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by Alberto Baffigi and Antonio Bassanetti

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TURNING-POINT INDICATORS FROM BUSINESS SURVEYS: REAL-TIME DETECTION FOR THE EURO AREA AND ITS MAJOR MEMBER COUNTRIES

by Alberto Baffigi* and Antonio Bassanetti**

Abstract

We present tools for real-time detection of turning points in the industrial production growth-cycle of the euro area and its four largest economies. In particular, we apply a multivariate hidden Markov model to national survey results – i.e. to the earliest information about current economic developments − in order to estimate the probability of expansionary and recessionary phases. The balances of opinions used as inputs of the model are selected by ranking them according to their degree of commonality with respect to the cyclical fluctuations of the industrial sector, as estimated with the Generalized Dynamic Factor Model. The indicators appear reliable and stable.

JEL classification: E32, E37.

Keywords: business cycle, hidden Markov model, business surveys.

Contents

* Bank of Italy, Historical Research Office.

** Bank of Italy, Economic Research Department.

1. Introduction[1]

Industrial activity represents only a minor share of the European economies, accounting for about 20 per cent of their GDP. Nonetheless, the cyclical dynamics of industrial production turn out to coincide closely with aggregate economic fluctuations.[2] This means that the ability to detect turning points in industrial dynamics early would help in assessing the cyclical position of the whole economy.

Unfortunately, the features of industrial production indexes preclude timeliness of detection: statistical institutes release their monthly updates about 45 days after the reference period.[3] Moreover, considering the high volatility of such statistics, a number of observations have to be recorded after the occurrence of a turning point in order to recognize it in the time series profile. As a result, economic analysts can only assess a regime switch in manufacturing activity accurately with, at best, a delay of several months.

Some improvement in the timely discernment of the current cyclical phase can be obtained by exploiting business surveys: they provide an almost *real-time* assessment of entrepreneurs' opinions about the current and prospective economic situation (section 2). In particular, the manufacturing sector survey is usually released about two months earlier than the industrial production index, without any delay with respect to the reference period. On the other hand, the qualitative nature of these data makes them particularly noisy, and it is sometimes difficult to draw a consistent interpretation of economic developments.

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[1] Useful suggestions were provided by Fabio Busetti, Giuseppe Parigi and Stefano Siviero. We also thank the partecipants in the "Workshop on business cycle analysis" (Rome, Banca d'Italia, 9 April 2003) and in the session "Forecasting and leading indicators for the euro area" at the International Symposium on Forecasting 2003 (Mérida, Mexico, 15-18 June). All responsibility for the paper, however, is shared by the authors alone and does not involve the institution with which they are affiliated.
E-mail: baffigi.alberto@insedia.interbusiness.it; bassanetti.antonio@insedia.interbusiness.it

[2] See Altissimo et al. (2001).

[3] The delay of quarterly national accounts is even larger.

Short-term analysts have tried to overcome this problem mainly by constructing business confidence indexes, calculated as a simple mean of some of the survey results.[4] They have proved to be a very useful instrument for summarizing entrepreneurs' opinions as they show a high degree of synchronization with industrial production dynamics. Nonetheless, they are not specifically suited to provide early and clear signals of a change in the cyclical phase and leave some room to develop new tools that allow this kind of information to be extracted.

The paper goes in this direction: its objective is to build five survey-based turning-point indicators, respectively for Germany, France, Italy, Spain and the euro area as a whole. Their goal is the real-time detection of regime switches in industrial dynamics and therefore they must be regarded as coincident indicators.[5] They provide, each month, an estimate of the probabilities that the industrial sector is in expansion or in recession; for presentation purposes, the indicator is obtained as the difference between these two probabilities and thus ranges from –1 to +1. When it takes on positive values (i.e. when the probability of expansion is greater than that of recession), the indicator qualifies the current cyclical phase as positive (an opposite reasoning applies for recessions). A turning point is signalled when the value of the indicator switches from positive to negative (and vice versa).

Before constructing the indicator, it is necessary to choose, among the many available business survey time series, those best able to assess the current cyclical phase. Monthly survey results are usually published in the form of balances of opinions: for each of the numerous questions put to entrepreneurs (for example, about short-term production expectations or about order book levels) a balance is obtained as the difference between the percentage of respondents giving positive and negative replies. Since our goal is to construct turning point indicators, we chose those that have a strong link with the cyclical dynamics of the whole industrial sector. In doing so we adopt, in practice, the traditional interpretation of the business cycle as a latent variable driving the (co)movements of the whole set of short-term economic statistics, therefore including survey data and industrial production indexes.

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[4] The choice of the time series to be averaged to this purpose is fundamentally based on experience and tradition.

[5] This means that their objective is not the assessment of historical (ex-post) chronologies.

We use the Generalized Dynamic Factor Model[6] (section 2.1) to estimate, for the time series of each balance, the share of variance explained by the (common) shocks driving the cyclical (co)movements within the industrial sector. The balances showing the largest share are then chosen.

Subsequently, the information content of the selected balances is analyzed on the basis of a multivariate Hidden Markov model, originally proposed by Gregoir and Lenglart (2000). It allows us to estimate, each month, the probability that the economy is in a 'good' or 'bad' state and therefore to calculate the indicator (section 3). This kind of model has been developed in the last decade, building on the seminal work by Hamilton (1989).

An assessment of indicator performance requires a comparison with some benchmark dating of the business cycle. Unfortunately, official chronologies are not available for all the countries of interest to us. We therefore calculate reference datings by applying the Bry and Boschan (1971) routine both to the national industrial production indexes (obtaining the classical 'trend-cycle' chronology) and to their cyclical component (obtaining the 'growth-cycle' chronology; section 4.1). It turns out that our indicators are successful in capturing the upcoming industrial *growth-cycle* turning points (sections 4.2-4.5 for the major euro-area countries).

As for the euro area as a whole, the construction of a turning-point indicator requires the preliminary solution of an aggregation problem: should the indicator be calculated directly using aggregate business survey results or should we obtain it by aggregating national indicators? We show that the best performance is delivered by the second approach (section 4.6).

Some final remarks are proposed in the last section.

2. The data

Business surveys play a major role in the analysis of short-term economic dynamics. National Institutes – Ifo, Insee, Isae and Ministerio de Economia y Hacienda respectively for

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[6] Forni et al. (2000), Forni and Lippi (2001).

Germany, France, Italy and Spain – conduct them at regular intervals, asking to entrepreneurs a set of questions about current and future developments in economic activity. Results are released without any delay with respect to the period to which they refer, thus providing analysts with valuable real-time information. In this work we focus on monthly industrial sector surveys, where questions relate to the evolution of production and order-book levels, short-term expectations, the assessment of stocks of finished products and many other issues.[7] Entrepreneurs answer in three ways: 'increasing', 'decreasing' and 'stable' (or 'high', 'low' and 'normal'). Survey data are merely qualitative and need to be 'quantified' before being processed for analytical purposes. To this end several methods can be used; the calculation of balances of opinions is certainly the most widely employed: for each question the balances are obtained as the difference between the percentages of respondents giving positive and negative replies. Ranging from –100 to +100, balances provide a synthetic measure: during cyclical expansions – the opposite applies during recessions – a progressively increasing percentage of entrepreneurs share positive views on a number of issues, which implies correspondingly larger balances. This process continues until macroeconomic activity reaches a cyclical peak, reversing thereafter.[8]

As observed in the introduction, survey data are quite noisy because of their qualitative nature: sometimes the signals coming from different balances (i.e. from the answers to different questions) are apparently inconsistent, making it particularly difficult to interpret them. To get a smoother signal, short-term analysts resort to confidence indexes, calculated as an average of selected balances of opinions, chosen on the basis of experience and tradition. They have proved to be valuable synthetic indicators of entrepreneurs' moods moving pro-cyclically with respect to business fluctuations. For an example, in Figure 1 balances of opinions relative to three different questions are reported for each country, together with business confidence (or climate) indexes.

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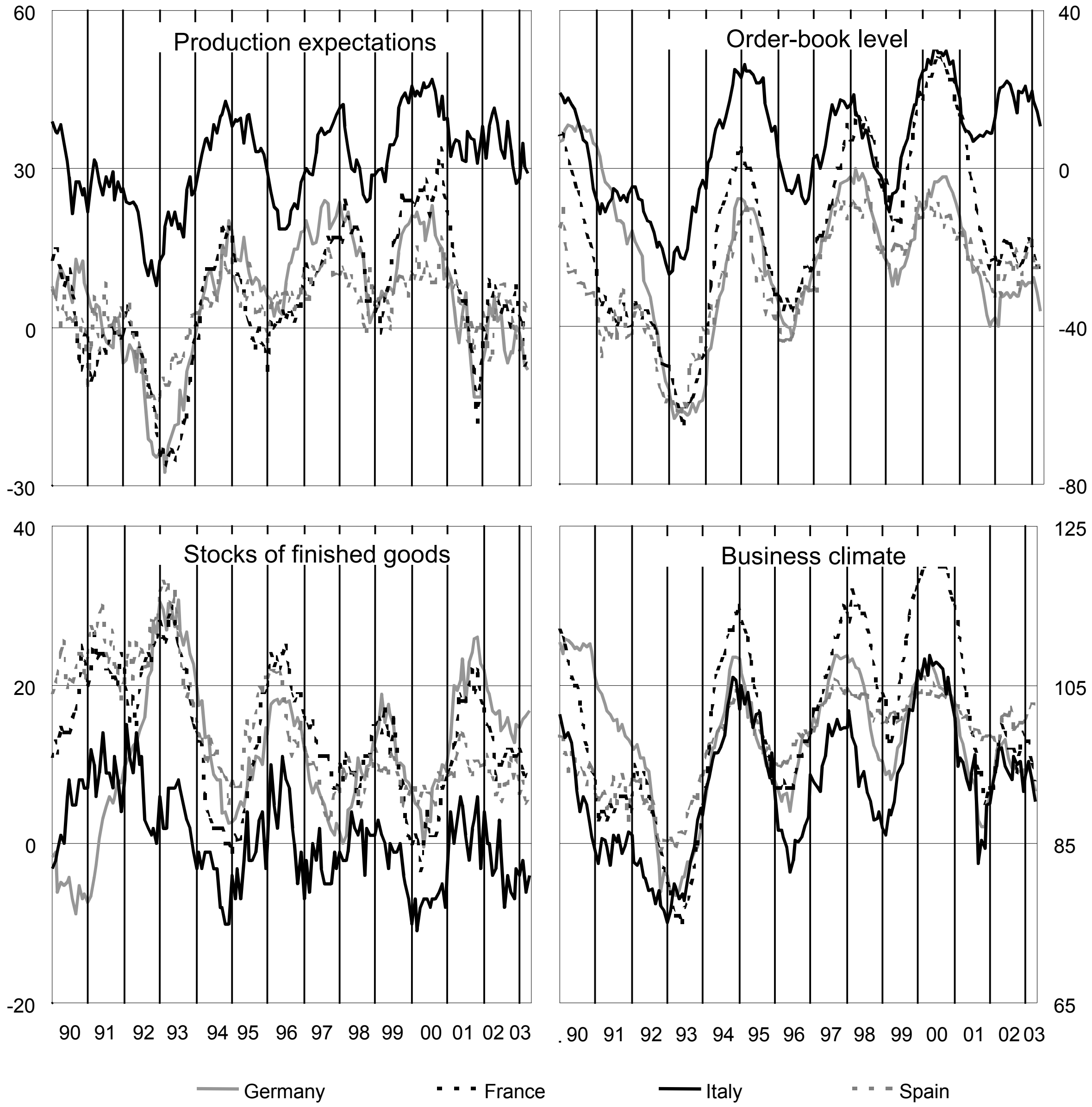
[7] These questions refer specifically to the manufacturing industry; the construction sector is surveyed separately and we do not consider it in our analysis.

[8] The calculation of diffusion indexes is another method of quantifying survey data: the respondents giving positive replies are summed with half those giving neutral replies (such as 'stable', 'normal'). Then the diffusion index is obtained as the percentage of this sum with respect to the total number of respondents. Diffusion indexes range from 0 to 100; 50 is the threshold which separates situations with prevailing pessimistic views from those with prevailing optimistic opinions.

Figure 1

BALANCES OF OPINIONS AND BUSINESS CLIMATES



Source: based on national data.

In this work, we look for another kind of synthetic instrument to play a complementary role to climate indexes in the tool kit of short-term analysts: the turning-point indicator exploits the information content of balances for clear and timely detection of upcoming regime switches in industrial dynamics. Therefore, its goal is not to extract an index of entrepreneurs' confidence through the opinions they express, but to exploit them to estimate the probability of persisting in the current cyclical phase or switching to the opposite one.

There is an ample availability of survey data in European countries, provided by many different sources. On the one hand, the national institutes mentioned earlier (and many others belonging to the European Union member countries) run national surveys in accordance with the 'Joint Harmonized European Union Programme of Business and Consumer Survey'.[9] Conformity with this programme ensures a certain degree of international comparability of the data, which are published very promptly and cover both the aggregate industry and the disaggregated branches of production.

On the other hand, the European Commission provides fully harmonized survey data for all member countries and for the euro area as a whole, allowing a more direct comparison between the cyclical position of different economies. The Commission does not conduct surveys on its own; it receives raw balances of opinions from the national institutes partecipating in the programme and performs a homogeneous seasonal adjustment to harmonize the data.[10] The results are published some days after those of national institutes and pertain only to the aggregate industrial sector.

The objective of this work is to develop single-country turning-point indicators for the industrial sector. In order to do so we prefer to exploit the richness and timeliness of national institutes data; for the euro area, both European Commission data and national indicators have been considered.

2.1 Selecting balances of opinions

For reasons of parsimony we select a relatively small (n-dimensional) subset of balances of opinions from those available in the large business survey dataset. In particular, considering the objective of the research, we look for the balances linked with industrial cyclical dynamics.

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[9] See European Commission (2000).

[10] Seasonal adjustment is performed by the European Commission through the Dainties procedure.

For each country we therefore apply the Generalized Dynamic Factor Model (Forni et. al, 2000; Forni and Lippi, 2001) to a dataset including industrial production indexes[11] and manufacturing sector survey results.[12] This allows us to estimate the two unobservable components of each variable, common and idyosincratic. Concentrating on balances we have:

$$X_t^i = \chi_t^i + \xi_t^i$$

where X^i is the i-th balance of opinion, whereas χ^i and ξ^i are, respectively, the common and the idyosincratic component.

The dynamics of the common component are driven by a small number of factors (shocks), which are common to the whole national industrial sector and drive the (co)movements of all the variables of the dataset; on the contrary, the idyosincratic component responds to specific shocks affecting each variable. Intuitively, to construct a well-performing indicator we turn to those balances whose dynamics are mostly driven by common industrial factors rather than by idyiosincratic shocks. To select this kind of variable we look at their degree of commonality, that is the share of their variance which is explained by common factors ($\text{var}(\chi_t^i)/\text{var}(X_t^i)$); in particular, calculations are performed at business-cycle frequencies, which are those that interest us.[13]

Not surprisingly, the highest degrees of commonality were found in the balances relating to the aggregate industrial sector and not to those pertaining to single branches of production. Relevant information contents also emerged from the intermediate goods sector; capital and consumer goods branches show a much lower degree of commonality (Table 1).[14]

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[11] The seasonally adjusted indexes refer to both the aggregate sector and disaggregated branches of production, according to the Nace Rev. 1 classification.

[12] Like industrial production indexes, the balances of opinions concern both the total industry and the disaggregated branches, according to the availability of the data in our sources. Balances are previously adjusted and cleaned from outliers using the Tramo-Seats procedure (see Gomez and Maravall, 1996).

[13] Business cycle frequencies refer to a period between 18 and 96 months.

[14] The degrees of commonality of the balances pertaining to more disaggregated branches of production – when available – were lower than those reported in Table 1.

Table 1

MANUFACTURING INDUSTRY SURVEY: AVERAGE DEGREE OF COMMONALITY BY BRANCHES OF PRODUCTION
(in percentage points)

Branches of production	Germany	France	Italy	Spain
Total industry	82	87	79	78
Intermediate goods	73	85	72	77
Capital goods	67	61	56	47
Consumer goods	67	49	54	60

Source: based on national statistics.

Against this background, a first version of the indicator for each country was built from all the available balances relating to total industry. Then, more thriftily, we progressively eliminated those with the lowest degree of commonality; the selection process was stopped when a further reduction in the number of input balances would have worsened the indicators performance in detecting turning points.

The balances of opinions finally chosen are listed in Table 2:[15] they share high degrees of commonality with respect to total industrial activity.[16] The choice reported has proved robust over time for each country, allowing us to compute real-time estimates of the turning-point indicators on the basis of the same sets of input variables.

[15] Table 2 also reports autoregressive orders (that pertain to the first step of the methodology, as will be seen in section 3.1) and Augmented Dickey-Fuller tests for unit roots. Balances of opinions are, by construction, bounded time series. Nonetheless, we have checked for their stationarity before going through the methodology. Given the features of the data-generating processes, the tests are calculated through regressions that do not include either a constant term or a time trend. Only in a few cases can the unit root hypothesis not be rejected at the 5% level, probably due to the shortness of the sample. In order to maintain a homogeneous approach, balances of opinions are always treated as stationary.

[16] In accordance with a widespread opinion among analysts, evaluations of selling price dynamics almost always show low degrees of commonality and are therefore always discarded. In addition, the following time series are eliminated because of their relatively low degree of commonality, reported in parenthesis: export expectations for Germany (69%); stocks of finished products for Italy (46%); forecast of stocks and opinions about present business situation for Spain (14% and 29%, respectively).

Table 2

MANUFACTURING INDUSTRY SURVEY: SELECTED BALANCES OF OPINIONS BY COUNTRY

Balances of opinions	AR order (1)	Aug. Dickey-Fuller (2)	Degree of commonality
Germany			
Present business situation	5	-3.74	95%
Production vs. last month	3	-2.55	74%
Order-book level	4	-2.35	96%
Order-book level vs. last month	7	-3.85	84%
Demand vs. last month	3	-1.63	75%
Inventories of finished goods	4	-1.77	88%
Business situation expectations	3	-3.92	91%
Production expectations	3	-1.98	80%
France			
Production level	3	-3.07	95%
Order-book level	4	-3.09	96%
Foreign order-book level	3	-2.46	93%
Inventories of finished goods	1	-1.27	86%
General economic prospects	3	-1.95	86%
Production expectations	1	-1.99	84%
Italy			
Production level	2	-1.95	89%
Production vs. last months	6	-0.90	58%
Order-book level	6	-2.42	93%
Domestic order-book level	4	-2.88	91%
Foreign order-book level	3	-1.02	79%
General economic prospects	2	-2.56	94%
Production expectations	2	-0.46	78%
Order-book expectations	1	-1.68	77%
Spain			
Production level	6	-2.98	90%
Order-book level	4	-0.79	96%
Domestic order-book level	1	-0.97	88%
Foreign order-book level	2	-1.46	75%
Inventories of finished goods	3	-0.86	77%
Production expectations	3	-1.84	68%
Order-book expectations	3	-0.17	40%
Domestic order-book expect.	5	-0.35	43%
Foreign order-book expect.	2	-2.42	51%

Source: based on national statistics.
(1) Relative to the first step of the methodology; the AR order is selected through Schwartz Bayesian Criterion (BIC). – (2) The critical value is –1.94.

3. The methodology

The goal of the research is to estimate the probabilities of expansion and recession for the industrial sectors of the whole euro area and its major member countries. To this end, we employ the Gregoir and Lenglart (2000) two-step procedure. Let us consider the vector X_t, whose elements X^i_t are the observations at time *t* of the *n* balances of opinions selected in the manner described in section 2.1.[17] According to the model of Gregoir and Lenglart, the realizations of X_t at different time *t* are drawn from possibly different probability laws, depending on the current state of the economy, which can be either 'good' (i.e. expansion) or 'bad' (i.e. recession).

3.1 First step

As a first step, for each of these *n* balances we run univariate autoregressive models and concentrate on the residuals (AR orders are listed in Table 2). In particular, if the time *t* residual is positive (negative), the corresponding original value of the balance is replaced with +1 (-1).[18] The resulting *n* time series are called 'coded residuals'.[19] Schematically, for the *i*-th original balance X^i_t we have:

$$X_t^i = a^i(L)X_t^i + \varepsilon_t^i \qquad i = 1,...,n$$

X^i_t is transformed into the coded residual x^i_t in the following way:

$$\hat{\varepsilon}_t^i > 0 \rightarrow x_t^i = +1$$
$$\hat{\varepsilon}_t^i < 0 \rightarrow x_t^i = -1$$

Intuitively, the idea behind this step is that the information content of balances can be thought of as composed of two parts. The first captures some sort of 'inertia' in the answers

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[17] The dimension *n* may differ across countries.

[18] In the case of the balance relating to the assessment of the stock level, which is a counter-cyclical variable, the coding procedure runs in the opposite direction.

[19] Insignificant changes in AR residuals signs from time *t* to time *t+1* (with *t=1,…,T*) may introduce some noise and, as a consequence, increase the volatility of the indicator which, as explained in section 3.2, is based on the coded residuals time series. For this reason, in the empirical analysis we regard a sign reversion as significant only if the absolute value of the residual lies outside the 75% confidence interval.

of entrepreneurs, in the sense that it is strongly related to the progressive diffusion, among them, of 'old' information about the state of the economy, i.e. information that actually originated in previous periods (*t-1*, *t-2* …) and gradually spread. The second component reflects the truly innovative content of balances; i.e. the news at time *t* about the current cyclical phase. This news may either signal a strengthening of the current phase (expansion, recession) or may point to an upcoming regime switch in the state of the economy. The aim of the first step is to separate these two parts. Autoregressive models provide, for each time *t*, an estimate of the first component, $\hat{a}^i(L)X_t^i$, while their residuals $\hat{\varepsilon}_t^i$ provide an estimate of the 'weak innovations' we are looking for. A positive (negative) residual at time *t* has to be interpreted as positive (negative) news, given the information set available at time *t-1*, pointing to accelerating (decelerating) economic activity.

Consequently, we can argue that the estimated probability that the economy is in expansion (recession) should increase with the number of balances whose coded residuals are currently equal to +1 (-1) and with the number of recent-past periods in which this same sign prevailed. The intuitive argument underlying this interpretation is made systematic by the Hidden Markov model algorithm used in the second step.

3.2 Second step

The second step exploits the weak innovation signs (i.e. coded residuals) to estimate the probabilities of expansion and recession. To this end a Hidden Markov model is employed: the variable Z_t represents the state of the economy, which is either 'good' or 'bad' (respectively, $Z_t = +1$ and $Z_t = -1$). Z_t is non-observable and driven by a Markov stochastic process. The objective is to calculate $\Pr(Z_t \mid I_t)$, where $I_t = \{x_1 \ldots x_t\}$ and x_i ($i = 1, \ldots, T$) is an *n*-dimensional vector of coded residuals.[20]

[20] As a matter of fact, the information content of business surveys may vary over time, given their noisy nature. According to Gregoir and Lenglart, this variation may be modelled as a second Markov two-state process of order one (W_t), which signals, for each time *t*, whether the information contained in x_t is reliable. Our estimation incorporates this second Markov process, which slightly complicates the algorithm described in the text but does not change the underlying logic. For further details, see Gregoir and Lenglart (2000), pp. 89-93.

The algorithm is based on the following two matrices. The first one is the Markov transition matrix η, which represents the probabilities of changing or persisting in the current state:

$$\eta = \begin{bmatrix} \Pr(Z_t = -1 \mid Z_{t-1} = -1) & \Pr(Z_t = -1 \mid Z_{t-1} = +1) \\ \Pr(Z_t = +1 \mid Z_{t-1} = -1) & \Pr(Z_t = +1 \mid Z_{t-1} = +1) \end{bmatrix}$$

The other one, π, contains the probabilities of the n coded residuals taking on either +1 or –1, conditional on the state of the economy being either 'good' or 'bad'.

$$\pi = \begin{bmatrix} \Pr(x_t^1 = -1 \mid Z_t = +1) & \Pr(x_t^1 = -1 \mid Z_t = -1) \\ \Pr(x_t^1 = +1 \mid Z_t = +1) & \Pr(x_t^1 = +1 \mid Z_t = -1) \\ \Pr(x_t^2 = -1 \mid Z_t = +1) & \Pr(x_t^2 = -1 \mid Z_t = -1) \\ \Pr(x_t^2 = +1 \mid Z_t = +1) & \Pr(x_t^2 = +1 \mid Z_t = -1) \\ . & . \\ . & . \\ . & . \\ \Pr(x_t^n = -1 \mid Z_t = +1) & \Pr(x_t^n = -1 \mid Z_t = -1) \\ \Pr(x_t^n = +1 \mid Z_t = +1) & \Pr(x_t^n = +1 \mid Z_t = -1) \end{bmatrix}$$

The parameters $\theta = \{\eta, \pi\}$ need to be estimated; however, let us suppose for a while that η, π are known. At each time t, the matrix η can be used to calculate the probability of expansion or recession, conditional on the information set of time $t\text{-}1$:[21]

(1) $$\Pr(Z_t = i \mid I_{t-1}) = \sum_{j=-1,+1} \Pr(Z_{t-1} = j \mid I_{t-1}) \cdot \Pr(Z_t = i \mid Z_{t-1} = j); \quad i = -1,+1$$

Moreover, at each time t, the matrix π can be used to calculate $\Pr(x_t \mid Z_t = i, I_{t-1})$, with $i = -1, +1$; assuming independence between coded residuals conditional to the state of the economy,[22] we have:

[21] When $t = 1$, $\Pr(Z_{t-1} \mid I_{t-1})$ in eq. (1) is set equal to the steady state probability of the Markov dynamics (referred to as Pr*), which can be recovered solving $\eta\Pr^* = \eta$ (see Kim and Nelson, 1999, pp. 70-71, for further details). For subsequent periods, $\Pr(Z_{t-1} \mid I_{t-1})$ is updated as is explained in eq. (4).

[22] This means we are assuming that the only source of correlation between coded residuals comes from the underlying (unobserved) state of the economy.

(2) $$\Pr\left(x_t \mid Z_t = i, I_{t-1}\right) = \prod_{k=1}^{n} \Pr\left(x_t^k \mid Z_t = i\right)$$

It is now possible to compute the unconditional probability $\Pr(x_t \mid I_{t-1})$ as a weighted average of the conditional probabilities $\Pr(x_t \mid Z_t = i, I_{t-1})$ resulting from equation (2), with weights provided by equation (1):

(3) $$\Pr\left(x_t \mid I_{t-1}\right) = \sum_{i=-1,+1} \Pr\left(x_t \mid Z_t = i, I_{t-1}\right) \cdot \Pr\left(Z_t = i \mid I_{t-1}\right); \quad i = -1,+1$$

Given equations (1), (2) and (3), we can calculate, at each t, $\Pr(Z_t = i \mid I_t)$ through Bayes' rule:

(4) $$\Pr\left(Z_t = i \mid I_t\right) = \frac{\Pr\left(Z_t = i \mid I_{t-1}\right) \cdot \Pr\left(x_t \mid Z_t = i, I_{t-1}\right)}{\Pr\left(x_t \mid I_{t-1}\right)}; \quad i = -1,+1$$

with $I_t = \{x_t, I_{t-1}\}$.

Once we know $\Pr(Z_t = i \mid I_t)$, we can calculate the turning-point indicator for the month t in the following way:

(5) $$TP_t = \Pr\left(Z_t = +1 \mid I_t\right) - \Pr\left(Z_t = -1 \mid I_t\right)$$

The procedure then goes back to equation (1) increasing time by one month until it goes through all observations: this allows us to obtain the time series of the indicator.

So far we have assumed that the parameters $\theta = \{\eta, \pi\}$ are known. In fact, they must be estimated. Let us therefore focus on the following likelihood function:

$$l(\vartheta) = \prod_{t=2}^{T} \Pr\left(x_t \mid I_t\right) \cdot \Pr(x_1)$$

whose value is calculated running the procedure eq. (1) – eq. (5) through all observations and updating $l(\theta)$ each time we go through eq. (2) and obtain $\Pr(x_t \mid I_t)$.[23] Estimates are

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[23] $\Pr(x_1) = (0.5)^n$.

obtained with an iterative numeric algorithm.[24] Once θ is estimated, the time series TP_t can be calculated as described above.

3.3 Interpreting the indicator

The indicator TP_t lies in the interval [-1;+1] and provides an assessment of the current cyclical phase. When it takes on values close to +1, i.e. when the probability of expansion is considerably greater than that of recession, it signals that industrial production is currently growing above some 'normal' growth rate (to be qualified in the following); on the contrary, the growth rate is deemed below 'normal' when the value of the indicator is close to –1. Consequently, a turning point in the dynamics of the manufacturing activity is detected when the indicator changes sign.

Due to the noisy nature of the qualitative data upon which they are based, these indicators are characterized by a certain degree of volatility. This feature has to be taken into account when detecting regime switches in order to avoid mistakes caused by false signals. To this end, we regard a change in sign as actual evidence of a turning point only when the signal persists in the new state (either expansion, i.e. $TP_t>0$, or recession, i.e. $TP_t<0$) for at least p consecutive months ('p-month' rule). In this case the regime switch (either a trough or a peak, respectively) is dated in the period immediately before the sign changes for the first time (i.e. $p+1$ months earlier).

The number p has to be chosen empirically. On the one hand, it has to be large enough to avoid the trap of false signals. On the other hand, it must not be too large otherwise it would invalidate the real-time feature of the indicator. A compromise has to be found: in section 4 it will be shown that the best performances in detecting turning points are obtained by setting $p = 3$ (we also checked for $p = 2$ and $p = 1$).

A few words are needed to comment on the real-time nature of the signal. The following figure gives a representative example of the release calendar for some of the main euro-area economic statistics.

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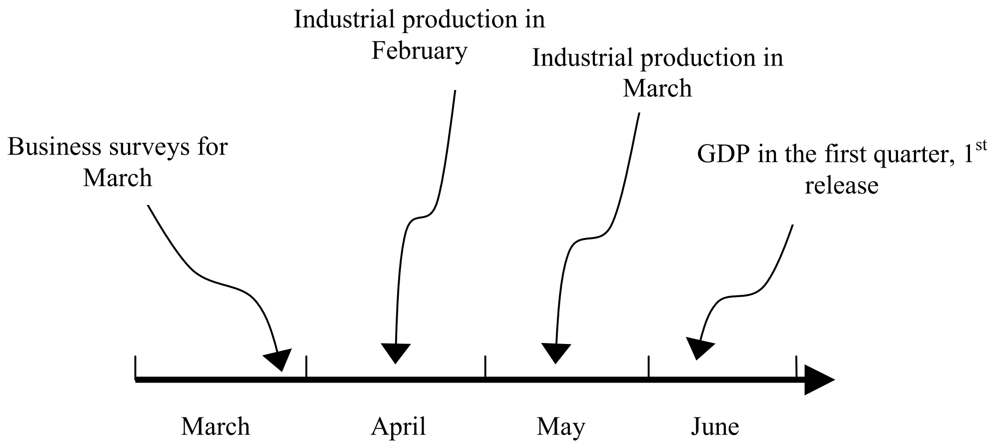
[24] Given the two steps of the Gregoir and Lenglart model, the likelihood maximization is conditional to the parameters of the AR models, which are preliminarily and separately estimated in the first step.

Figure 2

AN EXAMPLE OF RELEASE CALENDAR FOR EURO-AREA STATISTICS



Let us look closer at it, although these considerations apply to a much more general situation. As can be seen, in the second half of March, when the survey results are published, the turning-point indicator can be calculated, releasing a very first signal – in real time – for the current cyclical phase. In particular, let us suppose that the indicator has changed its sign with respect to the previous month (from positive to negative), indicating a peak to be recorded in February. If we set $p = 3$, we need the indicator to maintain its new sign in April and in May as well in order to be sufficiently confident of our assessment. This does not mean, however, that the sign change does not provide any interpretable signal in March or April, only that such a signal should be regarded with some caution and should be assessed along with other short-term information. In other terms, the '*p*-month' rule provides the conditions under which the signals conveyed by the *TP* indicator can be reliably interpreted even with no reference to further information. Indeed, we would not do much better by using exclusively the industrial production index: its March value is released in May and this would still not be enough to detect a possible regime switch. In fact, as already noticed in the introduction, a number of further observations have to be recorded after the occurrence of a turning point in order to recognize it in the time series profile and date it through the use of standard dating algorithms.

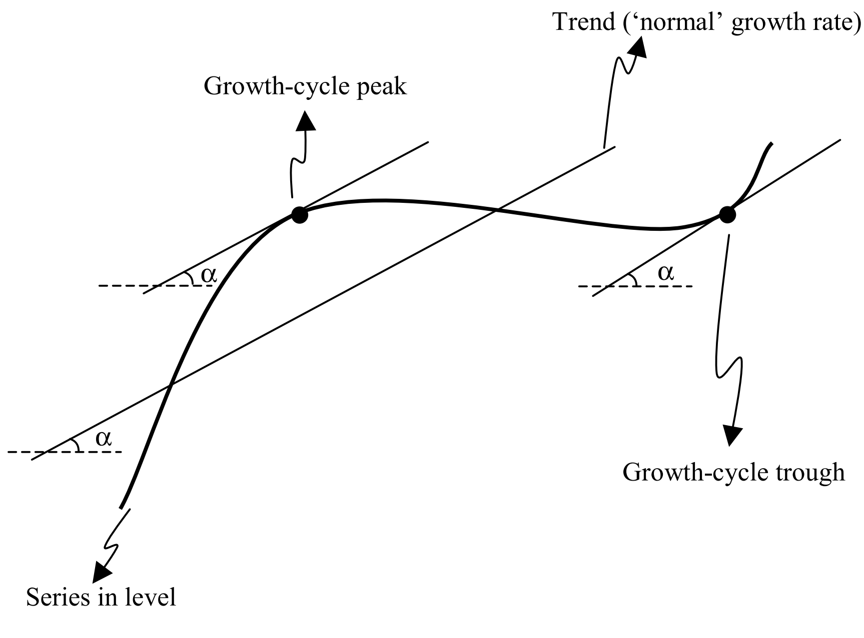
The qualification of the 'normal' growth rate is strictly connected with the assessment of indicator performances. We compare the dates of the regime switches it detects with the reference chronologies from the two main concepts of business cycle described in the literature:

1. the traditional *trend-cycle*, which simply refers to fluctuations in the level of the industrial production index (i.e. including trend);
2. the *growth-cycle*, which refers only to the cyclical component of the index, calculated as deviations from its trend.[25]

The methodology proposed by Gregoir and Lenglart does not make any explicit suggestion about which of the two chronologies is tracked by the indicator. Anyway, as could be expected, it turns out from our analysis that the indicator is particularly suited to detecting the growth-cycle turning points (see section 4).

Figure 3

GROWTH-CYCLE TURNING POINTS



This means that when $TP_t > 0$ (i.e during expansions) the indicator is pointing to a larger industrial production growth rate than the long-term one. An opposite reasoning

[25] Some authors have also considered cycles in the plain growth rates of economic time series, defining their method as following a 'growth-rate-cycle' concept. However, taking the growth rates of a time series, i.e. $(1-L^k)lny_t$, is nothing but a de-trending method which induces a $k/2$ periods lead in the transformed series. Hence, the growth-rate-cycle may be considered as a particular case of growth-cycle.

applies in the case of $TP_t < 0$ (i.e. during recessions). A turning point signals the moment in which the growth rate is switching from larger to smaller than the long-term one (in the case of a peak and vice versa in the case of a trough; see Figure 3). As a consequence, the 'normal' (i.e. long-term) growth rate has to be interpreted as the trend slope; the indicator points to such a growth rate when it takes on values close to zero, that is when the probabilities of expansion and recession are very similar.

4. Results

In this section the performances of the indicators for each country and for the euro area as a whole are presented separately. Specifically, we report the dates at which indicators would have detected turning points if they had been used in real-time economic analysis. To this end, we run simulations shifting the end of sample of our estimates month by month. The detected dates are assessed against *growth-cycle* benchmark chronologies, which are obtained as explained in section 4.1.[26] In presenting country results, we dwell upon a few selected regime changes whose features can help to clarify the correct way to employ the instrument we propose.

As already noted, the qualitative and noisy nature of survey data may induce some instability in the signal conveyed by the indicator: its estimates calculated at different points in time may release different shapes and therefore possibly different turning-point detections. Consequently, a correct interpretation of these instruments is fundamental if they are to be useful for short-term analysis. To this end the '*p*-month' rule has to be applied in order to minimize the risk of trusting in false signals, although without compromising the real-time characteristic of the indicator (see the previous section). Table 3 reports, for each country, the number of false signals we would wrongly trust if, using the turning-point indicator in a 12-year sample, we set p equal to, respectively, one, two or three (months). As a result it emerges that $p = 3$ is the best setting.

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[26] We do not report trend-cycle chronologies because they were not tracked by our indicators. Anyway, they can be broadly inferred from the profile of the industrial production index, whose level is shown in a figure for each country.

Table 3

'*P*-MONTH' RULE AND FALSE SIGNALS IN 1990.1 – 2001.12 (1)

Country	No. of actual turning points	No. of false turning points (False signals)		
		$p = 1$	$p = 2$	$p = 3$
Germany	8	2	0	0
France	10	1	1	0
Italy	9	1	0	0
Spain	7	4	4	4

Source: based on turning-point indicators.
(1) The growth-cycle reference chronology is available only for this period (see section 4.1).

In order to evaluate further the possible changes in the shape of the indicator over time, in the Appendix a selection of them, calculated at different dates, is reported for each country.

4.1 Benchmark chronology

We adopted a two-step dating technique to achieve a growth-cycle reference chronology. First, the industrial production index[27] is band-pass filtered with the Baxter and King (1999) procedure: only the cyclical component of the series is retained, defined as the fluctuations with periodicity between one and a half and eight years.[28] Then, the Bry and Boschan (1971) dating algorithm is applied to this component in order to obtain the reference chronology. The bilateral nature of the Baxter and King band-pass filter precludes the extraction of the cyclical component at the extremes of the sample; therefore, the very recent turning points are not identifiable with the procedure described. For this reason they are classified as 'not available' (n.a.) in the following tables and figures. Nonetheless, the

27 The index excludes the output of the construction sector and is seasonally and working days adjusted.

28 Stock and Watson (1989) adopted the same range of periodicity to extract business cycle components.

turning-point indicators release a clear signal even for these possible regime switches: this is an example of their potential usefulness. The evaluation of these signalled turning points – for which a reference dating is not available – can be broadly based on industrial production dynamics, taking into account the consensus view emerging in short-term economic reports.

Considering the questionability of de-trending procedures in econometrics,[29] our benchmark chronologies were checked for robustness by comparing them with the dating emerging from simply linearly de-trended industrial production indexes. The chronologies resulting from the two methods turn out to be substantially similar, with the exception of two major cases, one for Germany and one for France, to which we will return in the following pages.

4.2 Germany

German manufacturing activity experienced three complete growth cycles (from peak to peak) during 1990-2000; among them, a particularly severe recession in 1992-93 followed the country's reunification (Figure 4). More recently, the expansion that began in the first half of 1999 faded late in 2000; since then German industrial production has stagnated.

The turning-point indicator is calculated on the basis of the Ifo manufacturing sector survey (Figure 5).[30] The signal is almost always neat and clear-cut, with relatively low volatility (Figure A1 in the Appendix). This implies a small risk of false signals: as can be seen from Table 3, even if we set $p = 2$ we would obtain fully satisfactory performances. Nonetheless, in the real-time exercise reported in Table 4 we adopt $p = 3$ in order to be consistent with the indicators developed for the other countries. As a result, most of the growth-cycle regime switches are properly detected, with the only noteworthy exception being the first peak of the decade: while the benchmark chronology dates it in January 1992, the indicator points to a change in regime about one year earlier, in December 1990.

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[29] See Zarnowitz (1992) and Canova (1998, 1999).

[30] Excluding the food, beverages and tobacco.

Table 4

GERMANY: INDUSTRIAL ACTIVITY GROWTH CYCLE AND TURNING-POINT INDICATOR

	Peak	Trough	Peak	Trough	Peak
Growth-Cycle Chronology	Jan.-92	July-93	Dec.-94	Mar.-96	Mar.-98
Real-time detection (3-month rule)	Dec.-90	Mar.-93	Dec.-94	June-96	Apr.-98
Growth-Cycle Chronology	-	Apr.-99	Nov.-00	n.a.	n.a
Real-time detection (3-month rule)	-	Apr.-99	Nov.-00	Nov.-01	Aug.-02

Source: based on national statistics.

Despite this somewhat excessive time lead, a closer look at the industrial production index allows us to reappraise the question: as can be seen in Figure 4, German manufacturing activity decelerated sharply early in 1991, maintaining a slightly positive trend for the rest of the year, followed by a prolonged recession.

Against this background, the signal released by the indicator seems to be consistent with the interpretation in the Report of the Deutsche Bundesbank for the Year 1991: “In the course of last year [1991], however, the degree of capacity utilization declined in large areas of the economy. In the manufacturing sector, in particular, production returned to normal”. Moreover, it should be noted that the dating of this particular turning point is not robust with respect to the de-trending method adopted: if we employ a simple linear procedure instead of the band-pass filter, the peak of German industrial production is dated in February 1991, thus improving the reliability of the turning-point indicator.

Figure 4

GERMANY: INDUSTRIAL PRODUCTION (1)
(Index 2000=100; seasonally adjusted)

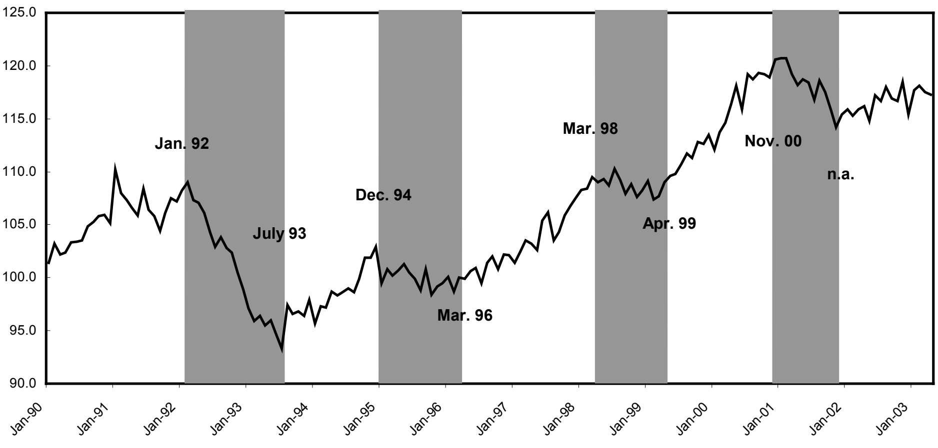
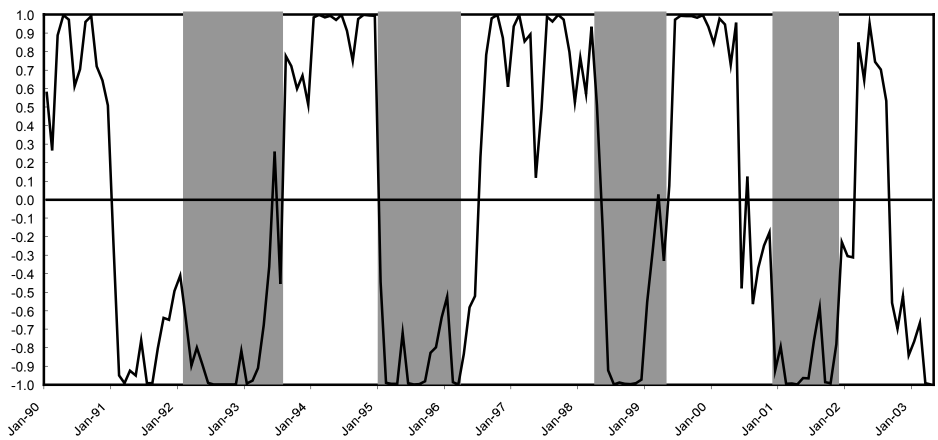


Figure 5

GERMANY: TURNING-POINT INDICATOR (1)
(April 2003 estimate)



Source: Figure 4 based on Eurostat data; Figure 5 based on Ifo data.
(1) Shaded areas represent negative growth-cycle phases. The cyclical phase of the last two years cannot be determined by standard dating algorithm; therefore the end of the last shaded area is merely tentative and its date is classified as 'not available' (n.a.).

4.3 France

According to the growth-cycle chronology, since 1990 French industrial production has experienced four complete cycles (from peak to peak, Figure 6): the first deceleration hit the sector between 1990 and 1991; as for the other three cycles, they are broadly synchronized with those in German industry, although differing in intensity. The indicator, based on Insee business surveys, closely tracks the benchmark dating. Its most reliable interpretation is the one based on the '3-month' rule, which allows a correct detection of all the regime switches. The '1-' and '2-month' rules would release one false signal (Table 3).

Table 5

FRANCE: INDUSTRIAL ACTIVITY GROWTH CYCLE AND TURNING-POINT INDICATOR

	Peak	Trough	Peak	Trough	Peak	Trough
Growth-Cycle Chronology	Mar.-90	May-91	Feb.-92	Aug.-93	Dec.-94	Dec.-96
Real-time detection (3-month rule)	Feb.-90	Mar.-91	May-92	June-93	Jan.-95	June-96
Growth-Cycle Chronology	Mar.-98	Apr.-99	Jan.-01	n.a.	n.a.	-
Real-time detection (3-month rule)	Aug.-98	Apr.-99	Mar.-01	Dec.-01	Apr.-02	-

Source: based on national statistics.

The estimates of turning points are almost always well-timed and clear cut (Figure 7 and Table 5). The December 1996 trough deserves some additional consideration since it is a particularly questionable date. In fact, the linearly de-trended French industrial production index dates the trough one year earlier, in December 1995, while according to the real-time turning-point indicator it should be in June 1996, just in-between the two candidate benchmark dates. This seems to reflect the slow and blurred transition from one regime to the other, which also caused some instability in the signal of the indicator (Figure A2 in the Appendix).

Figure 6

FRANCE: INDUSTRIAL PRODUCTION [(1)]
(Index 2000=100; seasonally adjusted)

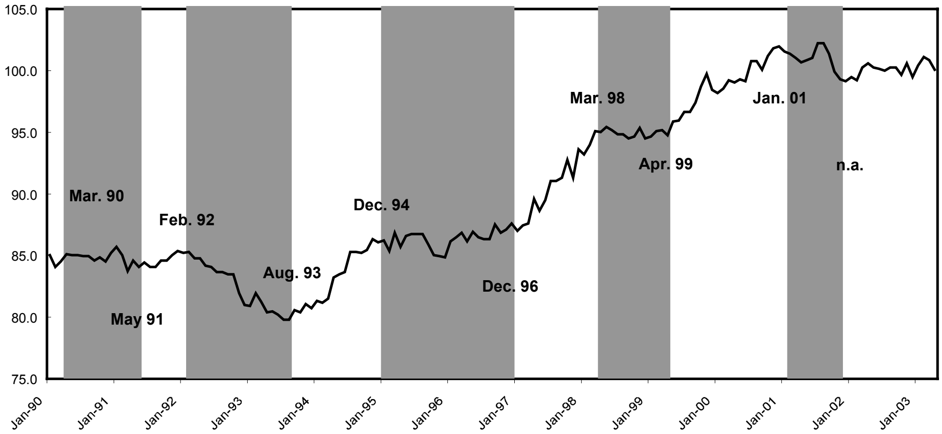
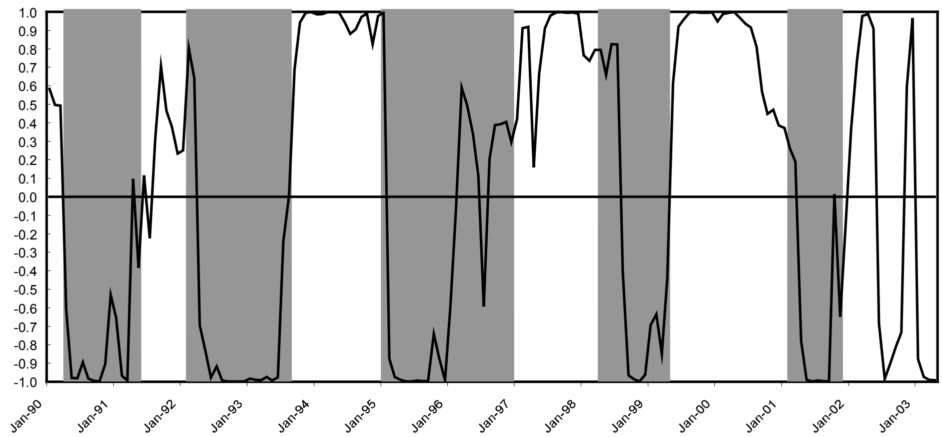


Figure 7

FRANCE: TURNING-POINT INDICATOR [(1)]
(April 2003 estimate)



Source: Figure 6 based on Eurostat data; Figure 7 based on Insee data.
(1) Shaded areas represent negative growth-cycle phases. The cyclical phase of the last two years cannot be determined by standard dating algorithm; therefore the end of the last shaded area is merely tentative and its date is classified as 'not available' (n.a.).

Useful hints on how to interpret the instrument we propose can be obtained from the cyclical phase recorded in 2001 and 2002. As Figure 6 shows, the recession that began early in 2001 continued for the whole year. According to the turning-point indicator, this phase was briefly interrupted by a slight acceleration at the beginning of 2002, before reverting to the subsequent prolonged stagnation. This brief episode, though also verifiable in the industrial production index profile, is too short to be classified as a proper cyclical phase: in fact it does not satisfy one of the censoring rules usually adopted to assess business cycle chronology, that is the minimum length of each phase.[31] By construction, the turning-point indicator does not take into account any censoring rules employed in official dating procedures; therefore it may single out regime switches that do not emerge by applying standard dating algorithms. Nonetheless, their timely assessment is useful for short-term analysis.

4.4 Italy

In the last decade four complete growth cycles have been created by the alternation of marked slowdowns and accelerations in Italian industrial activity (Figure 8).[32] Our benchmark chronology updates – with very slight modifications due to the availability of longer and partly revised time series – the one proposed by Altissimo et al. (2000).

The turning-point indicator, based on the Isae balances of opinions, was generally stable (Figure 9 and Figure A3 in the Appendix). As for its real-time interpretation, a false signal arises only when using the '1-month' rule, whereas none occurs in the other two cases ($p = 2$ and $p = 3$; Table 3).

Setting $p = 3$ the detection performances are satisfactory, as can be seen in Table 6. The use of the indicator would have produced some uncertainty only in the summer of 2001, when it released some feeble signals of an upcoming regime switch not confirmed by the autumn estimates.

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[31] The required minimum length is five months, whereas it amounts to fifteen months for a complete cycle.

[32] Only the recovery recorded between the early months of 1991 and 1992 is a relatively mild episode.

Figure 8

ITALY: INDUSTRIAL PRODUCTION [1]

(Index 2000=100; seasonally adjusted)

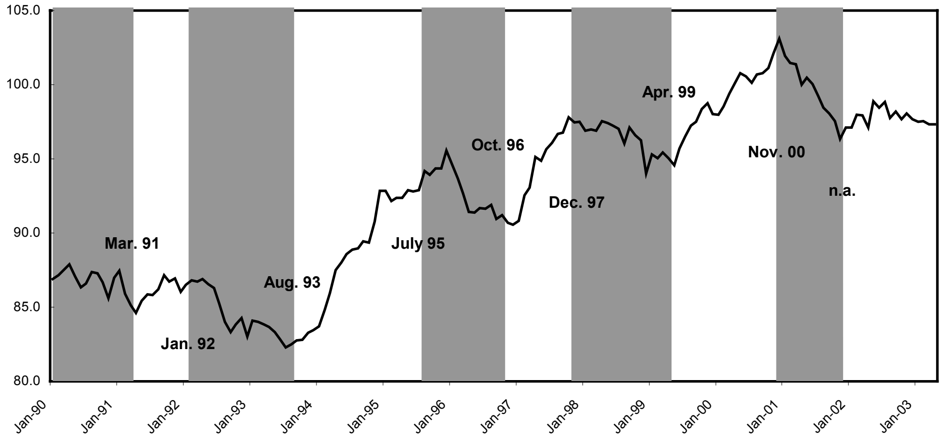
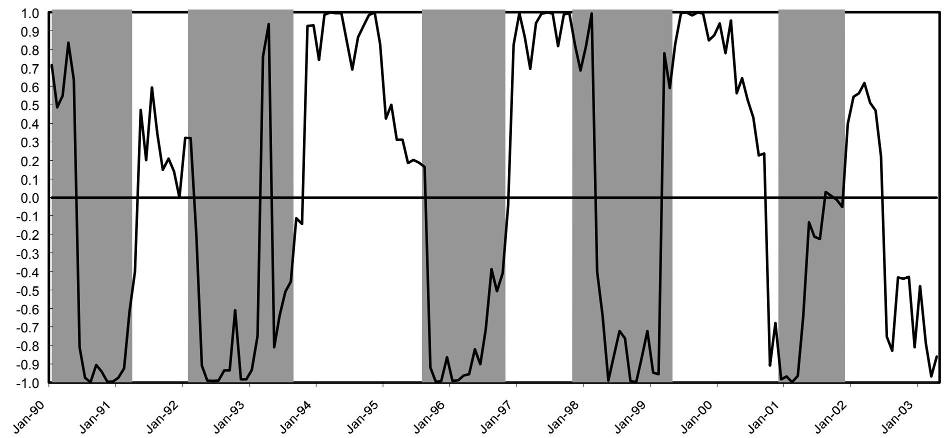


Figure 9

ITALY: TURNING-POINT INDICATOR [1]

(April 2003 estimate)



Source: Figure 8 based on Eurostat data; Figure 9 based on Isae data.

(1) Shaded areas represent negative growth-cycle phases. The cyclical phase of the last two years cannot be determined by standard dating algorithm; therefore the end of the last shaded area is merely tentative and its date is classified as ‘not available’ (n.a.).

Table 6

ITALY: INDUSTRIAL ACTIVITY GROWTH CYCLE AND TURNING-POINT INDICATOR

	Peak	Trough	Peak	Trough	Peak	Trough
Growth-Cycle Chronology	Dec.-89	Mar.-91	Jan.-92	Aug.-93	July-95	Oct.-96
Real-time detection (3-month rule)	May-90	Mar.-91	Mar.-92	Feb.-93	Aug.-95	Oct.-96
Growth-Cycle Chronology	Dec.-97	Apr.-99	Nov.-00	n.a.	n.a.	-
Real-time detection (3-month rule)	Apr.-98	Feb.-99	Nov.-00	Nov.-01	June-02	-

Source: based on national statistics.

Nonetheless, the indicator dynamics were consistent with the current economic situation as described, for instance, in the Bank of Italy Economic Bulletin: "In the weeks preceding the terrorist attacks in the United States, [...] the coincident and leading indicators of the business cycle began to show less negative signs, improving the forecasting scenario for Europe and for Italy in particular. The events of September 11 have newly clouded the outlook, making it more uncertain and subject to risk".[33] Italian industrial production recovered a slightly positive trend in the first half of 2002; coherently, the indicator turned positive before pointing, since the second semester, to the following negative cyclical phase.

4.5 Spain

The recession phase that hit the Spanish industrial production growth cycle in the early 1990s was a long one: it started in the second half of 1989 and ended in the second quarter of 1993 (Figure 10). For the rest of the decade, growth was interrupted by a contraction in the period March 1995 – July 1996 and by a relatively mild slowdown from March 1998 to March 1999. A prolonged stagnation started in the second half of 2000.

[33] Banca d'Italia, Economic Bulletin, no. 33, October 2001.

Figure 10

SPAIN: INDUSTRIAL PRODUCTION (1)
(Index 2000 = 100; seasonally adjusted)

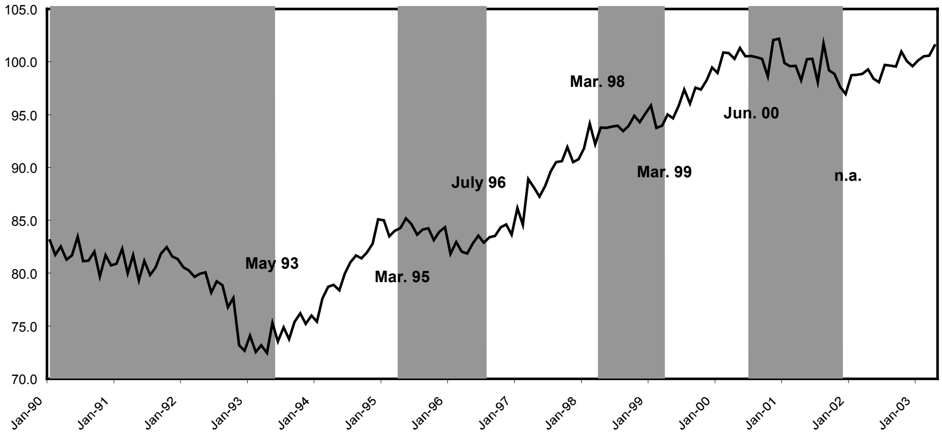
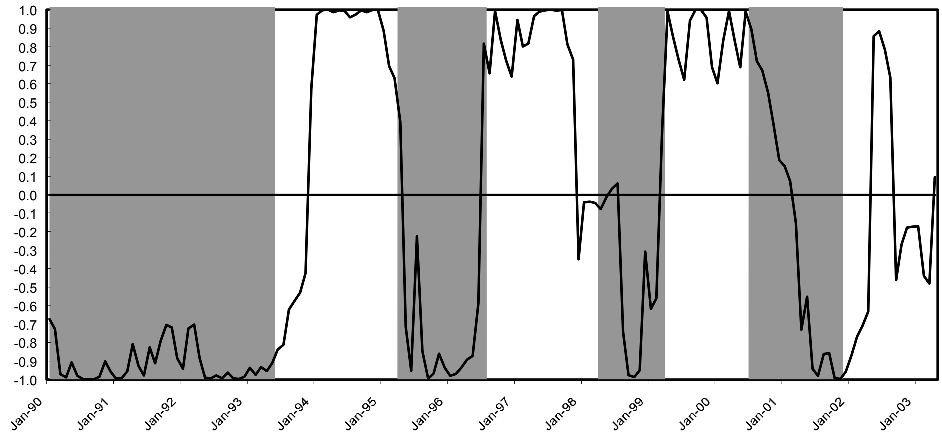


Figure 11

SPAIN: TURNING-POINT INDICATOR (1)
(April 2003 estimate)



Source: Figure 10 based on Eurostat data; Figure 11 based on Ministerio de Economia y Hacienda data.
(1) Shaded areas represent negative growth-cycle phases. The cyclical phase of the last two years cannot be determined by standard dating algorithm; therefore the end of the last shaded area is merely tentative and its date is classified as 'not available' (n.a.).

The business survey conducted by the Ministerio de Economia y Hacienda was employed to develop the turning-point indicator (Figure 11). Unlike the other countries, a relevant signal instability emerged in the neighbourhood of some regime switches (Figure A4 in the Appendix), with a number of false signals occurring even when adopting the '3-month' rule (Table 3). Therefore the use of the indicator in real time would not be fully reliable.

Table 7

SPAIN: INDUSTRIAL ACTIVITY GROWTH CYCLE AND TURNING-POINT INDICATOR

	Peak	Trough	Peak	Trough
Growth-Cycle Chronology	-	May.-93	Mar.-95	July-96
Real-time detection (3-month rule)	-	Feb.-93	Apr.-95	Mar.-96
Growth-Cycle Chronology	Mar.-98	Mar.-99	June-00	n.a.
Real-time detection (3-month rule)	Nov.-97	Mar.-99	July-00	Aug.-02

Source: based on national statistics.

Table 7 reports detection performances. A few words must be said about the mild slowdown from March 1998 to March 1999. According to our simulations, it is possible to date a cyclical peak in November 1997, with a time lead of some months with respect to the actual regime switch. Nonetheless, had we actually used the indicator at that time, we would have been cautious before declaring a recession had started. Indeed, though negative, the indicator's values were not far from zero, suggesting that Spanish industrial activity had just started a period of 'normal' growth rather than a period of below-trend growth. In the following months, as could be expected given this background, some instability in the signal of the indicator was experienced, due to the difficulty of capturing such a slight slowdown in a very fast-growing economy. This difficulty is witnessed, for instance, by the Banco de España analysis, reported in various issues of its monthly Bòletin Econòmico. In fact, although our benchmark chronology dates the peak in March 1998, the Bòletin only started to speak explicitly of a deceleration in the autumn of 1998 issues.[34] Retrospectively, we can see that our indicator could have helped us to detect late in 1997 the gradual end of the expansion phase that had begun in the summer of 1996, followed by a sign of a clear recession in the summer of 1998.

4.6 Euro area

In the euro area as a whole, industrial production dynamics recorded three complete growth-cycles in the last twelve years (from peak to peak, see Figure 12): the first and last recessions appear severe, while in the other negative phases manufacturing activity was virtually stationary.[35]

In constructing our indicator for the euro area it is not immediately clear how the available data should be employed: should we use an aggregate model which directly estimates a euro-area indicator through euro-area balances of opinions, or should we rely on a disaggregate model which constructs it on the basis of national indicators? This is a common problem in empirical works about the euro area. The peculiarity of our study is that the choice of the aggregation level is related to probabilities rather than to macroeconomic variables, such as industrial production, GDP or money demand.[36] No theoretical hints exist as to which solution is the most suitable for the analysis.

In order to deal empirically with this issue we calculate the euro-area indicator by estimating two alternative models whose performances have to be compared against the benchmark chronology. The aggregate model employs the balances of opinions of the European Commission survey referring to the whole euro area. The disaggregate model calculates the euro-area indicator as a weighted average of national turning-point

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[34] Banco de España, Bòletin Econòmico, October and November, 1998.

[35] It is worth mentioning that our benchmark dating for the euro area is, by construction, different from the one based on the Bank of Italy-CEPR coincident indicator EuroCoin (see Altissimo et al., 2001). While EuroCoin exploits the extraction of the cyclical component of GDP *growth rates*, our benchmark chronology is calculated through the cyclical component of the *level* of industrial production. All this implies that the chronology produced by EuroCoin leads our benchmark dating, other things being equal, simply because the growth rate of a variable leads its level.

[36] For some recent empirical literature on the aggregation issue see Baffigi et al. (2002), Marcellino et al. (2001), Zizza (2002).

indicators.[37] The weights are the estimated coefficients of a probit regression (therefore they are endogenously determined) and reflect the partial correlation between the coded euro-area reference business cycle (i.e. a time series that is +1 during expansions and –1 during recessions) and the national turning-point indicators. The performances of the two models are compared taking into account the number of false signals when using the '1-', '2-' and '3-month' rule.

Table 8

EURO AREA: '*P*-MONTH' RULE AND FALSE SIGNALS IN 1990.1 – 2001.12 (1)

TP Indicator based on:	No. of actual turning points	No. of false turning points (False signals)		
		$p = 1$	$p = 2$	$p = 3$
European Comm. Data (2)	8	6	1	1
Probit model (3)	8	2	0	0
Weighted average (4)	8	2	0	0

Source: based on turning-point indicators.
(1) The reference chronology is available only for this period (see section 4.1).
(2) Directly estimated, based on European Commission aggregate business surveys.
(3) Weighted average of national indicators (weights determined with a probit regression).
(4) Weighted average of national indicators (weights based on national industrial production).

The results reported in the first two rows of Table 8 show that the aggregation of national results delivers the best performance with no false signals when using both the '2-' and '3-month' rule. Unfortunately, it is not possible to perform a real-time detection using the probit model: at the end of the sample the benchmark chronology (i.e. the dependent variable) is not available for the reasons explained in section 4.1. We therefore tried a different aggregation procedure which turns out to provide a virtually identical detection performance. In fact we aggregate national indicators simply by weighting them with their respective shares of industrial value added. The third row of Table 8 provides results from this indicator, on which the following comment is based.

[37] Germany, France, Italy and Spain account for almost 83% of euro-area industrial activity and during the last decade their cyclical phases appear to be increasingly in line, concurring closely with the European fluctuations.

Figure 12

EURO AREA: INDUSTRIAL PRODUCTION (1)
(Index 2000 = 100; seasonally adjusted)

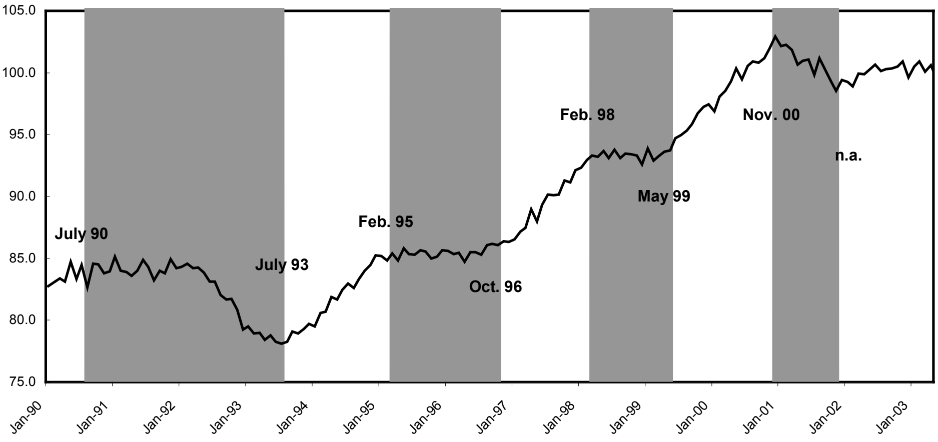
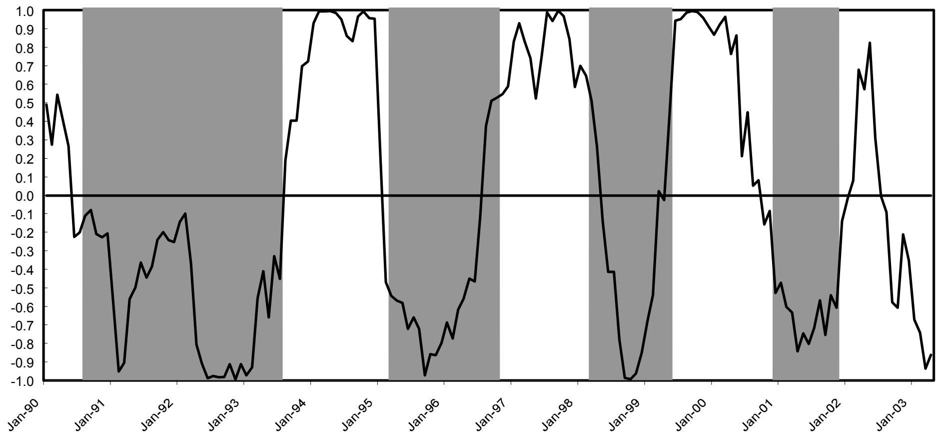


Figure 13

EURO AREA: TURNING-POINT INDICATOR (1)
(April 2003 estimates)



Source: Figure 12 based on Eurostat data; Figure 13 based on national turning point indicators.
(1) Shaded areas represent negative growth-cycle phases. The cyclical phase of the last two years cannot be determined by standard dating algorithm; therefore the end of the last shaded area is merely tentative and its date is classified as 'not available' (n.a.).

Table 9

EURO AREA: INDUSTRIAL ACTIVITY GROWTH CYCLE AND TURNING-POINT INDICATOR

	Peak	Trough	Peak	Trough	Peak	Trough
Growth-Cycle Chronology	July-90	July-93	Feb.-95	Oct.-96	Feb.-98	May-99
Real-time detection (3-month rule)	May-90	Mar.-93	Feb.-95	June-96	Apr.-98	Apr.-99
Growth-Cycle Chronology	Nov.-00	n.a.	n.a.	-	-	-
Real-time detection (3-month rule)	Nov.-00	Nov.-01	June-02	-	-	-

Source: based on national statistics.

As can be seen in Table 9 (and Figure A5 in the Appendix), the indicator detects fairly well all the main fluctuations in industrial production; in doing so, its values are always close to either +1 or –1, providing a very clear signal (Figure 13). An exception occurs in the period ranging from the mid-1990 to the early months of 1992: before pointing to a marked slowdown, the indicator takes on slightly negative values, coherently with a return to the 'normal' growth rate rather than with an effective recession, that was only revealed later.

5. Conclusions

The aim of this paper is to provide methodologically grounded tools to exploit business surveys – i.e. the earliest information about short-term economic developments – for real-time detection of cyclical turning points in industrial dynamics, both for the euro area and for its major countries. The monthly indicators have proved reliable in signaling the regime changes recorded in the last 12 years. In this respect, they can be used to support short-term analysis: in fact the assessment of a turning point on the basis of the industrial production index alone would require data for several months after its occurrence, implying a large delay in detection.

Although the potential instability of this kind of instrument is well known, our real-time simulations display a high degree of signal persistency; only in the case of Spain are the detection performances not fully satisfactory. In order to minimize the risk of trusting in possibly false signals we introduce the '*p*-month' rule: a reversal in the sign of the turning-point indicator is only regarded as evidence of an actual regime change in industrial dynamics when the new sign persists for at least p ($p = 3$) consecutive months.

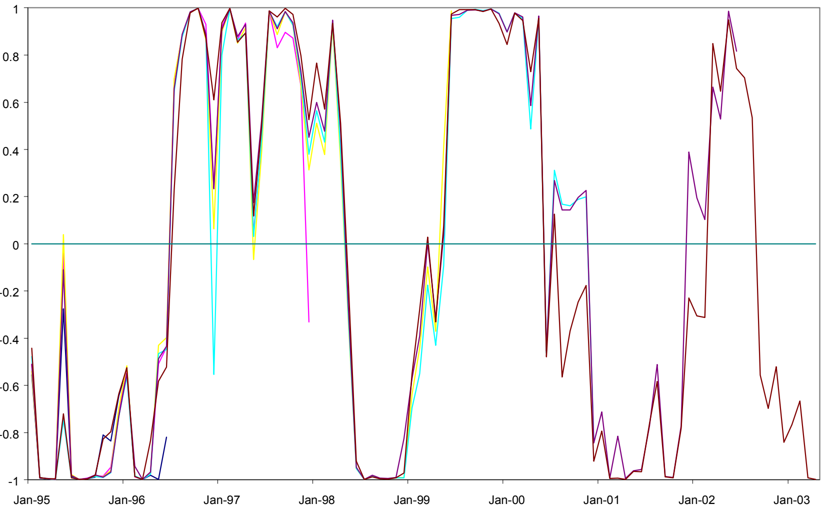
With respect to the euro area as a whole, we find that the best performances are obtained by aggregating national indicators (the four largest member countries on which we focus account for more than 80 per cent of the euro-area industrial sector) rather than by directly estimating an aggregate indicator.

Appendix

Turning-point indicators: evaluation of signal stability

Figure A1

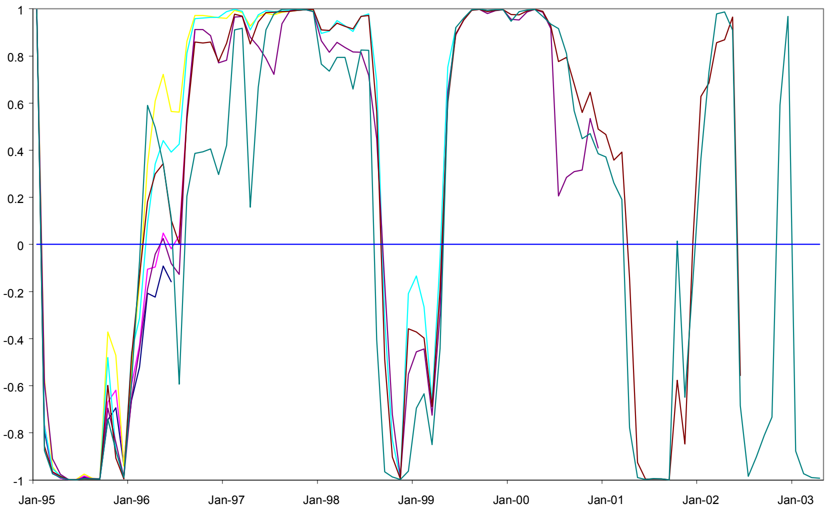
Germany: Selected Real-Time Turning-Point Indicators(1)



Source: based on Ifo data.
(1) Estimated in June 96, Dec.97, June 99, Dec.00, June 02, Apr.03

Figure A2

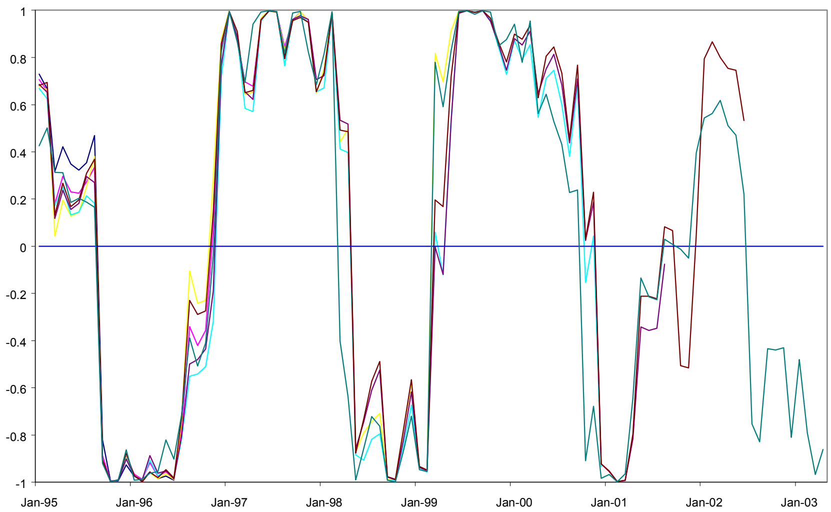
France: Selected Real-Time Turning-Point Indicators(1)



Source: based on Insee data.
(1) Estimated in June 96, Sep.96, Dec.97, June 99, Dec.00, June 02, Apr.03

Figure A3

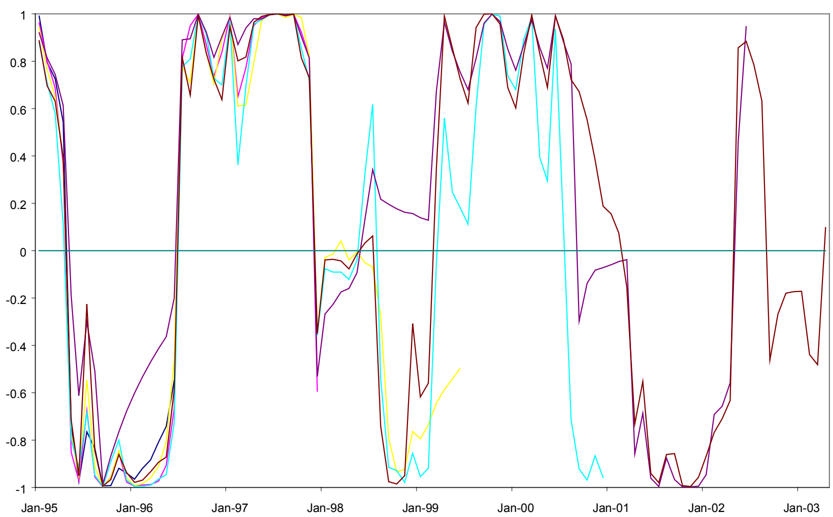
Italy: Selected Real-Time Turning-Point Indicators(1)



Source: based on Isae data.
(1) Estimated in June 96, Dec.97, June 99, Dec.00, Aug.01, June 02, Dec.03

Figure A4

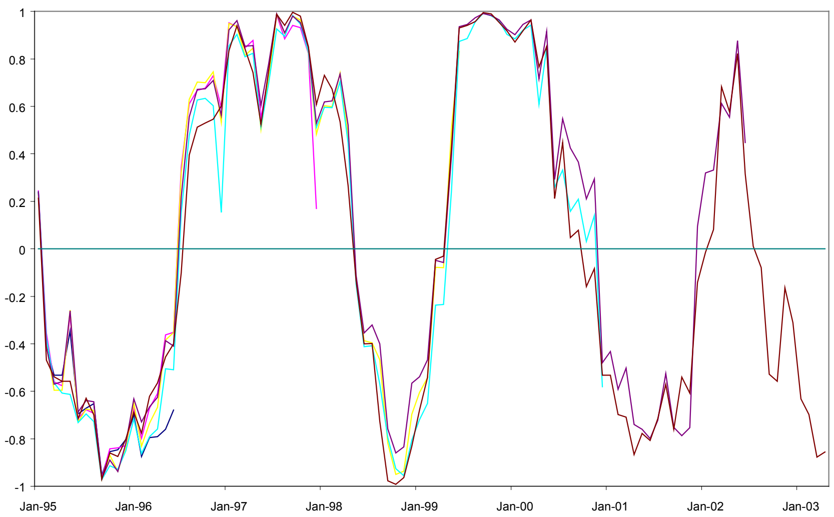
Spain: Selected Real-Time Turning-Point Indicators(1)



Source: based on Ministerio de Economia y Hacienda data.
(1) Estimated in June 96, Dec.97, June 99, Dec.00, June 02, Apr.03

Figure A5

Euro Area: Selected Real-Time Turning-Point Indicators(1)



Source: based on national turning point indicators.
(1) Estimated in June 96, Dec.97, June 99, Dec.00, June 02, Apr.03

References

Altissimo, F., Bassanetti, A., Cristadoro, R., Forni, M., Lippi, M., Reichlin, L. and Veronese, G. (2001), *A Real Time Coincident Indicator of the Euro Area Business Cycle*, Bank of Italy, Temi di discussione, no. 436

Altissimo, F., Marchetti, D.J. and Oneto, G.P. (2000), *The Italian Business Cycle: Coincident and leading Indicators and Some Stylised Facts*, Bank of Italy, Temi di discussione, no. 436

Baffigi, A., Golinelli, R. and Parigi, G. (2002), *Real Time GDP Forecasting in the Euro Area*, Bank of Italy, Temi di discussione, no. 456

Baxter, M. and King, R.G. (1999), *Measuring Business Cycles: Approximate Band-Pass Filters for Economic Time Series*, in “The Review of Economics and Statistics”, vol. 81 (4), pp. 575-93

Bry, G. and Boschan, C. (1971), *Cyclical Analysis of Time Series: Selected Procedures and Computer Programs*, NBER, Technical Paper, no. 20

Canova, F. (1998), *Detrending and Business Cycle Facts*, in “Journal of Monetary Economics”, vol. 41 (3), pp 475-512

Canova, F. (1999), *Does Detrending Matter for the Determination of the Reference Cycle and Selection of Turning Points*, in “The Economic Journal”, vol. 109 (452), pp. 126-50

European Commission (2000), *European Economy*, Report and Studies, no. 4

Forni, M., Hallin, M., Lippi, M. and Reichlin, L. (2000), *The Generalised Factor Model: Identification and Estimation*, in “The Review of Economics and Statistics”, vol. 82 (4), pp. 540-54

Forni, M. and Lippi, M. (2001), *The Generalised Factor Model: Representation Theory*, in “Econometric Theory”, vol. 17 (6), pp. 1113-41

Gomez, V. and Maravall, A. (1996), *Programs TRAMO and SEATS, Instructions for the User (Beta Version: September 1996)*, Bank of Spain, Working Paper, no. 9628

Gregoir, S. and Lenglart, F. (2000), *Measuring the Probability of a Business Cycle Turning Point by Using a Multivariate Qualitative Hidden Markov Model*, in “Journal of Forecasting”, vol. 19 (2), pp. 81-102

Hamilton, J.D. (1989), *A New Approach to the Economic Analysis of Nonstationary Time Series and Business Cycle*, in “Econometrica”, vol. 57 (2), pp. 357-84

Kim, C.J. and Nelson, C.R. (1999), *State-Space Models with Regime Switching*, Boston, MIT Press

Marcellino, M., Stock, J.H. and Watson, M.W. (2001), *Macroeconomic Forecasting in the Euro Area: Country Specific Versus Area Wide Information*, in "European Economic Review", forthcoming.

Stock, J.H. and Watson, M.H. (1989), *New Indexes of Coincident and Leading Economic Indicators*, NBER Macroeconomic Annual 1989, pp. 351-94

Zarnowitz, V. (1992), *Business Cycle. Theory, History, Indicators and Forecasting,* Chicago, the University of Chicago Press

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A. CUKIERMAN and F. LIPPI, *Central bank independence, centralization of wage bargaining, inflation and unemployment: theory and evidence*, European Economic Review, Vol. 43 (7), pp. 1395-1434, **TD No. 332 (April 1998)**.

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2000

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