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Should the EMU Stop Enlarging?

Summary: The aim of this research is to assess what would happen with the business cycle synchronization in the Economic and Monetary Union (EMU), if all new EU member states introduced the euro. In addition, the paper aims to explore how business cycle correlations have evolved over time. The assumption is that, if business cycles in the EMU members are not correlated and the state of integration remains as it is, the ECB's one-size-fits-all policy will require members to follow policies which are politically difficult to implement. Hence, we are analyzing whether the EMU should stop accepting new entrants in order to stop deteriorating mutual business cycle correlation. Results based on correlations of shocks between the EMU and individual countries and their sizes show that correlation of supply shocks would remain relatively high if all members introduced the euro, but low correlation of demand shocks, different sizes of shocks and transmission of shocks still remain as significant problems.

Key words: Business cycle correlations, Supply and demand shocks, EMU, Enlargement.

JEL: E32, F33.

Nowadays it is not easy to be a member of the euro area (EA). Since the bankruptcy of Lehman Brothers in September 2008, which was the trigger for the financial crisis to spread from the US to other parts of the world, the EMU has been struggling with recession, slow growth, a sovereign debt crisis in some member states as well as with credibility. In order to save the EMU and calm the financial markets, Greece and other troubled members received significant amounts of financial support. Still, there is lively interest for expansion. Slovakia closed its deal before the start of the recession in 2008 and it joined the EMU in 2009, while Estonia joined in 2011, Latvia in 2014 and Lithuania in 2015. In the preparation stage for joining the EMU the focus is on the potential member state and how it would cope with the single monetary authority. There is little interest in how the prospective member could affect the entire EMU. The reason for this is simple. The newcomers are relatively small economies and they have a much smaller impact in the EMU decision making process. Because of this, researchers have also been mainly interested in analyzing whether the prospective permanent EMU members are able to cope with the single monetary authority. Their results mostly show that only advanced new member states are prepared to introduce the euro. On the other hand, there is a lack of research showing the overall effect of enlarging the EMU to 26 members (excluding the UK and Denmark) or to 28 members. Therefore, in this research we aim to fill this gap in the literature. More precisely, we are interested in answering what would happen with business cycle synchronization,

which is a key condition for a viable monetary union, if all new member states introduced the euro. In other words, we are analyzing whether the EMU should stop accepting new entrants. It has to be noted, however, that the formal criteria for euro introduction do not deal directly with business cycle synchronization, which means that the euro area accepts entrants that might not be suitable to endure a single monetary policy, which in turn might harm the whole Union. In addition, we are exploring how business cycle correlations evolved over time and showing how policies that are aimed at increasing business cycle correlation can help in bringing the euro area closer together.

As a proxy for the business cycle, we are using correlation of supply and demand shocks between individual countries and the euro area aggregate variable. In order to extract supply and demand shocks we are using data on the real GDP and inflation for each EU member in the sample.

The rest of the article is organized as follows. The first section provides an overview of the literature on the synchronization of EU business cycles. The second section discusses methodology and data, while the third section analyses whether the EMU should continue increasing the number of its members. The final section highlights the main conclusions of the article.

1. Related Literature

If the business cycles of monetary union member states are correlated, then the cost of not having their own monetary policy, which could act against disturbances, is minimized. More precisely, monetary policy in a union which is hit mainly by symmetric shocks would have similar effects on all its members. This means that monetary union is more likely to be an optimum currency area. On the other hand, if a monetary union is hit by an asymmetric shock (meaning that the correlation of shocks between members is low), an individual country is unable to use independent countercyclical monetary policy to stabilize its economy. In this situation it would be desirable for members to possess some sort of insurance mechanisms which could help them to adjust, because adjustment is now taking place in the real economy, not in the exchange rate. Insurance mechanisms can be income transfers (fiscal, social or financial market transfers) or adjustment mechanisms (flexible prices and wages or labor mobility). If members in a monetary union do not have synchronized business cycles and do not have in place insurance or adjustment mechanisms, then a single monetary policy could result in an asymmetric transmission of monetary policy actions and generate persistent disequilibrium in individual members, causing economic divergence and increased dissatisfaction. Research cited in this section will help to provide insight into the question of how synchronized EU business cycles are.

Since Robert A. Mundell (1961) wrote his seminal article about optimum currency areas, there has been a growing interest in this subject. However, the main trigger for the popularity of this theory was the formation of the EMU. Even though before EMU formation many articles showed that the EU is not an optimum currency area (such as Tamim A. Bayoumi and Barry Eichengreen 1993; Jörg Decressin and Antonio Fatás 1995), member states powered by the report of the Commission of the European Communities (1990) decided politically to leap forward towards monetary unification.

The Exchange Rate Mechanism managed to shift convergence of European business cycles from the US business cycle to Germany's business cycle (Michael J. Artis and Wenda Zhang 1997), while the Maastricht criteria narrowed member states' gaps between inflation, exchange and interest rates. The positive spirit around monetary unification, probably additionally spurred by more affordable credit supply and the overall more stable state of the economy, resulted in the neglect of the possible negative impacts of the introduction of the euro. More precisely, in the long-run, if business cycles of the euro area members are not carefully monitored in order to increase or merely maintain mutual correlation, ECB's decisions could provoke unhappy members, despite the fact that member states should be aware ahead of time of the potential upsides and downsides of monetary unification.

Most research shows that, in terms of business cycle synchronization, the EU can be divided in two groups - the core and the periphery. Bayoumi and Eichengreen (1993) analyze shocks in 12 EU member states and calculate correlations of shocks between individual members and Germany, which serves as a proxy for the EU business cycle. In line with the analysis they divide members into two groups - the core (Germany, France, Belgium, the Netherlands, Denmark and Luxemburg) which is characterized by relatively correlated and small shocks, and the periphery (the UK, Italy, Spain, Portugal, Ireland and Greece) which is characterized by loosely correlated and large shocks. Laurence Boone (1997) measures (potential) structural similarities by estimating the macroeconomic shocks faced by the EU member states that are interested in forming a monetary union, and by computing the correlation coefficients between two members' series of shocks. Results show increased integration among core countries (Germany, Austria, Belgium, France and the Netherlands), but also show that, despite the greater integration within core countries, the direction of the integration process has always been focused on Germany alone. Luís Aguiar-Conraria and Maria J. Soares (2011) show that Germany and France form the core around which other countries gravitate. The exceptions are Portugal, Greece, and Finland which do not show relevant degree of synchronization with the core and are categorized as euro periphery. Maria Demertzis, Andrew H. Hallett, and Ole Rummel (2000) make no attempt to analyze which EU member should be in one of the two groups, but are interested in whether the observed business cycle symmetries are due to policy interventions or to natural symmetries in the member states. They concluded that roughly a half of demand, supply and monetary shocks were policy based and not caused by any underlying symmetry of shocks. José Ramón Cancelo (2012), who analyzed business cycles in the euro area after the 2007 financial crisis, concluded that business cycles of most member states remained closely aligned to the EMU aggregate. The exceptions were Ireland, Greece, Spain and Portugal, which experienced large changes in their co-movements. Maximo Camacho, Gabriel Perez-Quiros, and Lorena Saiz (2006) analyze common trends in EU business cycles and find that the distance between the business cycles of individual EMU members is large, but still smaller than between the EMU members and the new member states. Recent research by Varadarajan V. Chari, Alessandro Dovis, and Patrick J. Kehoe (2015), which focuses on the new optimum currency area criterion, shows that when (potential) monetary union members have credibility problems, single monetary policy can increase welfare in the union by

reacting only to union-wide and not to idiosyncratic variation in the markup shocks. This lowers volatility in the distortions in the sector of traded and increases welfare. Moreover, they argue that the existing union can benefit too if it accepts new members which do not have similar shocks to that of the union, because monetary policy adjusts as the composition of the union changes. However, the issue here is that if the new member is very small, then the composition of the union will not change much, but this new member can still transmit asymmetric shocks to other members, if their (financial) systems are integrated.

The enlarged EU consists of 13 new member states, which account for around 7 percent of the EU's GDP. Even though their economic power is not large in relative terms, they can still experience problems after introducing the euro if their business cycle is not synchronized with the rest of the euro area. For that reason, ever since new member states started the EU accession process, researchers have been interested in how their economic structures can cope with more developed Western European economic structures. Tanja Broz (2010) compares shocks between the EMU and CEE countries and finds that there are differences in shocks and in the adjustment processes between the EMU and most of the CEE countries. Zsolt Darvas and György Szapáry (2008) find that among CEE countries Hungary, Poland and Slovenia have the most synchronized business cycles with the EMU, while the Baltic countries, due to shocks experienced during the 1998 Russian crisis, are not synchronized at all. In their meta-analysis of business cycle correlations between the euro area and the CEE countries, Jarko Fidrmuc and Iikka Korhonen (2004) suggested that indeed Hungary, Poland and Slovenia have a relatively high degree of business cycle synchronization with the euro area business cycle, comparable to the euro area core members. Other CEE countries have a lower level of business cycle synchronization with the euro area.

More recent research shows that new member states are increasing the synchronization of their business cycles with the euro area. Christos Savva, Kyriakos Neanidis, and Denise Osborn (2010), who analyzed the period before the financial crisis, argue that the new member states experienced a sizeable increase in their business cycle synchronization with the euro area around or after the completion of their EU negotiation process. A similar conclusion was drawn by Nenad M. Stanišić (2013), who found that all new member states, after they had become EU members, experienced an increase in their business cycle correlation with the euro area. Further, the analysis of the decoupling of business cycles, explored in Cancelo (2012) for the original euro area members, was broadened in Martin Gächter, Aleksandra Riedl, and Doris Ritzberger-Grünwald (2013) with the new member states. They argue that the new member states are more heterogeneous than the original euro area members and that their business cycles decoupled from euro area business cycle starting with the onset of the financial crisis. However, since the "recoupling" is observed at the end of the sample and since the new member states actually have relatively high correlation of cyclical components with the euro area, the authors concluded that they are in a good position to introduce euro.

Even though literature argues that many of the new EU member states and the periphery of the euro area do not belong to the European optimum currency area, Jeffrey A. Frankel and Andrew K. Rose (1998) show that once a country enters a

monetary union, this situation can change. Their assumption is that once a country joins the monetary union, reduced trade barriers increase trade integration, which in turn increases the correlation of business cycles. More precisely, they argue that international trade and business cycle correlations are endogenous. Using a panel of 20 industrialized countries over 30 years they found a strong positive correlation between bilateral trade integration and business cycle synchronization. In other words, greater trade integration in a monetary union results in more correlated business cycles, which means that a monetary union is more likely to be an optimum currency area *ex post* than *ex ante*. Even though later studies questioned their methodology (William C. Gruben, Jahyeong Koo, and Eric Millis 2002) or found smaller effects (Gruben, Koo, and Millis 2002; António Mendonça, João Silvestre, and José Passos 2011), many empirical studies showed that sharing a currency should bring business cycles closer together and thus increase the optimality of a union.

However, the existing literature still does not offer a consensus about the direction of business cycle synchronization in the euro area after the euro introduction. Gabriele Tondl and Iulia Traistaru-Siedschlag (2006) show that, even though increasing trade integration between members is likely to foster regional growth cycle convergence and diminish the impact of asymmetric shocks, trade integration was more important for growth cycle correlations in the pre-EMU period than in the EMU period. Jean-Sébastien Pentecôte, Jean-Christophe Poutineau, and Fabien Rondeau (2015) divide trade to existing and new trade flows, which are important for the (enlargement of) the euro area. Since their analysis shows that synchronization of business cycles is weakened by new trade flows, *ex post* synchronization of business cycles for further euro area enlargement becomes questionable. Jim Lee (2013) confirms that business cycles in the euro area became more similar before the launch of the euro, but that the process of convergence was halted after 1999 when business cycles in the euro area became more diverse. Lee (2012), Carlos Vieira and Isabel Vieira (2012) and Sybille Lehwald (2013) for some members, argue the same.

On the other hand, Broz (2010) shows that business cycle synchronization in the euro area members increased in the EMU period compared to the pre-EMU period. Similar results are also reported by Darvas and Szapáry (2008). Rose (2009) aims to confirm that euro introduction increased business cycle synchronization by conducting a meta-analysis of 26 previous studies. Carlos Eduardo S. Gonçalves, Mauro Rodrigues, and Tiago Soares (2009) and António Afonso and Ana Sequeira (2010) assess the business cycle convergence and conclude that business cycles in the euro area have indeed become more similar in the EMU period.

Table 1 gives an overview of the literature presented in this section.

It is noteworthy, however, that the analysis of the business cycle correlations, which is in the focus of the previously mentioned studies and is in the focus of this research, leaves out the important question of the determinants and patterns of the business cycles synchronization. This type of analysis is already well-developed (e.g. Uwe Böwer and Catherine Guillemineau 2006; Pedro André Cerqueira and Rodrigo Martins 2009; Jonas Sachs and Andreas Keil 2013; Valerija Botrić and Broz 2016). Economic theory suggests the use of a set of potential causation factors in this type of analysis, such as bilateral and total trade share to GDP, interest rates, fiscal deficit

Table 1 Business Cycle Synchronization: A Summary of the Synchronization Issues

Authors	Findings
Mundell (1961)	First paper on optimum currency areas.
ORIGINAL EURO AREA MEMBER STATES	
Bayoumi and Eichengreen (1993), Decressin and Fatás (1995)	EU is not an optimum currency area.
Commission of the European Communities (1990)	Despite potential costs, single EU market needs one currency.
Artis and Zhang (1997)	ERM managed to shift convergence of European business cycles from the US to Germany's business cycle.
Boone (1997)	There is increased integration among the core countries (Germany, Austria, Belgium, France and the Netherlands).
Aguiar-Conraria and Soares (2011)	Germany and France form the core around which other countries gravitate.
Cancelo (2012)	Business cycles of most member states remained closely aligned to the EMU aggregate after the 2007 financial crisis.
Demertzis, Hallett, and Rummel (2000)	Roughly half of demand, supply and monetary shocks are policy based and not a result of any underlying symmetry of shocks.
Camacho, Perez-Quiros, and Saiz (2006)	Distance between business cycles of individual EMU members is large, but still smaller than between EMU members and the new member states.
NEW EU MEMBER STATES	
Broz (2010)	There are differences in supply and demand shocks and in the adjustment processes between the EMU and most of the CEE countries.
Gächter, Riedl, and Ritzberger-Grünwald (2013)	New member states are more heterogeneous than the original members of the euro area.
Chari, Dovis, and Kehoe (2015)	Existing monetary union can benefit if it accepts new members which do not have similar shocks to the union's.
Fidrmuc and Korhonen (2004), Darvas and Szapáry (2008)	Hungary, Poland and Slovenia have the most synchronized business cycles with the EMU.
Savva, Neanidis, and Osborn (2010), Stanišić (2013)	New member states experienced an increase in their business cycle synchronization with the euro area after the completion of their EU negotiation process.
ENDOGENEITY OF OCA	
Frankel and Rose (1998)	Greater trade integration in a monetary union results in more correlated business cycles, which means that a monetary union is more likely to be an optimum currency area *ex post* than *ex ante*.
Gruben, Koo, and Millis (2002), Mendonça, Silvestre, and Passos (2011)	Greater trade integration in a monetary union results in more correlated business cycles, but effects are smaller than in Frankel and Rose (1998).
DIRECTION OF THE BUSINESS CYCLE SYNCHRONIZATION	
Tondl and Traistaru-Siedschlag (2006)	Trade integration was more important for growth cycle correlations in the pre-EMU period than in the EMU period.
Lee (2012, 2013), Vieira and Vieira (2012), Lehwald (2013)	Business cycles in the EMU became more similar before the launch of the euro, but that the process of convergence was halted after 1999.
Pentecôte, Poutineau, and Rondeau (2015)	Since synchronization of business cycles is weakened by new trade flows, *ex post* synchronization of business cycles for further EMU enlargement becomes questionable.

| Darvas and Szapáry (2008), Gonçalves, Rodrigues, and Soares (2009), Rose (2009), Afonso and Sequeira (2010), Broz (2010) | Business cycle synchronization in the euro area members increased in the EMU period compared to the pre-EMU period. |

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Source: Author's compilation.

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differentials and stock market differentials. The analysis of the determinants and patterns of the business cycle synchronization also includes one of the key factors that economic theory would offer for explaining the weak demand shocks correlation, i.e. large differences in price competitiveness and very different labor market regulation amongst countries.

2. Methodology and Data

In this article we analyze whether the EMU should continue increasing the number of its permanent members and we examine the evolution of business cycle correlation, especially during the crisis. As proxies for the business cycle, we use supply and demand shocks employing the methodology of Olivier J. Blanchard and Danny Quah (1989), as well as Bayoumi and Eichengreen (1993).

Blanchard and Quah (1989) recognized that more than one type of shock could influence macroeconomic series such as GDP, which makes interpretation more difficult. Therefore, they suggested imposing *a priori* restrictions on the response to each of the shocks and assumed that there are two kinds of shocks - demand and supply. The assumption is that shocks are uncorrelated and that demand shocks have a permanent effect only on prices, while supply shocks have permanent effect both on prices and GDP. Blanchard and Quah (1989) suggest that a permanent change in output due to supply shocks and a temporary change due to demand shocks are used to decompose a structural VAR, while Bayoumi and Eichengreen (1993) suggest that the effects of supply and demand shocks on prices can be viewed as an over-identifying restriction, which enables us to check the consistency of the results. The accumulated effect of positive supply shocks on prices (GDP) should be negative (positive), while the accumulated effect of expansionary demand shocks on prices (GDP) should be positive (zero).

We used data on quarterly nominal and real GDP for 27 EU member states and the euro area that we obtained from Eurostat (2014)[1]. The variables included in the analysis are real GDP and inflation. Inflation, represented by an implicit GDP deflator, is calculated as the ratio of nominal and real GDP. We used an implicit GDP deflator, instead of CPI, because CPI reflects only consumption prices, while the GDP deflator reflects the price of total output. In most cases data span from the first quarter of 1997 to the fourth quarter of 2012. The exceptions are Greece (from Q1/2000), Malta (from Q1/2000), Romania (from Q1/1998) and Bulgaria (from Q3/1997). Croatia, which joined the EU on July 01, 2013, is not part of this analysis, because the sample period ends before its accession date. Analysis was conducted using data in domestic currencies. Real GDP growth and inflation are calculated as the first differences of the natural logarithms of the real GDP and implicit GDP deflator. All variables used in the analysis are seasonally adjusted.

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[1] **Eurostat.** 2014. Database. http://ec.europa.eu/eurostat/data/database (accessed February 16, 2014).

Before the start of the SVAR analysis, we examined optimal lag structure and integration of variables. Optimal lag structure was determined using the Schwartz information criterion, while (non)stationarity was checked using the augmented Dickey-Fuller test (all variables are stationary in first differences). Schwartz information criterion detected that for most of the countries in the sample the number of lags should be set to one. In 19 out of 28 cases (27 EU member states plus the euro area aggregate) Schwartz information criterion supported the lag length of one. In other cases, suggested lags range from two to five. Since in all equations we have the same independent variables, OLS estimates are consistent and asymmetrically efficient and we are hence able to use the same lag length for all country VARs (Julius Horvath and Attila Rátfai 2004). Besides, in this way we are able to maintain symmetry of specification across countries.

After determining stationarity of differentiated variables and lag lengths, we estimated a bivariate VAR with dummy variable for recession for every EU member state in the sample. In order to extract structural supply and demand shocks from reduced VAR, as previously explained, we imposed an additional restriction: the cumulative effect of the demand shock on GDP should be zero. The remaining restrictions are two normalization restrictions and the restriction that estimated residuals from the reduced VAR model are composed of uncorrelated demand and supply shocks. Since the proposed methodology imposes restrictions only on GDP and not on prices, in order to be able to interpret permanent shocks as supply shocks and temporary shocks as demand shocks, we need to check whether positive supply shock leads to a price decrease and positive demand shock to a price increase.

Over-identifying restriction was generally satisfied. In all cases positive demand shock led to a price increase, while in 19 out of 28 cases positive supply shock led to a price decrease. In the remaining nine cases it led to a price increase: in Cyprus, Denmark, Hungary, Ireland, Latvia, Lithuania, Poland, Portugal and Spain.

After the demand and supply shock extraction from the structural VAR, we calculated a set of correlations between individual EU member states and the euro area aggregate. However, in calculating correlations of shocks between the euro area and one of its members, we adjusted euro area aggregate variables so as not to include the member which the correlations are being calculated with. The reason for this is that we can expect the correlations between the euro area and large EU member states to be high, since they have a large weight in calculating the euro area aggregate variables. In this way we were able to generate more accurate correlations between the euro area and its members. Indeed, when we calculated correlations between the unadjusted euro area variables and its members, the correlations were significantly higher, proving that part of this correlation is coming from correlating the EMU member with itself.

3. To Enlarge or Not to Enlarge?

3.1 Correlations of Shocks

Existing research is usually concerned with how a single monetary policy would affect new entrants, but the effect of new entrants on the entire euro area is usually neglected. The reason for this is that prospective members are mostly small economies which

could not, in terms of business cycle synchronization, independently have a large adverse effect on the entire euro area. However, a lot of small diverse economies could have a significant negative impact on the enlarged area in a way that their mutual business cycle synchronization diminishes. Hence, in this section we are analyzing whether enlarging the euro area to 25 or 27 members would be acceptable in terms of business cycle synchronization.

In addition to that, deep economic crisis in one of the members could put pressure on similar countries and induce herd behavior by market participants that could influence financing costs for several member states. For that reason we are also inspecting whether business cycle correlation has changed over time, especially due to the 2008 recession.

Table 2 contains correlation coefficients between the euro area and individual EU members, as well as average correlations. For a start, we focus on correlation coefficients of supply shocks among the EA17. We are using the euro area consisting of 17 members, because Latvia joined the euro area on January 01, 2014 and Lithuania on January 01, 2015, while the sample period covers period until the end of 2012.We assume that core countries are countries with correlation of shocks with the euro area above 0.5 and the periphery below 0.5.

It can be observed that supply shocks between the adjusted euro area and individual members are highly correlated in Belgium, Finland, France, Germany, Italy and the Netherlands (these can be viewed as core members and others as periphery members). Even though periphery countries have lower correlations, all but three euro area members have statistically significant correlation of supply shocks with the euro area. Greece, Malta and Slovakia do not have statistically significant correlation of their supply shocks with the euro area, which means that only those three members do not have business cycles that follow a similar path to the euro area aggregated variable. If we take a look at the three "old" EU member states that have not yet decided to introduce the euro, we can observe that all of them have a lower correlation of supply shocks with the euro area than the core members, but still higher than the periphery and new member states. From the new member states that have not yet introduced the euro, only the Czech Republic has correlation of supply shocks with the euro area above 0.5. Latvia and Lithuania, which have introduced the euro in 2014 and 2015 respectively, have statistically significant correlation coefficients of 0.3 and 0.33. The weighted average of supply shocks correlations for core and periphery countries is 0.6 for the core and 0.38 for the periphery. New member states have an even lower correlation than the periphery (0.28), but among different groups of countries, the lowest correlation of supply shocks with the euro area is in new members who have already introduced the euro (0.23). This suggests that other factors beside the synchronization of business cycles were more important in making the decision to introduce the euro, but also that it takes time for business cycles of the new entrants' economies to synchronize with the rest of the euro area.

However, it has to be noted that correlations between individual members and the euro area are relatively high. Why is this correlation relatively high in comparison to older studies (such as Fidrmuc and Korhonen 2003; Horvath and Rátfai 2004; Raúl Ramos and Jordi Suriñach 2004)? Dividing the sample period into three periods

provides evidence of convergence between member states (Table 2). Weighted average correlation of supply shocks in EA17 increased from 0.45 in the first period to 0.6 in the second period (period after the launch of the euro), corroborating the endogeneity hypothesis, and to 0.66 in the last period, while in the EU25 it increased from 0.42 in the first period to 0.65 in the last. However, even though large EU economies are drivers of the overall correlation, the most dynamic behavior is observed in the new member states. Weighted average correlation of supply shocks between the euro area and the new member states was 0.13 in the first period, 0.19 in the second while it amounted to 0.55 in the last. High convergence of supply shocks in the last period can be attributed to the recession and global financial crisis. As Lillie Lam and James Yetman (2013) argue, co-movement patterns are sensitive to macroeconomic volatility over time. The period before the global financial crisis was relatively benign in economic terms, shocks were smaller (see the next section) and economies could grow relatively close to trend. In periods of high volatility, growth rates tend to deviate significantly from the trend, especially negatively. If countries of interest have integrated markets, business cycle correlation in these rough times will be much larger than in tranquil periods. In order to investigate more the impact of the recent global economic and financial turmoil, we performed similar analysis in the period from Q1/1997 until Q3/2008. Results reveal that correlations of shocks with the euro area were significantly lower when the crisis period was removed. Other characteristics remained relatively stable: the same countries have the highest correlation of supply shocks with the euro area. Lam and Yetman (2013) reveal that the stronger the trade linkages are the stronger is the co-movement of the business cycle during the crisis. As a result of the opening of their markets and the process of EU accession, new member states increased their trade linkages with the rest of the EU more strongly in the observed period (Timo Baas and Herbert Brücker 2011; Alessandro Antimiani and Valeria Costantini 2013), hence the correlation of supply shocks with the euro area should have increased much more than in the old member states.

One more point emerges from Table 2. If we judge by the increase in the correlation of supply shock in the EA17 in the period after the introduction of the euro, which could be a sign that endogeneity hypothesis holds, we can assume that correlation of supply shocks between the non-EA participants and the euro area could also increase after they introduce the euro.

However, the question is what would happen with the supply shock correlation and consequently with the business cycle synchronization, if all remaining EU member states introduced the euro? This is an important question to analyze, because none of the new member states has the opt-out clause, meaning that they are required to introduce the euro as soon as they fulfill the Maastricht criteria. However, as in the case of Sweden, which is not yet interested in joining the euro area and which thus has not entered the exchange rate mechanism of the European Monetary System, the remaining non-euro area new member states could stay out of the euro area as long as needed, if they never fulfill the Maastricht criteria. Also, it has to be noted that it is possible that some members are likely to never be able to fulfill the Maastricht criteria and will never be able to join the euro area.

Table 2   Correlation Coefficients between the Euro Area and Individual EU Member States (Q1/1997-Q4/2012)

Country	Correlations of supply shocks	Correlations of demand shocks	Country	Correlations of supply shocks	Correlations of demand shocks
Italy	0.68*	0.28*	Sweden	0.49*	0.06
Germany	0.62*	0.24	UK	0.45*	-0.08
Belgium	0.56*	-0.07	Denmark	0.41*	0.21
Finland	0.55*	-0.10			
France	0.55*	0.05	Czech R.	0.51*	-0.05
Netherlands	0.52*	0.20	Hungary	0.46*	0.05
Spain	0.45*	0.32*	Romania	0.39*	-0.14
Austria	0.44*	0.04	Lithuania	0.33*	-0.13
Luxembourg	0.38*	-0.23	Latvia	0.30*	0.00
Slovenia	0.37*	0.46*	Poland	0.13	-0.13
Estonia	0.34*	-0.06	Bulgaria	0.16	0.08
Portugal	0.32*	0.16			
Cyprus	0.30*	0.17			
Ireland	0.27*	0.15			
Greece	0.25	-0.09			
Malta	0.21	-0.01			
Slovakia	0.09	-0.14			
WAC - EA12	0.56*	0.18	WAC - EA17 core	0.60*	0.17
WAC - EA17	0.56*	0.18	WAC - EA17 periphery	0.38*	0.18
WAC - EU25	0.54*	0.16	WAC - new members	0.28*	-0.06
WAC - EU27	0.52*	0.12	WAC - new members non-EA participants	0.29*	-0.08
			WAC - new members EA participants	0.23	0.09

Notes: Positive statistically significant correlations ($p < 0.05$) are indicated with a star. WAC - weighted average correlation. EA12 refers to the first 12 euro area members, EA17 are joined by Slovenia, Cyprus, Malta, Slovakia and Estonia, EU25 include all EU member states except the UK and Denmark, while EU27 refers to all EU member states. EA17 core includes Belgium, Finland, France, Germany, Italy and the Netherlands, while EA17 periphery includes Austria, Cyprus, Estonia, Greece, Ireland, Luxemburg, Malta, Portugal, Slovakia, Slovenia and Spain. New member states include 12 new EU member states. New member states participating in the EA include Slovenia, Cyprus, Malta, Slovakia and Estonia, while new members, non-EA participants include the remaining 7 new EU member states.

Source: Author's calculation.

Table 3 Correlation Coefficients between the Euro Area and Individual EU Member States in Three Periods

	Correlations of supply shocks with the euro area			Correlations of demand shocks with the euro area		
	Q1/1997-Q2/2002	Q3/2002-Q4/2007	Q1/2008-Q4/2012	Q1/1997-Q2/2002	Q3/2002-Q4/2007	Q1/2008-Q4/2012
Italy	0.57*	0.74*	0.78*	0.34*	0.24*	0.33*
Germany	0.75*	0.71*	0.66*	0.37*	0.31*	-0.25
Belgium	0.24	0.48*	0.86*	-0.23	0.26*	-0.10
Finland	0.22	0.44*	0.64*	-0.31	0.25*	0.05
France	0.40*	0.66*	0.63*	-0.23	0.28*	0.28*
Netherlands	0.16	0.64*	0.51*	0.46*	0.26*	0.09
Spain	0.12	0.31*	0.80*	0.48*	-0.01	-0.01
Austria	-0.01	0.58*	0.77*	-0.07	0.09	-0.08
Luxembourg	0.27*	0.33*	0.46*	-0.26	-0.33	-0.19
Slovenia	0.08	0.47*	0.71*	0.63*	0.37*	0.13
Estonia	0.31*	0.33*	0.39*	-0.49	-0.02	0.36*
Portugal	-0.23	0.38*	0.21	-0.31	0.25*	-0.19
Cyprus	0.35*	0.07	0.27*	0.20	0.04	0.26*
Ireland	0.28*	0.25*	0.16	0.30*	-0.09	0.23
Greece	0.71*	-0.10	0.28*	0.05	0.13	-0.24
Malta	-0.34	0.31*	0.80*	-0.01	-0.10	0.32*
Slovakia	-0.30	0.32*	0.69*	-0.51	0.01	0.59*
Sweden	0.18	0.62*	0.62*	0.01	0.21	-0.17
UK	0.33*	0.24	0.61*	-0.05	-0.22	-0.19
Denmark	0.15	0.59*	0.53*	0.25*	0.51*	-0.02
Czech Republic	0.26*	0.52*	0.76*	-0.32	0.06	-0.02
Hungary	0.10	0.25*	0.80*	-0.11	0.23	0.30*
Romania	0.29*	0.34*	0.70*	-0.56	-0.21	0.12
Lithuania	0.16	-0.01	0.60*	-0.31	-0.09	0.10
Latvia	0.21	0.14	0.50*	-0.39	0.25*	0.16
Poland	0.09	-0.01	0.32*	-0.08	-0.21	-0.17
Bulgaria	0.11	-0.02	0.43*	-0.07	0.25*	0.02
WAC - EA12	0.45*	0.61*	0.66*	0.18	0.23	0.04
WAC - EA17	0.45*	0.60*	0.66*	0.18	0.23	0.05
WAC - EU25	0.42*	0.58*	0.65*	0.15	0.21	0.03
WAC - new members	0.13	0.19	0.55*	-0.19	-0.04	0.04
WAC - Greece, Ireland, Cyprus and Portugal	0.29*	0.15	0.22	0.02	0.10	-0.07

Notes: Positive statistically significant correlations ($p < 0.05$) are indicated with a star. WAC - weighted average correlation. EA12 refers to the first 12 euro area members, EA17 are joined by Slovenia, Cyprus, Malta, Slovakia and Estonia, while EU25 include all EU member states except the UK and Denmark. New member states include 12 new EU member states.

Source: Author's calculation.

The weighted average correlation of supply shocks in the EA17 is 0.56 and it is statistically significant. If all remaining EU member states introduced the euro, except the UK and Denmark, which have the opt-out clause, their correlation would not drop much, only to 0.54. Since the remaining members are relatively small economies, their impact on the weighted average correlation is not large, which means that the

weighted average correlation and synchronization of euro area business cycles should not be an issue in the enlarged euro area. However, it has to be noted that synchronization of business cycles, even though it is the central factor in determining whether countries form an optimum currency area, is not the only important factor in assessing the possible success of a monetary union. Differences, especially in financial systems and financial markets, can cause spillovers from small (un)synchronized members to large members or to the entire monetary union. The 2008 crisis is proof of that. Greece, Ireland, Cyprus and Portugal are among countries that have been hit by the financial and economic turmoil more strongly than the rest of the EU. They are also among the euro area members that have the lowest correlation of supply shocks with the euro area and are relatively small economies. If we remove them from EA17, the weighted average correlation of the remaining members increases only by 0.01 - to 0.57. This means that they should be too small to cause problems for the common monetary policy. And yet we witnessed that financial and economic turmoil in those members can be transmitted to large euro area members. This means that even though the tools of the optimum currency area theory suggest that the entire euro area has relatively correlated supply shocks and that common monetary policy should be good enough, too diverse small members are potentially a heavy burden for the entire monetary union and the enlargement process should be carried out cautiously.

Another interesting result emerges from Table 2. Weighted average correlation of supply shocks between the euro area and Greece, Ireland, Cyprus and Portugal shows little indication of convergence over time. Due to the much deeper crisis in those countries and the partial recovery in the rest of the euro area, their correlation of supply shocks with the euro area even decreased in the last period compared to the first. It is noteworthy that those members, except Greece, had lower than average EA17 correlation of supply shocks already in the first period. Hence, in later periods, the situation with synchronization of business cycles simply got worse. This implies that policies designated to increase business cycle correlation (such as more flexible labor laws and incentives for industry reallocation) should be used more actively and that differences between members that can cause adverse transmission of shocks should be minimized (i.e. through fiscal transfer mechanisms).

Results for demand shocks show a much lower convergence; more precisely, almost no correlation at all, regardless of whether we examine the weighted average correlation in the EA17 or EU25 (Table 2). Only Italy, Slovenia and Spain have statistically significant demand shocks with the euro area, while the correlation coefficient in none of them exceeds 0.5. There are also much more negatively correlated demand shocks. Dividing the sample into three periods reveals divergence in demand shock correlations, especially in the last period. It seems that the economic and financial crisis that brought supply shock correlations together, amplified the decoupling of co-movements in demand shocks between the euro area and individual members. This could be explained in terms of the countries' following different (fiscal) policies. Before 2008, some of the countries that were hit by the financial and economic crisis more strongly mostly conducted procyclical fiscal policies, especially in comparison to Germany, the country with the largest weight in the euro area. By the start of the recession, a considerable gap in fiscal stance between those countries and Germany

had emerged, which amplified asymmetries in their business cycles (José Abad et al. 2013). However, fiscal policy is not the only one to blame. Austerity was present in Germany already years before the 2008 crisis and it was present in the private sector as well. Nominal and real wages in the private sector in Germany did not follow the increase in productivity, while on the other hand in later troubled members it increased above the productivity growth both in the private and in the public sectors (Abad et al. 2013). Different direction of wages and prices, and consequently real exchange rates, means that a one-size-fits-all monetary policy is inadequate for diverging members.

Hence, business cycle synchronization needs to be monitored. The Convergence report covers non-euro area member states, but it does not give information about the synchronization of business cycles. The Stability and Growth Pact covers all EU member states, but it also does not monitor business cycle correlation. The Maastricht criteria for the newcomers do not include criteria on business cycle synchronization. Hence, the formal introduction of synchronization of business cycles parameters in the Convergence report and the Stability and Growth Pact, as well as in the Maastricht criteria could serve to increase awareness that single monetary policy is most effective when business cycles are aligned.

3.2 Size of Shocks

Successful monetary union requires that shocks are correlated *and* that they are of similar size. The reason for this is that, even if monetary union members had perfectly correlated business cycles, if the size of shocks significantly differs among them, individual members would demand different intensity of monetary policy reactions to a shock.

The sizes of shocks are calculated as standard deviations of the supply and demand shocks. Results indicate that supply shocks are in general of much higher magnitude than demand shocks. There is already a large difference in shocks between the core and periphery of the EA17, with demand shocks being twice larger and supply shocks being one-third larger in the periphery members (Table 3). The difference in shock sizes between the EA17 and the new member non-participants are much larger. While the average supply and demand shocks in the EA17 are 0.77 and 0.38, respectively, in the new member non-EA participants they are, on average, 72.7 and 339.5 percent larger. These results, together with the relatively low correlation of supply and demand shocks for non-euro area member states, suggest the need for careful monitoring of the enlargement of the euro area.

Results on the correlation of business cycles indicate that crisis generally increased co-movements. Crisis at the same time, expectedly, increased the size of the shocks. Supply and demand shocks are in the third (crisis) period in comparison to the pre-crisis period larger in almost all countries. However, shocks in the new member states are lower in the crisis period in comparison to the first period, probably due to the fact that transition was still underway in that period.

To sum up, if we were to judge only by the supply shock correlations, the euro area could continue its enlargement. However, the problem of very low correlation of demand shocks among both the EA and the non-EA participants, different sizes of supply and demand shocks and transmission of shocks from non-synchronized

Table 4 Sizes of Supply and Demand Shocks (Q1/1997-Q4/2012)

	Size of supply shocks				Size of demand shocks			
	Q1/'97-Q4/'12	Q1/'97-Q2/'02	Q3/'02-Q4/'07	Q1/'08-Q4/'12	Q1/'97-Q4/'12	Q1/'97-Q2/'02	Q3/'02-Q4/'07	Q1/'08-Q4/'12
Austria	0.89	0.76	0.76	1.14	0.42	0.49	0.31	0.43
Belgium	0.55	0.58	0.39	0.68	0.28	0.32	0.24	0.28
Finland	1.23	1.22	0.85	1.60	0.52	0.49	0.53	0.51
France	0.44	0.40	0.44	0.47	0.20	0.20	0.17	0.22
Germany	0.95	0.70	0.82	1.29	0.25	0.32	0.26	0.13
Greece	1.38	1.29	1.23	1.62	0.95	0.55	0.68	1.29
Ireland	1.80	1.88	1.82	1.42	1.30	1.35	0.99	1.51
Italy	0.71	0.68	0.51	0.91	0.40	0.33	0.48	0.34
Luxembourg	1.67	1.73	1.54	1.58	1.82	2.34	1.35	1.72
Netherlands	0.59	0.55	0.56	0.68	0.48	0.54	0.42	0.43
Portugal	0.90	0.82	0.64	1.12	0.52	0.43	0.48	0.57
Spain	0.65	0.73	0.38	0.75	0.50	0.68	0.31	0.41
Cyprus	0.72	0.75	0.52	0.81	0.58	0.58	0.52	0.60
Estonia	1.93	1.95	1.08	2.62	1.65	1.47	1.88	1.43
Malta	1.40	1.70	1.28	1.45	0.64	1.06	0.55	0.55
Slovakia	2.03	2.58	1.33	1.71	1.25	1.23	1.09	1.25
Slovenia	1.19	1.02	0.70	1.69	0.90	0.86	0.95	0.72
Denmark	0.96	0.86	1.05	0.97	0.51	0.41	0.47	0.65
Sweden	0.97	0.62	0.84	1.34	0.43	0.40	0.46	0.45
UK	0.74	0.67	0.60	0.88	0.60	0.36	0.69	0.68
Bulgaria	2.21	3.51	0.90	1.52	2.32	2.57	1.74	2.66
Czech Republic	0.89	0.58	0.94	0.97	0.95	0.83	0.84	1.03
Hungary	0.85	0.67	0.78	1.02	1.94	2.05	1.67	1.79
Latvia	1.99	2.32	1.30	2.23	2.01	1.58	2.05	2.27
Lithuania	2.24	2.61	0.99	2.75	1.70	1.69	1.36	1.91
Poland	0.90	1.10	0.79	0.72	1.00	1.20	0.85	0.72
Romania	3.22	5.36	1.30	2.48	4.20	5.11	1.61	4.24
WAS - EA12	0.76	0.68	0.63	0.94	0.37	0.39	0.33	0.33
WAS - EA17	0.77	0.69	0.64	0.95	0.38	0.40	0.34	0.33
WAS - EU25	0.81	0.75	0.66	0.97	0.46	0.50	0.40	0.42
WAS - non-EA new members	1.33	1.71	0.91	1.19	1.67	1.88	1.15	1.57
WAS - EA17 core	0.73	0.61	0.61	0.92	0.30	0.31	0.30	0.24
WAS - EA17 periphery	0.95	0.97	0.73	1.05	0.66	0.73	0.48	0.67

Notes: WAS - weighted average size. EA12 refers to the first 12 euro area members, EA17 are joined by Slovenia, Cyprus and Malta, Slovakia and Estonia, while EU25 include all EU members except the UK and Denmark. Non-euro area new member states include Bulgaria, Czech Republic, Latvia, Lithuania, Hungary, Poland and Romania. EA17 core includes Belgium, Finland, France, Germany, Italy and the Netherlands, while EA17 periphery includes Austria, Cyprus, Estonia, Greece, Ireland, Luxemburg, Malta, Portugal, Slovakia, Slovenia and Spain.

Source: Author's calculation.

members to the other members still remains. Hence, even though introducing the euro in remaining non-EA participants would not decrease average correlation of shocks much, non-EA participants that wish to join the euro area should, as Bernard Fingleton, Harry Garretsen, and Ron Martin (2015) put it, think twice about doing so.

However, what would happen with the euro area if it would not continue with the enlargement? Would the problem of different sizes of shocks as well as the transmission of shocks from non-synchronized members to other members disappear? It most probably would not. Since the euro area already is heterogeneous, especially in terms of fiscal policy and indebtedness, the lack of risk sharing mechanisms might prevent these problems from disappearing and turn the observed correlation into divergence even if the EMU stopped enlarging. Besides, since the EU/EMU institutions were not prepared for the 2008 crisis in the existing members and the mounting fragilities went unnoticed, there is a need to create a mechanism that will help manage future crises (Richard Baldwin and Francesco Giavazzi 2015). Especially if the euro area wishes to enlarge.

4. Conclusion

In this article we examined whether the EMU should continue with further enlargements. Results show that the periphery of the EU remained the periphery in the euro area as well, with much lower correlation of supply shocks with the euro area than core countries. Southern periphery members known for high inflation, which had to converge to the core members before the introduction of the euro, converged only apparently. At the first sign of trouble, they diverged again. More precisely, correlation of their supply shocks with the euro area decreased after the 2008 crisis compared to the period before the euro introduction. Are the new member states (non-EA participants) the same in this respect? If we were to judge only by the supply shock correlations, the euro area could continue with enlargement. Correlation of their shocks with the euro area increased through time and reached levels close to that of old member states. The same is true if we believe that synchronization of business cycles will increase after the euro introduction, resulting from increased trade integration. However, the problem of very low correlation of demand shocks among both the EA and the non-EA participants, different sizes of supply and demand shocks and transmission of shocks from non-synchronized members to the other members still remains. Hence, further progress toward the policies that will increase synchronization of the business cycles in the euro area, might correlate shocks more and thus increase the optimality of the Union. Furthermore, the introduction of insurance mechanisms, such as fiscal transfer mechanisms, or working on improving other optimum currency area criteria might also mitigate the impact of not completely synchronized business cycles. If that occurs, the EMU could continue to enlarge, but still with caution.

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