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ECONOMIC CYCLE SYNCHRONIZATION IN THE CONTEXT OF FINANCIAL CRISIS: EMPIRICAL EVIDENCE OF DENMARK, SWEDEN AND UNITED KINGDOM

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The paper focuses on the economic cycle synchronization of the euro area outsiders: Denmark, Sweden and United Kingdom. The authors discussed openness of the selected economies, their structural similarities and economic cycle synchronization in the years 2000–2011. They applied moving correlation and correlation between the selected countries and the euro area. They found significant synchronization of the economic cycles after the year 2005. Furthermore, economic cycles of the analyzed countries were exceptionally synchronized than the euro area average level.
Our contribution is in comparison of the economic cycle synchronization in the selected countries with the euro area average. The authors assume that changes in order provide important information about the synchronization, unbiased by the consequences of the financial crisis in the year 2007.
A theoretical background for the final discussions provided new version of the OCA theory focused on the costs associated with the loss of the monetary policy autonomy. The authors concluded that selected countries were not protected against the global macroeconomic shock after the year 2007, although they keep the autonomous monetary policy.

OCA theory, moving correlation, monetary policy efficiency, co-movements, euro rejection

The European integration process is theoretically supported by optimum currency area (OCA) theory which originates from debates about fixed versus flexible exchange rates, treating a common currency as the extreme case of a fixed exchange rate. A system of fixed exchange rate, applied by gold standard mechanism, was blamed by many economists for the world-wide spread of depression after 1929. Mundell (1961) starts with simple idea that flexible exchange rates are based on regional currencies, not on national currencies, if the macroeconomic shocks affect these regions differently. However, an economy with fixed exchange rate regime does not have monetary policy independence, because interest rates disparity in region will lead to unsustainable balance of payment imbalances. Within the fixed exchange rate region have to be applied market-based adjustment mechanisms for meeting asymmetric shocks – factor mobility. Inspired by Keynes and its price and wage rigidities assumptions, Mundell argues that if there is high degree of labour mobility within a region, then the member states should have a fixed exchange rate regime and flexible exchange rate against the rest of the world.

The key issue of the OCA theory is macroeconomic policy efficiency in an open economy. McKinnon (1963) supports OCA theory assumptions and argues that currency devaluation is ineffective in very open economies because prices and wages immediately increase. A large currency area is less open than its member countries and the efficiency of the exchange rate policy increases. In contrast with Mundel, McKinnon distinguishes labour mobility not only among regions but focuses on the inter-industrial immobility. Labour mobility

among industries reduces factor movement between regions. Consequently, effects of adjustment mechanism to prevent a fall of income vanish. Kenen (1969) further developed this effect and argues that regions are defined by their activities, not geographically or politically. He assumes that perfect interregional labour mobility requires perfect occupational mobility and this can only come about when labour is homogenous. Based on the same assumption, OCA member states should display very similar skill requirements.

The traditional version of OCA theory was supplemented by Corden (1972), who argues that joining a currency area is related with loss of autonomous monetary policy and exchange rate control. These arguments followed by new theoretical development of OCA which focuses more on the benefits and costs of adopting a common currency. In 1990 the case of adoption of single currency for members of European Communities was examined in an extensive report "One Market, One Money" by Commission of the European Communities (European Commission, 1990), in which the authors recommended creation of single currency area. The main benefits of single currency compared to EMS or floating of individual currencies consist of elimination of uncertainty and transaction costs, price stability, interest rate risks reduction, moderating inflation and improvement of fiscal discipline of particular countries.

On the contrary, national monetary policy tends to be better tailored to the preferences of the economy. Therefore, it could better contribute to the stabilized output, employment and inflation. The heterogeneity in inflation rates between the countries or regions affects differences in real interest rates. A country with higher inflation will have a lower real interest rate which can increase inflation pressures and undermine economic growth and competitiveness of the country. In this context, the benefits of common currency are reduced by different preference about inflation and unemployment as well (De Grauwe, 2009).

It is generally agreed that there are different preference in Greece, Ireland, Portugal and Spain. These differences are not apparent not only in inflation but firstly at the consumption and savings behavior of the individuals. In contrast to the PIIGS countries, there are three outsiders decided that they did not want to participate at the euro area, even if they achieved criterions for euro area membership. These are Denmark, Sweden and United Kingdom.

Great Britain and Denmark have an official opt-out form European Monetary Union. Sweden is obliged to access the EMU, but is not showing incentives to do so in the near future. Swedish krona and pound sterling are currently in the floating regime. Danish krone is pegged to euro within the ERMII framework.

For comparison, economic growth in real GDP is considerably higher in Sweden and the UK than in the euro area, while it has been somewhat lower in Denmark. In terms of GDP per capita, all of these three countries are above the EU average. The inflation rate has been kept close to 2% during the last decade. Moreover, Denmark and Sweden have a positive fiscal balance. Overall, the economic performance of these outsiders is better in comparison with other euro area member countries. Obviously, the euro rejection was a good decision. The question is, whether the national currency protected these countries from the financial crisis consequences.

It is generally agreed that the financial crisis is a global symmetric shock which affected all of the euro area member countries. There is international trade as the important transmission channel for foreign shocks. And not only the trade but also consumptions, investments, house prices are transmitted through consumer sentiment. Therefore we can expect that the financial crisis consequences were transmitted into the Denmark, Sweden and the UK as well, even if these countries stand outside the euro area.

We follow the idea that Denmark, Sweden and the UK decided to reject euro because they expect significant impact of the exchange rate and national monetary policy to protect the economy from the euro area negative shocks. Assume, that the national autonomous policy provide efficient instruments to stabilize output. Consequently, the economic cycle synchronization should be lower during the recessions because the national autonomous policy affect counter-cyclically.

The objective of this paper is to identify the impact of the financial crisis on the economic cycle synchronization between the Denmark, Sweden, the UK and the euro area. Our contribution is in answering the question, whether the selected countries were protected against the global macroeconomic shock after the year 2007. According to the theoretical background, we can suppose different response to the macroeconomic shock due to the autonomous monetary policy.

MATERIAL AND METHODS

There are several methods for measuring the synchronization of economic cycles. The most common method is the unconditional correlation between the two countries in different time periods, the identification of delays various phases of business cycles, volatility of cyclical fluctuations in economic activity, stability and similarity of sudden and unexpected fluctuations in economic activity or shock response due to the level of the euro area as a whole or individual Member the euro area (Darvas and Szapáry, 2005) or index of cyclical conformity, called Concordance Index (Harding and Pagan, 2006).

To identify changes of economic cycles' synchronization in different time periods we applied moving correlations. The function calculates the statistical correlation between two

arrays of data over a moving window defined by positions. For better understanding the changes before and during the financial crisis we split the time series and compare correlation coefficient before and during the crisis periods.

However, there is a significant methodological problem. The financial crisis is global shock which affected all EU countries. Therefore we have to eliminate spurious synchronization between the selected countries and the euro area. Therefore we arrange correlation coefficient of the all EA17 countries and other three selected countries (Denmark, Sweden, United Kingdom) and subsequently we compare the changes in order of selected countries among the others. Thus, we analyze synchronization of the economic cycles in relation to other EA17 countries. Higher position assumes that the financial crisis contributed to the higher synchronization with the euro area. And, the national autonomous policies did not stabilize the drop in economic activity as the policy makers assumed.

As the aggregate indicator of economic activity we used seasonally adjusted times series of GDP in the period 2000Q1–2011Q4 (prices of the year 2005). The time series usually contain several components, such as long-term trend component, cyclical or seasonal component. Before analysis of co-movements it is suitable to remove trend component. For this aim we can use additive decomposition of the time series $x_t, t = 1, \ldots, n$

$$x_t = g_t + c_t + \varepsilon_t, \qquad t = 1, \ldots, n, \tag{1}$$

where g_t denotes long-term trend, c_t is the cyclical component and ε_t is the irregular component. To remove trend component we applied Hodrick-Prescott filter (Hodrick and Prescott, 1980).

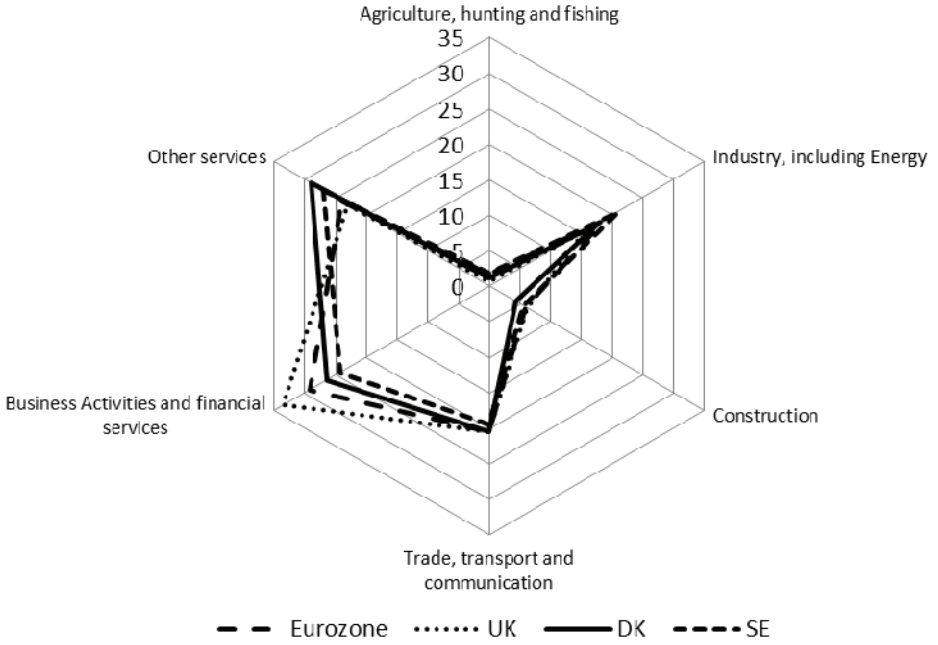
RESULTS

The economies which form an optimum currency area have very open trade relations and operate closely. The criterion of trade openness is considered the most important condition for currency areas in McKinnon's prominent seminal paper Optimum currency areas (1963). In an open economy the firms and individuals run economic activities with economic entities outside the domestic market. In case of our analysis we focused on export economy openness measured by export. We assumed that the symmetric shock caused by financial crisis is transmitted by drop in foreign demand which affects export of the selected countries. Tab. I shows the differences between the degree of openness among

I: *Openness of the selected economies measured by Export/GDP*

country/year	2002	2003	2004	2005	2006	2007	2008	2009	2010
Denmark	32.9%	31.2%	31.4%	33.0%	33.7%	33.1%	33.8%	30.1%	31.3%
Sweden	32.3%	32.4%	34.0%	35.3%	37.0%	36.4%	37.4%	32.1%	34.2%
United Kingdom	17.3%	16.4%	15.8%	16.8%	18.3%	15.6%	17.4%	16.2%	17.9%

Datasource: Eurostat



1: *Gross value added, percentage share of the sectors in 2010*
(datasource: Eurostat)

selected economies. The UK is closer economy than Denmark or Sweden.

Fig. 1 presents structural similarities of the selected economies and the euro area. The synchronization of economic activity movements increases with the higher similarities of the economic structures. The selected countries are characterized by low significance of agriculture, moderately significant industry, and well developed sector of business activities and financial services.

The significance of agriculture for the output is negligible in both the euro area and studied countries ranging from 0.7% in UK to 1.8% in Sweden against 1.7 in euro area. The other three sectors of industry, construction and trade are remarkably similar to euro area. There is an evident difference in sector of business activities and financial services. The UK highly developed business and financial sector accounts for 33.5% compared to the euro area with 29.3%. The slightly lower proportion of this sector in case of Denmark and Sweden is substituted by other services.

In order to simplify the comparison of economic structure similarity, the difference in economic structure were quantified as a sum of absolute differences of all observed sectors (SD) from the reference structure, which in this case is the sector structure of euro area. Tab. II shows lower structural similarity of the selected countries after the financial crisis in comparison with the other euro area members.

In both periods 2000 and 2010 out of the all observed economies the least similar structure with the euro area belongs to Luxembourg. This is mainly because of strong Business and financial sector (50.7%), which is more than 20 percentage points higher than in euro area and relatively weak industrial sector (7.3%). In exactly opposite situation is the second most divergent economy (2010), Slovakia. It has the highest reliance on industry (26%) and the least significant business and financial sector. These features are common also for the other post-communist countries Estonia, Czech Republic or Poland. In case of Slovakia the diversity is further supported by strong position of agriculture (3.9%) and construction (9.1%) sectors. Third most divergent country in both periods is Greece characterized by strong position of trade and transportation sector (33%), second least significant business and financial sector (20.7%) and agriculture with double the level as EA17. On the other hand the most similar structure was found in case of the Netherlands.

II: *Openness of the selected economies measured by Export/GDP*

2000									2010								
rank	**geo/sector**	**Agriculture**	**Industry**	**Construction**	**Trade**	**Business**	**Other**	***SD 2000***	**rank**	**geo/sector**	**Agriculture**	**Industry**	**Construction**	**Trade**	**Business**	**Other**	***SD 2010***
	EA17	2.4	22.2	5.7	21.0	26.6	22.1	0.0		EA17	1.7	18.6	5.9	20.5	29.3	24.0	0.0
1	BE	1.4	22.0	5.0	21.2	27.8	22.5	3.7	1	NL	2.0	18.6	5.3	20.6	27.9	26.2	4.6
2	**UK**	**1.0**	**22.0**	**5.3**	**22.9**	**27.0**	**21.8**	**4.6**	2	IT	1.9	19.3	5.9	22.1	28.3	22.1	5.4
3	NL	2.6	19.3	5.6	23.1	27.3	22.1	6.0	3	FR	2.8	17.8	5.2	18.9	30.7	24.8	6.4
4	IT	2.8	23.3	5.0	23.8	24.6	20.0	9.1	4	BE	0.7	16.5	5.3	21.7	30.1	25.2	6.9
5	DE	1.3	25.3	5.2	18.3	27.7	23.0	9.4	**5**	**UK**	**0.7**	**15.6**	**6.1**	**20.5**	**33.5**	**23.1**	**9.3**
6	**DK**	**2.6**	**21.3**	**5.5**	**21.8**	**22.3**	**26.4**	**10.7**	**6**	**DK**	**1.2**	**17.6**	**4.2**	**20.5**	**26.5**	**29.1**	**11.1**
7	**SE**	**2.1**	**24.5**	**4.3**	**18.9**	**24.9**	**25.3**	**11.0**	7	FI	2.9	22.4	6.6	19.9	24.1	24.3	11.8
8	AT	2.0	23.2	7.4	24.4	21.4	21.0	12.8	**8**	**SE**	**1.8**	**20.9**	**5.5**	**19.4**	**24.3**	**27.1**	**12.0**
9	FR	2.8	17.8	5.2	18.9	30.7	24.8	14.2	9	DE	0.9	24.0	4.2	17.4	30.8	23.8	12.7
10	FI	3.5	28.4	6.2	20.2	20.9	20.7	15.7	10	AT	1.5	22.3	6.9	23.3	24.0	21.9	15.1
11	PT	3.6	20.4	7.6	25.3	20.2	22.7	16.2	11	PT	2.4	17.0	6.0	25.5	23.1	26.0	15.6
12	SI	3.3	29.0	6.7	20.4	20.2	20.0	17.8	12	IE	1.0	25.9	5.5	16.9	26.9	22.5	15.9
13	EE	4.8	22.0	5.6	28.3	22.4	17.0	19.3	13	SI	2.5	24.7	6.9	22.6	23.8	21.7	17.8
14	ES	4.4	20.9	8.4	26.2	19.5	20.8	19.6	14	CY	2.3	9.3	7.3	25.7	30.2	26.1	19.5
15	MT	2.3	24.0	4.0	29.6	18.1	20.0	22.8	15	MT	2.0	16.1	3.6	24.1	25.4	30.9	19.5
16	CY	3.7	12.4	6.9	31.6	24.2	22.6	25.8	16	ES	2.7	15.8	10.2	25.6	23.1	23.8	19.6
17	SK	4.5	29.1	7.0	25.2	17.1	17.0	29.1	17	EE	3.5	23.0	5.8	25.6	24.2	19.4	21.1
18	GR	6.6	13.9	7.0	30.1	20.6	21.7	29.3	18	GR	3.3	14.0	4.1	33.7	20.7	25.4	31.2
19	IE	3.1	34.1	7.5	17.8	21.2	15.7	29.4	19	SK	3.9	26.0	9.1	24.4	19.3	18.2	32.5
20	LU	0.7	12.6	5.7	21.8	43.8	15.4	36.0	20	LU	0.3	7.3	5.5	19.2	50.7	16.9	42.9

Datasource: Eurostat

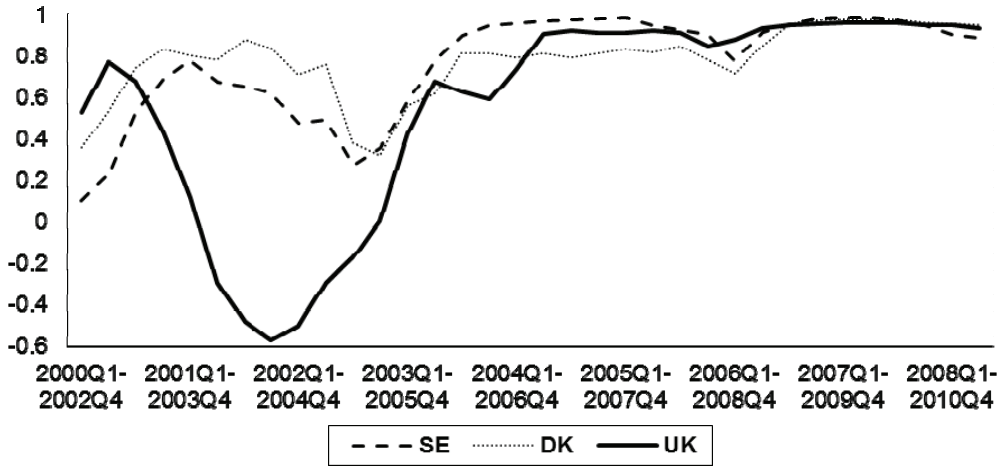
Its economy almost perfectly resembles the euro area pattern closely followed by Italy France and Belgium. The three studied countries show slightly higher levels of overall structure difference from the euro area (UK 9.3; Denmark 11.1; and Sweden 12.0). Rank 5, 6, and 8 respectively, puts them ahead of Germany and other euro area countries.

In order to get a wider overview about the development in time we also compare countries according to their economic structures in the year 2000. The trend of reduction/increase of structural differences over the observed period and its speed varies among the countries. Out of the 20 observed countries, 10 countries have diverged, 8 converged and two maintained the same level of structure similarity. Strongest divergence was recorded by Luxembourg (+6.9), mainly due to growing significance of its financial sector. Strongest convergence was in case of Ireland (–13.5). Between 2000 and 2010 the selected countries experienced divergence of their sector set-up (DK +0.4; SE +1.0; UK +4.7). In spite of this fact, their structure still appears very similar to the euro area and more convergent than in case of significant number of the current euro area member states.

Finally, we focused on the correlation of economic cycles. Since 2006 the development of correlation coefficients indicates a strong general tendency of increasing synchronization with the euro area in selected countries (Fig. 2). The development of UK synchronization with the euro area is rather specific. It's correlation started decreasing significantly short after the beginning of the observed period and reached a maximum negative value of –0.57. Since that, its correlation significantly increased and started to develop with the general converging tendency. By 2007 its correlation with the euro area reached over 0.9 and it stayed in this region for most of the rest of the observed period. The UK economic cycle recorded the strongest convergence with the euro area out of all observed countries. Sweden and Denmark correlated significantly since 2006 (DK over 0.8, Sweden over 0.9), which were maintained for most of the rest of the observed period. There was another short, less significant downward swing of the levels of correlation of the three studied countries in 2008 (DK 0.71, SE 0.77, UK 0.85) after which their correlation exceeded 0.9 again. However, the synchronization of economic cycles is affected by significant symmetric shock caused by financial crisis. Therefore we assume that results are biased.

To solve the problem of biased results we focused on evaluation of historical development of correlation of economic cycles expressed by GDP cycles. In order to get the data for historical comparison, the observed period of 2000Q1–2011Q1 is divided into the two partial periods, (1) 2000Q1–2005Q2 and (2) 2005Q3–2011Q1[1]. For each of these periods the correlation of business cycles with the euro area was calculated. Tab III shows significant increase of the correlation after the year 2005 (average correlation in the euro area increased from 0.698 to 0.895). Therefore we compare development in selected countries relatively to the other euro area members. These results provided information about the convergence or divergence tendencies.

In the first period the three selected countries showed correlation below the average of the euro area (UK 0.165, DK 0.655, SE 0.558). After the financial crisis their correlation exceeded the average of the euro area (UK 0.939, DK 0.927, SE 0.908). The symmetric negative macroeconomic shocks after the year 2005 was more significantly projected in the economic cycle co-movements in



2: *Moving correlation of selected countries (moving window = 12 quarters)*

1 The time periods are not based on the year when financial crisis began, but the year of the significant correlation (see Fig. 2).

III: *Changes in economic cycle synchronization*

2000Q1–2005Q2			2005Q3–2011Q1		
rank	**countries**	**correlation**	**rank**	**countries**	**correlation**
	EA17	1		EA17	1
1	NL	0.973	1	IT	0.980
2	DE	0.907	2	DE	0.979
3	ES	0.884	3	FI	0.979
4	IT	0.880	4	FR	0.979
5	FR	0.876	5	BE	0.978
6	SI	0.862	6	AT	0.967
7	CY	0.825	7	LU	0.966
8	FI	0.779	8	EE	0.959
9	AT	0.773	9	NL	0.952
10	SK	0.700	10	**UK**	**0.939**
	EA17 avg.	0.698	11	SI	0.929
11	EE	0.677	12	**DK**	**0.927**
12	BE	0.663	13	ES	0.923
13	**DK**	**0.655**	14	PT	0.911
14	**SE**	**0.558**	15	**SE**	**0.908**
15	IE	0.552	16	IE	0.907
16	PT	0.526		EA17 avg.	0.895
17	LU	0.483	17	SK	0.851
18	MT	0.420	18	MT	0.772
19	**UK**	**0.165**	19	CY	0.727
20	GR	0.094	20	GR	0.450
	EA17 stdev	0.219		EA17 stdev	0.132

Datasource: Eurostat

the selected countries than the rest or the euro area (its average).

DISCUSSION AND CONCLUSIONS

The crisis period and its consequences are recently discussed in many working papers. Dées and Zorell (2011) applied system of equations to identify production structures and concluded that financial integration tends to raise business cycle comovement between the EU countries. Antonakakis (2012) applied dynamic conditional correlation and identified unprecedented synchronization of business cycles between the G7. On the contrary, Gächter *et al.* (2012) identified divergent development of the business cycles in the euro area after the year 2008 and Filis *et al.* (2011) concluded that the recent financial crisis has halted and reversed the process of convergence of the business cycle synchronization in Europe. However, the analyses focused on the benefits of autonomous monetary and currency policy are missing.

According to the results of the empirical part of this paper, we can conclude that the selected countries (Denmark, Sweden and United Kingdom) were not protected against the global macroeconomic shock after the year 2007, although they keep the autonomous monetary policy. The correlation of the all selected countries and the euro area significantly increased after the year 2005.

SUMMARY

The objective of this paper is to identify the impact of the financial crisis on the economic cycle synchronization between the Denmark, Sweden, the UK and the euro area. Our contribution is in answering the question, whether the selected countries were protected against the financial crisis consequences.

It is generally agreed that the financial crisis is a global symmetric shock which affected all of the euro area member countries. We followed the idea that Denmark, Sweden and the UK decided to reject euro and supposed different response to the macroeconomic shock due to the autonomous monetary policy. However, we concluded that the common monetary policy rejection did not provide sufficient protection from the symmetric shock transmission.

Finally we provided the alternate way to evaluate convergence or divergence among the euro area countries, endogeneity of OCA criteria as well. We assume that the results of the empirical analysis are biased by the macroeconomic symmetric shock caused by financial crisis and the economic cycle synchronization is overestimated. Therefore we compared development in selected countries relatively to the other euro area members. We applied moving correlation which identified significant economic cycle synchronization after the year 2005. In order to get the data for historical comparison, the observed period of 2000Q1–2011Q1 is divided into the two partial periods, (1) 2000Q1–2005Q2 and (2) 2005Q3–2011Q1. In the first period the three selected countries showed correlation below the average of the euro area (UK 0.165, DK 0.655, SE 0.558). After the financial crisis their correlation exceeded the average of the euro area (UK 0.939, DK 0.927, SE 0.908). The symmetric negative macroeconomic shocks after the year 2005 was more significantly projected in the economic cycle co-movements in the selected countries than the rest or the euro area (its average).

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