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Trade and business cycle synchronization in Eurozone: a refresh wavelet approach

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ABSTRACT

The paper investigates the interaction between the trade and business cycle synchronization, using an extended wavelet approach. The analysis is conducted in several Eurozone countries, for the period 1960Q1-2016Q2. We show that the trade promotes economic synchronization in the considered Eurozone countries, on medium and long terms. The key ingredients are economic integration and monetary union. A reversed connection is also distinguished. On medium and long terms, a low degree of synchronization accelerates trade only if the given country has an ascending growth trend. Several different scenarios are found on short term, for particular economic contexts.

1- Introduction

The interaction between economic growth and trade was widely explored over the last decades. A particular focus has been put on business cycle synchronization and its determinants, among which trade is one of the most important. This issue has been especially important in the Eurozone. The related literature analyses either the impact of trade on economic growth and separately the business cycle synchronization, or the interaction between trade and business cycle synchronization.

The influence of trade on the economic growth is controversial. It has been showed that trade positively impacts growth. This hypothesis is validated by many theoretical models (Romer, 1986; Lucas, 1988) or empirical analyses (Dollar, 1992; Harrison, 1996; Frankel and Romer, 1999; Easterly and Levine, 2001; Lee et al., 2004; Wacziarg and Welch, 2008; Squalli and Wilson, 2011; Ezeani, 2013; Sakyi et al., 2015). They argue that the trade promotes a

better resource allocation, increases the level of specialization and improves the labour productivity, generating growth. On the other hand, the neoclassical exogenous growth models of Solow (1956) and Swan (1956) do not support such implications of trade on growth. Empirically, this is underlined by Rodriguez and Rodrik (2001), Vamvakidis (1999) or Lee et al. (2013). Several authors sustain the existence of a negative impact of trade on growth (Warner, 2003; Ugurlu, 2010; Abbas, 2014) while others claim the existence of mixed results (Mendoza, 2009; Chang et al., 2005; Cuadros et al., 2004). In the last case, the beneficial effect of the trade on growth is conditioned by different factors, such as: infrastructure, investment in human capital, stronger markets or extensive policies for attracting foreign direct investment.

The issue of business cycle synchronization is also a widely explored topic.

Herein, two antagonistic points of view are put forward. The first one states that the economic and monetary integration generates more synchronization ('optimistic view'), while the second one sustains the contrary ('pessimistic view'). The 'optimistic view' is relied to the theory of optimal currency areas of Mundell (1961). The author emphasizes that the costs of a common monetary union are minimal if the member countries have highly synchronised business cycles. The 'pessimistic view' follows the explanation of Krugman (1991). With respect to the European Union (EU), he stresses that the integration can lead to a concentration of industry, and therefore shocks become asymmetrical with region - specific characteristics. Furthermore, such asymmetry triggers diverging business cycles. Hence, Eurozone is one of the preferred area for investigations on this topic, the existent literature is abundant). Herein, the contribution of Artis and Zhang (1997) is representative. By using the correlation of cyclical indicators and Germany as main pillar, they find that the cycles of member countries in the post-European Monetary System (EMS) period are more synchronized. Conversely, Inklaar and De Haan (2001) express their reserves regarding Artis and Zhang (1997)'s results. With Germany also as reference point, the authors show that higher levels of cycles correlation are registered over 1971-1979 than in the period 1979-1987. In other words, the cycles were more synchronized during the pre-EMS period. An extensive literature review related to the business cycles synchronization in Eurozone is provided by De Haan et al. (2008). Most of the analyses on the topic were developed in a time-domain: however in the last years a specific focus has been put on the frequency domain and on the use of time-frequency tools. The researchers mostly preferred the time-domain analyses, but during the last years a special interest arises the frequency - (A'Hearn and Woitek, 2001; Pakko, 2004; Breitung and Candelon, 2006; Lemmens et al., 2006) and time-frequency tools (Gallegati et al., 2008; Yogo, 2008; Rua, 2010; Aguiar-Conraria and Soares, 2011; Rua, 2014). In this framework the driving factors of economic growth co-movement in Eurozone are crucial. Kalemli-Ozcan et al. (2001) find four general determinants of business cycle synchronization: knowledge spillovers, similarpolicy, trade barriers, and capital market integration. Among these factors, the trade intensity is the most important, being 'prominent' as De Haan et al. (2008) note it.

The theoretical implications of trade on business cycle synchronization are ambiguous. There are two main transmission channels for trade-business cycles synchronization nexus.

The first one is based on intra-industry shocks, the intensification of international trade increasing the degree of business cycles co-movement. According to Frankel and Rose (1998), this connection has as a starting point the demand and supply-side spillovers. On the demand-side, any consumption boom in one country attracts more imports from another one, while on the supply-side, the international trade intensification reduces prices, and as a consequence, the imported goods become cheaper. Such mutual spillover effects among countries improve the degree of business cycles synchronization across them.

The second channel is relied to inter-industry shocks, being characteristic for both classical and new trade theories. Herein, the trade stimulates the specialization, with negative impact of business cycles co-movement. The supporters of this hypothesis are Kenen (1969), Eichengreen (1991) and Krugman (1993), who argue that the business cycles are less synchronized when the economies faced industry-specific shocks.

On this ground, the paper explores the interaction between trade and business cycles co-movement in the Eurozone, over the period 1960Q1-2016Q2, by using a time-frequency analysis. The targeted countries are Germany and France, as core of Eurozone cycles co-movement, and the PIIGS group, comprising Portugal, Italy, Ireland, Greece and Spain. All those countries arise a special interest for Eurozone. Germany and France 'duo' represents 'the core of the Euro land, being the most synchronized countries with the rest of Europe', as (Aguiar-Conraria and Soares, 2011, p. 477) note. During the financial and economic crisis,

the PIIGS group, among all Euro countries, exhibited the worst economic period: slow GDP growth, high level of unemployment rate, and chronic persistence of public debts (i.e. the case of Greece was truly dramatic). In the considered Eurozone countries, we show that trade promotes the business cycles synchronization on medium and long terms. The crucial factors allowing this are the economic integration of the countries and the monetary union. An inverse connection is also identified on the same medium and long terms. A low degree of synchronization increases trade only if the given country exhibits an ascending growth trend. Additionally, several different scenarios are identified on short term, for particular economic situations

The contribution of paper is threefold. First, our study exclusively connects the 'Eurozone core' with the PIIGS countries, which is new in the literature, as far as we know it. Second, it employs a battery of empirical tools in the time (i.e. classical Granger causality a la Granger, 1969), frequency (i.e. causality in frequency domain based on the test of Breitung and Candelon, 2006) and time-frequency domains. The time-frequency approach comprises: the wavelet coherency proposed by Torrence and Campo (1998), developed by Grinsted et al. (2004) and corrected by Ng and Chan (2012), the multiple wavelet coherence belong to Mihanovic et al. (2009), and the wavelet cohesion promoted by Rua (2010)). Third, the paper offers new evidence about the interaction between trade and economic co-movement in the Eurozone based on updated datasets. It studies not only the impact of trade on the synchronization of economic activity but also the reversed connection, from synchronization to trade.

The paper is organized as follows. Section 2 is dedicated to the literature review. Section 3 describes the methodology and data, Section 4 presents the empirical results, while Section 5 checks the robustness of our analysis. Finally, Section 6 concludes.]

2- Literature

There is an extended literature regarding the impact of trade on business cycle synchronization, with different countries and periods, various datasets and methodologies, and heterogeneous overcomes. Two strands of literature validate the significant role of the international trade on business cycles co-movement, either with a positive effect or negative one. These approaches are both theoretical and empirical.

The theoretical papers have as ground the contributions of Frankel and Rose (1998) and Krugman (1991). Frankel and Rose (1998) shows that the trade is a good incentive for business cycles synchronization by spreading the demand shocks across countries, while Krugman (1991) invokes the country specialization with negative impact on business cycles co-movement, attenuating the output symmetry.

The positive influence of trade on business cycles synchronization is put forward in the seminal work of Oudiz and Sachs (1984), who offer a traditional argument: the intensification of international trade needs more actions for international policy coordination with a beneficial effect on the output synchronization. The same positive vector is demonstrated by Ambler et al. (2002). The authors consider the role of trade in intermediate goods and find that the trade leads production co-movement through the production structure. In the same vein, Davis (2014) considers trade and financial integration as key facets of globalization. He shows that trade integration generates more synchronization, while financial integration a lower one. Imbs (2004) also underlines the positive connection but offers a different explanation. He states that the imperfect information or liquidity constrains can conduct to a low level of GDP correlation between countries.

The negative influence of trade on business cycles synchronization has also many supporters. One of the first papers which claims such link belongs to Backus et al. (1992). This paper considers a real business cycle model in the international context, concluding that the international output co-movement has a low

degree, while international consumption co-movement registers a high one. Baxter and Crucini (1995) and Arvanitis and Mikkola (1996) develop the Backus et al. (1992)'s model by entering incomplete international asset markets. Their results suggest that the low cross country output correlation is related to high international consumption integration. Focusing on policy coordination, Obstfeld and Rogoff (2003) emphasise that the integration has the tendency to reduce the needs for international policy coordination, diminishing the synchronization of outputs.

The empirical literature is also generous. The methodologies are various,from simple Pearson correlations, multifactorial regressions or cross-sectional estimations to panel models, simultaneous equations or, more complex, spectral analyses in time-frequency domain. Positive influence of trade on business cycles synchronization, à la Frankel and Rose (1998), is empirically underlined by Heathcote and Perri (2002), Kose et al. (2003), Baxter and Kouparitsas (2004) or Inklaar et al. (2008).

For example, Heathcote and Perri (2002) perform correlations between output, consumption and investment, connecting US with Europe, Japan and Canada. They find lower correlations over the time span 1986-2000 than over 1972-1985. Baxter and Kouparitsas (2004) choose an extreme bound approach to demonstrate the positive interaction between trade and output co-movement. Kose et al. (2003) validate the same effect but with weak degree, introducing in the equation the financial integration, beside trade. Similar outcomes are obtained by Imbs (2004) via simultaneous equations with three-stage least squares estimator, Moneta and Ruffer (2008) in the case of East Asia by using dynamic factor model or He and Liao (2012) for Asian regions employing structural resorts. The industrialized countries are also deeply explored by Canova and Dellas (1993), Clark and van Wincoop (2001), Rose and Engel (2002), Ramanarayanan (2009) or Lee (2010).

Many empirical papers also validate the destructive effect of trade on business cycle co-movement following the Krugman (1991)'s

hypothesis. Based on annual dataset, Kalemli-Ozcan et al. (2001) investigate the US and OECD. They stress that the capital market determines less symmetric co-movements, while this resort attenuates the positive effect of trade integration according to Frankel and Rose (1998). Helbling and Bayoumi (2003) demonstrate a negative correlation in the trade-synchronization nexus for US and G-7 countries. Additionally, they show that the intensity was lower in 1986-2000 compared with 1972-1985. Also, two different periods of results find Stock and Watson (2005) relying on a factor-structural VAR model for G-7 countries, starting with 1960. Low degree of synchronization is registered in 1984-2002 and higher one in 1960-1983.

Several papers also claim that the trade does not matter for business cycles synchronization. For example, no connection between trade and synchronization co-movement is validated by Doyle and Faust (2005) based on VAR models applied to G-7 countries. Similar results are obtained by Shin and Wang (2004), Calderon et al. (2007) or Kose and Yi (2006). De Haan et al. (2008) perform an extended and useful literature review regarding the business cycle synchronization and its determinants

An important number of papers is exclusively devoted to the case of trade-synchronization nexus in the Eurozone. Herein, one group of papers traits the case of Eurozone or EU including Eurozone countries, while another one focuses on comparative approaches between world countries and Euro area.

For the first group, the very first papers on this topic seem to be the unpublished study of Traistaru (2004) and the contribution of Bower and Guillemineau (2006). In her working paper, Traistaru (2004) analyses the Economic Monetary Union (EMU) members and the Central European Countries (CEE) over 1990-2003, underlying the positive role of bilateral trade for business cycle synchronization. Bower and Guillemineau (2006) use an extreme bound analysis to explore several determinants of co-movement in Eurozone, such us: the bilateral trade, trade, sector specialization, labour protection, exchange rates variations, and

policy and structural measurements. By covering the period 1980-2004, the authors highlight the crucial role of trade on the economic activities' synchronization in Eurozone (especially the intra-industry trade).

Many other studies on the topic were developed. For example, Furceri and Karras (2006) consider trade and fiscal policy as main determinants of economic synchronization in the EU. Having as ground a quarterly sample from 1993 to 1999, the authors observe that trade, captured via imports and exports, increases the co-movement but after the introduction of Euro in 1999. A regional approach is proposed by Siedschlag and Tondl (2011), with 208 regions, for the period 1989-2002. Trade seems to be a good incentive for co-movement, while a negative influence reveals industry specialization and exchange rate volatility. Anagnostou et al. (2015) choose as tool a panel three-stage least squares. Their study covers the period 1980-2009, for 14 EU countries' regions, and takes into account a gravity index related to integration. The main finding is the stimulative role of trade integration on business cycle synchronization. The debt sovereign crisis is a central axe of Asteriou and Moudatsou (2015)'s research. Analysing the period 1998-2011, the authors emphasize the intensification of bilateral trade between EU member countries increases the economic synchronization but after crisis. Foreign Direct Investments (FDI) seems to play a non-direct role. A positive impact of trade on business cycle synchronization is found by Pentecote et al. (2015) for the 11 historical members of the Eurozone over the period 1995-2007. The authors show that the new trade flows are indirectly destructive for co-movement as well as for specialization. Two groups of EU countries (i.e. Greece, Italy, Portugal, and Spain versus 8 Eurozone member countries), considered for the period 1981-2011, are the ground of Gouveia and Correia (2013)'s work. Their intra-trade approach confirms the positive effect of trade on co-movement. Similar results are found by Solomos et al. (2013) for the Eurozone, based on EGLS, GLM and fixed-effects estimators using mixed-determinants of economic synchronization. In a recent work,

investigating also the Eurozone but through OLS regressions, Duran and Ferreira-Lopez (2017) also show that bilateral trade has positive effects on business cycle synchronization.

Conversely, different findings are obtained by Caporale et al. (2015). The authors compare 11 core EU states and periphery ones, for the period 1988-2011. The main overcomes highlight the importance of specialization instead of the beneficial role of trade on co-movement. Moreover, Kappler (2011) expresses his reserve regarding the role of trade as determinant of economic synchronization. He analyses the Eurozone via an augmented vector auto-regressive model with an unobserved common factor structure.

The second group of papers comparatively analyses the interaction between trade and business cycle synchronization by considering world and Eurozone countries. For example, Fidrmuc (2004) chooses as ground of investigation the OECD, EMU and Central and East European Countries (CEEC) and emphasises that the intraindustry trade improves the economic co-movement. Unfortunately, no direct influence between bilateral trade and economic convergence is found. Bergman (2004) explores 14 EU countries with non-EU states in parallel, by using pairwise correlations. The results underline the beneficial effect of trade on economic synchronization as well as for money market rate and exchange rate volatility. In the same methodological note, Camacho et al. (2006) connect current and future EU countries with several strong world economies (i.e. Canada, Japan, Norway and US). The period of investigation is 1965-2003. The authors show that the trade is good for economic co-movement, while monetary policy determinants are not important. Introducing the regional level, Clark and van Wincoop (2001) select 9 US regions, 4 regions from big EU and 14 EU countries. They find that trade has positive influence on economic co-movement but the degree of synchronization is higher in US and in the EU regions than in the EU countries.

Only one paper, to the best of our knowledge, belonging to Pomenkova et al. (2014), uses the

wavelet as tool to explore the trade-economic synchronization nexus. The authors compare China with G7 countries, including also Eurozone states. Their findings unravel that trade leads economic synchronization only at high frequencies, while the results are opposite at low frequencies, invalidating the assumption of Frankel and Rose (1998).

Based on this exhaustive literature framework, we investigate the influence of trade on business cycle synchronization in Eurozone by assuming the existence of a significant interaction between them.

All in all, the literature in the field is prolific but offers heterogeneous overcomes, as the authors focus on different countries and periods of time, use various techniques and datasets or follow different research strategies.

In many papers two aspects play a crucial role in the trade-synchronization equation: the economic crisis and the existence of the single currency (euro). Moreover, it is noteworthy that the using of wavelet in the literature on the topic is very poor. We consider that this tool deserves much more attention as it offers many advantages compared with the classical ones.

3- Methodology and data

3.1. Methodology

The research methodology is related to the time-frequency domain, having as empirical ground a battery of wavelet tools: the wavelet coherency, the phase difference and the wavelet cohesion. The research strategy is based on three steps.

In the first step we analyze the business cycle synchronization between Germany and France, as 'core of Eurozone', using the wavelet cohesion. The same tool is used, in a second step, to investigate the growth co-movement between the 'Eurozone core' and the PIIGS group. Further, in the step three, for each country, we explore via the wavelet coherency and phase difference, the impact of trade on economic growth. Finally, all three research sequences are corroborated in order to analyse

the interaction between trade and growth co-movements via the economic growth.

One of the main issue of working with economic variables is that the "true economic relationship among variables can be expected to hold at disaggregated (scale) level rather than at the usual aggregation level" (Dar et al., 2014, p. 3). Hence, here we fix the issue by following the wavelet approach.

The tool allows to deal with the particularities of the trade-growth policies as it operates with various horizons of time, from short- to medium- and long-terms. There are many advantages of wavelet compared with the classical time or frequency methods, as Mutascu (2017, p. 5) note: 'First, it generates short-, medium- and long-run frameworks. Second, it reveals how the relationship between variables varies across different frequencies over time. Third, it reveals the direction of causality between different frequencies over time. Finally, it illustrates the lead-lag status of the connection (i.e. whether it has cyclical or counter-cyclical status).' Last but not least, the Morlet wavelet represents a very good tool to analyze the business cycle synchronisation, for both amplitude and phase information points of view.

3.2. Data

The empirical ground is represented by a dataset of 7 Eurozone countries: Germany and France as 'Eurozone core', and the PIIGS group, composed of Portugal, Italy, Ireland, Greece and Spain. For each country, we considers two variables: trade and economic growth. The sample covers the period 1960Q1-2016Q2, with quarterly frequency. The source of data is the online OECD statistics database (2017).

The trade variable (x) is measured as the sum of imports and exports in US Dollars.

The economic growth (y) is represented by the Gross Domestic Product (GDP) also expressed in US dollars (i.e. in current PPPs). An aggregate GDP variable is also constructed - 'GDP Eurozone core', as GDP sum of Germany and France. The 'GDP Eurozone core' is used

for analysing the co-movement between the 'Eurozone core' and each of PIIGS country.

All variables are seasonally adjusted, being in natural logarithm form. As the stationarity is not a required property in the frequency-domain approach (Aguiar-Conraria et al., 2008; Mutascu, 2017), we deal only with the white noise of the series. This noise can induce strong disturbances in the time-frequency analyses, reducing the quality of results.

A battery of tests is considered to investigate the properties of series: Augmented Dickey-Fuller (ADF), Phillips-Perron (PP) and Kwiatkowski-Phillips-Schmidt-Shin (KPSS) tests. Expecting the existence of structural breaks, Zivot-Andrew (ZA) test for unit root with structural break is also performed. The series detrending is performed by using 'quarter-on-quarter' log level difference. This technique helps also to capture the growth cycle influence, as Rua (2010) notes.

4- Data analysis and findings

The stationarity and trend properties of the series are checked through ADF, PP and KPSS tests, while ZA allows for break points under the unit root condition. The tests are employed in level, assuming intercept and trend.

In all cases, the ADF, PP and KPSS suggest there is a unit root, the variables being non-stationary in their level. Moreover, the KPSS and partially the ADF and PP tests clearly show the existence of trend for all variables. Therefore, the series have been adjusted for trend component, finally appearing as 'quarter-on-quarter' log level difference.

The ZA test in Table 1 shows different structural break points in the trade series: France, Greece, Italy and Spain in 1972-1973, Germany in 1978, Portugal in 1988 and Ireland in 1996. The first group of countries accuses the shock of international trade during the oil crisis from '73, while Germany was hit by the energy crisis of 1979. Portugal registers a strong trade disturbance in 1988, over oil glut from 1980s. Ireland reveals a break point in trade in 1996, when the Irish economy, called the "Celtic

Tiger" in the period, has started to register real progresses in term of growth. The economic growth variable offers interesting overcomes, as the ZA test in Table 2 illustrates. For all countries (except Italy, where the test is not conclusive, as the GDP series is stationary), there are structural break points only over 1977-1980, around the energy crisis from 1979. This disturbance seems to have the most notable implications on growth for the whole period of analysis.

The first step of analysis explores the business cycle synchronization between Germany and France ('Eurozone core'). The related WC is plotted in the Figure A1, in Appendix. It is clear that high degree of comovement is registered at low frequency (i.e. long term), for more than 30 quarters band of scale. Further, the economic synchronization between Germany and France has get stronger /intensifies at all ranges of frequency since the middle of 90s on. Otherwise, at high and medium frequencies (i.e. short and medium terms), until 12 quarters of scale, the synchronization is 'chaotic'. However, two episodes of significant economic asymmetry are relevant: 1965-1972 and 1980-1990, respectively.

As for step two of study/ As for the second step of the analysis, the set of WCs of comovement between the growth cycles of 'Eurozone core' and PIIGS countries are illustrated in Figures A2, in Appendix. At low frequency (i.e. long term), for more than 30 quarters of scale, the 'Eurozone core' is strongly synchronized with all PIIGS countries, excepting Ireland and this for more than 60 quarters of scale. At medium range of frequency (i.e medium term), for 4-12 quarters scale, only Italy and Spain show common higher comovement with 'Eurozone core', especially since the 90s. Even so, Spain reveals ephemeral/brief sequences of asymmetry,for example during the period 1975-1985. Portugal, Ireland and Greece are low synchronized with the 'Eurozone core' at medium frequency (i.e. medium term), for 4-30 quarters of scale, until middle of '80s. After that a couple of comovement episodes arise. Herein, Greece unfortunately falls to be synchronized with the 'Eurozone core' in a persistent way, especially during the financial crisis from

2007/2008. Further, at high frequency (i.e. short term), considered up to 4 quarters of scale, the comovement between the PIIGS group and the 'Eurozone core' is rather idiosyncratic.

All in all, 'Eurozone core' and the PIIGS group are highly synchronized on long term, which is typical for business cycle frequency range. On medium term, the European economic integration from '90s plays a crucial role in growth cycle comovement. This process has been deeply reinforced by the establishment of the monetary union in 1999. Several countries, such as Portugal, Ireland and especially Greece registered strong economic cyclic asymmetry during the last economic crisis.

The third step of investigation involves the interaction between trade and economic growth, for each countries, through the WTC including phase difference. In parallel, as four step, the analysis of the interactions between the trade and economic comovements is also followed. All related plots are presented in the Figures A3 and A4, in Appendix.

Figure A3 shows the case of Germany and France. For both countries, at low frequency (i.e. long term), for more than 30 quarters of scale, the arrows are oriented to the right and up, trade positively driving growth. As the band coincides with high economic synchronization between countries, trade accelerates the comovement process via growth. Under the same comovement status, similar results are registered on short and medium frequencies (i.e. short and medium terms) starting with the middle of '90s.

Conversely, the arrows are pointed to the right and down at medium frequency (i.e. medium terms), at 6-22 quarters of scale, over the sequences 1965-1975, and at 6-10 quarters of scale, for 1980-1990, respectively. Herein, the growth positively drives trade under low synchronization pattern. This economic asymmetry seems to promote trade but only under positive growth country tendency.

Figure A4 depicts the case of PIIGS group. In Portugal, on medium term, at 4-8 quarters of scale, between 1965-1970, the arrows are pointed to the right and up. The trade positively

causes growth, the economy being synchronized with 'Eurozone core'. This sub-period shows that an intensification of international trade synchronizes the economies via growth.

At 10-16 quarters of scale, during the crises from '70, but synchronized pattern, the arrows are oriented to the right and down. The growth causes trade with positive sign. This means the comovement ensures well the conditions for expansion of international trade via an ascending growth country regime. On long term, at 30-48 quarters of scale, over 1972-2009, the arrows are pointed to the right and up, the trade driving growth with a positive sign. As a comovement pattern with respect to 'Eurozone core' exists, trade promotes synchronization through growth. Italy reveals similar overcomes. On medium term, under low to high synchronized pattern with 'Eurozone core', the arrows are oriented to the right and down suggesting the growth leads trade at 4-24 quarters of scale, over 1960-1978. In this period Italy was confronted with the so called 'Hot Autumn' (i.e. large strikes of workers in northern Italy) and the economic turbulence from '70s. The low comovement via a positive growth country trend is here a good environment for trade. At 4-20 quarters of scale, for 2000-2011, as the arrows are oriented to the right but up, the trade represents a good incentive for growth. Thus, the trade improves the economic comovement via growth. Further, a low economic synchronization characterizes the period 1997-2003, at 4-8 quarters of scale, when the arrows are pointed to the right but down. Therefore, the growth causes trade with positive sign. In this period, the Italian authorities tried to reduce the public debt, tax evasion and governmental spending, increasing the role of market in parallel. As in the previous case, the economic asymmetry generates trade via an ascending growth country status. For more than 30 quarters of scale, on long term, the arrows are oriented to the right and up, the trade exerting positive effect on growth over 1978-1997, under a strong comovement pattern. Herein, the trade improves the synchronization through growth. Ireland illustrates/shows noteworthy overcomes only on medium term, at

4-8 quarters of scale, for 1984-1990, period with pronounced economic problems (i.e. high public debt, accentuated budgetary deficit and inflation). The arrows are pointed to the right and down, the growth positively running trade, under a low degree of comovement. Therefore, the asymmetry is a good environment for trade taking into account an increasing growth country tendency. Greece registers similar results. On medium term, when the synchronization is low, at 4-8 quarters of scale, for 1972-1984, the arrows are oriented to the right and down, showing that growth leads openness. Thus, the economic asymmetry stimulates openness for a growing economic trend. When the level of comovement improves, at 8-16 quarters of scale, over 1984-1997, the arrows are pointed to the left and down. Curiously, trade becomes a disincentive for growth but accelerates the synchronization. Moreover, if for the rest of countries the short term is not important, Greece seems to be an exception. Trade starts to positively contribute to the growth in this country at the end of 2009-2012 period, at 1-4 to 8 quarters of scale, as the arrows are pointed to the right and up. Herein, the economy registers a low to high degree of comovement. More precisely, trade improves the synchronization via growth. In fact, this effect characterizes the apogee of Greece's public debt crisis. In Spain, on medium term, for 1972-1985, at 5-8 quarters of scale, and for 1995-1999, at 8-11 quarters of scale, the arrows are oriented to the right and down. The economic growth stimulates trade under a low level of comovement with 'core' group. In this context, the economic asymmetry promotes trade through an increasing growth country tendency. The first period is characterized by oil shocks from '70s, while the second one is related to the economic recovery from '90s. On long term, at 30-34 quarters of scale and synchronized period, over 1972-1997, as the arrow are pointed to the right and up, the trade positively leading growth. Herein, the intensification of international trade improves growth and comovement. When the degree of synchronization has a descending trend, for more than 60 quarters of scale, over 1972-1997, the arrows are pointed to the right but down. Hence, the growth is a good incentive for

international trade. In this situation, the asymmetry stimulates trade but only under a rising growth country regime.

On the one hand, the results confirm the conclusions of Frankel and Rose (1998): trade promotessynchronization through the economic growth but only for specific sub-periods of time, on medium and log terms. This process intensifies with the European economic integration in the '90s and becomes accentuated by the establishment of the monetary union in 1999, validating the contribution of Oudiz and Sachs (1984). As a particularity, in Greece, the role of trade is vital for the improvement of the synchronization, on short term, during the apogee of public debt crisis from 2009-2012.

Conversely, on medium term, in the same case of Greece, trade represents a disincentive for synchronization, over the period 1984-1997, with devastating inflationary years and high unemployment rates, reinforcing the theory of Krugman (1991).

On the other hand, the main novelfindings are obtained on medium and long terms emphasizing an inverse connection. This runs from growth to trade. Herein, a low degree of synchronization is able to promote trade when the country exhibits growing economic tendency. During the crises, an acceleration of trade is associatedonly to a vector of a strong comovement process, as shown in the cases of Portugal and Italy.

5- Conclusion

The interaction between trade and business cycle synchronization has started to be one of the key challenges in the Euro area, especially during the last years. The study explores the causality and sign of causality between the trade and economic comovement via growth, in several Eurozone countries (i.e. Germany and France, as 'Euro-zone core', and PIIGS group), for the period 1960Q1-2016Q2, by using an extended wavelet approach.

The main findings show that trade improves the economic synchronization on medium and long terms in the targeted Eurozone countries. The key elements through which this becomes

possible are the economic integration of countries and the monetary union. The existence of a group which acts as a 'vector leader' seems to be a plus. The effect of synchronization becomes stronger as more and more coordinated policies are reinforced within the group. Such outcome can also be spotted on.../ is also appropriate on short term but during the period with economic turbulence. Unfortunately, on medium term, considering the same shocks, trade becomes destructive for comovement as there is no need for additional international policy coordination.

An inverse nexus/opposite result is also found. On medium and long terms, a low degree of synchronization accelerates the trade openness only if the given country registers an ascending growth trend. A high degree of synchronization becomes important during the economic crises, when the comovement positively leads trade openness.

Regarding the policy implications, it is recommended for policy makers from Eurozone to boost the trade openness on medium and long terms in order to obtain a high economic synchronization, according to the theory of optimal currency area. The short term policies can also be targeted being efficient in periods with economic turbulence. On medium term and in the presence of the same economic shocks, trade should be used with precaution.

The decision makers can also exploit, on medium and long terms, the periods with low economic synchronization. Those have the capacity to stimulate trade openness but under a growing economic context. During the crises, the synchronization seems to be a key factor for promoting trade.

6. Perspectives of future collaborations with the host laboratory

The collaboration initiated with Camelia Turcu and with the LEO members in general, during the visiting period as Le Studium Fellow will lead to further research projects (i.e. implication in European projects, MSH projects).

Moreover, the different tools that were employed and developed within this research will also be used in the studies that I conduct with Camelia Turcu and Yunzhi Zhang (LEO CNRS) in order to investigate the link between oil prices, exchange rate and trade in China.

In general, I will have even stronger links with LEO in the near future as I will become a LEO affiliate researcher from September 2018 on.

7. Publications

Mutascu, M. (2017): New evidences regarding the tax-spending nexus in Romania through wavelet analysis, *Post-Communist Economies*, 29(3), 431-447 (ISI Thomson, IF=0.541, CNRS rank 2).

8. Acknowledgements

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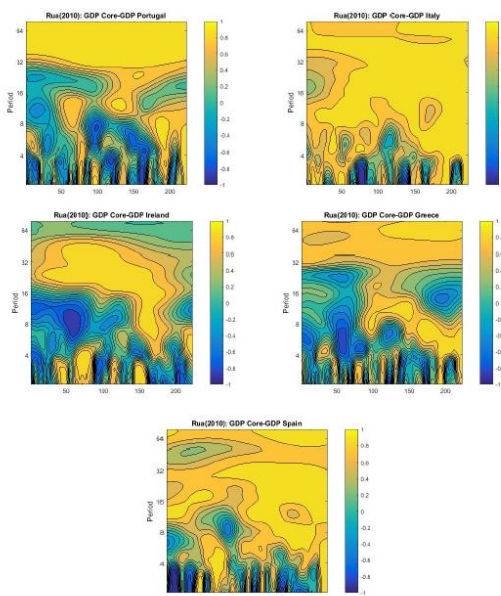
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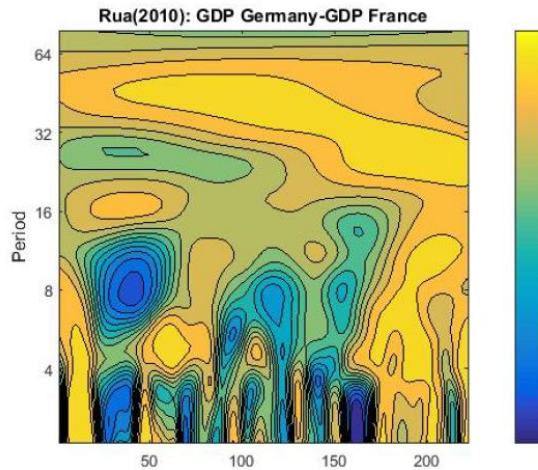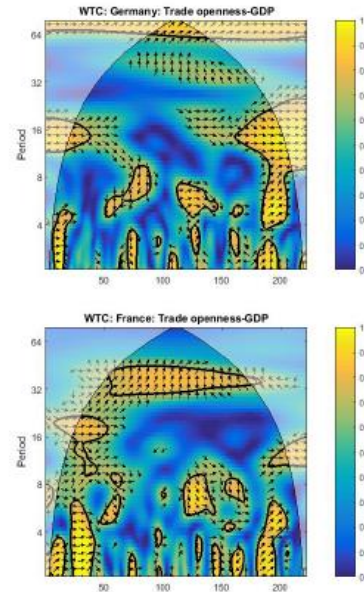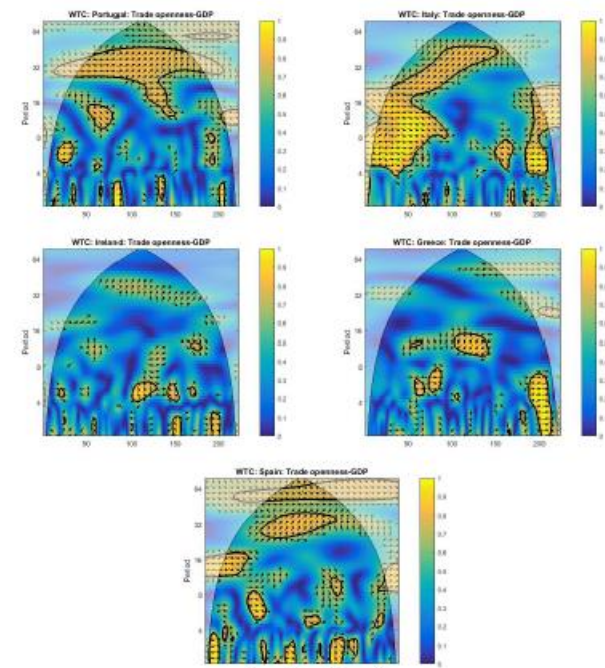
Note: (1) The colour code shows the intensity of correlations, which goes from blue (negative correlation) to yellow colour (positive correlation);
(2) The X-axis denotes the studied time-period, whereas the Y-axis illustrates the frequency.
(3) On the X-axis, 50 corresponds to 1972Q2, 100 to 1984Q4, 150 to 1997Q2 and 200 to 2009Q4, respectively.

Figure A1: WC of comovement between the growth cycles of Germany and France ('Eurozone core')

Note: (1) The thick black contour depicts the 5% significance level estimated from Monte Carlo simulations by following phase randomized surrogate series, while the cone of influence (COI) where the edge effects might distort the picture is designed as a lighted shadow;
(2) The colour code for power ranges goes from blue (low power) to yellow colour (high power);
(3) The arrows denote the phase difference between the two series. The variables are in phase when the arrows are pointed to the right (positively related). The trade openness is leading when the arrows are oriented to the right and up. Otherwise, GDP is leading when the arrows are pointed to the right and down.
(4) The variables are out of phase when the arrows are pointed to the left (negatively related). The GDP is leading when the arrows are oriented to the left and up, while the trade openness is leading when the arrows are oriented to the left and down.
(5) The variables have each other cyclical effect in the phase and anti-cyclical effect in the anti-phase or out of phase.
(6) The X-axis denotes the studied time-period, whereas the Y-axis illustrates the frequency.
(7) On the X-axis, 50 corresponds to 1972Q2, 100 to 1984Q4, 150 to 1997Q2 and 200 to 2009Q4, respectively.

Figure A3: WTC of interaction between trade openness and economic growth in 'Eurozone core' countries

Note: (1) The colour code shows the intensity of correlations, which goes from blue (negative correlation) to yellow colour (positive correlation);
(2) The X-axis denotes the studied time-period, whereas the Y-axis illustrates the frequency.
(3) On the X-axis, 50 corresponds to 1972Q2, 100 to 1984Q4, 150 to 1997Q2 and 200 to 2009Q4, respectively.

Figure A2: WC of comovement between the growth cycles of 'Eurozone core' and PIIGS countries

Note: (1) The thick black contour depicts the 5% significance level estimated from Monte Carlo simulations by following phase randomized surrogate series, while the cone of influence (COI) where the edge effects might distort the picture is designed as a lighted shadow;
(2) The colour code for power ranges goes from blue (low power) to yellow colour (high power);
(3) The arrows denote the phase difference between the two series. The variables are in phase when the arrows are pointed to the right (positively related). The trade openness is leading when the arrows are oriented to the right and up. Otherwise, GDP is leading when the arrows are pointed to the right and down.
(4) The variables are out of phase when the arrows are pointed to the left (negatively related). The GDP is leading when the arrows are oriented to the left and up, while the trade openness is leading when the arrows are oriented to the left and down.
(5) The variables have each other cyclical effect in the phase and anti-cyclical effect in the anti-phase or out of phase.
(6) The X-axis denotes the studied time-period, whereas the Y-axis illustrates the frequency.
(7) On the X-axis, 50 corresponds to 1972Q2, 100 to 1984Q4, 150 to 1997Q2 and 200 to 2009Q4, respectively.

Figure A4: WTC of interaction between trade openness and economic growth in PIIGS countries