Identification of slowdowns and accelerations for the euro area economy

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Abstract:
In addition to quantitative assessment of economic growth using econometric models, business cycle analyses have been proved to be helpful to practitioners in order to assess current economic conditions or to anticipate upcoming fluctuations. In this paper, we focus on the acceleration cycle of the euro area, namely the peaks and troughs of the growth rate which delimitate the slowdown and acceleration phases of the economy. Our aim is twofold: First we produce a reference turning point chronology of this cycle on a monthly basis, based on gross domestic product [GDP] and industrial production index [IPI]. We consider both euro area aggregate level and country specific cycles for the six main countries of the zone. Second, we propose a new tool based on business surveys carefully watched by short-term analysts in order to follow in real-time the fluctuations of the acceleration cycle.

Keywords:
Acceleration cycle, Euro area, Dating chronology, Probabilistic indicator, Business surveys.

JEL Classification:
C22, C52, E32.

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1 Introduction

Economic diagnosis and forecasting tools are generally based on quantitative econometric methods. For example, when one is trying to forecast the quarterly GDP growth rate of a given country, practitioners search for correlations between leading economic variables and figures provided by the quarterly national accounts. However, over the past, quantitative methods have been proved to lead to forecasting errors, especially just before the turning points of the business cycle. One striking example is the last US recession, from March to November 2001, that only very few economists had anticipated. For some years, several econometric tools have been proposed in the literature with the aim to provide with qualitative information on the current and future evolution of economic cycles. Those tools are complementary with classical quantitative forecasting tools in the sense that they timely provide with the direction of the growth rate and the assessment of current cyclical conditions. Such qualitative information may be used by forecasters in order to weight various forecasting scenarii.

Placing the cycle in the heart of the conjonctural economic analyses is not a recent idea. The first cyclical analyses at a large scale are due to the works of Wesley Mitchell and Arthur Burns at NBER in early 1920s and have been prolonged in many economic institutes like The Conference Board, OECD or ECRI. The renewal of cyclical approaches is mainly linked to the recent develoment of non-linear econometric models flexible enough to take certain stylized facts of the business cycle into account, such as asymmetries in the phases of the cycle. In this respect, emphasis has been put on the class of models that allows for regimes switching. Especially, Markov-Switching models popularized by Hamilton (1989) have been widely used in business cycle analysis in order to describe economic fluctuations.

The popularity of the work of Hamilton is mainly grounded on the ability of the model to reproduce the NBER business cycle dating estimated by expert claims within the Dating Committee. However, when dealing with economic cyles some confusion appears as regards the definition of those cycles. In the empirical litterature on economic cycles, we distinguish between three kinds of cycles: the business cycle, the growth cycle and the acceleration cycle whose characteristics differ. Basically, the business cycle refers the (log-)level of the series, as defined by Burns and Mitchell (1946). Turning points of the business cycle delimitate periods of recessions (negative growth rate) and expansions (positive growth rate). The business cycle is characterised by strong asymmetries in its phases, concerning for example durations or amplitudes. For example, since 1970, the average duration of an expansion phase in the euro area is of 28 years while the average duration of a recession is only of one year. It seems also that only recessions possess the property of duration-dependence implying thus that the probability of switching to the the regime of expansion increases with time. The growth cycle, introduced by Mintz (1969), is the cycle of the deviation to the long-term trend, which can be seen as the potential or tendencial growth. This cycle is sometimes referred to as the output gap. Last, the acceleration cycle is the cycle described by the increases and decreases of the growth rate. A turning point of this cycle occurs when a local extremum is reached. This cycle is thus a sequence of decelerating and accelerating phases. Such a cycle is very interesting for the short-term analysis of the euro area, not often affected by recessions, because of its high frequency. However, its more pronounced volatility implies a more complex real-time detection. We refer to Anas and Ferrara (2004) or Zarnowitz and Ozyldirim (2006) for a more detailed description of the stylised facts of those cycles.

When dealing with turning point indicators, it is necessary to possess a benchmark turning point chronology of the cycle we aim at tracking. Only the US have a well known benchmark turning point chronology of the business cycle established by the Dating Committee of the NBER. As regards the euro area, European institutes, such as CEPR (CEPR, 2003) or Eurostat (Mazzi and Savio, 2006), have proposed a reference dating for the business cycle. Otherwise, several academic studies have also developped dating chronologies for both the business and growth cycles, see for example Artis, Massimiliano and Proeitti (2002), Artis, Krolzig and Toro (2004), Anas and Ferrara (2004), Mönch and Uhlig (2005), Anas, Billio, Ferrara and LoDuca (2006) or Anas, Billio, Ferrara and Mazzi (2008). However, a historical turning point chronology of the euro area acceleration cycle has never been proposed, except in Harding (2004) but its analysis ends in 1998.

The innovation in this paper is twofold. First, we propose a monthly turning point chronology for the euro area acceleration cycle through a non-parametric approach from January 1987 to September 2007. Second, we develop a probabilistic coincident indicator to track in real-time the euro area acceleration cycle, based on well known economic soft indicators carefully watched by central banks and economic analysts in their short-term economic monitoring.

2 A turning point chronology of the euro area acceleration cycle

In this section we propose a monthly chronology of turning points for the euro area acceleration cycle. We use the basic version of the non-parametric dating algorithm proposed by Bry and Boschan (1971) and modified by Harding and Pagan (2002). This approach is very simple to handle and has been used in several empirical papers dealing with business cycles analysis (see for example Harding, 2004, Engel *et al.*, 2005, Anas *et al.*, 2006 or Demers and MacDonald, 2007). We apply this methodology to the broadest measure of economic activity, that is euro area GDP. In order to have a monthly dating, we replicate the same approach to the euro area IPI and we propose a rule to translate the quarterly dates into monthly dates. From this aggregated dating, some stylized facts of the cycle (duration, amplitude, geographical diffusion ...) are measured to validate this turning point chronology and a comparison with other existing chronologies is carried out.

2.1 Dating

Assume $(Y_t)_t$ is the series of interest (GDP or IPI), seasonally adjusted and corrected from trading days and outliers. The basic Bry-Boschan algorithm detects a peak at date t if the following condition is verified:

$$\{(\Delta_k Y_t, \dots, \Delta Y_t) > 0, (\Delta Y_{t+1}, \dots, \Delta_k Y_{t+k}) < 0\} \qquad (1)$$

and detects a trough at date t if the following condition is verified :

$$\{(\Delta_k Y_t, \dots, \Delta Y_t) < 0, (\Delta Y_{t+1}, \dots, \Delta_k Y_{t+k}) > 0\}, \qquad (2)$$

where the operator Δ_k is defined such as $\Delta_k Y_t = Y_t - Y_{t-k}$. Harding and Pagan (2002) suggest $k = 2$ for quarterly data and $k = 5$ for monthly data. Generally, turning points within six months of the beginning or end of the series are disregarded. Last, a procedure for ensuring that peaks and troughs alternate is developed, for example by imposing that in the presence of a double through, the lowest value is chosen and that in the presence of a double peak, the highest value is chosen. Censoring rules related to the minimum duration of phases are also imposed in the original algorithm saying that a phase must last at least six months and that a complete cycle

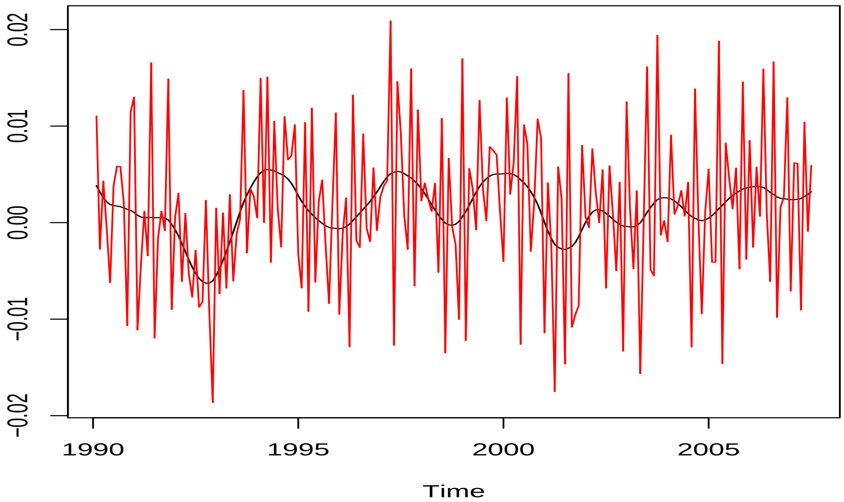

Figure 1: Monthly IPI growth rate and filtered IPI growth rate by removing high frequencies with the HP filter.

(from peak to peak) must last at least 15 months. In fact, this censoring rule applies for the business cycle, because as noted by the NBER in its seminal definition a recession must last *more than a few months*, but there is no reference minimum duration. In this paper, as we focus on the acceleration cycle, we apply the Bry-Boschan algorithm to the series $(Y_t)_t$ defined as the quarterly GDP growth rate or monthly IPI growth rate.

First, we choose the widest measure of economic activity of the zone, namely the aggregated GDP at the euro area level. Due to the need of a long historical series, we report our attention to the euro area GDP series estimated by Fagan, Henry and Mestre (2005, FHM hereafter) available through the EABCN web site [1]. This series ranges from Q1 1970 to Q4 2005 and is therefore more interesting for an historical analysis than the official series stemming from Eurostat that only starts in 1995. However, as regards the quarterly GDP growth rate, both series match on the common period Q1 1995 - Q4 2005. The average difference between FHM and Eurostat data [2] growth rate is only of -0.006 points. Therefore, we consider the GDP growth rate series constructed by taking the FHM series from Q1 1970 to Q4 1994 and the Eurostat series from Q1 1995 to Q3 2007. We apply the simplified Bry-Boschan algorithm to the growth rate series to identify peaks and troughs of the GDP acceleration cycle. It is noteworthy that we consider the Q4 1991 and Q1 1992 jumps and the consequent Q2 1992 strong dip as outliers. Those points are linked to the German reunification and trouble the cyclical diagnosis around this period. Estimated dates of turning points since 1987 are reported in the first column of Table 1. Second, we consider the IPI (global except construction) for the euro area. The official series computed by Eurostat starts in January 1990. We first filter the IPI monthly growth rate series by eliminating the fluctuations with a frequency higher than one year by using a classical Hodrick-Prescott filter with the appropriate cut-off frequency ($\lambda = 13.9$). This filtering step is necessary to remove the noise due to short-term fluctuations (see Figure 1). Then, we apply the same procedure as for GDP. The results are presented in the second column of Table 1.

[1] www.eabcn.org

[2] We use Eurostat data as published November 14, 2007.

It is noteworthy that both chronologies indicate the same number of cycles underlying thus the importance of the industrial sector in the global acceleration cycle. To provide with the final monthly dating, we propose the following rule. We say that if, for a given peak (or trough), the month belongs to the quarter, then we keep the monthly date. Otherwise, we pick up the month within the quarter that is the closest to the monthly date. The final proposed dating is presented in the third column of Table 1. The decelerating phase starts just after the peak and finishes at the date of the trough and the accelerating phase starts just after the trough and ends at the date of the peak.

	GDP	IPI	Dating	Duration	Amplitude	Excess
peak	1987 Q2	NA	1987 M5			
trough	1993 Q1	1992 M11	1993 M1	68	2.4	-0.18
peak	1994 Q1	1994 M3	1994 M3	14	1.6	0.10
trough	1996 Q1	1996 M2	1996 M2	21	0.9	-0.04
peak	1997 Q2	1997 M4	1997 M4	16	1.2	-0.14
trough	1998 Q4	1998 M10	1998 M10	15	1.0	0.07
peak	1999 Q3	1999 M9	1999 M9	11	1.0	0.03
trough	2001 Q3	2001 M9	2001 M9	24	1.2	-0.09
peak	2002 Q2	2002 M4	2002 M4	7	0.4	-0.05
trough	2003 Q2	2003 M4	2003 M4	12	0.4	0.04
peak	2004 Q1	2003 M10	2004 M1	9	0.6	0.17
trough	2004 Q4	2004 M11	2004 M11	10	0.3	0.04
peak	2006 Q2	2006 M4	2006 M4	17	0.7	-0.05

Table 1: Turning points chronologies for acceleration cycles for GDP and IPI, as well as the proposed dating (third column). Durations are in months and amplitudes are in points of percentage. *NA* stands for non-available information.

2.2 Characteristics of the cycle

Three main characteristic are often invoked in order to identify the phases of a cycle, namely the 3D's (duration, depth and diffusion) or, as in Banerji (1999), the 3P's (persistent, pronounced and pervasive). Persistence means that the phase must last more than few months. Generally, starting from the Bry and Boschan (1971) rule, empirical studies consider that a phase of the cycle must last at least five months. A pronounced phase of a cycle is phase with a sufficient amplitude from the peak to the trough and conversely. Last, to be recognized as a phase of the cycle, the cycle must be diffused either across the sectors or across the diverse countries of an economic zone.

Assume that the previous step has produced J accelerating and decelerating phases. For $j = 1, \ldots, J$, we note D_j^a and D_j^d the durations in months of, respectively, the j^{th} accelerating and decelerating phases. The amplitude of an descending (or ascending) phase is measured by the distance between the peak and the trough (or the trough and the peak). We note $A_j = |Y_{t_P} - Y_{t_T}|$ the amplitude of a given phase j where Y_{t_P} is the growth rate at the date of peak and Y_{t_T} is the growth rate at the date of trough. To sum up duration and amplitude of a phase j, an index of severity, noted S_j, is often used. The severity is sometimes referred to as the *triangle approximation to the cumulative movements* (Harding and Pagan, 2002, p. 370) and is defined by:

$$S_j = 0.5 \times D_j \times A_j. \tag{3}$$

The severity index measures the area of the triangle with length D_j and height A_j. In fact, the actual cumulative movements, which may be substantially different from S_j in case of departure from linearity is given by:

$$C_j = \left| \sum_{i}^{D_j} (Y_i - Y_0) \right| - 0.5 \times A_j, \quad (4)$$

where Y_0 is the value of the variable at the date of peak (or trough). The term $0.5 \times A_j$ removes the bias due to the approximation of a triangle by a sum of rectangles. Consequently, for a given phase j, the difference between the observed growth and a linear growth can be measured by the *excess cumulated movements* index defined by:

$$E_j = (C_j - S_j)/D_j. \quad (5)$$

This excess index E_j can be seen as a measure of the departure to the linearity for the growth of a given phase. The excess index is divided by the duration so that phases can be compared, independently from their duration. A null excess index implies a linear growth within a phase (decreasing or increasing growth), thus a constant acceleration (negative or positive). For a descending phase, a positive excess index means that the loss of growth is greater than it would be with a linear growth and a negative index indicates that the loss is lower. For an increasing phase, a positive excess index means that the gain of growth is greater than it would be with a linear growth and a negative index indicates that the gain is lower.

We measure those characteristics on the GDP quarterly growth rate series of the euro area, displayed in the last three columns of Table 1. From the peak located in May 1987, the euro area experienced 6 acceleration cycles (from peak to peak), the last peak located in April 2006 being provisional. The first decelerating phase was exceptionally long (68 months), mainly because of the economic recession experienced by the zone in 1992-93. Moreover, the German reunification implied a low growth rate during this period. Except this latter phase, the average durations of acceleration and deceleration phases are, respectively, of 12 and 16 months. This rather symmetric average duration of both phases is a stylized fact of the acceleration cycle that differs strongly from the business cycle, for which durations of phases are clearly different, recessions being shorter than expansions. The relatively high frequency of this cycle implies that its analysis may be very fruitful for a short-term analyst.

We focus now on the amplitude of the cycle. Average amplitude of an acceleration phase is of 0.9 percentage point of growth and, if we exclude the first decelerating phase of the analysis, exceptionally long, the average amplitude of a deceleration phase is of 0.7 percentage point. Here again, we point out the symmetry of the phases in terms of amplitude. However, we observe also that the amplitude of the phases tend to decay. We do not have enough data to carry out a dynamic analysis, but it will be interesting to follow this stylised fact in the future. Several studies have already underlined the decreasing amplitude of cycles since the eigthies (mainly in the US business cycle, see among others Sensier and van Dijk, 2004). This phenomenon is often referred to as the 'Great Moderation' and may be partly due to a better management of inventories and to more efficient monetary policies (see for example Summers, 2005, on that point).

As regards excess indexes, we note that three of the six decelerating phases possess a negative index implying thus a loss of growth lower than expected with a linear growth. The decelerating phase due to the Asian crisis in 1997-98 has an positive index (0.07), as well as the second decelerating phase of the double-dip in 2003 (0.04) and the 2004 deceleration (0.04), although close to zero. Concerning the accelerating phases, only two phases have a strong positive index indicating a gain of growth by comparison with a linear growth within the phase (in 1993-94 and 2003-04). Those phases start with a negative growth rate implying thus a sharp recovery. The acceleration before the Asian crisis presents a negative index indicating a loss of growth by comparison with a linear rate. Otherwise, other accelerating phases show an index close to zero. Thus, we note that the GDP growth rate generally presents a non-linear behaviour in the sense that the acceleration rate is not constant.

We focus now on the cross-country diffusion of the phases for both GDP and IPI series. We consider the six main countries of the euro area, namely Germany, France, Italy, Spain, Belgium and Netherlands, that cover more than 90 % of the GDP of the whole area. Series are official data stemming from Eurostat web site. For each country, we apply the previous Bry-Boschan approach on both GDP and IPI. The results are presented in Tables 2 and 3 [3]. We note that a turning point in the euro area is generally shared by a turning point in the countries. As regards GDP, exceptions are Netherlands, that do not present a deceleration in 2002-03 and are still in an acceleration phase at the end of the sample, and Spain which is decelerating since 2004 Q3. Otherwise, only Germany presents an extra-cycle in 2001-02. Thus, we can conclude that GDP acceleration cycles are well diffused across the contries. As regards IPI, the acceleration cycles are also well diffused, a turning point for the euro area always corresponds to a turning point in each country. Only at the end of the sample, a discordance appears. Indeed, the euro area industry is decelerating since April 2006, but Germany and Netherlands have switched to an acceleration phase. Moreover, France exhibits an extra cycle in 2006-07. It is noteworthy, that because of the well known end-point effects inherent to the Hodrick-Prescott filter, the last points of the analysis shoud be taken carefully.

In order to assess synchronisation among the country-specific cycles, the conconcordance index allows to estimate the fraction of times that cycles are in the same phase (decelerating or accelerating). Let $(S_{it})_t$ denotes the binary variable that represents the phase of the cycle (acceleration: $S_{it} = 0$, deceleration: $S_{it} = 1$) for a given country i. In the bivariate case, for two countries i

[3] For France, we replace the trough in 2001 Q4 by a trough in 2001 Q2, assuming the value in 2001 Q4 is an outlier and by coherence with other countries.

	Euro	Germany	France	Italy	Spain	Belgium	Netherlands
Trough	1996q1	1996q1	1996q4	1996q2		1996q1	1996q1
Peak	1997q2	1997q2	1998q2	1997q2	1997q4	1997q1	1997q2
Trough	1998q4	1998q2	1998q4	1998q4	1998q4	1998q3	1998q2
Peak	1999q3	1999q4	1999q4	1999q4	1999q2	1999q3	1999q1
Trough	2001q3	2000q3	2001q2	2001q2	2002q1	2001q3	
Peak		2001q1					
Trough		2002q1					2002q1
Peak	2002q2	2002q3	2002q1	2002q2	2003q1	2002q3	
Trough	2003q2	2003q1	2002q4	2003q1	2003q3	2003q1	
Peak	2004q1	2003q3	2004q2	2004q1	2004q3	2004q2	2004q1
Trough	2004q4	2004q3	2005q2	2004q4		2005q1	2005q1
Peak	2006q2	2006q2	2006q2	2006q4		2005q4	

Table 2: Turning points chronologies for the euro area and country-specific acceleration cycles based on GDP

	Euro	Germany	France	Italy	Spain	Belgium	Netherlands
Peak		1990m12	1991m10	1991m8	1991m9	1991m11	
Trough	1992m11	1992m12	1992m11	1992m7	1992m11	1992m11	
Peak	1994m3	1994m9	1994m4	1994m3	1994m6	1995m1	
Trough	1996m2	1995m10	1995m9	1996m3	1996m1	1995m9	1995m3
Peak	1997m4	1997m11	1997m4	1997m4	1997m3	1997m6	1995m11
Trough	1998m10	1998m9	1998m8	1998m11	1999m2	1998m10	1997m1
Peak	1999m9	2000m4	1999m9	1999m8	1999m11	1999m8	2000m1
Trough	2001m9	2001m9	2001m10	2001m7	2001m10	2001m4	2001m8
Peak	2002m4	2002m6	2002m4	2002m4	2002m8	2002m3	2002m4
Trough	2003m4	2003m4	2003m4	2003m2	2003m5	2002m11	2003m4
Peak	2003m10	2003m11	2003m10	2003m8	2004m2	2004m2	2004m1
Trough	2004m11	2004m10	2005m3	2004m11	2004m10	2004m12	2004m12
Peak	2006m4	2006m5	2005m11	2006m1	2006m5	2005m12	2005m12
Trough		2007m3	2006m8				2006m7
Peak			2007m2				

Table 3: Turning points chronologies for the euro area and country-specific acceleration cycles based on IPI

and j, the concordance index CI can be expressed in this way:

$$CI = \frac{1}{T}\sum_{t=1}^{T} I_t, \tag{6}$$

where

$$I_t = S_{it}S_{jt} + (1 - S_{it})(1 - S_{jt}). \tag{7}$$

At each date t, for all $(S_{it}, S_{jt}) \in \{0, 1\}$, I_t is equal to 1 when $S_{it} = S_{jt}$ and equal to 0 when $S_{it} = (1 - S_{jt})$. This tool is very interesting in empirical studies to assess the synchronisation between two cycles. Anyway, we should keep in mind that the conconrdance index should be misleading because, even if the correlation between S_{it} and S_{jt} is zero, the concordance index CI is equal to 0.5 only if the mean of S_{it} and S_{jt} are both equal to 0.5. It is possible to demonstrate that the expectation of the concordance index depends on the unconditional probabilities of S_{it} and S_{jt} (see Harding and Pagan, 2002, and Artis *et al.*, 2003). For example, if the unconditional probability is close to 0.9, as it is the case for expansion of the business cycle, it can be proven that, even though the correlation coefficient between the countries is zero, the expectation of CI is close to 0.84. Thus, this index has to be carefully considered in empirical studies.

Concordances indices are presented in Table 4. Based on IPI, all the countries acceleration cycles co-move with the euro cycle, with concordance indices greater than 0.81, except for Netherlands due to long duration phase. Note that the industrial country-specific cycles in the euro area are relatively well synchronized ($CI > 0.70$), except for Netherlands. The GDP-based analysis reveals that Italy and Belgium seem to be more synchronized with euro cycle than the other countries, with CI superior to 0.80.

2.3 Comparison with other existing chronologies

To evaluate our dating results, we compare them with other existing information available in the litterature or from economic research institutes. In opposition to the business and growth cycles, very few turning point chronologies are available for the acceleration cycle. The Economic Cycle Research Institute (ECRI hereafter) publishes a monthly dating of the acceleration cycle

	Euro	Germany	France	Italy	Spain	Belgium	Netherlands
Euro	1	0.83	0.86	0.91	0.85	0.81	0.64
Germany	0.73	1	0.74	0.74	0.80	0.72	0.67
France	0.66	0.48	1	0.82	0.74	0.78	0.67
Italy	0.86	0.68	0.70	1	0.77	0.84	0.63
Spain	0.59	0.45	0.52	0.45	1	0.73	0.57
Belgium	0.82	0.68	0.61	0.73	0.64	1	0.62
Netherlands	0.70	0.70	0.50	0.70	0.61	0.70	1

Table 4: Concordance indices for the IPI from Jan. 1996 to Dec. 2006 (upper diagonal) and GDP from 1996 Q1 to 2006 Q4 (lower diagonal)

for several countries. However, the ECRI does not provide a dating for the euro area as a whole, but only for the main countries of the zone. Therefore, we consider the dating chronologies for Germany, France, Italy and Spain (representing more than 90 % of the euro area GDP) and we aggregate them by computing a diffusion index weigthed by the economic importance of each country in the zone. We use the following diffusion index D_t defined as follows:

$$D_t = \frac{1}{\sum_{i=1}^{4} \omega_i} \sum_{i=1}^{4} \omega_i R_{it}, \tag{8}$$

where ω_i is the economic weight of the country i [4] and R_{it} is a binary variable equal to 1 when the country i decelerates and 0 otherwise. As a decision rule, we use the natural threshold of 0.50 to identify a switch in regimes, namely a turning point of the euro area acceleration cycle. The resulting dating is presented in Table 5.

Harding (2004) proposes also a dating chronology of the euro acceleration cycle that ends in 1998. We can also infer a turning point chronology by using the EuroCoin index now published by the Bank of Italy in collaboration with the CEPR (Altissimo *et al.*, 2007). As the EuroCoin index is supposed to track the medium long-term growth rate of the euro area, therefore peaks and troughs of the index delimitate accelerating and decelerating phases. Turning points are estimated with the Bry-Boschan algorithm. From Table 5, it appears that those chronologies are closely related. This strong coherence makes thus our results robust.

3 How to detect in real-time the acceleration cycle ?

3.1 Choice of the data

Generally, data sets are stemming from three main sources of information: macroeconomic data (hard data), opinion surveys (soft data) and financial data. Hard data are well known for their lack of timeliness: they are indeed published with a strong delay and are often revised from one month to the other. Financial variables have been proved to be leading towards the global economic cycle in many empirical studies and are consequently rather introduced in leading indicators of the cycle (see Estrella and Mishkin, 1998, or Anas and Ferrara, 2004, among others). In this paper, as our aim is to develop a coincident indicator of the acceleration cycle, available few days after the end of the reference month, we focus only on the most frequently watched

[4]We choose the industrial weights equal to 41.3 % for Germany, 18.0 % for France, 13.3 % for Italy and 9.3 % for Spain, according to Eurostat.

	Dating	Harding (2004)	ECRI based	Eurocoin based
peak	1987 M5	1988 M3	1986 M3	NA
trough			1987 M1	NA
peak			1991 M1	NA
trough	1993 M1	1993 M3	1993 M1	NA
peak	1994 M3	1994 M12	1994 M4	NA
trough	1996 M2	1995 M12	1996 M1	NA
peak	1997 M4	1998 M3	1997 M6	NA
trough	1998 M10	NA	1998 M10	NA
peak	1999 M9	NA	2000 M2	2000 M2
trough	2001 M9	NA	2001 M7	2001 M11
peak	2002 M7	NA	2002 M5	2002 M6
trough	2003 M4	NA	2003 M2	2003 M4
peak	2004 M1	NA	2003 M12	2004 M1
trough	2004 M11	NA	2004 M11	2005 M1
peak	2006 M4		2006 M3	2006 M6

Table 5: Turning points chronologies for the euro area acceleration cycle. *NA* stands for non-available information.

opinion surveys. Note that prices have not been considered.

Several soft data are available on a monthly basis for the euro area and for each specific country. A first alternative would be to consider all the available information and to summarize it into a synthetic indicator through a dynamic factor model proposed for example by Stock and Watson (2002) or Forni et al. (2000). To avoid a too systematic black-box indicator, we prefer to select with caution few components. We proceed first with this issue: Which is the sector the most closely linked to the acceleration cycle? To answer this question we consider the European Sentiment Index [ESI] computed by the European Commission [EC] and presented in Figure 5, as well as the deceleration phases estimated previously. The ESI is the weighted aggregation of the euro area confidence indicators for five components: industry (40%), services (30%), consumers (20%), retail trade (5%) and building (5%). Each confidence indicator is the arithmetic mean of few questions from the corresponding EC survey. In order to detect peaks and troughs on each component, as well as on the ESI, we apply the Bry and Boschan algorithm adapted by Harding and Pagan (2002). The analysis is first carried out on non-differencied surveys series. It turns out that peaks and troughs measured on those series are clearly lagged over the reference dating. Peaks and troughs measured on the first differences of series are closely linked to the reference acceleration cycle. Dating results are presented in Table 6.
From Table 6, it turns out that both aggregate ESI and its industrial component, namely the ICI (Industrial Confidence Indicator, see Figure 5), are the most closely linked to the reference dating. The services sector series is not so long as the other series, because the series only starts in April 1995. Moreover, the series is not strongly marked by a cyclical behaviour. As in the previous section, this analysis, based on ESI components, points out the fact that the euro area acceleration cycle is closely related to the industrial acceleration cycle. Therefore, in the data selection process, we decide to focus only on synthetic indicators in the industrial sector provided by opinion surveys.

Thus we consider a large set of soft indicators related to the industrial sector for the six main countries of the euro area, namely Germany, France, Italy, Spain, Belgium and Netherlands, and for the euro as a whole. We focus first on ICI series for those countries (see Figure 6). We observe that peaks and troughs of the differenced series match pretty well with the phases of

	Dating	ΔESI	ΔIndustry	ΔServices	ΔConsumers	ΔRetail	ΔBuilding
peak	1987 M5	1988 M6	1986 M3	na	1988 M11	1988 M9	1988 M7
trough		1990 M9	1987 M1	na	1990 M9	1991 M1	1991 M4
peak		1992 M2	1991 M1	na	1991 M9	1991 M11	1991 M12
trough	1993 M1	1992 M11	1993 M1	na	1992 M10	1992 M9	1993 M2
peak	1994 M3	1994 M4	1994 M4	na	1994 M4	1995 M1	1994 M4
trough	1996 M1	1995 M10	1996 M1	na	1995 M9	1995 M10	1996 M1
peak	1997 M6	1997 M7	1997 M6	1997 M4	1997 M8	1997 M11	1997 M12
trough	1998 M10	1998 M9	1998 M10		1999 M4	1999 M5	
peak	1999 M9	1999 M1	2000 M2			2000 M2	
trough	2001 M7	2001 M10	2001 M7	2001 M7		2002 M2	2002 M8
peak	2002 M7	2002 M3	2002 M5	2002 M2	2001 M12		
trough	2003 M4	2002 M10	2003 M2	2002 M10	2002 M10		
peak	2004 M1	2003 M8	2003 M12	2003 M8	2003 M4		
trough	2004 M11	2002 M5	2004 M11	2005 M3	2005 M5		
peak	2006 M4	2006 M4	2006 M4	2006 M6		2006 M2	2005 M11

Table 6: Turning points chronologies for the ESI and its components

the acceleration cycle. Then we focus on country-specific indicators such as IFO and ZEW for Germany, ICA Insee and ICA Bank of France for France, and Isae for Italy (see Figure 7). Note that most of those latter indicators serve as a basis for the EC survey. Last, we consider also Purchasing Managers Indexes. In spite of their short sample size, those data are interesting for international comparison because they are available for several countries and based on the same methodology.

3.2 The econometric framework

We assume now that N series have been selected from the previous step. The issue is now how to extract the common cycle of those series. We present the methodology that we used to compute the real-time indicator of the acceleration cycle. The methodology is based on the class of Hidden Markov Chain models. Especially, we focus on the Markov-Switching model popularized by Hamilton (1989) and generalized to the multivariate case by Krolzig (1997). This kind of model has been used in many empirical studies, among others we refer to Layton (1996), Chauvet (1998), Gregoir and Lenglart (2000), Chauvet and Piger (2003, 2008), Anas and Ferrara (2004), Chauvet and Hamilton (2006), Bruno and Otranto (2008) or Anas et al. (2008). We propose two econometric models to take the multivariate information into account: a MS-VAR process and a Markov-Switching factor model.

3.2.1 MS-VAR

We present below the multivariate extension of the Markov-Switching model with $K = 2$ regimes as proposed by Krolzig (1997). This definition can be easily extend to more than two regimes. We define the N-dimensional second order process $(X_t)_{t\in Z} = (X_t^1, \ldots, X_t^N)_{t\in Z}$ as a MS(2)-VAR(p) process if it verifies the following equations:

$$X_t - \mu(S_t) = \sum_{i=1}^{p} \Phi_i(S_t)(X_{t-i} - \mu(S_{t-i})) + \varepsilon_t, \quad (9)$$

where $(S_t)_t$ is a random process with values in $\{1, 2\}$, where $(\varepsilon_t)_{t\in Z}$ is a multivariate white noise Gaussian process with variance-covariance matrix $\Sigma(S_t)$ and where $\Phi_1(S_t), \ldots, \Phi_p(S_t)$ are $N \times N$

matrices describing the dependence of the model to the regime S_t. The full representation of the model requires the specification of the variable $(S_t)_t$ as a first order Markov chain with two regimes. That is, for all t, S_t depends only on S_{t-1}, i.e. for $i, j = 1, 2$:

$$P(S_t = j | S_{t-1} = i, S_{t-2}, S_{t-3}, \ldots) = P(S_t = j | S_{t-1} = i) = p_{ij} \quad (10)$$

The probabilities p_{ij} for $i, j = 1, \ldots, K$ are the transition probabilities; they measure the probability of staying in the same regime and to switch from a regime to the other one. They provide a measure of the persistence of each regime. Obviously, we get: $p_{i1} + p_{i2} = 1$, for $i = 1, 2$. The estimation step allows to get, for each date t, the forecast, filtered and smoothed probabilities of being in a given regime i, respectively defined by $P(S_t = i|\hat{\theta}, X_{t-1}, \ldots, X_1)$, $P(S_t = i|\hat{\theta}, X_t, \ldots, X_1)$ and $P(S_t = i|\hat{\theta}, X_T, \ldots, X_1)$, where $\hat{\theta}$ is the estimated parameter. Estimation is done by using the EM algorithm proposed by Krolzig (1997).

3.2.2 A Markov-Switching Factor Model

Introduction to the model and estimation in 2 steps. In this model, the information is first summarized into a univariate factor which assume to represent the common evolution of the series. This model was first sketched by Diebold and Rudebusch (1996), theoretical and empirical aspects are widely discussed in Kim and Nelson (1999). For a single common factor, we define the model as follows, for $n = 1, \ldots, N$

$$X_t^n = \gamma_n F_t + u_t^n, \quad (11)$$

where

$$\phi(B) F_t = \mu(S_t) + \varepsilon_t, \quad (12)$$

where γ_n are defined as the loadings, where $(u_t^n)_t$ is supposed to follow a Gaussian stationary AR(1) process with finite variance σ_n^2, where $(\varepsilon_t)_t$ is a Gaussian white noise process with unit variance and $(S_t)_t$ is a Markov chain defined by equation (10) and where $\phi(B) = I - \phi_1 B - \ldots - \phi_p B^p$. We assume that $(F_t)_t$ and the idiosynchratic noises $(u_t^n)_{n=1,\ldots,N}$ are non-correlated.

Parameter estimation of this model can done either simultaneously, as proposed by Kim and Nelson (1999), or in two steps, by estimating first the common factor $(\hat{F}_t)_t$ and then by fitting a MS(K)-AR(p) process on the estimated factor. As our aim is to propose an operational tool to be computed monthly, we prefer to tend towards the simplest estimation method assuming that simplicity goes along with robustness. Preliminary results with the simultaneous method show non-convergence of the estimation algorithm. The common factor estimation can be carried out according to two distinct methods. We can first estimate a static common factor model ($\phi(z) = 1$ in equation (12)), referred to as Static Factor Markov-Switching [SFMS]. Loadings are thus estimated by using Principal Component Analysis. Then we introduce dynamics into the factor, referred to as Dynamic Factor Markov-Switching [DFMS], and compute maximum likelihood estimates with a Kalman filter [5]. Both estimations methods are compared in the application section.

3.3 Indicator construction and quality criteria

Our aim is to construct the best acceleration cycle turning point indicator in the sense that it allows the more precise reproduction of the phases of the acceleration cycle, as described by the

[5] Parameter estimation is carried using the module Grocer of Scilab

reference dating (see Table 1). The turning point indicator is based on the filtered probabilities of being in a given regime. At each date t, the indicator I_t is computed by taking the difference between the probability of being in the high regime (acceleration) and the probability of being in the low regime (deceleration). When the indicator is close to 1, it means that the economy is accelerating and when the indicator is close to -1, we estimate that the economy is decelerating. To help the understanding of the indicator we propose a decision rule based on a threshold $\beta \in [0, 1]$. We will say that the economy belongs to an accelerating phase if $I_t \in]\beta, 1]$ and to a decelerating phase if $I_t \in [-1, -\beta[$. The threshold β is estimated empirically and is generally equal to 0.33 or 0.5 in the studies.

To assess the quality of the indicator $(I_t)_{t=1,\ldots,T}$, we propose several criteria. Let $(R_t)_{t=1,\ldots,T}$ be the binary variable such as $R_t = 1$ if the economy is decelerating at date t and $R_t = 0$ otherwise. This variable is computed starting from the reference dating. Each criteria depends on the threshold β in use in the decision rule.

The first considered criterion is the classical Quadratic Probabilistic Score of Brier (1950) defined by:

$$QPS(\beta) = \frac{1}{T} \sum_{t=1}^{T} (1_{(I_t < -\beta)} - R_t)^2, \tag{13}$$

where $1_{(.)}$ is the indicator function. This criteria is used in many empirical studies to assess the concordance degree between the indicator and a reference dating. However, this criterion presents several drawbacks. Especially, two non-correlated variables may present a high value of QPS if their persistence is strong (Harding and Pagan, 2006). This is specially the case when dealing with recessions for which the probabilities of staying in the same regime is greater than 0.9. Moreover, the distribution law of this criteria is unknown, which does not allow statistical inference.

The second criterion takes also into account periods where the indicator lies in the intermediate phase. We attribute the null value when the indicator is in the same phase as the reference dating, than value 2 when the indicator is in the opposite phase and the value 1 when the indicator belongs to the intermediate phase, that is between $-\beta$ and β. This cyclical goodness of fit (CGoF) criterion is defined by:

$$CGoF(\beta) = \frac{1}{T} \sum_{t=1}^{T} u_t(\beta), \tag{14}$$

where

$$u_t(\beta) = \begin{cases} 1 - (1_{(I_t > \beta)} - 1_{(I_t < -\beta)}), & \text{si } R_t = 0 \\ 1 + (1_{(I_t > \beta)} - 1_{(I_t < -\beta)}), & \text{si } R_t = 1 \end{cases} \tag{15}$$

This criterion should be minimized.

The third criteria that we use in this empirical part is the readability criterion. We start from the idea that the intermediate regime corresponds to a form of uncertainty in which the signal is very difficult to interpret. Therefore, a readable indicator is an indicator that does not stay a long time in the intermediate zone. We define the readability criteria by:

$$Readability(\beta) = \frac{1}{T} \sum_{t=1}^{T} 1_{(-\beta < I_t < \beta)}. \tag{16}$$

This criterion estimates the number of times that the indicator lies in the intermediate phase. Obviously, we aim at minimizing this criterion.

3.4 Empirical results

If we note $(Y_t)_t$ the original opinion survey series, we pointed out previously that peaks and troughs of the series in first differences, that is ΔY_t, match with peaks and troughs of the acceleration cycle. Therefore, in order to detect those peaks and troughs, we have to identify the switches in acceleration regimes, namely the switches in the regimes of the twice differenced series $\Delta^k \Delta Y_t$, where the operator Δ^k is defined such as $\Delta^k = I - B^k$. This twice-differenced series $\Delta^k \Delta Y_t$ appears very noisy and therefore the signal extraction step becomes very tricky. The choice of the integer k in the operator $\Delta^k \Delta$ is a way to reduce the noise without introducing too strong distortions in the cycle. However, this choice is totally empirical. To assess the value of k, we first work with the ESI, BCI and ICI for aggregate euro area. After several tries on each series, it turns out that $k = 6$ provides with the best trade-off between noise and lag in terms of replication of the cycle. Thus we decide to keep this lag $k = 6$ in the remaining analysis.

First we focus on the opinion surveys in the industry released by the EC. We consider in a first step the ESI, BCI and ICI for aggregate euro area (see Figure 5) and we apply a univariate model Markov-Switching model (equation (9) with $N = 1$) to those three series. Turning point indicators stemming from these 3 variables are presented in figure 2. All the indicators replicate the acceleration cycle, but the ICI presents better results in terms of criteria. Specially, QPS and CGoF are lower. In a second step, we consider the ICI for the six main euro countries, namely Germany, France, Italy, Spain, Belgium and Netherlands (see Figure 6). Those series are interesting because they are directly comparable through the European harmonization program of the DG-EcFin. We first fit a MS-VAR model, then a SFMS model and last a DFMS model. The resulting common factors stemming from the last two models are presented in figure 3. We note that the DFMS model allows to smooth the signal by comparison with other two methods. Taking the common factor dynamic into account implies thus a variance reduction of the common factor. Table 7 contains the values of different criteria.

We focus now on the most frequently watched opinion surveys at the Banque de France, namely IFO, ZEW, Insee, Isae, Bank of France. We retain a model integrating the three industrial surveys provided by IFO, Insee and Isae (see Figure 7). Those series are released the same day, that is the last working day of the reference month. Those national surveys serve as a basis for the construction of the national ICI by the European Commission. Using those series, we estimate a MS-VAR model, a SFMS model and a DFMS model. Criteria are presented in Table 7. It turns out that the DFMS model provides with the most accurate criteria. Moreover, this latter indicator provides with results comparable with the model with the 6 ICI.

Last we consider Purchasing Managers Index [PMI] in industry provided by NTC Research on the behalf of the Royal Bank of Scotland. Those indicators are often considered by macoreconomic analysts, beacause, according to their provider, they allow to an international comparison of economic activity among the countries. Indeed, for each country PMIs are simply the weighted average of 5 questions asked to a panel of managers. What could be surprising is the fact that the weights are identical for all the countries. In spite of their defaultsn those indicators are carefully watched each month by policy-makers. We decide thus to integrate them in the analysis. For our purpose, the main drawback is the lack of an historical time series. Namely, the industrial

PMI for the euro area as a whole is only only available since June 1997, that is we have around 10 years of data points. For the four main countries of the zone, the PMIs start in April 1996 for Germany, June 1998 for France, June 1997 for Italy and February 1998 for Spain. As for the other opinion survey sources, we apply the same procedure, that is we fit a MS model to the euro area PMI and a MSVAR model to the four main countries of the zone. Results are presented in figure 8. It turns out that the models do not allow to describe the euro area acceleration cycle as defined by the benchmark dating. This is certainly due to the fact that not enough cycles are available for the model. Consequently, in the lack of back-calculated data, it is not possible to integrate those variables in our models.

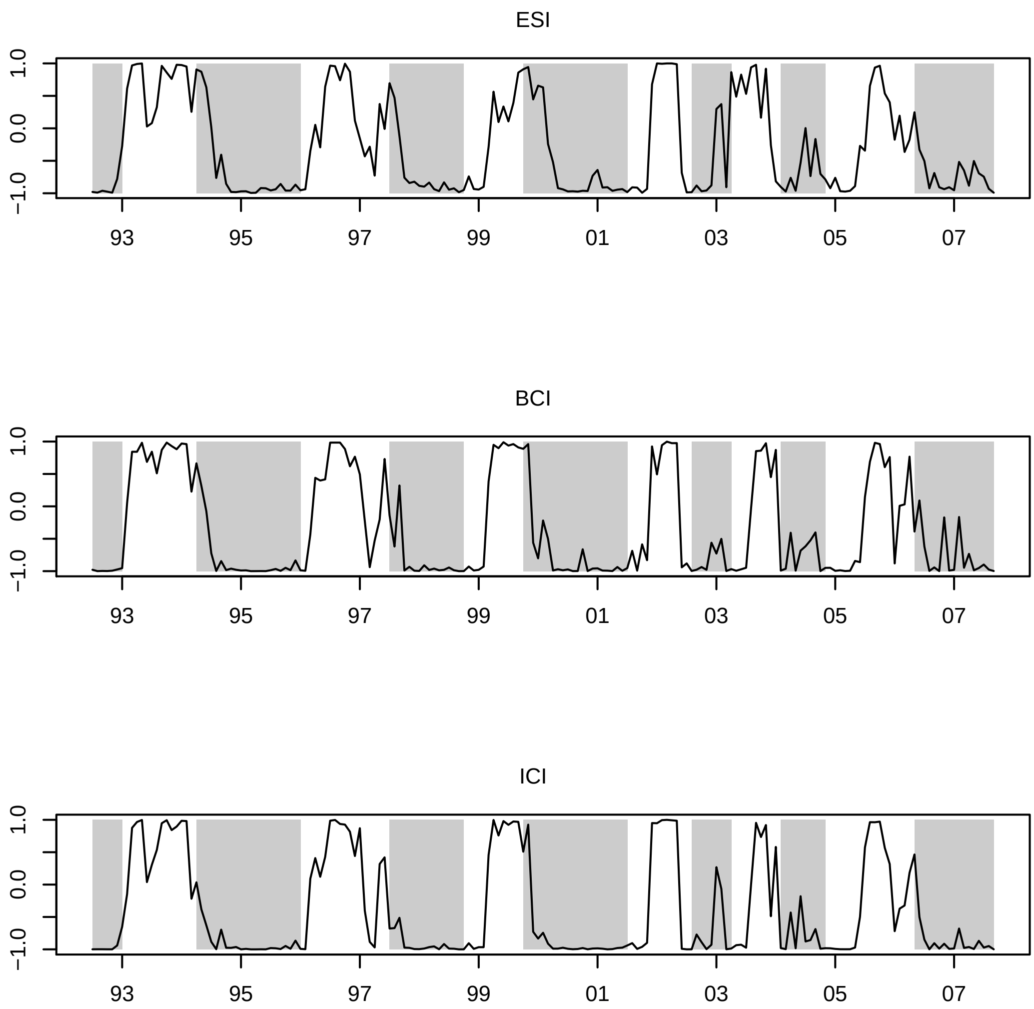

Figure 2: Indicators stemming from ESI (top), BCI (middle) and ICI (bottom)(Jul. 1992 - Sep. 2007)

	$\beta = 0.50$			$\beta = 0.33$		
	QPS	CGoF	Readibility	QPS	CGoF	Readibility
Composite Index						
ESI	0.213	0.486	0.224	0.229	0.503	0.153
BCI	0.197	0.410	0.147	0.186	0.361	0.087
ICI	0.164	0.377	0.147	0.175	0.377	0.082
6 main ICI						
MSVAR(6)	0.180	0.382	0.131	0.175	0.372	0.087
SFMS(6)	0.175	0.372	0.120	0.169	0.344	0.071
DFMS(6)	0.142	0.311	0.060	0.142	0.306	0.022
IFO - Insee -Isae						
MSVAR(3)	0.208	0.404	0.186	0.191	0.399	0.093
SFMS(3)	0.202	0.426	0.153	0.186	0.366	0.093
DFMS(3)	0.158	0.284	0.055	0.158	0.290	0.038
PMI						
PMI ZE	0.239	0.504	0.060	0.239	0.496	0.034
6 PMI	0.257	0.543	0.048	0.257	0.543	0.048

Table 7: Quality criteria for indicators with $\beta = 0.50$ and $\beta = 0.33$

4 Conclusion

The follow-up of accelerations and decelerations of the euro area economy is of great interest for short-term analysts. In this paper we provide two main results that will be useful for economists aiming at studying the euro area activity. First we construct a reference turning point chronology, on a monthly basis, for the euro area acceleration cycle from 1987 to 2006 based on estimated turning point dates of both GDP and IPI. Second, we develop of monthly turning point indicator based on information conveyed by opinion surveys often watched in central banks. We empirically prove that this indicator is able to track each month the acceleration cycle of the euro area.
In this paper, we also point out that accelerations and decelerations of the economy are mainly generated by the industrial sector. In this respect, further empirical research could be to add progressively quantitative indicators related to the industrial activity to assess the gain in reliability at the cost of a more delayed indicator. From a methodological point of view, a focus should be made on the improvements that could be done by taking simultaneously into account in modelling a dynamic factor that switches according to a Markov chain as proposed by Kim and Nelson (1999). Especially, effort should be concentrated on the computational aspects of such model for a regular use by practitioners.

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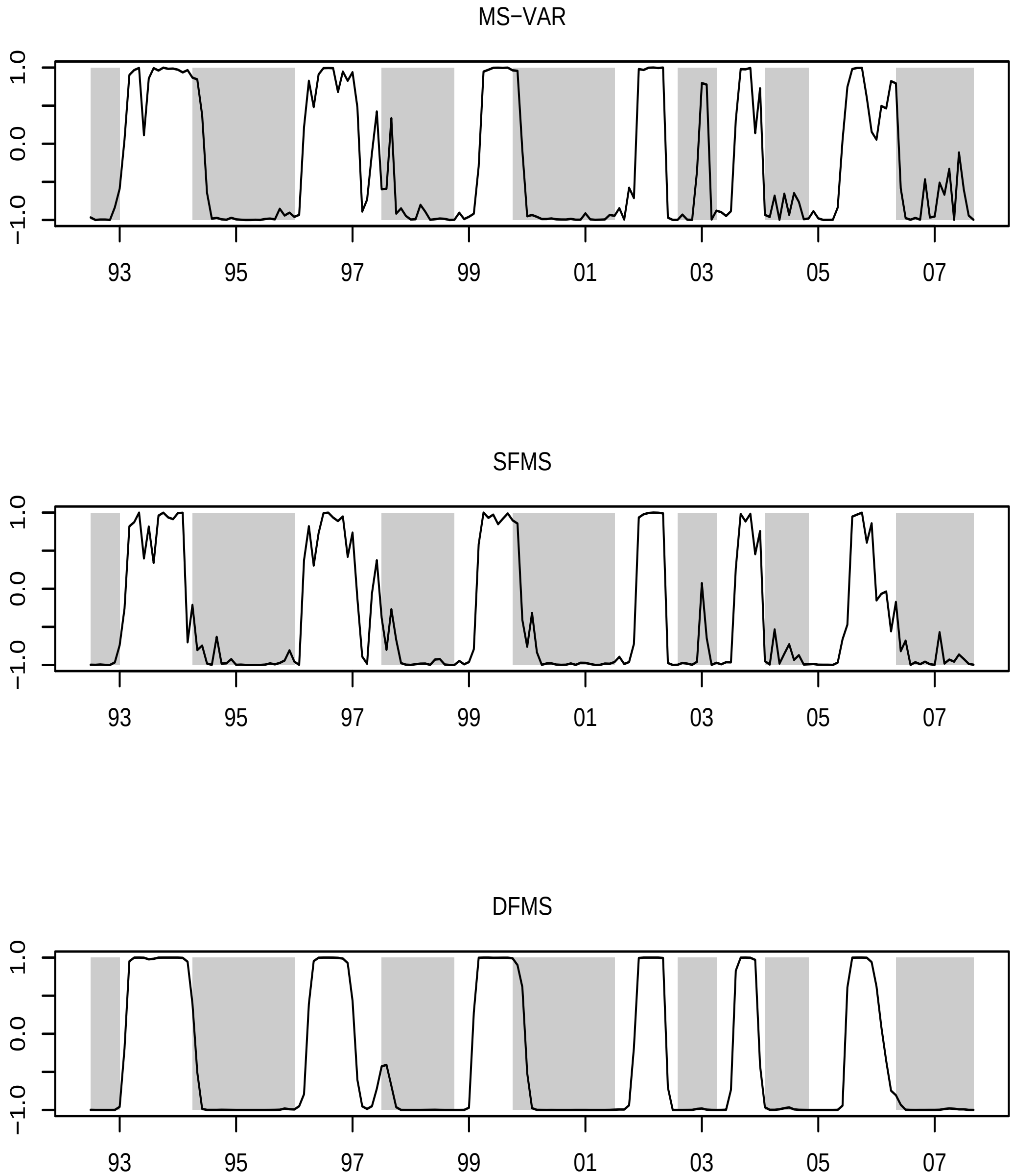


Figure 3: Indicators stemming from MS-VAR model (top) SFMS model (middle) and DFMS model (bottom) applied to the 6 country-specific $\Delta\Delta^6 ICI$ (Jul. 1992 - Sep. 2007)

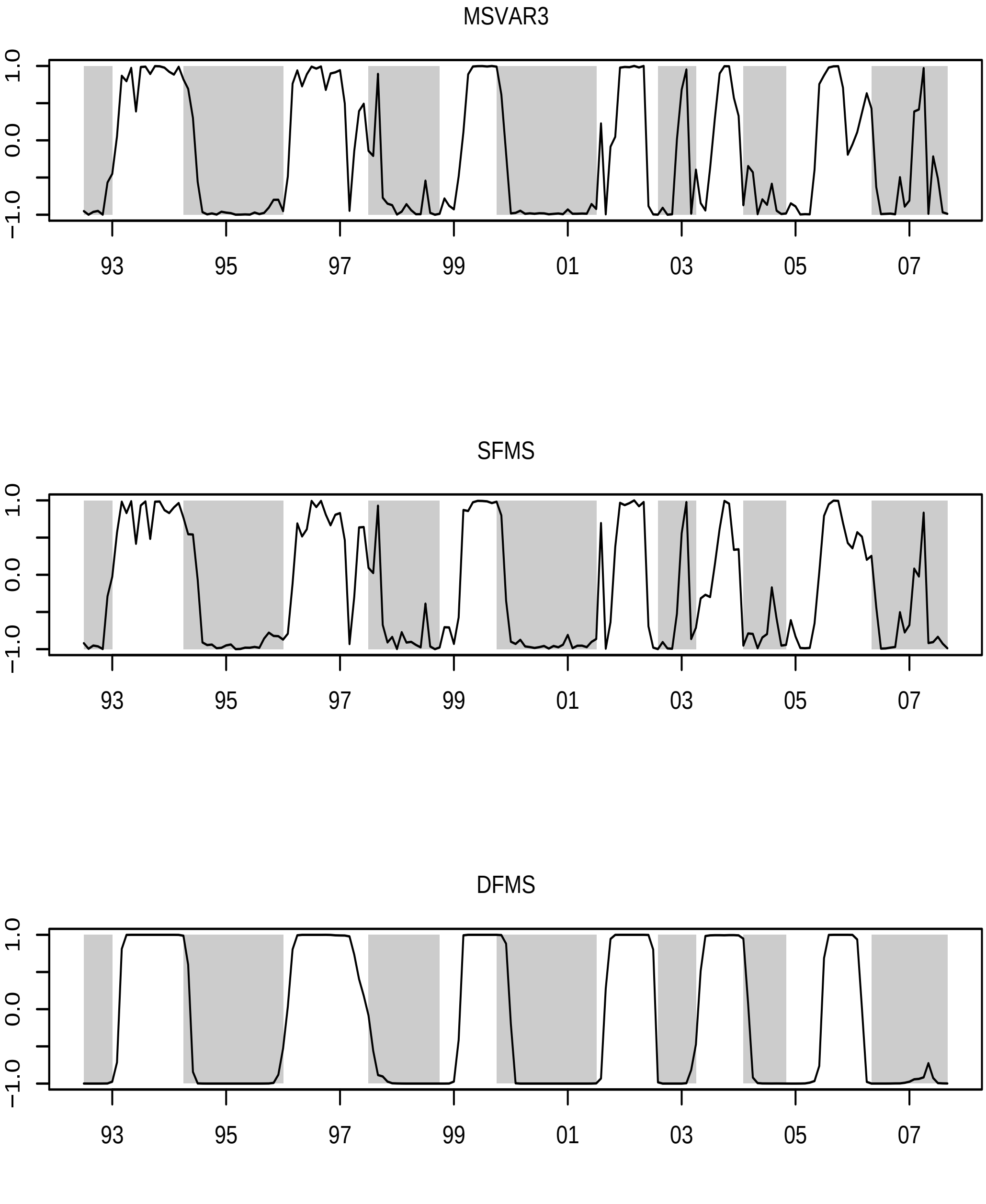


Figure 4: Indicators stemming from MS-VAR model (top) SFMS model (middle) and DFMS model (bottom) applied to the 3 country-specific confidence index (IFO, Insee and Isae) filtered by $\Delta\Delta^6$ (Jul. 1992 - Sep. 2007)

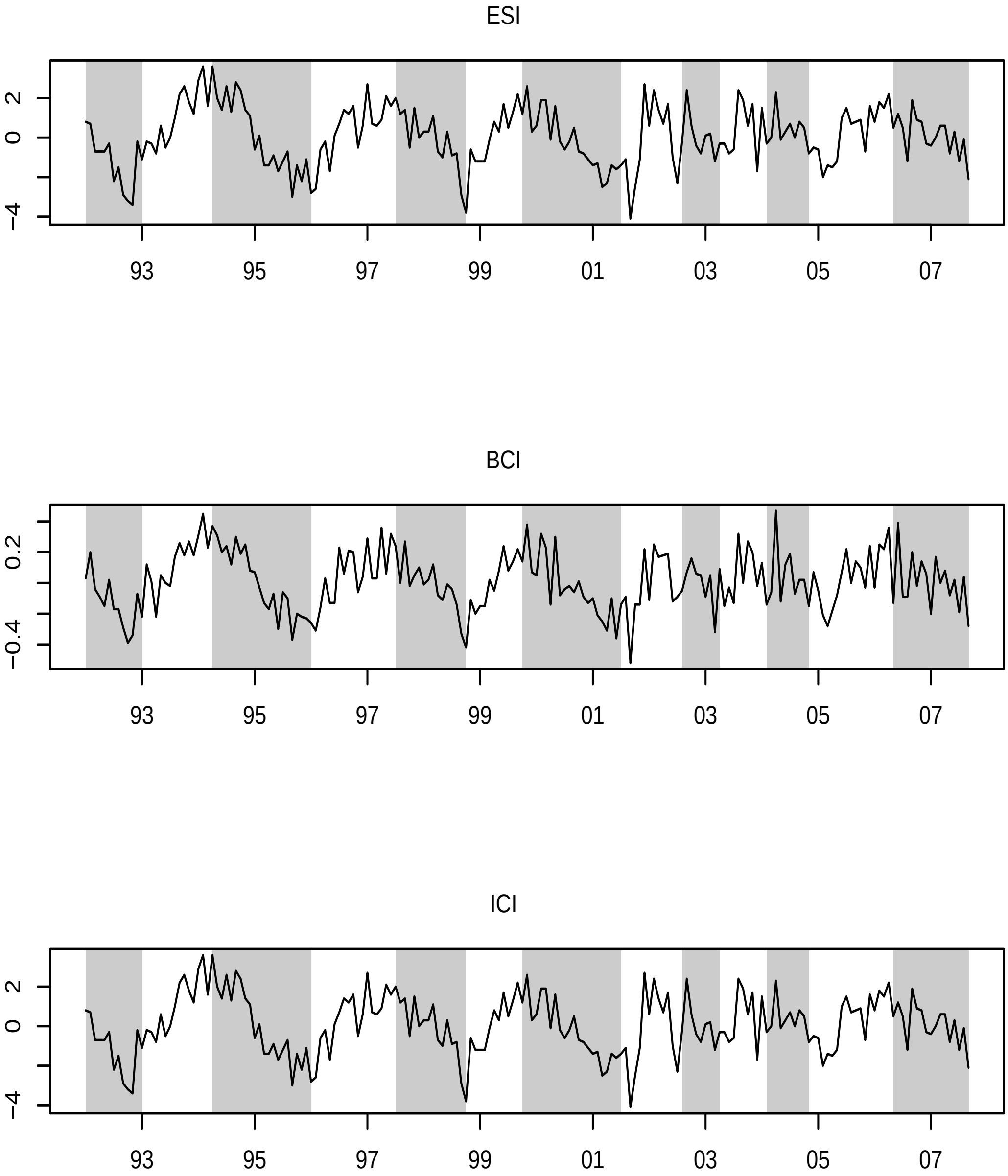


Figure 5: ESI, BCI and ICI in differences

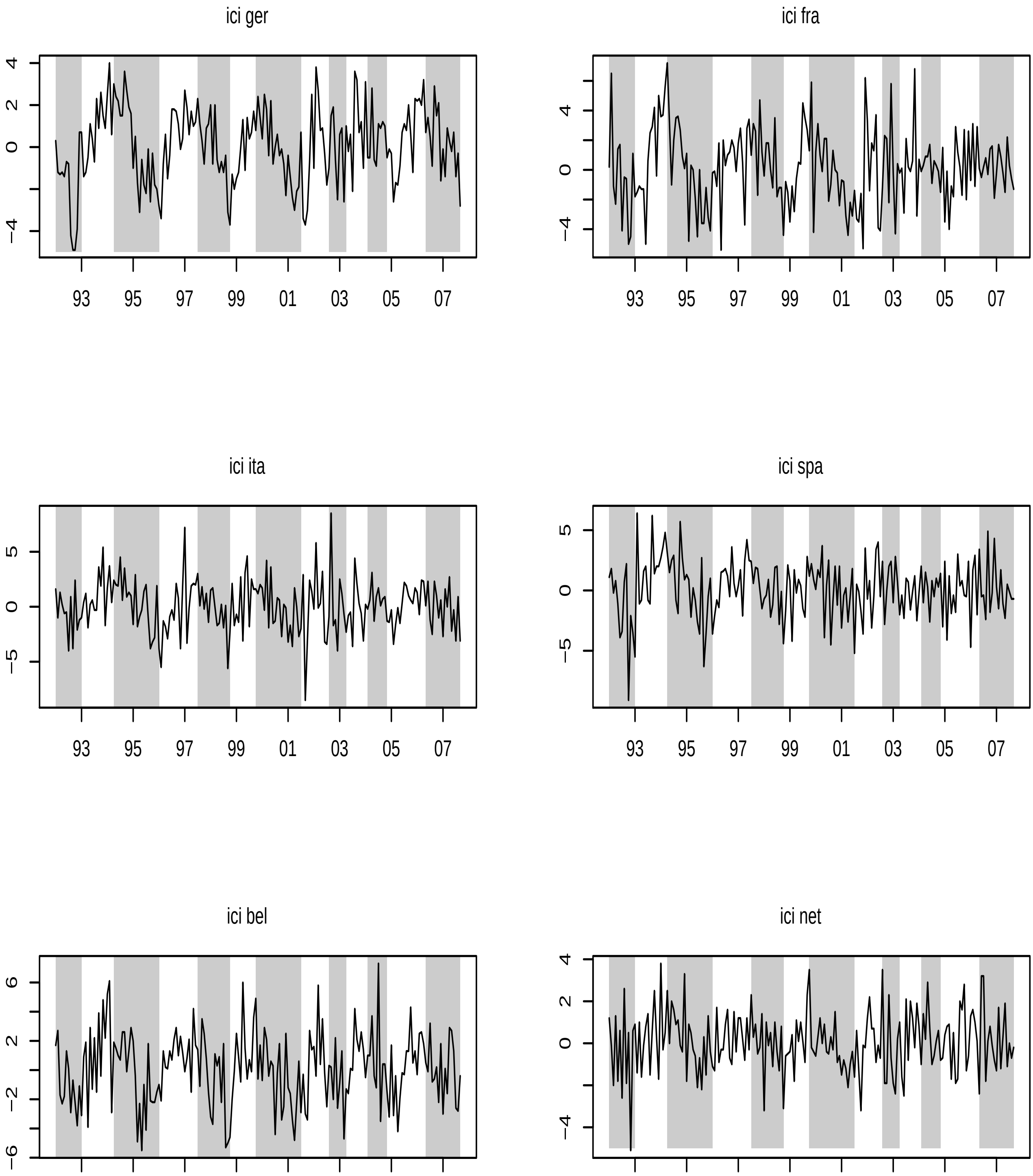


Figure 6: ICI for the 6 main Euro area countries (in differences) and phases of deceleration in the euro area (shaded areas) over the period January 1992 - September 2007.

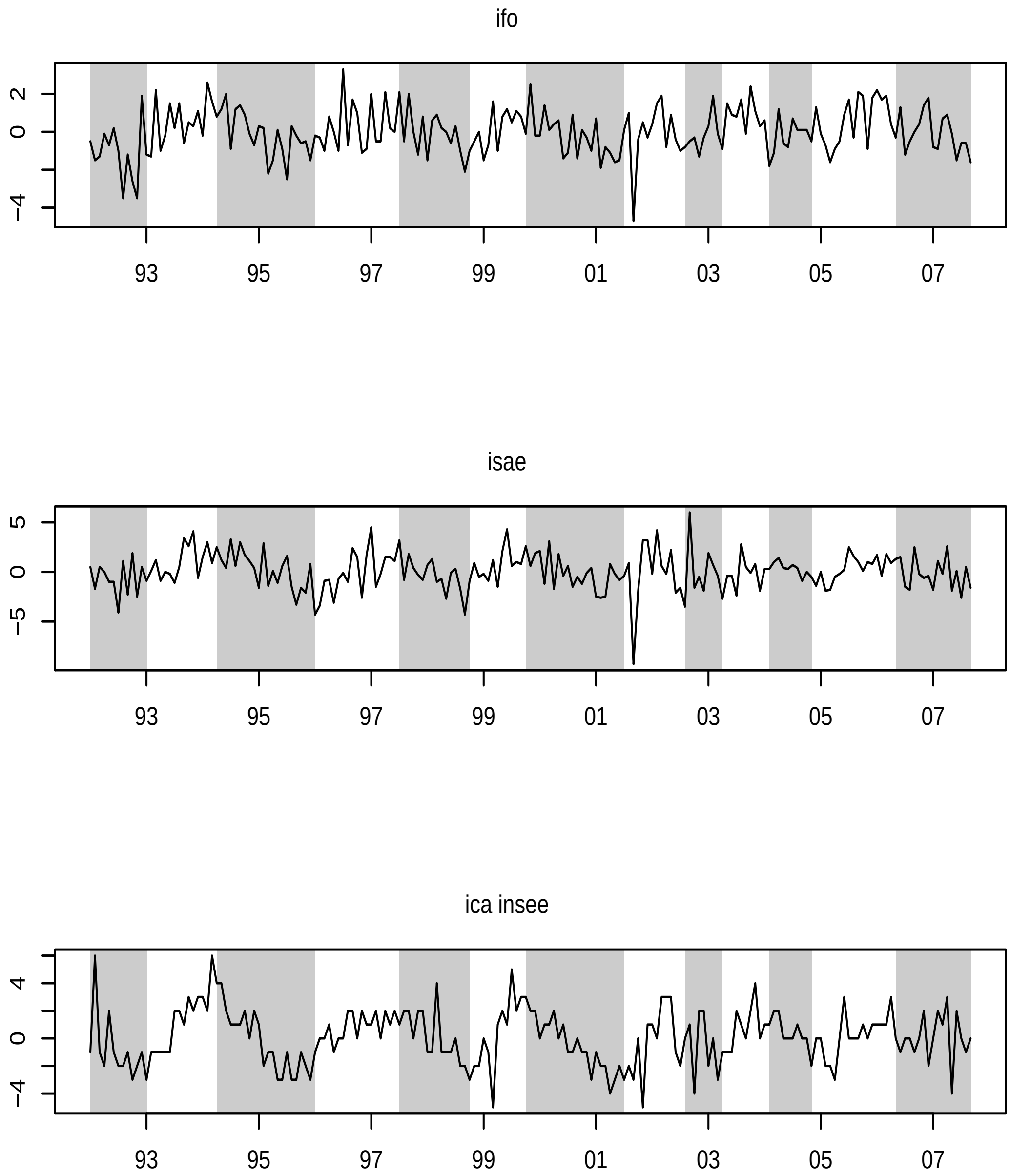
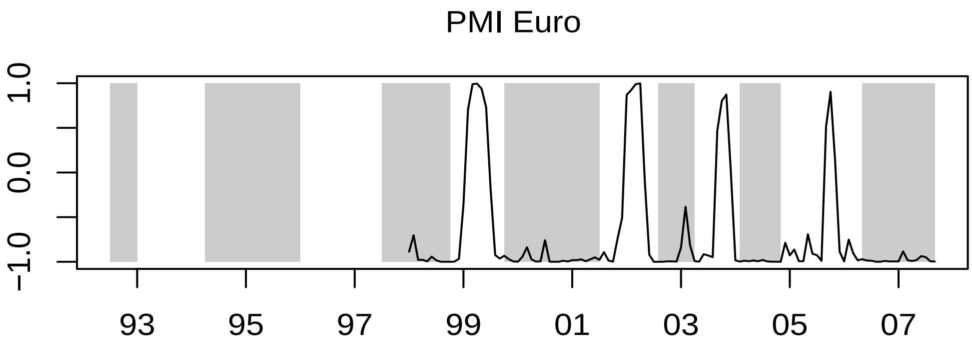


Figure 7: Composite Confidence Indicators from IFO, ISAE and INSEE in differences



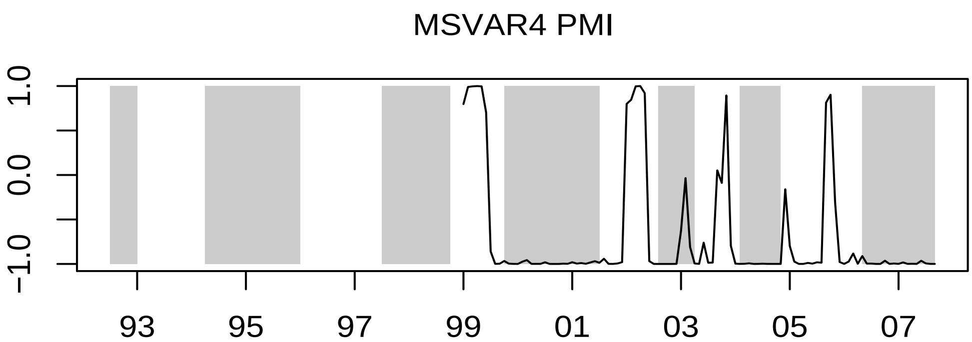


Figure 8: Comparison of indicators stemming from the 3 opinion surveys for Germany, France and Italy using a MS-VAR model (top), a SFMS model (middle) and a DFMS model (bottom) (Jul. 1992 - Sep. 2007)