of a possible stabilisation of the downturn for mid-2009 and these signals of the long-term ALI intensified in the following quarters up to May 2008 but without indicating that a turning point had been realised. The indicated outlook worsened suddenly in August 2008 and further in November 2008 after the collapse of Lehman Brothers with the longer-term ALI pointing to a continuation of the downturn in mid-2009. Only in February 2009 the longer-term ALI started to stabilise again and provided first signs of an upcoming turning point. These signals continually strengthened in the following quarters and the latest long-term ALI points to a return to above trend growth for the second half of 2011. All in all, the results show that also the long-term ALI provides valuable and indeed extremely timely information on the state of the business cycle. Its signals are, however, not always fully reliable and the revisions are larger than those of the ALI.

Overall, the extended real-time analysis highlights that valuable information on the future development of the business cycle can be gained well in advance with the longer leading ALIs. The reliability of these indications naturally declines with the prediction horizon but very reliable information may be gained for a period of almost one year ahead.

5 Conclusions

This study develops a new monthly euro Area-wide Leading Indicator, the ALI, for the euro area business cycle which belongs to the class of traditional "non-model based" indicators and focuses on aggregate euro area wide data, i.e. directly on the entity of the whole euro area economy. The ALI is based on the concept of deviation cycles, i.e. cyclical fluctuations in the deviations from the long-term trend. The cyclical component of the series is determined by applying a one-sided band pass filter as developed by Christiano and Fitzgerald (2003). To derive the cyclical component the band pass method filters out all fluctuations at both low frequencies (underlying trend) and high frequencies (short-run noise) that are considered as non-cyclical. The applied minimum and maximum length of a cycle are 2 and 10 years, respectively. A one-sided or asymmetric filter is only based on past observations and therefore insensitive to new observations. Given this property it is well suited to obtain real-time estimates of the cyclical component. The ALI is derived as a composite index of nine leading series which are selected from a large pool of data based on their good and consistent leading indicator properties for the euro area business cycle. Moreover, a broad mixture of the leading series is ensured in the selection process to guarantee that information from different data sources and GDP components is exploited which should enhance the robustness of the indicator. The ALI is a un-weighted average of the included leading series: ten-year government bond yield, stock price, US unemployment rate, real M1, German ifo expectations indicator, building permits granted, consumer confidence, economic sentiment, and PMI new orders-stocks ratio.

Three main conclusions emerge from our empirical results. First, our reference series for the business cycle, i.e. the cyclical deviation from trend according to the one-sided CF filter of industrial production excluding construction, closely matches the real GDP cycle. Our business cycle indicator (BCI) can thus be viewed as a monthly tracer of the real GDP cycle. Second, the ALI reliably leads the BCI by 6 months. Third, the longer leading components of the ALI are good predictors of the ALI and therefore the BCI by up to almost a year ahead and satisfactory predictors by up to 2 years ahead. A real-time analysis for predicting the future developments of the euro area business cycle up to 2 years ahead during the 2008/2009 recession and following recovery confirms these findings. It also shows that the ALI is revised much less than the BCI, which is another favourable property of this indicator. It, moreover, suggests that the ALI provided during this period more reliable turning point signals than the only comparable regularly published leading indicator that was available over the whole of this period, the OECD Composite Leading Indicator (CLI) for the euro area. The latter is derived as an aggregate of the OECD CLIs for euro area countries, while the second regularly published indicator for the euro area from the Conference Board was launched too late (in January 2009) for a comparison.

All in all, our findings imply that the BCI is an important new monthly device for tracking at an early stage cyclical developments in euro area real GDP and the ALI for signalling in an accurate way the future direction of the euro area business cycle, in particular up to 10 months ahead.

References

Agresti, A.M. and B. Mojon (2003), "Some Stylised Facts on the Euro Area Business Cycle", In: I. Angeloni, A. Kashyap and B. Mojon (ed.), "Monetary Policy Transmission in the Euro Area", Cambridge University Press, Part 1, Chapter 1, pp. 15- 35.

Altissimo, F., A. Bassanetti, R. Cristadoro, M. Forni, M. Lippi, M. Hallin, L. Reichlin, G. Veronese (2001), "Eurocoin: A Real-time Coincident Indicator of the Euro Area Business Cycle", Centre for Economic Policy Research Discussion Paper No. 3108.

Altissimo, F., R. Cristadoro, M. Forni, M. Lippi and G. Veronese (2007), "New Eurocoin: Tracking Economic Growth in Real Time", Bank of Italy Discussion Paper No. 631, July.

Anas, J., M. Billio, L. Ferrara and M. Lo Duca (2007), "Business Cycle Analysis with Multivariate Markov Switching Models", University of Venice Working Paper, No. 32.

Andersson, M. and A. D'Agostino (2008), "Are Sectoral Stock Prices Useful for Predicting Euro Area Real GDP?", European Central Bank Working Paper No. 876, February.

Andersson, M., L. Hansen and S. Sebestyén (2009) "Which News Moves the Euro Area Bond Market?", German Economic Review, Vol. 10, No. 1, pp. 1-31.

Angelini, E., M. Banbura and G. Rünstler (2008), "Estimating and Forecasting the Euro Area Monthly National Accounts from a Dynamic Factor Model", ECB Working Paper No. 953, October 2008.

Angelini, E., G. Camba-Mendez , D. Giannone , L. Reichlin and G. Rünstler (2008), "Short-term Forecasts of Euro Area GDP", CEPR Discussion Paper No. 6746.

Arnaud, B. and E.P. Hong (2001), "Comparison of Compilation Methodologies for the Composite Leading Indicators of Euro Area", OECD manuscript.

Artis, M.J., H.-M. Krolzig and J. Toro (2004), "The European Business Cycle", Oxford Economic Papers, Vol. 56, No. 1, pp. 1-44.

Baffigi, A., R. Golinelli and G. Parigi (2002), "Real-time GDP Forecasting in the Euro Area", Banca d'Italia Discussion Paper No. 456.

Banbura, M. and G. Rünstler (2007), "A Look into the Factor Model Black Box: Publication Lags and the Role of Hard and Soft Data in Forecasting GDP", ECB Working Paper No. 751.

Baxter, B. and R.G. King (1999), "Measuring Business Cycles: Approximate Band-Pass Filters for Economic Time Series", Review of Economics and Stastistics, Vol. 81, No. 4, pp. 575-593.

Bondt, G.J. de (2009), "Predictive Content of the Stock Market for Output Revisited", Applied Economics Letters, Vol. 16, No. 13, pp. 1289-1294.

Brand, C., H.-E. Reimers, F. Seitz (2004), "Forecasting Real GDP: What Role for Narrow Money?", Review of Economics, Vol. 55, pp. 246-262.

Burns, A.F. and W.C. Mitchell (1946), "Measuring Business Cycles", National Bureau of Economic Research, New York.

Camacho, M. and G. Perez-Quiros (2008), "Introducing the Euro-STING: Short-term Indicator of Euro area Growth", Journal of Applied Econometrics, Vol. 25, No. 4, pp. 663-694.

Camba-Mendez, G., Kapetanios, G., Weale, M. R. and R. J. Smith (2001), "The Forecasting Performance of the OECD Composite Leading Indicators for France, Germany, Italy and the UK", In: D. Hendry and M. Clements (ed.) "A Companion to Economic Forecasting", Blackwell Publishers, Oxford.

Christiano, L. J. and T. J. Fitzgerald (2003), "The Band Pass Filter", International Economic Review, Vol. 44, No. 2, pp. 435-465.

De Nederlandsche Bank (DNB) (2008), "Predictive Power of Leading Indicators for Euro Area GDP Growth", Quarterly Bulletin, June, pp. 43-47.

Diebold, F.X. and G.D. Rudebusch (1996), "Measuring Business Cycles: A Modern Perspective", The Review of Economics and Statistics, Vol. 78, No. 1, pp. 67-77.

Diron, M. (2008), "Short-Term Forecasts of Euro Area Real GDP Growth: An Assessment of Real-Time Performance Based on Vintage Data", Journal of Forecasting, Vol. 27, pp. 371-390.

Drake, L. and T. Mills (2010), "Trends and Cycles in Euro Area Real GDP", Applied Economics, Vol. 42, No. 11, pp. 1397-1401.

Fichtner, F., Rüffer, R. and B. Schnatz (2009). "Leading Indicators in a Globalised World", European Central Bank Working Paper No. 1125, December.

Forni, M., M. Hallin, M. Lippi, L. Reichlin (2000), "The Generalized Factor Model: Identification and Estimation", The Review of Economics and Statistics, Vol. 82, No. 4, , pp. 540-554.

Forni, M., M. Hallin, M. Lippi, L. Reichlin (2001), "Coincident and Leading Indicators for the Euro Area", Economic Journal, Vol. 111, pp. 62-85.

Forni, M., M. Hallin, M. Lippi, L. Reichlin (2005), "The Generalized Dynamic Factor Model: One-sided Estimation and Forecasting", Journal of the American Statistical Association, Vol. 100, No. 471, pp. 830-840.

Friedman, M. and A.J. Schwartz (1963), "Money and Business Cycles", Review of Economics and Statistics, Vol. 45, pp. 32-64.

Gelper, S. and C. Croux (2010), "On the Construction of the European Economic Sentiment Indicator", Oxford Bulletin of Economics and Statistics, Vol. 72, No. 1, pp. 47-62.

Geweke, J. (1977), "The Dynamic Factor Analysis of Economic Time Series", In: Aigner, D.J. and A.S. Goldberger (ed.), "Latent Variables in Socio-Economic Models", North Holland, Amsterdam, Chapter 19.

Giannone, D., L. Reichlin and D. H. Small (2006), "Nowcasting GDP and Inflation – The Real-time Informational Content of Macroeconomic Data Releases", ECB Working Paper No. 633.

Gyomai, G. and E. Guidetti (2008), “OECD System of Composite Leading Indicators”, OECD manuscript.

Hahn, E. and F. Skudelny (2008), “Early Estimates of Euro Area Real GDP Growth: A Bottom Up Approach from the Production Side”, ECB Working Paper No. 975.

Hamilton, J.D. (1989), “A New Approach to the Economic Analysis of Nonstationary Time Series and the Business Cycle”, Econometrica, Vol. 57, pp. 357-384.

Hodrick, R.J. and E.C. Prescott (1997), “Postwar U.S. Business Cycles: An Empirical Investigation”, Journal of Money, Credit, and Banking, Vol. 29, No. 1, pp. 1-16.

Kim, C.-J. and C.R. Nelson (1998), “Business Cycle Turning Points, a New Coincident Index, and Tests of Duration Dependence Based on a Dynamic Factor Model with Regime Switching”, The Review of Economics and Statistics, Vol. 80, pp. 188-201.

Kranendonk, H., Bonenkamp, J. and J. Verbruggen (2004), “A Leading Indicator for the Dutch Economy – Methodological and Empirical Revision of the CPB system”, CPB Discussion Paper No. 32, June.

Krolzig, H.-M. (1997), “Markov Switching Vector Autoregressions. Modelling, Statistical Inference and Application to Business Cycle Analysis”, Springer, Berlin.

Leamer, E.E. (2007), “Housing is the Business Cycle”, NBER Working Paper, No. 13428.

Ludvigson, S.C. (2004), “Consumer Confidence and Consumer Spending”, Journal of Economic Perspectives, Vol. 18, No. 2, pp. 29-50.

Mariano, R.S. and Y. Murasawa (2010), “A Coincident Index, Common Factors, and Monthly Real GDP”, Oxford Bulletin of Economics and Statistics, Vol. 72, No. 1, pp. 27-46.

Marcellino, M. (2006), “Leading Indicators”, In: Elliott, G., C.W.J. Granger and A. Timmermann (ed.), “Handbook of Economic Forecasting”, Elsevier, Vol. 1, Chapter 16, pp. 879-960.

Nilsson, R. and G. Gyomai (2009), “Cycle Extraction. A Comparision of the Phase-Average Trend Method, the Hodrick-Prescott and Christiano-Fitzgerald filters” http://www.oecd.org/dataoecd/32/13/41520591.pdf.

Ozyildirim, A., B. Schaitkin and V. Zarnowitz (2010), “Business Cycles in the Euro Area Defined with Coincident Economic Indicators and Predicted with Leading Economic Indicators”, Journal of Forecasting, Vol. 29, No. 1-2, pp. 6-28.

Parigi, G. and G. Schlitzer (1995), ”Quarterly Forecasts of the Italian Business Cycle by Means of Monthly Economic Indicators”, Journal of Forecasting, Vol. 14, pp. 117 – 141.

Reijer, A.H.J. den (2006), “The Dutch Business Cycle: Which Indicators Should We Monitor?”, DNB Working Paper No. 100.

Reijer, A.H.J. den (2007), “Deviation Cycles in Manufacturing: Business Cycle Measurement and Leading Indicators”, Journal of Business Cycle Measurement and Analysis, Vol. 3, No. 1, pp. 43-77.

Rua, A. and L.C. Nunes (2005), “Coincident and Leading Indicators for the Euro Area: A Frequency Band Approach”, International Journal of Forecasting Vol. 21, No. 3, pp. 503-523.

Rünstler, G. and F. Sédillot (2003), “Short-term Estimates of Euro Area real GDP by Means of Monthly Data”, ECB Working Paper No. 276.

Sargent, T.J. and C.A. Sims (1977), “Business Cycle Modeling without Pretending to have too much a priori Economic Theory”, In: Sims, C.A. et. al. (ed.), “New Methods in Business Cycle Research”, Federal Reserve Bank of Minneapolis.

Stock, J.H. and M.W. Watson (1989), “New Indexes of Coincident and Leading economic Indicators”, In: Blanchard, O. and S. Fischer (ed.), “NBER Macroeconomics Annual”, MIT Press, Cambridge, MA, pp. 351-394.

Stock, J.H. and M.W. Watson (1991), “A Probability Model of the Coincident Indicators”, In: Lahiri, K. and G.H. Moore (ed.), “Leading Economic Indicators: New Approaches and Forecasting Records”, Cambridge University Press, Cambridge, UK.

Stock, J.H. and M.W. Watson (1992), “A Procedure for Predicting Recessions with Leading Indicators: Econometric Issues and Recent Experience”, NBER Working Paper No. 4014.

Stock, J.H. and M.W. Watson (1999), “Business Cycle Fluctuations in US Macroeconomic Time Series”, In: J.B. Taylor and M. Woodford (ed.), “Handbook of Macroeconomics”, Elsevier Science, Vol. 1, Part 1, Chapter 1, pp. 3-64.

Veer, van der K. and J. de Winter (2009), „Economic Recovery in the Euro Area Takes its Time” (in Dutch), Economisch Statistische Berichten, Vol. 94, No. 4562, pp. 365-366.

Zarnowitz, V. and A. Ozyildirim (2006), “Times Series Decomposition and Measurement of Business Cycles, Trends and Growth Cycles”, Journal of Monetary Economics, Vol. 53, No. 7, pp. 1717-1739.

Appendix

Chart A.1: Ten-year government bond yield (24-month lead, inverted) and business cycle indicator

(standardised percentage deviation from trend)

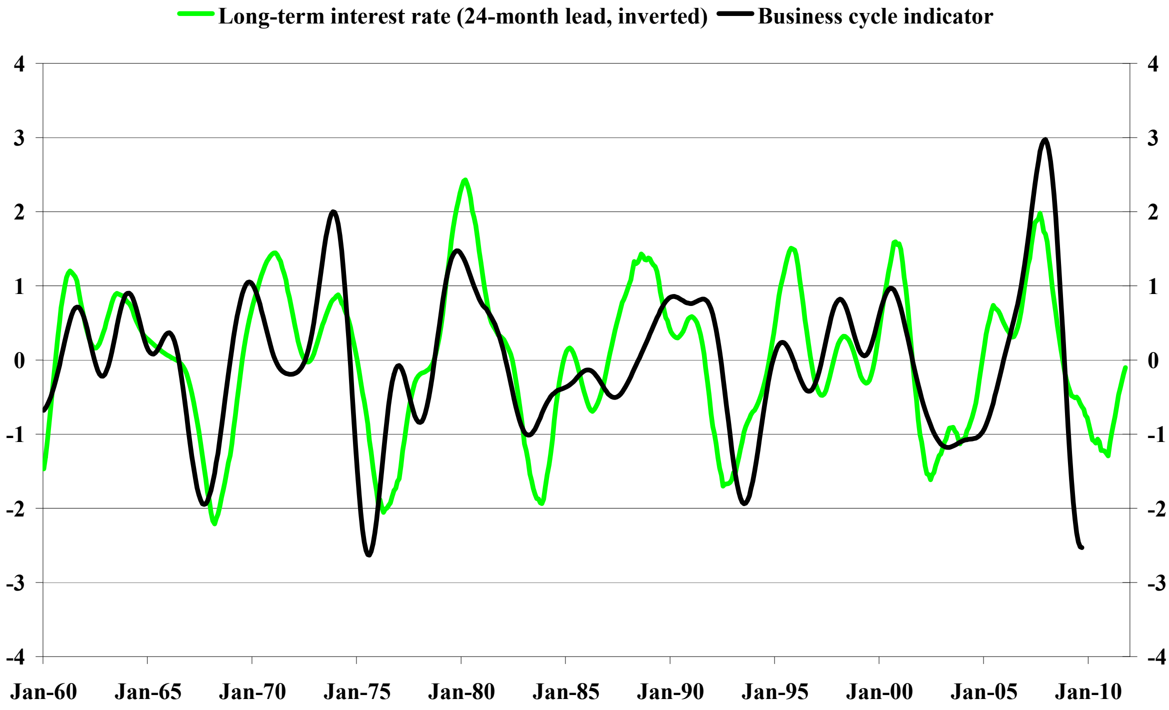


Chart A.2: Nominal stock price index (6-month lead) and business cycle indicator

(standardised percentage deviation from trend)

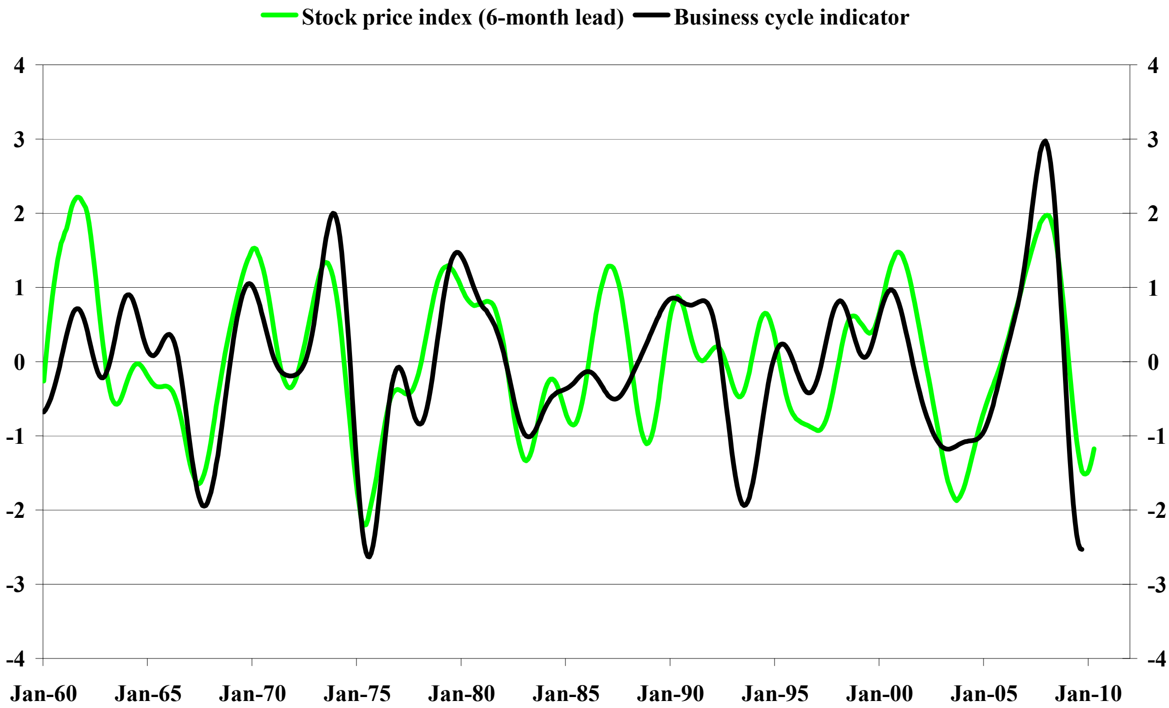


Chart A.3: US unemployment rate (5-month lead, inverted) and business cycle indicator

(standardised percentage deviation from trend)

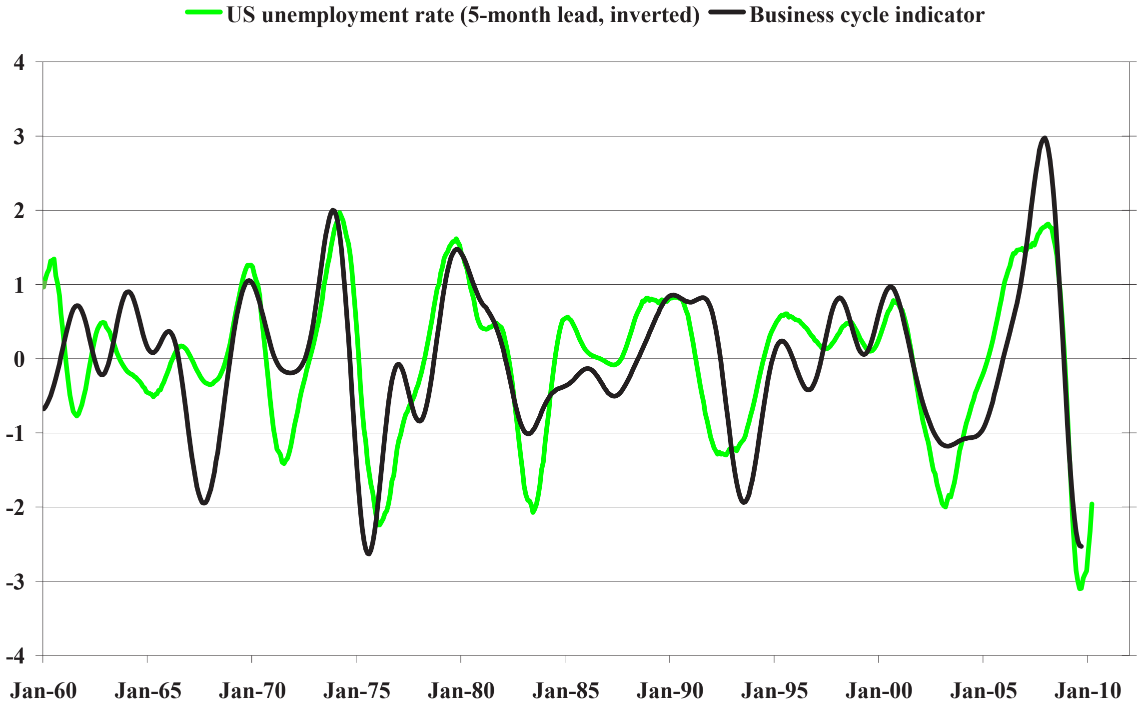


Chart A.4: Real M1 (11-month lead) and business cycle indicator

(standardised percentage deviation from trend)

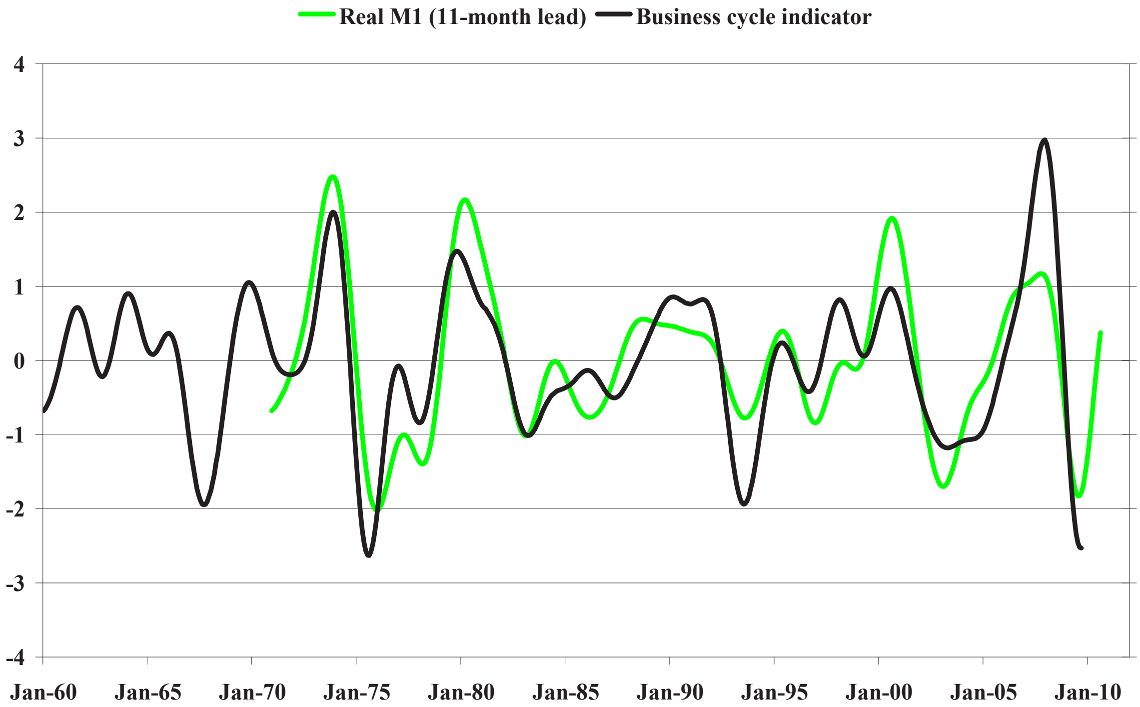


Chart A.5: German IFO business expectations (8-month lead) and Business Cycle Indicator

(standardised percentage deviation from trend)

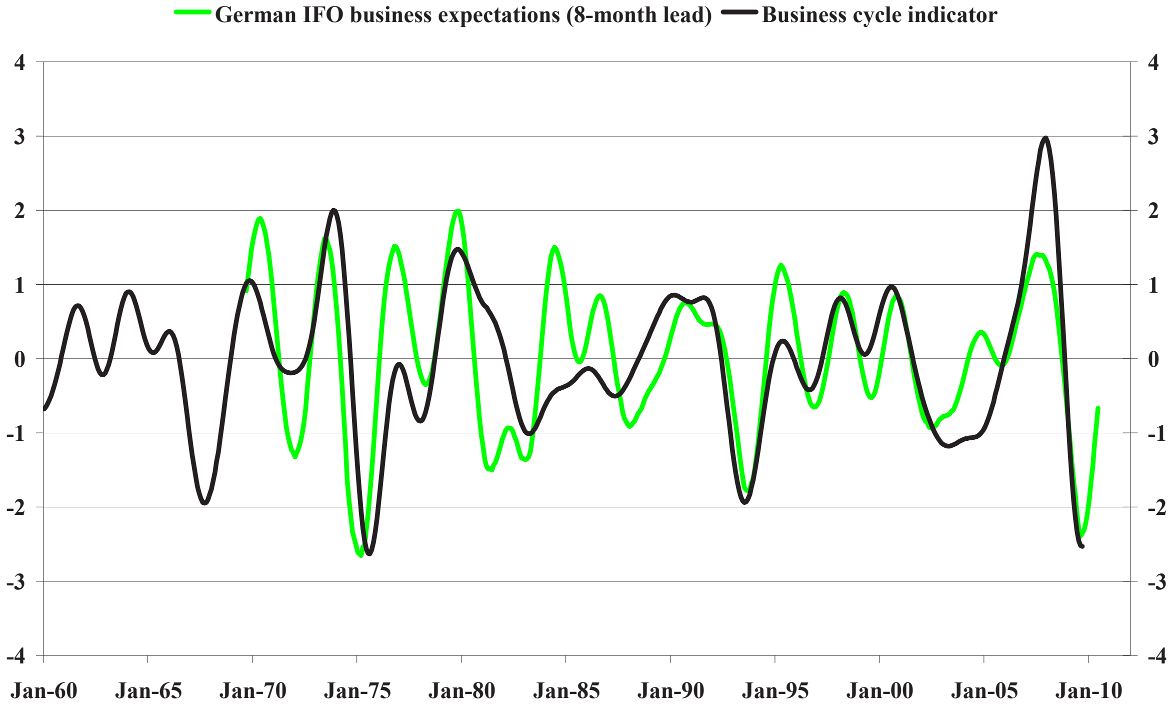


Chart A.6: Building permits (13-month lead) and business cycle indicator

(standardised percentage deviation from trend)

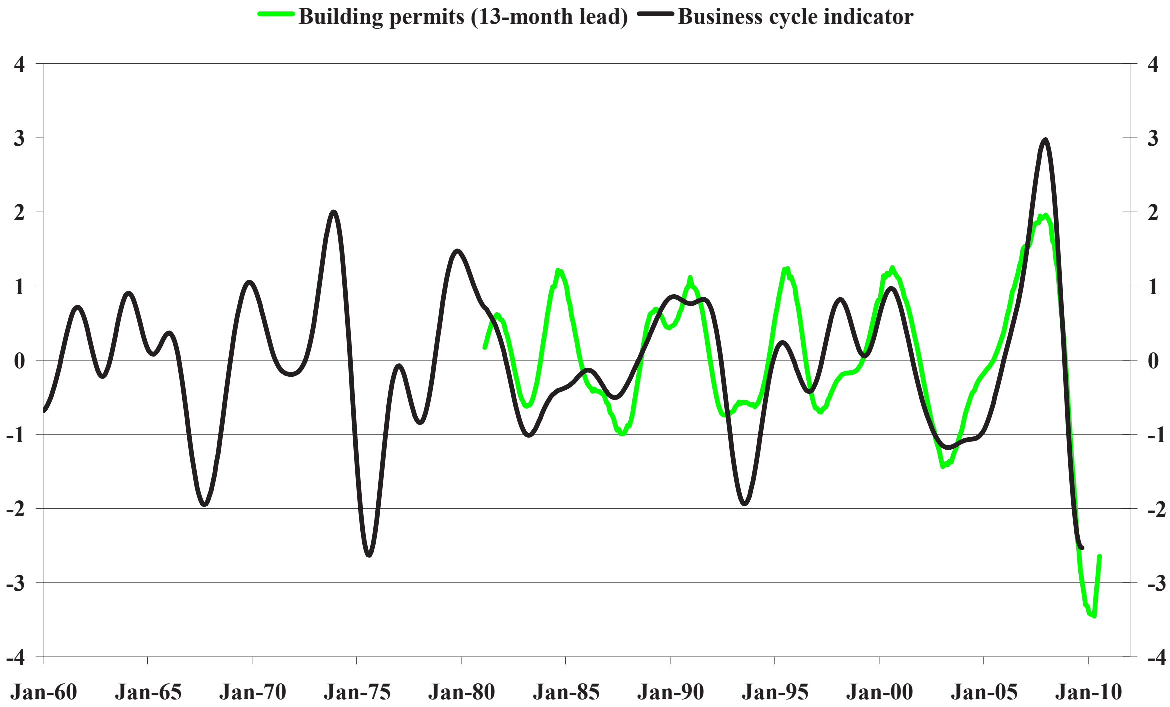


Chart A.7: Economic sentiment indicator (5-month lead) and business cycle indicator

(standardised percentage deviation from trend)

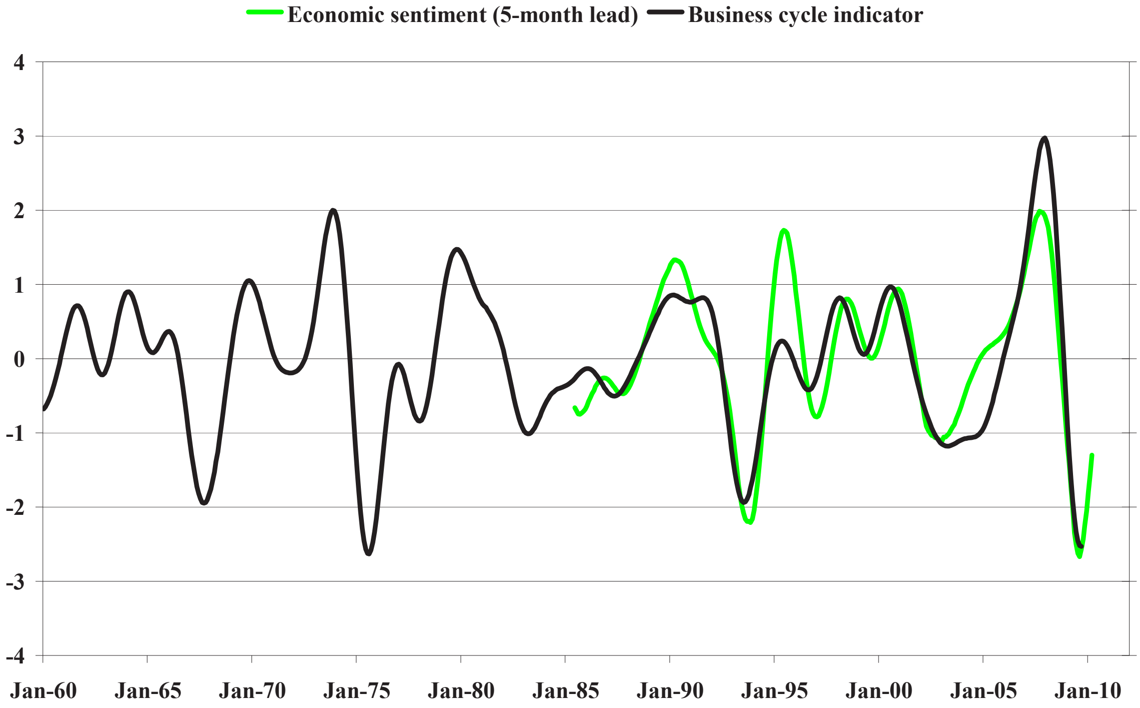


Chart A.8: Consumer confidence index (5-month lead) and business cycle indicator

(standardised percentage deviation from trend)

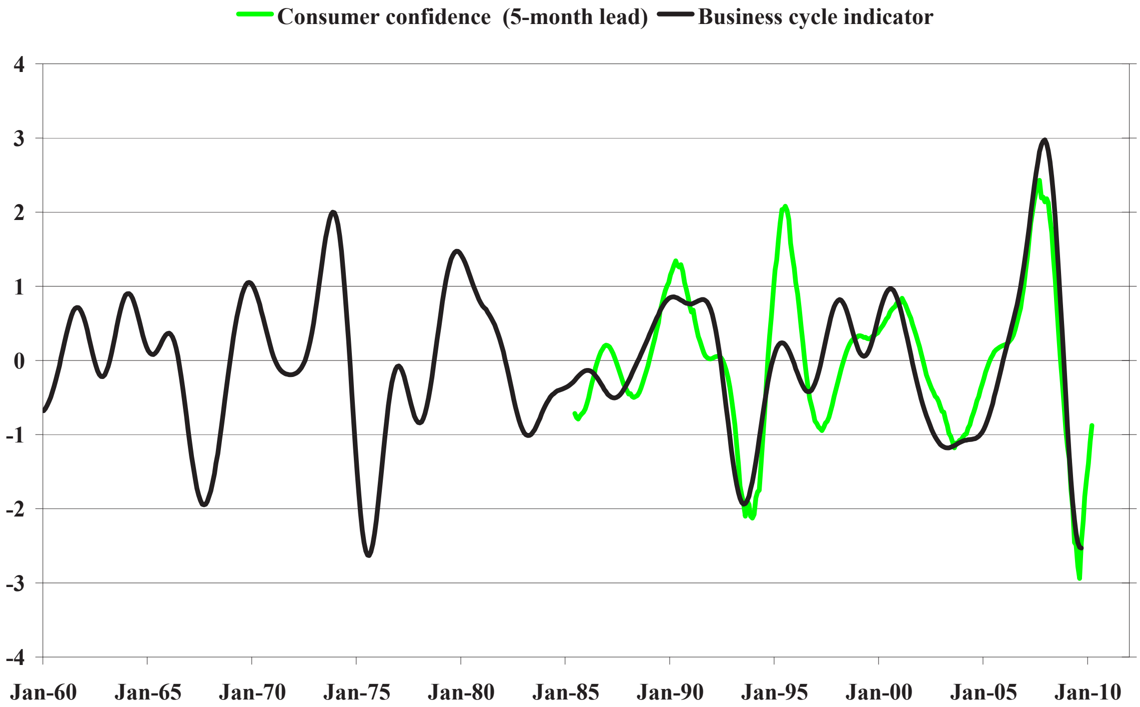


Chart A.9: PMI manufacturing new orders-stocks ratio (9-month lead) and business cycle indicator

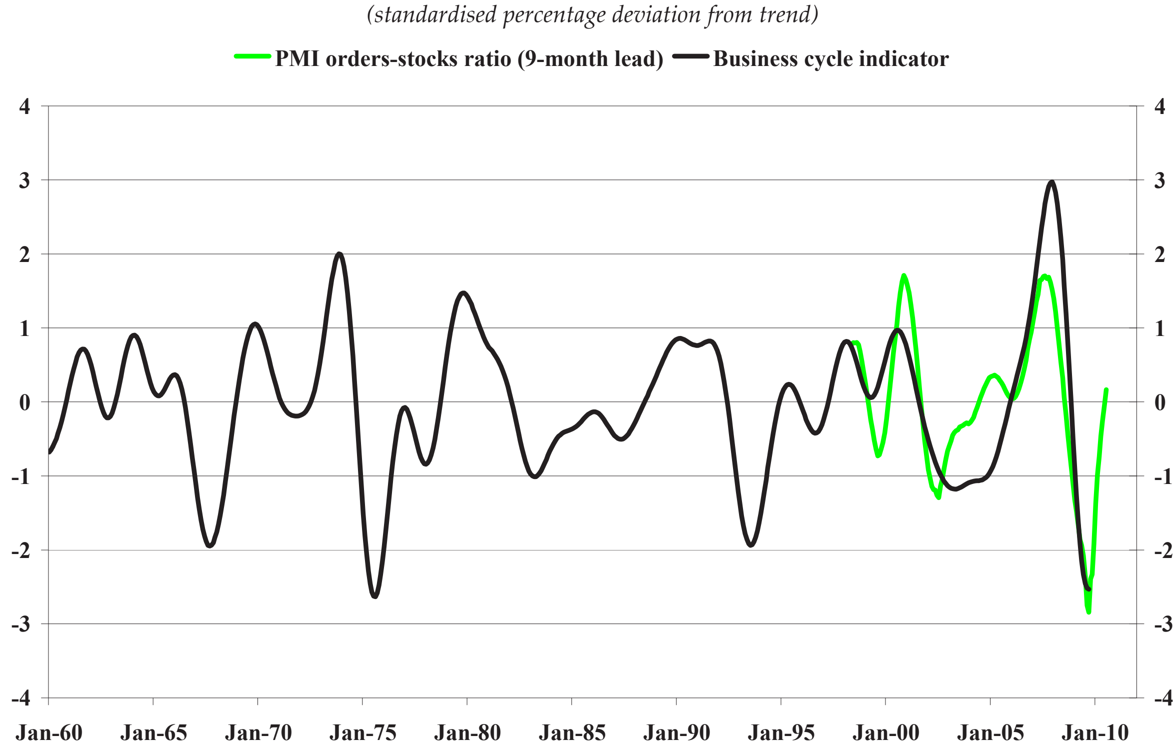
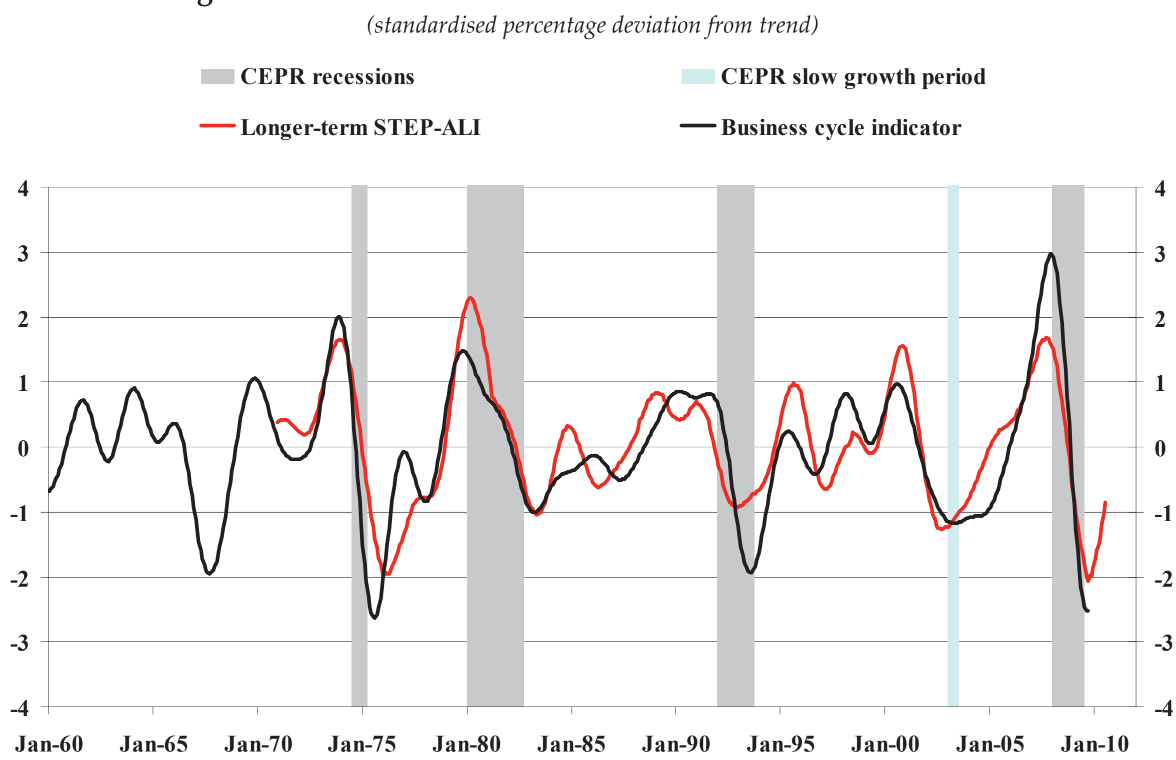


Chart A.10: Longer-term STEP-ALI



Note: The longer-term STEP ALI is represented in this chart by the longer-term ALI 3.