The Cyclical Experience of the Acceding Countries

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Abstract

We study the business cycle in the acceding countries, focusing on the degree of cyclical concordance both within this group of countries, which turns out to be in general lower than that between the existing EU countries, and with respect to the Eurozone, which is also generally low when GDP data are used, slightly higher with industrial production. In the light of the optimal currency area literature, these results cast doubts on the usefulness of adopting the euro in the near future for most acceding countries, though other criteria such as the extent of trade and the gains in credibility may point in a different direction.

JEL Classification: E32, E39

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1 Introduction

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The structure of the paper is as follows. In Section 2 we summarize the properties of the business cycle dating algorithms proposed by AMP. In Section 3 we discuss the available data and present the results for the classical cycle. In Section 4 we discuss the findings for the deviation cycle. In Section 5 we summarize and conclude.

2 The Dating Algorithm

The two dominant approaches to business cycle dating rely either on deterministic algorithms to identify particular patterns in the data, e.g. Bry and Boschan (1971) and Harding and Pagan (2001), or on Markov switching models to estimate the probability that a certain observation belongs to a recessionary period, e.g. Hamilton (1989), see Harding and Pagan (2003) and Hamilton (2003) for a comparison of the two approaches.

AMP proposed a probabilistic dating algorithm, as in the Markow switching apporach, but where the probability of being in a certain regime is computed non-parametrically based on a particular pattern recognition scheme, as in the deterministic approach. This algorithm allows more flexibility than the traditional deterministic methods but estimation is simpler than in the standard Markov switching approach, which is an important advantage to analyse short time series as those available for the acceding countries.

For exposition sake we illustrate the dating algorithm with reference to the quarterly case, additional details can be found in AMP. Despite the apparent complexity of the algorithm, its implementation requires less than 70 lines of Ox code.

At any time t the economy can be in either of two mutually esclusive states or *phases*: expansion (E_t) or recession (R_t). A peak terminates an expansion, whereas a trough terminates a recession. For the imposition of minimum duration constraint and to enforce the alternation of peaks and troughs, it is useful to distinguish turning points within the two basic states, by posing:

$$\mathsf{E}_t \equiv \begin{cases} \mathsf{EC}_t & \text{Expansion Continuation} \\ \mathsf{P}_t & \text{Peak} \end{cases}$$

$$\mathsf{R}_t \equiv \begin{cases} \mathsf{RC}_t & \text{Recession Continuation} \\ \mathsf{T}_t & \text{Trough} \end{cases}$$

From EC_t we can make a transition to P_{t+1} or continuate the expansion ($\mathsf{EC}_t \rightarrow \mathsf{EC}_{t+1}$), but not viceversa, since only $\mathsf{P}_t \rightarrow \mathsf{RC}_{t+1}$ is admissible. Analogously, from RC_t we can visit either RC_{t+1} or T_{t+1}, but from T_t we move to EC_{t+1} with probability 1.

Denoting by $p_{_{EP}} = P(\mathsf{P}_{t+1}|\mathsf{EC}_t)$ the probability of making a transition to a peak within an expansionary pattern, $p_{_{EE}} = P(\mathsf{EC}_{t+1}|\mathsf{EC}_t) = 1 - p_{_{EP}}$, and analogously $p_{_{RT}} = P(\mathsf{T}_{t+1}|\mathsf{RC}_t)$, $p_{_{RR}} = P(\mathsf{RC}_{t+1}|\mathsf{RC}_t) = 1 - p_{_{RT}}$, we define a first order Markov chain (MC) with four states, denoted S_t, with transition matrix:

	EC_{t+1}	P_{t+1}	RC_{t+1}	T_{t+1}
EC_t	$p_{_{EE}}$	$p_{_{EP}}$	0	0
P_t	0	0	1	0
RC_t	0	0	$p_{_{RR}}$	$p_{_{RT}}$
T_t	1	0	0	0

The dating rules impose ties on the minimum duration of a phase, which amounts to two quarters, and this is automatically enforced in the quarterly case by our four states characterisation, and on the minimum duration of a full cycle, which amounts to five quarters. The minimum duration constraint are important for the characterisation of the chain: that imposed on the full cycle duration determines the order of the MC, whereas that imposed on the phases length determines the number of admissible states.

The tie on the full cycle yields a 5th order MC that can be converted to a first order one by combining elements of the original chain, S_t. The states of the derived MC are defined by appropriately combining the original ones into

$$S_t^* = \{S_{t-4}, S_{t-3}, S_{t-2}, S_{t-1}, S_t\}.$$

The ties however reduce the number of states to 24. These are listed in table 1: the first column labels the states and the second spells out how they are formed by combining the elementary states of the original MC.

The last two columns indicate the states to which a transition is admissible (two at most) and the associated transition probability. The transition matrix is thus immediately derived from the above table. It should be noticed that all the states ending with a peak or a trough must visit certain states with probability one.

The two parameters p_{EP} p_{RT} uniquely specify the Markov chain. These can be estimated by maximum likelihood techniques from an observed time series in a model based framework, if it is assumed that the latter is a realisation of a stochastic process that is dependent upon the state of the economy as represented by the chain. This idea is at the foundation of the class of Markov switching models, that postulate that the growth rate and/or the innovation variance and/or the transmission mechanism vary according to recessions and expansions.

As mentioned above, we consider the alternative strategy of scoring the two parameters according to patterns in the series, y_t. There are several ways of doing so, with different degrees of complexity, but we will concentrate on the BBQ rule by Harding and Pagan (2001). Other, simpler, popular rules are the calculus and the Okun's rule.

According to the BBQ dating rule, we define an expansion termination sequence, ETS_t, and a recession terminating sequence, RTS_t, respectively as:

$$\begin{aligned} \mathsf{ETS}_t &= \{(\Delta y_{t+1} < 0) \cap (\Delta_2 y_{t+2} < 0)\} \\ \mathsf{RTS}_t &= \{(\Delta y_{t+1} > 0) \cap (\Delta_2 y_{t+2} > 0)\} \end{aligned} \quad (1)$$

The former defines a candidate point for a peak, which terminates the expansion, whereas the latter defines a candidate for a trough.

The joint distribution of the sequences $\{\mathsf{ETS}_t, \mathsf{RTS}_t, t = 1, \dots, T\}$ depends on the stochastic process generating the available series and is usually analitically intractable

Table 1: Description of the Markov chain generated by the quarterly dating rules.

States	$S_t^* = \{S_{t-4}, S_{t-3}, S_{t-2}, S_{t-1}, S_t\}$					States S_{t+1}^* that can visited			
S_t^*	S_{t-4}	S_{t-3}	S_{t-2}	S_{t-1}	S_t	S_{t+1}^*	Trans. Prob.	S_{t+1}^*	Trans. Prob.
S_1^*	P	RC	RC	RC	RC	S_{17}^*	p_{RR}	S_{18}^*	p_{RT}
S_2^*	P	RC	RC	RC	T	S_{19}^*	1		
S_3^*	P	RC	RC	T	EC	S_{20}^*	p_{EE}	S_{21}^*	p_{EP}
S_4^*	P	RC	T	EC	EC	S_{22}^*	p_{EE}	S_{23}^*	p_{EP}
S_5^*	T	EC	EC	EC	EC	S_9^*	p_{EE}	S_{10}^*	p_{EP}
S_6^*	T	EC	EC	EC	P	S_{11}^*	1		
S_7^*	T	EC	EC	P	RC	S_{12}^*	p_{RR}	S_{13}^*	p_{RT}
S_8^*	T	EC	P	RC	RC	S_{14}^*	p_{RR}	S_{15}^*	p_{RT}
S_9^*	EC	EC	EC	EC	EC	S_9^*	p_{EE}	S_{10}^*	p_{EP}
S_{10}^*	EC	EC	EC	EC	P	S_{11}^*	1		
S_{11}^*	EC	EC	EC	P	RC	S_{12}^*	p_{RR}	S_{13}^*	p_{RT}
S_{12}^*	EC	EC	P	RC	RC	S_{14}^*	p_{RR}	S_{15}^*	p_{RT}
S_{13}^*	EC	EC	P	RC	T	S_{16}^*	1		
S_{14}^*	EC	P	RC	RC	RC	S_1^*	p_{RR}	S_2^*	p_{RT}
S_{15}^*	EC	P	RC	RC	T	S_3^*	1		
S_{16}^*	EC	P	RC	T	EC	S_4^*	1		
S_{17}^*	RC	RC	RC	RC	RC	S_{17}^*	p_{RR}	S_{18}^*	p_{RT}
S_{18}^*	RC	RC	RC	RC	T	S_{19}^*	1		
S_{19}^*	RC	RC	RC	T	EC	S_{20}^*	p_{EE}	S_{21}^*	p_{EP}
S_{20}^*	RC	RC	T	EC	EC	S_{22}^*	p_{EE}	S_{23}^*	p_{EP}
S_{21}^*	RC	RC	T	EC	P	S_{24}^*	1		
S_{22}^*	RC	T	EC	EC	EC	S_5^*	p_{EE}	S_6^*	p_{EP}
S_{23}^*	RC	T	EC	EC	P	S_7^*	1		
S_{24}^*	RC	T	EC	P	RC	S_8^*	1		

due to the presence of serial correlation and the mutually non exclusive nature of the termination sequences. As regards the latter, denoting by $\overline{\mathsf{ETS}}_t$ the complementary event of ETS_t, $\overline{\mathsf{RTS}}_t$ that of RTS_t and defining $\mathcal{P}_t^{(ETS)} = P(\mathsf{ETS}_t), \mathcal{P}_t^{(RTS)} = P(\mathsf{RTS}_t)$, at time t the joint probability distribution of the possible events is provided by the following table:

	ETS_t	$\overline{\mathsf{ETS}}_t$	$Marginal$
RTS_t	0	$\mathcal{P}_t^{(RTS)}$	$\mathcal{P}_t^{(RTS)}$
$\overline{\mathsf{ETS}}_t$	$\mathcal{P}_t^{(ETS)}$	$1-\mathcal{P}_t^{(ETS)}-\mathcal{P}_t^{(RTS)}$	$1-\mathcal{P}_t^{(RTS)}$
$Marginal$	$\mathcal{P}_t^{(ETS)}$	$1-\mathcal{P}_t^{(ETS)}$	1

whence it can be seen that ETS_t and RTS_t cannot both be true at the same time.

Serial correlation complicates the computation of $\mathcal{P}_t^{(ETS)}$ and $\mathcal{P}_t^{(RTS)}$, since the terminating sequences are not independent of their past; furthermore it must be stressed that the BBQ rule induces autocorrelation itself, that is even if $\Delta y_t \sim \text{NID}(\mu, \sigma^2)$, e.g. y_t is a random walk, $\{\mathsf{ETS}_t, \mathsf{RTS}_t, t = 1, \ldots, T\}$ will be autocorrelated. Therefore it seems that the only way to go about the characterisation of business cycle for a particular stochastic process is stochastic simulation.

Let us return to the non parametric scoring of the transition probabilities according to the available time series. If at time t the chain S_t^* is in any of the expansionary states for which a transition to a peak is possible and an expansion terminating sequence occurs at time $t+1$, i.e ETS_{t+1} is true, then we move to a new state S_{t+1}^*, such that $S_{t+1} = \mathsf{P}_{t+1}$ and the previous four elementary states are common to the last four in S_t^*.

It is useful at this point to classify the states of S_t^* by defining the sets:

$\mathcal{S}_{EP} = \{S_3^*, S_4^*, S_5^*, S_9^*, S_{19}^*, S_{20}^*, S_{22}^*\}$ defines the set of states featuring an expansionary state at time t ($S_t = \mathsf{EC}_t$) and that are available for a transition to a peak.

$\mathcal{S}_{P} = \{S_6^*, S_{10}^*, S_{21}^*, S_{23}^*\}$ defines the set of states featuring a peak at time t ($S_t = \mathsf{P}_t$).

$\mathcal{S}_{RT} = \{S_1^*, S_7^*, S_8^*, S_{11}^*, S_{12}^*, S_{14}^*, S_{17}^*\}$ defines the set of states featuring a recessionary state at time t ($S_t = \mathsf{RC}_t$) and that are available for a transition to a trough.

$\mathcal{S}_T = \{S_2^*, S_{13}^*, S_{15}^*, S_{18}^*\}$ defines the set of states featuring a peak at time t ($S_t = \mathsf{P}_t$).

The set of expansionary states, $\mathcal{S}_E$, is the union of $\mathcal{S}_{EP}, \mathcal{S}_P$ and S_{16}^*, in symbols:

$$\mathcal{S}_E = \mathcal{S}_{EP} \cup \mathcal{S}_P \cup S_{16}^*$$

The set of recessionary states, $\mathcal{S}_R$, is the union of $\mathcal{S}_{RT}, \mathcal{S}_T$ and S_{24}^*, in symbols:

$$\mathcal{S}_R = \mathcal{S}_{RT} \cup \mathcal{S}_T \cup S_{24}^*$$

The scoring rules are then formalised in the following algorithm:

If $\{S_t^* = s_{EP}, s_{EP} \in \mathcal{S}_{EP}\}$ *and* ETS_{t+1} *is true, then* $\{S_{t+1}^* = s_P, s_P \in \mathcal{S}_P\}$*. Hence, the transition probability* p_{EP} *is computed as:*

$$\begin{aligned} p_{EP} &= P\left(\{S_t^* = s_{EP}, s_{EP} \in \mathcal{S}_{EP}\} \cap \mathsf{ETS}_{t+1}\right) \\ &= \mathrm{I}(\mathsf{ETS}_{t+1}) \sum_{s_{EP} \in \mathcal{S}_{EP}} P\left(S_t^* = s_{EP}\right), \end{aligned} \tag{2}$$

where $\mathrm{I}(\cdot)$ *is the indicator function. Else, if* ETS_{t+1} *is false then the expansion is continued, that is* $S_{t+1}^* = s_{EP}, s_{EP} \in \mathcal{S}_{EP}$*; the associated transition probability is* $p_{EE} = 1 - p_{EP}$*.*

Else, if $\{S_t^* = s_{RT}, s_{RT} \in \mathcal{S}_{RT}\}$ *and* RTS_{t+1} *is* true*, then* $\{S_{t+1}^* = s_T, s_T \in \mathcal{S}_T\}$*. Hence, the transition probability* p_{RT} *is computed as:*

$$\begin{aligned} p_{RT} &= P\left(\{S_t^* = s_{RT}, s_{RT} \in \mathcal{S}_{RT}\} \cap \mathsf{RTS}_{t+1}\right) \\ &= \mathrm{I}(\mathsf{RTS}_{t+1}) \sum_{s_{RT} \in \mathcal{S}_{RT}} P\left(S_t^* = s_{RT}\right), \end{aligned} \tag{3}$$

Else, if RTS_{t+1} *is false, then the recession is continued, that is* $S_{t+1}^* = s_{RT}, s_{RT} \in \mathcal{S}_{RT}$*; the associated transition probability is* $p_{RR} = 1 - p_{RT}$*.*

The case when ETS_{t+1} and RTS_{t+1} are both false is implicitly covered by the above dating rule. Probabilistic dating based on a maintained stochastic process replaces the indicator function, $\mathrm{I}(\cdot)$, with the probability of the terminating sequences, $\mathcal{P}_{t+1}^{(ETS)}, \mathcal{P}_{t+1}^{(RTS)}$.

Let now $\mathcal{F}_t$ denote the collection of $\mathrm{I}(\mathsf{ETS}_j), \mathrm{I}(\mathsf{RTS}_j), j = 1, 2, \dots, t$, and let $P(S_t^*|\mathcal{F}_t)$ denote the probability of being in any particular state at time t conditional on this information set. Assuming that this probability is known we can compute recursively the probability of the chain at subsequent times by the following filter:

i. Given the availability of $P(S_t^*|\mathcal{F}_t)$ at time t, let us denote by π_t^* the $m \times 1$ vector containing them, with $m = 24$ in the quarterly case. Define the two $m \times 1$ selection vectors $v_{_{EP}}$, with ones corresponding to the elements of $\mathcal{S}_{_{EP}}$ and zero otherwise, and $v_{_{RT}}$, with ones corresponding to the elements of $\mathcal{S}_{_{RT}}$ and zero otherwise.

ii. Compute the transition probabilities of the chain according to (2) and (3), that is $p_{_{EP}} = \mathrm{I}(\mathsf{ETS}_{t+1})v_{_{EP}}'\pi_t^*, p_{_{RT}} = \mathrm{I}(\mathsf{RTS}_{t+1})v_{_{RT}}'\pi_t^*, p_{_{EE}} = 1-p_{_{EP}}, p_{_{RR}} = 1-p_{_{RT}}$ and insert them in the transition matrix of the chain, hereby denoted by $\mathcal{T}$.

iii. Compute the probabilities $P(S_{t+1}^*|\mathcal{F}_{t+1})$ belonging to the vector π_{t+1}^* as

$$\pi_{t+1}^* = \mathcal{T}'\pi_t^*$$

The algorithm is initialised by assigning values to π_1^*: if one knows that at the beginning of the sample we are in expansion, $\pi_1^* \propto v_{_E}$, where $v_{_E}$ is the selection vector corresponding to $\mathcal{S}_{_E}$, whereas if we know that the system was in recession, $\pi_1^* \propto v_{_R}$, where $v_{_R}$ selects the elements of $\mathcal{S}_{_R}$. Otherwise, we can learn from the first observations about the initial probability vector, and in the case these are ambiguous use a uniform prior, which amounts to set the elements of π_1^* equal to $1/m$.

Finally, the algorithm recursively produces $P(S_t^*|\mathcal{F}_t)$, for all $t = 1, \dots, T$, and hence, marginalising previous states $S_{t-j}, j = 1, 2, 3, 4$, the probabilities of each elementary event, $P(S_t|\mathcal{F}_t)$, and $P(\mathsf{E}_t|\mathcal{F}_t) = P(\mathsf{EC}_t|\mathcal{F}_t) + P(\mathsf{P}_t|\mathcal{F}_t)$, $P(\mathsf{R}_t|\mathcal{F}_t) = P(\mathsf{RC}_t|\mathcal{F}_t) +$

$P(\mathsf{T}_t|\mathcal{F}_t)$, can be obtained. For instance,

$$P(\mathsf{E}_t|\mathcal{F}_t) = \sum_{s_E \in \mathcal{S}_E} P\left(S_t^* = s_E\right).$$

3 Classical Business Cycles

As the reports prepared by the European Commission highlight, the progress made by accession countries in the direction of statistical harmonisation with the EU has been substantial[1]. The quarterly national accounts macro aggregates are produced at a very high level of compliance with the European System of Accounts (ESA95) methodology. However, they are available for a very short time span, typically starting in the early '90s. Therefore, we focus on the quarterly gross domestic product (GDP) series at constant prices, which is the most used summary measure of aggregate economic activity, but also compare the results with those obtained by AMP2 using the monthly industrial production index (total industry). The data sources are the OECD (Main Economic Indicators) and Eurostat. The series are available for different sample periods, as is illustrated in table 2, and in general refer to eight of the 10 enlargement countries, excluding Cyprus and Malta.

Figure 1 reports the dating of the classical cycles for the acceding countries and the euro area. It turns out that Poland, Hungary and Slovakia are in expansion for the entire period under investigation. The cyclical experience of the Eurozone, with a trough in 1993:1, appears to be rather different from that of the acceding countries.

Lithuania and Estonia experienced a common downturn during the years 1998-1999, connected with the contemporaneous Russian economic crisis. The amplitude of this recessionary episode has also the same size, the output loss being around -3%, and the steepness is similar, since the recession lasted between 4 and 5 quarters. The fluctuations in the Latvia GDP series around the same period do not qualify for a major recession, as

[1]The reports are available at the website http://europa.eu.int/comm/enlargement/report2002/index.htm. Chapter 12 of the individual country documents report on statistical harmonisation.

the absolute fall in output concerns only two quarter with very limited amplitude.

For the Czech Republic a recession is found starting in the third quarter of 1996 and ending in 1998, that is not found in industrial production. The output loss associated with this recession is about -3%.

For comparison purposes, in Figure 2 we report the classical dating for the same sample period and countries based on IP series, see AMP2 for details. Some interesting results emerge. In particular, the downturn in 1998-99 is now common to all the acceding countries, with some differences in the exact dates, and it also emerges for the Eurozone, though with a very limited output loss. A second milder recessionary episode is also indentified in the first part of the sample for the Czech Republic, Slovakia, Slovenia and Latvia, but in this case the interested period differs substantially across countries. Overall, the evidence of cyclical synchronization remains rather weak both across countries and with the Eurozone.

AMP2, using the sample available for IP (reported in Table 2), find that certain characteristics of the post-transition business cycle of the acceding countries are not dissimilar from those of some EU countries and the Eurozone. In particular, the proportion of time spent in expansion is around 0.75, a shade less than the the value for the Eurozone, which amounts 0.81. The average duration of the downturns is slightly less than one year, which is longer than the Eurozone (7.3 months), but is comparable to Italy (11.2 months); the dispersion around the average is not negligible, however, and it must be stressed that duration is longer for the Baltic states. The main difference lies with the amplitude of the downturns, the percentage of output lost on average in recession is much larger for the acceding countries than for the Eurozone.

AMP2 also compute a formal measure of cyclical concordance, the standardised concordance index proposed in AMP (2002), finding that among the countries under analysis only Poland has significant concordance with the Eurozone. Across acceding countries, the cyclical concordance is statistically significant only for 5 out of 21 pairs of countries, namely, Slovenia - Czech Republic, Slovenia - Slovakia, Estonia - Czech Republic, Estonia - Slovakia, and Estonia - Slovenia. Though these results should be interpreted with care because of the small sample available, they are in line with the reported descriptive evidence based on GDP data of low synchronisation of the classical business cycles of acceding countries across themselves and with the Eurozone.

We do not report on classical business cycle concordance based on GDP for two related reasons: first and foremost the pervasive growth which characterised the post-transition period renders classical business cycle concordance and synchronisation less likely and perhaps less relevant from an interpretative standpoint; the second reason is related to the limited extension of the available sample, for which too few recessionary episodes are found: as it is clear from Figure 1 classical business cycle synchronisation would be perfect for Slovakia, Poland and Hungary, but this evidence has little if no value.

4 Growth rate cycles

In this section and the next we turn our attention to the measurement of two alternative definitions of business cycle definitions that are potentially more valuable, especially for the assessment of cyclical concordance, in a situation characterised by pervasive growth and a sustained catching up process.

The first deals with the notion of a *growth rate cycle* and is concerned with the cyclical upswings and downswings in the growth rate of economic activity at a given, usually yearly, horizon. A recession is defined as a prolonged and sustained decline in underlying growth.

Growth rate chronologies are produced by the Economic Cycle Research Institute (http://www.businesscycle.com), that adopts as a measure of underlying growth with an annual horizon, constructed as follows (Layton and Moore, 1989):

$$q_t = \left[\frac{y_t}{\sum_{j=1}^{s} y_{t-j}/s}\right]^{2s/(s+1)},$$

where y_t is the level of the series and s is the number of observations in a year; for instance, when $s = 4$ the formula above yields the ratio of the latest quarter's figure to the average of the preceding four quarters, raised to the power $4/2.5$ to express it as an annual rate.

The turning points in q_t are the same as $\Delta_s \ln y_t$. As a matter of fact, if the arithmetic average in the denominator is replaced by a geometric one, it is immediate to show that the logarithm of q_t is a running weighted average of $s-1$ consecutive growth rates, $\Delta \ln y_t$, with linearly decreasing weights:

$$\ln q_t = w(L)\Delta \ln y_t, \qquad w(L) = \frac{2s}{s+1}\sum_{j=0}^{s-2}(s-j)L^j.$$

Recalling that the yearly growth rate $\Delta_s \ln y_t$ is an average of s growth rates with uniform weights,

$$\Delta_s \ln y_t = S(L)\Delta \ln y_t, \quad S(L) = 1 + L + L^2 + \cdots + L^{s-1},$$

the use of q_t or the latter for quarterly data does not make much difference, so we apply our dating algorithm to $\Delta_4 \ln y_t$.

Table 3 reports the pairwise correlation coefficient between the GDP yearly growth rates for the eight countries, a selection of countries belonging to the Eurozone, namely Austria, representing a relatively small economy in the EA, Germany, Italy, and Eurozone itself. The empirical evidence is clear cut: correlation is fairly high within the Euro area, within the Baltic countries and between Hungary, Poland and the Euro area.

Growth cycle chronologies are displayed in Figure 3 for the acceding countries and in Figure 4 for the Eurozone and its selected member countries. Table 4 reports the pairwise standardised concordance indices. The location of the turning point and the values of the indices confirm the high degree of concordance of the growth rate cycle in the Euro area: both Germany and Italy assist to the emergence of a growth-rate cycle recession at the end of 2002, whereas for Austria growth peaked two quarters before; more generally, peaks and troughs are almost coincident. The same cannot be said with respect to the eight acceding countries, which undergo rather different business cycle experiences, as Figure 3 clearly shows. Nevertheless, at the end of the sample a recessionary pattern, concordant with that experienced in the Euro area, emerges for five countries. The standardised concordance index is significant only within the eurozone and between Hungary and the Eurozone.

5 Deviation Cycles

It might be argued that the deviation cycle is the notion of business cycle that is prominent for our investigation, in that considers the fluctuations relative to a measure of tendency, thereby providing a way to assess business cycle stance that abstracts from catching-up dynamics.

As it is well known, the measurement of the deviation cycle raises many controversies. The solution that we have adopted is pretty standard: the deviation cycle has been extracted using the band-pass version of the so-called Hodrick and Prescott filter, which attempts to isolate the fluctuations with a periodicity between 1.25 and 8 years.

The filter is easily obtained from the difference of two low-pass filters, the first being the HP trend filter with smoothness parameter, λ_1, corresponding to the cut-off frequency, $\omega_l = 2\pi/(1.25s)$, where s is the number of observations in a year; this reduces the amplitude of high-frequency components, with period less than $1.25s$ years, e.g. 5 quarters or 15 months. The second is the HP filter for trend extraction with smoothness parameter λ_2 corresponding to $\omega_u = 2\pi/(8s)$ (period of 8 years), which aims at retaining the components with period greater than 8 years. The smoothness parameter is related to the cut-off frequency via the equation: $\lambda = [2(1 - \cos\omega)]^{-2}$. See Pollock (1999) and Gomez (2000) for further details. Hence, for quarterly data ($s = 4$), $\lambda_1 = 0.52$ and $\lambda_2 = 667$ (notice that the latter is smaller than the value suggested by Hodrick and Prescott for quarterly data, which is 1600).

The choice of the second cut-off frequency is arbitrary[2], but we follow the convention used by Baxter and King (1999). As a matter of fact, the HP band-pass filter could be viewed as a finite sample implementation of the Baxter and King ideal filter. With respect to the approximation proposed by these authors, it provides estimates for the first and final three years, that obviously rely on asymmetric filters, and it does not suffer from the Gibbs phenomenon. See AMP for details.

It is a matter of debate whether we should concentrate our analysis and dating efforts on the band-pass component rather than the high pass one (that is, in our case, the HP cycle corresponding to λ_2); the latter is affected by high frequency variation, which greatly interferes with the dating process, so that the dating procedure would nevertheless need to go through a preliminary stage where turning points are identified on the band-pass series. Then, a local search on the high-pass series around the provisional turning points would be required. However, we have decided to adopt the first solution.

The dating is carried out as described in Section 2: by cumulating the HP band-pass component and applying the Markov chain dating algorithm we identify the points at which the deviation cycle crosses zero (the duration restrictions are enforced at this stage); subsequently, the maximum (peak) or the minimum (trough) are located between two crossings.

Figure 5 displays the HP-bandpass deviation cycles extracted for the acceding countries (excluding Hungary) and the Eurozone. The three countries for which no classical cycles were found, Slovakia, Poland and Latvia, now present clear cyclical patterns, which are also very similar in the case of Slovakia and Latvia.

The amplitude of the output gap is larger for Estonia and Lithuania, whose cyclical pattern is comparable and close to that for Latvia. The amplitude of the gap for the other countries is in general larger than for the Eurozone, a fact confirmed by the analysis of the industrial production series. Average steepness is instead comparably sized.

[2] According to the Burns and Mitchell definition, "…in duration business cycles vary from more than one year to ten or twelve years; …" (Burns and Mitchell, 1946, p. 3).

For the Czech Republic one major recessionary episode is found, with the trough in 1999:1, in line with the previous finding using GDP level data and in common with several other acceding countries.

Tables 5 and 6 report, respectively, the pairwise correlation coefficients and the standardised concordance index (the values in bold are significant at the 5% level). Although the sample sizes available do not allow any firm conclusion to be drawn, the highest concordance with the Eurozone deviation cycle is found for Hungary, followed by Poland, but the null hypothesis of no cyclical synchronization cannot be rejected for any country except Hungary (with respect to Austria and Germany). AMP2 report slightly better results when using IP data.

Finally, in general the highest degree of synchronisation across the acceding countries is among the Baltic states, a finding that is also robust to the use of IP series.

6 Conclusions

In this paper we have analysed the evolution of the business cycle in the accession countries. Because of the pervasive growth in the post-transition period, the deviation cycle (where the turning points are characterized by changes relative to *trend*) represents a more promising and appropriate version of the business cycle. We find that the degree of concordance *within* the group of accession countries is not in general as large as that between the existing EU countries (the Baltic countries constitute an exception). Between them and the Eurozone the indications of synchronization are generally low when GDP data are used, slightly higher with industrial production. Similar results are obtained for the classical cycle.

The process of European integration has experienced already four waves of accessions, the first occurring in 1973 (Denmark, Ireland and the United Kingdom), the second in 1981 (Greece), the third in 1986 (Spain and Portugal); finally, at the beginning of 1995 Austria, Finland and Sweden joined the European Union. The issue that emerges quite naturally is whether the degree of business cycle synchronisation was similar at the time of these earlier accession as it is now for the current enlargement. AMP2 find that the business cycle concordance was generally higher in those previous episodes, and that only Poland, Hungary and Slovenia comply with the same level of cyclical synchronisation.

Overall, these results are not in favour of an early adoption of the euro, but the very high levels of trade with EU countries (see Buiter and Grafe (2001)) and the acquisition of policy credibility and hence stability in the currency and related features point in the opposite direction. Therefore, there is substantial scope for additional research in this area.

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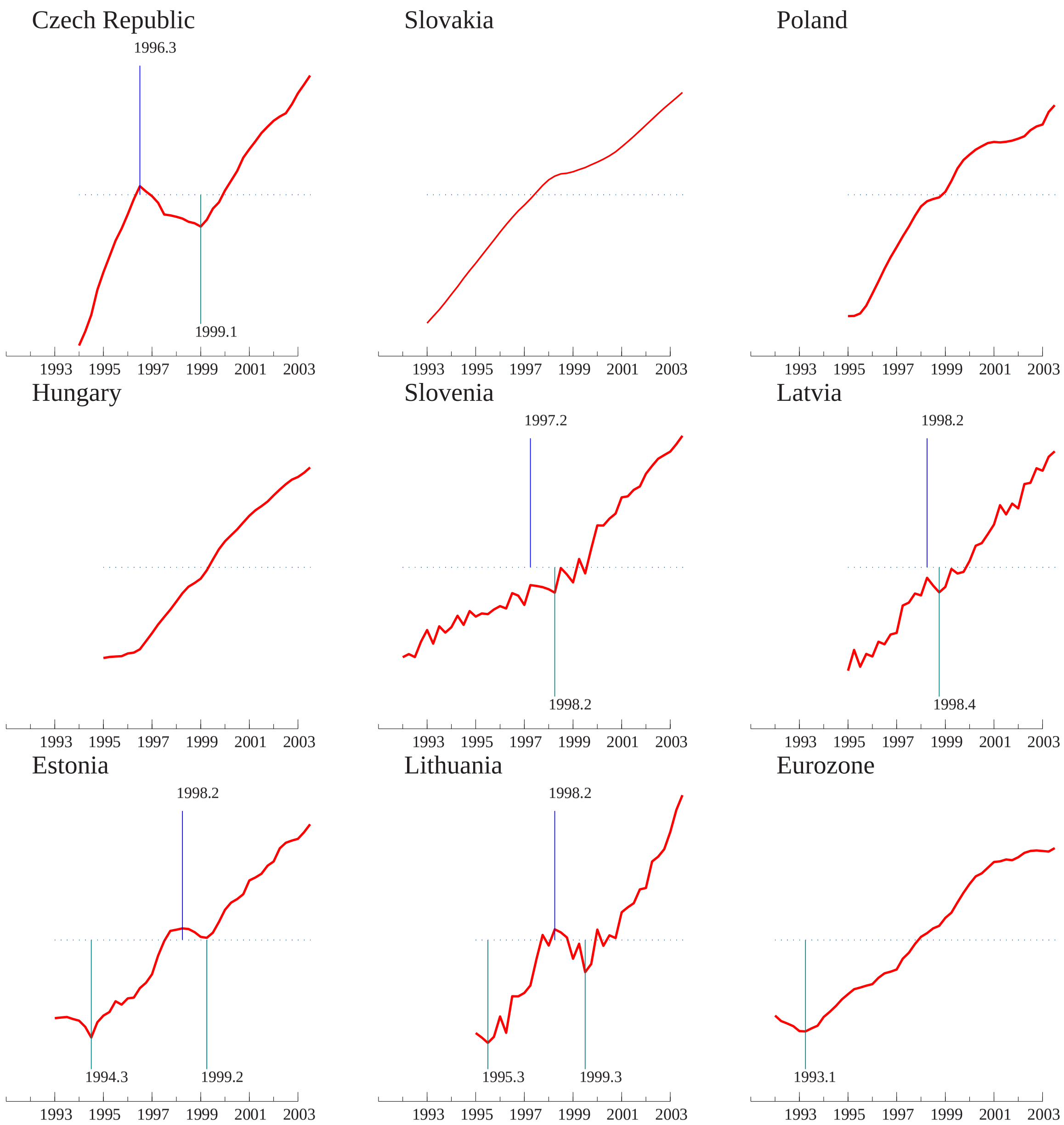

Figure 1: Quarterly seasonally adjusted GDP: classical cycle turning points.

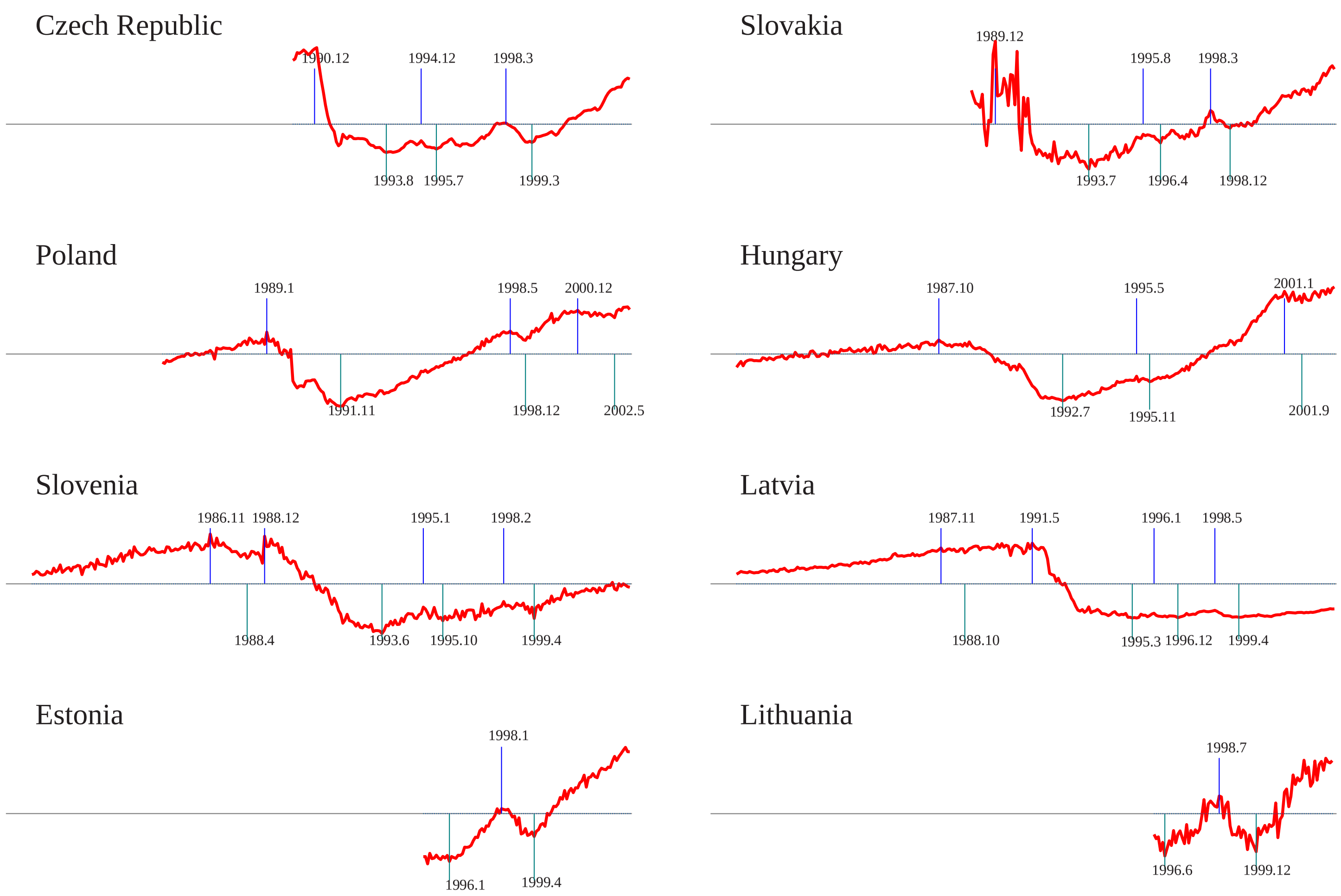

Figure 2: Industrial Production classical cycle turning points.

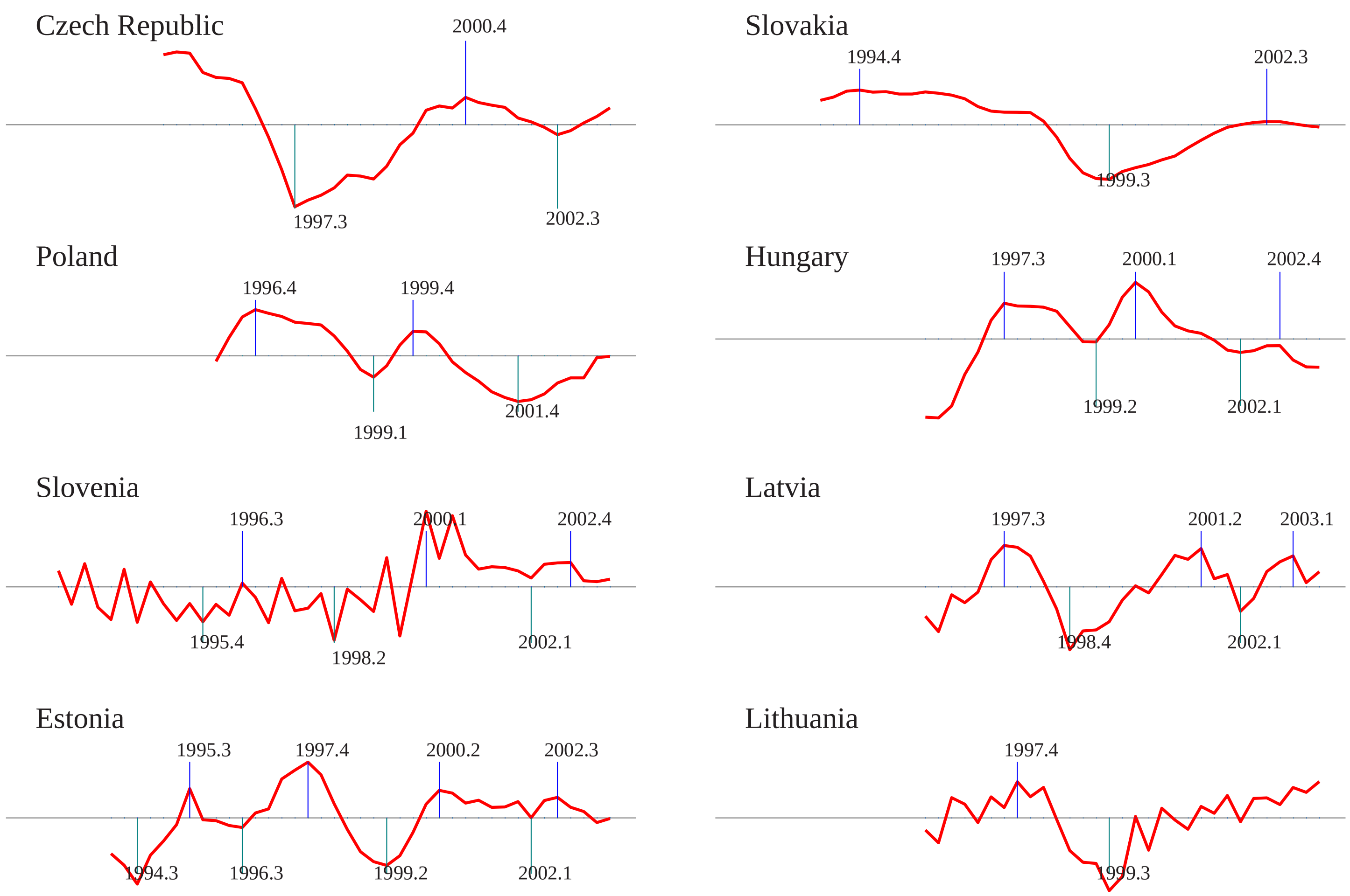

Figure 3: Quarterly seasonally adjusted GDP: growth rate cycle turning points.

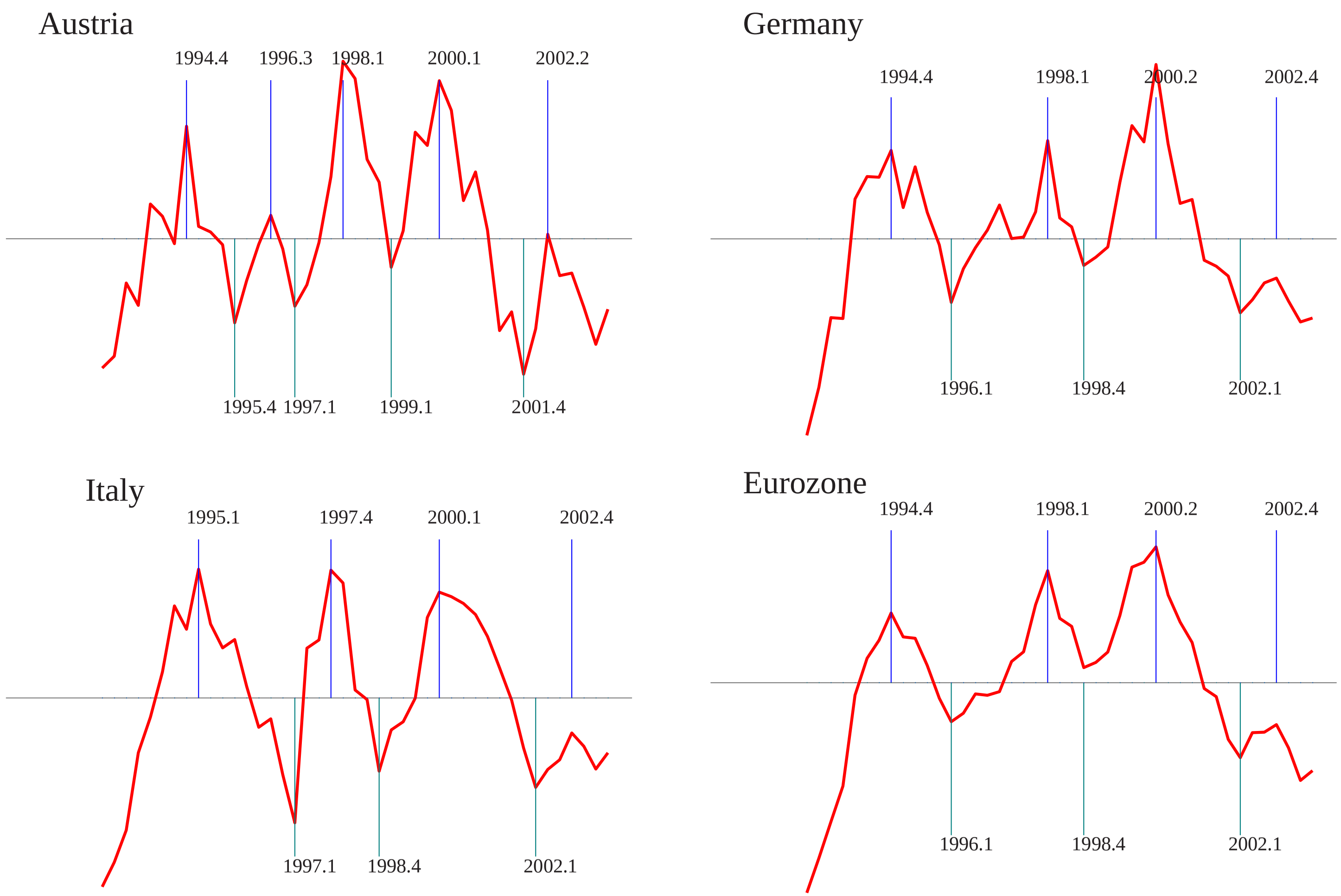

Figure 4: Quarterly seasonally adjusted GDP: growth rate cycle turning points.

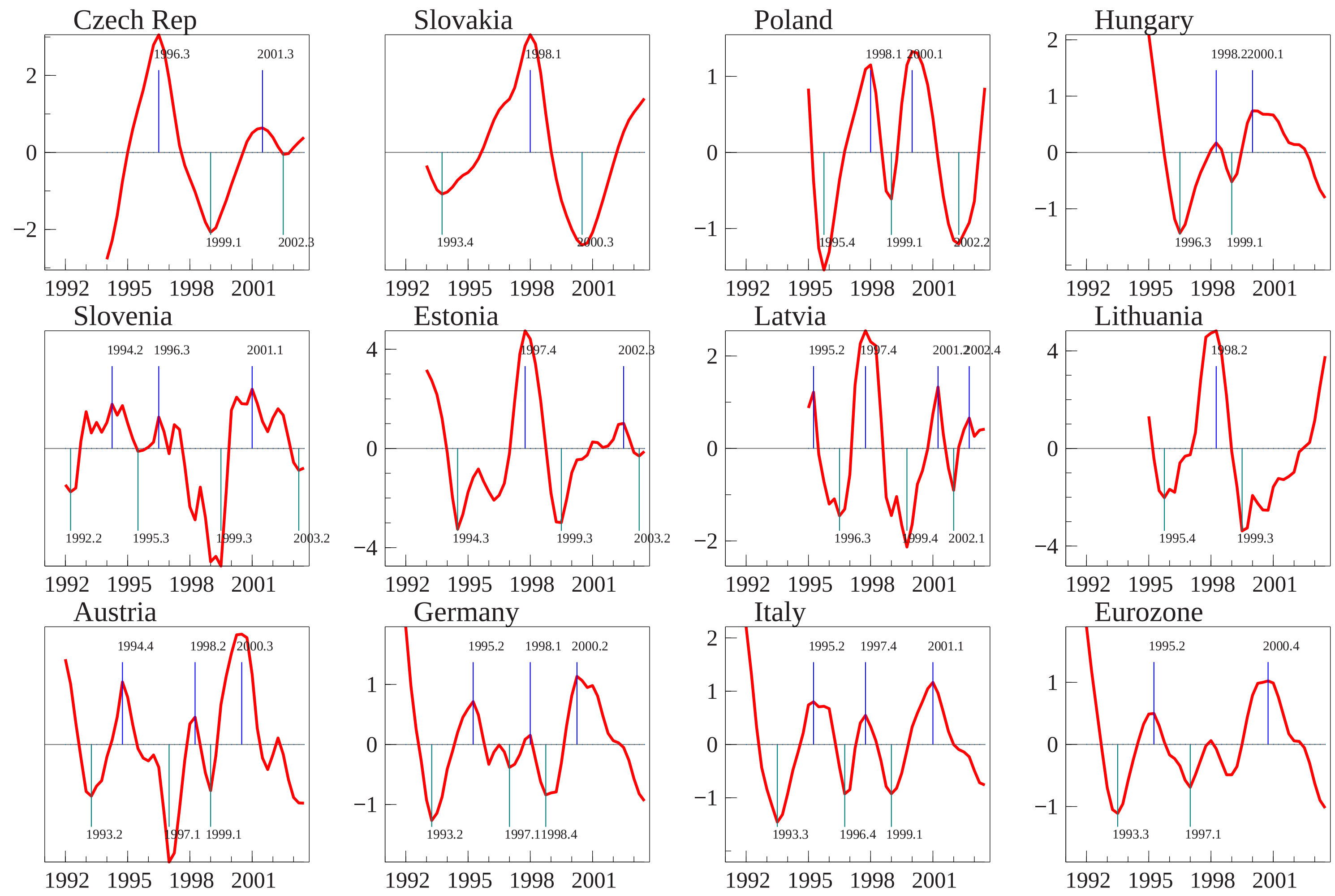

Figure 5: Quarterly seasonally adjusted GDP: HP Bandpass Deviation cycles.

Table 2: Data availability for accession countries

Country	GDP (quarterly)		IPI (monthly)	
	Start	End	Start	End
Czech Republic (CZE)	1994.q1	2003.q3	1990.m01	2003.m12
Slovak Republic (SVK)	1993.q1	2003.q3	1989.m01	2003.m12
Poland (POL)	1995.q1	2003.q3	1985.m01	2003.m12
Hungary (HUN)	1995.q1	2003.q3	1980.m01	2003.m12
Slovenia (SVN)	1992.q1	2003.q3	1980.m01	2003.m12
Estonia (EST)	1993.q1	2003.q3	1995.m01	2003.m12
Latvia (LVA)	1995.q1	2003.q3	1980.m01	2003.m12
Lithuania (LTU)	1995.q1	2003.q3	1996.m01	2003.m12

Table 3: Correlation between yearly growth rates, $\Delta_4 \ln y_t$.

	CZE	SVK	POL	HUN	SVN	EST	LVA	LIT	A	D	I	EURO
CZE	1.00	0.36	-0.26	-0.57	0.12	-0.15	-0.09	-0.01	-0.31	-0.01	0.09	-0.23
SVK	0.36	1.00	0.30	-0.58	-0.45	0.04	0.25	0.63	-0.24	-0.16	0.01	-0.32
POL	-0.26	0.30	1.00	0.12	-0.35	0.22	0.05	0.02	0.46	0.46	0.28	0.44
HUN	-0.57	-0.58	0.12	1.00	0.23	0.32	0.32	-0.11	0.58	0.68	0.62	0.75
SVN	0.12	-0.45	-0.35	0.23	1.00	0.23	0.24	0.13	0.02	0.06	0.07	0.05
EST	-0.15	0.04	0.22	0.32	0.23	1.00	0.82	0.67	-0.00	-0.01	0.19	0.06
LVA	-0.09	0.25	0.05	0.32	0.24	0.82	1.00	0.68	-0.07	0.11	0.45	0.07
LTU	-0.01	0.63	0.02	-0.11	0.13	0.67	0.68	1.00	-0.27	-0.35	-0.05	-0.37
A	-0.31	-0.24	0.46	0.58	0.02	-0.00	-0.07	-0.27	1.00	0.77	0.62	0.82
D	-0.01	-0.16	0.46	0.68	0.06	-0.01	0.11	-0.35	0.77	1.00	0.80	0.94
I	0.09	0.01	0.28	0.62	0.07	0.19	0.45	-0.05	0.62	0.80	1.00	0.85
EA	-0.23	-0.32	0.44	0.75	0.05	0.06	0.07	-0.37	0.82	0.94	0.85	1.00

Table 4: Real GDP - Growth rate Cycle - Standardised Concordance Index (computed on available data points from 1993 to 2003). Values greater than 2.33 (99-th percentile of a standard normal variate) in bold.

	CZE	SVK	POL	HUN	SVN	EST	LVA	LIT	A	D	I	EURO
CZE	-	-0.31	-0.29	-1.52	-0.82	-1.06	-0.78	-1.43	-0.19	0.35	0.67	0.35
SVK	-0.31	-	-0.68	-0.57	0.67	-0.09	0.52	1.24	0.59	0.20	0.73	0.20
POL	-0.29	-0.68	-	1.47	-1.38	0.02	0.77	0.59	1.32	0.67	0.56	0.67
HUN	-1.52	-0.57	1.47	-	-1.65	2.16	2.29	1.13	2.06	**2.40**	1.79	**2.40**
SVN	-0.82	0.67	-1.38	-1.65	-	0.00	-1.11	1.13	-0.84	-1.05	-0.88	-1.05
EST	-1.06	-0.09	0.02	2.16	0.00	-	1.45	1.07	0.66	1.62	1.66	1.62
LVA	-0.78	0.52	0.77	2.29	-1.11	1.45	-	1.09	0.73	1.99	1.43	1.99
LTU	-1.43	1.24	0.59	1.13	1.13	1.07	1.09	-	-0.05	-0.10	-0.37	-0.10
A	-0.19	0.59	1.32	2.06	-0.84	0.66	0.73	-0.05	-	**3.12**	**2.84**	**3.12**
D	0.35	0.20	0.67	**2.40**	-1.05	1.62	1.99	-0.10	**3.12**	-	**3.08**	**4.13**
I	0.67	0.73	0.56	1.79	-0.88	1.66	1.43	-0.37	**2.84**	**3.08**	-	**3.08**
EA	0.35	0.20	0.67	**2.40**	-1.05	1.62	1.99	-0.10	**3.12**	**4.13**	**3.08**	-

Table 5: Correlation between HP bandpass cycles.

	CZE	SVK	POL	HUN	SVN	EST	LVA	LIT	A	D	I	EURO
CZE	1.00	0.19	-0.35	-0.38	0.37	-0.01	-0.07	-0.21	-0.30	0.16	0.28	-0.02
SVK	0.19	1.00	-0.07	-0.55	-0.38	0.48	0.49	0.83	-0.60	-0.44	-0.20	-0.51
POL	-0.35	-0.07	1.00	0.25	-0.04	0.27	0.24	0.22	0.41	0.28	0.11	0.28
HUN	-0.38	-0.55	0.25	1.00	0.25	0.00	0.21	-0.19	0.70	0.70	0.66	0.78
SVN	0.37	-0.38	-0.04	0.25	1.00	0.06	0.13	-0.26	0.11	0.30	0.18	0.14
EST	-0.01	0.48	0.27	0.00	0.06	1.00	0.83	0.74	-0.27	-0.23	-0.04	-0.22
LVA	-0.07	0.49	0.24	0.21	0.13	0.83	1.00	0.70	-0.13	0.07	0.35	0.01
LTU	-0.21	0.83	0.22	-0.19	-0.26	0.74	0.70	1.00	-0.39	-0.47	-0.25	-0.50
A	-0.30	-0.60	0.41	0.70	0.11	-0.27	-0.13	-0.39	1.00	0.77	0.64	0.84
D	0.16	-0.44	0.28	0.70	0.30	-0.23	0.07	-0.47	0.77	1.00	0.89	0.96
I	0.28	-0.20	0.11	0.66	0.18	-0.04	0.35	-0.25	0.64	0.89	1.00	0.90
EA	-0.02	-0.51	0.28	0.78	0.14	-0.22	0.01	-0.50	0.84	0.96	0.90	1.00

Table 6: Gross Domestic Product - HP bandpass deviation cycles: Standardised Concordance Index. Values greater than 2.33 (99-th percentile of a standard normal variate) in bold.

	CZE	SVK	POL	HUN	SVN	EST	LVA	LIT	A	D	I	EURO
CZE	-	0.19	0.09	-1.11	**2.50**	-0.01	-0.31	-0.32	0.18	0.34	1.10	-0.19
SVK	0.19	-	0.57	-0.81	-0.95	1.45	0.91	1.31	-1.52	-0.93	-0.35	-1.51
POL	0.09	0.57	-	1.96	0.42	-0.67	-0.12	1.40	1.19	0.94	0.39	-0.34
HUN	-1.11	-0.81	1.96	-	-1.16	-0.12	0.84	0.05	**2.82**	**2.69**	2.21	2.00
SVN	**2.50**	-0.95	0.42	-1.16	-	0.05	-0.26	1.20	0.15	-0.47	0.21	-0.72
EST	-0.01	1.45	-0.67	-0.12	0.05	-	2.22	1.19	-0.99	-0.81	0.65	-0.92
LVA	-0.31	0.91	-0.12	0.84	-0.26	2.22	-	1.23	0.54	0.83	**2.40**	0.65
LTU	-0.32	1.31	1.40	0.05	1.20	1.19	1.23	-	0.47	-1.11	-0.22	-1.31
A	0.18	-1.52	1.19	**2.82**	0.15	-0.99	0.54	0.47	-	**3.80**	**3.15**	**3.35**
D	0.34	-0.93	0.94	**2.69**	-0.47	-0.81	0.83	-1.11	**3.80**	-	**3.37**	**3.50**
I	1.10	-0.35	0.39	2.21	0.21	0.65	**2.40**	-0.22	**3.15**	**3.37**	-	**3.28**
EA	-0.19	-1.51	-0.34	2.00	-0.72	-0.92	0.65	-1.31	**3.35**	**3.50**	**3.28**	-