Convergence between the business cycles of Central and Eastern European countries and the Euro area

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Abstract

Although entry to the Euro area (EA) is based only on fulfilment of the Maastricht criteria, implementation of optimum currency criteria and real economic convergence determines the benefits and costs of monetary integration. This paper focuses on the synchronization of business cycles among Central and Eastern European countries (CEECs) and the EA. Business cycles are extracted from GDP data series using a double Hodrick–Prescott filter method. The degree of co-movement of cycles is evaluated on the basis of various methods of rolling correlation. Results show that there is no common CEE business cycle, although a synchronization trend is evident. Similarly, there is a strong trend of convergence of CEEC national business cycles toward that of the EA.

Keywords: Business cycles, Central and Eastern European countries, Monetary integration, Euro area
JEL classification: F33, F44

1. Introduction

While EU officials emphasize respect for the Maastricht criteria for entry to European monetary union, researchers have focused on the criteria of an optimal currency area (OCA). OCA theory states that countries are more suited to belonging to a monetary union when they meet certain criteria related to real economic convergence: a high degree of external openness, mobility of factors of production, and diversification of production structures. A strong degree of business-cycle synchronization across monetary union members reduces the cost of giving up an independent exchange rate and monetary policy, especially when alternative adjustment mechanisms are unable to absorb the impact of (temporary) asymmetrical shocks across countries because of price and wage rigidities and insufficient labour mobility.

Business-cycle synchronization in currency unions is very significant from a policy perspective. In the context of a single currency and common monetary policies in the Euro area, the resemblance of the business cycles of participant countries is a major concern (Koopman and Azevedo, 2008). If synchronization of business cycles in the union is high, the critique that a common monetary policy may not be equally good for all countries or regions in the union ("one size does not fit all") can be dismissed. However, if the business cycles of member countries are desynchronized, a common monetary policy may have a different effect in the

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various economies. This could raise tensions among member states and endanger the union. Business-cycle synchronization results from common external shocks and similar transmission of country-specific shocks through various macroeconomic channels such as international trade in goods and financial assets. Although international trade in goods is usually thought of as fostering business-cycle synchronization, its overall effects remain theoretically ambiguous. On the demand side, higher aggregate demand in one country will partially fall on imported goods, thereby raising the output and income of trading partners and inducing output co-movements across countries (Wälti, 2011). On the supply side, however, there are two opposing effects. According to the "optimistic view", economic and monetary integration will stimulate intra-industrial trade relations, which in turn will lead to better business-cycle synchronization (Jeffrey A. Frankel and Andrew K. Rose, 1997, 1998).

On the other hand, trade integration may lead economies to specialize in production of goods for which they have a comparative advantage, hence reducing co-movements. Furthermore, Paul R. Krugman (2003) argues that integration could lead to regional concentration of industrial activities, mainly because of economies of scale and scope. Because of this concentration, sector-specific shocks may become region-specific shocks, thereby increasing the likelihood of asymmetric shocks and diverging business cycles.

Regardless previous considerations, Ayhan Kose, Christopher Otrok, and Eswar Prasad (2012) conclude that the increase in trade and financial linkages among industrial countries and among EMEs [emerging market economies] has been associated with the emergence of group-specific cycles. Empirical studies of business-cycle synchronization in the Euro area (EA) mainly confirm the optimistic view, although the evidence so far has not been conclusive. While Michael J. Artis and Wenda Zhang (1997) find that involvement in the European Exchange Rate Mechanism (ERM) has promoted convergence between participating countries' business cycles, Robert Inklaar and Jakob de Haan (2001) challenge this finding. Michael Massmann and James Mitchell (2004) present evidence that the EA has been converging since the early 1990s. Several authors find the effect of currency unions on business-cycle synchronization to be positive (following Rose and Engel, 2002), although Marianne Baxter and Michael A. Kouparitsas (2005) challenge this. Maximo Camacho et al. (2006) and Artis (2003, 2005) conclude that European business cycles show signs of failing to hold together. Christian Gayer (2007) finds that the mean level of synchronization of national cycles within the currency union since 1999 is generally high, though not higher than in the first half of the 1990s. Periklis Gogas and George Kothroulas (2009) provide evidence that synchronization of cycles has weakened since adoption of the euro. On the other hand, Lourdes Montoya and Jakob de Haan (2008) conclude that, on average, synchronization has increased since the single currency was introduced.

Although empirical findings of the impact of a common currency on business cycles and economic shocks in the EA do not agree, there is certainly no serious evidence of business-cycle desynchronization. We can therefore conclude that Krugman's pessimistic scenario has not as yet been realized in the EA.

However, there is another possible threat to the "euro cycle": future EA enlargement. New member states (NMS) of the EU, while generally willing in any case, are obliged to adopt the euro as soon as they meet the Maastricht convergence criteria, and five of them (Slovenia,

Malta, Cyprus, Slovakia and Estonia) have already become members of the EA. Altogether, there are eight candidates for future enlargement of the EA (Poland, Hungary, the Czech Republic, Latvia, Lithuania, Romania, Bulgaria and Sweden), while Denmark and the United Kingdom have negotiated an 'opt-out' clause that allows them to remain outside the Euro area. This enlargement may result in serious economic divergences in the European monetary union (EMU) and may be the main obstacle to a smooth common monetary policy in the future.

Thus, this paper tests three hypotheses relevant to the topic. The main hypothesis is that there are considerable cyclical co-movements of gross domestic product (GDP) between CEE10 and EA countries. In addition, the paper tests the hypotheses that business cycles of CEE10 and EA countries are becoming increasingly correlated and that a common CEE regional business cycle exists.

The remainder of this paper is organized as follows. Section 2 reviews previous studies on the business-cycle and economic-shock synchronization of CEECs and EA member states. Section 3 summarizes the data and methodology, while section 4 presents the results. Finally, section 5 concludes.

2. Overview of the literature

Numerous economic studies concern the synchronization both of business cycles and of economic shocks between "new" and "old" EU member states. The results often differ widely and depend both on the methodologies and on the data used. According to Marco Weimann (2003), "one cannot judge the CEECs as worse accession candidates than present EMU members". On the other hand, Helge Berger (2004) finds that business cycles are far from being synchronized between Western and Eastern countries, mainly because the demand side represents the greatest obstacle to closer business-cycle synchronization with the EA. Hungary, Poland, and Slovenia are CEECs that have achieved a high degree of synchronization with the EMU for GDP, industrial production, and exports, but not for consumption and services (Zsolt Darvas and Gyorgy Szapary, 2004). Fabrizio Carmignani (2005) concludes that, apart from Hungary and Poland, European emerging market economies are poorly synchronized with the EA. Jarko Firdnuc and Iikka Korhonen (2006) find that supply shocks in some CEECs such as Hungary, Estonia, and Slovenia are highly correlated with EA shocks, but not in other CEECs. Michael Frenkel and Cristiane Nickel (2005) show that the Czech Republic, Estonia, and Hungary have relatively strong economic links with major eurozone countries, although "the CEECs as a group exhibit still considerably different disturbances and adjustment paths in comparison with the eurozone countries". Obvious heterogeneity among CEECs concerning cycle and shock convergence with the EA is also illustrated by Sandra Eickmeier and Jorg Breitung (2005). Poland, Slovenia, Hungary, and Estonia are "more suitable EMU candidates" than other CEECs. According to Iulia Traistaru (2004), bilateral correlations of business cycles between EA countries and NMS are still low. Josef C. Brada, Ali M. Kutan, and Su Zhou (2005) state that "cointegration for the transition economies was comparable for M2 (base money) and prices, but not for monetary policy and industrial output".

An interesting way to summarize the findings of this large body of literature is given by Firdnuc and Korhonen (2006) in "Meta-analysis of the business cycle correlation between

the Euro area and the CEECs", in which they review 35 studies related to this topic. They find that CEECs have a comparably high correlation with the EA business cycle, while the highest average estimates of business-cycle correlation with the EA are reported for Hungary, followed by Slovenia and Poland. Furthermore, Hungary is more highly correlated with the EA compared to countries such as Greece, Ireland, or Portugal. Then follows a group of countries that exhibit a lower degree of correlation with the EA: the Czech Republic, Estonia, and Latvia. Finally, Slovakia has a positive but small correlation index, and Lithuania exhibits negative correlation with the EA. As indicated by the authors, this study shows that, overall, "the available estimates of business cycle correlation provide a fairly consistent ranking of the CEECs".

3. Data and methodology

As in the majority of papers on business-cycle synchronization, this paper examines correlations of a time series of indicator of aggregated output across countries. Real GDP, industrial production, or a similar indicator can be used as a measure of aggregate output. Alternatively, survey data may be used for the same purpose. Data on industrial production are available at a relatively high frequency, but do not represent the whole economy, given the significant decline in the role of manufacturing. Consequently, it is usually agreed that GDP is a more appropriate variable. Quarterly GDP is typically thought of as being the most appropriate for identifying the business cycle. This paper uses quarterly, seasonally adjusted real GDP data series for the period 1995–2012, obtained from the Eurostat National Accounts database. The choice of starting date (1995Q1) has several motivations. First, pre-transition data are not meaningful for business-cycle analysis, since the economic system was completely different. Second, the methodology of GDP measurement was also remarkably different in the pre-transition period. Third, for some countries no comparable data seem to be available before 1995, hence the analysis is conducted on a post-1995 sample.

In statistical terms the data series of GDP can be considered a combination of four components: a long-run trend, business cycles, seasonal fluctuations, and short-run shocks to the economy, which can all be isolated using statistical techniques.

The objective of this paper is to decompose the real GDP of CEECs into the above-mentioned components and to compare them with the EA business cycles, extracted in the same way. Several methods have been proposed in the literature for separating the trend from the other components of an economic time series. The most popular is the Hodrick–Prescott (HP) technique; others include the Rotemberg method and the Baxter–King filter.

The HP filter is widely used among macroeconomists to obtain a smooth estimate of the long-term trend component of a series. The filter is two-sided and linear and computes the smoothed series s of y by minimizing the variance of y around s. The penalty parameter λ controls the smoothness of the series. The larger the value of λ, the smoother the series. For quarterly data, a value of $\lambda = 1600$ is recommended.

Unlike in most of the literature, the HP filter is applied twice in the present study. This deviation from the "standard" procedure seems to be more appropriate because it allows a distinction of business cycles and irregular economic shocks, which are quite common in a transi-

tion period. Economic shocks in transition are often the result of domestic economic policy changes and should not be compared with economic shocks in developed economies. Thus, this modified methodology is expected to reveal a statistically stronger correlation between CEEC and EA business cycles than most previous studies.

First, the HP filter is applied to the original series of real GDP (in natural log - Y_t) to extract the trend (T_t) component. By subtracting the trend from the original series (Y_t), we obtain a new series (Z_t) that contains cyclical and irregular components.

In most of the literature, the business cycle is obtained in this way, by filtering out the time-varying trend from macroeconomic time series on output. However, the series Z_t clearly consists not only of business cycles but also of irregular economic shocks. For this reason, another step is necessary to isolate business cycles. In the second stage, the HP filter is applied to Z_t to extract oscillations around the smooth component that represents Cycle − C_t. The difference between Z_t and C_t is the Irregular − shock component (I_t).

After isolation, national business cycles have to be compared in terms of their co-movements. The coefficient of correlation between business cycles is a well-known tool for estimating the degree of synchronization of business cycles and shocks.

The evolution of synchronization over time can be studied by computing such correlation coefficients over different sub-samples of the data or by using rolling correlation coefficients. The choice of sub-sample is largely arbitrary, and different sub-samples of the same data can yield different conclusions. Rolling correlation coefficients avoid the need for defining arbitrary sub-periods (Wälti, 2009). In this paper, correlation coefficients are computed over a series of rolling windows (rolling correlation), providing a continuous track of developments over time and allowing for an assessment of the robustness of coefficients to the time span.

There are three types of rolling correlations: pure rolling correlations, recursive rolling correlations and reverse recursive rolling correlations. Pure rolling correlation is the first way to date potential changes in co-movements, with a fixed number of quarters in a "rolling window". In this paper, a rolling window covers 20 quarters (5 years), which can be considered reasonable in terms of "cycle" length and statistically appropriate.

The recursive rolling correlation holds the starting date as fixed (i.e. 1995Q1 in this case), and the window size grows as the ending date is advanced. The first correlation is based on the first 20 quarters (i.e. 1995Q1-1999Q4), the second correlation on the 21 first quarters (i.e. 1995Q1-2000Q1) and so on, finishing with a correlation based on all 72 quarters (from 1995Q1 to 2012Q4). This method of analysis shows how each new quarter affects the coefficient correlation.

The "reverse recursive method" holds the ending year as fixed (i.e. 2012Q4 in this case), and the window size shrinks as the starting date is advanced. The first correlation is based on all 72 quarters (i.e. 1995Q1-2012Q4), the second correlation on 71 quarters excluding the first one (i.e. 1995Q2-2012Q4) and so on. We stop the reverse recursive correlations at 2008Q1 as a starting quarter, which corresponds to a correlation based on the five last observed years (20 quarters).

An increase in the correlation coefficient over time is almost always interpreted as evidence of higher business-cycle synchronization. However, few studies actually test whether this increase is statistically significant, which this paper attempts to do.

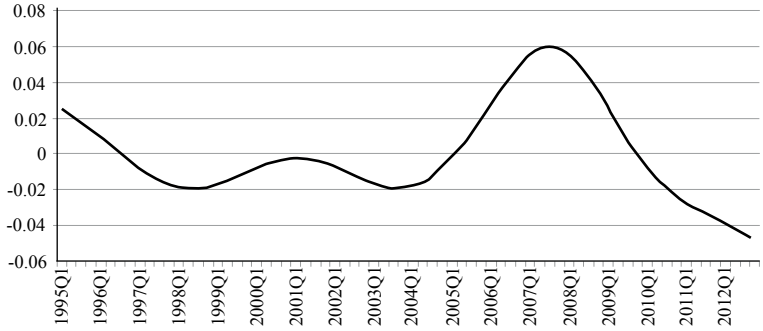
4. Results

Figure 1 displays the business cycle of the EA16 group of countries from 1995Q1 to 2012Q4 (i.e. four years before and 12 years after creation of Economic and Monetary Union). The previously explained difference in the methodology of business-cycle isolation is evident here. Panel a represents the result of a "typical" approach in cycle-isolation methodology (one HP filter applied), while Panel b shows the business cycle obtained by the modified procedure (double HP filter applied).

Figure 1: EA16 business cycle, 1995-2012

Panel a

Panel b



Source: author's calculations

Three descending trajectories, i.e. recession phases in the EA16, can be seen in Figure 1 (Panel b). The first is during the mid 1990s; the second occurs at the beginning of this century, after the burst of the "dot-com bubble"; and the third denotes the current global recession since 2008.

Before we turn to estimating CEEC and EA16 business-cycle synchronization, we should investigate whether it is possible to define a common CEEC business cycle. Table 1 presents the correlation matrix of national business cycles in the region for the period 1995Q1–2012Q4, with high correlation values (above 0.80) emphasized.

Table 1: Correlation matrix for the business cycles of CEECs, 1995Q1–2012Q4

		Bulgaria	Czech R.	Estonia	Latvia	Lithuania	Hungary	Poland	Romania	Slovenia	Slovakia
Bulgaria	Pearson Corr.	1									
	Sig. (2-tailed)										
Czech R.	Pearson Corr.	.734	1								
	Sig. (2-tailed)	.000									
Estonia	Pearson Corr.	.458	.615	1							
	Sig. (2-tailed)	.000	.000								
Latvia	Pearson Corr.	.799	.736	**.800**	1						
	Sig. (2-tailed)	.000	.000	.000							
Lithuania	Pearson Corr.	.616	.562	**.917**	**.852**	1					
	Sig. (2-tailed)	.000	.000	.000	.000						
Hungary	Pearson Corr.	-.093	.347	.153	-.074	-.200	1				
	Sig. (2-tailed)	.464	.003	.198	.539	.092					
Poland	Pearson Corr.	.564	.573	.484	**.874**	.707	-.434	1			
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000				
Romania	Pearson Corr.	.935	.866	**.804**	**.961**	**.946**	.154	**.832**	1		
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.274	.000			
Slovenia	Pearson Corr.	.701	**.955**	.654	**.867**	.666	.180	.741	**.931**	1	
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.131	.000	.000		
Slovakia	Pearson Corr.	.687	**.962**	.726	.759	.683	.238	.562	**.876**	**.927**	1
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.044	.000	.000	.000	

Source: author's calculations

The matrix shows the heterogeneity of national business cycles in the CEE region, implying that a common cycle for the whole region does not exist. This result is not surprising and was obtained in every previous similar study. Only 19 of 45 country pairs have business-cycle correlations above 0.80. However, high business-cycle synchronization is evident in the case of the Baltic countries (Lithuania, Latvia, and Estonia) and three Central European countries (Slovenia, Slovakia, and the Czech Republic). This clearly suggests that geographical proximity, as well as historical factors play an important role in the economic integration of countries. The Czech Republic and Slovakia were Czechoslovakia until 1993, and still remained highly economically integrated even after dissolution. The Baltic countries, apart from vicinity, were all oriented to the Russian market, at least at the beginning of the transition. Also, all countries mentioned are small economies that are naturally more open and more integrated in the world market, and thus share the same economic developments with their trade partners. When the correlation matrix is computed for the shorter, recent period (2000Q1–2012Q4), results reveal better mutual synchronization of CEEC business cycles, but still far from a common cycle. This time, 25 of 45 country pairs display business-cycle correlations above 0.80. Consequently, synchronization with the business cycle of the EA16 should be computed on the national, rather than the regional, level.

The level of synchronization of CEEC business cycles with the EA16 business cycle can be evaluated based on the results presented in Table 2, which presents the correlation coefficient

of national CEECs and EA16 business cycles. Slovenia and Slovakia are included in the analysis although they are members of the EA (since 2007 and 2009, respectively). The first column of Table 2 shows the correlation coefficients of CEEC national business cycles and the EA16 business cycle for the entire period observed (1995Q1–2012Q4). Only two countries display a high positive correlation of business cycle with the EA: the Czech Republic and Slovenia. Correlations are positive and large (above 0.6) for Bulgaria, Hungary, Latvia, Estonia, Romania and Slovakia; and they are positive and moderate (above 0.4) for Poland and Lithuania.

Table 2: Correlation of CEEC national business cycles and the EA12 business cycle

	1995Q1-2012Q4 (1)	Sig.	Before EU entry* (2)	Sig.	After EU entry* (3)	Sig.	difference (4)=(3)-(2)
Bulgaria	0.671	0.000	0.306	0.113	**0.893**	0.000	0.587
Czech R.	**0.827**	0.000	0.356	0.033	**0.875**	0.000	0.519
Estonia	0.632	0.000	-0.494	0.002	**0.931**	0.000	1.425
Latvia	0.718	0.000	-0.183	0.283	**0.920**	0.000	1.103
Lithuania	0.436	0.000	-0.634	0.000	**0.960**	0.000	1.594
Hungary	0.607	0.000	0.500	0.002	0.724	0.000	0.224
Poland	0.414	0.000	-0.248	0.144	0.696	0.000	0.944
Romania	0.784	0.000	0.483	0.000	**0.983**	0.000	0.500
Slovenia	**0.822**	0.000	0.132	0.440	**0.888**	0.000	0.756
Slovakia	0.748	0.000	0.056	0.742	**0.891**	0.000	0.835

* Five CE and the three Baltic countries entered the EU in 2004, while Romania and Bulgaria entered in 2007. **Source:** author's calculations

Assuming that transition brought closer economic relations for CEECs with the EU and that EU accession had further positive effects on economic integration, it is useful to divide the whole period observed into two categories: pre and post EU entry. Correlation coefficients for these two periods are given in columns 2 and 3 of Table 2. A comparison reveals an important feature of business-cycle synchronization development: co-movement of business cycles increases significantly over time. Before EU accession, four out of ten countries even have negative correlation coefficients, and the rest are positive, but low correlations (less then 0.5). Values differ for the period after EU accession. In the post-entry period, all CEECs display positive coefficients of business-cycle correlation with the EA16, with eight highly positive correlations (Czech Republic, Estonia, Latvia, Lithuania, Romania, Slovenia, Slovakia, and Bulgaria), and a moderately positive correlation in the case of Poland and Hungary. All observed correlation coefficients for this period are statistically significant. Regarding improvements, all countries achieved impressive convergence toward the EA business cycle (column 4 of Table 2). Using the Fisher *r*-to-*z* transformation, a value of *z* is calculated and applied to assess the significance of the difference between two correlation coefficients. All differences in correlation coefficients between two sub-periods are statistically very significant.

The general trend toward larger business-cycle synchronization of CEECs with the EA16 can be analysed in more detail using the "rolling correlations" method. Pure rolling and reverse recursive methods are used.

All ten CEE countries show positive and large coefficients (above 0.90) for the last "rolling window" of reverse recursive correlation (from 2008Q1 to 2012Q4). Also, all countries show a positive difference between correlation coefficients for the last and the first "rolling windows" (2008Q1–2012Q4 vs.1995Q1–2012Q4), implying growing synchronisation of business cycles over time.

Table 3 presents the parameters of linear trend-line equations of pure rolling correlation coefficients in the whole of the period observed, while Table 4 presents the parameters of linear trend-line equations of reverse recursive correlation coefficients. Nine out of ten countries show a strong trend to business-cycle convergence to the euro cycle throughout the period observed (the Czech Republic, Estonia, Latvia, Lithuania, Slovenia, Slovakia, Poland, Romania, and Bulgaria). For these countries, the linear trend model for pure rolling correlations fits the data well (values of R^2 are above 0.50). F-statistics are extremely significant, too, indicating that a positive trend of correlation coefficients of business cycles exists.

Table 3: Trend-line parameters of pure rolling correlation coefficients

	Constant		Time variable		Model		
	β	Sig.	β	Sig.	R square	F-stat.	Sig.
Bulgaria	0.083	0.217	0.018	0.000	0.584	71.460	0.000
Czech R.	-0.133	0.285	0.025	0.000	0.531	38.671	0.000
Estonia	-0.854	0.000	0.045	0.000	0.785	186.520	0.000
Latvia	-0.403	0.000	0.035	0.000	0.721	131.962	0.000
Lithuania	-0.834	0.000	0.046	0.000	0.731	142.384	0.000
Hungary	0.011	0.937	0.010	0.059	0.091	5.075	0.059
Poland	-0.056	0.574	0.022	0.000	0.502	48.768	0.000
Romania	-0.281	0.039	0.032	0.000	0.547	59.168	0.000
Slovenia	-0.623	0.000	0.038	0.000	0.663	100.336	0.000
Slovakia	-0.594	0.000	0.035	0.000	0.680	112.442	0.000

Source: author's calculations

Table 4: Trend-line parameters of reverse recursive correlation coefficients

	Constant		Time variable		Model		
	β	Sig.	β	Sig.	R square	F-stat.	Sig.
Bulgaria	0.646	0.000	0.005	0.000	0.856	254.724	0.000
Czech R.	0.842	0.000	0.001	0.000	0.675	106.142	0.000
Estonia	0.751	0.000	0.004	0.000	0.697	117.550	0.000
Latvia	0.751	0.000	0.005	0.000	0.951	980.846	0.000
Lithuania	0.612	0.000	0.009	0.000	0.771	171.297	0.000
Hungary	0.464	0.000	0.009	0.000	0.457	159.283	0.000
Poland	0.401	0.000	0.010	0.000	0.940	792.312	0.000
Romania	0.856	0.000	0.003	0.000	0.931	420.457	0.000
Slovenia	0.835	0.000	0.002	0.000	0.812	220.475	0.000
Slovakia	0.769	0.000	0.003	0.000	0.870	340.495	0.000

Source: author's calculations

For Hungary, correlation coefficients started to increase recently, whereas they were almost constant before EU accession. Consequently, the linear trend line does not fit the data well (R^2 equals only 0.091 in the case of pure rolling correlation, and 0.457 in case of reverse recursive correlation).

5. Conclusions

Although CEEC membership in the Euro area is based on prior fulfilment of the Maastricht criteria, economists instead investigate the level of real economic convergence and integration between CEECs and the EA, i.e. fulfilment of the optimum currency area criteria. In this respect, synchronization of business cycles is important for countries wishing to realize monetary integration. Co-movements of economic activity between member states prevent the emergence of national-specific shocks which makes a common monetary policy inappropriate for unified countries. Thus, business-cycle synchronization lowers the "vulnerability" of a monetary union. This is especially important when price and wage rigidity and low labour mobility (i.e. the low "flexibility" of a monetary union) are serious obstacles to economic adjustment mechanisms. Business-cycle synchronization is therefore an important aspect of the readiness of CEECs outside the EA to enter the monetary union.

The empirical study presented in this paper shows that there is no common business cycle in the CEE. A high degree of GDP co-movements was identified only among the Baltic countries and three Central European countries (the Czech Republic, Slovakia, and Slovenia). This is probably a result of their geographical proximity, economic smallness and historical factors that influenced their trade patterns, but this needs to be confirmed in a scientific manner in some following studies. However, data from the recent period reveals that mutual CEEC business-cycle synchronization has shown only an increase, implying that a common CEE cycle may be accomplished soon.

Heterogeneity in mutual business cycles among CEECs reflects national business-cycle synchronization with the EA. Concerning GDP movements throughout the period observed (from 1995Q1 to 2012Q4), a high positive correlation with the EA16 was found only in the case of two CEECs: Slovenia and the Czech Republic.

However, comparisons of the business cycles of CEECs and the EA for the whole period observed (1995-2012), and making conclusions based only on these, have serious limitations and can be misleading. This period covers dramatic changes in the economic structures of CEECs because of the transition to a market economy as well as the rapid and significant redirection of trade and financial flows toward the EU. The last decade of the 20th century was a time of significant political and economical turmoil and changes throughout the CEE region. Significant economic restructuring and foreign trade redirection of CEECs during transition are expected to have serious effects on business-cycle convergence toward the EA cycle. Indeed, when the correlation coefficients are computed separately for the periods before and after EU accession, findings reveal that every CEEC has achieved business-cycle convergence toward the EA16 cycle, and the results are impressive for all countries.

Correlation after EU accession is highly positive (above 0.80) for eight countries (the Czech Republic, Estonia, Latvia, Lithuania, Romania, Slovenia, Slovakia, and Bulgaria), and mod-

erately positive for Poland, and Hungary. Thus, the hypothesis that the business cycles of CEE10 and EA16 countries are becoming increasingly correlated can be confirmed.

This paper also analysed in a more detailed manner the general trend toward larger business-cycle synchronization between CEECs and the EA16, using the "rolling correlations" method, which can help to date changes in correlation coefficients more precisely. Results confirm the previous observation that every CEEC experienced a positive trend toward more synchronized business cycles with the EA. While this trend is clear throughout the period observed for most countries, the correlations for Hungary started to increase only recently (after 2003).

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