

Business Cycle Similarity Measuring in the Eurozone Member and Candidate Countries: An Alternative Approach¹

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Abstract

The article sheds some light on the process of measuring business cycle similarity and points out the fact that contemporary studies usually simplify this problem by measuring a simple correlation of cyclical development in GDP. The main goal is to assess the level of business cycle similarity in selected Eurozone member and candidate countries using the Concordance index. The article also includes a comparison of the Concordance index technique with traditional correlation methods. The results show that the Czech Republic belongs to the states with relatively high level of concordance comparing to the other Eurozone member and candidate countries. The resulting concordance measures also give an evidence of relatively low level of the business cycle similarity of Slovak economy and the Eurozone.

Keywords: *business cycle, concordance index, correlation analysis, optimum currency area*

JEL Classification: E32, F41

Introduction

The Central and Eastern European Countries (CEECs) that enlarged the European Union in 2004 are facing the question of appropriate timing for joining the Eurozone. The adoption of the Euro is an integral and also obligatory strand of Economic and Monetary Union (EMU) membership. Joining the Eurozone is

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conditioned by fulfilling the Maastricht criteria assessing the level of nominal convergence. Moreover, the preparedness of the candidate countries to adopt the Euro is assessed by alternative measures.

A discussion on the suitable moment for the Euro adoption involves a great deal of empirical studies focusing on the assessment of various indicators of the structural and cyclical similarity among the candidate and member economies. A vast majority of such academic studies and convergence reports are based on theoretical and methodological foundations of the Theory of Optimum Currency Areas (OCA). This theory was proposed by the Nobel Prize laureate Robert Mundell in his classic article in 1961. The characteristics of optimum currency areas, which determine an effective formation of a common currency area, are classified and characterized in that paper. Besides Mundell, the list of original OCA characteristics is defined by the other authors and pioneers of this theory such as McKinnon (1963), Kenen (1969) or Ingram (1962). The criteria of labour mobility, the openness of an economy, commodity diversification of production and consumption, fiscal integration, inflation rates similarity and financial markets integration are involved within classical OCA list. Although the original OCA papers and namely Mundell's study theoretically explain the need of fulfilling the OCA criteria in order to minimize the risk of asymmetric shocks occurrence, a later approach to OCA theory called the "New" Optimum Currency Areas Theory" (Mongelli, 2002) focuses on empirical testing of the criteria. The New OCA theory approach brings many studies dealing with testing the OCA characteristics including business cycle similarity, a/symmetry of shocks occurring within the acceding economies, which covers the influence of the initial characteristics from the traditional OCA list (mentioned above). The similarity of business cycles belongs to the characteristics defined in details in the frame of the New OCA theory. From the perspective of the OCA theory the synchronized business cycles² minimize the risk of asymmetric shocks occurrence, which do not affect the member countries equally.³ Similar cycles also reduce the necessity of national autonomous monetary policy conduct.⁴

The majority of contemporary studies dealing with business cycle similarity of the Eurozone member and candidate countries use the correlation analysis approach. The individual analytical reports assessing correlation of the cycles

² Similar and synchronised business cycles are considered as synonymous in the paper.

³ A detailed analytical study of an asymmetric shock resulted from the German re-unification provides Kouba (2010). In his study he analyses also the institutional aspects of the transformation and integration processes in the Central and Eastern Europe.

⁴ Assessing the asymmetry of shocks we might take into account an influence of the global economic crisis as a kind of symmetric shock affecting the countries in the common sense but with dissimilar intensity. Šikula (2009) provides an overview of dissimilarities in the global economic crises.

usually differ only in selection of the input data and the way of adjusting data (filtering technique). The studies on business cycle similarity became popular in connection with the European Union and also Eurozone enlargement processes in the past decade. Fidrmuc and Korhonen (2006) summarize the existing studies through their meta-analysis approach. The authors point out significant differences in the studies measuring the business synchronization. The optimum currency area theory does not specify a unified concept or methodology how to measure the business cycle similarity. Therefore all the studies focusing on the same topic of business cycle similarity may substantially differ. In addition to that, these methods actually measure the correlation of the cyclical path of the selected indicator (gross domestic product – GDP, industrial production etc.) approximating the overall economic activity of a nation. The correlation method does not include identification of the business cycle itself. Such identification would consist of the indication of turning points and different phases of a cycle. The concordance index technique is considered as an alternative but rarely used approach to measure the business cycles synchronization. The concordance technique requires identifying the turning points and phases of the analysed business cycle first by contrast to the traditional correlation approach.

The purpose of the paper is to assess the level of similarity of business cycles of the selected Central and Eastern European Countries and the Eurozone member states' economies by application of the Concordance index technique. Except from the introduction, the structure of the paper is composed of four main parts. Firstly, the data and methodology are explained. The second part includes the application of the traditional approach of correlation analysis on a sample of selected Eurozone candidate and member countries. The Concordance index technique is applied in the fourth part of the text. Finally, concluding remarks are summarized.

Data and Methodology

The aim of the paper is to evaluate actual business cycle similarity in the Eurozone member states with the selected countries of Central and Eastern European Countries applying for full EMU membership. An indicator of aggregate economic activity approximating the business cycles – gross domestic product (measured in constant prices, seasonally adjusted) is used for the measurement of business cycles similarity.

Two alternative approaches are also applied to the business cycles identification. Such approaches are currently considered as predominant identification techniques in economic theory. The *classical approach* defines a business cycle as a cyclical fluctuation covering the decline and growth in an absolute level of

aggregate economic activity of a nation (Burns and Mitchell, 1946). The growth cycle approach is an alternative to the classical cycle. The growth (deviation) cycle specifies business cycles as cyclical fluctuations in the cyclical component of an economic variable around its trend (Lucas, 1977). The later approach therefore needs the application of selected time series detrending techniques. Growth cycles are often identified in recent economic literature, which usually includes subsequent correlation analysis.

The alternative methods of measuring the similarity of business cycles are used in the analytical part. Namely, the traditional correlation analysis and the Concordance index technique, including the identification of the turning points and individual phases of the cycle, were applied to assess the current similarity of the sample.

Our data set includes adjusted time series of quarterly GDP in the period 1996 – 2009. The Eurostat was the data source. The data set comprises the natural logarithms of indicators, which are subsequently stylized with the first order differences procedure, which is partially in line with the presumptions of the classical approach to business cycle identification. The data were also detrended with Hodrick-Prescott filter (HP) applying parameters $\lambda = 1\ 600$ for quarterly data and Christiano-Fitzgerald band-pass filter (BP). Three different detrending techniques were used to modify the input data series in order to identify the classical and growth business cycles in line with the theoretical definitions by Burns and Mitchell (1946) and Lucas (1977). The selection of Central and Eastern European countries covering Hungary, Poland, Slovakia, Slovenia and Czech Republic was done in relation to former intensive economic and political relations as well as to a similar position at the beginning of the transformation period in 90's. Although Slovenia and Slovakia have only been members of the Eurozone since 2007 and 2009 respectively, they were candidate countries during the majority of analyzed time period. Thus, it will be useful to compare the similarity of their business cycles with the Eurozone together with the other Central and Eastern Europe (CEE) candidate countries. As inspired by Artis and Zhang (2001) the sample of selected countries consists of the core as well as the periphery of the Eurozone. The set of Eurozone member countries is composed of the core countries Germany and France representing the leading economies in terms of GDP per capita and their trade relations to other Eurozone member countries. The periphery countries, namely, Spain and Portugal were also included due to their lower GDP per capita which is comparable to current economic level of converging candidate countries. Finally, the selection of Eurozone countries is completed with Austria due to its structural similarity to the Czech, Slovak and possibly Hungarian economy.

The Traditional Approach: Correlation of Business Cycles

The correlation analysis is the most usual method to measure the business cycle similarity today. In fact, it just measures the level of linear association between selected time series of the input variable. It actually does not identify the business cycle, its turning points and phases. On the contrary the concordance technique measures the business cycle synchronization based on the identification of the phases of the cycle. The resulting correlation coefficients⁵ indicate the intensity of association between the aggregate activity (GDP) time series of the compared economies within a whole analyzed time period. Tables 1 – 2 characterize cross correlation between all researched countries and describe actual similarity of the business cycles. Thus, the results in the tables describe the model situation of cycle similarity assessment in the case of Eurozone enlargement at the end of 2009 respectively in the beginning of 2010.

Table 1

Cross Correlation of Classical GDP Cycles in the Period 1996 – 2009 (differenced time series)

	AT	CZ	DE	EA	ES	FR	HU	PL	PT	SI	SK
AT	1										
CZ	0.52***	1									
DE	0.68***	0.52***	1								
EA	0.68***	0.42***	0.85***	1							
ES	0.76***	0.50***	0.61***	0.74***	1						
FR	0.73***	0.37***	0.70***	0.79***	0.74***	1					
HU	0.71***	0.44***	0.60***	0.67***	0.85***	0.73***	1				
PL	0.30**	0.12	0.19	0.22	0.25*	0.28**	0.14	1			
PT	0.56***	0.21	0.49***	0.48***	0.51***	0.52***	0.43***	0.22	1		
SI	0.72***	0.55***	0.68***	0.65***	0.67***	0.65***	0.65***	0.16	0.47***	1	
SK	0.32**	0.50***	0.30**	0.20	0.25*	0.18	0.25*	-0.16	0.19	0.40***	1

Note: */**/** denote significance at the 10%, 5%, 1% levels.

Source: Eurostat; authors' calculations.

Table 2

Cross Correlation of Growth GDP Cycles in the Period 1996 – 2009 (HP filter, BP filter)

HP/BP	AT	CZ	DE	EA	ES	FR	HU	PL	PT	SI	SK
AT	1	0.75***	0.85***	0.85***	0.96***	0.96***	0.92***	0.75***	0.91***	0.90***	0.61***
CZ	0.75***	1	0.93***	0.91***	0.85***	0.78***	0.69***	0.43***	0.73***	0.83***	0.58***
DE	0.85***	0.82***	1	0.97***	0.93***	0.87***	0.84***	0.65***	0.83***	0.93***	0.70***
EA	0.81***	0.82***	0.95***	1	0.94***	0.88***	0.83***	0.63***	0.85***	0.91***	0.68***
ES	0.92***	0.89***	0.88***	0.89***	1	0.95***	0.93***	0.74***	0.90***	0.95***	0.67***
FR	0.92***	0.77***	0.87***	0.88***	0.91***	1	0.89***	0.77***	0.91***	0.83***	0.51***
HU	0.78***	0.82***	0.71***	0.73***	0.89***	0.76***	1	0.73***	0.89***	0.88***	0.69***
PL	0.70***	0.40***	0.60***	0.51***	0.61***	0.65***	0.46***	1	0.62***	0.67***	0.35***
PT	0.81***	0.57***	0.78***	0.75***	0.72***	0.80***	0.52***	0.58***	1	0.83***	0.61***
SI	0.88***	0.84***	0.88***	0.85***	0.93***	0.82***	0.84***	0.60***	0.70***	1	0.82***
SK	0.63***	0.65***	0.63***	0.58***	0.67***	0.51***	0.68***	0.37***	0.49***	0.78***	1

Note: */**/** denote significance at the 10%, 5%, 1% levels.

Source: Eurostat; authors' calculations.

Table 1 reports cross correlation coefficients of quarterly GDP series in first differences, which represents here the classical business cycle. Tables 2 shows the correlation of the growth cycles using the Hodrick-Prescott filter (south-western part) and Christiano-Fitzgerald band-pass filter (north-eastern part). Results of correlation in GDP cycles provide different results when various detrending techniques are applied. Comparing the results of classical and growth business cycles correlation we can notice generally higher correlation coefficients in case of the growth approach. Correlation of the classical cycles using the differenced time series provides lower coefficients than the cycles generated through Hodrick-Prescott and Christiano-Fitzgerald filter. Whereas the latter two filters reveal similar and higher standard deviation and produce similar cycles, first differences usually reveals a lower volatility in the series with higher frequencies. According to Baxter and King (1999), who introduce their own band-pass filter modification,⁶ the frequent turning points result from the fact, that differenced time series emphasizes the high frequencies and down weights the lower frequencies in the initial time series. HP filter works as a high-pass filter which leaves the higher frequencies component in the time series whereas the band-pass removes them. HP produces little higher volatility than BP because GDP and other indicators of aggregate economic activity do not have much of high frequency components. The lower correlation in differenced time series cycles is due to removing the low frequencies of the time series and overweighs the high frequencies with very low intensity of association. This is why the differenced time series reveal very low autocorrelation within the analyzed time series and also low correlations of the input time series.

Baxter and King (1999) recommend using the HP and BP filters rather than the first differencing technique. However, the first order differencing of logarithms of the input data produces the growth rates of the indicators. The correlation of growth rates of real output as well as detrending techniques belongs to the most used techniques of measuring the GDP cycles similarity by the central banks as well as academic researchers. Therefore we might expect that the studies

⁵ The resulting correlation coefficients characterise linear association between two (or more) economic time series in the range of $<-1, 1>$. Positive correlation indicates that the researched time series vary in the same direction whereas negative correlation describes the opposite direction of the time series varying. Low value of correlation coefficient may not mean weak association. There could still be high non-linear association between variables. The precondition of sufficiently long-time series is important as well as indication of spurious correlation resulted from existing dominant trend in the series are also important for correct measurement among others.

⁶ Initially, the author worked with the band-pass filter in the Baxter-King modification (using the Matlab program). However, this filter needs to cut off three years at the beginning and the end of the data series to dissect the cyclical component. Considering rather short data series of macro-economic indicators available in case of the central and eastern European countries, the Christiano-Fitzgerald band-pass filter was finally used.

on business cycle similarity will still produce different results and interpretations provided that the selected filtering techniques of the input data time series differ. This is actually a reason why we try to use the concordance index approach to measure the business cycle similarity.

Table 1 indicates low correlation of cycles in the candidate countries and the Eurozone or Germany. Slovenia and Hungary reaches the highest correlation coefficients among the CEECs. Czech Republic and Slovakia (as a representative of a new member of the Eurozone) reveal relatively low correlation (comparing to the Eurozone member countries) around 0.5. Analyzing the growth cycles correlation we can get rather different results. The Czech Republic reaches high levels of correlation (0.82 and 0.91 in cases of HP and BP filters respectively). Also Slovenia reveals highly correlated cycles. Poland and mainly Slovakia seem to be rather less correlated.

The Concordance Index Technique

Comparing to the traditionally used correlation method to assess the similarity of business cycles, the Concordance index technique is a rarely used approach. However, this technique is slowly being taken into account by an increasing number of authors.⁷

The Concordance index represents a simple empirical measure of a similarity which “...*basically indicates the proportion of time for which the countries have shared the same cycle phase*” (Artis, 2003, p. 8). The resulting values range in $\langle 0; 1 \rangle$ or $\langle 0\%; 100\% \rangle$ as an indication of the fraction (percentage) of the whole time period that the countries have gone through for the same phases of their business cycles. Although the measure was mainly applied on the classical cycles, the growth cycles application has recently become more popular. The precondition of the Concordance technique is the identification of the turning points and related phases of the cycle in the analyzed time period. The identified phases are modified into a binary series (1; 0) subsequently. The binary indicators suggest the identified phases of recession (1) or expansion (0) in the cycle. Harding and Pagan (2002; 2006) propose a simple measure of concordance through the following equation:

$$I_{ij} = \frac{1}{T} \sum_{t=1}^T [S_{it}S_{jt} + (1 - S_{it})(1 - S_{jt})]$$

$S_{it} = 1$ (for $t = 1, \dots, T$ and $i = 1, \dots, N$) indicates, that the country i is experiencing a recession in the time period t , whereas $S_{it} = 0$ indicates an expansion).

⁷ For Instance the Concordance Index measure is involved in Artis (2003) complementing the official report of HM Treasury on preparedness of Great Britain to adopt Euro.

The sufficiently long time series of the indicators available at the official statistical authorities are likely the reason for the rare use of the Concordance index technique. Lower harmonization of the statistical methods (collection, processing and stylizing the data) in the CEECs are also considered a problem. As far as short available time periods of indicators were mentioned, it is the classical cycles in the CEECs, which are especially difficult to indicate. Artis, Marcellino and Proietti (2004) state that post communist countries went through maximally one completed classical business cycle in the transformation period. The authors suggest analyzing solely the similarity of the growth cycles with respect to the dominating growth trend within the time series. Regarding the transformation process the results become more reliable the longer the time series we can get from the official statistics. Accordingly, a wider use of the concordance technique, even applied on the classical cycles of the CEECs, might be expected in the forthcoming future.

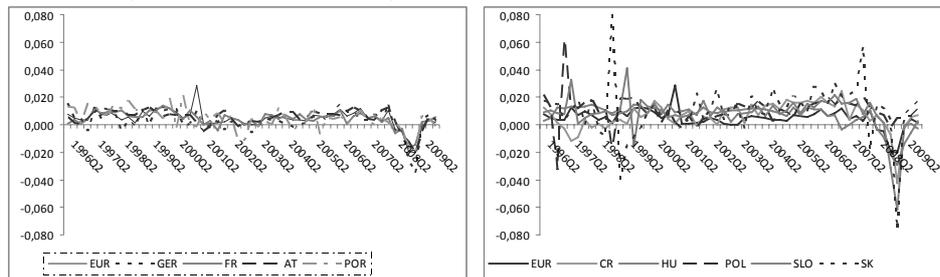
Before applying the Concordance technique to measure the similarity of the cycles we have to identify the turning points and the phases of recession and expansion of the business cycle. To identify the cycle the rules defined in Canova (1999) were used. According to these rules, the peak of the cycle is foregone by two rises in the cyclical component of the time series c (identified by the Hodrick-Prescott filter or the band-pass filter) and then at least two subsequent declines in quarterly GDP follow, which could be written as $c_{t+1} < c_t > c_{t-1} > c_{t-2}$. On the contrary, the bottom (trough) is defined by two consecutive decreases in the cyclical component followed by its rise – written in symbols $c_{t+1} > c_t < c_{t-1} < c_{t-2}$. For the identification of peaks and troughs the condition of intersecting the trend $c_t <(>) 0$ a $c_{t-1} <(>) 0$ or $c_{t+1} <(>) 0$ a $c_t <(>) 0$ must also be fulfilled. Finally the minimum length of a cycle phase of 6 months and a total cycle of 15 months is also required.

Whereas the identification of the classical cycle through the first order differencing procedure generates the business cycle with frequent turning points and lower standard deviation, the growth cycles clearly illustrate rather smooth and regular fluctuations of the cyclical component around its trend separated with the chosen filtering techniques. The differenced time series (growth rates) and the Hodrick-Prescott filter belong among the most often used filtering techniques in the economic literature. The band-pass filters have become quite popular recently. The theory of optimum currency areas does not specify clearly how to measure the business cycle similarity. It does not define how to identify the cycles neither. Thus, three different filtering techniques were used for the business cycles identification and measuring similarity to get more robust significant results. Figures 1 – 3 characterize the business cycles synchronization of the CEECs

and selected member countries to the Eurozone. The classical cycles comparison identified with differencing technique is illustrated in the Figure 1. Figures 2 and 3 compare the growth cycles of the Czech economy and the Eurozone with Hodrick-Prescott filter and Christiano-Fitzgerald band-pass filter respectively.

Figure 1

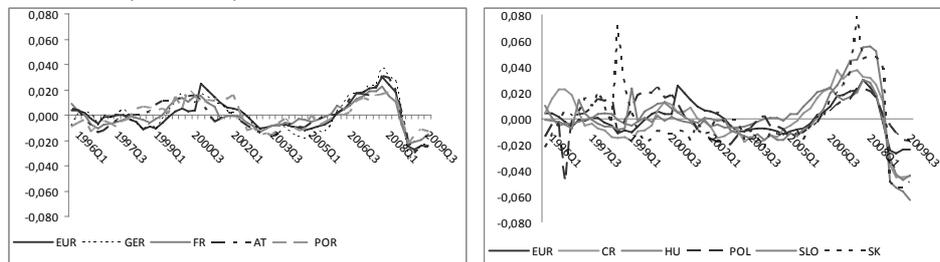
Classical Business Cycles of the Original Eurozone Member States and CEE Countries (differenced time series) in 1996 – 2009



Source: Eurostat; authors' calculations.

Figure 2

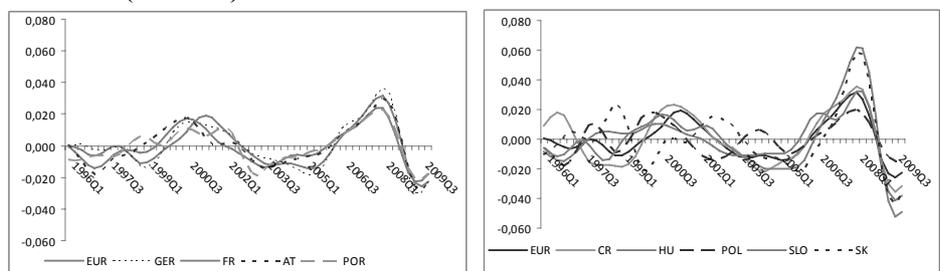
Growth Business Cycles of the Original Eurozone Member States and CEE Countries (HP filter) in 1996 – 2009



Source: Eurostat; authors' calculations.

Figure 3

Growth Business Cycles of the Original Eurozone Member States and CEE Countries (BP filter) in 1996 – 2009



Source: Eurostat; authors' calculations.

An increasing similarity between the classical as well as growth cycles of the Eurozone and the Czech Republic in the second part of analyzed time period is obvious in the Figures 1 – 3. Different cycles in the beginning of the period likely resulted from an intensive transformation process in the Czech economy at the beginning of nineties in the last century. It included price and trade liberalization, industrial restructuring, the privatization of the state factories connected with high foreign capital inflows etc. All the mentioned factors mainly contributed to the formation of the Czech national economy in the transformation period and influenced the trends in inflation, unemployment, GDP growth as well as the business cycle. Higher similarity in the second part of the period is in line with a continuous integration process and more intensive economic and trade links between the Czech Republic and the rest of European Union. The current global economic downturn is also obvious namely in the case of classical cycles. In all three cases the Czech and Slovak economies seem to suffer from the output drop rather more than the Eurozone. Business cycles of Slovakia reveal larger deviations from trend than Czech and Eurozone economies. Especially the upturn phases are higher due to fast economic growth of Slovak economy in the past years (before the global crises started). On the other hand, the business cycles of Slovak economy seem rather less synchronized with the Eurozone. Comparing the similarity of the Eurozone member countries and selected CEECs we can notice higher volatility of the CEE cycles. Particularly the classical CEE cycles reveal apparently larger deviations from trend than the Eurozone members' cycles. The concordance calculations in the following part will describe the level of business cycle synchronicity in more details. The Tables 4 – 6 present the results of cross concordance indices of the selected Eurozone member and candidate countries. The classical and growth cycles were identified with the rules for the turning points identification defined in Canova (1999).

Table 3 includes the concordance indices of the classical cycle (GDP) using the differenced time series. Table 4 shows the concordance indices of the growth cycles (GDP) when the Hodrick-Prescott (south-western part) and Christiano-Fitzgerald band-pass (north-eastern part) filters were applied. The turning points identification analysis confirmed the conclusion by Artis (2004) of minimum number of completed cycles during the transformation period in the Central and Eastern European countries. Majority of analyzed economies went through one or two completed classical or growth business cycles in the period 1996 – 2009. Comparing the concordance results of the classical and growth cycles, we can note generally higher concordance indices in case of the classical cycles. The reasons are the longer phases of expansion and shorter recessions when the increasing long-term GDP trend (potential output) is observed in the time series. Accordingly,

the countries share the same phase of the cycle (expansion) for a longer time, which increases the concordance measures. The detrending techniques of HP and BP filters separate the long-term trend in the GDP time series which eliminates the problem of longer expansions in the case of the growth cycles.

Table 3

Cross Concordance Indices of the Classical Business Cycles of the Eurozone Member and Candidate Countries in the Period 1996 – 2009 (differenced time series)

FOD	AT	CZ	DE	EA	ES	FR	HU	PL	PT	SI	SK
AT	1										
CZ	0.82	1									
DE	0.84	0.73	1								
EA	0.95	0.84	0.89	1							
ES	0.91	0.80	0.85	0.96	1						
FR	0.93	0.82	0.91	0.98	0.95	1					
HU	0.89	0.78	0.84	0.95	0.95	0.93	1				
PL	0.89	0.82	0.84	0.91	0.87	0.93	0.85	1			
PT	0.82	0.71	0.95	0.84	0.84	0.85	0.78	0.82	1		
SI	0.91	0.84	0.82	0.93	0.96	0.91	0.91	0.91	0.84	1	
SK	0.73	0.80	0.67	0.75	0.71	0.76	0.69	0.84	0.65	0.75	1

Source: Eurostat; authors' calculations.

Table 4

Cross Concordance Indices of the Classical Business Cycles of the Eurozone Member and Candidate Countries in the Period 1996 – 2009 (HP filter, BP filter)

HP/BP	AT	CZ	DE	EA	ES	FR	HU	PL	PT	SI	SK
AT	1	0.70	0.66	0.70	0.89	0.96	0.95	0.75	0.80	0.77	0.52
CZ	0.66	1	0.93	0.86	0.77	0.66	0.68	0.59	0.64	0.79	0.57
DE	0.71	0.66	1	0.89	0.73	0.63	0.64	0.66	0.57	0.86	0.61
EA	0.77	0.68	0.77	1	0.77	0.66	0.68	0.70	0.61	0.89	0.57
ES	0.73	0.68	0.70	0.93	1	0.86	0.88	0.71	0.70	0.77	0.52
FR	0.89	0.66	0.64	0.70	0.66	1	0.91	0.71	0.77	0.73	0.48
HU	0.71	0.66	0.64	0.55	0.59	0.68	1	0.73	0.79	0.75	0.54
PL	0.75	0.73	0.71	0.52	0.55	0.71	0.82	1	0.63	0.73	0.48
PT	0.66	0.50	0.80	0.57	0.57	0.59	0.73	0.73	1	0.57	0.68
SI	0.80	0.79	0.66	0.82	0.86	0.70	0.66	0.66	0.54	1	0.57
SK	0.61	0.77	0.68	0.55	0.59	0.61	0.86	0.79	0.73	0.66	1

Source: Eurostat; authors' calculations.

The core countries of the Eurozone reveal higher classical business cycle concordance. As for the candidate and new Eurozone member countries, Hungary and Slovenia show highly similar business cycles to the Eurozone. Surprisingly, Slovakia (0.75) and Czech Republic are less synchronized with the Eurozone among the selected CEE countries. Evaluation of the growth cycles concordance (Tables 5 and 6) takes into account the fact of eliminated long-term trend in the analyzed time series. We can confirm high business cycle synchronization among the traditional Eurozone member states such as Germany, France and Austria. The Czech Republic shows relatively high levels of concordance 0.68

(HP filter) and 0.86 (BP filter). These numbers mean that the Czech Republic shared the same phase of the cycle with the Eurozone during 68% (or 86%) of the analyzed period 1996 – 2009. Both new Eurozone member states show interesting results among the states that went through the transformation period in the last decade. Whereas Slovenia reveal stable high levels of concordance (0.82 and 0.89), Slovakia has the least synchronized cycle (0.55 and 0.57). In real this means that the Slovak economy shared the same phase of the cycle with the Eurozone roughly only half of the analyzed period. However, this result cannot be interpreted ultimately concluding with a low synchronicity of the Slovak cycle to the Eurozone. Firstly the differences are rather small and secondly the Concordance results for Slovakia are comparable to those of France and Portugal with Germany, which are traditional Eurozone members.

Conclusion

The concordance index represents an alternative approach to measuring the business cycle similarity. The resulting concordance measures indicate a high level of business cycle synchronicity among the traditional Eurozone member countries Germany, France, Austria and also a new member Slovenia. Slovenia was a candidate country during the majority of the analyzed period. In spite of the fact that Slovenian economy went through the transformation process in the last decades similarly as the other Central and Eastern European countries, Slovenia shows stable higher levels of classical and growth business cycle concordance among the former centrally planned economies. The similarity of Slovenian cycle to the Eurozone is comparable to the other Eurozone member countries. Czech Republic reveals relatively high level of concordance, which implies that it followed the same phase of the business cycle with the Eurozone during the majority of analyzed period. Slovakia as a new member of the Eurozone shows relatively low level of classical and growth business cycle similarity to the Eurozone. However, the differences are relatively small and in addition they are comparable with concordance results for France, Portugal and other Eurozone countries. Therefore it might be difficult to assess Slovakia as a less suitable for the common monetary union with the rest of the Eurozone. It will be interesting to look at the future evolution of the business cycle of the Slovak and other converging economies, because the measure of concordance should improve according to the optimum currency areas endogeneity theory (Frankel and Rose, 1998). The Slovak business cycle should become more synchronized to the Eurozone provided that the integration process will continue and the business and economic relation to the Eurozone will become more intensive.

Comparing the results of business cycle concordance to the traditional correlation approach we can conclude that there are obvious differences in results of both approaches. Particularly in case of classical cycles the results differ substantially. Correlation of classical cycles reports relatively low similarity of the CEECs with the Eurozone. In addition, higher correlation among the Eurozone countries than the CEECs is obvious. On the contrary, concordance of classical cycles does not indicate significant differences between the core, periphery of the Eurozone and the CEECs. Similarly, the growth cycles correlation shows higher similarity of the Eurozone member countries than the CEECs with the Eurozone average or Germany. Concordance index does not show such significant differences between the member and non-member countries. Considering the individual countries results of business cycles similarity measuring, we can point out that apart from the original Eurozone member countries, particularly Germany, France as a core of the Eurozone, also Austria and Slovenia reveal high correlation. Growth cycles of the Czech Republic are also relatively highly synchronized to the Eurozone and Germany. Slovakia that adopted the Euro in 2009 has substantially less synchronized cycles to the Eurozone than Czech Republic and the Eurozone member countries mentioned above.

The results also shed some light on a possible influence of selected detrending techniques allowing identifying the classical and growth cycles. The resulting concordance indices reaches higher levels of concordance in case of classical cycles because of an influence of an increasing long-term in GDP time series. In case of growth cycles the impact of trend is eliminated through applying the appropriate detrending techniques.

From the prospect of the optimum currency areas theory the numerical results of the concordance measure the Czech Republic belongs among the states with relatively high level of synchronization. Thus, the OCA criterion of business cycles similarity should not serve as an argument for slowing down the process of monetary integration in the Czech Republic. On the contrary, a low synchronicity of the Slovak business cycle with the Eurozone might imply a higher risk of the asymmetric shock occurrence.

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