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BUSINESS CYCLE SYNCHRONISATION OF CEE COUNTRIES WITH THE EURO AREA. BETWEEN CORE AND PERIPHERY

***Abstract.** In this study, we aimed to assess the degree of business cycle synchronisation in five CEE countries that have not adopted the euro (Romania, Bulgaria, Hungary, Poland and the Czech Republic), from the perspective of investigating similar developments with the three most important countries of the monetary union (Germany, France and Italy), respectively, with the peripheral countries most affected by the sovereign debt crisis (Greece, Portugal and Spain). The results confirm that membership of the monetary union does not automatically reduce the potential for asymmetric shocks, as in the case of peripheral countries, and that CEE countries do not have a similar path of improving business cycle synchronisation, with Romania and Bulgaria being closer to the Greek experience.*

***Keywords:** business cycle synchronisation, monetary union, clustering, divergence, CEE countries*

JEL Classification: C51, F44, F45

1. Introduction

The three crises of the last 15 years (the financial crisis, the sovereign debt crisis, and the health crisis) have shown that the heterogeneity of Member States can become a serious problem for the sustainability of the euro area. Thus, it becomes important to examine the synchronisation of CEE economies with monetary union, including for those countries that are not yet monetarily integrated. According to the theory of optimal currency areas, increasing the degree of convergence of the business cycles of monetary-integrated countries becomes a prerequisite for the sustainability of the monetary union in the context of the loss of the autonomous monetary policy instrument.

As CEE countries are trade and financial integrated with the euro area core, especially with Germany, their business cycle will be influenced by developments and shocks specific to the core. Under these conditions, the flexibility of CEE economies needs to increase to mitigate shocks at a pace like the developed countries of the monetary union. In addition, a countercyclical fiscal policy, including during periods of economic expansion, can provide a fiscal margin to combat shocks leading to a recessionary output gap. Automatically, economies with high public debt and those that promote pro-cyclical policies cannot use fiscal policy to stabilise the economy, as in the case of the core, and the timing of business cycles is reduced. The aggregate macroeconomic data in the euro area are constructed as weighted averages so that developments specific to Germany, Italy, and France explain approximately two-thirds of their level. Therefore, the core dictates the dynamics of the region and influences joint monetary policy decisions so that high synchronisation with the center becomes an essential condition for smaller economies and relatively less developed ones.

To achieve the assumed research objective, the article was structured into four sections: a brief presentation of the specialised literature in the field of business cycle synchronisation, the methodological aspects specific to the estimation procedures used, the results obtained analysis, and the conclusions.

2. Literature review

Suppose the incidence of demand and supply shocks, respectively, the speed of their adjustment, are similar in the partner countries, then the shocks become more symmetrical, and the business cycles become more synchronised. Therefore, the need for monetary policy independence is reduced, and the benefits of the single currency can be high (Mundell, 1961). Because the European monetary union is made up of heterogeneous economies, then a more pronounced asymmetry of shocks will be manifested in the case of peripheral countries. Therefore, the opportunity of adopting the euro by all Central and Eastern European countries should be analysed by using the business cycles correlation with the monetary union core (Fidrmuc and Korhonen, 2006).

The CEE countries have registered a development pattern characterised by trade integration with developed EU countries, the European fund's absorption, and public investments, the use of taxation to increase investment attractiveness, respectively, by foreign direct investment (FDI) and technology inflows, which contributed to increase the added value of domestic products and to increase exports with a medium/high degree of technological complexity. However, the performances were not homogeneous, the CEE countries were relatively geographically closer to the EU core, being more competitive for investors, while Romania and Bulgaria were characterised by slower structural transformations, despite the increase in the size of the sales markets and income. Therefore, countries such as the Czech Republic, Hungary, and Poland tend to be more synchronised with the euro area core. In contrast, Romania and Bulgaria are closer to Greece's evolution (Marinaş, 2013). Furthermore, Zaman and Goskin (2015), respectively, Andrei and Păun (2015) examined Romania's business cycle phases with the help of the cyclical component of GDP, identifying periods of economic expansion and economic decline below the potential level.

The occurrence of an economic and financial crisis tends to business cycle divergences, and the common monetary policy would rather have a destabilising role. Consequently, the prospects for an extended monetary union are unclear given the low degree of economic alignment of the future member states (Gehring and König, 2021). Filis et al. (2010) concluded that some CEE economies, such as Bulgaria, were characterised by low business cycle synchronisation with monetary union. The business cycle synchronisation represents the most critical criterion of optimal monetary areas, as well as one of the fundamental conditions for the effective functioning of the EMU (Papadimitriou et al., 2022). Insufficient synchronisation and cyclical divergences may lead to a procyclical impact of the ECB's monetary policy on member countries (Dajcman, 2020).

Papadimitriou et al. (2016) studied the convergence of economic cycles in the period 1986-2011, based on the Pearson correlation of economic growth rates, and established that the economic cycles of European countries showed a generally increased degree of synchronisation and, therefore, of convergence in the era of a single currency. Augustyński and Laskoś-Grabowski (2018) used the cluster method, comparing the time series of EU member states' GDPs over two sub-periods (2000Q1-2007Q4 and 2008Q1-2017Q1), respectively, over the entire period, establishing that the global financial crisis reversed the dynamics of the economic integration process within EU, resulting in two main groups of countries – the core, made up of France, Germany, the Netherlands, Austria, Belgium, and Spain, respectively, the periphery, which includes the rest of the EU member states.

Belke et al. (2016) showed that there has been a decline in synchronisation in the peripheral states of the euro area rather than in the states that form the core of the euro area. At the same time, Grigoras and Stanciu (2016) highlight that the post-crisis developments show high heterogeneity in terms of synchronising the economic cycles of EU member states. Kovačić and Vilotić (2017) examined the prospects of

a monetary union among European countries by assessing the business cycles synchronisation extracted using the Hodrick-Prescott filter for the period 2000Q1-2016Q4, concluding that both the concordance index and the cross-correlations of business cycles indicated that most of EU-15 countries register a high synchronisation, while in the new EU member states it is characterised by a relatively lower correlation of business cycles. According to Borowiec (2020), economic cycles in the member states of the monetary union are characterised by a relatively high and undiversified concordance with the euro area. However, business cycles are much more synchronised in the countries that form the core of monetary area than in peripheral states, even during periods of economic activity contraction.

3. Methods

The business cycle represents a succession of a recession period and economic expansion, which can be approached both from the perspective of the dynamics of some macroeconomic and financial indicators of the quarterly GDP depending on the growth/decrease periods relative to the previous quarter, respectively, of the output gap, depending on which the economy can produce below potential (recessionary gap) or more than potential (inflationary gap). A common way used in the economic literature to determine the output gap is to extract the cyclical component of quarterly real GDP using the Hodrick-Prescott (HP) econometric filter, and then calculate the business cycle synchronisation using the Pearson business cycle statistical correlation.

The HP filter introduced by Hodrick and Prescott (1997) decomposes the time series into the cyclical component and the trend component, with a smoothed evolution over time and a more volatile minimised cyclical part, the new data series obtained representing potential GDP. The following equation represents the minimisation of square time series deviation:

$$\min_{s,y} \sum_{t=1}^T (y_t - s_t)^2 + \lambda \sum_{t=2}^T ((s_{t+1} - s_t) - (s_t - s_{t-1}))^2 \text{ where:}$$

- y_t and s_t represent log GDP and log potential GDP;
- $(y_t - s_t)^2$ is the sum of the squared deviations of GDP compared to potential GDP;
- $((s_{t+1} - s_t) - (s_t - s_{t-1}))^2$ penalises square deviations in the growth rate of the trend component.
- λ can take the following values: 100 (for annual data), 1600 (for quarterly data), and 14400 (for monthly information); if $\lambda = 0$, then $y_t - s_t = 0$, hence $y_t = s_t$ and the cyclic component is zero.

The Pearson coefficient is calculated as the ratio between the covariance of two countries and the product of their mean squared deviations, according to the following formula: $\rho_{X,Y} = \frac{\text{cov}(X,Y)}{\sigma_X \sigma_Y}$.

The Pearson correlation coefficient can take values between -1 and 1, thus indicating a negative/positive correlation between the variables considered. The closer the business cycles synchronisation degree is to 1, the stronger the correlation between the respective economies, and the business cycles will evolve in the same direction, corresponding to an effective neutralisation of shocks through a common monetary policy.

Using the HP filter, we estimated the cyclical component of GDP in constant prices with a fixed base in 2015 in the form of quarterly data from 1996Q1-2022Q1, a total of 105 observations. Before extracting the cyclical component, the data series were deseasonalised (removing seasonality) using the Tramo/Seats function and expressed in logarithm. In the business cycle analysis, we used quarterly data, which implies using the value of 1600 for the lambda smoothing coefficient, whose role is to penalise the acceleration of the trend component relative to the cyclical component of GDP. The HP filter was used to extract business cycles for the member states that are part of the CEE (Poland, the Czech Republic, Hungary, Romania, and Bulgaria), those that make up the euro area core (Germany, France, Italy), and those of the euro area periphery (Greece, Portugal, Spain).

In order to group the analysed countries according to the process of business cycle convergence, we opted for cluster analysis. This process could be expressed by squared Euclidean distances within the analysed clusters over a certain period or sub-period if specific economic shocks left their mark on the economy at a given time. For example, if the squared Euclidean distance between two analysed countries decreases during the analysed period, then there is a high convergence between the two economies. Conversely, when there is an increase in the squared Euclidean distance, the two countries become more divergent. The methodology for applying cluster analysis is represented by Ward's method of clustering, which minimises the total variance within the cluster (clusters are groups resulting from the slightest variation between two or more economies). Meloun and Militký (2004) describe the cluster-type relationship according to the following formula, where WCV is Within-cluster variance:

$$WCV = \sum_{j=1}^m \sum_{i=1}^k (x_{ij} - \bar{x}_j)^2, \text{ where: } \bar{x}_j = \frac{1}{k} \sum_{t=1}^k x_{tj}$$

The squared Euclidean distance is used as the measure, representing the basis of the method. The formula for the squared Euclidean distance is based on extracting the root of the sums of the squares of the differences between the x and y values, as follows:

$$\text{Euclidian distance} = \sqrt{\sum_{i=1}^k (x_i - y_i)^2}, \text{ where } x \text{ and } y = \text{output gaps}$$

The ranking of clusters is done according to the smallest Euclidean distance value to identify economies with a similar degree of synchronisation.

4. Results

During the period under review, the economies included in the study were subject to several economic shocks, which increases the relevance of this study. Thus, the CEE economies were initially in the transition process to the market economy that generated a structural break with the previous economic system through the liberalisation of markets and prices and the development of private property, respectively, through the application of strict reform measures and privatisation of companies that belonged to the state. At the same time, the euro area economies were in the process of meeting the nominal convergence criteria and preparing to adopt the single currency. Since 2004, most of the economies studied have experienced a period of economic expansion, more pronounced in the case of CEE countries, which had the potential to grow faster from a relatively lower level of development and which thus became more attractive to investors, more chosen after accession to the European Union.

The financial crisis of 2007-2008 penalised economies where macroeconomic imbalances had previously been accentuated, so there was a rapid contraction of their production and a slower recovery in the absence of domestic mechanisms to stimulate economic growth. In addition, countries historically characterised by high public debt have shown problems refinancing their growing loans at low interest rates, leading to a sovereign debt crisis within the monetary union and threatening its integrity. The lender of last resort status assumed by the ECB since 2014-2015 allowed the artificial reduction of the risks of economies vulnerable to previous crises and facilitated the relaunch of the entire euro area. The pandemic crisis has caused a substantial drop in output within the monetary union. However, the response of governments has been coordinated and immediate, and the intervention packages have exceeded the fiscal programs several times since the financial crisis.

To capture the dynamics of the business cycles synchronisation degree between countries and euro area (Table 1), we performed an analysis for the entire period (1996-2022), respectively a study for the three sub-periods (1996-2000, 2001-2008, 2009-2022). The differentiation of the three sub-periods has the purpose of highlighting the dynamic of the correlation according to inevitable economic shocks specific to some groups of countries (the transition for CEE countries or the debt crisis for the peripheral countries), respectively, for all the countries analysed (the financial crisis and the pandemic crisis). At the same time, the sub-periods studied include periods of economic expansion and periods of economic recession, increasing the significant degree of the results obtained. Thus, business cycles become more synchronised if the results lead to a higher correlation coefficient in the next sub-period relative to the first.

Table 1. Pearson correlation of business cycles with the euro area

| Countries | 1996Q1- 2000Q4 | 2001Q1- 2008Q4 | 2009Q1- 2022Q1 | 1996Q1- 2022Q1 |
|---------------------------|-------------------|-------------------|-------------------|-------------------|
| Germany | 0.84 | 0.98 | 0.93 | 0.93 |
| France | 0.89 | 0.97 | 0.96 | 0.95 |
| Italy | 0.88 | 0.96 | 0.99 | 0.97 |
| Greece | -0.23 | 0.73 | 0.51 | 0.55 |
| Portugal | 0.48 | 0.87 | 0.91 | 0.89 |
| Spain | 0.89 | 0.96 | 0.93 | 0.93 |
| Hungary | 0.15 | 0.66 | 0.93 | 0.87 |
| Poland | 0.49 | 0.81 | 0.86 | 0.76 |
| The Czech Republic | 0.39 | 0.91 | 0.90 | 0.86 |
| Romania | -0.12 | 0.70 | 0.64 | 0.58 |
| Bulgaria | 0.12 | 0.68 | 0.83 | 0.45 |

Source: Eurostat, own calculations

Calculating the Pearson correlation with the euro area shows that, in the case of core states (Germany, France, Italy), there is a strong correlation over the entire period and the three sub-periods analysed. At the opposite pole, among the peripheral states of the monetary union (Greece, Spain, and Portugal), Greece was out of synchronisation with the euro area regardless of the period examined.

Regarding the CEE case, the states examined, namely Bulgaria and Romania, have the weakest correlated economies with the euro area. At the same time, the business cycle correlation of Hungary, Poland, and the Czech Republic increased after the European Union accession. They grew or remained high after the economic and financial crisis. According to the Theory of optimum currency area, Bulgaria and Romania have demonstrated that they need efficient mechanisms, which would generate more disadvantages of giving up their currency in the case of the two economies.

With their European Union accession, the CEE countries have become heavily trade and financial integrated with the core countries of the monetary union, responsible for more than half of their total trade and foreign investment flows from these economies. Therefore, the business cycle synchronisation has increased in most CEE countries from values below 80% to values above this threshold, the highest correlation coefficients being specific to the Czech Republic, Hungary, and Poland. Thus, in the sub-period that followed the financial crisis, the business cycles of most CEE countries were more synchronised not only within the group but also with the core of the monetary union, but mostly with its periphery, less with Greece. Bulgaria recorded a higher correlation with the CEE countries and Spain, respectively, and a lower one with the euro area core. At the same time, Romania had a weak synchronisation with all other countries in the sample, which improved relatively slower than the countries in the region due to the austerity policies promoted after the financial crisis (Table 2).

Table 2. Business cycles correlation between CEE countries and euro area member states

| | BG | CZ | PL | RO | HU | DE | FR | IT | EL | PT | ES |
|-----------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------|-------------|-------------|
| BG (1996-2022) | | 0.56 | 0.21 | 0.57 | 0.50 | 0.42 | 0.39 | 0.43 | 0.34 | 0.35 | 0.48 |
| BG (1996-2000) | | 0.42 | -0.38 | 0.49 | 0.49 | 0.00 | 0.15 | 0.19 | 0.14 | -0.35 | 0.26 |
| BG (2001-2008) | | 0.77 | 0.61 | 0.83 | 0.69 | 0.69 | 0.72 | 0.71 | 0.75 | 0.63 | 0.82 |
| BG (2009-2022) | | 0.90 | 0.85 | 0.67 | 0.81 | 0.77 | 0.74 | 0.80 | 0.49 | 0.80 | 0.87 |
| CZ (1996-2022) | 0.56 | | 0.66 | 0.70 | 0.82 | 0.82 | 0.74 | 0.80 | 0.56 | 0.75 | 0.86 |
| CZ (1996-2000) | 0.42 | | -0.20 | 0.76 | 0.36 | 0.36 | 0.21 | 0.45 | -0.09 | -0.34 | 0.46 |
| CZ (2001-2008) | 0.77 | | 0.74 | 0.68 | 0.79 | 0.85 | 0.93 | 0.90 | 0.67 | 0.71 | 0.96 |
| CZ (2009-2022) | 0.90 | | 0.86 | 0.66 | 0.87 | 0.83 | 0.80 | 0.87 | 0.53 | 0.89 | 0.93 |
| PL (1996-2022) | 0.21 | 0.66 | | 0.37 | 0.63 | 0.66 | 0.71 | 0.74 | 0.51 | 0.79 | 0.77 |
| PL (1996-2000) | 0.38 | -0.20 | | -0.54 | -0.07 | 0.29 | 0.48 | 0.41 | -0.14 | 0.54 | 0.40 |
| PL (2001-2008) | 0.61 | 0.74 | | 0.65 | 0.48 | 0.75 | 0.80 | 0.76 | 0.75 | 0.62 | 0.78 |
| PL (2009-2022) | 0.85 | 0.86 | | 0.60 | 0.83 | 0.75 | 0.80 | 0.85 | 0.55 | 0.91 | 0.90 |
| RO (1996-2022) | 0.57 | 0.70 | 0.37 | | 0.64 | 0.54 | 0.52 | 0.49 | 0.66 | 0.49 | 0.61 |
| RO (1996-2000) | 0.49 | 0.76 | -0.54 | | 0.25 | 0.08 | -0.31 | -0.05 | 0.07 | -0.72 | -0.07 |
| RO (2001-2008) | 0.83 | 0.68 | 0.65 | | 0.60 | 0.67 | 0.75 | 0.69 | 0.65 | 0.72 | 0.72 |
| RO (2009-2022) | 0.67 | 0.66 | 0.60 | | 0.71 | 0.53 | 0.65 | 0.58 | 0.72 | 0.64 | 0.71 |
| HU (1996-2022) | 0.50 | 0.82 | 0.63 | 0.64 | | 0.79 | 0.83 | 0.83 | 0.57 | 0.75 | 0.84 |
| HU (1996-2000) | 0.49 | 0.36 | -0.07 | 0.25 | | -0.14 | 0.11 | 0.43 | 0.30 | -0.44 | 0.20 |
| HU (2001-2008) | 0.69 | 0.79 | 0.48 | 0.60 | | 0.51 | 0.66 | 0.63 | 0.57 | 0.33 | 0.66 |
| HU (2009-2022) | 0.81 | 0.87 | 0.83 | 0.71 | | 0.88 | 0.89 | 0.88 | 0.55 | 0.86 | 0.88 |

Source: own calculations

To accurately capture the influence of shocks on the business cycles synchronisation, we used the correlation method over a rolling window of 7 years, the duration being similar to that of a normal business cycle. According to this method, one correlation coefficient will be calculated for each 7-year interval, starting with quarter 1 of 1996 and adding one observation at a time until the last quarter of the data series used. Thus, the first interval concerned the period 1996:1-2002:4, the previous was between 2015:2-2022:1, and the number of moving intervals for which correlation coefficients were determined was 78. The analysis confirms the variation in the degree of business cycle correlation because of the occurrence of several external crises and domestic shocks. According to Figure 1, it is noted that the business cycles the core economies of the euro area were highly correlated, the only exception being France for the seven-year intervals ending between the quarters 2016:3 and 2018:1, when the correlation fell below 0,8. It is also noted that there were two periods in which greater heterogeneity was manifested between the business cycles of the countries included in the sample (Figure 1).

The first includes the business cycles completed until 2005, when CEE countries, especially Bulgaria, Romania, and Hungary, respectively, Greece, were not synchronised with euro area. If for CEE countries, the explanation lies in the specifics of the internal transition process they went through and in the reaction of the economies to specific reforms, in the case of Greece, an overheating of the economy was manifested, because of the reduction of interest rates and the increase of public expenditures, in a period in which the euro area had slow economic growth.

The second period includes the intervals after the financial crisis and up to 2018-2019, when Greece and Romania experienced a substantial reduction in potential output because of fiscal austerity measures, with their economies performing contrary to the core economies of the euro area and other CEE countries.

In general, the accession of the CEE countries to the European Union gradually led to more synchronised macroeconomic developments until 2008, when expansion had become the rule at the level of the entire community area. As a result of the occurrence of the financial crisis, business cycles were influenced both by the external shock and the reaction of the various sectors of activity and the labor market, as well as by the effectiveness of domestic policies in supporting the economic recovery, so that the previous synchronisation process was stopped. Still, the intensity of divergence was no longer at the pre-accession level. As the seven-year intervals began to exclude the economic downturn quarters of 2008-2010, CEE countries returned to the pre-financial crisis synchronisation process, which continued until the end of the last interval, despite the pandemic crisis and inflationary pressures from the previous year.

In conclusion, it can be stated that the shocks generating economic-financial crises (the transition for CEE countries, the financial crisis, and the sovereign debt crisis) led to the intensification of the business cycles divergence, while the periods of economic expansion and recovery, due to a high sense of confidence, marked the increase in the correlation between business cycles. In addition, unconventional measures and measures to reduce sovereign risks adopted by the Central Bank, as well as government intervention programs coordinated at the European level, can increase the degree of business cycles correlation, including in the case of relatively less developed countries and more vulnerable from the perspective of macroeconomic imbalances (figure 1).

Another method of identifying differences between business cycles refers to their persistence, determined on the basis of the first-order correlation coefficient (Darvas and Szapáry, 2004). It is calculated as the simple correlation between the business cycle for the first $N-1$ quarters, starting from the first quarter of the sample, and the related business cycle for the next $N-1$ quarters starting from the second quarter. The higher this coefficient is, the more persistent the business cycle is. We calculated this coefficient for the entire studied period and for three sub-periods to capture the dynamics of the persistence of the business cycle because of the creation of the monetary union, the accession EU of CEE countries, and the influence of the major crises that affected the European economy since 2009.

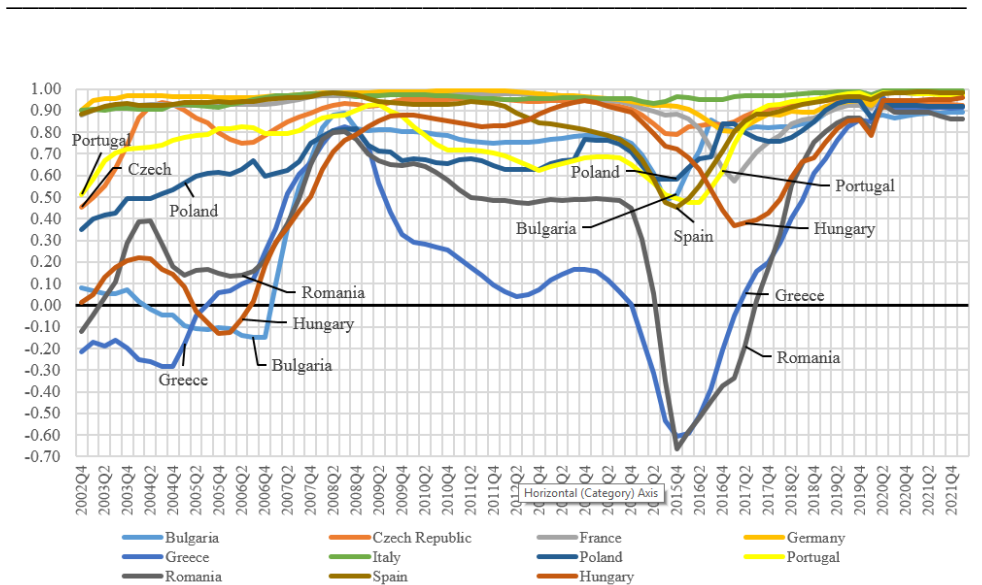


Figure 1. Rolling window correlation of the business cycles

Source: own calculations

Table 3. The business cycles persistence

| | 1996-2022 | 1996-2000 | 2001-2008 | 2009-2022 |
|--------------------|-------------|-----------|-----------|-----------|
| The Czech Republic | 0.80 | 0.93 | 0.96 | 0.70 |
| Greece | 0.79 | 0.74 | 0.88 | 0.76 |
| Romania | 0.75 | 0.84 | 0.89 | 0.58 |
| Germany | 0.65 | 0.60 | 0.93 | 0.55 |
| Bulgaria | 0.64 | 0.56 | 0.97 | 0.67 |
| Italy | 0.56 | 0.71 | 0.86 | 0.51 |
| Euro area | 0.56 | 0.83 | 0.94 | 0.46 |
| Hungary | 0.55 | 0.54 | 0.87 | 0.46 |
| Spain | 0.55 | 0.87 | 0.96 | 0.49 |
| Portugal | 0.53 | 0.85 | 0.90 | 0.48 |
| Poland | 0.52 | 0.24 | 0.70 | 0.53 |
| France | 0.40 | 0.88 | 0.90 | 0.33 |

Source: own calculations

From 1996-2022, the Czech Republic, Greece, and Romania recorded the most persistent business cycles, while relatively temporary shocks characterised France, Poland, and Portugal. The heterogeneity between the analysed euro area countries is relatively low (except for Greece), proof of the transmission of standard shocks between monetarily integrated countries and a similar capacity to neutralise shocks. It should be noted that the high persistence of the business cycle, as the

Czech Republic's case, only sometimes represents an unfavorable situation resulting from a sustained rate of reduction of income gaps relative to the European average. In the case of some CEE countries, such as Hungary and Poland, the influence of economic shocks is like the euro area average because those economies have understood that integration into a common economic space must be accompanied by the creation of complementary domestic shock adjustment mechanisms, through stimulus policies of foreign capital flows and domestic capital development.

In general, periods of economic expansion at the European level have led to more persistent business cycles because of the maintenance of high economic sentiment and capital flows that have supported relatively high growth rates for several years, including the CEE economies that joined the EU in a favorable economic period. The economic crises accentuated the heterogeneity between the analysed countries, and the succession of some phases of economic growth with others of slowdown and even decrease in economic activity became the rule at the European level, leading to more frequent shocks, but with longer-term influences short. The persistence degree decreased in all countries relative to the previous sub-period due to domestic policies to mitigate the effects of crises and coordinated measures applied by European authorities.

Therefore, the benefits of adopting the single currency are greater for emerging economies when a moderate expansionary production gap is manifested because commercial and financial integration generates positive contagion effects in the community space. The perception of risk decreases significantly artificially. Conversely, the euro area tends to perform with syncopation when adverse external shocks are transmitted to already vulnerable economies, as risks minimised during periods of economic growth surface and are amplified by markets that are suddenly much more averse to risk.

To identify the stage and dynamics of the business cycle synchronisation process for the economies included in the sample, we used the clustering method with XLSTAT Software for the entire period (1996-2022) and for the sub-periods, as follows: 1996-2000, 2001-2008, and 2009-2022. In the following figures, you can see the graphical representations of the clusters, based on which the analysed countries can be grouped according to the existing Euclidean distance. Thus, the distance between the clusters can be determined based on the dendrograms obtained below. As a result, the farther apart the horizontal lines are, the more significant the differences from a given cluster.

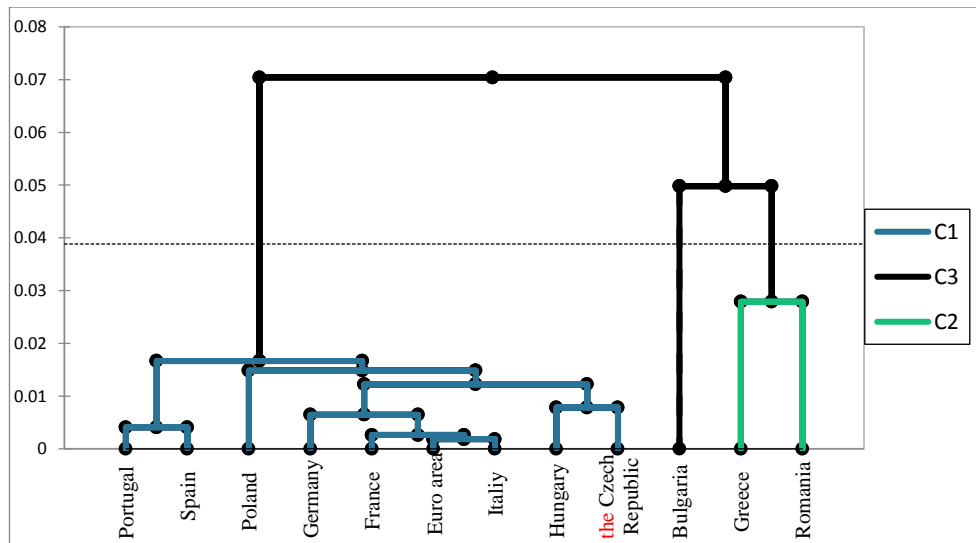


Figure 2. The business cycle clusters over the entire period 1996 - 2022
Source: own calculations

The cluster analysis of business cycles highlights the fact that for the entire period studied (1996-2022), the first cluster was made up not only of core countries of the euro area (Germany, Italy, and France, which make up a sub-cluster), but also from peripheral countries of the Monetary Union (Portugal and Spain), and Central and Eastern European economies (Hungary, Poland, the Czech Republic). The presence of these three economies in euro area cluster is evidence of their trade and financial integration, enhanced by foreign direct investment and technology transfers to those economies, which has led to increasing synchronisation with the developed economies of the Monetary Union, even in the absence of the use of a common currency. Instead, Romania formed a cluster together with Greece, evidence of similar boom and bust periods, respectively, of their significant budget consolidation processes after the financial crisis and the sovereign debt crisis.

Business Cycle Synchronization of CEE Countries with the Euro Area. Between Core and Periphery

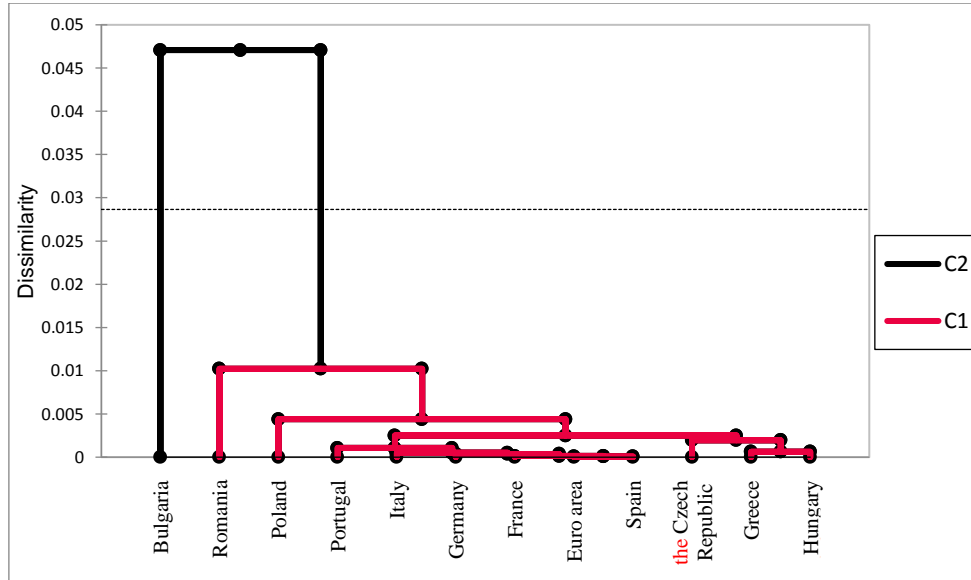


Figure 3. The business cycle clusters during the period 1996-2000

Source: own calculations

Among all the analysed economies, Bulgaria recorded the most significant distance relative to the business cycles of euro area economies over the entire period, a matter decisively influenced by the economic shock of 1996-2000, specific to the transition period to the market economy. In general, the business cycle of Romania registered a greater distance than other countries relative to the business cycles of euro area core economies, the only exception being reported within the first sub-period studied.

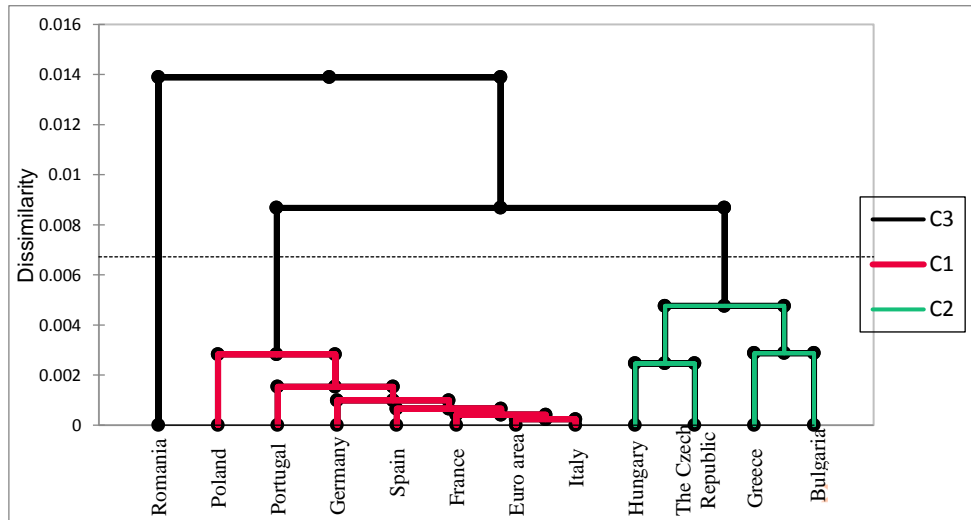


Figure 4. The business cycle clusters during the period 2001-2008

Source: own calculations

Thus, even between 2001-2008, Romania diverged from all other economies, while Greece and Bulgaria were part of the second cluster together with Hungary and the Czech Republic. Although Romania recorded a period of economic expansion like the countries in the second cluster, however, the macroeconomic imbalances (in particular, the commercial and fiscal ones) were superior to them, which led to a hard landing of the economy in 2009 accentuated by the harsh fiscal adjustment measures of 2010.

In conclusion, joining the Economic and Monetary Union does not automatically guarantee a superior synchronisation with euro area business cycles, as is Greece's case, just as the increase in the degree of economic integration with the union's monetary policy does not ensure the achievement of a business cycle close to this one, especially in the context of internal structural problems, as in the Romania case. The good news is that since the financial crisis, the gaps between business cycles have narrowed, and most economies included in this study (without Greece and Romania) were part of the same cluster. Moreover, in the 2009-2022 sub-period, Greece and Romania had relatively more synchronised business cycles, being grouped in a separate cluster from the other examined economies.

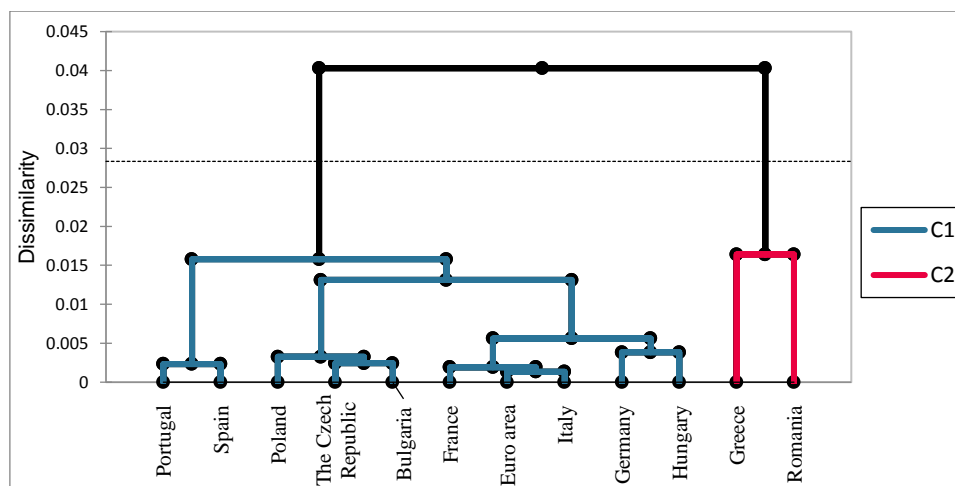


Figure 5. The business cycle clusters during the period 2009-2022
 Source: own calculations

5. Conclusions

The results of this study confirm the existence of a multi-speed monetary union in case of the entire period examined, 1996-2022, which can generate an asymmetric impact of the common monetary policy and create higher shock adjustment costs for the less synchronised economies. The representativeness degree of the performed analysis results both from the several methods applied to estimating business cycles in a period of 26 years characterised by several crises, recessionary

gaps, but also exuberant economic expansions, as well as from the selection of some economies groups (euro area core, its periphery and CEE countries that have not adopted the single currency) relevant from the perspective of differences in economic importance, development level, and capacity to neutralise shocks.

According to our results, the monetary integration process does not seem to have significantly reduced the gaps between the core and periphery in the context in which even GDP per capita of the southern countries decreased, even significantly in Greece and Portugal cases, relative to the euro area average. Although the persistence degree of business cycles has decreased due to belonging to a common monetary area, the distances between business cycles remain high. A similar divergence was seen among CEE economies, Romania and Bulgaria being more correlated with the southern countries, especially Greece, which is the most divergent economy of the monetary union. Most of the structural characteristics of the two economies, such as the capacity for innovation, access to new technologies, and business digitalisation, bring them closer to southern countries and not to continental or northern European countries. In contrast, the other CEE countries included in this study, Hungary, Poland, and the Czech Republic, have become increasingly synchronised with the euro area as a whole, respectively, with its core, as a result of significant integration from an investment, trade, and financial point of view with developed European economies. The single currency adoption will automatically be more expensive in CEE countries with technological and investment deficits, specific structural weaknesses, and macroeconomic imbalances, as in Romania's case.

As we showed in our study, the European economies are more synchronised during periods of economic expansion due to the improvement of the business climate and the significant reduction of risks, respectively less synchronised when they are affected by specific shocks, such as the global financial crisis and the sovereign debt crisis. Typically, economically more vulnerable countries, such as some of the Southern and CEE countries, tend to experience capital outflows when global economic shocks occur, which increases their financing cost and affects their growth model from the economic boom period, revealing neglected imbalances in the context of a favorable economic evolution.

Another contribution of this study, which may be explored in other European monetary integration studies, is to point out that the deepening of an optimal currency area leads to business cycle synchronisation. Thus, as a result of the pandemic crisis, but also of the military conflict in Ukraine, several packages of common measures have been adopted at the European countries level, financed by issuing European bonds, which can lead to better coordination of member countries' responses to shocks and improving perceptions of the sustainability and expansion of the monetary union. Compared to the previous two crises specific to the existence of the monetary union, the pandemic crisis no longer generated the accentuation of cyclical divergences between countries but, on the contrary, a more robust business cycles synchronisation.

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