VARIABILITY OF DYNAMIC CORRELATION – THE EVIDENCE OF SECTOR-SPECIFIC SHOCKS IN V4 COUNTRIES

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Abstract:

We focus on changes in dynamic correlation during the recent financial crisis. The results show different responses to this symmetric shock in V4 countries. We discuss possible specialization if the dynamic correlation increases only at certain of the frequencies. Especially, in case of the Czech Republic where the variability of dynamic correlation in business cycle frequencies increased in relation to the euro area, whereas decreased in relation to Germany. Consequently, we point out to the limitations of a correlation and concordance index as common indicators of business cycle synchronization in time domain.

Keywords: OCA theory, synchronization, business cycle, frequency domain, concordance index, real convergence.

JEL Classification: E32, F15, C14

Introduction

One of the commitments associated with accessing the European Union (EU) includes adopting euro and giving up the monetary policy autonomy. This act is conditioned by satisfying the Maastricht nominal convergence criteria. Nevertheless, the costs and benefits are associated with fulfilling the real convergence criteria based on the Optimum Currency Area (OCA) theory. Despite the theory, the euro area member countries did not evidently fulfill the Optimum Currency Area (OCA) criteria, possibly with the exception of a small DM-area which had been relatively integrated even before the euro. Nevertheless, the question is whether the OCA theory provides an appropriate framework for the creation of the monetary union.

The literature has employed various econometric methods to estimate the degree of real convergence. We follow the assumption that the fulfillment of the real convergence criteria in a broadly defined sense results in highly correlated business cycles (Artis, Zhang, 1999; Fatás, 1997). However, there are several widely discussed outstanding issues stemming from the business cycle correlation analyses. (1) The OCA theory does not provide a clear definition of sufficient degree of business cycle synchronization, (2) different measures of business cycles often provide different results (Fidrmuc, Korhonen, 2006) and (3) the assessment of the past developments has no value for the future developments (Lucas, 1976).

Our contribution is in a detailed look into the structure of time series and separate analysis of individual frequencies. We apply the frequency domain approach and focus on dynamic correlation shape. We argue that high correlation in full range of frequencies is not evidence of economic cycle synchronization if this correlation is changing at different frequencies. We assume that the variability of dynamic correlation at different frequencies indicates sector-specific shocks which limit real convergence.

The frequency domain approach was applied by Croux *et al*. (2001), Messina *et al*. (2009), Fidrmuc and Korhonen (2010) or Fidrmuc, J. *et al*. (2012), but the recent empirical studies applied dynamic correlation at full range of frequencies or at selected range of frequencies (mostly at business cycle frequencies. *i.e.* from 8 to 32 quarters).

The purpose of this paper is twofold: (1) to identify changes in business cycle synchronization of V4 countries with the euro area during the recent financial crisis and (2) to assess the variability of estimated dynamic correlation at different range of frequencies. The results are discussed in the context of OCA endogeneity hypothesis and compared with the indicators of regional specialization – the Herfindahl-Hirschman Index, the Krugman Dissimilarity Index and the Lilien Index.

1. Theoretical Background

The traditional version of the optimum currency area (OCA) theory originates from the debates about fixed *versus* flexible exchange rates, treating a common currency as the extreme case of a fixed exchange rate. Mundell (1961) pioneered with a simple idea that flexible exchange rates are based on regional currencies, not on national currencies if the macroeconomic shocks affect these regions differently. Inspired by Keynes and his price and wage rigidities assumptions, Mundell argues that if there is a high degree of labour mobility within a region, then the member states should have a fixed exchange rate regime and a flexible exchange rate against the rest of the world. The modern reconsideration of the OCA theory generally considers three market-based adjustment mechanisms to asymmetric shocks within the currency union: (1) wage and price flexibility, (2) mobility of labour and (3) mobility of capital. It is, however, widely discussed and generally agreed that increasing labour and capital mobility can lead to regional concentration and industrial specialization (Krugman, 1992, 1993; Eichengreen, 1992; Bertola, 1993;

Rauch, Weinhold, 1999). The regional concentration within the currency union is, however, defined by activities, not geographically or politically. Horváth and Komárek (2002) argued that Krugman's view implicitly assumes that the regional concentration of industry will not cross the borders of the countries within the currency union.

The key problem is that the wage and price settings appropriately reflect different situations of specific sectors or firms and overall market conditions. Whereas the currency devaluation affects prices of all exported and imported goods and could increase competitiveness of the country in short term, the wage and price adjustment mechanisms affect sectors and firms heterogeneously.

Carlsson and Nordstrom Skans (2012) or Druant *et al.* (2009) showed a heterogeneous degree of the price rigidity across the sectors. Druant *et al.* (2009, p. 4) identified that the degree of rigidity *"depends strongly on economic features, such as the intensity of competition, the exposure to foreign markets and the share of labour costs in total cost."* Assume that the differences across firms, sectors and countries concern the frequency and timing of wage and price changes and their relationship. Frequencies of adjustment to shocks, therefore, differ across the sectors and imply asymmetric effects of shocks within individual countries.

This heterogeneity appears also in the case of symmetric shock, such as decline in economic activity caused by financial crisis. Assume highly specialized countries and heterogeneous sectoral structure within the currency area where symmetric shocks increase unemployment. In that case, highly correlated business cycles in time domain indicate synchronization but efficiency of the common monetary policy will be limited by heterogeneous adjustment to the changes of the common central bank's interest rates. The limitation increases with industrial specialization when symmetric macroeconomic shocks appear to be sector-specific shocks.

2. Methods

In order to quantify the co-movements in time series, we use the concept of the dynamic correlation according to Croux *et al.* (2001). The dynamic correlation measures the similarity of the frequency components of two time series y and z and can be defined as:

$$\rho_{yz}(\omega) = \frac{C_{yz}(\omega)}{\sqrt{S_z(\omega)S_y(\omega)}}, \tag{1}$$

where *Cyz* is a co-spectrum (the real part of the cross-spectrum) and *Sy*, *Sz* are the individual spectra of time series y and z for frequencies ω. The dynamic correlation values can lie in the interval from -1 to +1. Integrating the formula in the frequency band from ω_1 to ω_2 a dynamic correlation coefficient arises:

$$\rho_{yz}\left(\omega_1,\omega_2\right) = \frac{\displaystyle\int_{\omega_1}^{\omega_2} C_{yz}\left(\omega\right)d\omega}{\sqrt{\displaystyle\int_{\omega_1}^{\omega_2} S_z\left(\omega\right)d\omega \int_{\omega_1}^{\omega_2} S_y\left(\omega\right)d\omega}}, \tag{2}$$

which evaluates the common behaviour of two time series in the given band of frequencies, e.g. in the business cycle frequencies. For $\omega_1 = 0$, $\omega_2 = \pi$ the integration is done over the whole defined frequency range and thus the dynamic correlation coefficient corresponds to the classical correlation coefficient (Bátorova *et al.*, 2013).

The industrial specialization of the countries is measured on the basis of the gross value added and the number of employed population. The first popular figure in most empirical studies on this topic is the Herfindahl-Hirschman Index (Herfindahl, 1950; Hirschman, 1964) for specialization, defined as:

$$H_i^S = \sum_{j=1}^{m}\left(\frac{g_{ij}}{g_i}\right)^2, \quad j = 1, \ldots, m, \ i = 1, \ldots, n, \tag{3}$$

where g_{ij} is gross value added in branch j and country i and g_i is total gross value added in country i. The Krugman Dissimilarity Index (Krugman, 1991) used for measuring specialization is defined as:

$$K_i^S = \sum_{j=1}^{m}\left|\frac{g_{ij}}{g_i} - \frac{g_j}{g}\right|, \quad j = 1, \ldots, m, \ i = 1, \ldots, n, \tag{4}$$

where g represents the total gross value added of the whole region. The third indicator of specialization is the Lilien Index (Lilien, 1982). This index reflects the speed of the sectoral employment reallocation in the economy:

$$L_i^S = \sqrt{\sum_{j=1}^{m}\frac{e_{ij}}{e_i}\left(\Delta \log e_{ij} - \Delta \log e_i\right)^2}, \quad j = 1, \ldots, m, \ i = 1, \ldots, n, \tag{5}$$

where e_{ij} represents employment (persons) in the sector j and the country i and e_i is the total employment (persons) in the country i.

The concordance index measures the degree of synchronization of cycles via fractions of time when the cycles are in the same phase (Harding and Pagan, 2006). The resultant value lies between 0 and 1 and identifies the proportion of the time when two time series are in the same phase of business cycle. The corresponding formula for its calculation takes the form

$$I_{ij} = \frac{1}{n}\left\{\sum_{t=1}^{n} S_{it}S_{jt} + \sum_{i=1}^{n}\left(1 - S_{it}\right)\left(1 - S_{jt}\right)\right\}, \tag{6}$$

where $S_{it} = 1$ ($S_{jt} = 1$), $t = 1, …, n$ denotes that the country i (j respectively) is in the time t in recession, $S_{it} = 0$ ($S_{jt} = 0$) denotes that the country i (j respectively) is in the time t in expansion. You can see Harding and Pagan (2006) for a detailed description.

In order to identify the turning points which help to distinguish business cycle phases we apply the Bry-Boschan procedure. The idea of Bry-Boschan algorithm is to present different levels of smoothing with the aim to localize surroundings of potential turning points which are consequently specified with the help of input time series. In the first step, the Bry-Boschan algorithm identifies the major cyclical movements. Consequently, the algorithm determines the surroundings of maxima and minima. At the end the algorithm proceeds to narrowing the search of turning points leading to the specification of the turning moment. This algorithm takes into account the individual nature of time series. A more detailed description of this procedure is provided in Bry and Boschan (1971).

3. Data Description

We use seasonally adjusted quarterly values of gross domestic product at prices of the year 2000. We analyze the economic cycles in the euro area (EA12), the Czech Republic (CZ), Hungary (HU), Poland (PL) and Slovakia (SK) in the period 1997/Q1–2012/Q3. Germany (DE) in the same period is included due to the foreign trade linkage and geographical proximity which can allow the concentration of cross-industry. The source of the data is Eurostat (Eurostat, 2012a).

In order to isolate the business cycle frequencies (Figure 1) we use the Hamming Window filter (HW) proposed for the short time series by Iacobucci and Noullez (2005). Prior to the application of the HW filter, we remove the trend by using the high-pass Hodrick-Prescott filter (Hodrick, Prescott, 1980).

Regional specialization is calculated by gross value added at prices of the year 2000 and employed persons at the NACE Rev.2 aggregation level in the period 2000/Q1–2012/Q1 (2004/Q2–2012/Q1 in case of employment in Poland). In terms of specialization, the whole region is represented by the European Union (EU27). All datasets were gathered from the national accounts aggregates and labour market statistics provided by Eurostat (Eurostat, 2012b).

Figure 1
Growth Business Cycles of Selected Countries
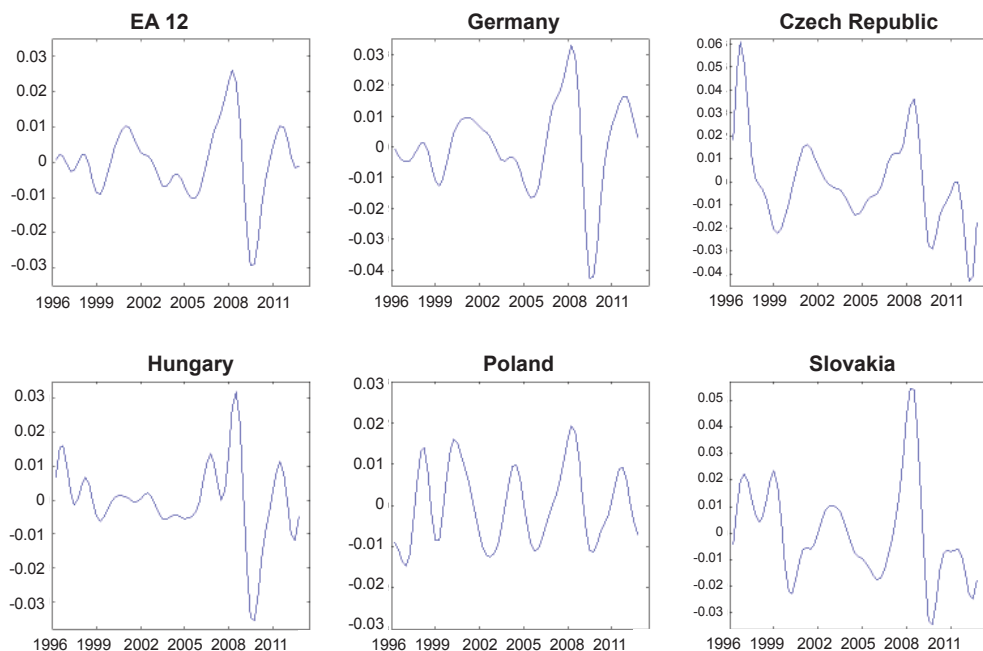
4. Basic Results

After business cycle identification, we proceed with measuring the co-movement via dynamic correlation. We calculate the dynamic correlation and its volatility (with respect to the frequency) in business cycle frequencies and also in full range of frequencies. The value of dynamic correlation in full range of frequencies were calculated according to the formula (2) with the integration limits $\omega_1 = 0$, $\omega_2 = \pi$. We perform all calculation in four periods, *i.e.* 1996–2007, 1996–2008, 1996–2009 and 1996–2012.

In Figure 2 you can see the shape of dynamic correlation curves. Each graph of Figure 2 displays the dynamic correlation value (*y*-label) in dependence on the frequency (*x*-label). The range of business cycle frequency is emphasized using horizontal lines. Since Figure 2 is illustrative and the eye-metric evaluation of the graphs in Figure 2 is quite difficult, we add a numerical evaluation of variability of dynamic correlation (Table 1). Table 1 also contains the values of dynamic correlation in full range of frequencies and in business cycle frequencies calculated according to the Formula (2). Focusing on the results of dynamic correlation presented in Table 1 (in business cycle as well in full range of frequencies) we can generally see a fluctuation among the values. The correlation between the euro area and Germany, which is economically the most important member of the euro area, stay quite stable across the four data samples. The variability of dynamic

correlation between the euro area and Germany in 1996–2007 is the lowest among all of the data samples and has the tendency to grow with respect to the growing sample size, after macroeconomic shocks appear. In the period 1996–2008 the level of co-movement is the lowest in most cases. Obviously, the symmetric shock caused by the financial crisis was fully transmitted after the year 2008.

Figure 2
Dynamic Correlation Curves between EA12, Germany and V4 Countries

Figure 2 - continuation
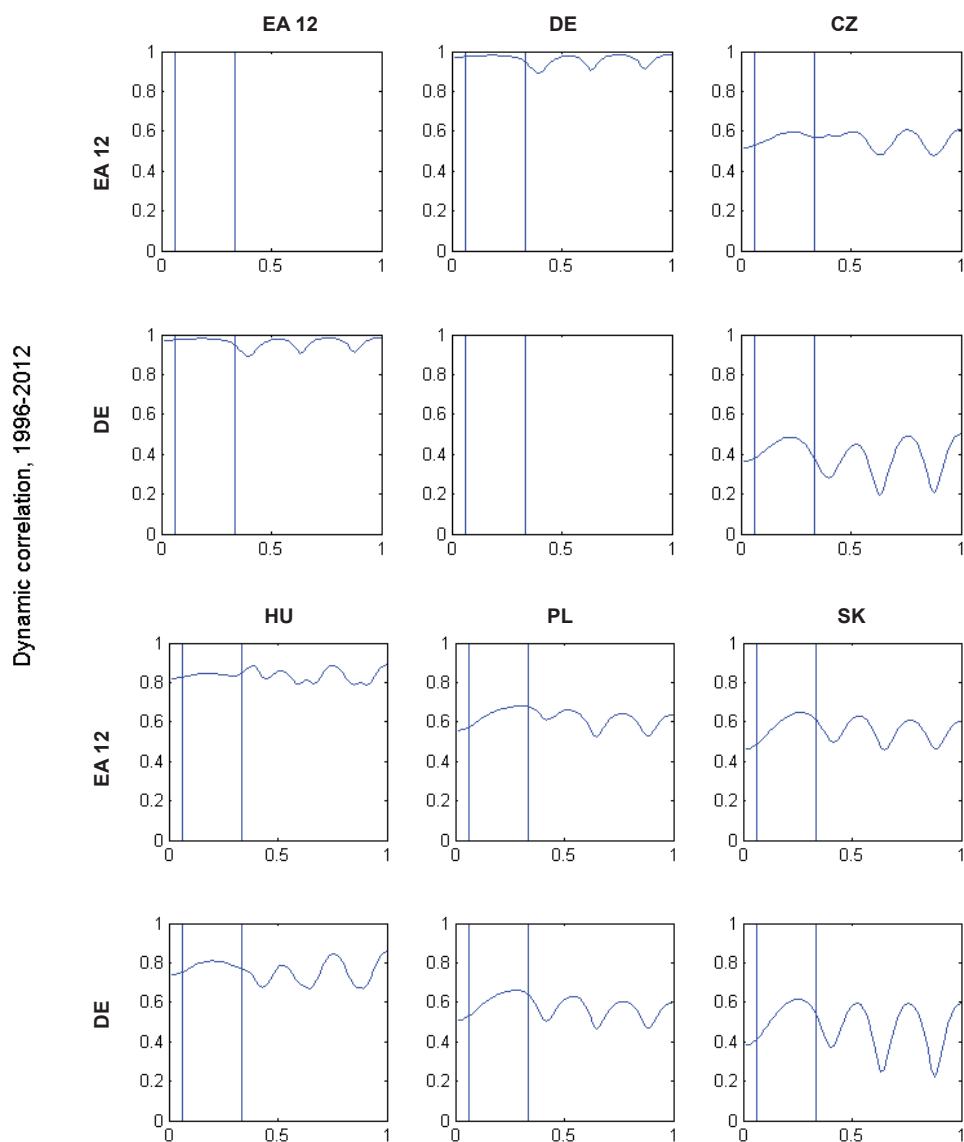
Figure 2 - continuation

Dynamic correlation, 1996-2008
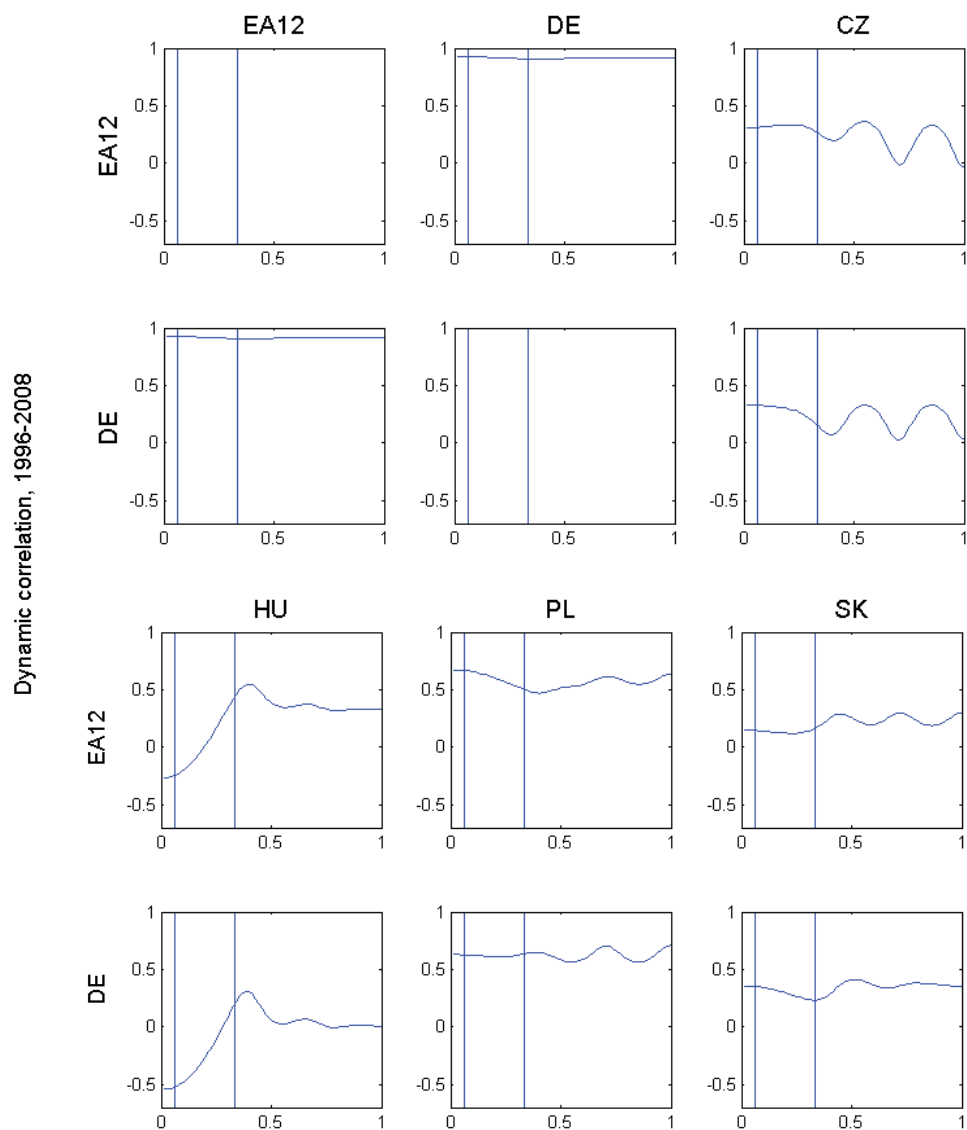
Figure 2 - continuation
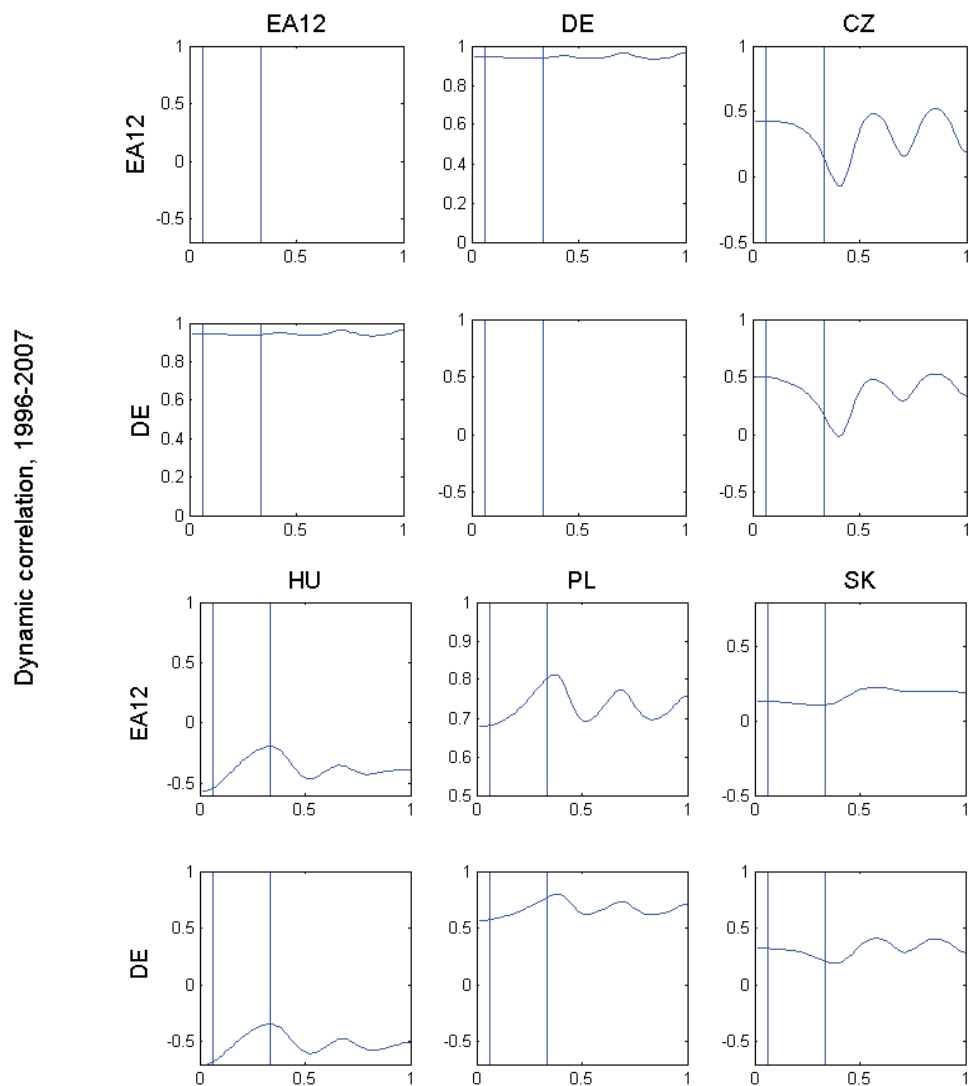
Note: dynamic correlation value (*y*-label), frequency (*x*-label)

The measured values for the Czech Republic in business cycle frequencies fluctuate within a growing sample, which shows the highest level of co-movement in the period 1996-2009. However, the variability of dynamic correlation in business cycle frequencies increases in relation to the euro area, whereas decreases in relation to Germany. These two neighbouring countries are an example of specialization which crosses the borders. In the context of the OCA theory, the level of the real convergence is different despite the high business cycle correlation of both samples.

Table 1

Dynamic Correlation and Its Variability between EA12, Germany and Selected Countries

	1996–2012		1996–2009		1996–2008		1996–2007	
	EA12	DE	EA12	DE	EA12	DE	EA12	DE
	Dynamic correlation in business cycle frequencies							
EA12	1	0.9771	1	0.9724	1	0.9184	1	0.9413
DE	0.9771	1	0.9724	1	0.9184	1	0.9413	1
CZ	0.5698	0.4446	0.7787	0.7423	0.3221	0.2967	0.3874	0.4318
HU	0.8335	0.7869	0.7748	0.6689	-0.0282	-0.3102	-0.3517	-0.4922
PL	0.6409	0.6142	0.6072	0.6093	0.6138	0.6177	0.7143	0.6341
SK	0.5885	0.5440	0.7352	0.7334	0.1329	0.3083	0.1206	0.2917
	Dynamic correlation in full range of frequencies							
EA12	1	0.9744	1	0.9695	1	0.9183	1	0.9426
DE	0.9744	1	0.9695	1	0.9183	1	0.9426	1
CZ	0.5569	0.4198	0.7686	0.7286	0.3102	0.2951	0.3853	0.4378
HU	0.8269	0.7695	0.7563	0.6367	-0.0265	-0.3163	-0.3838	-0.5210
PL	0.6244	0.5912	0.6034	0.6065	0.6186	0.6204	0.7075	0.6242
SK	0.5608	0.5060	0.7243	0.7211	0.1476	0.3231	0.1290	0.2954
	Variability of dynamic correlation in business cycle frequencies							
EA12	0	0.00011	0	0.00007	0	0.00004	0	0.00001
DE	0.00011	0	0.00007	0	0.00004	0	0,00001	0
CZ	0.00028	0.00118	0.00110	0.00189	0.00042	0.00309	0.00864	0.01099
HU	0.00002	0.00022	0.00564	0.01514	0.04804	0.05381	0.01081	0.00994
PL	0.00076	0.00103	0.00005	0.00014	0.00280	0.00005	0.00155	0.00368
SK	0.00166	0.00252	0.00191	0.00134	0.00018	0.00153	0.00008	0.00130
	Variability of dynamic correlation in full range of frequencies							
EA12	0	0.00062	0	0.00006	0	0.00004	0	0.00007
DE	0.00062	0	0.00006	0	0.00004	0	0.00007	0
CZ	0.00142	0.00701	0.00169	0.00251	0.01235	0.01012	0.02459	0.02110
HU	0.00079	0.00278	0.00467	0.01156	0.05321	0.05165	0.00857	0.00815
PL	0.00189	0.00300	0.00105	0.00093	0.00328	0.00150	0.00144	0.00372
SK	0.00343	0.01188	0.00204	0.00193	0.00348	0.00239	0.00180	0.00387

Source: own calculation

Hungary has an increasing level of co-movement measured in business cycle frequencies spanning from negative (1996–2007) through zero-level (1996–2008) to the positive value (1996–2009, 1996–2012). The level of co-movement after the crisis in 1996–2009

and 1996–2012 becomes quite similar. The volatility arises dramatically in 1996–2008. Turning our attention to the full range of frequencies we can see the same fluctuation as in case of business cycle frequencies. Both the lowest and the highest level of co-movement are achieved in the same period of 1996–2008 and 1996–2012, respectively. In comparison with the Czech Republic, the variability of dynamic correlation in Hungary decreases after the symmetric shock appears.

The co-movement measures for Poland show a larger volatility of results with respect to the euro area and Germany and to both frequency ranges. In the business cycle frequencies the highest value of dynamic correlation is in the period 1996–2007 and the lowest value in 1996–2009. Note that this situation is opposite to the case of Slovakia. The volatility of dynamic correlation slightly arises in 1996–2008, during the crisis. In full range of frequencies the highest value of dynamic correlation is achieved also in the period 1996–2007, but the lowest level for co-movement with Germany is in the period 1996–2012 and with the euro area in the period 1996–2009.

For the last case – Slovakia – the co-movement has the same tendency (and even very close results) in business cycle frequency as in the full range of frequency. The highest values of co-movement is achieved in 1996–2009 (after the crisis) with a lower variability followed by a decrease of dynamic correlation level in the period 1996–2012 and an increase of its volatility. The lowest level of dynamic correlation can be seen in the first periods of 1996–2007.

Generally, we can identify the highest co-movement in the business cycle frequency range during the period 1996–2009 for the Czech Republic and Slovakia, and in the period 1996–2007 for Poland. In the full range of frequencies the results remain the same for the Czech Republic, Hungary and Slovakia. We can also point out to a big difference between the highest and the lowest level of co-movement for Slovakia and Hungary, also for the Czech Republic, which is, however, a bit smaller. As for Poland, the difference is not so remarkable. The increase in variability of dynamic correlation in business cycle frequencies was found only in the case of co-movement between Germany and the Czech Republic.

To identify a specialization in production we use indexes based on the gross value added and the figure of employed population in a selected region/country and sector. We employ the Herfindahl-Hirschman Index for specialization, the Krugman Dissimilarity Index and the Lilien Index (Table 2). Our results correspond to the results of economic cycle correlation in time and frequency domains in the previous chapter, as well as to our assumption of sector-specific shocks. Even though the results could be biased, since we base our calculation on the whole European Union (EU27), all of the indicators identify the highest degree of specialization in the case of the Czech Republic. The Krugman Dissimilarity Index and the Lilien Index show a substantial increase after the year 2008 when the negative symmetric shock caused by the financial crisis appears.

Table 2
Industrial Specialization

Periods	DE	CZ	HU	PL	SK
Herfindahl-Hirschman Index					
2000–2012	0.1971	0.2585	0.2093	0.2022	0.2334
2000–2009	0.1988	0.2468	0.2071	0.1970	0.2166
2000–2008	0.2009	0.2441	0.2088	0.1952	0.2172
2000–2007	0.2006	0.2380	0.2081	0.1932	0.2141
Krugman Dissimilarity Index					
2000–2012	0.2130	0.3832	0.2632	0.3205	0.3763
2000–2009	0.2188	0.3521	0.2437	0.2954	0.3261
2000–2008	0.2233	0.3388	0.2400	0.2825	0.3209
2000–2007	0.2217	0.3227	0.2334	0.2767	0.3048
Lilien Index					
2000–2012	0.0023	0.0047	0.0059	0.0087	0.0090
2000–2009	0.0024	0.0045	0.0053	0.0091	0.0094
2000–2008	0.0023	0.0039	0.0053	0.0090	0.0091
2000–2007	0.0023	0.0041	0.0053	0.0088	0.0092

Source: own calculation

5. Robustness Analysis

Finally, we estimate the Concordance Index to verify our previous results of business cycles synchronization during the financial crisis. Table 3 compares the Concordance Index and the Correlation Coefficient in time domain.

As for the Czech Republic, the Concordance Index of economic activity co-movements is volatile among the samples and values for the euro area and Germany, but there are no strong differences. The highest co-movement is achieved for the sample in the period 1996–2009, the lowest for 1996–2007 (this results is not confirmed by the dynamic correlation). Note that the tendency of the Concordance Index is growing from 1996–2007 to 1996–2009. In case of Hungary the Concordance Index has a growing tendency through all samples, *i.e.* the smallest value for 1996–2007 (this result is not confirmed by the dynamic correlation), growing values in 1996–2008 and 1996–2009, with the highest value in 1996–2012. The biggest disproportion appears in Poland, where the index is the highest for the sample in the period 1996–2012, the lowest in co-movement with the euro area in the period 1996–2008 and in co-movement with Germany in 1996–2007. Note that the Correlation Coefficient and the dynamic correlation reach the highest level of co-movement in the period 1996–2007.

The results for Slovakia are volatile among the samples and the values for the euro area and Germany, but there are no strong differences. Like in the case of Poland, the Concordance Index indicates a disproportion of the results. The highest co-movement measured by the Concordance Index is in the period 1996–2008, the lowest in co-movement with the euro area in the period 1996–2007 and in co-movement with Germany in 1996–2012.

Table 3

Concordance Index and Correlation Coefficient

	1996–2012		1996–2009		1996–2008		1996–2007	
	EA12	DE	EA12	DE	EA12	DE	EA12	DE
	Concordance Index							
EA12	1	0.8806	1	0.8909	1	0.8824	1	0.8723
DE	0.8806	1	0.8909	1	0.8824	1	0.8723	1
CZ	0.7463	0.7463	0.7636	0.8000	0.7451	0.7843	0.6596	0.7021
HU	0.7313	0.6418	0.6364	0.5273	0.6275	0.5098	0.5532	0.4681
PL	0.8209	0.7910	0.8000	0.7273	0.7451	0.7059	0.7872	0.7021
SK	0.5672	0.5970	0.5636	0.6000	0.5686	0.6863	0.5319	0.6596
	Correlation Coefficient							
EA12	1	0.9744***	1	0.9698***	1	0.9181***	1	0.9425***
DE	0.9744***	1	0.9698***	1	0.9181***	1	0.9425***	1
CZ	0.5581***	0.4214***	0.7701***	0.7306***	0.3104***	0.2941**	0.3839***	0.4356***
HU	0.8272***	0.7703***	0.7595***	0.6419***	-0.0191	-0.3090**	-0.3797***	-0.5170***
PL	0.6260***	0.5933***	0.6037***	0.6069***	0.6168***	0.6201***	0.7085***	0.6260***
SK	0.5635***	0.5093***	0.7263***	0.7229***	0.1476	0.3220**	0.1289	0.2948**

Source: own calculation

In order to complete the calculations we present also the classical correlation coefficients results in Table 3. As mentioned above in the methodology commenting the Formula (2), the classical correlation is equal to the dynamic correlation with the integration limits $\omega_1=0$, $\omega_2=\pi$. A more detailed look to Tables 1 and 3 shows only negligible differences between the classical correlation and the full-range dynamic correlation results, thus the comments from Section 5 would be valid for both cases. Comparing the results of the classical Correlation Coefficient and the Concordance Index we find some discrepancy causing an inappropriate interpretation of co-movement via these two basic instruments.

6. Discussion

Kočenda (2001) or Kutan and Yigit (2005) discovered that the real convergence of the new EU member countries is rather idiosyncratic although there is empirical evidence

showing that it will take several decades for the convergence to be fully completed (Kočenda *et al.*, 2006). These integration tendencies are given by intra-industry trade (Fidrmuc, 2004). Artis *et al.* (2008) confirmed that extensive trade and financial linkage result in further increases in the business cycle correlation, but an increase in the labour market regulation and pursuing national fiscal policies may bring a counteracting effect. Kučerová (2009) confirms the existence of strong relation between trade and financial integration in new EU member countries (except for Bulgaria and Romania). According to this, the growing foreign trade of these countries contributes to an increase in the level of foreign assets and liabilities and *vice versa*.

These effects, especially a sectoral specialization, play an important role in the monetary policy implementation. Various degrees of price adjustments can be temporarily influenced by different sizes of sectors with strong or weak price dynamics. Peersman and Smets (2002) and ECB (2004) assumed that the capital intensity, the average firm size and the degree of openness to foreign competition are important factors which determine monetary policy impact on output growth and inflation. More specifically, the sectors with higher capital intensity, a lower average firm size and lower degrees of openness are more sensitive to the monetary policy changes than other sectors within the country.

Concurrently, sector-specific responses are not only exposed to different kinds of exogenous shocks but also to symmetric shocks. Therefore, cross-country differences play an important role in discussions about the economic cycle synchronization. It is generally agreed that increased intra-industry trade can lead to a higher synchronization of economic cycles within the currency union; nevertheless, Imbs (2001a, 2001b) showed that sectoral specialization has a negative impact on the business cycle synchronization even if it can be the result of trade and financial integration. The reason is the fact that sectoral specialization can lead to an increasing importance of sector-specific shocks and finally reduce synchronization of economic cycle. Afterwards, Imbs (2003) provides empirical evidence that a direct positive impact of intra-industry trade on economic cycle synchronization usually dominates the negative effect of sectoral specialization.

7. Conclusion

We have found a rapid increase in business cycle correlation at business cycle and full range of frequencies after the year 2008, when the symmetric shock caused by the financial crisis appears. In comparison with the Concordance Index we did not find significant differences. However, the results show an increase in the variability of dynamic correlation between the Czech Republic and the euro area. On the other hand, the variability of dynamic correlation decreases in relation to Germany. The Herfindahl-Hirschman Index for Specialization, the Krugman Dissimilarity Index and the Lilien Index confirmed the highest degree of sectoral specialization in case of the Czech Republic.

We discussed the business cycle correlation and its robustness in the context of the OCA

theory. We conclude that the dynamic correlation provides a more detailed look to the structure of time series co-movement. We suppose that macroeconomic shocks have asymmetric effects which differ by the frequency of adjustment across the sectors. Our contribution lies in the identification of these asymmetric shocks covered in the business cycle correlation in time domain.

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