

BUSINESS CYCLE COHERENCE AND OCA ENDOGENEITY TESTING DURING THE INTEGRATION PERIOD IN THE EUROPEAN UNION

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Abstract

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The paper deals with assessing the EU from the new optimum currency area theory perspective. It focuses on measuring of the business cycle coherence applying the composite indicators of output gap similarity and synchronicity. Static as well as dynamic business cycle analysis is applied in the paper. In addition, the OCA endogeneity hypothesis is tested based on results of the business cycle coherence analysis. The results show high general coherence of the business cycles across the EU countries in terms of synchronicity measures. Detailed analysis of the output gap similarity indicates differences in the scale of cyclical deviations and impact of shocks in individual countries in the EU. Also the ability to cope with the crisis as a kind of external shock differs in the EU countries. The results do not provide a clear evidence of the OCA endogeneity hypothesis related to the Euro area member and non-member countries.

business cycle coherence, Euro area, global financial crisis, optimum currency area theory

Europe has been hit with few types of crises recently. One might see the influence of global economic crises, which pushes most of countries into the same phase of a business cycle, particularly recession or stagnation. Also there is the debt crisis, which brings painful solution in terms of decreasing government expenditures and transfer payments. Such situation leads to a rather frustrating atmosphere in the EU, which supports spreading of the crisis of confidence. Today the government bonds are not automatically considered to be the safe assets for investors as the economics textbooks used to teach in the past. Not only relatively small or less developed countries such as Ireland, Portugal or Greece request the international financial aid to get over the liquidity shortages. In addition, the large economies including Italy and Spain seem to face serious problems. Accordingly, there is no wonder that some of the Central and Eastern European Countries (CEEC) such as Czech Republic, Poland or

Hungary still do not consider an explicit obligatory date of adoption the Euro. However, focusing on the Czech Republic the fear from the Euro is dated to times before the crisis.

From a theoretical point of view the argument against enlarging the Euro area by the CEE countries is that the EMU is not an optimum currency area. Such a theory proposed by R. Mundell in his pioneering article published in 1961 (Mundell, 1961) defines criteria for the currency area member states to minimize the costs of fixed exchange rate and common currency respectively. Subsequent contributors McKinnon (1963), Ingram (1962) or Kenen (1969) augment the list of OCA criteria. The recent approach titled as “New” optimum currency area theory prefers an empirical approach to testing the OCA optimality (Tavlas, 1993; Mongelli, 2002, 2008). The business cycle similarity and shock asymmetry are stressed as the OCA “metacriteria” in this new approach. Regarding the new OCA

theory the general pessimistic and refusing mood regarding the Euro in the Czech economic society and academia is often based on an argument of dissimilar business cycles to the rest of the Euro area.

There is a wide range of literature and research dealing with the issue of economic similarity measured traditionally with the business cycle correlation. Lots of recent studies also assessed the business cycle similarity with a special focus on the CEE countries. Fidrmuc and Korhonen (2006) or De Haan *et al.* (2008) notice that there are few characteristics such as method to measure similarity, detrending technique, data and results, which make the studies on business cycles different. Majority of studies apply traditional correlation approach using the time domain filters such as Hodrick-Prescott filter or first differencing technique. A number of studies including Wynne and Koo (2000) or Gouveia and Correia (2008) prefer applying the frequency domain filters such as Christiano and Fitzgerald or Baxter-King band pass filters. Harding and Pagan (2002, 2006), Artis and Zhang (1997) and Rozmahel and Najman (2011) apply the alternative measure of business cycle similarity based on the Index of Concordance. Contrary to the correlation method the Concordance Index needs the turning points and phases of the cycles to be indicated first in the analysis. Next, the fraction of time the countries share the same phase of the cycle is estimated. Comparing approaches to business cycle similarity measuring we should also put some stress on different technical definitions of business cycles in literature. From a technical point of view the classical cycles present fluctuations including the decline and growth in an absolute level of aggregate economic activity of a nation. 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. The later approach therefore needs the application of selected time series detrending techniques.

According to studies by De Haan *et al.* (2008) or Fidrmuc and Korhonen (2006) the growth cycle analysis predominates in economic literature. King and Rebelo (1993) consider using stationary time series in case of growth cycle analysis to be the most important advantage of this approach. In addition, Artis (2004) concludes that Central and Eastern European Countries are characterised with high growth trends. Therefore he considers appropriate to use the growth cycle analysis or those countries. On the contrary, there are still influential studies such as Bordo and Helbling (2010), Giannone *et al.* (2008), Ozyildirim *et al.* (2010) and other papers with sufficiently long time series using classical cycle analysis. The Pearson correlation coefficient measuring correlation of dissected cyclical components in analysed time series is prevailing as the main business cycle similarity measure in

literature as concluded in De Haan *et al.* (2008), Flood and Rose (2010) or Mink *et al.* (2012).

Regarding the recent evolution in the business cycle similarity analysis, we should mention the alternative approaches such as Wälti (2012) or Mink *et al.* (2012) to traditional correlation method. Mink *et al.* (2012) distinguish between the output gap synchronicity and similarity. The measure of synchronicity examines the fraction of time the countries appear jointly above or under the trend. The similarity index compares the extent of deviation from trend. Resultant composite measure consisting of the synchronicity as well as similarity indicator takes differences in the signs and amplitudes of the output gaps more adequately into account than correlation. The composite business cycle coherence indicator proposed by Mink *et al.* (2012) was applied in this paper.

In our paper we aim to contribute to current discussion on assessment of the Euro area from the new OCA theory perspective. We focus on business cycle coherence measuring using composite indicators of output gap synchronicity and similarity. In addition, to that we applied our original simple measure of the OCA endogeneity hypothesis to detect the influence of the Euro area membership on business cycle coherence in analysed period.

The paper is structured as follows. The introductory part provides the research motivation and review of related literature. The main goal, research questions and used methods are introduced in the second section. The results of the business cycle analysis are described in the third section. The fourth section concludes.

OBJECTIVE AND METHODS

The paper focuses on assessing the business cycle coherence in the EU from the perspective of the new theory of optimum currency areas theory. Particularly, the position of the Czech Republic and other CEEC was examined. The goal is also to assess the dynamics of business cycle coherence over time with a special focus on the influence of the main historical milestones such as the EU enlargement in 2004 or a beginning of global financial crisis in 2008. Using alternative composite indicators suggested by Mink *et al.* (2012), consisting of the output gap similarity and synchronicity measures a static as well as dynamic business cycle coherence analysis was done. A general research question whether the current EU 27 appears as an optimum currency area applying the business cycle coherence measures should be answered. Using the dynamic analysis we also ask whether there is an obvious impact of the EU enlargement and financial crisis on the business cycle coherence across the EU countries. In addition to that, the OCA endogeneity hypothesis was tested. Using a simple measure based on the output gap similarity and synchronicity results we examined the influence of staying in or out of the Euro area upon the business cycle coherence over time.

The indices of output gap synchronicity ϕ and similarity γ suggested by Mink *et al.* (2012) were applied to estimate the business cycle coherence. The coherence of the EU member country i and the benchmark r represented by the enlarging Euro area was measured.

$$\phi_{ir}(t) = \frac{g_i(t)g_r(t)}{|g_i(t)g_r(t)|} \quad (1)$$

$$\gamma_{ir}(t) = 1 - \frac{|g_i(t) - g_r(t)|}{|g_i(t) + g_r(t)|}, \quad (2)$$

where the $g_i(t)$ is the cyclical component of the analyzed GDP time series of a country (i) in selected time period (t) and a $g_r(t)$ refers to the cyclical GDP component of the reference country (r) in a given time period (t). The synchronicity and similarity indices were modified with

$$\frac{\phi_{ir} + 1}{2}, \text{ and } \frac{\gamma_{ir} + 1}{2}$$

to be scaled as $<0; 1>$. The modified indices indicate the fraction of time (percentage) at which the analysed countries share the same phase of a business cycle. A simple measure of OCA endogeneity hypothesis was applied to get some evidence on the common

currency influence upon the business cycle coherence.

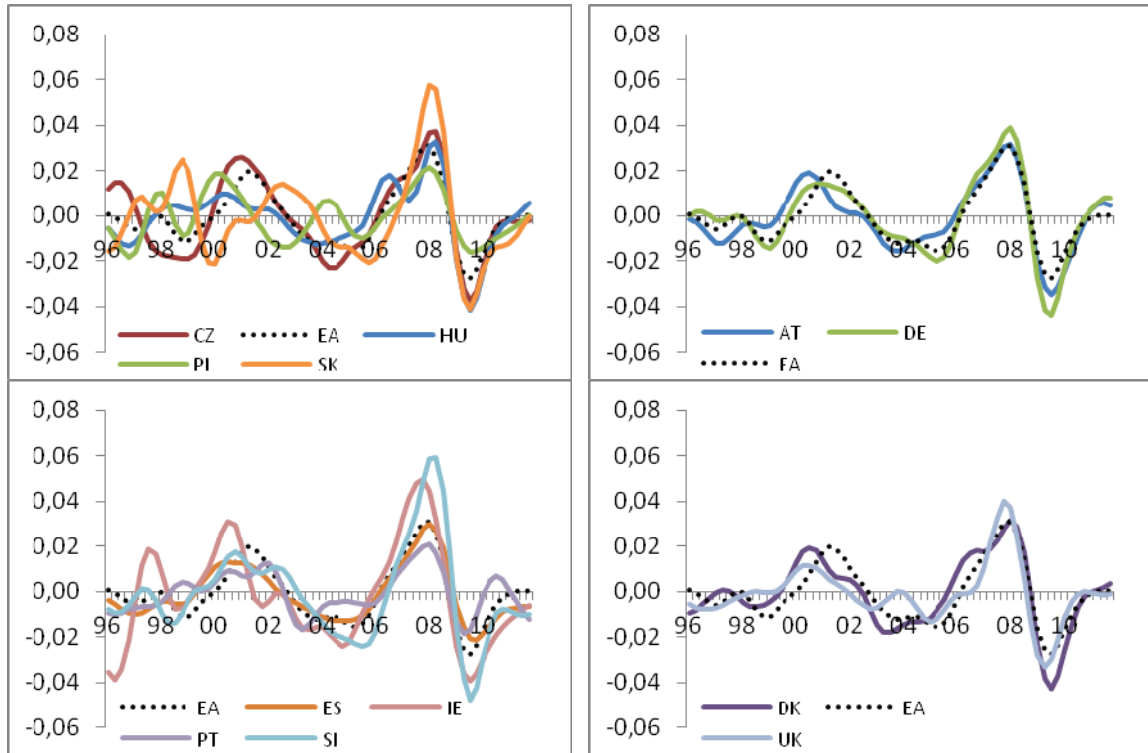
$$i = (s_{t1(ea)} - s_{t1(non-ea)}) - (s_{t0(ea)} - s_{t0(non-ea)}), \quad (3)$$

where $s_{t(ea)}$ denotes the synchronicity (similarity) index in time period (t) for the Euro area member countries $s_{t(non-ea)}$ denotes the synchronicity (similarity) index in time t for the non-member countries. The measure indicates whether the increase in business cycle coherence of the Euro area member countries exceeded the coherence growth of non-member countries.

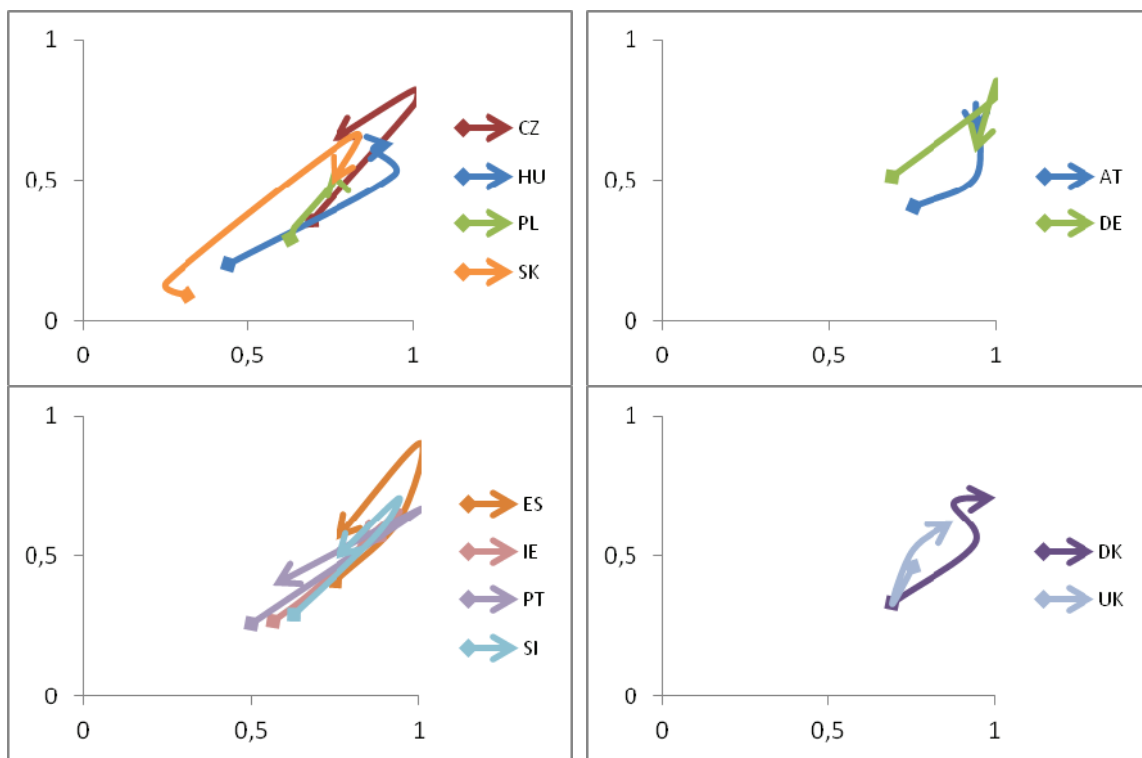
The GDP quarterly time series of the EU27 countries excluding Malta and Romania of the period 1996Q1–2011Q4 were used in the analysis. The time spans of 1996–2003 and 2004–2011 were analysed separately to examine the dynamics of business cycle coherence and clustering. Following the critique by Inklaar and de Haan (2001) we also used four time spans of 1996–1999; 2000–2003; 2004–2007 and 2008–2011 to focus on the dynamics in more details. The Christiano-Fitzgerald band pass filter was used to dissect the cyclical component of the GDP time series. The data were sourced from the Eurostat.

RESULTS

At Fig. 1 the dissected cyclical component of the GDP time series are illustrated. Selected groups consist of the Euro area core countries, periphery



1: Business cycles of selected EU countries (BP filter)
Source: Authors' calculations



2: Business cycle coherence (96–99, 00–03, 04–07, 08–11, BP filter)
Source: Authors' calculations

countries and countries staying outside the Euro area. In each figure the Euro area business cycle is also depicted. At first sight one might notice high similarity of the German and Austrian business cycle. Also the non-euro economies of Denmark and Great Britain follow the Euro area with some delay. Especially, the upswing in 2005–2008 followed by a downswing since 2008 is obvious in all sample countries. The cycles of periphery and CEE countries look rather heterogeneous and seem to be affected with the crisis at the same time but with different intensity.

Applying the measures of output gap synchronicity and similarity we can compare the business cycle coherence of the countries. Let's recall that the synchronicity measure examines to what extent the output gaps have the same signs i.e. to what extent the countries share the phase above or under the trend. The similarity measure examines the amplitude, which is the extent of deviation of the cycle from its trend. A Tab. I gives an overview of the average synchronicity and similarity measures in the analysed period 1996 and 2011. In addition, it also presents the coherence measures in subsequent following time spans so that we could examine the dynamics of the indicators.

Fig. 2 illustrates development of the output gap synchronicity (horizontal axis) and similarity (vertical axis) in four consecutive periods of 1996–1999; 2000–2003; 2004–2007 and 2008–2011. A rise towards the right up corner implies improving of both measures. There are few interesting findings

assessing the results of changes in synchronicity and similarity indicators at the Fig. 2. Generally, we might conclude that countries improved in terms of both business cycle coherence measures since the beginning of analysed period in 1996. Considering the first analysed period Spain revealed higher coherence measures to the Euro area than Germany and Austria, which seems rather surprising. From the OCA perspective Spain was better prepared to adopt Euro than Germany and Austria in that time. Moving over the next periods of a common rise in business cycle coherence across the EU countries we focus on the impact of global financial crises. The crises had considerably different impact on individual EU countries after 2009. Gächter *et al.* (2012) came up with similar conclusions. They focused on an impact of global financial crisis on business cycle similarity applying the measures of rolling correlation coefficients and dispersion indices. Whereas the rolling correlation of the Euro area countries declined after 2009, the dispersion measures raised. Both results in Gächter *et al.* (2012) give an evidence of a business cycles coherence decrease due to global financial crisis.

The Czech Republic improved the synchronicity and similarity measures sharply after 2000. During 2000–2007 the measures of Czech business cycle coherence to the Euro area fully equalled to German cycle coherence and even exceeded the Austrian coherence. Spain experienced similar development in that period. The Denmark and Great Britain reached the highest measures of business cycle

I: Business cycle coherence (96–99, 00–03, 04–07, 08–11, BP filter)

	synchronicity				similarity			
	96–99	00–03	04–07	08–11	96–99	00–03	04–07	08–11
AT	0.75	0.94	0.94	0.94	0.41	0.52	0.77	0.66
CZ	0.69	1.00	1.00	0.75	0.36	0.78	0.83	0.64
DE	0.69	1.00	1.00	0.94	0.52	0.80	0.86	0.60
DK	0.69	0.94	0.88	1.00	0.33	0.55	0.69	0.71
ES	0.75	0.94	1.00	0.75	0.41	0.63	0.91	0.56
HU	0.44	0.94	0.88	0.94	0.20	0.52	0.62	0.64
IE	0.56	0.69	0.94	0.81	0.27	0.39	0.66	0.53
PL	0.63	0.63	0.75	0.75	0.29	0.32	0.49	0.54
PT	0.50	1.00	0.94	0.56	0.26	0.67	0.63	0.40
SI	0.63	0.88	0.94	0.75	0.29	0.58	0.71	0.49
SK	0.31	0.25	0.81	0.75	0.09	0.14	0.66	0.49
UK	0.69	0.81	0.88	0.75	0.30	0.37	0.62	0.53

Source: Authors' calculations

II: Average business cycle coherence (BP filter)

time	synchronicity	similarity
1996–1999	0.63	0.31
2000–2003	0.84	0.53
2004–2007	0.91	0.67
2008–2011	0.80	0.52

Source: Authors' calculations

coherence to the Euro area later in 2008–2011. However, this rise was still lower than results in cases of Czech Republic and Spain.

Results depicted in Tab. I suggest the time span 2004–2007 to be the most appropriate time period for common monetary policy conduct. This is in line with the central banks' lending interest rates development in that period. After 2003 the official lending rates converged sharply. For instance in Poland and Slovenia the lending rates decreased below 10% and the convergence continued. In 2006 the maximum interest rate differential amounted to 2.5 percentage point. Apart from Hungary, the central banks' repo operations rates (repo rates) also converged in 2004–2007. After the global financial crisis outbreak all rates decreased across the EU countries. However, the interest rate differentials among individual countries increased. Whereas the Czech National Bank's repo-operation rate was 0.75% and ECB's rate amounted to 0.75%, Polish National Bank announced the rate at 4.5% at the end of 2011. Regarding Poland, it is important to mention that the Polish economy did not experience a real GDP recession since 1996, which is an exception among the most of the EU countries.

In Tab. II the EU average synchronicity and similarity indices are summarized. The overall business cycle coherence is rising over initial three analysed periods. In the last period of 2008–2011 the coherence measures decreased implying unequal influence of the crisis on individual EU economies.

Nevertheless, the level of coherence in the last analyzed period of 2008–2011 is still higher than in 1996–1999 and comparable to pre-enlargement period of 2000–2003. Evaluation of the OCA endogeneity hypothesis seems to be rather complicated since the business cycle coherence increases in case of member as well as non-member countries over time. The OCA endogeneity hypothesis is based on assumption of rising business cycle coherence due to increasing trade intensity with other monetary union members. International trade is considered as a main transmission channel to improve business cycle coherence under the OCA endogeneity hypothesis. However, our results show that the EU enlargement had comparable effects on business cycle coherence as membership in the Euro area. We attribute this to a significant factor of joining the single market by new EU countries. Still, the OCA endogeneity hypothesis cannot be rejected in our analysis since the business cycle coherence of the Euro area member countries increased from the initial period of 1996–1999. However, the common currency is definitely not the only factor contributing to improving business cycle coherence in the EU as shown in Tab. I. The table presents estimations of a simple OCA endogeneity measure:

$$i = (s_{t1(ea)} - s_{t1(non-ea)}) - (s_{t0(ea)} - s_{t0(non-ea)}), \quad (3)$$

where denotes the synchronicity (similarity) index in selected time period (t) for the Euro area member countries. denotes the synchronicity (similarity) index in time t for the non-member countries. The measure indicates whether the Euro area member countries experienced faster growth in business cycle coherence than the non-members.

A positive values presented in Tab. III imply a higher growth of the business cycle coherence measures in the Euro area contrary to the non-Euro area countries. The negative values indicate coherence improvement in case of the Euro

III: OCA endogeneity hypothesis

time	index	EA12 × non-EA ¹	core-EA × skep-non-EA ²
96–99 × 00–03	synchronicity	–0.04	–0.03
	similarity	–0.10	–0.08
00–03 × 04–07	synchronicity	0.00	0.04
	similarity	0.08	0.11
04–07 × 08–11	synchronicity	–0.08	–0.01
	similarity	–0.04	0.00

Source: Authors' calculations

area non-member countries. The results show a significant rise in coherence between two first initial periods of 1996–1999 and 2000–2003 in case of non-member countries. The business cycle coherence of the Euro area member countries improved faster than in non-member countries over the periods 2000–2003 and 2004–2007. During the final periods of 2004–2007 and 2008–2011 there is slightly higher coherence growth apparent for the non-member countries. Considering those rather mixed results we cannot provide a clear evidence of the endogeneity OCA hypothesis. The results rather confirm improved similarity and synchronicity measures across the EU no matter whether in the Euro area member or non-member countries over analysed periods. Similarly as Mink (2012) we consider the overall business cycle coherence within the Euro area relatively high with limited space for further improvement. In addition to that, we attribute rising coherence in the non-member countries to the catching up process. Weyerstrass *et al.* (2011) have also similar findings concluding that the Euro introduction did not have a remarkable impact on the business cycle similarity.

Summarizing the analyzed business cycle coherence, we can consider the Czech Republic to be synchronised to the Euro area over the analyzed period. Despite average results in 2008–2011, there is a high coherence detected in preceding periods. Slovakia experienced a significant business cycle coherence improvement since its synchronicity measure rose from 0.31 in 1996–1999 to 0.81 in 2004–2007 and finally to 0.75 in the crisis period of 2008–2011. Also the similarity measures increased from initial 0.09 in 1996–1999 to 0.66 and 0.49 in the last periods of 2004–2007 and 2008–2011 respectively.

Ceteris paribus both countries should not fear from the ECB common monetary policy taking into account the business cycle coherence criteria as defined in the new OCA theory. Focusing on the Czech Republic, our results are in line with those of the Czech National Bank (CNB). In a study by

the CNB (2011) the actual similarity measured with the Pearson correlation coefficient and also dynamic correlation measures reaching the level of 0.8 and 0.9 at the end of analyzed period. Also a high correlation of demand and supply shocks was estimated in the study. Our results are highly similar in a sense that the initial economic activity decline was really common for all EU countries in 2009. The performance in 2010 and 2011 described with the synchronicity and particularly with the similarity measures depend crucially on ability of an economy to cope with the recession. From a short-run perspective, the global economic crisis was a kind of symmetric shock in 2009. Afterwards its influence on the business cycle coherence was negative. The business cycle coherence decreased implying the different abilities of individual EU economies to cope with the crisis. This is in line with conclusions of the study CNB (2011), which considers high correlation of cycles and shocks to be a consequence of global recession and crisis as a common external shock. The CNB study suggests waiting out for the post-crisis performance of business cycles under “usual” conditions of the world economy to assess the business cycle similarity.

CONCLUSIONS

Assessing the business cycle coherence across the EU countries and testing the OCA endogeneity hypothesis few major findings should be summarised. Overall business cycle coherence across the EU is high. Especially the output gap similarity measures indicate high coherence of identical business cycle phases in countries in the EU. The output gap similarity measures reach lower values than the synchronicity measure implying the fact that the deviations of business cycles and impact of shocks differ in individual economies. Also the ability to cope with the crisis is different across the EU countries. Nevertheless, both coherence measures are relatively high and increasing over the analysed periods. Looking at the dynamics the coherence measures improved during

1 **EA12** – Original Euro area members (dated to 2002). **Non-EA** – EU countries out of the Euro area (dated to 2002) excluding Malta and Romania.

2 **Core-EA12** – Euro area 12 member countries excluding PIIGS. **Skep-non-EA** – EU countries out of the Euro area (excluding Malta and Romania).

analysed periods till the final time span, which was influenced mainly by the global crisis. Although the crisis is considered as a kind of negative symmetric shock, its impact on individual countries was uneven. The coherence measures, especially the output gap similarity indicators gently decreased in the final partial analysed period. Focusing on the Czech Republic, its business cycle coherence to the Euro area average has been gradually increasing till the crisis period. Although the impact of the global crisis was negative upon the Czech and Euro area business cycle coherence, the individual synchronicity and similarity measures did not decrease so much as in case of other CEE countries such as Poland, Slovakia, Slovenia. In addition, the Czech coherence decrease was not so extensive as

in case of the Euro area periphery countries Spain, Portugal or Ireland. Results of our paper did not provide a clear evidence of the endogeneity OCA hypothesis. The impact of the common currency upon the business cycle coherence does not seem to be high in case of the Euro area countries. Improvement of business cycle coherence measured with the similarity and synchronicity indicators tend to be higher in case of non-member countries including the Czech Republic even in periods of the common currency introduction. Our results support the general findings of other related studies and economics papers that the impact of the EURO introduction upon the business cycle coherence was actually not as high as expected.

SUMMARY

The paper deals with assessing the Euro area member and non-member countries from the perspective of the optimum currency areas theory. The main goal is to assess the business cycle coherence in a static and dynamic perspective. The composite indicators of output gap synchronicity and similarity are applied in the paper. In addition, the optimum currency area endogeneity hypothesis is tested using an original simple measure based on the coherence indicators results. The time series of quarterly GDP of the EU27 countries in 1996–2011 filtered with the Christiano-Fitzgerald band pass filter were analysed. Regarding the results, the overall business cycle coherence across the EU is high. Especially the output gap similarity measures indicate high coherence of identical business cycle phases in countries in the EU. The output gap similarity measures reach lower values than the synchronicity measure implying the fact that the deviations of business cycles and impact of shocks differ in individual economies. Also the ability to cope with the crisis is different across the EU countries. From a dynamics point of view the coherence measures improved during analysed periods till the final time span, which was influenced mainly by the global crisis. Although the crisis is considered as a kind of negative symmetric shock, its impact on individual countries was uneven. The coherence measures, especially the output gap similarity indicators decreased in the final partial analysed period. The business cycle coherence of the Czech Republic to the Euro area average has been gradually increasing till the crisis period. Although the impact of the global crisis was negative upon the Czech and Euro area business cycle coherence, the individual synchronicity and similarity measures did not decrease so much as in case of other CEE countries such as Poland, Slovakia, Slovenia. In addition, the Czech coherence decrease was not as extensive as in case of the Euro area periphery countries Spain, Portugal or Ireland. Results of our paper did not provide a clear evidence of the endogeneity OCA hypothesis.

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