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DISSERTATION

HOW THE INCREASED TRADE INTEGRATION IN THE EMU AFFECTS THE SYMMETRY OF SHOCKS

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GLOSSARY

EMU – European Economic Monetary Union

F&R – Frankel and Rose (1998)

HIIT – Horizontal intra-industry trade

OCA – Optimum Currency Areas

R&D – Research and Development

VAR – Vector auto-regressor

VIIT – Vertical intra-industry trade

ABSTRACT, KEYWORDS AND JEL CODES

In this paper, I investigate if the increased trade integration in the EMU can translate into a higher symmetry of shocks between countries, implying a higher synchrony of business-cycles and consequently a lower cost of sharing a common monetary policy, using quarterly data from the 19 Euro Area countries for the period between 2004Q1-2019Q4. By applying the Blanchard-Quah (1989) structural VAR's methodology, I was able to individually separate demand and supply shocks from cyclical fluctuations in real output and prices, followed by the computation of correlation coefficients of shocks between trading partners and 3 alternative benchmarks – Germany, European Union 27 and France. In comparison to previous literature, this dissertation includes, in the final analysis, new data regarding trade intensity, intra-industry trade, a proxy for fiscal-policy convergence and an explanatory variable that takes into account real-GDP discrepancy between trading partners, in order to identify the main drivers that justify demand and supply shocks co-movements in the EMU. The overall results show a positive relationship between higher intra-industry trade and demand shock correlations in the EMU, while specialization leads to stronger asymmetric demand shocks. Since trade in the Euro Area is to a large degree intra-industry, these results provide evidence in support of a Frankel-Rose type of effect, but one cannot identify the direct relationship between demand shock symmetry and trade variables if the regressions are augmented by additional structural variables. Regarding supply-side shock correlations, the results obtained provide evidence in favor of inter-industry trade increasing positive effects on supply shock symmetry due to international spillover effects, i.e., the new knowledge and innovations created due to a country's productivity level are spread internationally. Lastly, a section regarding future expansions and research is included, giving special attention to the separation between Vertical Intra-Industry Trade and Horizontal Intra-Industry Trade and their implications in the model.

KEYWORDS: EMU; demand shocks; supply shocks; trade intensity; intra-industry trade; specialization; business-cycle synchrony; symmetric shocks; innovations, spillovers.

JEL CODES: F10; F11; F14; F44; F45; L81

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HOW THE INCREASED TRADE INTEGRATION IN THE EMU AFFECTS THE SYMMETRY OF SHOCKS

By Pedro Oliveira

In this paper, I investigate if the increased trade integration in the EMU can translate into a higher symmetry of shocks between countries, implying a higher synchrony of business-cycles and consequently a lower cost of sharing a common monetary policy. The overall results show a positive relationship between higher intra-industry trade and demand shock correlations in the EMU, while specialization leads to strong asymmetric demand shocks. Regarding the supply-side shock correlations, the results obtained provide evidence in favor of inter-industry trade increasing positive effects on supply shock symmetry due to international spillover effects.

3. INTRODUCTION

The theory of Optimal Currency Areas (OCA), theoretical framework of reference in the process of a Monetary Union formation, analyses the costs and benefits of monetary integration, specially the European Economic and Monetary Union (EMU). It was initially developed by Mundell (1961), and a vast literature has been written since then, including important classic contributions by McKinnon (1963) and Kenen (1969).

Much of this literature focuses on four inter-relationships between the members of a potential OCA: the extent of trade connections; the similarity of the shocks and business cycles; the degree of international factor mobility (especially migration) and the possession of an efficient adjustment mechanism that can mitigate the adverse effects of asymmetric shocks, usually through fiscal transfers. Thus, two countries or regions would benefit from forming a Monetary Union if they are characterized by a great linkage between these four inter-relationships.

In the case of the EMU, differences in cultural, language and institutional barriers are inhibitory factors to a greater labor mobility, demarcating the need to establish explicit European labor market policies; while many studies find a positive and significant impact of the euro on trade between the euro adopters.

In this dissertation, I investigate if the increased trade integration in the EMU can translate into a higher symmetry of shocks between countries, implying a lower cost of sharing a common monetary policy, using quarterly data from the 19 Euro Area countries for the period between 2004Q1-2019Q4.

There are two contradictory theoretical views as to the overall impact of trade integration on shock symmetry of the countries participating in a Monetary Union, classified by De Grauwe (1997) as 'The European Commission View' and 'The Krugman View'. According to the European Commission (1990), as the degree of economic integration between countries increases, asymmetric shocks will occur less frequently, income and employment will tend to become more correlated, thus, observing more synchronized business cycles between countries. On the other hand, Krugman (1993) defends that increase in economic integration will lead countries to become more specialized, as to profit from comparative advantages, thus facing more asymmetric shocks and reducing the overall degree of symmetry in the movements of output and employment between the group of countries within the union.

Many contributions from different researchers followed this discussion, with special attention to Frankel and Rose (1998) debate regarding the endogeneity argument of OCA criteria fulfillment, i.e., countries which have decided for closer bilateral trade links face higher levels of business cycle synchronization, becoming better candidates for integration, providing evidence in favor of 'The European Commission View'. Many research papers provided proof that Frankel and Rose (1998)'s results were upward biased "(e.g. Gruben et al, 2002; Kenen, 2000)", however, other studies suggest that what explains the evidence of economic cycles is the similarity of productive structures as measured by intra-industry trade (trade which involves a country exporting and importing products of the same category) and not only bilateral trade itself "(Shin and Wang, 2005)".

The international R&D spillovers argument introduced by Coe and Helpman (1995, 2001) can also play a crucial role in explaining why country-specific spending shocks are spread internationally. This new theory of international trade explains how increases in overall trade intensity leads to the diffusion of knowledge and technology, resulting in a quicker transmission of productivity shocks.

So, based on the information already described, on one hand, if the international R&D spillovers argument and the observed intensive intra-industry trade continues to take place, one would expect increased overall trade to be positively and significantly related to cross-country shock correlations, both from a demand and supply side. Spending spillovers could affect demand shocks while productivity spillovers and industrial structure's similarities could have an impact on supply-side shocks. On the other hand, if inter-industry trade (associated with specialization) dominates, one would expect increased overall trade to be negatively associated with correlations of supply-side shocks, since countries are producing different category of goods, but also, bilateral trade intensities may be positively linked with demand-shock correlations, due to aggregate spending and income spillovers.

This dissertation builds on existing literature regarding the relationship between business cycle co-movements and trade intensity, but now, using more recent data, I separate demand and supply shocks from cyclical fluctuations in real output and prices, include an intra-industry trade variable, a proxy for fiscal-policy convergence and an explanatory variable that takes into account real-GDP discrepancy between trading partners, in order to identify the main drivers that justify demand and supply shocks co-movements in the EMU.

The main conclusions of this dissertation are as follows: if demand-side shocks are the main driving force of business cycles, one would expect inter-industry trade to create stronger asymmetries between nations and, on the opposite side, intra-industry trade would lead to greater cross-country business cycle synchrony. These first results provide evidence in support of “The European Commission View”, rather than “The Krugman View”, since trade in the EMU is, to a large degree, intra-industry and based on the existence of economies of scale and imperfect competition. On the other hand, if supply-side shocks are the main driving force of business cycles, one could expect a strong positive effect of specialized trade on cross-country business cycle correlation, due to international spillover effects, as initially argued by Coe and Helpman (1995).

The paper is organized in 8 sections as follows. After this brief introduction, section 2 presents the main related literature. In the third section I present and analyze some stylized facts from the European Economic and Monetary Union group of countries. In Section 4, I describe the VAR model initially proposed by Blanchard and Quah (1989), in order to identify supply and demand shocks, followed by the trade intensity and intra-industry trade measures, proposed by Frankel and Rose (1998) and Grubel and Lloyd (1975), respectively. Section 5 focus on the empirical analysis of my computations regarding demand and supply shock correlations, as well as trade intensity and intra-industry trade indicators. The sixth section states the main conclusions followed by a section regarding future extension to this paper, mainly the effects on shock symmetry of horizontal intra-industry trade and vertical intra-industry trade.

4. LITERATURE REVIEW

According to the classical OCA theory, developed by Mundell (1961), the right criteria for designing a currency area should be the degree of international factor mobility (both capital and labor) within the region, which facilitates the adjustment to adverse effects of asymmetric shocks and thus reduces the pressure for exchange rate adjustments. Moreover, other important classic contributions like McKinnon (1963), predict price instability to increase in line with the degree of openness in a floating rates regime, assuming that exchange rate changes have the objective to offset the effects of domestic demand shocks on the current account. Additionally, Kenen (1969) focuses on the degree of product diversification and argues that countries exporting highly diversified products are less vulnerable to sector-specific shocks, thus compensating for low labor mobility and are less likely prompt to use the exchange rate as an adjustment tool.

Following the classical debate, much of the literature started to focus on the inter-relationships between the members of a potential OCA, specially, the extent of trade links and the similarity of shocks and business cycles, resulting into two contradictory theoretical views as to the overall impact of trade integration on shock symmetry of the countries participating in a Monetary Union, classified by De Grauwe (1997) as “The European Commission View” and “The Krugman View”.

On one hand, according to the European Commission (1990), as the degree of economic integration between the industrial European nations increases, asymmetric shocks will occur less frequently, since the trade is to a large degree intra-industry and based on the existence of economies of scale and imperfect competition. On the other hand, for Eichengreen (1992) and Krugman (1993) trade integration leads to regional concentrations of industrial activities so as to profit from economies of scale. Thus, when economic integration increases, the industrial European nations involved become more specialized and subject to more asymmetric shocks. A synthesis of both views is illustrated on the following Figure 1, establishing the relationship between the degree of trade integration between groups of countries (mutual trade of these countries as a percentage of GDP) and the degree of symmetry in the movements of output and employment between groups of countries.

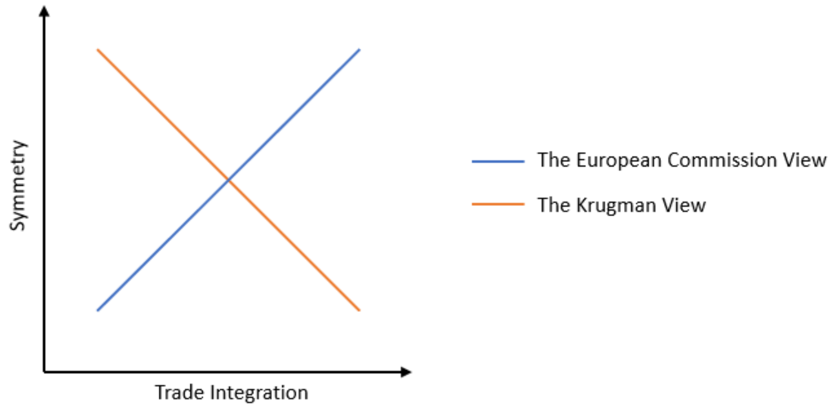

Figure 1 – Relationship between trade integration and symmetry of shocks

Source: Paul de Grauwe (2018)

Following the same school of thought of the European Commission (1990), Frankel and Rose (1998) - F&R - became one of the most cited research paper in the literature, offering evidence that currency area optimality is endogenous, namely, a country is more likely to satisfy the OCA criteria *ex post* than *ex ante*, thus, a common currency area could be self-fulfilling optimal. Using data of 21 industrialized countries, covering the period 1959-1993, F&R found that when a more vast number of countries started to trade with each other, their business cycles were more correlated, i.e., there is a strong positive relationship between the degree of bilateral trade intensity and the cross-country bilateral correlation of outputs. Although these indicators do not enter directly in their analysis, F&R's hypothesis underlines that bilateral trade is mainly intra-industry (trade which involves a country exporting and importing products of the same category), leading to business cycle co-movements, as opposed to inter-industry trade (when a country exports and imports different category of goods), which reflects specialization, thus leading to potential asymmetric shocks, as defended by Krugman (1993).

Addressing the results of F&R empirically, Gruben, Koo and Millis (2002), used the same sample of 21 countries in order to test and refine the specifications. Although their results confirm Frankel and Rose's general conclusion, it is also stated that the estimated coefficients of trade intensity were biased upwards. In addition, Gruben, Koo and Millis (2002) estimates do not support the idea that increases in inter-industry trade (which may indicate a rising specialization phenomenon) has a negative effect on business cycle correlation.

Additionally, Shin and Wang (2005) extended F&R contribution and investigated four possible channels through which increased trade affects business cycle co-movements: inter-industry trade, intra-industry trade, demand spillovers and policy coordination channels. Shin and Wang (2005) results indicated that intra-industry trade is the major channel though which trade integration synchronizes the business cycles in Europe, although monetary policy coordination has some responsibility too.

However, on the opposite side of this discussion, Kenen (2000) criticized F&R's results and claimed they were biased, since trade, a real variable, cannot be exogenous to fluctuations of another real variable such as economic activity. Kenen (2000) also showed that, within a Keynesian model framework, the correlations in output co-movements of two countries are positively related to bilateral trade intensity, but it does not directly correspond to a reduction in asymmetric shocks. Therefore, it is important to highlight that trade intensity is not the only dynamic responsible for the convergence of business cycles in an OCA and its impact on shock asymmetry depends on the type of shock.

Moreover, Fidrmuc (2004) tested the endogeneity argument of OCA criteria introduced by F&R in a cross-section of OECD countries in the period of 1990-1999. Reconfirming the interpretation by Frankel and Rose (1998) and bypassing Kenen (2000)'s criticism due to the direct inclusion of intra-industry trade in the regression, since trade, a real variable, is not exogenous to fluctuations of another real variable such as economic activity, it is shown that the convergence of business cycles is a consequence of intra-industry trade and, based on his econometric analyses and results, there is no direct relationship between business cycle and trade intensity if regressions are augmented by additional structural variables.

Representing one of the initial arguments for the new theory of international trade, Coe and Helpman (1995) introduced international research and development spillovers as factors responsible for a greater correlation of shocks across countries. The authors found that a country's productivity level depends on domestic and of its trading partners R&D capital stocks, thus, the cumulative R&D experience results in new knowledge and innovations, representing a major transmission mechanism through which country-specific spending shocks are spread internationally.

In terms of econometric methods used in this dissertation, it is important to highlight the work of Blanchard and Quah (1989), which proposes a bivariate VAR procedure in order to separate shocks from responses, thus, allowing to identify the origins of fluctuations in GNP and unemployment, which can be demand or supply-side disturbances. They assume these two disturbances to be uncorrelated at all lags and the demand shocks only have a temporary effect while supply shocks have a long-term effect on output and unemployment. Blanchard and Quah (1989) concludes that demand disturbances have a hump-shaped effect on output and unemployment which fade after a period of two to three years, and that supply disturbances have an effect on output which builds-up over time to reach a state of little or no change after five years.

Following the classical studies and subsequent developments already mentioned, this dissertation is mainly built on Babetskii (2005)'s methods to extract supply and demand shocks from quarterly series of real output and prices and Zervoyianni and Anastasian (2007)'s work, specially, the direct inclusion of intra-industry trade in the regressions.

Babetskii (2005) tried to determine whether "The European Commission View" or "The Krugman View" was supported by data. To reach an answer, he confronted estimated time-varying coefficients of supply and demand shock asymmetry (using the Blanchard-Quah (1989) structural VAR methodology) with indicators of trade intensity and exchange rates from seven Central Eastern European Countries plus Ireland, Portugal and Spain for the period 1990-2002, using the EU-15, and Germany as alternative benchmarks. As a result, he found that an increase in trade intensity results in higher symmetry of demand shocks, supporting F&R endogeneity argument, and a decrease in exchange rate volatility leads to a positive effect on demand shock convergence. Thus, confirming the "European Commission view" and the impact of trade integration on shock asymmetry depended on the type of shock, as initially defended by Kenen (2000). Although, Babetskii (2005) is one of the few existing papers which focus on the direct link between trade flows and cross-country symmetry of shocks, he was unable to conclude the impact of overall trade intensity on the symmetry of supply shocks and the role of intra-industry trade was not explored either.

Additionally, Zervoyianni and Anastasian (2007) complemented Babetskii (2005) work, tackling its main critics and reaching robust results. Using the same Blanchard-Quah structural VAR methodology in order to identify demand and supply disturbances, Zervoyianni and Anastasian (2007) presented three important conclusions: firstly, trade intensity has a positive impact on the correlation of both type of shocks across the European countries; secondly, intra-industry trade is positively linked to the correlation of supply side shocks but negatively linked to the correlation of demand side shocks; and lastly, both international spillovers and intra-industry trade represent the most dominant mechanisms through which trade flows affect the cross-country transmission of shocks across Europe. These results provided evidence in favor of F&R endogeneity argument and also suggested that more trade intensity would imply both less asymmetric demand and supply shocks, then, assuming a continuously upward intra-EU trade, the process of European integration is expected to result in more synchronized national business cycles.

This dissertation builds upon the existing literature regarding the relationship between business cycle co-movements and trade intensity, but in this case, I made use of more recent data and focus only on EMU countries, resulting in different outcomes that support "The European Commission View", Fidrmuc (2004) conclusion and Coe and Helpman (1995) new international theory arguments. Similarly to Babetskii (2005), I separate demand and supply shocks from cyclical fluctuations in real output and prices using Blanchard and Quah (1989) method, but in this paper I also include an export and import trade intensity variables never used before. Likewise Zervoyianni and Anastasian (2007), an intra-industry trade variable, a proxy for fiscal-policy convergence and an explanatory variable that takes into account real-GDP discrepancy between trading partners, are included in order to identify the main drivers that justify demand and supply shocks co-movements in the EMU.

3. EVOLUTION OF THE SIZE AND DEGREE OF TRADE OPENNESS IN THE EMU

In this section I present and analyze some stylized facts from the European Economic and Monetary Union group of countries, also referred to as the Euro Area.

Firstly introduced in 1999, the Euro Area was initially composed by 11 European Union Member States, as studied by Faruqee (2004), with the objective to promote greater intra-area trade in goods and services via lower currency transaction costs, diminished exchange rate uncertainty and promote competition though greater price transparency. In 2001, Greece joined too, followed by Slovenia in 2007, Cyprus and Malta in 2008, Slovakia in 2009, Estonia in 2011, Latvia in 2014 and Lithuania in 2015. Currently, the Euro Area numbers 19 European Union Member States, and the EMU has been an ongoing process, which will take more years to be fully complete.

As one can observe from Table I, from a demographic perspective, the Euro Area's population (19 countries) increased almost 8 million from 2008 to 2019 mostly due to net migration and natural increase in most of the countries, being Greece, Latvia, Lithuania, and Portugal the main outliers. Regarding macroeconomic statistics, since the end of 2009, the European Sovereign Debt Crisis period hit countries like Greece, Portugal, Ireland, Spain and Cyprus with serious problems to repay or refinance their government debt, resulting in serious economic growth barriers, for example, austerity programs, leading to an overall decrease in GDP per capita in the Euro Area (from 29.365€ in 2008 to 28.437€ in 2013), which has already recovered (31.320€ in 2019), although nations like Greece and Italy have not yet reach the same level of GDP per capita as of 2008.

Due to the increasing globalization and transportation innovations, trade is an important driver for euro area economies' growth. The euro area as a whole and its 19 member countries are characterized by a high degree of trade openness, i.e., the ratio between the sum of exports and imports of goods and services and nominal GDP, as can be seen in Table I - total imports and exports constituted about 87,7%% of euro area GDP in 2019 (almost 10 pp. higher than what was observed in 2008). On average, smaller nations that adopted the euro on a later stage are more open to international trade, while the advanced and emerging economies have achieved a stable level of trade openness over the last decade. One can also highlight Luxembourg (380,1%), Malta (275,3%) and Ireland (252,3%) extreme degree of trade openness in 2019 due to, respectively, high services content; the size and geography of the country; and lastly the capital and labour market reforms towards the more export productive sectors.

Table I

Size and degree of openness of the Euro Area countries

Country	**GDP per capita (€), chain linked volumes (2010)**			**[Exports + Imports] / GDP (%)**			**Population (Millions)**		
	2008	**2013**	**2019**	**2008**	**2013**	**2019**	**2008**	**2013**	**2019**
BE	33.640	33.490	36.090	161,1%	157,9%	163,7%	10,71	11,16	11,49
DE	32.320	33.330	35.980	81,5%	85,1%	87,6%	82,11	80,65	83,09
EE	12.590	12.540	15.510	136,7%	166,5%	143,9%	1,34	1,32	1,33
IE	38.550	37.060	60.130	160,0%	188,8%	252,3%	4,49	4,62	4,93
GR	22.370	16.630	17.760	59,3%	62,9%	82,0%	11,08	10,97	10,72
ES	24.200	21.840	25.200	56,0%	62,0%	67,0%	45,95	46,62	47,13
FR	31.310	31.170	33.320	57,4%	59,8%	64,1%	64,18	65,88	67,25
IT	28.250	25.620	27.230	54,5%	54,9%	59,9%	58,83	60,23	59,73
CY	24.680	20.400	25.370	112,9%	121,1%	151,0%	0,79	0,86	0,88
LV	10.050	9.980	12.530	91,2%	125,2%	120,4%	2,18	2,01	1,91
LT	10.130	10.810	14.050	126,8%	155,9%	149,4%	3,20	2,96	2,79
LU	86.330	82.400	85.030	292,2%	320,5%	380,1%	0,49	0,54	0,62
MT	15.960	17.650	22.660	298,8%	304,3%	275,3%	0,41	0,43	0,50
NL	39.810	38.180	41.980	131,1%	149,5%	155,3%	16,45	16,80	17,34
AT	36.280	36.180	38.110	102,1%	104,1%	107,5%	8,32	8,48	8,88
PT	17.260	16.050	18.670	72,1%	78,1%	86,6%	10,56	10,46	10,29
SI	19.190	17.160	20.720	134,7%	143,8%	159,3%	2,02	2,06	2,09
SK	12.610	13.250	15.890	162,1%	182,0%	184,1%	5,38	5,41	5,45
FI	37.330	34.660	37.150	86,2%	77,1%	79,6%	5,31	5,44	5,52
EA19	29.365	28.437	31.320	77,2%	81,8%	87,7%	333,78	336,90	341,97

Sources: Trade openness and GDP per capita*: Eurostat, National accounts*, author's computations; Population: *Pordata, Population.*

DE – Germany; AT – Austria; BE – Belgium; CY – Cyprus; SK – Slovakia; SI – Slovenia; ES – Spain; EE – Estonia; FI – Finland; FR – France; GR – Greece; IE – Ireland; IT – Italy; LV – Latvia; LT – Lithuania; LU – Luxembourg; MT – Malta; NL – Netherlands; PT – Portugal.

Excluding specific structural issues such as historical relationships or the size of the economies in analysis, the increase in trade openness of euro area countries has unquestionably benefited from the Single Market and monetary integration, both within the euro area and with the other members of the European Union. Thanks to the removal of trade impediments and the harmonization of regulations within Europe, in addition to the elimination of exchange rate risk due to the creation of a single currency, members and non-members of the EMU have more incentives to deepen trade integration and participate in global supply chains.

In Table II, one can observe the exports and imports value, as percentage of GDP, of each of the euro area countries in relation to the remaining members and non-members of the EMU.

Within the euro area, the evolution of trade growth has been impressive, especially for countries that did not belong to the 11 founders of the Euro. Nations like Malta, Cyprus and Greece almost doubled the value of exports with EMU members and Latvia and Lithuania statistics increased from 13,1% and 14,1% in 2008 to 29,2% and 35,6% in 2019, respectively, verifying the pre-euro trade literature view, i.e., on average, joining a common currency would lead to an increase in overall trade, and specially with the members of the monetary union. From the 11 initial funders, intra-EMU exports has slow downed in Belgium and Germany, while exports to non-members of the EMU saw a small increase after a long period of foreign direct investment directed towards export industries.

From the imports side, the elimination of customs barriers on imports and the adoption of a common currency lead to a shift in the import's origin, towards the EMU members, as can be seen in Table II. With the exception of Cyprus and Slovakia, all EMU countries imported larger quantities of goods and services from other EMU partners, while the observable data with non-members of the EMU is more split, presenting increases or decreases depending on the country in question.

Table II

Euro Area (18) trade with members and non-members of the EMU

Country	**Exports (% GDP)**				**Imports (% GDP)**			
	Members EMU		**Non-Members EMU**		**Members EMU**		**Non-Members EMU**	
	2008	**2019**	**2008**	**2019**	**2008**	**2019**	**2008**	**2019**
BE	48,3%	45,1%	11,6%	12,0%	49,2%	49,7%	10,3%	10,4%
DE	17,5%	16,9%	9,5%	9,9%	14,4%	15,7%	7,3%	8,2%
EE	24,1%	36,9%	23,9%	16,3%	30,3%	39,7%	27,9%	16,4%
IE	32,8%	32,7%	21,1%	21,4%	23,5%	25,3%	21,8%	14,9%
GR	8,0%	14,1%	4,8%	6,6%	14,6%	15,4%	4,2%	5,0%
FR	12,2%	13,7%	4,4%	4,3%	13,3%	15,0%	4,2%	4,1%
IT	11,7%	13,1%	4,1%	4,7%	12,1%	13,6%	3,0%	3,6%
CY	12,4%	22,2%	15,3%	16,3%	29,7%	28,9%	9,5%	10,7%
LV	13,1%	29,2%	12,7%	13,5%	20,4%	34,5%	17,8%	12,1%
LT	14,1%	35,6%	20,7%	16,4%	19,6%	31,4%	19,8%	16,8%

LU	102,7%	119,6%	19,2%	37,7%	84,4%	96,2%	15,0%	25,3%
MT	28,8%	51,5%	24,4%	17,8%	43,1%	36,3%	17,9%	28,5%
NL	39,2%	40,7%	12,1%	14,0%	26,2%	29,3%	7,8%	10,2%
AT	27,7%	32,2%	12,3%	9,6%	28,6%	30,3%	7,9%	9,2%
PT	19,1%	26,2%	4,2%	6,4%	27,0%	28,7%	3,6%	3,9%
SI	34,3%	46,3%	11,5%	19,6%	42,0%	43,4%	9,3%	16,1%
SK	37,9%	45,6%	29,7%	32,9%	30,7%	27,0%	26,0%	29,6%
FI	14,3%	13,7%	9,4%	9,1%	15,5%	16,6%	10,2%	11,4%

Source: *Eurostat, National Accounts*

Notes: Values of Spain were confidential, and so, not available to present. The non-members of the EMU are Bulgaria, Croatia, Czechia, Hungary, Poland, Romania, Sweden and Denmark.

4. MODEL

4.1. IDENTIFYING DEMAND AND SUPPLY SHOCKS

Real variables may be affected by more than one disturbance, so it is extremely important for this investigation to identify the origin of shocks, i.e., if they are either coming from the demand or the supply-side. I will use a structural vector autoregressive (VAR) model with two variables: real output and prices. This method used to separate demand and supply shocks was initially proposed by Blanchard and Quah (1989), whose purpose was to identify the origins of fluctuations in GNP and unemployment, between 1950 and 1987.

In this model, I assume that supply disturbances have a permanent effect on output and prices, whereas demand disturbances only have a permanent effect on prices. As can be seen in Figure 2, supply shocks, which are associated with a shift in the aggregate supply curve away from the equilibrium, impact both output and prices in the short and long run. Shifts in the aggregate demand curve have temporary effects on both variables but, since the supply curve is vertical in the long run, demand shocks do not have a permanent effect on the level of output.

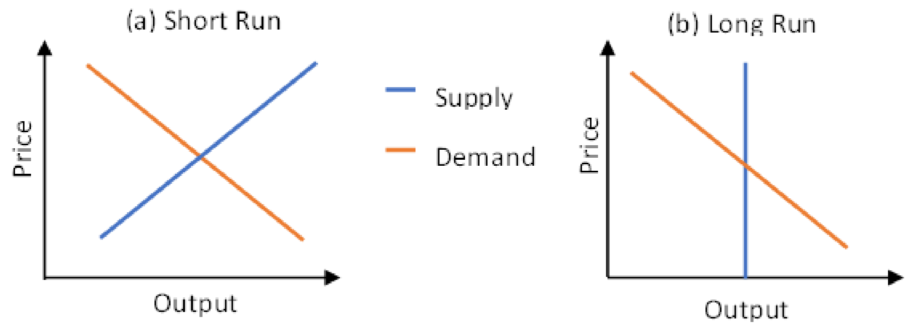

Figure 2 – (a) Demand and Supply Equilibrium Model in the Short Run; (b) Demand and Supply Equilibrium Model in the Long Run

Formally, y_t and p_t represent, respectively, the first differences of logarithmic GDP and logarithmic prices: $y_t = \log GDP_t - \log GDP_{t-1}$ and $p_t = \log P_t - \log P_{t-1}$, which approximate the growth rates of GDP and prices, respectively. Using both stationary variables, the following structural vector autoregressive representation can be estimated:

$$(1)\ y_t = b_{01} + \sum_{k=1}^{K} b_{11,k} y_{t-k} + \sum_{k=1}^{K} b_{12,k} p_{t-k} + e_t^y$$

$$(2)\ p_t = b_{02} + \sum_{k=1}^{K} b_{21,k} y_{t-k} + \sum_{k=1}^{K} b_{22,k} p_{t-k} + e_t^p$$

Where variables in equation (1)-(2) are e_t^y and e_t^p representing independent white-noise disturbances and $b_{ij,k}$ are unknown coefficients to be estimated. The lag length chosen is represented by K.

Although white-noise disturbances e_t^y and e_t^p are not structural, they correspond to components in output growth and inflation changes not explained by the underlying econometric model. With regard to recover structural disturbances, namely those holding an economic interpretation of demand and supply-side shocks, the following two equations are proposed:

$$(3)\ e_t^y = c_{11}\varepsilon_t^D + c_{12}\varepsilon_t^S$$

$$(4)\ e_t^p = c_{21}\varepsilon_t^D + c_{22}\varepsilon_t^S$$

Where variables in equation (3)-(4) are ε_t^D and ε_t^S representing, respectively, demand and supply shocks and c_{ij} are coefficients.

Thus, the unexplainable components in output growth and inflation movements, can be interpreted as linear combinations of supply and demand shocks. In matrix form, equations (3)-(4) can be represented by the following expression: $e_t = C\varepsilon_t$, where $e_t = \begin{bmatrix} e_t^y \\ e_t^p \end{bmatrix}$, $C = \begin{pmatrix} c_{11} & c_{12} \\ c_{21} & c_{22} \end{pmatrix}$, and $\varepsilon_t = \begin{bmatrix} \varepsilon_t^D \\ \varepsilon_t^S \end{bmatrix}$

In order to know the 2x2 coefficient matrix C, Blanchard and Quah (1989), showed that four restrictions must be imposed. The variance-covariance matrix of the estimated demand and supply disturbances, ε_t^D and ε_t^S, is sufficient to identify three out of the four restrictions:

(5) $Var(e^y) = c_{11}^2 + c_{12}^2$

(6) $Var(e^p) = c_{21}^2 + c_{22}^2$

(7) $Cov(e^y, e^p) = c_{11}c_{21} + c_{12}c_{22}$

Restrictions (5)-(6)-(7) are directly derived from equations (3)-(4) using the following normalization conditions:

(i) Both demand and supply disturbances variance are equal to one: $Var(\varepsilon^D)$ = Var(ε^S) = 1;

(ii) Demand and supply shocks are orthogonal, meaning that the covariance between both is equal to zero: Cov(ε^D,ε^S) = 0.

The fourth and last restriction on coefficients c_{ij} refer to this section's initial assumption where demand shocks ε_t^D have no permanent impact on the level of real output. In order to translate this restriction into a mathematical form, one should substitute equations (3)-(4) into the VAR system represented by equation (1)-(2), followed by the expression of both stationary variables y_t and p_t as the sum of the contemporaneous and past realizations of demand and supply shocks ε_t^D and ε_t^S:

(8) $y_t = c_{01} + \sum_{k=0}^{\infty} c_{11,k}\varepsilon_{t-k}^D + \sum_{k=0}^{\infty} c_{12,k}\varepsilon_{t-k}^S$

(9) $p_t = c_{02} + \sum_{k=0}^{\infty} c_{21,k}\varepsilon_{t-k}^D + \sum_{k=0}^{\infty} c_{22,k}\varepsilon_{t-k}^S$

System (8)–(9) corresponds to an infinite moving-average representation of the structural VAR form (1)–(2), where variables $c_{ij,k}$ represent the impulse response functions responsible for the effect of structural disturbances on the left-hand-side variables after k periods. In equation (8) specifically, $c_{11,k}$ represents the impact of the demand disturbances on output growth after k periods and since it is assumed that demand disturbances have no long-term impact on the level of output movements this can be transformed mathematically into the following restriction: $\sum_{k=0}^{\infty} c_{11,k} = 0$ which can furthermore be translated into the parameters of interest c_{ij} and the coefficients b_{ij}(k) of the unrestricted VAR system (1)–(2) as:

(10) $$c_{11}[1 - \sum_{k=0}^{K} b_{22}(k)] + c_{21}[\sum_{k=0}^{K} b_{12}(k)] = 0$$

In sum, restrictions (5), (6), (7), (10) allows to identify the four coefficients c_{ij} used to obtain the supply and demand shocks from the VAR residuals by simply inverting matrix C: $\varepsilon_t = C^{-1}e_t$.

4.2. MEASURING TRADE INTENSITY AND INTRA-INDUSTRY TRADE

The next step is to mathematically express some trade intensity parameters that will be used as an attempt to explain demand and supply shock correlations in the EMU.

The trade intensity between trading partners *i* and *j* is calculated from exports, imports or total bilateral trade according to the following expressions (in natural logarithms), initially proposed by Frankel and Rose (1998):

(11) $$\mathrm{TI}_{ij,\tau}^{EX} = \left[\frac{EX_{ij}}{EX_i + EX_j}\right]_\tau$$

(12) $$\mathrm{TI}_{ij,\tau}^{IM} = \left[\frac{IM_{ij}}{IM_i + IM_{jt}}\right]_\tau$$

(13) $$TI_{ij,\tau}^{T} = \left[\frac{EX_{ij} + IM_{ij}}{EX_i + EX_j + IM_i + IM_j}\right]_\tau$$

, where the variables in equation (11), (12), (13) are EX_i (IM_i) representing total exports (imports) of country *i*, EX_j (IM_j) are total exports (imports) of partner *j*, EX_{ij} (IM_{ij}) corresponds to bilateral exports (imports) of *i* and *j*, and lastly, τ refers to the period average.

An index for intra-industry trade ($INT_{ij,\tau}$) is computed following Grubel and Lloyd (1975) methodology:

(14) $$INT_{ij,\tau} = 1 - \omega_{ij,\tau}$$

(15) $$\omega_{ij,\tau} = \left[\frac{\sum_k |EX_{ij} - IM_{ij}|}{\sum_k (EX_{ij} + IM_{ij})}\right]_\tau$$

, where *k* in equation (15) represents the number of industries.

5. EMPIRICAL ANALYSIS

5.1. CORRELATION OF DEMAND AND SUPPLY SHOCKS

With regards to the dependent variables, I firstly extracted the quarterly nominal and real cyclical GDP for the nineteen Eurozone countries, from the Eurostat National Accounts Database, for the period between 2004Q1-2019Q4. To calculate the GDP Deflator I used the following formula:

$$P_t = \frac{nominal\ GDP}{real\ GDP} * 100 \qquad (16)$$

As following the methodology applied by Babetskii (2005), I calculate an individual vector autoregressive for each country with an estimation sample of 64 observations using econometric software EViews. By applying the Akaike, Schwarz and Haman-Quinn information criterion, the lag order selected for each country (denoted as K in equations (1)-(2)) varies from four to six lags while also taking into consideration the Lagrange Multiplier test to avoid autocorrelation in the residuals.

With the optimal lag length and no evidence of serial correlation, I impose restrictions (5), (6), (7), (10) of the model and analyze the impulse responses for each individual country. As already explained in section 4.1, demand shocks have no permanent impact on the level of real output, i.e., the accumulated response on the level of output movements to demand disturbances will tend to zero in the long run, as showed from the top left graph in Figure 3, which uses France as an example.

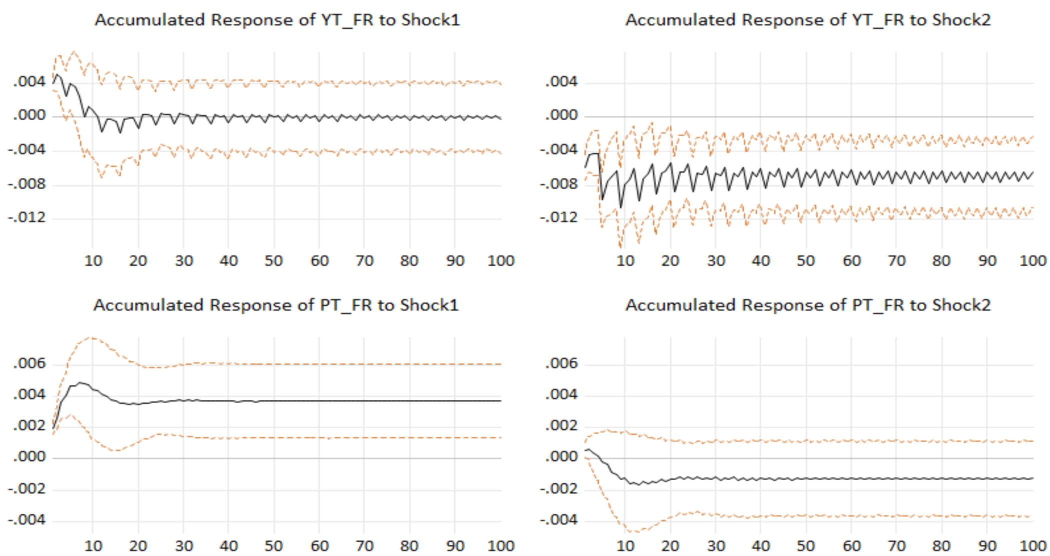

Figure 3 – Accumulated Response to Structural VAR Innovations in France

Source: EViews software package

Notes: Shock1 refers to demand shocks, Shock2 refers to supply shocks, YT_FR and PT_FR correspond to real GDP and GDP Deflator movements in France for the period of 2004Q1-2019Q4, respectively

After obtaining estimates from the supply and demand shocks from the VAR residuals decompositions for each country, I compute the correlation coefficients of shocks between trading partners versus 3 alternative benchmarks: Germany, the European Union 27 and France for two sub-periods of equal length, namely 2004Q1-2011Q4 and 2012Q1-2019Q4. As studied by Artis and Zhang (1995), countries tend to synchronize their business cycle to the anchor country of the Exchange Rate Mechanism (e.g., Germany/France for the European countries) so, in the long run, Eurozone countries may be more correlated with Germany or France than the 'peripheral' countries.

Table III

Correlation coefficients of demand and supply shocks vs Germany, EU-27 and France

(a) Demand Shocks

	Germany		**European Union-27**		**France**	
Partner	2004Q1-2011Q4	2012Q1-2019Q4	2004Q1-2011Q4	2012Q1-2019Q4	2004Q1-2011Q4	2012Q1-2019Q4
AT	-0,030	-0,057	0,404	-0,190	0,273	0,029
BE	0,165	-0,103	0,036	**0,295**	0,005	**0,190**
CY	-0,017	-0,322	0,543	0,318	0,602	0,299
DE			-0,059	-0,486	0,050	-0,190
EE	-0,278	**-0,234**	0,139	-0,118	0,471	0,172
ES	0,023	0,012	0,083	-0,477	0,031	-0,089
FI	0,047	-0,096	0,557	0,368	0,175	0,161
FR	0,050	-0,190	0,514	0,287		
GR	-0,061	**0,004**	0,451	0,159	0,478	0,192
IE	-0,033	-0,258	-0,194	**-0,091**	-0,300	**0,058**
IT	-0,055	-0,391	0,416	0,204	0,282	-0,099
LT	-0,030	-0,389	0,632	0,519	0,256	0,033
LU	0,446	-0,062	0,013	**0,309**	0,138	**0,143**
LV	-0,069	-0,189	0,282	0,163	0,163	0,002

MT	0,269	-0,034	0,141	0,105	-0,045	**0,265**
NL	0,421	0,138	0,080	-0,032	0,073	0,057
PT	0,130	0,070	0,190	0,020	0,249	**0,381**
SI	0,063	-0,251	0,251	**0,265**	0,272	0,151
SK	0,162	0,030	-0,029	-0,208	-0,122	**-0,012**

(b) Supply Shocks

	Germany		European Union-27		France	
Partner	2004Q1-2011Q4	2012Q1-2019Q4	2004Q1-2011Q4	2012Q1-2019Q4	2004Q1-2011Q4	2012Q1-2019Q4
AT	0,772	0,162	0,609	0,518	0,501	0,298
BE	-0,442	**0,002**	-0,479	**-0,043**	-0,243	-0,252
CY	0,224	-0,194	-0,152	**-0,058**	0,079	0,062
DE			0,425	**0,608**	0,712	0,461
EE	0,415	-0,030	0,313	-0,122	0,299	-0,268
ES	-0,662	-0,512	-0,439	**-0,206**	-0,643	**-0,173**
FI	0,302	0,195	0,162	**0,361**	0,295	**0,428**
FR	0,712	0,461	0,445	**0,626**		
GR	0,155	-0,075	0,316	0,121	0,354	0,132
IE	-0,292	**0,079**	-0,297	**-0,145**	-0,315	**-0,033**
IT	0,588	0,393	0,620	0,493	0,540	0,476
LT	0,458	-0,444	0,233	-0,405	0,394	-0,285
LU	0,397	0,147	0,404	0,210	0,493	0,095
LV	-0,360	**0,105**	0,009	-0,099	-0,465	**0,039**
MT	-0,297	-0,378	-0,316	**-0,151**	-0,154	**-0,039**
NL	0,754	0,119	0,525	0,481	0,720	0,249
PT	-0,529	**0,046**	-0,248	**-0,155**	-0,439	**-0,310**
SI	0,390	0,355	0,448	0,363	0,163	**0,339**
SK	-0,548	**-0,272**	-0,189	**-0,169**	-0,327	**0,151**

Sources: Author's computations obtained though the EViews econometric software package. Values in bold denote increasing correlation of shocks.

In Table III, one can observe the correlation of both demand and supply shocks across the EMU economies versus 3 benchmarks regions. From the first period, 2004Q1-2011Q4, to the second period, 2012Q1-2019Q4, it is possible to see an overall decrease in the demand-side shock asymmetry, with a few exceptions - Estonia and Greece versus Germany; Belgium, Ireland, Luxembourg and Slovenia versus EU-27 and lastly, Belgium, Ireland, Luxembourg, Malta, Portugal and Slovakia in comparison to France. On one hand, it can be highlighted the negative and near zero correlation values against Germany and, on the other hand, the low and positive demand shock correlation versus France providing evidence of a closer symmetry of demand disturbances in comparison with France or the EU-27 between 2004Q1 and 2011Q4, which has significantly decreased ever since.

Relatively to supply shocks correlations, it is visible a larger variance and heterogeneity in values. In comparison to Germany, countries like Austria, France, Italy and the Netherlands responded to supply shocks in a similar fashion during the first period, but from 2012Q1 to 2019Q4 this symmetry decreased substantially. Against the European Union-27, 10 economies improved their supply shock correlation but more than half are still negative correlated. Lastly, and similar to Germany, it is again noticeable an overall decrease in supply shock asymmetry of Euro Area nations in comparison withFrance, from the first to the second period.

The results can be interpreted in favor of demand and supply shock divergence. On the demand side, one could justify these values due to the sovereign debt crisis that affected many European countries, with different magnitudes, during 2008-2012, leading to unemployment and decrease in consumer's purchasing power. On the supply side, there can be two possible reasons that justify the shock asymmetries: the catching-up process (productivity gains in peripheral countries translate into increases in per capita incomes) and the Schumpeterian innovations, which can lead to technological progress (Schumpeter, 1943).

5.2. TRADE INTENSITY AND INTRA-INDUSTRY TRADE

As following the methodology applied by Frankel and Rose (1998), and using quarterly trade data drawn from the International Trade Centre (Trade Map), I was able to compute the three trade intensity variables: exports, imports and total bilateral trade versus three benchmarks, the later represented in Table IV.

Table IV

Total Bilateral Trade Intensity vs Germany, EU-27 and France

	Germany		European Union-27		France	
Partner	2004Q1-2011Q4	2012Q1-2019Q4	2004Q1-2011Q4	2012Q1-2019Q4	2004Q1-2011Q4	2012Q1-2019Q4
AT	4,53%	4,11%	2,33%	2,22%	0,73%	**0,77%**
BE	4,76%	3,80%	5,25%	4,64%	5,80%	5,31%
CY	0,04%	0,03%	0,06%	0,05%	0,04%	0,03%
DE			10,96%	10,35%	5,91%	5,03%
EE	0,11%	0,11%	0,18%	**0,22%**	0,04%	**0,05%**
ES	2,74%	2,47%	3,54%	3,26%	5,22%	4,88%
FI	0,78%	0,72%	0,85%	0,74%	0,39%	0,33%
FR	5,91%	5,03%	6,56%	5,38%		
GR	0,51%	0,31%	0,57%	0,41%	0,40%	0,28%
IE	0,62%	0,62%	0,79%	0,75%	0,73%	**1,05%**
IT	4,36%	3,78%	4,55%	2,18%	4,65%	4,34%
LT	0,20%	**0,22%**	0,25%	**0,35%**	0,12%	**0,15%**
LU	0,45%	0,36%	0,38%	0,30%	0,53%	0,44%
LV	0,10%	**0,11%**	0,15%	**0,20%**	0,04%	**0,05%**
MT	0,03%	0,03%	0,05%	0,05%	0,08%	0,05%
NL	6,24%	5,95%	5,39%	5,36%	3,09%	3,07%
PT	0,71%	0,62%	0,95%	0,90%	0,97%	**1,02%**
SI	0,45%	**0,47%**	0,45%	**0,47%**	0,27%	0,23%
SK	0,98%	**1,22%**	0,90%	**1,20%**	0,42%	**0,60%**

Source: ITC Trade Map; author's computations. Values in bold denote increasing total bilateral trade intensity.

In Table IV, one can highlight two important takeaways. Firstly, larger economies trade more with their Monetary Union members than peripheral countries do, meaning that nations like Belgium, Germany, Spain, France, Italy and Netherlands present higher levels of total bilateral trade intensity with the above-mentioned benchmarks. Secondly, the only countries that increased their trade intensity with European Union (27 countries) nations from 2004Q1-2011Q4 to 2012Q1-2019Q4, were only the latter adopters of the euro, namely Estonia, Latvia, Lithuania, Slovenia and Slovakia, due to sharing a stronger currency, it facilitated business with other European countries and better price comparison incentivized productivity and competition.

Secondly, as following the methodology applied by Grubel and Lloyd (1975), the index of intra-industry trade was constructed from quarterly disaggregated trade data according to the Standard International Trade Classification (SITC 2 - Division), extracted from International Trade Centre (Trade Map) and represented in Table V. The disaggregation involved 98 industries from 6 categories: food, drinks and tobacco; raw materials; energy products; chemicals; machinery and transport equipment and other manufactured goods.

Table V

Intra-industry Trade Index vs Germany, EU-27 and France

	Germany		European Union-27		France	
Partner	2004Q1-2011Q4	2012Q1-2019Q4	2004Q1-2011Q4	2012Q1-2019Q4	2004Q1-2011Q4	2012Q1-2019Q4
AT	0,759	**0,763**	0,848	0,838	0,675	0,624
BE	0,770	0,703	0,847	0,839	0,669	**0,683**
CY	0,198	0,172	0,218	**0,293**	0,071	**0,080**
DE			0,834	**0,844**	0,776	**0,789**
EE	0,334	**0,403**	0,661	**0,709**	0,255	**0,360**
ES	0,583	**0,671**	0,752	**0,773**	0,766	0,762
FI	0,468	0,448	0,621	0,569	0,482	**0,513**
FR	0,776	**0,789**	0,808	**0,819**		
GR	0,316	**0,357**	0,414	**0,526**	0,276	**0,353**
IE	0,492	**0,494**	0,362	**0,379**	0,349	0,257
IT	0,682	**0,732**	0,742	**0,784**	0,691	**0,694**
LT	0,377	**0,462**	0,485	**0,593**	0,265	**0,299**
LU	0,634	0,593	0,632	**0,673**	0,576	0,527
LV	0,301	**0,337**	0,518	**0,646**	0,215	**0,223**
MT	0,394	**0,456**	0,441	0,362	0,631	0,541
NL	0,665	**0,679**	0,675	**0,688**	0,553	0,519
PT	0,609	**0,668**	0,643	**0,711**	0,621	0,582
SI	0,697	0,698	0,772	**0,791**	0,663	**0,678**
SK	0,750	0,740	0,783	**0,836**	0,590	**0,636**

Source: International Trade Centre (Trade Map), author's computations. Values in bold denote increasing intra- industry trade.

In Table V, one can observe an overall increase in intra-industry trade, between trading partners and the three established benchmarks. In the Euro Area, richer nations with similar economic structures that are geographically close, result in higher gains from variety and economies of scale. Another reason that might explain this phenomenon can be the linkage between intra-industry trade and foreign direct investment, as multinational firms locate affiliates in closer countries and trade goods between the affiliates and the holding company.

6. FINAL RESULTS

Since I consider two periods of equal time length, there is a need to consider other time and country varying characteristics which may impact shock correlations, besides trade intensity and intra-industry trade. As all countries in analysis share the same currency but are sovereign states that retain responsibility for their fiscal policies, an important time-varying characteristic can be fiscal co-operation across the Eurozone, which was intensified as circulation of the common currency. To account for this, I have included three additional explanatory variables: $Fisc_{ij,\tau}$ represents the correlation of budget deficits as percentage of GDP in the EMU, corresponding to a proxy for fiscal-policy convergence; EUR is a dummy variable that takes the value of 0 for the eleven countries that first joined the Euro Area in 1999, and the value 1 for the later joiners, and lastly, to account for real-GDP discrepancy between trading partners, $Size_{ij,\tau}$, is also considered as an explanatory variable, calculated by subtracting the logarithmic real-GDP of the country out of the logarithmic real-GDP of the benchmark nation/region, since larger economies can have a stronger influence on the shocks magnitude faced by smaller nations.

Formally, φ_{ij}^{D} and φ_{ij}^{S} represent, respectively, the demand and supply shock correlations between country *i* and benchmark country/region *j*. The following regressions, attempts to mathematically explain the relationship between the different explanatory variables and the demand and supply shock correlations in the Euro Area:

$$(17)\qquad \varphi_{ij,\tau}^{D} = \beta_{10} TI_{ij,\tau}^{T} + \beta_{11}\mathrm{TI}_{ij,\tau}^{EX} + \beta_{12}\mathrm{TI}_{ij,\tau}^{IM} + \beta_{13} INT_{ij,\tau} + \beta_{14}\mathrm{EUR}_{\mathrm{ij},\tau} + \beta_{15} Fisc_{ij,\tau} + \beta_{16} Size_{ij,\tau} + u_{ij,\tau}$$

$$(18)\qquad \varphi_{ij,\tau}^{S} = \beta_{20} TI_{ij,\tau}^{T} + \beta_{21}\mathrm{TI}_{ij,\tau}^{EX} + \beta_{22}\mathrm{TI}_{ij,\tau}^{IM} + \beta_{23} INT_{ij,\tau} + \beta_{24}\mathrm{EUR} + \beta_{25} Fisc_{ij,\tau} + \beta_{26} Size_{ij,\tau} + \eta_{ij,\tau}$$

, where the variables in equation (17) and (18) are $TI_{ij,\tau}^{T}$, $\mathrm{TI}_{ij,\tau}^{EX}$, $\mathrm{TI}_{ij,\tau}^{IM}$ representing total trade intensity between country i and benchmark j calculated from total, exports and imports bilateral trade, respectively. $INT_{ij,\tau}$ is an index for intra-industry trade, EUR is a dummy variable that takes the value of 0 for the eleven countries that first joined the Euro Area in 1999, and the value 1 for the later joiners, $Fisc_{ij,\tau}$ represents a proxy for fiscal-policy convergence and lastly, $Size_{ij,\tau}$ corresponds to real-GDP discrepancy between trading partners (in log form). τ refers to the period average.

Table VI and VII report both demand and supply shock regressions, respectively, for the period of 2004Q1-2019Q4, with 108 observations, providing some interesting insights about the linkages between trade fluctuations and shock's correlations.

Table VI

Demand Shock Regressions

	Demand Shocks				
	(a)	(b)	(c)	(d)	(e)
$TI^{T}_{ij,\tau}$	0,963	-2,117*	-7,284	-0,339	-8,648
	(0,828)	(1,152)	(11,030)	(1,480)	(10,714)
$TI^{EX}_{ij,\tau}$			3,861		4,248
			(6,179)		(6,018)
$TI^{IM}_{ij,\tau}$			1,141		4,192
			(5,791)		(5,742)
$INT_{ij,\tau}$		0,204***	0,205***	-0,142	-0,160
		(0,056)	(0,057)	(0,127)	(0,134)
EUR				-0,078	-0,077
				(0,069)	(0,069)
$Fisc_{ij,\tau}$				0,122*	0,123*
				(0,069)	(0,069)
$Size_{ij,\tau}$				0,035*	0,037*
				(0,018)	(0,019)
Nº of observations	108	108	108	108	108
Adjusted R-squared	-0,132	-0,015	-0,030	0,045	0,032
S.E. of regression	0,250	0,237	0,239	0,230	0,232

Source: Author's computations.

Notes: Ordinary Least Square estimation; Significance at 1%, 5% and 10% are represented by ***, ** and * respectively. Standard errors in parenthesis. Dependent variable: correlations of demand shocks versus Germany, EU-27 and France.

Starting from Table VI column (a), one can observe that total trade intensity is not statistically significant to explain changes in demand shock correlations, but with the addition of intra-industry trade, $INT_{ij,\tau}$ in regression (b), $TI^{T}_{ij,\tau}$ can be considered as the effects of specialized trade, i.e. inter-industry trade. Now, total trade intensity is strongly negative and statistically significant at a 10 percent level, while intra-industry trade is positive and statistically significant at 1 percent level, meaning, if one only considered these two explanatory variables, it could conclude for evidence that higher inter-industry trade in the EMU leads to less correlated demand shocks, while intra-industry can have the opposite effect resulting in higher symmetry.

In column (c), if exports and imports trade intensity are included in the regression, with the objective to test total trade intensity significance in the model, it is visible the same intra-industry trade magnitude on demand shock correlation, but now, not a single trade intensity variable is statistically significant, showing no evidence that specialized trade is the main dynamic responsible for the symmetry of demand shocks in the Euro Area.

If the regression is augmented with EUR, $Fisc_{ij,\tau}$ and $Size_{ij,\tau}$ variables, as can be seen in columns (d) and (e), only the real-GDP discrepancy between trading partners (in log form) and the correlation of budget deficits as percentage of GDP in the EMU are positive and statistically significant at a 10 percent level, meaning that there is no evidence of direct relationship between demand shock symmetry and trade integration if regressions are augmented by additional structural variables, similar to Fidrmuc (2004) empirical results, which highlighted the importance of other structural variables (in this case $Fisc_{ij,\tau}$ and $Size_{ij,\tau}$) for the harmonization of the business cycles between trading partners.

Table VII

Supply Shock Regressions

	Supply Shocks				
	(f)	(g)	(h)	(i)	(j)
$TI_{ij,\tau}^{T}$	4,356***	3,901**	-14,192	2,654	-13,697
	(1,149)	(1,695)	(16,102)	(2,267)	(16,318)
$TI_{ij,\tau}^{EX}$			6,553		5,909
			(9,020)		(9,166)
$TI_{ij,\tau}^{IM}$			11,895		11,210
			(8,453)		(8,746)
$INT_{ij,\tau}$		0,030	0,008	0,099	0,026
		(0,082)	(0,084)	(0,195)	(0,204)
EUR				-0,038	-0,041
				(0,105)	(0,105)

$Fisc_{ij,\tau}$				0,037	0,045
				(0,105)	(0,106)
$Size_{ij,\tau}$				-0,009	-0,003
				(0,028)	(0,029)
Nº of observations	108	108	108	108	108
Adjusted R-squared	0,071	0,064	0,064	0,045	0,042
S.E. of regression	0,347	0,349	0,349	0,352	0,353

Source: Author's computations.

Notes: Ordinary Least Square estimation; Significance at 1%, 5% and 10% are represented by ***, ** and * respectively. Standard errors in parenthesis. Dependent variable: correlations of supply shocks versus Germany, EU-27 and France.

In Table VII a smaller set of statistically significant variables can be found, especially in columns (f) and (g), for explaining supply shock correlations in the European Economic Monetary Union.

Regarding column (f), and in opposition to what was observed in column (a), from Table VI, total trade intensity is strongly positive and statistically significant at 1 percent level, providing evidence for a positive association between greater total trade intensity and cross-country correlation of supply-side innovations, against Germany, EU-27 and France.

Following column (g), with the inclusion of intra-industry trade, one can already identify the channels through which more intense trade affects supply shock correlations. Although it faced a small decrease in magnitude, total trade intensity (which is now capable of capturing the effects of inter-industry trade) is strongly positive and significant at 5 percent, while it cannot be taken any conclusions regarding intra-industry trade. These results provide evidence of inter-industry trade increasing positive effects on supply shock symmetry due to international spillover effects, i.e., the new knowledge and innovations created due to a country's productivity level are spread internationally.

Lastly, and similar to what was analyzed in Table VI, there is no evidence of a direct relationship between supply shock symmetry and trade integration if regressions are augmented by additional structural variables, as observed in columns (h), (i) and (j), neither the additional explanatory variables, EUR, $Fisc_{ij,\tau}$ and $Size_{ij,\tau}$, are significant to explain changes in supply-side shock symmetry. Future extensions to this paper might explain this particular outcome, more specifically, the usage of a higher level of quarterly disaggregated trade data according to the Standard International Trade Classification and the division of intra-industry trade into two different types: horizontal intra-industry trade and vertical intra-industry trade, as explained in the next section of this dissertation.

The results observed in Tables VI and VII column (a), (b), (f) and (g) provide an interesting explanation for the mixed evidence in the literature, regarding the relationship between trade integration and cross-country cyclical output co-movements, since the coefficients' magnitude and effect depend on the type of shock, as highlighted by Kenen (2000).

If demand-side shocks are the main driving force of business cycles, one would expect inter-industry trade to create stronger asymmetry and, on the opposite side, intra-industry trade would lead to greater cross-country business cycle synchrony, providing evidence in support of "The European Commission View" (1990), rather than "The Krugman's View", since trade in the EMU is to a large degree intra-industry and based on the existence of economies of scale and imperfect competition. On the other hand, if supply-side shocks are the main driving force of business cycles, based on the results above analyzed, one could expect a strong positive effect of specialized trade on cross-country business cycle correlation, due to international spillover effects, as initially argued by Coe and Helpman (1995).

Following this results section, I propose a future extension to this paper, based on the work of Fontoura & Crespo (2002) and Fontagné et al (2005).

7. FUTURE EXTENSIONS

In this paper I followed the methodology applied by Grubel and Lloyd (1975), the index of intra-industry trade was constructed from quarterly disaggregated trade data according to the Standard International Trade Classification (SITC 2 - Division), extracted from International Trade Centre (Trade Map), but with recent studies the usage of this index might not be the most adequate to measure similarities of productive structures.

The recent theory of international trade emphasizes that intra-industry trade does not occur only with countries exporting/importing similar products, since it can be further divided into two different types: horizontal intra-industry trade (HIIT), where the products marketed are differentiated by their characteristics, assuming identical quality, and vertical intra-industry trade (VIIT), where products marketed differentiate by their quality, thus, the determinants of each type of trade may not be the same and one can now take into account specialization along scales of quality within industries (superior VIIT and inferior VIIT).

While HIIT predominates in countries with similar productive structures, VIIT can be considered a proxy for intra-industry trade in models that include countries with different productive structures, namely differences in factorial abundance (Falvey, 1981). According to the Falvey model, the pattern of intra-industry trade between countries reflects a connection of factor endowments and intensities to the phenomenon of product differentiation, taking into consideration the following critical assumption: product quality can be represented by the capital/labor ratio used in production. Thus, differences in income per capita and in economic size encourages specialization of countries in quality and the changeability of factorial intensity is larger within industries than between industries.

In order to separate horizontal and vertical intra-industry trade, one can assume that differences in prices within one product category translates into differences in quality, after observing divergences in Grubel and Lloyd (1975) index against Fontagné and Freudenberg (1997) method. This intra-industry trade distinction was ignored in the analysis of this work.

In addition, and based on the existing literature, VIIT can be considered as a proxy for capturing different productive structures of trading partners, while HIIT can be a proxy to capture similar productive structures of country that trade with each other.

Following empirical evidence studied by Fontoura & Crespo (2002) and Fontagné et al (2005), over the past few decades, European countries, in addition to the increase in intra-industry trade, as analyzed in section 5.2, are also characterized by an increase in vertical intra-industry trade, which can result in more asymmetric industrial shocks and consequently more desynchronized business-cycles in the EMU.

8. CONCLUSION

The relationship between trade integration and business-cycle synchronization in the EMU presents many mixed views in the literature, with some authors believing in "The

European Commission View" or in "The Krugman's View". Regarding empirical evidence, some studies suggest a strong positive connection between trade intensity and business-cycle synchrony, while others indicate a weak or even insignificant link between increased trade flows and business-cycle correlations.

In this paper, I investigate if the increased trade integration in the EMU can translate into a higher symmetry of shocks between countries, implying a higher synchrony of business-cycles and consequently a lower cost of sharing a common monetary policy. Using quarterly data, regarding Real GDP and GDP Deflator from the 19 countries that represent the Euro Area, for the period of 2004Q1-2019Q4, I used a 2 variable structural vector autoregressive (VAR) model, initially proposed by Blanchard and Quah (1989). By assuming that demand shocks have no permanent impact on the level of real output, I was able to separate demand and supply-side shocks, for each Euro Area country, and compare them to 3 alternative benchmarks – Germany, European Union 27 and France.

My results point to the existence of a trade intensity's impact in cross-country shock correlations and, also, that the relation depends on the type of shock, i.e., whether it is coming from the demand or supply-side as highlighted by Kenen (2000). By incorporating intra-industry in the analysis, following Grubel and Lloyd (1975) methodology, one could identify the channels through which more trade intensity could affect shock symmetries, namely that they depend on whether it comes from specialization or trade of products within the same industry.

The results show a positive relationship between higher intra-industry trade and demand shock correlations in the EMU, while specialization leads to strong asymmetric demand shocks. Since trade in the Euro Area is to a large degree intra-industry, these results provide evidence in support of a Frankel-Rose type of effect, but one cannot identify the direct relationship between demand shock symmetry and trade if regressions are augmented by additional structural variables, similar to Fidrmuc (2004) empirical results. Regarding the supply-side shock correlations, the results obtained suggest that increasing inter-industry trade has positive effects on supply shock symmetry due to international spillover effects, i.e., the new knowledge and innovations created due to a country's productivity level are spread internationally, as initially argued by Coe and Helpman (1995).

In any case, it would be an interesting research avenue on this topic to deepen the analysis of the results obtained for the crucial variables in a more robust manner. Namely, considering that the intra-industry trade proxy was calculated using a disaggregation process involving 98 industries from 6 different categories, one could analyse the results coming out from a more disaggregated level of the data. In addition, the possibility of existing unobserved time-invariant country or specific effects on the relationship between trade intensity and shock correlations that are correlated with the explanatory variables of the model cannot be disregarded.

Lastly, an interesting extension of this paper could include a separation between Vertical Intra-Industry Trade (where products marketed differentiate by their quality) and Horizontal Intra-Industry Trade (products marketed are differentiated by their characteristics, assuming identical quality) assuming that differences in prices within one product category translates into differences in quality. Thus, HIIT could be a proxy to capture similarities of productive structures between trading partners, while VIIT could be considered as a proxy for capturing differences in productive structures between the EMU nations.

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APPENDICES

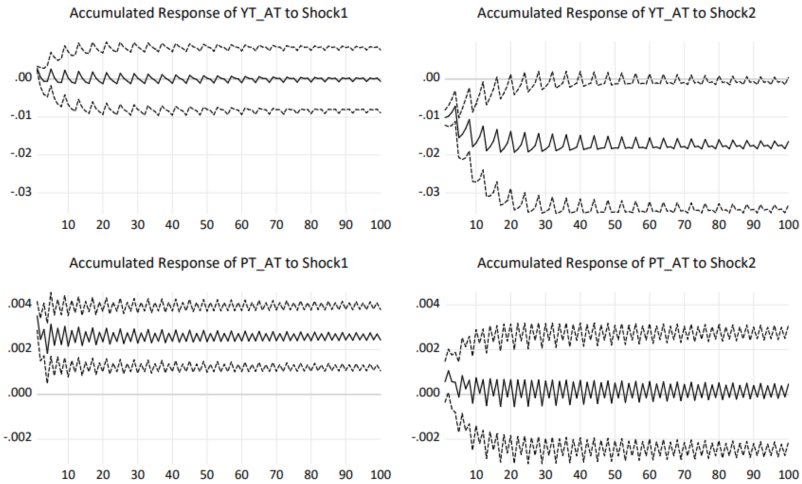

Figure 4 – Accumulated Response to Structural VAR Innovations in Austria

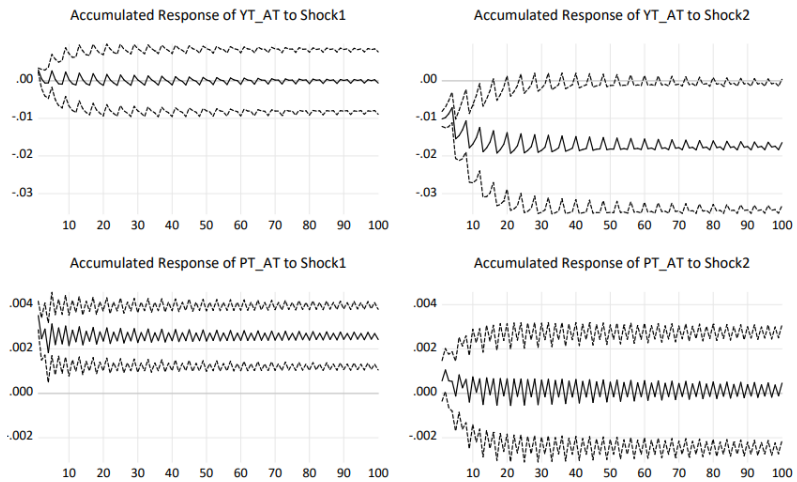

Figure 5 – Accumulated Response to Structural VAR Innovations in Belgium

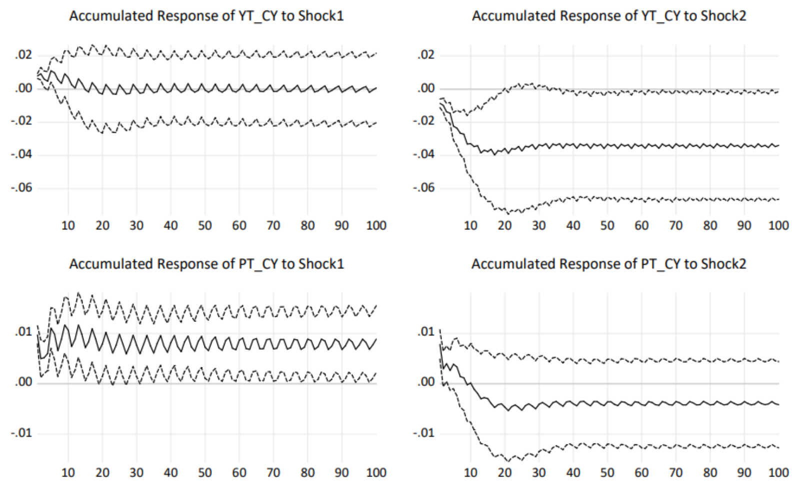

Figure 6 – Accumulated Response to Structural VAR Innovations in Cyprus

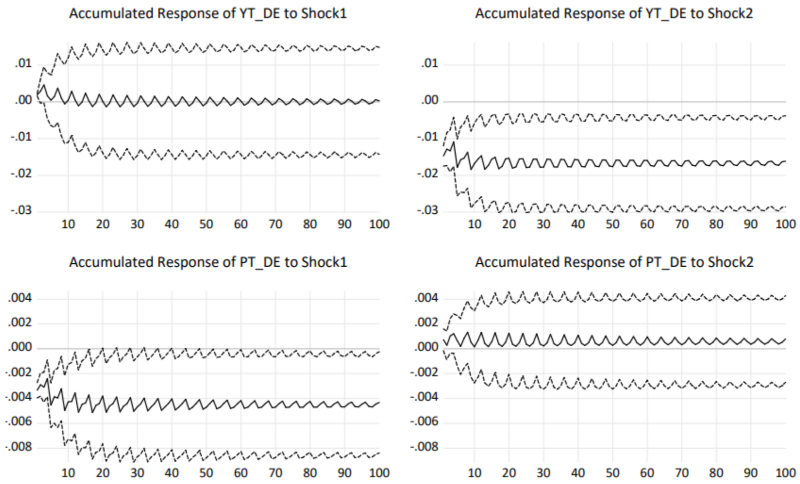

Figure 7 – Accumulated Response to Structural VAR Innovations in Germany

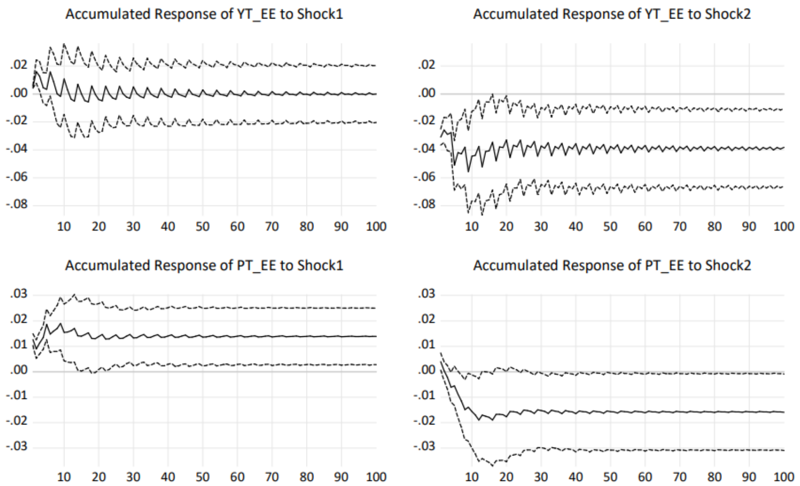

Figure 8 – Accumulated Response to Structural VAR Innovations in Estonia

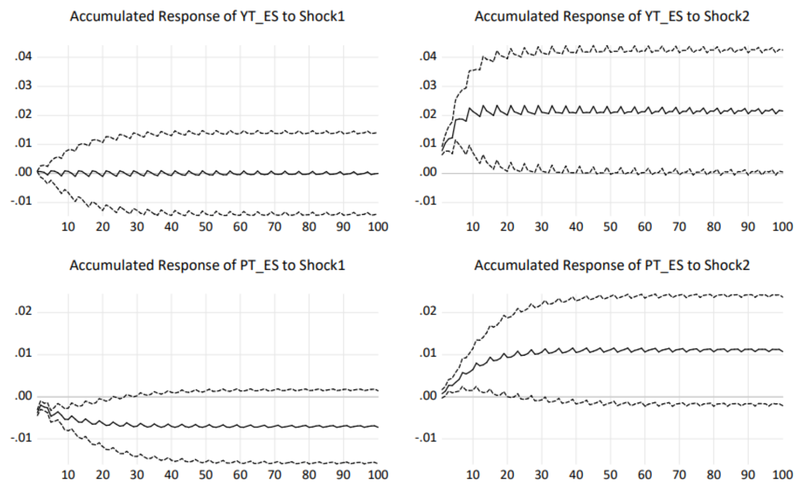

Figure 9 – Accumulated Response to Structural VAR Innovations in Spain

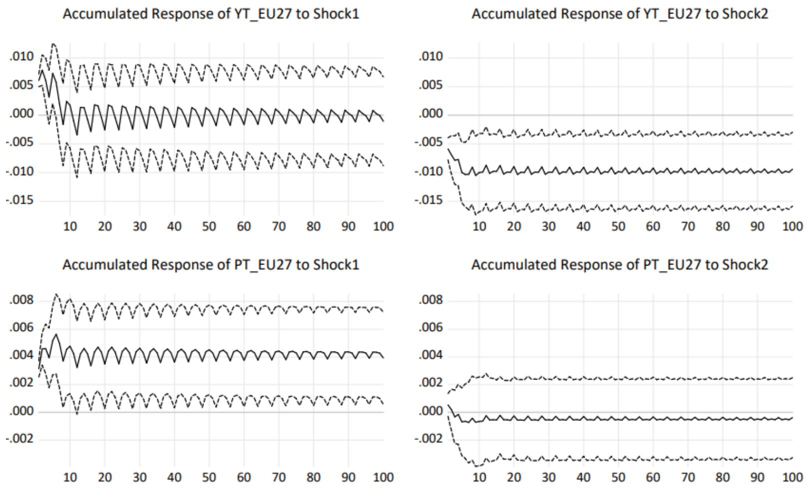

Figure 10 – Accumulated Response to Structural VAR Innovations in the European Union (27)

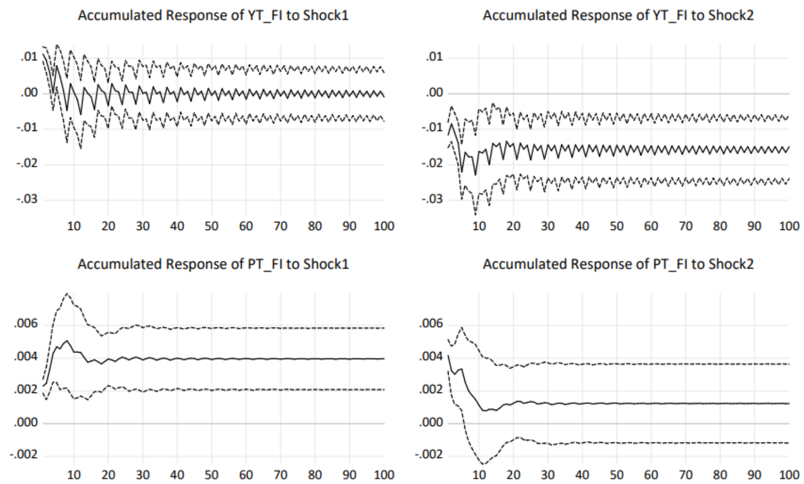

Figure 11 – Accumulated Response to Structural VAR Innovations in Finland

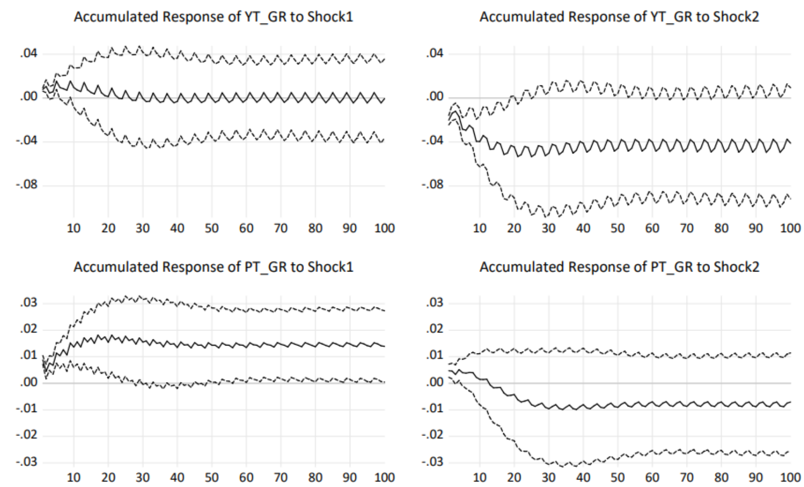

Figure 12 – Accumulated Response to Structural VAR Innovations in Greece

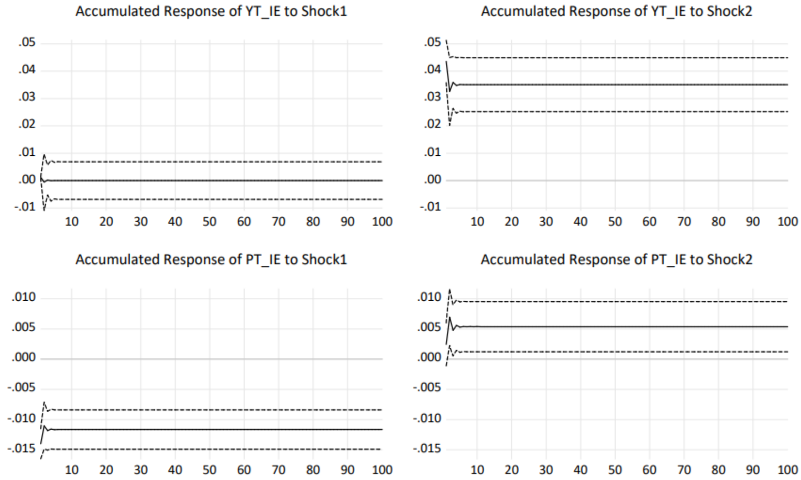

Figure 13 – Accumulated Response to Structural VAR Innovations in Ireland

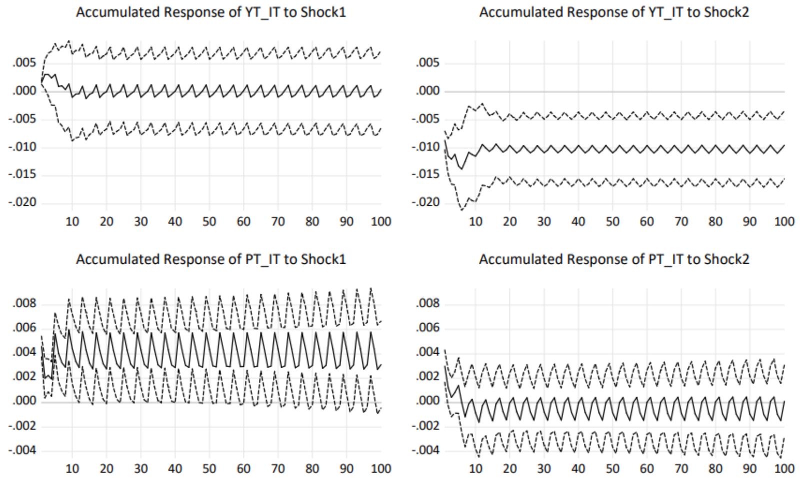

Figure 14 – Accumulated Response to Structural VAR Innovations in Italy

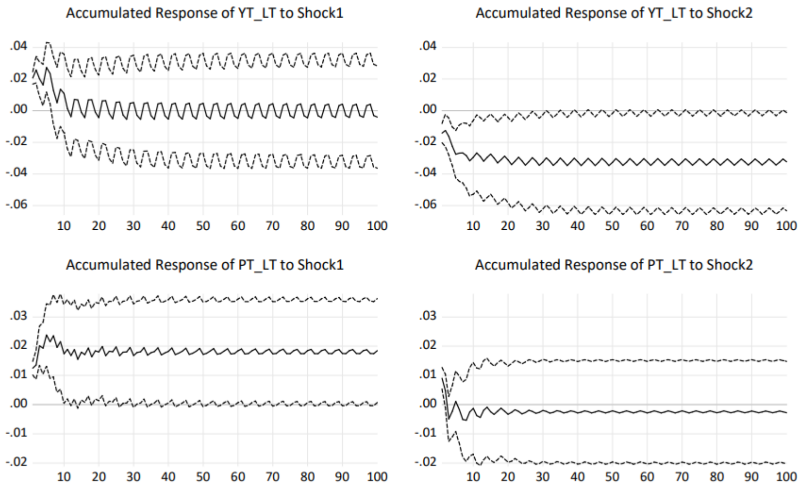

Figure 15 – Accumulated Response to Structural VAR Innovations in Lithuania

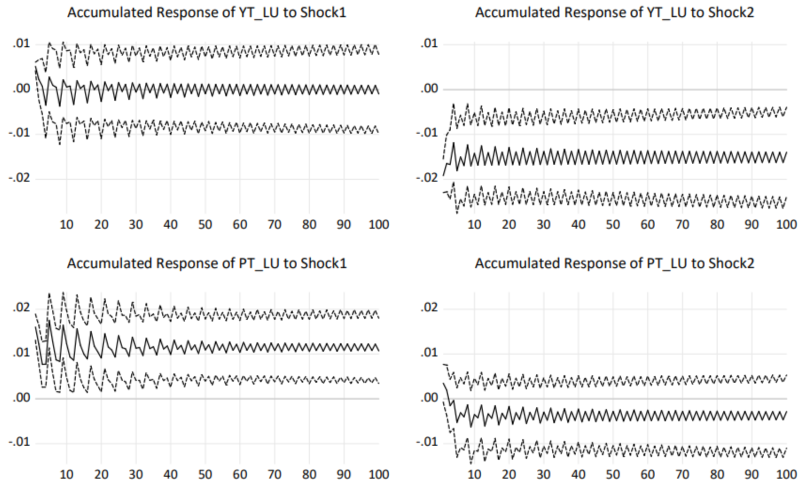

Figure 16 – Accumulated Response to Structural VAR Innovations in Luxembourg

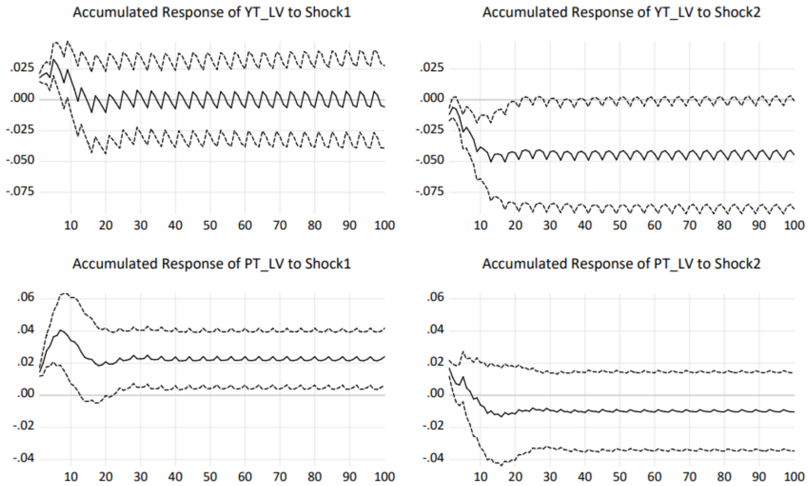

Figure 17 – Accumulated Response to Structural VAR Innovations in Latvia

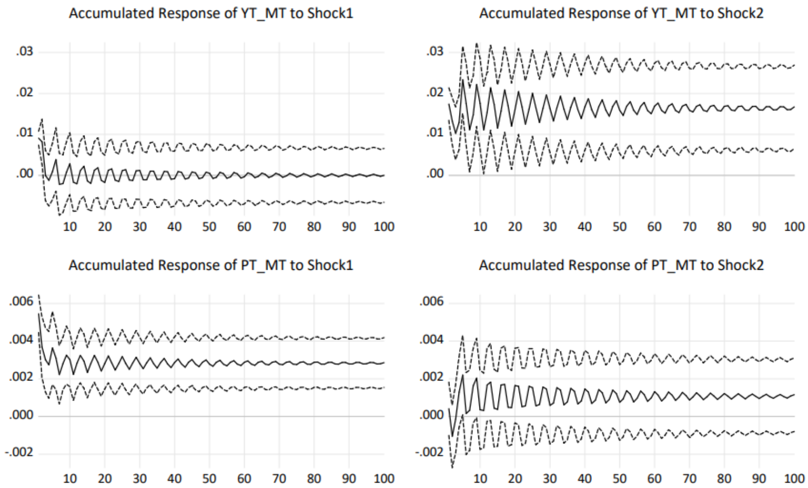

Figure 18 – Accumulated Response to Structural VAR Innovations in Malta

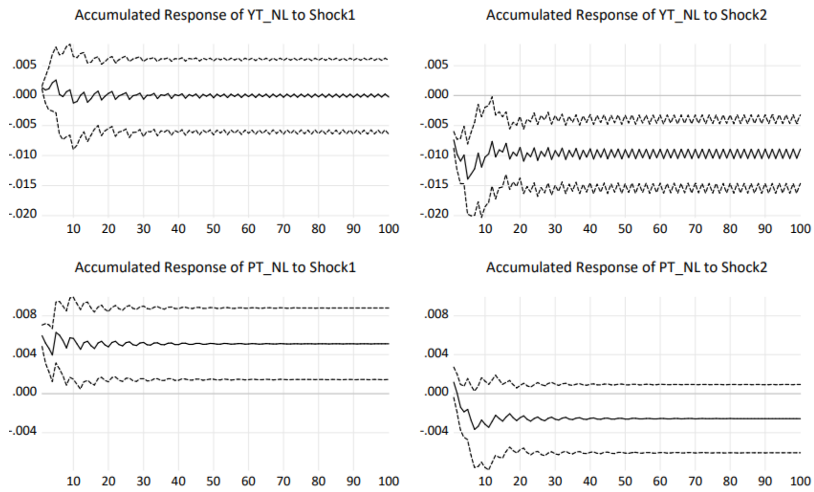

Figure 19 – Accumulated Response to Structural VAR Innovations in Netherlands

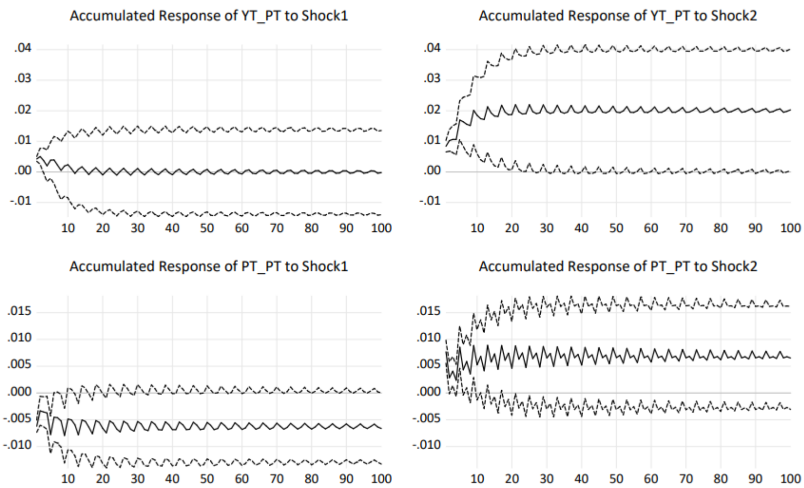

Figure 20 – Accumulated Response to Structural VAR Innovations in Portugal

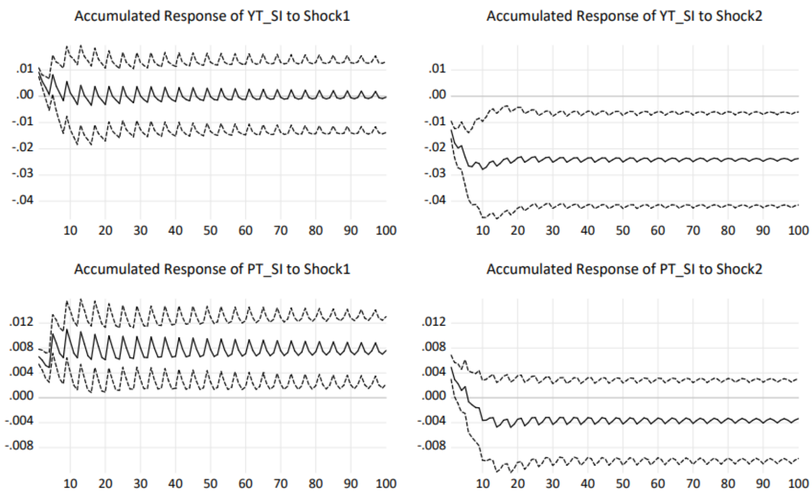

Figure 21 – Accumulated Response to Structural VAR Innovations in Slovenia

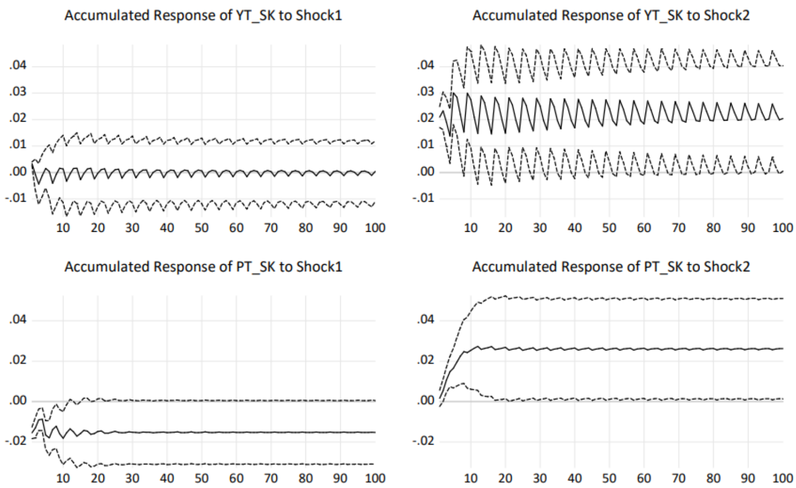

Figure 22 – Accumulated Response to Structural VAR Innovations in Slovakia

Table VIII

Export Trade Intensity vs Germany, EU-27 and France

	Germany		European Union-27		France	
Partner	2004Q1-2011Q4	2012Q1-2019Q4	2004Q1-2011Q4	2012Q1-2019Q4	2004Q1-2011Q4	2012Q1-2019Q4
AT	3,33%	3,07%	2,15%	2,00%	0,83%	1,03%
BE	4,78%	4,01%	5,47%	4,74%	7,30%	6,78%
CY	0,01%	0,01%	0,01%	0,02%	0,01%	0,00%
DE			11,56%	10,58%	7,22%	5,85%
EE	0,05%	0,06%	0,15%	0,19%	0,04%	0,05%
ES	1,82%	1,94%	3,13%	3,13%	5,82%	5,71%
FI	0,57%	0,55%	0,77%	0,62%	0,41%	0,32%
FR	4,72%	4,28%	5,76%	4,74%		
GR	0,22%	0,16%	0,30%	0,29%	0,17%	0,16%
IE	0,65%	0,64%	1,13%	0,94%	1,04%	0,85%
IT	3,53%	3,24%	4,84%	4,23%	5,35%	5,09%
LT	0,13%	0,15%	0,22%	0,30%	0,14%	0,14%
LU	0,36%	0,27%	0,36%	0,24%	0,65%	0,48%
LV	0,06%	0,07%	0,11%	0,16%	0,02%	0,04%
MT	0,03%	0,03%	0,03%	0,02%	0,07%	0,05%
NL	7,18%	6,97%	6,82%	6,67%	4,29%	4,45%
PT	0,49%	0,48%	0,72%	0,74%	1,04%	1,26%
SI	0,42%	0,47%	0,43%	0,49%	0,31%	0,29%
SK	0,90%	1,20%	0,94%	1,21%	0,54%	0,78%

Source: ITC Trade Map; author's computations.

Table IX

Import Trade Intensity vs Germany, EU-27 and France

	Germany		European Union-27		France	
Partner	2004Q1-2011Q4	2012Q1-2019Q4	2004Q1-2011Q4	2012Q1-2019Q4	2004Q1-2011Q4	2012Q1-2019Q4
AT	5,97%	5,36%	2,52%	2,46%	0,65%	0,55%
BE	4,74%	3,56%	5,02%	4,53%	4,38%	3,94%
CY	0,07%	0,06%	0,10%	0,09%	0,06%	0,05%
DE			10,34%	10,11%	4,72%	4,28%
EE	0,16%	0,15%	0,21%	0,26%	0,04%	0,05%
ES	3,76%	3,09%	3,94%	3,39%	4,73%	4,15%
FI	1,04%	0,92%	0,92%	0,88%	0,37%	0,33%
FR	7,22%	5,85%	7,36%	6,04%		
GR	0,85%	0,50%	0,84%	0,54%	0,60%	0,37%
IE	0,59%	0,61%	0,45%	0,54%	0,43%	1,24%
IT	5,31%	4,43%	5,02%	4,49%	4,02%	3,63%
LT	0,28%	0,31%	0,28%	0,40%	0,10%	0,15%
LU	0,56%	0,47%	0,41%	0,36%	0,42%	0,40%
LV	0,16%	0,17%	0,19%	0,25%	0,05%	0,06%
MT	0,04%	0,04%	0,07%	0,07%	0,08%	0,05%
NL	5,13%	4,74%	3,93%	3,98%	1,91%	1,72%
PT	0,97%	0,79%	1,19%	1,06%	0,92%	0,83%
SI	0,49%	0,47%	0,46%	0,46%	0,24%	0,18%
SK	1,07%	1,26%	0,87%	1,19%	0,31%	0,44%

Source: ITC Trade Map; author's computations.

Table X

Fiscal-policy convergence proxy

	Germany		European Union-27		France	
Partner	2004Q1-2011Q4	2012Q1-2019Q4	2004Q1-2011Q4	2012Q1-2019Q4	2004Q1-2011Q4	2012Q1-2019Q4
AT	0,820	0,831	0,770	0,841	0,721	0,793
BE	0,456	0,866	0,892	0,921	0,907	0,947
CY	0,691	0,622	0,850	0,684	0,772	0,509
DE			0,661	0,972		
EE	0,054	-0,446	0,517	-0,399	0,543	-0,363
ES	0,264	0,909	0,894	0,963	0,915	0,948
FI	0,628	0,763	0,982	0,806	0,969	0,720
FR	0,574	0,930	0,984	0,953		
GR	0,294	0,906	0,849	0,885	0,882	0,758
IE	0,405	0,952	0,841	0,974	0,857	0,904
IT	0,802	0,771	0,784	0,806	0,697	0,667
LT	0,211	0,934	0,864	0,941	0,895	0,868
LU	0,887	0,924	0,643	0,884	0,537	0,889
LV	0,397	0,586	0,909	0,624	0,939	0,472
MT	-0,014	0,873	-0,009	0,922	-0,084	0,881
NL	0,522	0,925	0,946	0,976	0,956	0,899
PT	0,770	0,838	0,973	0,854	0,948	0,778

SI	0,583	0,865	0,918	0,946	0,929	0,954
SK	0,403	0,809	0,910	0,718	0,900	0,575

Source: *Eurostat, National accounts*, author's computations.

Table XI

Real-GDP discrepancy between trading partners (in log form)

	Germany		European Union-27		France	
Partner	2004Q1-2011Q4	2012Q1-2019Q4	2004Q1-2011Q4	2012Q1-2019Q4	2004Q1-2011Q4	2012Q1-2019Q4
AT	2,162	2,183	3,621	3,604	1,916	1,900
BE	1,969	1,980	3,428	3,401	1,723	1,697
CY	4,923	4,992	6,381	6,413	4,676	4,709
DE			1,458	1,421		
EE	5,091	5,059	6,549	6,480	4,844	4,776
ES	0,865	0,952	2,324	2,373	0,619	0,669
FI	2,600	2,676	4,058	4,097	2,354	2,393
FR	0,246	0,283	1,705	1,704		
GR	2,353	2,725	3,811	4,146	2,106	2,442
IE	2,705	2,531	4,163	3,952	2,458	2,248
IT	0,432	0,581	1,891	2,002	0,186	0,298
LT	4,484	4,404	5,942	5,825	4,237	4,121
LU	4,137	4,075	5,595	5,496	3,890	3,791
LV	4,875	4,876	6,334	6,297	4,629	4,593
MT	5,993	5,746	7,452	7,167	5,747	5,463
NL	1,394	1,431	2,852	2,852	1,147	1,147
PT	2,653	2,773	4,112	4,194	2,407	2,489
SI	4,261	4,298	5,719	5,719	4,015	4,015
SK	3,708	3,590	5,166	5,011	3,462	3,307

Source: *Eurostat*, *National accounts*, author's computations.