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Abstract

In this paper we study business cycle correlations in the Eurozone, and its determinants. Additionally, we also analyze the determinants of the lead and lag behavior of business cycles in the Eurozone. We explore the relevance, in the Eurozone context, of the determinants of business cycle synchronization identified in the literature, namely bilateral trade intensity, dissimilarity of labor market rigidity, net external migration, dissimilarity in industrial structures, financial openness, and FDI relations. We estimate a simultaneous 4-equations model by OLS and 3SLS to investigate empirically the above mentioned determinants of business cycle correlation. Bilateral trade relations present a positive influence on business cycle correlations, while the dissimilarity of labor market rigidity presents a negative influence. The rest of the above mentioned variables are non-significant. In what concerns the determinants of the lead and lag behavior results show that the member states of the Eurozone that usually lead the cycle are the ones that are wealthier, with strict employment legislation, more specialized in construction and finance sectors, and more prone to international capital movements.

Keywords: Bilateral Business Cycles Correlations, Lead and Lag Behavior of Business Cycles, Labor Market Flexibility, External Migration

JEL Codes: C3, E32, F15, F21, F22, F44.

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1. Introduction

Business cycle synchronization is an important factor for Eurozone policy makers to take in consideration when making decisions about their policies, since lack of synchronization of business cycles may incite heterogeneous effects of these policies. Likewise, a sound understanding on the determinants of business cycle synchronization in the Eurozone is of extreme importance to create tailor-made policies for member countries when facing asymmetric shocks. In this work we tackle this issue, taking into consideration most of the determinants of business cycle synchronization identified in the business cycle literature.

The literature about the determinants of business cycle synchronization is a fertile field of research. Past works have concluded that the most important determinants of business cycle synchronization are trade relations, characteristics of the labor market, labor migration, differences in sectoral specialization, financial openness and FDI relations. While these determinants have been analyzed for several countries, to our knowledge, the literature for these determinants for the Eurozone is still scarce.[1] We aim to fill this gap with this work.

A set of papers has studied the above mentioned determinants jointly. Böwer and Guillemineau (2006) is the first paper that we have knowledge of that has studied the determinants of business cycle synchronization in the Eurozone. The authors apply the extreme bound analysis (i.e., a global sensitivity analysis to choose the relevant variables) to the study of traditional (i.e., more commonly used in the literature, such as bilateral trade, trade and sector specialization, labor protection, exchange rates variations, etc.) and also to new determinants, such as policy and structural indicators for a period of 25 years (1980-2004). The theory of endogeneity of optimum currency area seems to be a reasonable explanation to explain business cycle synchronization, with trade playing an important role, in particular intra-industry trade. Fiscal policy and the financial and industrial sectors were important during the Single Market phase, while short-term interest rate differentials are relevant since the start of the Economic and Monetary Union (EMU). Furceri and Karras (2008) analyze if business cycle in the EU have become more synchronized after the Euro was introduced and which variables can account for this. Hence, the direct focus, of the paper is not the Eurozone, although the paper studies 9 Eurozone countries (Austria, Belgium, Finland, France, Germany, Greece, Italy, Netherlands, and Spain) and compares it with Denmark, Sweden, and the UK. Using quarterly data from 1993 until 2004, they uncovered that trade related factors, such as exports and imports, were the main determinants of the increase in business cycle synchronization after the introduction of the euro in 1999, and not so much fiscal policy variables. The survey by De Haan *et al.* (2008) about business cycle convergence in the Eurozone and its determinants has found clear cut conclusions about the positive role of trade intensity in increasing business cycle synchronization, while empirical evidence for other factors (financial openness, sectoral specialization, employment protection, fiscal policy variables, monetary policy variables, FDI, among others) is mixed. Siedschalg and Tondl (2011) using regional data for 208 regions for the period 1989-2002 analyze the role of regional trade integration, industry specialization and exchange rate volatility on regional output growth synchronization using a system of simultaneous equations. While trade integration promotes synchronization, industry

[1] In section 2, in which we present a discussion on the variables used, we will present some examples of the results achieved by the literature for other countries. In the Introduction we will focus on the Eurozone.

specialization and exchange rate volatility are factors of divergence of business cycles. An example of this type of study, but for the EU, is Antonakakis and Tondl (2014).

Some other papers have studied only one set of determinants and/or only specific countries inside the Eurozone. Hauge and Skulevold (2011) analyze the role of fiscal policy on business cycle synchronization in the Eurozone. The authors found, using panel data techniques, that convergence of automatic stabilizers (government revenues and expenditures) increases business cycle synchronization for the period between 1980 and 2010, as well as convergence of accumulated government debt. Gouveia and Correia (2013) analyze synchronization between 1981 and 2011 for Southern European countries (Greece, Italy, Portugal, and Spain) *vis-à-vis* the other 8 Eurozone member countries in the sample, using intra-EMU trade as the main explanation for business cycle synchronization, founding a positive relation between trade intensity and cyclical correlations in the Southern countries. Solomos *et al.* (2013) examines several financial sectors indicators as possible determinants of business cycles between 1996 and 2011 for the Eurozone, using EGLS, GLM, andfixed-effects methods. Variables such as the total value of stocks traded, private sector debt, and net inflows of FDI are meaningful determinants of business cycle, while results for financial depth are mixed.

We extend Böwer and Guillemineau (2006) analysis with variables such as external migration and FDI and also to a new analysis of leads and lags and its determinants, which will help in the understanding of how to deal with the possibility of asymmetric shocks. Additionally, our period of analysis, 1997-2013, covers more years of the actually functioning of the Eurozone and we use quarterly data, instead of annual data.

The remainder of this paper is structured as follows. In Section 2 we analyze business cycles correlations and its determinants. Section 3 deals with the lead and lag behavior of business cycles and its determinants. In Section 4 we conclude and take some policy implications from our results.

2. Business Cycles Correlations

In this section we analyze the determinants of the correlation between business cycles in the Eurozone, using data for the 18 Eurozone member countries.[2] We describe in detail the variables used in this analysis, we analyze bilateral business cycle correlations, and we present the estimation methods and also the results of our estimations.

2.1. Data Treatment and Analysis

In this section we describe in detail the variables we use in this analysis. For this analysis it becomes crucial which variable to use to represent the business cycle, the variable we intend to explain. A variety of indicators have been employed in the literature. For instance, IPI - Industrial Production Index - has been used by a group of scholars to capture the economic fluctuations within EU. Some examples of these studies are Artis and Zhang (1997; 1999), Angeloni and Dedola (1999), Beine *et al.* (2000), Massman and Mitchel (2004), and Camacho *et al.* (2006). On one hand, the main

[2] Eurozone Member Countries (in parenthesis is the date of accession to the Eurozone): Austria (1999), Belgium (1999), Cyprus (2008), Estonia (2011), Finland (1999), France (1999), Germany (1999), Greece (2001), Ireland (1999), Italy (1999), Latvia (2014), Luxembourg (1999), Malta (2008), Netherlands (1999), Portugal (1999), Slovakia (2009), Slovenia (2007), and Spain (1999).

advantage of the IPI is its availability at high frequency, i.e., monthly, and its cyclical sensitivity with respect to the disturbances in macroeconomic conditions. On the other hand, its major drawback is the absence of other sectors in measurement, i.e., services, agriculture, construction, public sector, which might significantly bias the estimated business cycles.

Another group of researchers rely on GDP data, which is a more general measure. For instance, Harding and Pagan (2001), Croux *et al.* (2001), Azevedo (2002), Darvas and Szapary (2004), and Altavilla (2004), have employed in their study the nominal or real GDP to measure the European business cycle. The main advantage is that it covers all sectors and, therefore, represents well the aggregate economic activity. Thus, it is likely to provide more accurate estimate of economic cycles. Given its known merits, we prefer to adopt GDP. We use quarterly GDP (in logs) at market prices from EUROSTAT, millions of national currency, chain-linked volumes, reference year 2005 (including 'euro fixed' series for euro area countries), not seasonally adjusted data, taken from Eurostat database. Data is for the period 1997: Q1 to 2013: Q3, for 18 Eurozone member countries, but Malta was excluded from the sample, since data for this country only begins in 2000:Q1 and we wanted to have the longest time series possible, so we were certain that we had at least one complete business cycle.

Data was seasonally adjusted using the multiplicative ratio to moving average procedure.[3] With regard to the methodology for business cycle extraction, there exist various filtering methods used in the literature. For instance, Band Pass filtering developed by Baxter and King (1999) and Christiano and Fitzgerald (2003) have been extensively used. It directly extracts the cycle given a frequency interval (i.e. 18 to 96 months). Some examples of these studies are Gruben *et al.* (2002), Koopman and Azevedo (2003), Darvas and Zsapary (2004), and Altavilla (2004). Some other methods are also used, to a lesser extent, such as simple output growth rates (Bordo and Heibling 2003; Kose *et al.* 2003) or non-parametric Markov-Switching techniques (Artis *et al.* 2004; Altavilla 2004).

Among others, the Hodrick-Prescott (HP) (1997) filter that we adopt is known to be the most simple, widespread used and the most intuitive technique (adopted by Clark and Van Wincoop 2001; Kose and Yi 2002; Darvas *et al.* 2005; and Calderon et al. 2007). It is widely preferred, as it is more tractable than others and provides accurate estimates of business cycles. Specifically, the estimation of the cycle is based on the minimization (in τ) of the following expression (Hodrick and Prescott 1997):

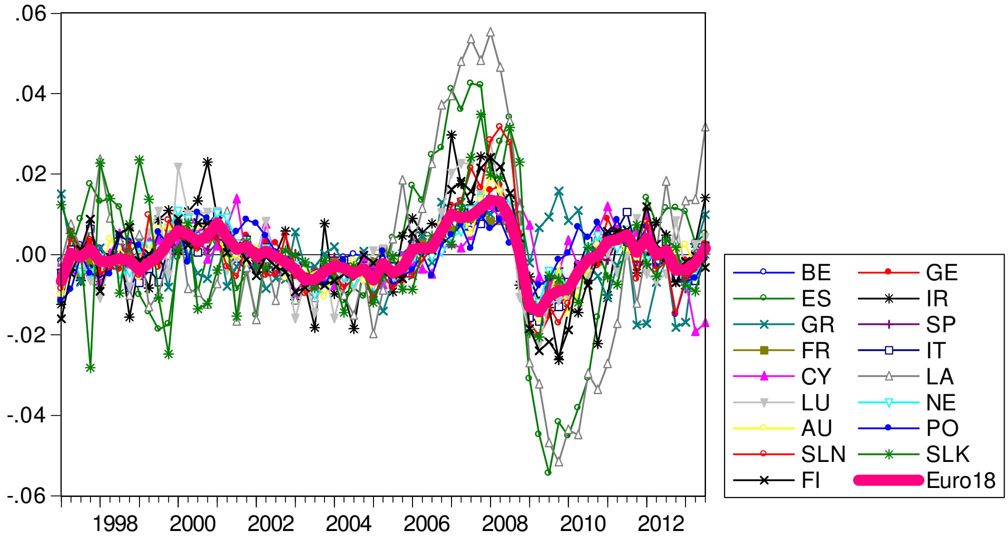
$$\sum_{t=1}^{T}(gdp_t - \tau_t)^2 + \lambda \sum_{t=2}^{T-1}[(\tau_{t+1} - \tau_t) - (\tau_t - \tau_{t-1})]^2 \quad (1)$$

$$cyc_t = gdp_t - \tau_t \quad (2)$$

Where *gdp* represents the actual values of the variable of interest. τ is its estimated long term trend (potential GDP). λ is the penalty parameter that is used to set the smoothness of trend. The first component of (1) represents the deviations of actual GDP from its trend, while the second part represents the temporal variability of trend. So, as we attribute larger values to λ, smoother estimates of the trend are obtained. As suggested by Hodrick and Prescott (1997), we set λ=1600.

To have a primary look at the estimated business cycles (*cyc*) for the Eurozone countries, we depict their evolution in Figure 1 below.

[3] The empirical analyses in this paper has been implemented using EVIEWS 6, STATA 9.1, and BUSY software packages.



Note: BE: Belgium, GE: Germany, ES: Estonia, IR: Ireland, GR: Greece, SP: Spain, FR: France, IT: Italy, CY: Cyprus, LA: Latvia, LU: Luxembourg, NE: Netherlands, AU: Austria, PO: Portugal, SLN: Slovenia, SLK: Slovakia.

Fig. 1 - Business Cycles in Eurozone Countries, 1997:1-2013:3, Eviews Software

It seems that until 2008, quite idiosyncratic movements are observed with large cross-country variability in timing and amplitudes of cycles. During the financial crisis 2008-2009, countries tend to exhibit co-moving fluctuations with similar shifts in their cycle phases. This is consistent with the conventional argument and empirical findings in the literature that Eurozone economies manifest a tendency to have increasingly correlated business cycles, particularly after the introduction of the European Exchange Rate Mechanism (Fatás 1997; Montoya and De Haan 2008) However, from 2011 onwards, synchronization tends to decline again.

To investigate the synchronization further, we calculate the Pearson's bilateral correlation coefficient for the business cycle of each pair of Eurozone countries: $\rho_{ij} = corr(cyc_i, cyc_j)$, where ρ_{ij} represents the correlation between the cycles of country i and j. We document the results in Table 1 from which it is worthy to note that the bilateral coefficients range between 0.017 and 0.90.

Table 1 - Bilateral Business Cycle Correlations 1997:1-2013:3

	BE	GE	ES	IR	GR	SP	FR	IT	CY	LA	LU	NE	AU	PO	SLN	SLK
GE	0,796															
ES	0,612	0,732														
IR	0,668	0,678	0,652													
GR	0,139	0,052	0,040	0,161												
SP	0,780	0,756	0,674	0,725	0,433											
FR	0,874	0,886	0,737	0,739	0,141	0,814										
IT	0,785	0,900	0,716	0,696	0,147	0,750	0,878									
CY	0,492	0,497	0,229	0,291	0,017	0,503	0,438	0,405								
LA	0,583	0,652	0,880	0,698	0,262	0,678	0,692	0,636	0,148							
LU	0,820	0,731	0,613	0,696	0,148	0,744	0,826	0,717	0,396	0,601						
NE	0,824	0,787	0,491	0,618	0,259	0,820	0,859	0,762	0,613	0,514	0,734					
AU	0,832	0,857	0,691	0,664	0,073	0,812	0,845	0,763	0,522	0,628	0,783	0,783				
PO	0,576	0,617	0,180	0,391	0,156	0,592	0,608	0,576	0,550	0,134	0,529	0,672	0,598			
SLN	0,696	0,834	0,647	0,669	0,324	0,823	0,770	0,786	0,476	0,691	0,672	0,770	0,772	0,532		
SLK	0,422	0,400	0,506	0,245	0,370	0,470	0,480	0,387	0,284	0,579	0,426	0,545	0,371	0,169	0,543	
FI	0,778	0,891	0,788	0,703	0,066	0,821	0,874	0,834	0,514	0,699	0,763	0,740	0,856	0,612	0,837	0,407

Note: BE: Belgium, GE: Germany, ES: Estonia, IR: Ireland, GR: Greece, SP: Spain, FR: France, IT: Italy, CY: Cyprus, LA: Latvia, LU: Luxembourg, NE: Netherlands, AU: Austria, PO: Portugal, SLN: Slovenia, SLK: Slovakia.

In general, we observe that business cycles correlations are on average 0.59, which is low, compared to US, (in Carlino and Sill 2001) cross regional cycle correlation in U.S. is often above 0.8) and display heterogeneous cyclical movements between each other. Moreover, the standard deviation is high (0.23), which represents a high dispersion among members. Individually, the pair which presents the highest bilateral correlation is Italy-Germany with a correlation coefficient of 0.9, followed by France-Germany (0.886) and Finland-Germany (0.891). The pair which has the lowest correlation is Cyprus-Greece with a correlation coefficient of 0.017, followed by Greece-Estonia (0.04), and Germany-Greece (0.052).

The analysis we made so far is static which refers to the entire period. To be able to observe the evolution of business cycle correlations over time, we perform a dynamic analysis based on rolling window correlations between business cycles of each country and the aggregate Eurozone business cycle. In fact, Weyerstrass *et al.* (2011) have introduced in their study the cyclical convergence criterion. Such that, if all Eurozone countries tend to have a perfect correlation with the aggregate eurozone cycle, one may speak of business cycle convergence. In that case, cross sectional mean of correlations should approach 1, while the standard deviation should approach zero. To check this, we calculate the correlations for 5-year intervals rolling windows and present the cross-sectional average and standard deviation of these correlations in Figure 2.

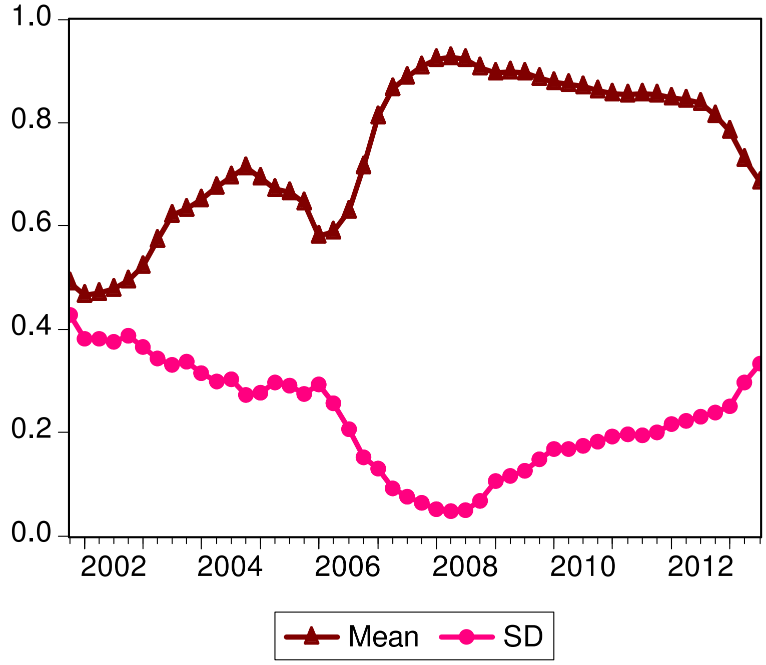


Fig. 2 – 5-Year Rolling Window Correlation between Countries and Aggregate Eurozone's Business Cycle, **Eviews Software**

Note: End points of intervals have been illustrated, i.e., 2001:4 represents the period of 1997:1-2001:4 period.

It is clearly seen that mean correlations have been rising from 2002 to 2008, followed by a decline afterwards, settling around 0.68 recently. Although a general trend to improve correlations is observed, it is far from a perfect correlation which indicates the presence of asymmetries in the cyclical shifts of member states. Accordingly, standard deviation of correlations decreased until 2008, exhibit a through, during which the global financial crisis and then tend to increase and hit a high level of 0.35 during the most recent period. Overall, correlations tend to decline in the last few years and exhibit a greater heterogeneity among member states.

To study the possible determinants of business cycles correlations, we construct a simultaneous 4-equations model, represented below, to investigate empirically the determinants of correlations/synchronization:

$$\rho_{ij} = \alpha_0 + \alpha_1 T_{ij} + \alpha_2 L_{ij} + \alpha_3 S_{ij} + \alpha_4 F_{ij} + \varepsilon_{ij} \quad (3)$$

$$T_{ij} = \gamma_0 + \gamma_1 S_{ij} + \gamma_2 Bord_{ij} + \gamma_3 Lang_{ij} + \gamma_4 GDPprod_{ij} + \gamma_5 GDPpcprod_{ij} + \gamma_6 GDPgap_{ij} + \delta_{ij} \quad (4)$$

$$S_{ij} = \vartheta_0 + \vartheta_1 T_{ij} + \vartheta_2 F_{ij} + \vartheta_3 GDPprod_{ij} + \vartheta_4 GDPpcgap_{ij} + \mu_{ij} \quad (5)$$

$$L_{ij} = \varphi_0 + \varphi_1 S_{ij} + \varphi_2 GDPpcgap_{ij} + \varphi_3 GDPgap_{ij} + \omega_{ij} \quad (6)$$

In equation (3) the determinants of business cycles synchronization have been modelled. The dependent variable is the pairwise correlation of business cycles between country i and j for 15 Eurozone countries - ρ_{ij}. We had to exclude Latvia and Cyprus from our dataset due to lack of data.

Hence, we have 105 pairs in total (N=105). In our empirical analysis, we employ a broad range of variables from different sources. The first independent variable is the bilateral trade intensity among member states - (T_{ij})- It is measured on the basis of the following formula (Imbs 2004):

$$T_{i,j} = \frac{X_{i,j} + M_{i,j}}{GDP_i + GDP_j}$$

Where $X_{i,j}$ and $M_{i,j}$ are the flows of exports and imports respectively from country i to j in 2005. The commodity flows are measured by trade in value added data provided by Organization for Economic Cooperation and Development (OECD) and World Trade Organization (WTO) for year 2005. The expected sign of α_1 is positive as commonly argued in the literature. Such that intense bilateral trade between countries is likely to create input-output linkages, which will cause the increase in business cycle correlation (Frankel and Rose 1998; Baxter and Kouparitsas 2005). In other words, pairwise trade intensity leads to a synchronization of economic shocks, spillover of economic phases and hence, synchronizing business cycles (Lee 2010). This spillover effect is likely to be more pronounced if the trade is done within the same industry (in the form of intra-industry trade (Garnier 2004 and Fidrmuc *et al.* 2012).[4]

A counter argument on trade is, however, provided by Krugman (1991) according to whom if trade openness causes a further specialization of countries in different industries (as standard Ricardian trade theory suggest), than any sector specific shock will become a country-specific shock that will create dispersed cyclical movements and asynchronous fluctuations.

The second determinant, $L_{ij} = |L_i\text{-}L_j|$, represents the dissimilarity of labor market rigidity between two countries. We measure L using Employment Protection for Regular Contracts (EPRC) data from the OECD Indicators of Employment Protection (EPRC_V1) - Strictness of employment protection – individual and collective dismissals (regular contracts). The data is available for the period of 1985-2013. However, we use the average of period values. The expected sign of α_2 is negative. Countries that have similar labor market characteristics are likely to respond at similar times and with similar magnitudes to economic shocks (Fonseca *et al.* 2012). Hence, their economic cycles are expected to be more correlated. In other words, dissimilarity in labor market institutions like employment protection laws or direct taxation rules, will contribute to the reduction of cycle correlation between two countries (Fonseca *et al.* 2012).

Alternatively to L_{ij}, we use Net External Migration, which we call $migr_{ij}$.[5] We take Net External Migrations from the Eurostat, using the net migration rate for the period 1997-2012, for each one of 15 Eurozone member countries. We then calculate $Migr_{ij} = |Migr_i\text{-}Migr_j|$, representing the dissimilarity of external labor mobility between two countries. The values are averaged over the period. As with L_{ij}, the expected sign of α_2 is negative.

In the equation presented below, S_{ij} measures the dissimilarity in industrial structure between two countries (Imbs 2004, Krugman 1991).

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[4] Inklaar *et al.* (2008) found a positive, yet small, effect of trade on business cycle synchronization. Factors like specialization and monetary and fiscal policy convergence have a similar impact.

[5] When we use $migr_{ij}$ in the estimations, we don't use L_{ij} in the estimations. The two variables indicating labor market discrepancies are not included in the same regression model to avoid a possible collinearity problem. Indeed, we prefer to observe their effects separately.

$$S_{ij} = \frac{1}{N}\sum_{t} \sum_{n=1}^{5} |s_{n,j,t} - s_{n,i,t}|$$

Where *N is* the total number of years considered (*N=1, …, t*). In our case, the data is available from 2000 to 2009. *n* denotes a specific industry. *s* is a set of sectoral shares in total Gross Value Added (GVA) of that country. In terms of industries, it includes agriculture, industry, construction ,public sector, services, and finance industries. We obtain these data from Eurostat. The expected sign of α_3 is negative: the countries which specialize in similar industries are likely to have more correlated business cycles. This is supported both theoretically and empirically in the literature. The main argument is that two countries with different industrial characteristics will react arbitrarily to any sector specific shock, (Krugman 1991). On empirical grounds, Clark and Van Wincoop (2001), Imbs (2004), and Magrini *et al.* (2013) report evidence in favor of the negative impact of industrial dissimilarity on the comovement of business cycles.

Finally, F_{ij} represents the financial openness in terms of FDI between countries. It is measured using the Foreign Direct Investment *(FDI)* data. Specifically, we use inward and outward FDI stocks (from UNCTAD) data for each country and for the period of 2002-2012 (11 years). Specifically, *F* is defined as (Imbs 2004):

$$F_{ij} = \sum_{t=1}^{11} \frac{FDI_{t,i} + FDI_{t,j}}{GDP_{t,i} + GDP_{t,i}}$$

$$FDI_{t,i} = FDI_{\ inward,t,i} + FDI_{\ outward,t,i}$$

Where $FDI_{i,t}$ is the *FDI* stock of country *i* at year *t.* Actually, FDI consists of two components - inward and outward FDI stocks. The sum of these two stocks for both countries divided by the sum of GDP for both countries helps to measure the financial openness in terms of FDI of two countries. The expected sign of α_4 is positive, i.e., the higher the financial openness of countries, the higher their integration, as in Imbs (2004).[6]

In the first equation, *S, T*, and *L* are known to be endogenous to ρ_{ij} (Imbs, 2004). To allow for such endogeneity and define the simultaneity channels, we model the determinants of *S, T,* and *L* in the remaining equations.

In equation (4), bilateral trade integration of countries is, firstly, related to industrial similarity (*S*). So, if $\gamma_1 < 0$ it means that most trade is done at intra-industry level. *Bord* and *Lang* variables are the dummies used to measure the impact of having common borders and languages among the countries. They take value 1 if countries have common borders and languages, respectively, and 0 otherwise. Naturally, both variables are expected to influence positively the trade integration as indicated in the literature (Imbs 2004). *GDPprod, GDPgap*, and *GDPpcprod* are the remaining exogenous variables that are supposed to affect the trade integration as well. The first one is the multiplication of GDPs of both countries, measuring the total size of market area. The second one is the difference in the size of two economies and the third one is the multiplication of per capita incomes. All three values are in logarithmic forms, in absolute values and obtained from Eurostat. The variables are available for the period 1997-2013; however, average values are adopted in the

[6] Contrary to most of the literature Cerqueira and Martins (2009) found a negative (and significant) relationship between financial openness and business cycle synchronization.

calculation. These variables actually represent the exogenous determinants which are commonly used as instruments in the literature (see Imbs 2004 for their possible effects). In terms of their possible impact, *GDPprod* and *GDPpcprod* are expected to influence positively the trade integration. Such that as two countries constitute a greater market place (captured by *GDPprod*) or a richer economic area (captured by *GDPpcprod*), they are likely to have more trade opportunities, integration, and commodity flows. We, therefore, find it crucial to include both variables.

Equation (5) includes the determinants of industrial dissimilarity among the member states. It is primarily related to trade and FDI. The expected sign for both ϑ_1 *and* ϑ_2 are positive. So, as economies integrate via trade or investments, it is expected for them to specialize in different industries. This fact is well known from Classical Ricardian Trade theory. The other two determinants are *GDPprod* and *GDPpcgap.* Similar to the third equation, the two variables represent the exogenous factors which are used to instrument the industrial differences across countries. Both variables are expected to have a positive coefficient. The rationale behind this is motivated by the fact that as two member states constitute a greater market place (captured by *GDPprod*) and show a discrepancy in the level of development (captured by *GDPpcgap*), they are likely to specialize in diverse industries which creates dissimilar sectoral economic structures.

Finally, equation (6) consists of the determinants of labor market dissimilarity of countries. The first determinant is S and its expected sign is positive. So, countries with arbitrary industrial structures are likely to have dispersed labor market characteristics. The other two variables are *GDPpcgap* and *GDPgap*. Both are expected to have a positive effect. Such that the pair of countries with large differences in its level of development (*GDPpcgap*) and market size are expected to have differentiated labor market characteristics. This seems plausible given the fact that more developed states (i.e. Germany, Belgium) are likely to develop distinguished welfare and labor market institutions compared to less developed ones (i.e. Greece, Cyprus). Such that rate of unionization or level of unemployment benefits will be very different among these countries. For these reasons, we find it worthwhile to include both variables in the equation.

2.2. Estimation Methods and Results

We estimate our model using two methodologies. First, we use OLS and estimate the model equation-by-equation, assuming no endogeneity and simultaneity. Second, we estimate it using a Three-Stage Least Squares algorithm since it allows simultaneity (as in Imbs 2004).

Table 3 presents the results for equation-by-equation estimates. In the first equation, *T* and *L* variables have a strongly significant coefficient while others are insignificant. The sign of trade variable is positive and indicates the fact that pair of countries which have strong trade ties and bilateral commodity flows are likely to share the economic fluctuations and exhibit more coherent cycles. This finding is quite in line with the conventional argument that intense input-output linkages among the countries cause the transfer of economic shocks and lead to more correlated shifts in their business cycles (Lee 2010; Frankel and Rose 1998; Baxter and Kouparitsas 2005). Indeed, this has largely been supported by the empirical literature. For instance, Frankel and Rose (1998) has, initially, examined the linkage between trade intensity and synchronization for 21 industrial countries and reported evidence of the positive impact of trade. Similarly, De Haan *et al.* (2002) have found an inducing effect of trade on synchronization among 18 OECD countries between 1961 and 1997.

The second variable, *L*, which is one of our special focuses, has a negative and significant coefficient. It, therefore, means that member states with large differences in labor market institutions, such as discrepancy in the level of labor market flexibility, unionization and unemployment legislation, are likely to respond arbitrarily to economic circumstances and end up with asynchronous economic cycles. In contrast, countries that exhibit similar characteristics of labor market are likely to have more correlated cycles. This finding has been empirically supported by the literature as well. One particular paper is written by Fonseca *et al.* (2010) who focused on the link between labor market institutions and GDP co-movement among 20 OECD countries between 1964 and 2003. They find that labor market heterogeneity reduces the business cycle co-movements. Such that, discrepancy in employment protection laws and direct taxation lowers the association of business cycles, while disparities in union density, indirect taxation and unemployment benefits enhance the synchronization. The remaining variables S and F have an insignificant effect in the equation.

With regard to the relative impact of variables in the first equation, we calculate their elasticity. Specifically, we calculate the impact of one standard deviation (SD) increase in each independent variable on the dependent variable. The resulting elasticities are presented in Table 2 below.

Table 2 – Elasticity Analysis

Variable	Magnitude of Impact
T	0,37
L	-0,19
S	-0,09
F	0,08

Trade is the most influential variable followed by the labor market variable. Such that 1 SD increase in *T* causes a 0.37 SD increase in bilateral cycle correlation. Similarly, 1 SD discrepancy in labor market characteristics leads to a 0.19 SD decline in synchronization.

The second equation in the model includes the determinants of trade integration. All variables except *GDPprod* are significant. To begin with *S*, it has a negative and significant coefficient indicating the fact that most trade is done at the intra-industry level. This is argued to induce business cycle synchronization to a greater extent, when compared to the impact of inter-industry trade (Garnier 2004 and Fidrmuc *et al.* 2012). Additionally, we find that having common borders and languages contributes to trade integration among the pairs of countries as it lowers transport costs. It also enhances the minimization of information costs since it is easier to develop commercial networks and relationships among trading partners.

Remaining variables, *GDPpcprod* have a positive and significant coefficient and *GDPgap* has a negative and significant coefficient. So, pairs of countries that constitute a rich and developed economic zone, (captured by *GDPpcprod)* and those pairs which exhibit low discrepancy in the size of market between each other, *GDPgap,* are likely to have more intense trade ties.

Table 3 - Equation-by-Equation Estimates Using OLS

Equation1	*Dependent Variable: ρ*	Coefficient	S.E.	P-Value
	constant	0,6123***	0,0608	0,0000
	T	0,0071***	0,0018	0,0000
	L	-0,0650**	0,0309	0,0360
	S	-0,2113	0,2195	0,3360
	F	0,0045	0,0055	0,4210
Equation 2	*Dependent Variable: T*	Coefficient	S.E.	P-Value
	constant	-40,1445***	11,4006	0,0000
	S	-33,0134***	10,6309	0,0020
	Bord	8,5061***	2,9474	0,0040
	Lang	11,3134***	4,1062	0,0060
	GDPprod	0,2862	0,2604	0,2720
	GDPpcprod	3,6235***	1,0230	0,0000
	GDPgap	-3,2448**	1,5541	0,0370
Equation 3	*Dependent Variable: S*	Coefficient	S.E.	P-Value
	constant	0,1912**	0,0762	0,0130
	T	-0,0007	0,0010	0,4830
	F	0,0048*	0,0026	0,0680
	GDPprod	-0,0017	0,0029	0,5640
	GDPpcgap	0,1481**	0,0625	0,0180
Equation 4	*Dependent Variable: L*	Coefficient	S.E.	P-Value
	constant	0,9201***	0,1736	0,0000
	S	-0,5247	0,7105	0,4610
	GDPpcgap	0,3761	0,3863	0,3310
	GDPgap	-0,2721**	0,1270	0,0330

Note: *** denotes the significance at 1 %, ** at 5%, * at 10%.

The third equation consists of the determinants behind industrial dissimilarity. Financial integration and *GDPpcgap* variables have a positive and significant coefficient. So, the two countries with intense financial ties are likely to specialize in different industries in accordance with their comparative advantage. Similarly, countries with large difference in the level of welfare and development are likely to have an arbitrary industrial structure.

Finally, regarding the last equation, the determinants of *L* are modeled. Only *GDPgap* is significant. It has a negative coefficient, indicating the fact that pair of countries which have large differences in market size, are likely to have similar labor market characteristics.

Table 4 - Equation-by-Equation OLS Estimates using net migration as an alternative measure of labor market flexibility

Equation1	*Dependent Variable: ρ*	Coefficient	S.E.	P-Value
	constant	0,5697***	0,0566	0,0000
	T	0,0077***	0,0018	0,0000
	migr	0,0116	0,0080	0,1460
	S	-0,3603	0,2599	0,1660
	F	0,0014	0,0057	0,8020
Equation 2	*Dependent Variable: T*	Coefficient	S.E.	P-Value
	constant	-40,1445***	11,4006	0,0000
	S	-33,0134***	10,6309	0,0020
	Bord	8,5061***	2,9474	0,0040
	Lang	11,3134***	4,1062	0,0060
	GDPprod	0,2862	0,2604	0,2720
	GDPpcprod	3,6235***	1,0230	0,0000
	GDPgap	-3,2448**	1,5541	0,0370
Equation 3	*Dependent Variable: S*	Coefficient	S.E.	P-Value
	constant	0,1912**	0,0762	0,0130
	T	-0,0007	0,0010	0,4830
	F	0,0048*	0,0026	0,0680
	GDPprod	-0,0017	0,0029	0,5640
	GDPpcgap	0,1481**	0,0625	0,0180
Equation 4	*Dependent Variable: migr*	Coefficient	S.E.	P-Value
	constant	-0,7426	0,6500	0,2540
	S	14,3309***	2,6600	0,0000
	GDPpcgap	5,5756***	1,4461	0,0000
	GDPgap	-0,0923	0,4753	0,8460

*** denotes the significance at 1 %, ** at 5%, * at 10%

Alternatively, it may be useful to incorporate a different measure of labor market flexibility. Hence, we use net external migration, *migr,* instead of *L,* that represents the bilateral differences in external migration across countries. The estimations are done using OLS and equation-by-equation system. The table 4 summarizes the results. *migr* in the first equation has an insignificant coefficient in contrast to *L* in Table 3. In the last equation, *S* and *GDPpcgap* variables have a positive and significant coefficient. It indicates the fact that countries with similar industrial structure and per capita income levels are likely to have similar level of labor mobility. *GDPgap* is now insignificant unlike the initial results. All other estimated coefficients are consistent with the initial OLS results in Table 3.

Although the results we have so far obtained are satisfactory and according to the theory, equation-by-equation estimates should be interpreted cautiously for two reasons. First, it is not designed to capture the possible endogeneity in the relationships between variables, which might, in turn, bias significantly the results. Second, it does not allow the simultaneity and, thus, we are not able to observe the direct and indirect impacts of variables on each other (Imbs 2004; Magrini *et al.* 2013). To address these issues, we estimate the system using a three stage least square estimator (3SLS) introduced by Zellner and Theil (1962). In 3SLS estimations, a three step procedure is followed. Initially, endogenous and exogenous variables are defined in each equation. For instance, all variables in the first equation are endogenous (except *F,* as indicated in the literature, Imbs 2004). *S* is an endogenous variable in the second equation, *T* in the third and *S* in the last equation. In the first step of estimation, endogenous variables are regressed on exogenous variables (instruments), except the ones that are in the same equation with endogenous variables. In the second step, a consistent covariance matrix for equation disturbances is estimated. In the third step, the fitted values from first step regressions are used to estimate the coefficients and their standard errors. The results are presented in table 4 below.[7]

In the first equation, we observe the direct impact of variables on business cycle correlations. *T* and *L* variables have a significant coefficient, with the same sign of coefficients in (Table 3) OLS estimation. Hence, validity of these variables has been shown once more.

In the second equation, the sign of the coefficients are generally consistent with the OLS estimations with approximately the same level of significance. In the third equation, all variables' coefficient signs are consistent with the OLS estimation (except *T*), but the FDI variable turns out to be insignificant. In the last equation, signs are the same but the level of significances change. For instance, *GDPpcgap* becomes now significant.

[7] Alternative to 3SLS, there exist various methods available in the literature, such as instrumental variables or GMM approaches. However, these methods require a number of well defined 'instruments' which we lack considerably. For this reason, we estimate our system of equations with a 3SLS approach.

Table 5 - Simultaneous Equations with Three Stage Least Squares

Equation1	*Dependent Variable: ρ*	Coefficient	S.E.	P-Value
	constant	0,8246***	0,2009	0,0000
	T	0,0083**	0,0036	0,0220
	L	-0,5545***	0,1972	0,0050
	S	0,1088	0,4773	0,8200
	F	0,0115	0,0071	0,1040
Equation 2	*Dependent Variable: T*	Coefficient	S.E.	P-Value
	constant	-56,3934***	14,4727	0,0000
	S	-87,9329***	29,9906	0,0030
	Bord	8,2785***	2,9372	0,0050
	Lang	8,0275*	4,1364	0,0520
	GDPprod	-0,3572	0,4526	0,4300
	GDPpcprod	6,5845***	1,9048	0,0010
	GDPgap	-1,7469	1,7837	0,3270
Equation 3	*Dependent Variable: S*	Coefficient	S.E.	P-Value
	constant	0,2433***	0,0807	0,0030
	T	0,0021	0,0017	0,2100
	F	0,0008	0,0032	0,8070
	GDPprod	-0,0047	0,0033	0,1590
	GDPpcgap	0,1932***	0,0685	0,0050
Equation 4	*Dependent Variable: L*	Coefficient	S.E.	P-Value
	constant	0,9820***	0,2111	0,0000
	S	-1,3643	1,0022	0,1730
	GDPpcgap	0,8588***	0,3169	0,0070
	GDPgap	-0,2835**	0,1148	0,0140

Note: *** denotes the significance at 1 %, ** at 5%, * at 10%.

More importantly, we may distinguish between the direct and indirect impact channels of variables using a system of simultaneous equations. In what follows, a summary of these channels is presented.

Table 6 - Channels of Causality

Variable	*Direct Impact on ρ*	*Indirect Impact on ρ*
T	α_1 (0,0083)	$\vartheta_1\alpha_3$ (0,00022848)
L	α_2(-0,5545)	-
S	α_3(0,1088)	$\gamma_1\alpha_1 + \varphi_1\alpha_2$ (0,0267)
F	α_4 (0,0115)	$\alpha_3\vartheta_2$ (0,00008704)

Firstly, labor market variable has only a direct and significant impact captured by α_2 $(-0{,}5545)$. The indirect effect of trade is measured by $\vartheta_1\alpha_3$ (0,00022848). Although the effect is insignificant, trade variable influences the industrial specialization that, in turn, affects the synchronization. So, trade has an overall positive impact regardless of the direct or indirect channel. However, the direct impact has a much greater magnitude than the indirect one.

The direct impact of industrial dissimilarity is negative and insignificant (0.1088.) The indirect effect is, however, positive (0,0267). It consists of two components. First, $\gamma_1\alpha_1$ captures the effect of trade on synchronization induced by specialization, second, $\vartheta_1\alpha_2$ represents the impact of labor market dissimilarity induced by specialization. Lastly, α_4 (0.0115) represents the direct effect of FDI openness on business cycle correlations. The indirect effect that works through specialization $(\alpha_3\vartheta_2)$ is much smaller.

Overall, one may speak of two main results from three stage least squares estimations. First, Trade integration and labor market similarity are the main driving forces behind synchronization patterns. Second, that direct effects are clearly more influential than the indirect ones.

As mentioned before, we would like to address the robustness of the measurement of the labor market variable. Since *L* is one of our special variables, we focus on the alternative measures and in this way we check its robustness again. Hence, in order to do this, we use net external migration data *(migr)* instead of *L* and re-estimate the whole system again. The results are presented in the table 6 below.

Table 7 - Simultaneous Equations with Net External Migration Using Three Stage Least Squares

Equation1	*Dependent Variable: ρ*	Coefficient	S.E.	P-Value
	constant	0,2060**	0,0981	0,0360
	T	0,0099***	0,0027	0,0000
	migr	-0,0762***	0,0296	0,0100
	S	2,5703***	0,7650	0,0010
	F	0,0081	0,0067	0,2300
Equation 2	*Dependent Variable: T*	Coefficient	S.E.	P-Value
	constant	-57,9903***	14,7222	0,0000
	S	-85,9387***	29,9149	0,0040
	Bord	8,8467***	2,8781	0,0020
	Lang	7,8631*	4,0335	0,0510
	GDPprod	-0,2775	0,4442	0,5320
	GDPpcprod	6,4372***	1,9225	0,0010
	GDPgap	-0,0435	1,6997	0,9800
Equation 3	*Dependent Variable: S*	Coefficient	S.E.	P-Value
	constant	0,2330***	0,0785	0,0030
	T	0,0026	0,0017	0,1210
	F	0,0002	0,0031	0,9570
	GDPprod	-0,0045	0,0032	0,1620
	GDPpcgap	0,2165***	0,0678	0,0010
Equation 4	*Dependent Variable: migr*	Coefficient	S.E.	P-Value
	constant	-1,5342*	0,7926	0,0530
	S	21,9792***	4,0027	0,0000
	GDPpcgap	4,4344***	1,5509	0,0040
	GDPgap	-0,7774*	0,4005	0,0520

Note: *** denotes the significance at 1 %, ** at 5%, * at 10%.

The implications are quite similar to the previous findings. Such that migration variable has a negative and significant coefficient in the first equation, which means that differential labor market characteristics lead to a decline in the association of business cycles. All other estimated determinants are consistent with the previous estimations, with the only exception of *S* variable's sign in the first equation. In the last equation, determinants of external migration have been modeled. We observe that all variables have a significant coefficient. *GDPpcgap and S* have a positive and significant coefficient. Thus, it means that disparity in development and sectoral structure across two countries is associated with a dispersed labor market. The implication driven by *GDPgap* is that two states with large differences in market size are likely to have similar labor market characteristics.

Overall, in this section, we have seen that traditional determinants of business cycle synchronization such as trade are found to be evident with expected signs of coefficients. More interestingly, a less emphasized factor by the literature; labor market dissimilarity, is found to be robustly evident and, therefore, critical to business cycle correlations, either if we use labor market protection statistics or net external migration.[8]

3. Lead and Lag Behavior of Business Cycles

3.1. Methodology

The second aim of the present study is to understand the lead/lag behavior across the business cycles of the Eurozone member countries. To be able to investigate this, we first need to identify the turning points (i.e. peaks and troughs) within the business cycles of each country and the aggregate Eurozone cycle. To do so, we employ HP de-trended GDP series (as in section 2) and apply a Bry-Boschan (1971) algorithm to estimate the turning points.

In terms of methodology for turning point detection, several tools have been developed in the literature (see Harding and Pagan, 2002a). To provide a brief account, early literature has focused on the replication of official turning points in U.S. declared by NBER (National Bureau of Economic Research). For instance, Bry and Boschan (1971) have introduced the initial algorithm for this purpose. The detected turning points were found to overlap well with the official ones. Harding and Pagan (2002b) have generalized this algorithm and designed it for quarterly data. Despite its accuracy and simplicity, it has been criticized for several reasons. The major argument emphasizes the fact that the results obtained are likely to depend on the subjective choice of several parameters (i.e., maximum phase length parameter, etc.).

Alternatively, following Hamilton (1989)'s pioneering work, Owyang *et al.* (2005) have employed a Markov-Switching model to identify the timing of the shifts in U.S. business cycle. This model allows the growth rate to switch across different growth regimes (like low growth and high growth regimes). Specifically, it calculates the probabilities of different business cycle phases, which are used then to identify the timing of turning points. Although, it represents a more general approach, i.e., being more consistent with data generating process, it has been criticized for being less intuitive.

Given its simplicity and accuracy, we prefer adopting Bry-Boschan (1971) program in our study. The algorithm follows a two-step procedure. In the first step, it calculates a set of local minima and maxima in the series, then imposes several restrictions to ensure a certain level of phase duration. In terms of parameters used, the local maxima/minima have been searched in every 2 quarters; thus, the window length is 2 quarters, which is the default value. The minimum length of a phase (expansion or recession) is 2 quarters and minimum cycle length is 5 quarters. (For a detailed description of algorithm, see Duran (2014) or BUSY program manual user guide).

Having detected the turning points, the next empirical issue is to construct a model to investigate the possible determinants of lead/lag behavior across member states. In fact, there is a scant

[8] We also tried to estimate the impact of other known determinants such as similarity of fiscal and monetary policy among the member states but never found a significant effect.

empirical literature on this subject. The majority of work done in this field does not use the information from turning points in determination of lead/lag patterns, but refers mostly to the dynamic correlation analyses among the business cycles. This makes our study more interesting *per se*.

One example of such studies is implemented by Kang (2011) who analyzed the lead/lag patterns in an international context. He obtained a (quarterly) dataset that covers EU15 members, US, Australia, Canada and Japan over the period 1985-2009. He employed various variables including output, employment, TFP and investment. He concludes that US business cycle tend to lead the business cycle of other countries. The lead/lag pattern is more pronounced in employment cycles compared to other variables. In terms of determinants, he considered labor market differences, disparity in GDP and population across countries. Most interestingly, he reports evidence in favor of the fact that the countries that have a more rigid labor market tend to lag more the U.S. cycle. Hence, labor market flexibility is shown to be critical in lead/lag behavior.

In case of U.S., there exist several studies. Sill (1997) has, for instance, identified the leading and lagging regions using quarterly employment data for 8 BEA regions and for the period 1955-1995. Moreover, he argues that most of the leading regions have large employment share in manufacturing and less share in services and government. Similarly, Magrini *et al.* (2013) have investigated the determinants of lead/lag behavior across 48 states between 1979-2010 and found that states that specialize in high-tech goods tend to anticipate persistently the business cycles. Lastly, Park and Hewings (2003) have studied the cyclical behavior of 5 Midwest states and found that states that specialize more in manufacturing tend to respond more promptly to economic shocks.

The analysis we propose here attempts to follow a comprehensive approach and tries to include both industrial mix, income and labor market variables. The empirical model takes the following form:

$$\boldsymbol{LL_{ij} = \partial_0 + \partial_1 income\_pc_{ij} + \partial_2 industry_{ij} + \partial_3 construction + \partial_4 EPRC_{ij} + \partial_5 migration_{ij} + \partial_6 finance_{ij} + \partial_7 FDI_{ij} + \emptyset_{i,j}} \quad \textbf{(7)}$$

The dependent variable $LL_{i,j} = LL_i - LL_j$, represents the lead of country *i's* business cycle over country *j*'s (in quarters). Since there are 15 countries in our dataset, the number of observations is 105. LL_i is the mean (or median) lead/lag of country i with respect to the Eurozone cycle over the period of analysis (1997-2013). LL_j is the mean (or median) lead/lag of country j with respect to the Eurozone cycle. (+) sign denotes the lead and (–) denotes the lag behavior.

In terms of independent variables, $income\_pc_{ij} = income\_pc_i - income\_pc_j$ represents the difference i*n per capita* incomes between country i and *j*. $industry_{ij}, construction_{ij}$ and $finance_{ij}$ represent the variables that capture the differences in industrial specialization. For instance, $construction_{ij} = construction_i - construction_j$ captures the discrepancy between country i and j*'s* GVA share of construction sector in total GVA of that country. In terms of the labor market variable $EPRC_{ij}$= L_i-L_j, represents the disparity in labor market rigidity between i and *j*, while $migration_{ij}$= $migr_i - migr_j$ represents the bilateral differences in net external migration. For all variables, averaged values over the corresponding periods are used. Finally, FDI_{ij}= $FDI_i - FDI_j$ represents the differences in the share of FDI stock (sum of 2002-0212 period) relative to GDP between *i* and *j*.

3.2. Results

The estimated turning points are displayed in the table below. For the aggregate Eurozone cycle, 4 peaks and 4 troughs are found. For each member state, the durations of lead and lags are presented in cells (in quarters). An empty cell means that the country does not experience any turning point around the Eurozone turning point. In the last 3 columns, mean, median and modes of leads/lags are summarized for each country.

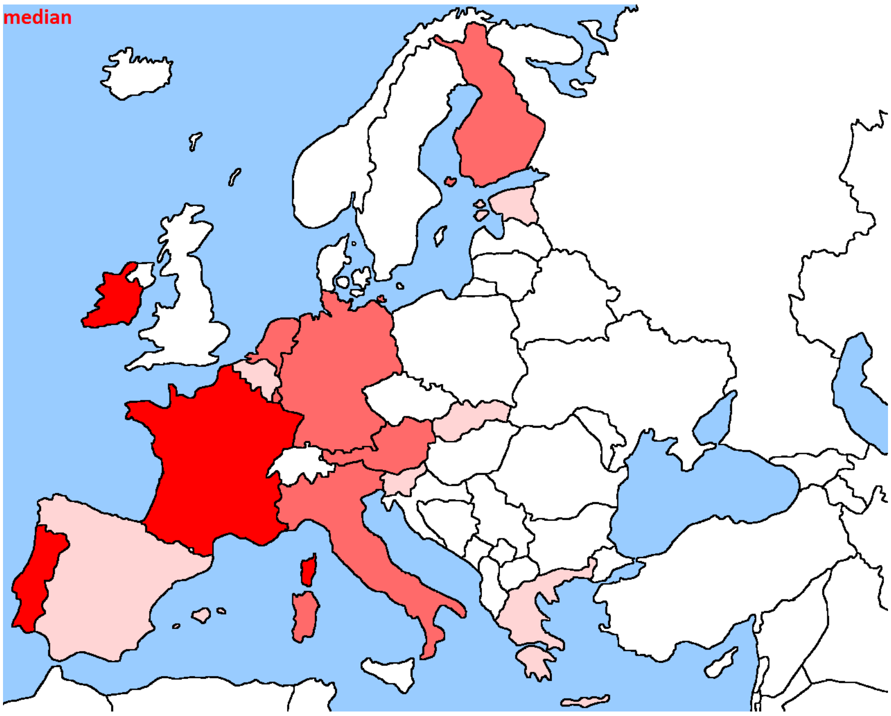
In terms of mean values, maximum lead is 1.14 quarters (Netherlands) and maximum lag is 1.625 quarters (Slovakia).

Table 8 - Turning Points and Lead and Lag of Business Cycles of Countries with respect to the Eurozone-18 Cycle

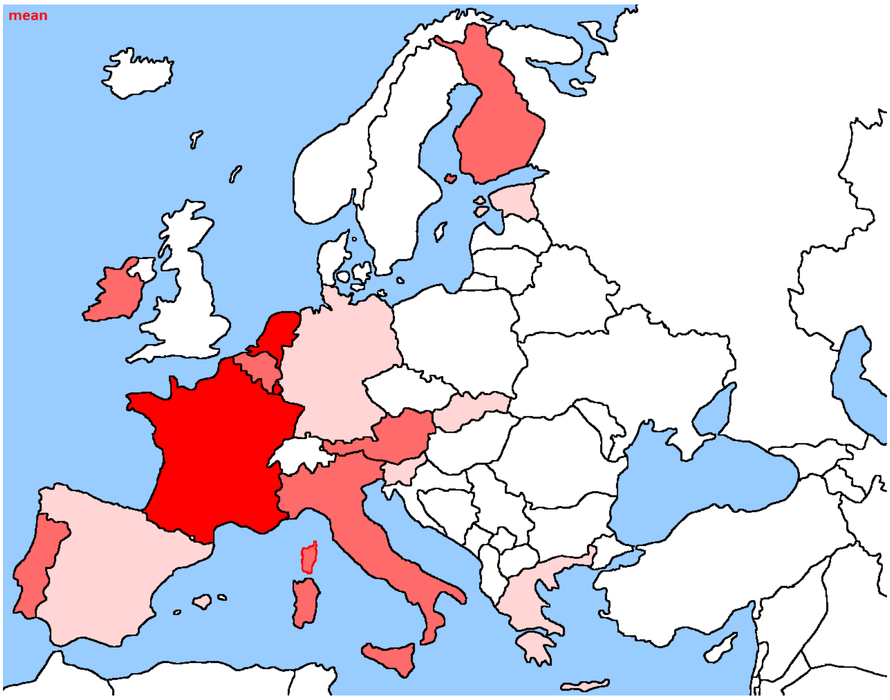
	Peak	Trough	Peak	Trough	Peak	Trough	Peak	Trough			
	Q3-1997	**Q4-1998**	**Q4-2000**	**Q1-2003**	**Q4-2007**	**Q1-2009**	**Q2-2011**	**Q3-2012**	**Mean**	**Median**	**Mode**
BE		1	4	-1	-1	0	-1	-1	0,142857	-1	-1
GE		0	0	-7	-1	0	2	0	-0,85714	0	0
ES	0	-2	3	-4	2	-1	-5		-1	-1	
IR		1	1	-5	4	-2			-0,2	1	1
GR			-8	4	-1			0	-1,25	-0,5	
SP			0	-4	0	-3	1	-1	-1,16667	-0,5	0
FR			4	0	1	1	0	-1	0,833333	0,5	0
IT	0	0	0	-1	0	0	0	-2	-0,375	0	0
LU		4	4	-3	0	0			1	0	4
NE		5	4	-1	1	0	0	-1	1,142857	0	-1
AU	-2	0	3	-2	0	0	1	-2	-0,25	0	-2
PO			-3	-2	1	1	1	0	-0,33333	0,5	1
SLN			-8	7	-1	-2	-2	0	-1	-1,5	-2
SLK	-5	5	-7	-4	1	0	-1	-2	-1,625	-1,5	
FI			2	1	0	-2	-2	0	-0,16667	0	0

Note: + (-) denotes a lead(lag) with respect to the reference series

To provide a more general picture, we present in the following maps the geographical distribution of leads/lags within Eurozone. The dark red color represents the countries which are at least 0.5 quarters a head of the aggregate Eurozone cycle while the lightest pink color represents the lagging states.



(a). Median



(b). Mean

>0.5		leading
(-0.5,0.5)		coincident
<-0.5		lagging

Fig. 3 - Distribution of Lead and Lag Behavior of Countries

Although, no clear geographical pattern is observed at a glance, some interpretations can be made on the type of leading countries. Firstly, western countries seem to exhibit a leading behavior over the Eastern ones. Second, particularly some states like Luxembourg, France and Netherlands seem to anticipate the business cycles. In terms of lagging countries, some Eastern and South Eastern European economies like Greece, Slovakia, and Slovenia tend to display a lagging behavior.

To be able to provide a more systemic analysis, we summarize below the regression results obtained from the estimation of equation 7. There are 4 different versions of regression results. In the first and third columns, the dependent variable *(LL)* has been calculated using mean values of lead/lag indicators and in the second and last columns median values have been used instead. *Finance* and *FDI* variables have not been included in the same regression to avoid a possible multi-collinearity problem. Hence, in the first two models, *finance* variable has been used while *FDI* has been employed in the last two models.

Table 9 - Determinants of Lead and Lag Behavior

Dependent Variable: ***LL***	**Model (1) Mean**	**Model (2) Median**	**Model (3) Mean**	**Model (4) Median**
Independent Variables:				
Constant	-0,174608	0,209673**	-0,137019*	0,150815*
income_pc	3,576004***	4,982975***	3,846269***	4,723701***
Industry	-6,277529***	-1,009176	-4,010959**	-2,756781**
construction	3,467382	33,62886***	12,60721***	27,29532***
EPRC	-0,015047	0,490683***	0,249172***	0,385897***
migration	-0,159569***	-0,258637***	-0,222785***	-0,193724***
Finance	2,480721	3,77386***	-	-
FDI	-	-	0,071815***	-0,010226
N	105	105	105	105
R-Squared	0.75	0.75	0.85	0.72
Diagnostics:				
White-Heterosk.	1,43	1,09	1,79*	1,52
Breusch-Pagan	66,55***	37,43***	61,76***	23,90***
Jargue-Bera	0,81	0.74	0,95	Oca.40
AIC	1,93	1,64	1,39	26.299

Notes: *** denotes the significance at 1 %, ** at 5%, * at 10%, HAC (Heteroskedasticity-Autocorrelation Consistent) estimators used). White-Heterosk. Represents White's Heteroskedasticity test (F) statistics, Breusch-Pagan denotes LM Serial Correlation test statistics. Jargue-Bera is the normality of errors test.

The findings provide several intuitive results. First, the *income_pc* variable has a positive and significant coefficient at 1% in all regressions, which means that more developed (richer) countries tend to lead the business cycles of relatively low income countries.

Second, the *construction* variable has a positive and significant coefficient almost in all regressions. This finding is consistent with the literature. Such that construction sector is known to be particularly sensitive to economic cycles. It has also been perceived as a credit dependent investment good, making its demand more sensitive to changes in the interest rate. Hence, as it is a cyclically responsive sector, the countries that include a large share of the construction sector tend to respond earlier to economic disturbances.

In contrast with our expectations, we are not able to observe the same effect for the industry variable, as its impact is negative and significant. This might have arisen due to the presence of both durable and non-durable goods production in industry.

The two variables regarding the labor market characteristics (*EPRC* and *migration*) have a strongly significant coefficient almost in all regressions. Hence one may argue that labor market differences play a critical role in lead/lag of business cycles. EPRC has a positive coefficient, while the migration variable has a negative sign. However, both signs are in contrast with the conventional view that economies which have flexible labor market and with mild employment protection, can adjust the real wages easily and move more quickly towards new equilibrium level of employment (Kang 2011). Hence, it is likely that the employment levels of such economies respond to shocks promptly. However, we observe that the countries in which employees are protected more and the labor force is less mobile, quicker shifts in employment have been observed. This result is as surprising as interesting which needs a clearer explanation in our future research.

Finally, *finance* and *FDI* variables are also found to be partially important. They both have a positive and significant coefficient in the 2nd and 3rd regressions. This actually means that as a country is more open to international financial movements (in terms of direct investment), it naturally becomes more exposed to global shocks. Hence, economic developments in other countries can inevitably spillover to the country. Moreover, this effect is even more pronounced within the countries that have a higher share of employment in the finance sector, captured by the finance variable.

Overall, having implemented our analysis, typical economies that may lead the business cycles in Eurozone can be defined in a following way: relatively wealthier states with high level of income, welfare regimes with strict employment legislation, the ones which specialize more in construction and finance sectors and more open to international capital movements are likely to anticipate the business cycles in Eurozone.

4. Conclusions and Policy Implications

In this work we study the determinants of business cycle correlation and of the lead and lag behavior of business cycles in the Eurozone, i.e., business cycles synchronization of Eurozone member countries. We analyze if the determinants usually identified in the literature – bilateral trade intensity, dissimilarity of labor market rigidity, net external migration, dissimilarity in industrial structures, financial openness, and FDI relations - are relevant also for the Eurozone and estimate by means of OLS and 3SLS techniques.

Bilateral trade intensity and the dissimilarity of labor market rigidity are important factors of business cycles correlations in the Eurozone. Our results are in agreement with ones found in previous literature on the topic, although sectoral differences seem to be irrelevant.

In what concerns the lead behavior of business cycles, the most important factors to determine its behavior are income *per capita*, countries with stricter employment legislation, countries which present a higher specialization in the construction and finance sectors, and countries more open to international capital movements. The behavior of the labor market variables are in sharp contrast to what is expected in the literature and it is an avenue for future research.

Taking into account our results, policy makers in the Eurozone should take careful attention to the specificities of labor market and the rigidities of each member country and to the sectoral and trade specialization of countries, since the possibility of asymmetrical shocks can be enhanced if large asymmetries are present. Specifically, the harmonization of the European Union labor market, through the creation of a common set of institutions would be a possibility.

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