Full Length Research Paper

The management of euro enlargement: Estimates for the degree of synchronization of the business cycles among European Union countries

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The objective of this study is to estimate the degree of synchronization of the business cycles for seven of the European Union (EU) new member countries with that of the Euro area and to assess the differences from the five most important economies in European Union (EU), respectively, its four peripheral economies. The more synchronized the business cycles are, the lower the costs for extending the Euro area will be, as the occurrence potential of asymmetric shocks will become lower, and it will be much more difficult to eliminate it without a proper monetary policy. The business cycles have been deduced based on four technical filters and on a composite method which allowed the identification of the first principal component. The obtained results outline the growth path of the new member countries' cyclic correlation with the Euro area during the period 2005 to 2011, if compared to the period 1998 to 2004, along with the increase of the degree of financial and commercial integration with the economies which use euro as their currency. Among the ECE economies, Hungary, the Czech Republic, Slovakia and Slovenia are strongly correlated with the Euro area, their level being comparable with the one recorded by most of the peripheral economies, except Greece. Bulgaria, Romania and Poland which are less correlated with the Euro area, so that the accession to the Euro area will be more expensive for them.

Key words: Principal component, business cycle, Pearson correlation, euro area, rolling-window correlation.

INTRODUCTION

The subject treated within this study refers to one of the most important criteria of an optimum currency area, namely to the synchronization between the business cycles of the economies which adopted a common currency. The main idea is that when the occurrence of the shocks of demand and offer, respectively the speed of adjustment, are similar in the partner countries, the independence need of the monetary policy decreases, and the benefits of the single currency will get increased. The economies of which response to the shocks of the demand or of the offer are similar can achieve a monetary union, the result of which will be net benefits. The countries exposed to symmetric shocks have the tendency to have more synchronized business cycles, and, consequently, they will have similar economic policies. Generally, the growth of the commercial and financial integration with the Euro area will result in the increase of the correlation with its business cycle, while the development of divergent macroeconomic and structural policies will contribute to the decrease of synchronization between the business cycles. Consequently, the lower the nation business cycle's synchronization with the one from the Euro area is, the higher the costs for giving up their own currency will be.

The analysis made for the business cycles' correlation within the Euro area becomes relevant in terms of the economic and structural differences existing between the monetary union member countries and in the case of

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those which will access it. Actually, the advanced economies which are quite close from a geographical point of view have the tendency to have a synchronized business cycle, while the less advanced and peripheral economies are less correlated with the union’s nucleus. As a result, a union consisting of heterogeneous economies is liable to encounter asymmetric shocks and to a convergence with two speeds of the business cycles. Under these terms, the Central and East European countries’ opportunity to access the Euro area should be explained in terms of the synchronization of their business cycles with the economies constituting the nucleus of the Euro area (Darvas and Szapáry, 2005; Fidrmuc and Korhonen, 2006).

The paper is structured in three main parts. The first part includes a synthesis of the results obtained in the economic literature which have made analyses of the techniques for estimating the business cycles and the factors influencing their synchronization, especially the case of the Euro area. In the second part, we have used four econometric filters (Hodrick-Prescott, Band Pass, Beveridge-Nelson, Quadratic trend) in order to extract the business cycles of the 16 EU economies and that of the Euro area. In order to harmonize the results which are partially divergent, we have used the method of the principal components and, based on it, we have identified the first component of the business cycle (PC1). In the third part, we have used the Pearson and Spearman correlation coefficients in order to determine the synchronization between the business cycles. The analysis has been made both for the entire period 1998 to 2011, and also for sub-periods, also applying the correlation based on the mobile average.

LITERATURE REVIEW

Here, we have described the main results obtained within the economic literature, especially following two directions: the first one refers to the studies researching the way in which the business cycles are identified, and the second one is concerned with the estimates regarding the correlation between the business cycles. Generally, there are at least two reasons for which contradictory results occur for the measurements made for the degree of synchronization of the business cycles within the European monetary union. The first one refers to the methodology used to extract the cyclic component. For example, Inklaar and Haan (2001); Dickerson et al. (1998) used the Hodrick-Prescott filter, while Artis and Zhang (1997) used, besides this filter, the filter for the linear trend and the one proposed by OECD. Most of the methods for extracting the business cycle were used by Canova (1998) for USA. He used both univariate filters, such as the Hodrick-Prescott filter, the Beveridge Nelson decomposition, the linear trend, the segmented trend, the first difference, the unobserved components model, and also multivariate techniques, such as co-integration, the common linear trend and the multivariate frequencies.

The author’s conclusion is that the characteristics of the business cycles significantly vary depending on the quantitative and qualitative techniques which are used, but each filter extracts different types of information from the data series of the GDP. Darvas and Vadas (2005) used five univariate filters to extract the cyclic component of the GDP – the segmented deterministic trend, the HP filter, the BP filter, the Beveridge-Nelson decomposition and the wavelet transform.

The second reason concerns with the method used to measure the correlation of the business cycles. As a matter of fact, until now, there is no consensus referring to the minimum value of the correlation coefficient which should indicate a synchronization of the business cycles. The economic literature included estimates referring to the fact that the accession to the Euro area has determined intensive commercial relations, and this has positively influenced the convergence of the business cycles. The use of a common currency has a positive effect upon the intra-industry trade, even though the economic structures are not convergent. As a conclusion, the commercial specialization can intensify the degree of correlation of the business cycles if the trade-offs between countries is made with goods belonging to the same industry.

Micco et al. (2003) showed that the accession to the monetary union determined the intensification of the bilateral trade between 4 and 16%, and the macro-economic benefits were higher than the economic costs generated by losing the independence of the monetary policy. Baldwin (2006) estimated that the introduction of euro generated the costs reduction related to the businesses between countries, and this induced the intensification of the commercial and financial relations between the member economies and, consequently the increase of synchronization between the business cycles. On the other hand, Berger and Nitsch (2005) estimated that the introduction of Euro did not generate a significant statistic impact upon the trade between the member countries. Afonso and Fuceri (2007) outlined that the introduction of euro generated the increase of the degree of the cycles’ synchronization for all the Euro area countries, except Germany, while Mink et al. (2007) estimated that an obvious ascendent tendency of the correlation was not recorded. Gayer (2007) concluded that Greece, Finland, Belgium and Ireland have had business cycles uncoupled from that which characterizes the Euro area.

Most of the studies which have been made lately conclude that a higher synchronization of the business cycles has been recorded within the Euro area, especially as a consequence of the influence of the economies from the nucleus of the monetary union, such as Germany, France and Italy. Nevertheless, Gogas and Kothroulas (2009) estimated that the common monetary policy tends to destabilize the peripheral economies, as they are less correlated with the group of the biggest three countries,
which achieve 60% of the GDP of the entire Euro area. Aguiar and Soares (2009) studied the correlation between the business cycles by using the wavelet transform and they identified the existence of a convergence of the peripheral economy towards the nucleus of the Euro area, but with different speeds. Kappler (2008) calculated that, as a consequence of introducing the euro currency, the business cycles of Greece and Finland only turned aside from the reference for the Euro area.

The synchronization of the business cycles between the new member states and the Euro area is lower than in the individual countries forming the monetary union. The literature referring to the correlation between the business cycles of the new economies is influenced by the existence of short data series for them and by the variety of the methods used to extract the business cycles. The results outline the fact that there is no homogenous group of the new member states, but most of them are rather correlated with Germany than with the Euro area.

As for the correlation of the business cycles of the new member states with those of the economies in the Euro area, Boone and Maurel (1999) showed that there is a higher synchronization with Germany for the Czech Republic, Hungary and Slovak Republic. Boone and Maurel (1998) calculated the correlation coefficients from the cyclic components of the industrial output and the rate of unemployment for a series of ECE countries and Germany, estimating a high degree of correlation between them. The economies which are mostly correlated with the nucleus of the monetary union are those which have attracted foreign investments from countries belonging to the nucleus of the monetary union, which developed macroeconomic policies allowing them to stabilize inflation and to more easily reduce the economic shocks. Van de Coevering (2003) estimated that the same three central European countries recorded the fastest growth of the intra-industry trade with the Euro area, and this will increase the synchronization with its business cycle. Artis et al. (2004); Darvas and Szapary (2005) described the business cycles of the ECE countries by using the band pass filter. The first authors identified the existence of more correlated business cycles with the Euro area for Hungary and Poland. In the second study, the authors estimated that there is a high correlation between the GDP, the industrial output and the exports for Hungary, Poland, Slovenia and the Euro area. Nevertheless, as for consumption and services, a significant correlation has been recorded.

Berger and Mueller (2004) argued that the shocks related to the aggregate demand have the tendency to generate business cycles which are less correlated with the Euro area, as there are different preferences of the economic agents and divergent fiscal policies. Carmignani (2005) estimated that Hungary and Poland only have business cycles which are correlated with the Euro area to a greater extent, while in the case of the other new member states, the correlation coefficients are insignificant. Kutan and Yiigit (2004) estimated that the Baltic States can more easily access the Euro area due to the monetary arrangements they adopted, and the others should achieve fiscal discipline before deciding to give up the single currency. Trăistaru (2004) showed that there is a low bilateral correlation between the business cycles of the Euro area and of the new member states, but the insistence upon the commercial integration could improve the previous conclusion. According to a meta-analysis of the correlation of the business cycles, Fidrmuc and Korhonen (2006) concluded that Hungary, Slovenia and Poland recorded the highest values for the correlation coefficients, the first of these countries being more correlated than the peripheral economies from the Euro area. Savva and others (2007) extracted the business cycles on the basis of the industrial output and they estimated that most of the new member states doubled their correlation with the Euro area, if compared to the beginning of the 90s, and some of them changed from a negative correlation to a positive one.

METHODOLOGY

Within this study, we have used four univariate filters which decompose the real GDP noticed in a trend component with a smooth evolution in time and with a more volatile cyclic component, respectively a composite method used to harmonize the business cycles with those filters. The changes of the trend are explained as being the result of the factors influencing the aggregate offer on a long term (the capital stock, the labor offer, the total factor productivity), and the variations of the cyclic component are the effect of the short-term shocks of demand and offer. The filters used in this study are as it follows:

The Hodrick-Prescott filter (HP)

It was introduced by Hodrick and Prescott in 1997, and it supposes the decomposition of a data series in two unobserved components, respectively, the trend and the cyclic component. This statistical method is based on solving a problem referring to the minimization of a function related to the mean square deviations of the cyclic component and to the changes recorded in the trend increase rate. In their original paper, Hodrick and Prescott (1997) recommended values for the smoothing coefficient – 100 for the annual data, 1600 for the quarterly data and 14400 for the monthly data.

The band pass filter (BP)

This filter was developed in different variants by Baxter and King (1995), Woitek (1998), Christiano and Fitzgerald (2003). The band-pass (BP) filter decomposes the time series into components with periodic fluctuations, each of the components corresponding to a certain frequency/periodicity. For example, the fluctuations which repeat to a period of four quarters correspond to the seasonal component, and those with periods of 6 to 32 quarters are deemed to be fluctuations related to the economic cycle.

The Beveridge-Nelson decomposition (BN)

Beveridge and Nelson (1981) demonstrated that an ARIMA type
The square trend filter (QT)

This method can be used in case the GDP increase rate records increases and decreases, and thus the trend will record minimum/maximum points. The trend can be described as a square polynomial function. The GDP will be described as a sum between the two components — the trend and the business cycle.

The principal components analysis (PCA)

The objective of this composite method is to extract the common factors encountered in the business cycles extracted on the basis of the four previous methods. The method of the principal components analysis (PCA) transforms k explanatory variables between which there is a high correlation into k new variables between which there is no correlation. The number of the variables will get decreased, keeping the components which explain, to a large extent, the variation of the initial data. They constitute independent linear combinations of the previous variables. The importance of each principal component is explained according to the capacity to explain a certain part of the total variation of the initial data series. Thus, PC1 represents the component which catches, to the greatest extent, the variation of the business cycles determined by means of the 4 methods. Similarly, PC2 will be the component which includes the greatest part of the remaining variation. According to the economic literature, those components which altogether explain at least 75% of the total initial variation will be kept.

As for the case of this study, the initial explanatory variables are the data series related to the business cycles extracted by using the 4 methods (HP, BP, BN and QT) for each of the 17 entities (16 EU member states and the current monetary union with 17 members). The principal components will have the same number as the previous variables, being indicated with PC1, PC2, PC3 and PC4; they can be written as a matrix, as it follows (Equation 1):

\[
\begin{bmatrix}
PC1 & e_{11} & e_{12} & e_{13} & e_{14} \\
PC2 & e_{21} & e_{22} & e_{23} & e_{24} \\
PC3 & e_{31} & e_{32} & e_{33} & e_{34} \\
PC4 & e_{41} & e_{42} & e_{43} & e_{44}
\end{bmatrix}
\]

(1)

where, \(e_{ij}\) (i, j from 1 to 4) constitute the components of an eigenvector, of which length is equal to the unit vector and which has the orthogonality characteristic (namely, the product between the matrix of these coefficients and its transpose is equal to the 4th order identity matrix). According to Brooks (2008), the sum of the coefficients' squares for each component should be equal to 1.

From a vectorial point of view, PC1 can be calculated starting from the vector including the business cycles discovered by means of the 4 methods (BC), the vector of the coefficients (E) and that of the principal components (PC).

\[
PCEB
\]

where, PC is a linear combination of the elements belonging to the vector BC.

The vector of the initial data series BC has a matrix of variance-covariance \(\Sigma\) as it follows (Equation 2):

\[
\begin{bmatrix}
\Sigma
\end{bmatrix}
\]

where BC is symmetrical, namely, for example, \(\text{cov}(BP,HP) = \text{cov}(BP,HP)\).

The variance of the business cycles determined by means of the 4 methods actually represents the dispersion of each variable, and the covariance between two data series will be calculated as it follows:

\[
\text{Cov}(X,Y) = \sum_{k=1}^{n} (x_k - \bar{X})(y_k - \bar{Y})
\]

(3)

where \(mX, mY\) represent the mean of the two variables.

We can notice that, when \(X = Y\), the covariance changes into variance or dispersion. According to the definition, PC1 is the component which corresponds to the highest proportion in the variance of the initial data series.

\[
PCEH(1).B
\]

where \(E(1)\) represents the vector of the coefficients corresponding to the first principal component, with the characteristic of orthogonality \(E(1).E(1)^T = I\).

Consequently, the condition of variance maximization should be laid:

\[
\text{Var}(E(1).B)\]

under the terms of \(E(1).E(1)^T = I\), according to \(E(1)\).

The function of the Lagrangian multiplier is as it follows:

\[
\min_{\text{subject to} \sum_{i=1}^{k} \lambda_i = 1}
\]

where \(\lambda(1)\) represents the Lagrange multiplier associated to the constraint of orthogonality. The condition corresponding to the maximization of the Lagrange function under constraint conditions is as it follows:

\[
\sum_{i=1}^{k} \lambda_i = 1
\]

The coefficients of the vector \(E(1)\) should satisfy four simultaneous linear equations (corresponding to the number of coefficients):

\[
\begin{bmatrix}
Q \\
B_1 \\
B_2 \\
B_3
\end{bmatrix}
\]

which corresponds to:

\[
\begin{bmatrix}
Q \\
B_1 \\
B_2 \\
B_3
\end{bmatrix}
\]

In order to determine which of the four solutions of the equations will be chosen, the previous system will be multiplied with the transposed vector, as it follows:

\[
\begin{bmatrix}
Q \\
B_1 \\
B_2 \\
B_3
\end{bmatrix}
\]

resulting:
Thus, the maximization of the variance PC1 is equivalent to the selection of the highest characteristic root. Consequently, \( l(1) \) is the highest eigenvalue of the covariance matrix, and \( E(1) \) represents the eigenvector which is a solution for \( E \).

**Identification of the business cycles**

The four filters used to extract the GDP cyclic component, together with their first principal component will be used to determine the business cycles of seven ECE countries which adhered to EU in 2004, respectively 2007 (Romania, Bulgaria, the Czech Republic, Poland, Hungary, Slovenia and Slovakia), of the current Euro area with 17 members (in order to explain the national divergences in terms of common monetary policy) and of nine economies from the Euro area (Germany, France, Austria, the Netherlands, Italy, Spain, Portugal, Greece, Ireland). The objectives of the performed research are as it follows:

1. To determine the heterogeneity between the business cycles of the new member countries.
2. To identify the differences existing within the Euro area.
3. To estimate the business cycles synchronization between the new member countries and the Euro area, as a whole, respectively with the countries from the nucleus of the Euro area (Germany, France, Austria and the Netherlands) and from the periphery of the Euro area. As a matter of fact, a part of the Euro area member countries included in the analysis, such as Germany, France, Italy, Austria, the Netherlands, are the most commercially and financially integrated with the ECE countries.
4. The evolution of the business cycles correlation degree during the analyzed period and the influence of certain events (introduction of euro, EU accession, the economic and financial crisis) upon the correlation.

We have excluded the Mediterranean economies (Malta and Cyprus) and the Baltic States from the group of the EU new member countries, as they tend to be more correlated with the Northern countries and with Russia. We have used the GDP data series in constant prices (millions of euros) with 2000 as a fixed basis. For 16 out of the 17 entities included in the analysis, the data series covers the period 1998:Q1 to 2011:Q1, namely 53 observations, while for Greece 45 observations are available starting from quarter 1 of 2000. Before using the filters to extract the cyclic component, we proceeded to eliminating the seasonality by using the TRAMO/SEATS procedure offered by the Eviews 7 program.

In order to use the HP filter, we have used a value of 1600 for the lambda smoothing coefficient, of which role is to penalize the acceleration of the trend component related to the GDP cyclic component. As for the determination of the GDP cyclic component based on falling within the frequency band, we have used the Christiano-Fitzgerald filter. Before using it, we have studied the stationary characteristic of the 18 GDP data series, as this filter allows to extract the business cycle according to the degree of integration \( l(0) \), respectively, \( l(1) \) of the data series. The duration of the business cycle used in the decomposition was suggested by the economic literature, namely between 1.5 years and 8 years. In order to determine the business cycle by means of the square trend, we have expressed the GDP logarithm according to the trend and to the square trend and we have calculated the residue of that regression. The fourth method (Beveridge-Nelson) has been more complex as it supposed applying the Box-Jenkins procedure to identify the best ARIMA representation associated to a data series and to check the white noise conditions for the residue of the estimated model.

In order to determine the common components of the business cycles determined by the use of the four methods, we have applied the principal components analysis, explained in the previous section. Based on it, we have calculated the first principal component (PC1) and we have determined the contribution of each method for finding the business cycle upon this component. The importance of each method has been identified by means of the values of the eigenvector corresponding to PC1. The sum of this vector's elements has been between 1.6 and 2, and according to the individual values and to the total sum; we have calculated the shares of each method for generating the business cycle in PC1.

Table 1 presents the previously determined values, the importance of the first component, respectively of the first two components in explaining the total variance of the vector formed by the four business cycles and the correlation coefficients for three out of the four business cycles extracted within the study (BP, HP, QT).

All the entities included in the analysis are characterized by relatively similar shares of the business cycles identified by means of the methods BP, HP and QT (between 0.27 and 0.36) and by a lower importance of the method BN (between -0.02 for Germany and 0.16 for Bulgaria). This situation is generated by the fact that the first three methods are based on the initial GDP series (expressed in the logarithm), while the last one has been deduced starting from the first difference of the GDP. The analysis based on the principal components has been efficient, as the first component explains approximately 70% of the total variation, and the first two components include, in most of the cases, more than 90% of the variation of the group consisting of the four business cycles. Generally, the advanced countries forming the nucleus of the Euro area are characterized by a higher macroeconomic stability and by a lower volatility of the economic shocks. Consequently, the extraction of the business cycles has not been very sensitive according to the various methods which had been used, these economies recording a very high correlation (over 90%, even 97 and 98%) between the cycles determined based on the cycles BP, HP and QT. As a result, in the case of these countries, the filter through the first principal component will be highly correlated with the three previous filters. Among the three groups of correlations, the one between HP and QT records the highest value for all the economies included in the sample, and thus it has been between 92% (Hungary) and 99% (Germany).

**Estimates for the degree of synchronization between the business cycles**

The most used technique for estimating the convergence between the business cycles in the case of two countries A and B is to calculate the statistic correlation between them. From a conceptual point of view, a correlation coefficient catches two characteristics of the relation between two business cycles—synchronization and amplitude of their variation. Thus, the existence of a perfect concordance of the recessionary and inflationary gap periods for two economies reveals two perfectly synchronized business cycles. However, there is a very small probability that A and B are perfectly correlated, as the amplitude with which each economy grows over its potential level or decreases under its level is important. Consequently, the correlation between the business cycles is influenced both by the nature of the output gaps of the two economies and also by their variation.

From the point of view of the optimum currency areas theory, the analysis of the contemporary correlation between the business cycles is useful, irrespective of the nature of the relation between the economies forming a monetary union. The main motivation is constituted by the study made for the way in which the common monetary policy can adjust to the current situations of each member state. The lower the contemporary correlation with the countries...
influencing the business cycle of the Euro area the most (especially Germany and France), the more asymmetric impact of the common monetary policy will be upon the member states, thus increasing the costs for stabilizing the shocks in the case of the uncorrelated economies.

Within this study, we have applied the two methods for estimating the statistic correlation (Pearson and Spearman) in order to estimate the degree of synchronization between the business cycles during the entire period, on two sub-periods and based on a mobile average with a duration of five years (Rolling window correlation). The Pearson coefficient of correlation between the business cycles of countries A and B is determined as a ratio of the variation and the product between their square means deviations. By means of normalization, the coefficient may take values between -1 and 1. For all the cases, the values of each type of parametric measure are validated, it will indicate more accurate information than the Spearman coefficient. In order to catch the variation of the synchronization between the business cycles of countries A and B in its dynamics, we have made both an analysis on two sub-periods and also a mobile window type analysis on five years (rolling window correlation). The structuring of the temporary sample in sub-periods has the role to outline the possible differences related to the correlation and to explain, based on them, the influences of certain economic processes and phenomena, such as the ECE economies’ accession to the European Union.

Within this study, we have made an analysis for the correlation of the business cycles between the countries A and B both on the entire period 1998 to 2011, and also on the sub-periods 1998 to 2004 and 2005 to 2011. Both sub-periods include recessional and expansionistic output gap phases, and this increases the significance degree of the obtained results. In case a higher correlation coefficient is recorded during the second sub-period if compared to the first one, then the business cycles of the countries A and B have become more synchronized. The mobile window method for 5 years has been chosen to be able to make an accurate estimate of the correlation coefficients for each of the 20 quarters, and to outline the temporal dynamics of the convergence between the business cycles. By applying this method, the result will be approximately 34 correlation coefficients between the countries A and B calculated starting with periods 1998 to 2002, 1998 to 2003 and ending with that between 2006 to 2011. Similarly, the ascendant tendency of the correlation coefficients will suggest a better synchronization between the business cycles of the economies A and B.

**Analysis for the entire period 1998 to 2011**

Initially, we have calculated the Pearson and Spearman coefficients of correlation between the national business cycles (for the 16

<table>
<thead>
<tr>
<th>Country</th>
<th>Shares of the four methods for PC1</th>
<th>Share of the total PC1 variance (%)</th>
<th>Share of the total PC2 variance (%)</th>
<th>Coefficients of the correlation between the business cycles</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>BN</td>
<td>BP</td>
<td>HP</td>
<td>QT</td>
</tr>
<tr>
<td>Austria</td>
<td>0.09</td>
<td>0.30</td>
<td>0.31</td>
<td>0.30</td>
</tr>
<tr>
<td>Bulgaria</td>
<td>0.16</td>
<td>0.27</td>
<td>0.29</td>
<td>0.27</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>0.13</td>
<td>0.30</td>
<td>0.28</td>
<td>0.30</td>
</tr>
<tr>
<td>France</td>
<td>0.07</td>
<td>0.31</td>
<td>0.31</td>
<td>0.31</td>
</tr>
<tr>
<td>Germany</td>
<td>-0.02</td>
<td>0.33</td>
<td>0.34</td>
<td>0.34</td>
</tr>
<tr>
<td>Greece</td>
<td>0.09</td>
<td>0.28</td>
<td>0.33</td>
<td>0.30</td>
</tr>
<tr>
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<td>0.11</td>
<td>0.30</td>
<td>0.30</td>
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</tr>
<tr>
<td>Italy</td>
<td>0.14</td>
<td>0.28</td>
<td>0.29</td>
<td>0.29</td>
</tr>
<tr>
<td>Netherlands</td>
<td>0.07</td>
<td>0.31</td>
<td>0.31</td>
<td>0.31</td>
</tr>
<tr>
<td>Poland</td>
<td>0.13</td>
<td>0.29</td>
<td>0.29</td>
<td>0.28</td>
</tr>
<tr>
<td>Portugal</td>
<td>0.07</td>
<td>0.30</td>
<td>0.32</td>
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</tr>
<tr>
<td>Romania</td>
<td>0.12</td>
<td>0.28</td>
<td>0.31</td>
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<tr>
<td>Slovakia</td>
<td>0.09</td>
<td>0.29</td>
<td>0.32</td>
<td>0.30</td>
</tr>
<tr>
<td>Slovenia</td>
<td>0.09</td>
<td>0.30</td>
<td>0.31</td>
<td>0.30</td>
</tr>
<tr>
<td>Spain</td>
<td>0.08</td>
<td>0.30</td>
<td>0.32</td>
<td>0.30</td>
</tr>
<tr>
<td>Hungary</td>
<td>0.09</td>
<td>0.29</td>
<td>0.32</td>
<td>0.30</td>
</tr>
<tr>
<td>EMU (17)</td>
<td>0.08</td>
<td>0.30</td>
<td>0.31</td>
<td>0.31</td>
</tr>
</tbody>
</table>

**Table 1. The results of applying the principal components method.**
countries) and the business cycles of the Euro area with 17 members, for the entire period 1998 to 2011. The results are presented in Table 2. We have analyzed four forms of the business cycles, that is, those which have been determined by using the filters HP, BP, QT and the one calculated based on the principal components method (PC1). The obtained results confirm the existence of an extremely high correlation in the case of the business cycles of the countries from the nucleus of the Euro area and the business cycle of the whole monetary union. Among the economies which are the most correlated with the Euro area we can find the biggest three countries from the monetary union - Germany, France and Italy, of which correlation coefficient is between 93 and 98%. Besides them, Austria and the Netherlands record correlations of the business cycles which are similar to the common one of the Euro area. For the 5 economies, there are no significant differences between the correlation coefficients determined based on the two methods (Pearson and Spearman) and the four forms of the business cycles.

Analyzing the data of the Euro area, Ireland and Spain are characterized by a correlation between 90 and 95% of the national BP and PC1 business cycles with the similar ones from the Euro area, and this brings them closer to the countries forming the nucleus of the monetary union. The contrary is the case of the peripheral economies. In the case of Hungary, the correlation coefficient is the highest among the economies included in the analysis. Among the new EU member states, Slovenia, the Czech Republic and Hungary have a very high correlation of the business cycles extracted by means of the Band-Pass filter, while the correlations based on the PC1 cycle are superior to the value recorded by Portugal. The economies which have been the lowest correlated with the Euro area during the analyzed period have been Romania, Bulgaria and Slovakia, the last one, despite adopting euro at the beginning of 2009. From the point of view of the optimum currency areas theory, Romania could lose the most after giving up the proper monetary policy, especially because it has no sufficiently strong internal mechanisms to adjust certain asymmetric shocks.

Analysis based on two sub-periods

The examination of the synchronization between the business cycles for the entire period taken into consideration within this study cannot outline the changes generated by some processes such as – adoption of the single currency, successive accessions to EU or the influence of the generous capital flows from the period 2005 to 2008. Theoretically, they can induce a higher correlation of the countries from the periphery of the Euro area and of the emergent economies from the Eastern and Central Europe with the economies from the nucleus of the Euro area. By calculating the correlation between the business cycles and the Euro area for two approximately equal periods of time (1998 to 2004 and 2005 to 2011), the result is the validation of the previous suppositions, as it can be noticed in Table 3. Thus, an increase of the business cycles degree of synchronization with the Euro area has been recorded during the second period if compared to the first one in the case of all the economies included within this study. According to the business cycle determined on the basis of the principal components, Germany, France, Italy, Austria and the Netherlands have recorded an evolution which is almost perfectly similar to the Euro area, as the correlation coefficients are between 96 and 99%. Among the peripheral countries, Portugal and Greece had better performances during the second sub-period if compared to the first one, as the correlation coefficients are superior to those calculated for the entire period (Table 2).

As for Spain and Ireland, the correlation of the business cycles have recorded a low decrease starting from 2005, if compared to the sub-period started in 1998. With reference to the EU emergent economies, all of them have recorded a higher correlation of the business cycles, along with the factual accession to EU and with the emphasis of the degree of commercial and financial integration with the economies from the nucleus of the Euro area. Generally, their synchronization coefficients for the second sub-period are superior to those calculated for the entire period. Thus, the business cycles of Hungary, Slovenia, the Czech Republic and Slovakia have become similarly correlated with the Euro area, as it is the case of the peripheral economies. In the case of Hungary, the coefficients of correlation with the Euro area have been of minimum 89%, irrespective of the coefficient which has been used or of the method used to extract the business cycles. If during the first sub-period, the evolutions of Romania, Greece and Slovakia have been negatively correlated with the Euro area, only positive correlations have been recorded during the second one, which are higher for the last economy and lower for Greece. Romania's correlation of the business cycles has been between 67 and 72% during the period 2005 to 2011, the value being lower than those recorded by Bulgaria, but superior to those of Greece (Table 3).

The analysis made for the two sub-periods allows the examination of the hypothesis referring to the endogeneity of the optimum currency areas theory. As the business cycles become more correlated with the Euro area along with the use of a single currency or with the increase of the commercial integration degree, then the criterion for the synchronization of the business cycles should not be ex ante analyzed, but ex-post, namely subsequently to the accession to the monetary union. Consequently, the national costs for a common monetary policy will decrease along with the adoption of the single currency.

Estimates for the synchronization based on the mobile average

Another method used in the economic literature to estimate the dynamics of the degree of synchronization of the business cycles is to calculate a mobile average for 5 years. We have used the business cycle determined on the basis of the first principal component method, the result being 29 correlation coefficients for the period 2004 to 2011.

The obtained results outline the fact that there have been records of a progressive increase of the correlation related to the business cycles with the Euro area up to the moment when the economic and financial crisis occurred, and afterwards a decrease tendency has been recorded for the synchronization in the cases of most of the less competitive economies. Thus, during the periods 2003 to 2008 and 2003 to 2008, all economies recorded a high correlation of the business cycles with the Euro area, the correlation coefficients being between 90% (Romania) and 99% (Spain, Italy and Austria). Along with the occurrence of the crisis, the synchronization degree of the business cycles with the Euro area significantly decreased in Greece, Romania and Bulgaria, while it was minimum 86% in 2005 to 2011, the value being lower than those recorded by Bulgaria, but superior to those of Greece (Table 3).
Table 2. Correlation between the business cycles during the entire period 1998 to 2011.

<table>
<thead>
<tr>
<th>Country</th>
<th>HP (P)</th>
<th>BP (P)</th>
<th>QT (P)</th>
<th>PC1 (P)</th>
<th>HP (S)</th>
<th>BP (S)</th>
<th>QT (S)</th>
<th>PC1 (S)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Romania</td>
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<td>0.38</td>
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<td>0.25</td>
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<td>0.63</td>
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<td>0.64</td>
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<td>0.95</td>
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Table 3. Correlation between the business cycles during two sub-periods.

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<th>Country</th>
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<th>HP (S)</th>
<th>BP (P)</th>
<th>BP (S)</th>
<th>QT (P)</th>
<th>QT (S)</th>
<th>PC1 (P)</th>
<th>PC1 (S)</th>
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<td>0.89</td>
<td>0.92</td>
<td>0.67</td>
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<table>
<thead>
<tr>
<th>Country</th>
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<th>BP (P)</th>
<th>BP (S)</th>
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</tbody>
</table>

Note: (P) – Pearson correlation; (S) – Spearman correlation.
the Euro area has significantly increased in most of the economies included in the below graph. Thus, Greece and Romania passed from a negative correlation to a positive one, which is not statistically significant and, afterwards, to a significantly positive one, while Poland, Bulgaria and Hungary recorded a correlation increase from approximately 30% up to more than 90% (Figure 1). Another point of inflexion has been the business cycle finalized during quarter 2 of 2008, as we have previously presented. Hungary is the only economy where a maximum was recorded at the end of the interval, the correlation of the business cycles being by 5% higher than previous to the economic crisis. Slovenia is also a more special case, as the correlation of the business cycles with the Euro area has only temporarily been lower than 90%.

Among the peripheral economies of the Euro area, Greece recorded only temporarily a quite high correlation with the business cycle of the monetary union. Spain, Portugal and Ireland have become extremely synchronized with the Euro area, starting with the quarter 3 of 2007, this situation continuing up to the end of 2009. The issues related to the financing of the public debt service supposed the implementation of budgetary austerity measures with a restrictive effect, and this induced a lower correlation with the countries forming the nucleus of the Euro area. The evolutions of these economies have been quite strong, as it has not been affected by the enlargement of the mobile interval beyond the economic crisis. From the point of view of the optimum currency areas theory, the evolution of the correlation coefficients is extremely important starting from quarter 1 of 2007, the one corresponding to a complete interval of 5 years during which the euro currency has been used. The analysis made confirm the fact that the economic and financial integration favored by a single currency has increased the correlation of the business cycles from the Euro area. Nevertheless, as long as there are economies encountering difficulties in adjusting the negative shocks which affect the output, the optimality of the Euro area tends to get decreased, but not to an extent which involves insurmountable costs for a single currency.

Conclusions

The study includes estimates for the business cycles’ degree of synchronization between seven new EU member countries and that of the Euro area. Synchronous business cycles mean costs for extending the reduced Euro area, under the terms of a possible facility to absorb the asymmetric shocks. The management for the extension of the Euro area should lay its account on the integration of Hungary, the Czech Republic, Slovakia and Slovenia, economies which are highly correlated with the Euro area. The accession of Bulgaria, Romania and Poland to the Euro area would be more expensive, as these economies are lower correlated with Euro area countries.

Even though the analysis confirms the fact that the economic and financial integration increased the business cycles’ degree of correlation within the Euro area, the world financial crisis and the emergency in promoting austerity packages have induced a lower correlation of the new member states with the countries forming the nucleus of the Euro area.

It is more and more obvious that a structural mistake of the Economic and Monetary Union was that of ignoring the Optimum Currency Areas criteria, focusing on taxation and public debt related criteria only. It has been very much insisted upon the endogeneity of the Optimum Currency Areas in the disadvantage of the OCA exogeneity (the high coordination of the institutions and of the macroeconomic policies). We consider that the idea of developing a fiscal union in the Euro area should be adopted, including the procedure for harmonization of charges and taxes and also settling of a European Union’s Ministry of Finance and a common budget which could act as a damper for the asymmetric shocks, automatically redistributing revenues to countries encountering financial problems.

AKNOWLEDGEMENT

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REFERENCES


