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Divergence during crisis? The effect of the 2008 crisis on factors of business cycle synchronization of EMU countries.

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Abstract:

The paper examines the effect of the economic crisis of 2008 on factors influencing business cycle synchronization, namely trade intensity, financial integration and difference in economic structure. Using fixed effect regression models, I find that financial integration has a robust positive effect on business cycle synchronization, which is stronger among countries members of the European Monetary Union. There is some evidence that trade intensity is less important in the years of the crisis, while difference in economic structure shows increased significance in those years, especially for countries members of the EMU.

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1. Introduction

In the current political situation, when the European Union (EU) is facing serious problems threatening its unity, the political debate on the continent has shifted its focus, placing even greater attention on the problems, which have bothered the union over the past years. As a major project of the EU, the European Monetary Union (EMU) has also been in the spotlight.

There is huge discussion as to whether and to what extend can the Eurozone, and the EU in general, be considered an optimal currency area (OCA). A cost-benefit analysis of a currency union has been initially presented in the work of R. A. Mundell (1961). This branch of economic has ever since further developed the ideas presented in Mundell's paper, discussing issues like factor mobility, size of the economy, etc. (Dellas and Tavlas, 2009). However, it can be argued that of all criteria the most important one is the business cycle homogeneity of the area, as it summarizes most of the other suggested requirements (Cuaresma et al, 2010).

As it is one of the most important requirements for an OCA, a lot of emphasis is placed on business cycle synchronization. According to the theory on the topic a country with a higher degree of business cycle synchronization will have lower costs and greater benefits from a membership in a monetary union. The importance of the topic has been the reason behind the vast amount of economic research on the matter of business cycle synchronization over the past decades.

Different perspectives of the issue have been discussed in the literature. Topic as the endogeneity of a currency area, factors affecting output co-movement, regional business synchronization, etc. have attracted the attention of the academic and political community. However, most of those papers are fairly outdated and do not show the present situation in the monetary union

Another important issue on which some authors have focused their attention is the effect of a crisis on the business cycle synchronization. This issue, however, seems to be rather under researched in the case of EMU, mainly because of the fact that the monetary union

was established in 1999 and since the last major economic crisis in 2008 have only passed 8 year. This period was up to very recently barely sufficient in order to extract any useful information about the trends in the business cycles around Europe. Now, however, data is available on all major economic indicators for all European countries starting before the formation of the EMU and up to the year 2014. This time period is expected to suffice for rather meaningful results.

In order to fill in this gap in previous research, in this paper I investigate the effect that the economic crisis of 2008 had on factors influencing business cycle synchronization within the EU. Moreover, I distinguish between countries which are part of the monetary union and those who are not, contributing to the political debate about the economic efficiency of the EMU in the context of recent events. Due to the fact that countries have to fulfill certain requirements in order to become a part of the EMU, a definite difference between the two groups exists. Since the effect which economic factors have on business cycle synchronization is largely dependent on country specific factors, EMU membership could make a significant difference in the way business cycles react to economic distress. I consider the effect of trade intensity, financial integration and difference in economic structure, as they are proven to be some of the most predominant determinants of economic co-movement.

The paper is structured as follows:

In Section 2 I review the most influential research on the topic, focusing on those papers discussing the Euro area. Since the empirical literature of business cycle synchronization is rather inconclusive, and the effect of different factors is hard to predict theoretically, the empirical survey also serves as a justification for the hypotheses I make in the study. Section 3 briefly presents the methods used in the paper. Then I present the data used and the definitions I have adopted for the variables under consideration. The empirical results are presented in Section 5. I estimate the effect of trade intensity, financial integration and economic structure on economic co-movements. I distinguish the different effect they have on countries before and after the crisis for the two different groups of countries. The results are summarized and discussed in Section 6.

2. Business cycle synchronization

In this section I start with presenting a brief review of previous research on the topic of business cycle synchronization and the variables influencing it. The review is largely inspired by De Haan et al. (2008), who provide a critical survey of empirical literature on the topic. Then, I continue with a theoretical discussion on the potential effect of the economic crisis on the way trade intensity, financial integration and difference in economic structure affect economic co-movement.

2.1 Measuring business cycle synchronization

Economic research on the topic of business cycle synchronization has been abundant throughout the past decades. There are numerous papers discussing various aspects of the issue. There are two main branches of research in the existing literature, using the methods of data filtering and shock accounting models in order to access business cycle synchronization respectively. These approaches are, however, not substitutes to each other, each extracting different type of information from the data on economic activity (De Haan et al, 2008).

To understand the essence of filtering in estimating a business cycle, one must firstly understand what is meant by business cycle, when used in the context of business cycle synchronization studies. Burns and Mitchell (1946) define the term as the absolute contractions and expansion of economic activity. Due to the stationary nature of economic activity however, most studies which investigate business cycle synchronization look at deviation cycles instead (De Haan et al, 2008). This means that the input used to calculate the business cycle is the deviation of economic activity from a trend. Thus, there is a need to isolate a cyclical and a trend component from the time series of economic activity. Authors approach this issue differently, using various filtering techniques. Among the most commonly used filters in previous research are the Kalman (1960), Hodrick-Prescott (1997), Baxter-King (1999), the Christiano-Fitzgerald (2003) filters, and the phase average

trend (PAT, Boschan and Ebanks, 1978). Although there is irrefutably a difference between those filters, studies show that the choice of a particular filter is not likely to affect the conclusions of the study significantly (Artis and Zhang, 1997; Calderon et al., 2002; Massman and Mitchell, 2004).

Filtering techniques like the ones mentioned above give a great inside into the economic cycles of countries, capturing the similarity in movements of the business cycles irrespective of the source of the shock and the corresponding government intervention. This provides information, which is particularly important when discussing monetary unions, since the information can be rather straightforwardly used to access how appropriate a common monetary policy might be (De Haan, 2008).

2.2 Variables behind business cycle synchronization

There is a vast amount of research focused on investigating which variables have a significant effect on business cycle synchronization. A particular attention is placed on trade intensity, financial integration and economic structure.

Trade intensity is the most common variable discussed as a significant determinant of business cycle synchronization. Although theoretically the effect of trade intensity is ambiguous, most empirical studies on the topic find a positive relationship between the variables (De Haan et al., 2008). However, the magnitude of the effect of trade intensity varies largely from paper to paper. Frankel and Rose (1998) discover that bilateral trade has a strong positive effect on synchronization. Using a similar model Kose and Yi (2002) find that the variable has even greater influence. Inklaar et al. (2005), Imbs (2004) among others find a rather smaller, but still significant effect of trade intensity on synchronization. Gruben et al. (2002) distinguishes between inter and intra industry trade and find that inter-industry trade has ambiguous effect on synchronization, whereas intra-industry has a statistically significant, but small positive effect. Babetskii (2005) argues that trade intensity positively influences demand shocks, but the evidence on supply shocks is mixed.

Another largely discussed determinant of business cycle synchronization is the level of financial integration between countries. The theoretical effect of the variable is again ambiguous, since it is expected to affect the demand and supply side of the economy differently (De Haan et al., 2008). Empirical research is also inconclusive on the topic. Positive effect of financial integration is found by Imbs (2004) and Jensen and Stokman (2004) among others, while Baxter and Kouparitsas (2005) and Inklaar et al. (2008) do not find a robust relationship. Controlling for country specific characteristics, Kalemli-Ozcan et al. (2009) find a negative relationship between financial integration and business cycle synchronization. Monnet and Puy (2016) also report a robust negative effect of financial integration.

Economic structure is another variable considered by many as one of the factors, which can determine business cycle synchronization. Different economic structure implies less synchronized economic activity, due to industry specific shocks (De Haan, 2009). Imbs (2004), Calderon et al. (2007) among others provide empirical evidence confirming this proposition. However, research is not conclusive on the topic. Monnet and Puy (2016) do not find evidence for the effect of share of manufacturing on synchronization. Similarly, Baxter and Kouparitsas (2005) report that the effect of sectoral similarity is not robust.

Other factors are also discussed in the literature as potential determinants for business cycle synchronization. De Haan et al. (2002) find that exchange rate volatility has a positive effect on synchronization. Exchange rate is also considered by Bordo and Heblling (2003), but the estimated effect is not robust. Otto et al. (2001) find that exchange rate volatility negatively influences synchronization. Monetary policy variables are considered by Camacho et al. (2006), but no relationship is found between them and synchronization. Inklaar et al. (2005) use different approach in their estimations and report positive effect of similar monetary and fiscal policy. Fiscal policy is also included as a potential determinant of economic co-movement by Darvas et al. (2005) Camacho et al. (2006), Clark and van Wincoop (2001) among others. Kose et al. (2003) find that terms of trade volatility negatively influences output correlation. Foreign direct investments are considered by Otto et al. (2001) and are found to have a negative relationship with business cycle synchronization. The paper also discusses the effect of common legal system, good

accounting practices and common take-up of new technology, which are all statistically significant.

In conclusion, there are many variables, which are considered by previous research to explain the level of business cycle synchronization. Empirical research on the topic is however not conclusive on the way even the most widely studied variables affect economic co-movement. The direction and magnitude of the effect of all variables are highly dependent on the time period and panel of countries discussed, as well as the econometric procedure applied. The majority of research, however, does show a positive effect of trade intensity and financial integration, as well as a negative effect of difference in economic structure.

For convenience of the reader, the effect of trade intensity, financial integration and economic structure which theory predicts, as well as the effect which is found most frequently in previous research are summarized in the table below.

Table 2.2.1 Effect of trade intensity, financial integration and economic structure

Variable	Effect predicted by theory	Effect according to previous research
Trade intensity	+/-	+
Financial integration	+/-	+
Difference in economic structure	-	-/?

2.3 The potential effect of a crisis

As noted before, the factors affecting business cycle synchronization vary greatly with the time period discussed, as well as the panel of countries examined. Thus, there is a reason to believe that the effect of the variables discussed in the paper is affected by the economic

crisis of 2008. Moreover, under the assumption that EMU countries have different characteristics than non-EMU countries, the effect of the factors is expected to differ with EMU membership.

The effect of the economic crisis on business cycle synchronization that theory suggests is ambiguous. On one hand it can be argued that due to country specific factors the crisis affects different countries in a different way, leading to difference in co—movement of economic activity. However, due to the difficult economic situation in other parts of the world it can also be expected for the economic crisis to increase business synchronization between European countries, due to decreased linkages with other parts of the world (Gächter et al. 2013). Those opposite effects make determining the effect of a crisis on economic co-movement an empirical rather than a theoretical issue.

Moreover, variables that are considered to influence business cycle synchronization tend to behave differently in times of economic distress. Financial integration largely depends on the economic stability of a country, since the markets require additional return for riskier assets. Besides, international trade decreases in times of economic instability, decreasing the effects it is expected to have on business cycle synchronization. Economic structure, however, is rather sluggish and is not expected to be significantly affected by the economic crisis.

Regarding the difference between the two different groups of countries, economic theory suggest that countries, which are part of a monetary union trade more between each other due to the fact that exchange rate risk is non-existent. During times of economic instability the positive effect of the lack of exchange rate risk can be expected to be even higher, since international trade is significantly lower. Similarly, financial integration is expected to be higher between EMU members, due to the centralized monetary policy. The difference in economic structure between members and non-members is not straightforward to analyze from theoretical perspective and is to be considered an empirical issue. Those suggestions are summarized in Table 2.3.1

Table 2.3.1 Potential effect of the crisis on business cycle synchronization, trade intensity, financial integration and economic structure among EMU and non-EMU countries

Variable	Potential effect on non-EMU countries	Potential effect on EMU countries
Business cycle synchronization	+/-	+/-
Trade intensity	-	+
Financial integration	-	- (but smaller)
Difference in economic structure	n/a	n/a

3. Methodology

The following section explains the models I use, in order to draw conclusions about business cycle synchronization between the countries in the sample, as well as the effect trade intensity, financial integration and difference in economic structure have on it. The models are complementary to each other, each exploring a different side of the issue.

I first, following Monnet and Puy (2016), set up the model:

$$\Theta_{ij,t} = \beta_1 * \text{Trade Intensity} + \beta_2 * \text{Economic Structure} + \beta_3 * \text{Financial Integration} + \alpha_{ij} + \gamma_t + \varepsilon_{i,t} \quad (3.1)$$

where $\Theta_{ji,t}$ is the business synchronization measure between country i and country j at time t. The definitions of trade intensity, economic structure and financial integration are described in detail in the section that follows. α_{ij} is a factor, specific for each country pair, and γ_t is a time specific factor. These are included in order to avoid problems associated with common shocks and country fixed effects and any bias that they might cause (Monnet and Puy, 2016).

The purpose of this model is to give initial view on how business cycle synchronization is affected by the variables under consideration.

In order to assess the effect of the financial crisis on the way the economic factors under consideration affect business cycle synchronization between countries, I expand the model, adding interactions between the variables and a dummy variable (CRISIS) which is switched on in the time period 2009-2014.

$$\Theta_{ij,t} = \beta_1 * \text{Trade Intensity} + \beta_2 * \text{Economic Structure} + \beta_3 * \text{Financial Integration} + \beta_4 * \text{CRISIS} * \text{Trade Intensity} + \beta_5 * \text{CRISIS} * \text{Economic Structure} + \beta_6 * \text{CRISIS} * \text{Financial Integration} + \alpha_{ij} + \gamma_t + \varepsilon_{i,t} \quad (3.2)$$

The estimates from the interaction variables in this model represent how the crisis affected the way the explanatory variables influence business cycle synchronization among all

countries in the sample. For the years 2009-2014 the effect of the variables is the sum of the coefficients of the interaction terms and trade intensity, economic structure and financial integration respectively. However, insignificance of the interaction variables would imply that the economic crisis did not have an impact on the effect of the repressors.

The next model I consider aims to distinguish between EMU members and non-members. It is an expansion of Model 3.1 but this time I include an interaction of trade intensity, economic structure and financial integration with an EMU dummy, which is switched on for all country pair where both countries are part of the monetary union. The model takes the following form:

$$\Theta_{ij,t} = \beta_1 * \text{Trade Intensity} + \beta_2 * \text{Economic Structure} + \beta_3 * \text{Financial Integration} + \beta_4 * \text{EMU} * \text{Trade Intensity} + \beta_5 * \text{EMU} * \text{Economic Structure} + \beta_6 * \text{EMU} * \text{Financial Integration} + \alpha_{ij} + \gamma_t + \varepsilon_{i,t} \quad (3.3)$$

The estimates of the interaction variables, similarly to the previous model, provide information about the difference in effect of the explanatory variables, but this time with respect to membership status.

The last specification I consider aim to isolate the effect of the financial crisis on the behavior of countries members of the EMU. It takes the following form:

$$\Theta_{ij,t} = \beta_1 * \text{Trade Intensity} + \beta_2 * \text{Economic Structure} + \beta_3 * \text{Financial Integration} + \beta_4 * \text{EMU} * \text{Trade Intensity} + \beta_5 * \text{EMU} * \text{Economic Structure} + \beta_6 * \text{EMU} * \text{Financial Integration} + \beta_7 * \text{EMU} * \text{CRISIS} * \text{Trade Intensity} + \beta_8 * \text{EMU} * \text{CRISIS} * \text{Economic Structure} + \beta_9 * \text{EMU} * \text{CRISIS} * \text{Financial Integration} + \alpha_{ij} + \gamma_t + \varepsilon_{i,t} \quad (3.4)$$

All models are estimated using panel regression with fixed effects. This estimation technique deals with problems, which might arise from country-specific characteristics. It is to be noted that the estimates provided from the models are highly dependent on the sample because of the fixed effects (Baltagi, 2013). However, this is not of particular importance for the study, since no out-of-sample predictions are to be made.

4. Data and descriptive statistics

The following section presents the computational procedures I employ in order to calculate the variables used in the paper. I also discuss the data sources used, as well as limitations the study faces regarding data availability. Summary statistics are presented and discussed.

4.1 Variables

One of the major empirical issues in the field of business cycle synchronization studies is estimating economic co-movement. There are various ways to estimate the cyclical components of series on economic activity, as well as the correlation between them.

In order to compute business cycle synchronization for all pairs of countries over the period 2000-2014 I employ a two-stage procedure, consisting of filtering the data on yearly GDP in order to get an estimate of the cyclical component of the series. Then, I compute a time-varying correlation index following Cerqueira and Martins (2009).

The filtering technique I use is the Hodrick-Prescott filter, which is one of the most widely used when estimating business cycles. It was first proposed by E. T. Whittaker (1923), but was later made popular in the field of economics by Robert J. Hodrick and Edward C. Prescott (1997).

This filter removes the cyclical component from the logarithm of the GDP time series data, making it more sensitive to long run fluctuations by minimizing the deviation from a trend in the following way:

$$min_{\tau}\left(\sum_{t=1}^{T}(y_t-\tau_t)^2+\ \lambda\ \sum_{t=2}^{T-1}[(\tau_{t+1}-\tau_t)-(\tau_t-\tau_{t-1})]^2\right) \tag{4.1.1}$$

where y is the logarithm of GDP and τ is the trend component of the time series.

It can be seen from Equation 4.1.1 that the filter penalizes both any deviation from the trend component (the first term) and the variations of its growth (the second term). As established by previous research, the value of λ used in this study is 6.25 given the fact the yearly frequency of the data (Ravn and Uhlig,2002).

It is to be noted that a major flaw of the Hodrick-Prescott filter is that is provides unreliable estimates in the end points of the sample. This is why I use GDP series starting from 1995 to 2016, and then disregard the first five and the last two estimated cyclical components.

Then, I use the business cycle data in order to compute the time-varying correlation index. In accordance with Cerqueira and Martins (2009), the index takes the following form:

$$\theta ij,t = 1 - \frac{1}{2}\left(\frac{d_{j,t} - \bar{d}_j}{\sqrt{\frac{1}{T}\sum_{t=1}^{T}\left(d_{j,t} - \bar{d}_j\right)^2}} - \frac{d_{i,t} - \bar{d}_i}{\sqrt{\frac{1}{T}\sum_{t=1}^{T}\left(d_{i,t} - \bar{d}_i\right)^2}}\right)^2 \qquad (4.1.2)$$

Where $d_{i,t}$ is the cyclical component of the GDP series computed by the Hodrick-Prescott filter for country i at year t, and d_i is the average GDP over the whole period. The index takes values in the interval [3-2T; 1].

As noted in Section 2, previous research in the field of business cycle synchronization examines various variables as potentially affecting business cycle synchronization. Since there is evidence of the great importance trade intensity, financial integration and economic structure on economic co-movement, the focus of this paper is on the way those three variables influence business cycle synchronization. Thus, I continue the discussion by shortly describing the definitions of the variables as used in the empirical part of the paper. I also briefly discuss the dummy variables I use in order to account for monetary union status, as well as to distinguish between the period before and after the crisis.

As trade intensity is one of the most important factors used to explain business factor synchronization, there are many different measures which have been considered in the

literature. However, the use of a specific measure does not affect the qualitative conclusion that can be drawn (De Haan et al., 2008)

Clark and van Wincoop (2001), Frankel and Rose (1997, 1998) and Imbs (2004) among others suggest the following definition of trade intensity:

$$T_{i,j} = \frac{1}{T}\sum_{t}\frac{X_{ij,t} + M_{ij,t}}{Y_{i,t} + Y_{j,t}} \tag{4.1.3}$$

where $X_{ij,t}$ and $M_{ij,t}$ are the exports and imports from country i to country j at time t, and $Y_{i,t}$ and $Y_{j,t}$ is the annual GDP for country i and j respectively. A higher trade intensity index suggests a higher volume of trade between countries with respect to their GDP.

The next variable considered is financial integration. In the literature, different studies have used various ways of measuring financial integration between countries. Although I consider bilateral financial flows to be a superior way of measuring the financial integration between countries, data is rather limited, not covering the entire time period discussed, as well as the entire panel of countries.

Thus, similarly to Schiavo (2008) and Pontines and Parulian (2010) among others, I use the Euclidean distance between the short term and long term interest rates in order to compute an index representing financial integration:

$$F_{ij} = \sqrt{(loir_i - loir_j)^2 + (sir_i - sir_j)^2} \tag{4.1.4}$$

where $lior_i$ and $lior_j$ are the long run interest rates of country i and j, and sir_i and sir_j are the short term interest rates at a given year. The index takes the minimum value of 0, when countries have identical interest rates. Thus, higher values imply that the countries are not as financially integrated.

Next, in order to compute an index, representing difference in economic structure between pairs of countries, I follow Clark and van Wincoop (2001) and Imbs (2004, 2006) among others and use the following definition of the variable:

$$S_{i,j} = \frac{1}{T}\sum_{t}\sum_{n}^{N}\left|S_{ni} - S_{nj}\right| \tag{4.1.5}$$

where $S_{n,i}$ and $S_{n,j}$ are the shares of value added trade of sector n is countries i and j respectively. The sectors considered in the paper are agriculture, manufacturing, industry and services.

Finally, I divide the sample into two subsamples with respect to monetary union status; Accounting for the monetary union status of the countries in the study is slightly problematic, since the EMU is a growing monetary union, where different countries in the sample entered at different time point. However, in order to estimate the effect of the financial crisis of 2008 on the sample of countries, the study considers a monetary union status of a country to be constant throughout the period 2000-2014, regardless of the fact that some of the considered countries have changed their monetary status during the time period discussed. As EMU countries in the sample are regraded all countries which have adopted the Euro before 2009. This seemingly arbitrary choice comes from the fact that countries usually go through a long period of preparation to enter the monetary union. Thus, I assume that countries which entered 2007, 2008 and 2009 to have a similar behavior as other EMU members when it comes to the effect of the 2008 financial crisis.

The other dummy variable used in the study distinguishes between the period before and after the crisis and therefore is used to estimate the effect of the financial crisis on business cycle synchronization. It takes the value of 1 for all years from 2009 onwards.

4.2 Data sources and limitations in data availability

For the purpose of the study I use a panel data of 27 European countries in the period 2000-2014. A list of all countries I consider in the paper is provided in Table A.1 in the appendix.

In order to examine the common business cycle factor around Europe, as well as the effect of trade intensity, economic structure and financial integration on it, I have collected data from various sources, mostly Eurostat and OECD Statistics. In order to make sure that the different data sources are not causing any significant disturbance in the results of the study, the data points collected from complimentary sources are carefully checked for compatibility. Information about other periods and countries were nearly to completely identical, thus, I assume that they can be used together in order for me to be able to estimate the parameters under consideration for countries, for which data availability is limited.

Business cycle synchronization is traditionally estimated in the literature using either GDP or monthly statistics on industrial production (IP). However, manufacturing output represents only less than 20% of the total output of European counties and tends to have significantly higher volatility (De Haan et al. , 2008). Thus in the current study I shall use GDP statistics in order to estimate business cycle synchronization. Most of the data used is extracted from Eurostat. However, due to a limited availability on GDP for Poland I have used OECD Statistics´ estimated quarterly growth rate in order to fill in the missing observations for 2000 and 2001.

Bilateral data on imports and exports, which I use in order to compute trade intensity, is available at OECD Statistics. However, the imports and exports in the data do not mirror each other and thus, in order to have only one measure for trade intensity for each pair of countries, I use the better supervised imports data, assuming that exports of country i to county j are exactly the same as the imports of j form i.

Difference in economic structure is estimated using data from the World Bank on share of GDP of the agriculture, manufacturing, industry and service sectors in the countries under investigation. Although a more precise division of economic activity might give a better insight on the difference in the economic structure between countries, due to data limitations I look at the four major economic sectors. Moreover, the data I use in on value added trade, which is more meaningful when it comes to growth and growth co-movement (Duval et al, 2015).

Most of the data on long term interest rate is extracted from Eurostat. However, there was no data available for Estonia, since "there are no Estonian sovereign debt securities that comply with the definition of long-term interest rate" according to Eurostat. In order to be able to include Estonia in the sample of countries, I use an additional data source, https://knoema.com/, which seems to be consistent with the data collected from Eurostat. This data source is also used to avoid missing data point in year 2000 for the Czech Republic, Poland and Slovakia. In order to check if the results of the study are unusually sensitive to the presence of this additional data, I compose an alternative data set, where this data is not used.

Data on short term interest rate is also collected from the Eurostat database. However, the data is not available for Lithuania. In order to be able to use the complete sample of countries I intended, I calculate the missing observations using the average of the reported by the Lithuanian central bank for 1-3 interbank interest rates. The same is done for the period 2000-2007 for Malta. The comparability of the data is insured by the fact that Eurostat employs the same definition for short term interest rate. Nevertheless, I do exclude the countries in an alternative sample, in order to check if there are any unexpected results that might come from the different source of the data.

4.3 Descriptive statistics

Descriptive statistics on business cycle synchronization, trade intensity, difference in economic structure and financial integration are presented in table 4.3.1 In order to provide information about how the variables behave differently between the two groups in the sample I compute separate summaries for EMU member states and non-members.

Table 4.3.1 Descriptive statistics – business cycle synchronization, trade intensity, financial integration and difference in economic structure with respect to membership status

	Mean	St. Dev	Min	Max
Business cycle synchronization				
EMU members	0.8929	0.1869	-0.5340	0.9999
Non-members	0.7812	0.3841	-3.6727	0.9999
Trade intensity				
EMU members	6.8578	11.5786	0.0239	107.6654
Non-members	4.1677	6.9078	0.0003	72.8394
Financial Integration				
EMU members	1.4098	2.6410	0.0000	21.0000
Non-members	3.4998	3.6353	0.0100	23.5680
Difference in economic structure				
EMU members	17.6115	9.2698	1.5040	52.4167
Non-members	20.4374	12.0518	0.6282	68.2731

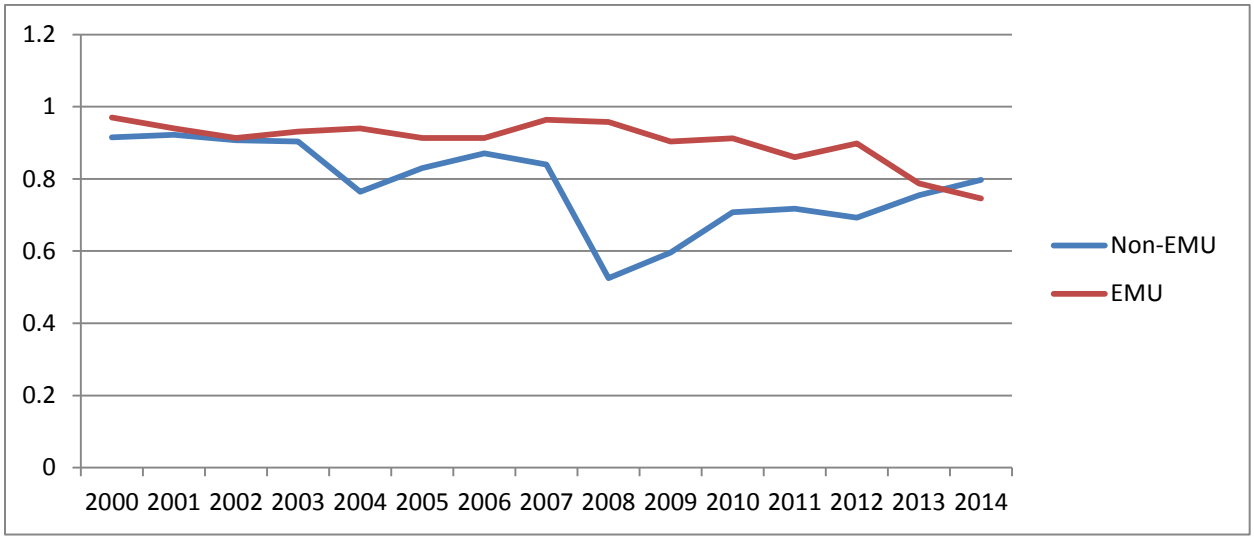
As it can be seen from the table above, business cycle synchronization takes a wide range of values among all pairs of countries. However, a couple of trends can be observed.

First, on average, members of the monetary union are more synchronized than countries which are not part of the EMU. The volatility of the variable is also lower (1.867 compared to 0.384), showing that EMU countries do not vary as much in the level of synchronization. This is also confirmed by the large difference in the minimum values that the business synchronization index shows in the two different groups.

EMU member trade with each other more, relatively to the trade with and between non-members. Moreover, there are differences between EMU members and non- when looking at financial integrations as well. EMU countries have significantly smaller difference in interest rates. This does not come as a surprise, since a large part of the political decisions regarding the financial sector are done in a centralized manner within the monetary union. Finally, EMU members are on average more similar in terms of economic structure between each other than when looking at the other countries in the sample. This could imply that industry specific shocks will have a smaller desynchronizing effect between EMU countries compared to the effect on the other country pairs. This is particularly important in times of economic tranquility, since idiosyncratic shocks are of higher relative importance then than in times of economic distress.

It can be of interest to the reader to see how business cycle synchronization has changed over time between EMU members and non-members respectively. The average values for the synchronization index for the two groups for each respective year are plotted in the graph below:

Graph 4.3.1: Average business cycle synchronization (2000-2014)



It can be seen from Graph 4.3.1 that there is a significant difference between business cycle synchronization among pairs, where both countries are part of the EMU, and those pairs where at least one country do not belong to the monetary union. Non-EMU countries experienced a sharp decrease in economic co-movement from the beginning of the crisis. However, shortly after that business cycle synchronization went on an upwards trend. The situation is very different when looking at EMU members. The economic crisis of 2008 did not have a strong effect on countries part of the monetary union right away. However, starting 2009, business cycle synchronization of EMU members slowly declines. The sharpest decline among the group is in the years 2012 to 2014.

5. Results

The following section presents the results I have obtained from implementing the models described in section 3. I briefly discuss those results and draw implications based on the obtained estimates.

Table 5.1 Estimation results

		Model 1	Model 2	Model 3	Model 4
Constant			0.8720*** (0.0199)	0.9249*** (0.0194)	0.9239*** (0.1947)
Trade intensity		-0.0009 (0.0017)	0.0334 * (0.0020)	-0.0008 (0.0020)	-0.0007 (0.0020)
Financial integration		-0.0088*** (0.0012)	-0.0052*** (0.0016)	-0.0071*** (0.0013)	-0.0072*** (0.0013)
Economic structure		-0.0041*** (0.0009)	-0.0013 (0.0009)	-0.0039*** (0.0009)	0.0042 (0.0009)
Trade intensity*CRISIS		-	-0.0014 * (0.0007)	-	-
Financial integration*CRISIS		-	-0.0025 (0.0018)	-	-
Economic structure*CRISIS		-	-0.0031 *** (0.0004)	-	-
Trade intensity*EMU		-	-	0.0002 (0.0033)	0.0011 (0.0036)
Financial integration*EMU		-	-	-0.0092*** (0.0029)	0.0076 (0.0181)
Economic structure*EMU		-	-	-0.0006 (0.0007)	0.0016 * (0.0010)
Trade intensity*EMU*CRISIS		-	-	-	-0.0007 (0.0010)
Financial integration*EMU*CRISIS		-	-	-	-0.0112 (0.0181)
Economic structure*EMU*CRISIS		-	-	-	-0.0032*** (0.0009)
R^2	within	0.0082	0.0246	0.0096	0.0119
	between	0.0111	0.0227	0.0016	0.0077
	overall	0.0070	0.0226	0.0040	0.0080

Note! *** indicates significance at the 1% level; ** indicates significance at the 5% level; * indicates significance at the 10% level. The standard errors are reported in brackets below the estimated coefficients

The first model I implement provides estimates of the way trade intensity, financial integration and difference in economic structure affect all pairs of countries in the sample over the whole period discussed. Difference in interest rates and economic structure are both significant determinants of business cycle synchronization according to the results of the model. They have a negative impact on synchronization, which is in accordance with the hypotheses of the study and previous research. Trade intensity, however, is highly insignificant with a p-value of 0.587, which raises concerns, since it is empirically one of the most significant determinants of business cycle synchronization (Frankel and Rose (1998), Otto et al. (2001), Bergman (2004) among others). This might be due to significant differences in the way the variable affect synchronization before and after the crisis, or in the way the two groups of countries are affected by it. The model is thus expanded in order to investigate the issue.

In the second model specification, where I account for the difference in the effect of the variables between the before and after crisis period trade intensity has a statistically significant coefficient at the 10% level. The effect of the variable shows a change between the two periods discussed. However, the sign of the coefficient is different when looking at the variable and its interaction with the crisis dummy. In the years of the economic crisis, trade intensity has a lower effect on business cycle synchronization according to the results of the model. This suggests that disturbances in economic activity do in fact lessen the positive effect trade has on synchronization.

The effect of financial integration is not different in the two periods, as implied by the insignificant coefficient of the interaction between the variable and the crisis dummy. However, interest rate differentials are still significant determinants of business cycle synchronization, affecting it negatively.

The effect of economic structure is only significant in this model when interacting with the crisis dummy. This implies that difference in economic structure has a stronger negative impact on business cycle synchronization in times of economic distress. This might be due to the reduced significance of the other factors emerging from the overall decline in economic activity.

The third specification I consider aims to differentiate between the effects which the explanatory variables have with respect to their monetary union status. Trade intensity shows insignificant coefficient both when interacting with the EMU dummy variable and when it is estimated on its own. This suggests that the effect of the variable is more depended on the period under consideration, rather than the cross-section of countries. Economic structure also seems to not be affected by EMU membership. On the other hand, interest rate differentials have a more negative effect on business cycle synchronization among EMU members, as shown by the negative and significant coefficient of the interaction of the variable with the EMU dummy.

The last model specification discussed in the paper aims to investigate the different effect which the economic crisis has had on countries depending on their monetary union status.

The influence of trade intensity continues to be insignificant, confirming the results of Model 1 and Model 3. Similarly, the interaction of the variable with the EMU dummy is also not statistically significant. However, once both membership status and the effect of the crisis are accounted for, trade intensity has a slight negative effect on business synchronization among EMU countries, implied by the significant negative coefficient on the interaction of the variable with both the EMU and the CRSIS dummies.

Similarly to Model 3, economic structure shows to be more important for business cycle synchronization among EMU countries. However, in the latest specification of the model, the variable is not significant when standing on its own. The evidence of the importance of financial integration is in accordance with the previous three models, with significant negative effect of interest rate differentials on business cycle synchronization. However, in this specification of the model, the estimated results do not show significant difference between the two groups of countries or the time period discussed.

One issue to consider is that all models that I have implemented have a rather low R-squared. Although this should not be of huge concern, when combined with results, which are fairly sensitive to model specification, it can be considered as a sign of model misspecification. Futhermore, variables are likely to be correlated with each other, especially in models with large number of explanatory variables. Thus, additional research

on the topic might be needed in order to increase confidence in the conclusions of the paper.

Another thing to note is that the estimates obtained by the models are not always in line with the majority of previous research on the topic. Highly significant in most papers discussing the issue, trade intensity is only significant in one of the model specifications I consider. Similarly, difference in economic structure is only significant in two out of the four considered model. However, this is not of such concern, since a substantial number of papers conclude that the variable has non to marginal effect on business cycle synchrronization. On the other hand, the estimates for financial integration are not influenced by the model specification, showing a robust negative effect of difference in interest rates on economic co-movements. This is consistent with most of the previous research on the topic.

6. Conclusion

In this paper, I use a fixed effect panel data regression in order to analyze the effect on business cycle synchronization and its determinants of the economic crisis of 2008 depending on monetary union status of European countries. There are some important conclusions that can be drawn from the empirical results.

First, there is some indication for the negative effect of the economic crisis on business cycle synchronization among the countries in the sample. The disruption of economic activity influences negatively synchronization in the discussed countries, causing economic activity to fluctuate in less coordinated manner.

Moreover, there is rather strong evidence of the negative effect of difference in interest rates on co-movement in countries in the sample. All implemented models suggest that the relationship exist, being more significant among members of the monetary union. One possible explanation behind the higher importance of financial integration between EMU countries could be that the monetary policy stabilization measures cannot be used by Eurozone countries due to the exchange rate regime. However, there is no evidence for difference in the effect of financial integration between the period before and after the crisis.

Furthermore, the effect of trade intensity and economic structure on business cycle synchronizations according to the results in the paper is not robust. The significance of the estimated coefficients depends largely on the model specification. However, there is some evidence that trade intensity is less important for business cycle synchronization in times of crisis than in normal economic conditions. On the contrary, difference in economic structure is more significant in times of economic distress.

It is to be noted that the suggested variables explain only small part of the changes in business cycle synchronization in the sample. This might be an indication that an important determinant of economic co-movement is missing in the model, but can also be an indication of the idiosyncratic nature of business cycles.

A main restriction of the study is the fact that the time series of economic variables are barely enough in order to draw any significant decisions. Filtering techniques tend to be rather imprecise in the end points of the sample, which can significantly affect the results of the study. Thus, further investigation of the effect of the economic crisis on synchronization could be necessary in order to gain higher confidence in the results.

Moreover, the results might be affected by the choice of indices measuring trade intensity, financial integration and economic structure. Thus an analysis of the sensitivity of the results to the particular definition of variables could also be considered. Specifically, data availability on bilateral financial flows could improve the accuracy of the models, since it could be a better approximation of financial integration. Also, division of economic activity on larger number of sectors might be better in estimating the significance of the difference in economic structure between countries.

Having those caveats in mind, the study finds evidence for a significant effect of the 2008 crisis on factors of business cycle synchronization. Trade intensity is less significant in the years of the crisis, while difference in economic structure has a larger influence on economic co-movement. The effect of financial integration is statistically significant in the whole period discussed in the paper, especially for countries part of the EMU. Also, there is no evidence for a difference in the magnitude of that effect with regards of time period.

7. References

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8. Appendix

Table A.1 Counties considered in the study

EMU Members	Non-members
Austria	Czech Republic
Belgium	Denmark
Cyprus	Estonia
Finland	Hungary
France	Latvia
Germany	Lithuania
Greece	Norway
Ireland	Poland
Italy	Sweden
Luxembourg	Switzerland
Malta	United Kingdom
Netherlands	
Portugal	
Slovakia	
Slovenia	
Spain	