ACTA UNIVERSITATIS AGRICULTURAE ET SILVICULTURAE MENDELIANAE BRUNENSIS

Volume 63 141 Number 4, 2015
http://dx.doi.org/10.11118/actaun201563041277

A COMPARISON OF BUSINESS CYCLES SYNCHRONIZATION IN THE EURO AREA AND SOME POTENTIAL MONETARY UNIONS

Stanislav Kappel[1]

[1] Department of National Economy, Faculty of Economics, VŠB-Technical University of Ostrava, Sokolská tř. 33, 701 21 Ostrava 1, Czech Republic

Abstract

KAPPEL STANISLAV. 2015. A Comparison of Business Cycles Synchronization in the Euro Area and Some Potential Monetary Unions. *Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis,* 63(4): 1277–1285.

Synchronization of business cycle is one of the main criteria for creation of a monetary union. With increasing synchronization of business cycle, a probability of occurrence of demand and supply shocks, which are asymmetric, decreases. The aim of this contribution is to evaluate synchronicity of business cycle in the euro area and some potential monetary unions. There are MERCOSUR (i.e. Argentina, Brazil, Paraguay, Uruguay and Venezuela), NAFTA (Canada, Mexico and the United States of America). For this aim, correlation analysis and two indexes of cyclical components of GDP are used. The cyclical components of GDP are obtained due to the Hodrick-Prescott filter. The results indicate a high degree of business cycles synchronization among states of the euro area (especially in countries of so called core of the euro area) and states of NAFTA. In opposite, a lower degree of business cycles synchronization was reached among states of MERCOSUR. According to the criterion of business cycle synchronization, NAFTA is more appropriate candidate than MERCOSUR for creation monetary area.

Keywords: business cycle, monetary systems, monetary union, economic integration, monetary policy, the euro area, NAFTA, MERCOSUR

INTRODUCTION

It is not easy to make a decision which countries are appropriate candidates for joining or creation of a monetary union. On the one hand, the membership in a monetary union has some advantages (i.e. reduction of transaction costs, elimination of exchange change risk etc.), but on the other hand, it has some disadvantages. Probably, a loss of autonomy of monetary policy and a loss of exchange rate policy are the most important. The Optimum Currency Area (OCA) theory is the instrument for quantification of costs and benefits for a membership in monetary union.

Synchronization of business cycle is one of the main conditions for successful implementation and functioning of a monetary union. With increasing synchronization of business cycle, a probability of occurrence of demand or supply shocks, which are asymmetric, decreases. Hence, the effectiveness of monetary policy in a monetary union increases because one monetary policy is appropriate for all countries in this monetary union.

The aim of this contribution is to evaluate synchronicity of business cycle of the euro area member states and selected potential monetary unions, namely MERCOSUR and NAFTA. In other words, are NAFTA and MERCOSUR the appropriate candidates for creating a monetary union in compare with the euro area?

The member states of MERCOSUR are Argentina, Brazil, Paraguay, Uruguay and Venezuela. The member states of NAFTA are Canada, Mexico and the United States of America. For our aim, the method of correlation analysis and two indexes (synchronicity and similarity) are used.

The text is organised as follows: the first part is an introduction. In the following part, there are some remarks about criteria of the OCA theory, especially the criterion of business cycle synchronization is

mentioned, and some remarks about researched monetary areas are presented. In the next part, the data, period and methods are described. It is followed by the results and in the end, there are discussion and conclusion.

LITERATURE OVERVIEW

Optimum Currency Area Theory

The basic approach for researching monetary union is the OCA theory. A research of the optimum currency area begun in the sixties in so called traditional versions of OCA theory. In this decade, well-known papers were published, Mundell (1961), McKinnon (1963) and Kenen (1969). Mundell (1961) researches an adaptation of a country or a region in the case of external imbalance. He defines the optimum currency area as an area with internal mobility and external immobility of production factors (especially labour) and existence of fixed exchange rate among members. According to Mundell (1961), the world is not the optimum currency area and therefore a flexible exchange rate among some regions or states must exist. The adaptation could be reached by the flexible exchange rate in the case of an asymmetric shock. McKinnon (1963) adds the next criterion, the degree of economic openness. It is defined as a proportion of tradable and non-tradable goods. A flexible exchange rate is appropriate for closed economy and a fixed exchange rate for the open one. The third criterion is the diversification in production and consumption (Kenen, 1969). The fixed exchange rate is more appropriate for economy with diversification of production, because this economy reacts to asymmetric shocks better. Other criterions are (Mongelli, 2002): price and wage flexibility, financial market integration, similarities of inflation rates, fiscal integration, political integration, similarities of supply and demand shocks and just business cycles synchronization.

In economic theory, there are two basic approaches to business cycle in the frame of the OCA theory. The first approach is based on Frankel and Rose (1996); according to them the correlation of business cycles depends on its bilateral trade. If two countries have mutual trade, it will tend to a correlation of business cycles more. It is suitable to adopt common currency for both countries, because it has a positive influence for mutual trade and it follows that a correlation of business cycles is higher. The theory is based on a hypothesis of endogenous character of OCA criteria. The second approach is represented especially by Krugman (1993); he argues that business cycles could be idiosyncratic after entering into a monetary union. It is based on the theory of specialization. Countries start specializing after entering the monetary union due to comparative advantages. It can tend to divergence of business cycles.

One of the approaches, how business cycle synchronization is researched, is through to some indexes. For example, Altavilla (2004) computes concordance index and correlation of business cycle for Germany, France, Italy, Spain, Belgium, Great Britain, the euro area and the USA from 1980Q1 to 2002Q4. The euro area states reach the highest degree alignment of business cycles, especially Germany, France and Belgium. Wynne and Koo (2000) compare correlation of cyclical components of GDP, inflation and unemployment among EU15 and among 12 US monetary districts from 1950 to 1992. US monetary districts are more synchronized than EU 15.

Monetary Areas

The euro area is the best known monetary union. It was established in 1999, but the predecessor was European Monetary System, established in 1979. Basic components were Exchange Rate mechanism (ERM), European Currency Unit (ECU) and credit mechanism (more see e.g. Dědek, 2008). At the moment, the euro area has nineteen members. There are: Austria (1999), Belgium (1999), Cyprus (2008), Estonia (2011), Finland (1999), France (1999), Germany (1999), Greece (2001), Ireland (1999), Italy (1999), Latvia (2014), Lithuania[1] (2015), Luxemburg (1999), Malta (2008), the Netherlands (1999), Portugal (1999), Slovakia (2009), Slovenia (2007) and Spain (1999)[2].

MEROSUR (Mercado Común del Sur – Common Market of the South) was created in 1991 and it is a trade agreement among Argentina, Brazil, Paraguay, Uruguay and Venezuela. Venezuela has become the member since 2012. Grigoli (2012) shows, that MERCOSUR was established as a free trade zone at first. Customs union is MERCOSUR since 2006. Numa (2011) argues that MERCOSUR states are not ready for creation common currency at this time because the conditions for accepting common currency are not fulfilled.

NAFTA (North Free Trade Area) is an economic group of Canada, Mexico and USA. This free trade agreement was created in 1994. Chriszt (2000) shows two basic approaches for creating a monetary union NAFTA. The first is an acceptance of US dollar by Canada and Mexico (dollarization). The second one is creation of a new common currency. It speaks about Amero as the name of the new currency. Chriszt (2000) argues that NAFTA is ready for creating a monetary union on the base of the OCA theory. But Canada is prepared more than Mexico to join to the USA.

1 Lithuania is not in analysed states.
2 In parentheses are introduced years when the states entranced to the euro area.

METHODOLOGY AND DATA

Three methods are used for evaluating business cycle synchronization in this text. Calculation of a cyclical component is based in Lucas' conception of business cycle. It means fluctuation of macroeconomic variable around its trend, see Lucas (1977). Data are adjusted seasonally, logarithms and a cyclical component of GDP are obtained through the Hodrick-Prescott filter. The Hodrick-Prescott filter has the following expression:

$$min\sum_{t=1}^{T}(y_t - y_t^*)^2 + \lambda\sum_{t=2}^{T-1}\left[(y_{t+1}^* - y_t^*) - (y_t^* - y_{t-1}^*)\right]^2, \quad (1)$$

where
y_t..... real gross domestic product in time t,
y_t*..... trend component and
λ ..... a multiplier.

Hodrick and Prescott (1997) suggest 1600 as a value for λ for quarterly data, which is our case. Mathematical derivation, pros and cons are debated by Czech authors e.g. Plašil (2011).

Correlation analysis is the first method. Correlation between two variables is a measure how the variables are related. The most widely used technique is a Pearson correlation coefficient. The Pearson correlation coefficient (r_{xy}) is formally expressed as:

$$r_{xy} = \frac{s_{xy}}{s_x s_y}\frac{\sum_{i=1}^{n}(x_i - \overline{x})(y_i - \overline{y})}{\sqrt{\sum_{i=1}^{n}(x_i - \overline{x})^2\sum_{i=1}^{n}(y_i - \overline{y})^2}}, \quad (2)$$

where
s_{xy}..... the covariance x and y,
s_x..... the standard deviation of x,
s_y..... the standard deviation of y,
$\overline{x}$..... the mean of x,
$\overline{y}$..... the mean of y.

The correlation coefficient ranges from –1 to 1. A value of 1 implies the perfect relationship between x and y. A value of –1 implies the perfect negative relationship and a value of 0 implies that there is no linear correlation between x and y.

The second approach is based on two indexes. The first index, used in this contribution, called "synchronicity index", is based on the Concordance index (see Harding and Pagan, 2006 or Rozmahel and Najman, 2010) and it is expressed as follow:

$$I_{ij} = \frac{1}{T}\sum_{t=1}^{T}\left[S_{it}S_{jt} + (1 - S_{it})(1 - S_{jt})\right], \quad (3)$$

where S_{it} denotes an output gap of a country i at time t and S_{jt} an output gap of a country j at time t. Time series must be converted into a binary series in order to calculate this index. The Concordance index works with the same cycle phase, i.e. using the binary series identifying the phases of recession (0) and phases of expansion (1). In opposite to Concordance index, we work with a positive output gap and negative output gap. The positive output gap has a value of 0 and the negative output gap has a value of 1. The index indicates how many percentages have two countries its output gap above or under their potential product at the same time.

The second index, "similarity index", is based on Mink, Jacobs and de Haan (2007). This index into account distance output gaps of two countries. So the index works with differences of the magnitude of cycles. This index has following specification:

$$\gamma(t) = 1 - \frac{\sum_{i=1}^{n}|g_i(t) - g_r(t)|}{\sum_{i=1}^{n}|g_i(t)|}, \quad (4)$$

where $g_i(t)$ denotes an output gap of country i in time t and $g_r(t)$ an output gap of reference country r in time t. A higher index indicates a higher level of similarity of business cycles. In this paper, the index is computed towards the economically strongest country. In the euro area, there is Germany, Brazil is in MERCOSUR and the USA in NAFTA.

Data

Data are obtained from the Eurostat database for the euro area countries, Eurostat (2014); for NAFTA countries from OECD database, OECD (2014); and for MERCOSUR countries from CEPALSTAT database, CEPALSTAT (2014). CEPALSTAT is a statistical database of Economic Commission for Latin America and the Caribbean, United Nations. The research period is based on quarter observation from the first quarter 1995 to the fourth quarter 2013. For Greece data are available only from the first quarter 2000 to the first quarter 2011, for Malta from the first quarter 2000, for Ireland from the first quarter 1997 to the third quarter 2013, for Portugal to the third quarter 2013, for Uruguay from the first quarter 2005, for Venezuela from the first quarter 1998 to the third quarter 2013 and for Argentina to the third quarter 2013.

RESULTS

Empirical results for the euro area and potential monetary union, MERCOSUR and NAFTA, are presented in this section. Firstly, there is computed standard deviation (SD) for each country, than the correlation coefficient, the synchronicity index and the similarity index.

The Euro Area

At first, there is standard deviation in Tab. I.

France, Belgium, Germany and Spain have low levels of standard deviation. It means smaller fluctuation of cyclical component of GDP. On the contrary, Latvia, Slovakia or Estonia have high levels. For business cycle synchronization the standard deviation should be the same or at least very similar. In next Tab. II correlations are presented.

The best values of the correlation coefficient are measured in case of the states which adopted euro

I: *Standard deviation of cyclical components of GDP the euro area states*

Country	AT	BE	CY	EE	FI	FR	DE	EL	IE
SD	0.0157	0.0132	0.0209	0.0584	0.0241	0.0118	0.0158	0.0219	0.0347
Country	**IT**	**LV**	**LU**	**MT**	**NL**	**PT**	**SL**	**ES**	**SK**
SD	0.0182	0.0825	0.0358	0.0202	0.0167	0.0132	0.0241	0.0158	0.0401

Note: Data were available only from 2000q1 to 2011q1 for Greece, from 2000q1 for Malta, from 1997q1 to 2013q3 for Ireland
Source: Eurostat (2014), author's calculations

II: *Correlation of cyclical components of GDP between the euro area states*

	AT	BE	CY	EE	FI	FR	DE	EL	IE	IT	LT	LU	MT	NL	PT	SI	ES	SK
AT	1																	
BE	0.90 (0.00)	1																
CY	0.61 (0.00)	0.63 (0.00)	1															
EE	0.55 (0.00)	0.39 (0.00)	0.24 (0.04)	1														
FI	0.81 (0.00)	0.82 (0.00)	0.66 (0.00)	0.63 (0.00)	1													
FR	0.95 (0.00)	0.88 (0.00)	0.61 (0.00)	0.64 (0.00)	0.85 (0.00)	1												
DE	0.88 (0.00)	0.84 (0.00)	0.49 (0.00)	0.58 (0.00)	0.85 (0.00)	0.90 (0.00)	1											
EL	0.38 (0.01)	0.32 (0.03)	0.30 (0.05)	0.59 (0.00)	0.43 (0.00)	0.47 (0.00)	0.35 (0.02)	1										
IE	0.72 (0.00)	0.66 (0.00)	0.29 (0.02)	0.80 (0.00)	0.71 (0.00)	0.75 (0.00)	0.70 (0.00)	0.54 (0.00)	1									
IT	0.22 (0.06)	0.09 (0.45)	0.12 (0.32)	0.71 (0.00)	0.24 (0.04)	0.35 (0.00)	0.27 (0.02)	0.45 (0.00)	0.59 (0.00)	1								
LT	0.66 (0.00)	0.55 (0.00)	0.48 (0.00)	0.83 (0.00)	0.77 (0.00)	0.71 (0.00)	0.61 (0.00)	0.62 (0.00)	0.77 (0.00)	0.46 (0.00)	1							
LU	0.82 (0.00)	0.78 (0.00)	0.37 (0.00)	0.42 (0.00)	0.61 (0.00)	0.77 (0.00)	0.75 (0.00)	0.31 (0.04)	0.67 (0.00)	0.15 (0.2)	0.46 (0.00)	1						
MT	0.52 (0.00)	0.48 (0.00)	0.48 (0.00)	0.38 (0.00)	0.51 (0.00)	0.50 (0.00)	0.52 (0.00)	–0.05 (0.73)	0.32 (0.02)	0.46 (0.00)	0.48 (0.00)	0.38 (0.00)	1					
NL	0.84 (0.00)	0.79 (0.00)	0.65 (0.00)	0.41 (0.00)	0.82 (0.00)	0.84 (0.00)	0.82 (0.00)	0.34 (0.02)	0.61 (0.00)	0.14 (0.23)	0.66 (0.00)	0.63 (0.00)	0.65 (0.00)	1				
PT	0.56 (0.00)	0.60 (0.00)	0.53 (0.00)	0.22 (0.00)	0.57 (0.00)	0.56 (0.00)	0.60 (0.00)	0.10 (0.51)	0.31 (0.01)	0.17 (0.14)	0.43 (0.00)	0.49 (0.00)	0.66 (0.00)	0.65 (0.00)	1			
SI	0.57 (0.00)	0.51 (0.00)	0.51 (0.00)	0.59 (0.00)	0.75 (0.00)	0.62 (0.00)	0.64 (0.00)	0.60 (0.00)	0.49 (0.00)	0.23 (0.05)	0.73 (0.00)	0.34 (0.00)	0.58 (0.00)	0.66 (0.00)	0.61 (0.00)	1		
ES	0.79 (0.00)	0.68 (0.00)	0.48 (0.00)	0.66 (0.00)	0.65 (0.00)	0.86 (0.00)	0.71 (0.00)	0.63 (0.00)	0.72 (0.00)	0.43 (0.00)	0.68 (0.00)	0.66 (0.00)	0.49 (0.00)	0.75 (0.00)	0.49 (0.00)	0.66 (0.00)	1	
SK	0.18 (0.12)	0.18 (0.12)	0.33 (0.00)	0.62 (0.00)	0.42 (0.00)	0.30 (0.01)	0.22 (0.05)	0.66 (0.00)	0.33 (0.01)	0.46 (0.00)	0.63 (0.00)	–0.03 (0.81)	0.38 (0.00)	0.25 (0.03)	0.20 (0.08)	0.58 (0.00)	0.40 (0.00)	1

Note: Data were available only from 2000q1 to 2011q1 for Greece, from 2000q1 for Malta, from 1997q1 to 2013q3 for Ireland; in parentheses are levels of significance
Source: Eurostat (2014), author's calculations

in 1999 and especially so called "core" states in the euro area; there are Germany, Austria, Belgium, Netherlands, Luxemburg, France and Finland. Lower values are measured in case of so called "periphery" states and the states which adopted the euro later. In the case of Italy and Slovakia statistic signification is not always confirmed. In the rest of the countries, statistic signification is confirmed almost everywhere. Tab. III shows results for the synchronicity index.

Again, the previous results are confirmed. The highest values have countries which adopted euro first. From these countries there are the states of "core", especially Germany, Austria, Belgium, France or Finland. The indexes are from 0.74 to 0.92 in these countries. The lowest values have Greece

III: *Synchronicity index between cyclical components of GDP of the euro area states*

	AT	BE	CY	EE	FI	FR	DE	EL	IE	IT	LT	LU	MT	NL	PT	SI	ES	SK
AT	1																	
BE	0.83	1																
CY	0.78	0.79	1															
EE	0.58	0.50	0.54	1														
FI	0.80	0.74	0.84	0.57	1													
FR	0.92	0.80	0.78	0.61	0.86	1												
DE	0.86	0.74	0.76	0.59	0.87	0.91	1											
EL	0.56	0.56	0.56	0.60	0.51	0.60	0.53	1										
IE	0.75	0.73	0.63	0.69	0.70	0.75	0.78	0.58	1									
IT	0.71	0.68	0.59	0.76	0.70	0.76	0.70	0.60	0.64	1								
LT	0.67	0.54	0.67	0.74	0.70	0.68	0.70	0.62	0.71	0.78	1							
LU	0.78	0.76	0.68	0.54	0.61	0.75	0.74	0.58	0.69	0.57	0.57	1						
MT	0.68	0.70	0.70	0.59	0.71	0.75	0.71	0.38	0.62	0.70	0.64	0.68	1					
NL	0.83	0.76	0.79	0.49	0.90	0.88	0.87	0.53	0.55	0.70	0.67	0.68	0.73	1				
PT	0.72	0.71	0.73	0.44	0.73	0.72	0.75	0.44	0.61	0.59	0.63	0.72	0.86	0.76	1			
SI	0.63	0.57	0.64	0.55	0.73	0.63	0.70	0.53	0.54	0.62	0.57	0.62	0.70	0.70	0.71	1		
ES	0.72	0.76	0.68	0.65	0.68	0.78	0.71	0.64	0.76	0.70	0.65	0.68	0.66	0.73	0.63	0.59	1	
SK	0.51	0.50	0.59	0.72	0.61	0.57	0.55	0.71	0.58	0.75	0.72	0.50	0.63	0.61	0.55	0.68	0.72	1

Note: Data were available only from 2000q1 to 2011q1 for Greece, from 2000q1 for Malta, from 1997q1 to 2013q3 for Ireland
Source: Eurostat (2014), author's calculations

IV: *Similarity index of cyclical components of GDP between Germany and other states of the euro area*

Country	**AT**	**BE**	**CY**	**EE**	**FI**	**FR**	**EL**	**IE**	**IT**
Value	0.54	0.37	0.14	0.08	0.42	0.41	0.07	0.26	–0.02
Rank	1.	5.	10.	11.–12.	3.	4.	13.–14.	7.	16.–17.
Country	**LT**	**LU**	**MT**	**NL**	**PT**	**SI**	**ES**	**SK**	
Value	0.07	0.27	0.06	0.46	0.08	0.16	0.23	–0.02	
Rank	13.–14.	6.	15.	2.	11.–12.	9.	8.	16.–17.	

Note: Data were available only from 2000q1 to 2011q1 for Greece, from 2000q1 for Malta, from 1997q1 to 2013q3 for Ireland
Source: Eurostat (2014), author's calculations

(from 0.38 to 0.71), Malta (from 0.38 to 0.71), Slovakia (from 0.50 to 0.75) or Slovenia (from 0.54 to 0.71).

Tab. IV shows the last index, the similarity index. There is a value of the index and the rank of each country according to the value toward Germany. The highest value has the rank 1 and the smallest value has the rank 17. It is calculated in relation to Germany as the economically strongest country in the euro area. Austria, Finland and France have the highest similarity index in relation to Germany. In opposite, Slovakia and Italy achieved the lowest indexes. In these countries, the similarity index is even negative. It means that Slovakia and Italy have their output gap very different and in some cases even in opposite towards Germany.

In Tab. V, there are summary results for researched countries in relation to Germany. For all countries, there is introduced the results and the rank for each index. The best results have Austria (rank: 2., 4. and 1.), Finland (3., 2.–3., 3.), France (1., 1., 4.) or Netherland (5., 2.–3., 2.). The poorest results have Slovakia (17., 16., 16.–17.), Italy (16., 12.–14., 16.–17.), Greece (15., 17., 13.–14.) or Estonia (13., 15., 11.–12.).

MERCOSUR

In this part, results for MERCOSUR are presented. At first, again, a standard deviation is showed in Tab. VI.

The standard deviation is high in the case of Argentina and Venezuela. It means that volatility of business cycles is high in these two countries. Standard deviation is lower in the other countries. We can conclude that volatility in MERCOSUR is very variable and this is not optimal for business cycle synchronization.

In Tab. VII, there are results for correlation coefficients. The correlation coefficients are from 0.4 to 0.6. An exception is the correlation between Venezuela and Brazil, Paraguay and Uruguay and the correlation of Argentina with Brazil. The values

V: *Summary results of cyclical components of GDP of the euro area states towards Germany*

Country	Correlation coefficients		Synchronicity index		Similarity index	
	Value	Rank	Value	Rank	Value	Rank
AT	0.88	2.	0.86	4.	0.54	1.
BE	0.84	4.	0.74	8.–9.	0.37	5.
CY	0.49	14.	0.76	6.	0.14	10.
EE	0.58	13.	0.59	15.	0.08	11.–12.
FI	0.85	3.	0.87	2.–3.	0.42	3.
FR	0.90	1.	0.91	1.	0.41	4.
EL	0.35	15.	0.53	17.	0.07	13.–14.
IE	0.70	8.	0.78	5.	0.26	7.
IT	0.27	16.	0.70	12.–14.	–0.02	16.–17.
LT	0.61	10.	0.70	12.–14.	0.07	13.–14.
LU	0.75	6.	0.74	8.–9.	0.27	6.
MT	0.52	12.	0.71	10.–11.	0.06	15.
NL	0.82	5.	0.87	2.–3.	0.46	2.
PT	0.60	11.	0.75	7.	0.08	11.–12.
SI	0.64	9.	0.70	12.–14.	0.16	9.
ES	0.71	7.	0.71	10.–11.	0.23	8.
SK	0.22	17.	0.55	16.	–0.02	16.–17.

Note: Data were available only from 2000q1 to 2011q1 for Greece, from 2000q1 for Malta, from 1997q1 to 2013q3 for Ireland
Source: Eurostat (2014), author's calculations

VI: *Standard deviation of cyclical components of GDP of the MERCOSUR states*

Country	ARG	BRA	PAR	URG	VEN
SD	0.0402	0.0202	0.0287	0.0141	0.0554

Note: Data were available only from 2005q1 for Uruguay, from 1998q1 to 2013q3 for Venezuela and to 2013 for Argentina
Source: CEPALSTAT (2014), author's calculations

VII: *Correlation of cyclical components of GDP between MERCOSUR states*

	ARG	BRA	PAR	URG	VEN
ARG	1				
BRA	0.26 (0.02)	1			
PAR	0.47 (0.00)	0.49 (0.00)	1		
URG	0.58 (0.00)	0.48 (0.00)	0.50 (0.00)	1	
VEN	0.48 (0.00)	0.08 (0.56)	0.12 (0.33)	–0.06 (0.72)	1

Note: Data were available only from 2005q1 for Uruguay, from 1998q1 to 2013q3 for Venezuela and to 2013 for Argentina; in parentheses are levels of significance
Source: CEPALSTAT (2014), author's calculations

are lower. A level of significance is higher than 10% in the case of Venezuela (excluding Venezuela with Argentina).

Tab. VIII shows results for the synchronicity index. The value of the index is from 0.48 to 0.71. The index has the lowest values in the case of Venezuela again. In the other cases, a synchronicity index has approximately from 0.6 to 0.7.

VIII: *Synchronicity index between cyclical components of GDP of the MERCOSUR states*

	ARG	BRA	PAR	URG	VEN
ARG	1				
BRA	0.57	1			
PAR	0.65	0.66	1		
URG	0.71	0.61	0.67	1	
VEN	0.65	0.48	0.46	0.51	1

Note: Data were available only from 2005q1 for Uruguay, from 1998q1 to 2013q3 for Venezuela and to 2013 for Argentina.
Source: CEPALSTAT (2014), author's calculations

IX: *Similarity index of cyclical components of GDP between Brazil and other states of MERCOSUR*

Country	Value
ARG	0.02
PAR	0.09
URG	–0.64
VEN	–0.09

Note: Data were available only from 2005q1 for Uruguay, from 1998q1 to 2013q3 for Venezuela and to 2013 for Argentina
Source: CEPALSTAT (2014), author's calculations

The similarity index is computed in the relation to Brazil in the Tab. IX, because Brazil is the economically strongest country in the frame of MERCOSUR. The results are following: Paraguay and Argentina have a positive similarity index in relation to Brazil. However, the indexes are very low. Uruguay and Venezuela have a negative similarity index.

We can say, according to Tabs. VI–IX, that the worst results are in the case of Venezuela. It can be caused by later entrance to MERCOSUR (in 2012). To conclude, on the base of these results, MERCOSUR is not a good candidate for creating monetary union at this time.

NAFTA

NAFTA is the last researched area. Empirical results are showed for NAFTA in the Tabs. X–XIII.

X: *Standard deviation of cyclical components of GDP of the NAFTA states*

Country	CAN	MEX	USA
SD	0.0109	0.0194	0.0122

Source: OECD (2014), author's calculations

Tab. X shows standard deviations. The standard deviation is the highest in the case of Mexico. Mexico's business cycle is the most volatile from these countries.

XI: *Correlation of cyclical components of GDP between the NAFTA states*

	CAN	MEX	USA
CAN	1		
MEX	0.74 (0.00)	1	
USA	0.82 (0.00)	0.81 (0.00)	1

Note: In parentheses are levels of significance
Source: OECD (2014), author's calculations

Correlation coefficients (Tab. XI) are comparatively high. There are from 0.74 to 0.81. The highest is with the USA. The correlation coefficient between Canada and Mexico is lower but still relatively high.

XII: *Synchronicity index between cyclical components of GDP of the NAFTA states*

	CAN	MEX	USA
CAN	1		
MEX	0.78	1	
USA	0.87	0.78	1

Source: OECD (2014), author's calculations

XIII: *Similarity index of cyclical components of GDP between the USA and other states of NAFTA*

Country	Value
CAN	0.30
MEX	0.39

Source: OECD (2014), author's calculations

The synchronicity index (Tab. XII) is also high. The highest (0.87) is between the USA and Canada. Between Mexico and Canada and between the USA and Mexico is the same, specifically 0.78.

The similarity index (Tab. XIII) is higher in the case of Mexico in relation to USA (0.39) than Canada in relation to USA (0.30).

According to these results, we can say that Canada, Mexico and the USA are relatively good candidates for creating a monetary union. Their synchronization of business cycle is relatively high and even in some cases, the results are better than in the case of the euro area.

DISCUSSION

According to the results, the hypothesis of Frankel and Rose (1996) was confirmed rather than the hypothesis of Krugman (1993), because the euro area has the highest level of business cycles synchronization, especially the states which adopted the Euro firstly. It follows, that "core" and "periphery" in the euro area was confirmed. The best values have Austria, Finland, Germany or Netherlands. In opposite, the worst values have Slovakia, Italy or Greece. So, the countries which entered to the euro area at first have the highest synchronization of business cycles. According to Krugman (1993) these countries should be specialize and the synchronization of business cycles should by lower.

NAFTA is an appropriate candidate for creating monetary union, because the results are high in this economic integration area. It confirms conclusions of Chriszt (2000). He argues that NAFTA is ready for creating monetary union according to the OCA criteria. A lower level of business cycles synchronization was reached in the case of MERCOSUR. According to these results, MERCOSUR is less appropriate candidate for creating a monetary union. Similar results were achieved e.g. by Numa (2011). He argues that the MERCOSUR states are not prepared for creation of monetary union according to the OCA theory. It does not fulfil this criterion ex ante but with creation of monetary union, alignment of business cycles could be subsequently increased, ex post.

However, the criterion of business cycle synchronization is only one of the criteria of the OCA theory. To find out, if some potential monetary union is appropriate for a creating real monetary union, we must consider other criteria of the theory optimum currency area. It is the following step in our research.

CONCLUSION

The aim of this article was to evaluate synchronicity of business cycles of the euro area member states and selected potential monetary unions – MERCOSUR and NAFTA. Our analysis was based on three methods: on correlations of cyclical components of GDP, output gaps synchronicity calculation, and measuring the similarity of output gaps amplitude.

In the euro area, the "core" and "periphery" was confirmed. The countries of "core", especially Germany, the Netherlands, Austria, Finland and France, have the highest alignment of business cycle. On contrary, the countries of "periphery" – Greece or Italy and the countries which entered to the euro area later (especially Slovakia), have lower alignment of business cycles.

The NAFTA states have a higher level of synchronization of business cycles. The results are even better than in some states of the euro area. According to our results, Canada, Mexico and the USA are appropriate candidates or creating a monetary union.

A lower level of business cycles synchronization was reached in our research in the case of MERCOSUR. According to these results, MERCOSUR is less appropriate candidate for creating a monetary union. MERCOSUR does not fulfil this criterion ex ante.

Acknowledgement

This contribution was created under the terms of the project SGS VŠB-TUO SP2014/115 *Assessing the Macroeconomic Impacts of Unconventional Monetary Policy Measures of Selected Central Banks.*

REFERENCES

ALTAVILLA, C. 2004. Do EMU Members Share the Same Business Cycle? *Journal of Common Market Studies,* 42(7): 869–896.

CHRISZT, M. 2000. Perspective in a Potential North American Monetary Union. *Economic Review*, 2000(4): 29–38.

DĚDEK, O. 2008. *Historie evropské měnové integrace: od národních měn k euru*. Praha: C. H. Beck.

FRANKEL, J. A. and ROSE, A. K. 1996. The Endogenity of the Optimum Currency Area Criteria. *National Bureau of Economic Research Working Paper No. 5700*.

GRIGOLI, F. 2012. The Impact of Trade Integration on Business Cycle Synchronization for Mercosur Countries. *European Journal of Comparative Economics*, 9(1): 103–131.

HARDING, P. and PAGAN, A. 2006. Synchronization of Cycles. *Journal of Econometrics*, 132(1): 59–79.

HODRICK, R. J. and PRESCOTT, E. C. 1997. Post-war U.S. Business Cycles: An Empirical Investigation. *Journal of Money, Credit and Banking*, 29(1): 1–16.

ECONOMIC COMMISSION FOR LATIN AMERICA AND THE CARIBBEAN. 2014. *CEPALSTAT. Database and Statistical Publications.* [Online]. Available at: http://estadisticas.cepal.org/cepalstat/WEB_CEPALSTAT/estadisticasIndicadores.asp?idioma=i. [Accessed: 2013 April 20].

EUROSTAT. 2014. *Statistics Database.* [Online]. Available at: http://epp.eurostat.ec.europa.eu/portal/page/portal/statistics/search_database. [Accessed: 2013, April 28].

KENEN, P. B. 1969. The Theory of Optimum Currency Areas. In: MUNDELL, R. A. and SWOBODA, A. K. (eds.), *Monetary Problems of the International Economy.* Chicago: Chicago University Press, 41–60.

KRUGMAN, P. 1993. Lesson of Massachusetts for EMU. In: TORRES, F. and GIAVAZZI, F. (eds.), *Adjustment and Growth in the European Monetary Union*. Cambridge: Cambridge University Press, 241–261.

LUCAS, R. E. 1977. Understanding Business Cycles. *Carnegie-Rochester Conference Series on Public Policy*, 5: 7–26.

McKINNON, R. I. 1963. Optimum Currency Areas. *American Economic Review*, 53(4): 717–725.

MINK, M., JACOBS, J. and DE HAAN, J. 2007. Measuring Synchronicity and Co-movement of Business Cycles with an Application on the Euro Area. *CESifo Working Paper Series No. 2112.* CESifo Group Munich.

MONGELLI, F. P. 2002. "New" Views on the Optimum Currency Area Theory: What is EMU Telling us? *European Central Bank Working Paper, No. 138*, April 2002.

MUNDELL, R. A. 1961. Theory of optimum Currency Areas. *American Economic Review,* 51(4): 657–665.

NUMA, M. 2011. The Feasibility of a Monetary Union in MERCOSUR. *Michigan Journal of Business,* 4(2): 11–59.

ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT. 2014. *OECD StatExtracts.* [Online]. Available at: http://stats.oecd.org/. [Accessed: 2014, May 20].

PLAŠIL, M. 2011. Potenciální produkt, mezera výstupu a míra nejistoty spojená s jejich určením při použití Hodrick-Prescottova filtru. *Politická ekonomie*, 2011(4): 490–507.

ROZMAHEL, P. and NAJMAN, N. 2010. The Concordance Index of the Business Cycles in the Czech Republic and other selected Central and Eastern European Countries and the Eurozone. *Acta Unv. Agric. Silvic. Mendelianae Brun.*, 50(6): 407–414.

WYNNE, M. A. and KOO, J. 2000. Business Cycle under Monetary Union: A Comparison of the EU and US. *Economica*, 67(267): 347–374.

Contact information

Stanislav Kappel: stanislav.kappel@vsb.cz