Faculty of Business and Economics
Mendel University in Brno

Identification of Shocks and Imbalances in the European Union

Master Diploma Thesis

Thesis Supervisor:

doc. Ing. Petr Rozmahel, Ph.D.

Author:

Bc. Thanh Tâm Lê

Acknowledgement

Acknowledgement

I would like to express my gratitude to doc. Ing. Petr Rozmahel, Ph.D. for his supervision. His expertise, guidance and support has helped me greatly in understanding all the key knowledge in macroeconomics and econometrics that were of critically important to the completion of this thesis.

Declaration

Declaration

I agree that my work will be published in accordance with Section 47b of Act No. 111/1998 Coll. On Higher Education as amended thereafter and in accordance with the Guidelines on the Publishing of University Student Theses.

I am aware of the fact that my thesis is subject to Act. No. 121/2000 Sb., the Copyright Act and that the Mendel University in Brno is entitled to close a license agreement and use the results of my thesis as the "School Work" under the terms of Section 60 para. 1 of the Copyright Act. Before closing a license agreement on the use of my thesis with another person (subject) I undertake to request for a written statement of the university that the license agreement in question is not in conflict with the legitimate interests of the university, and undertake to pay any contribution, if eligible, to the costs associated with the creation of the thesis, up to their actual amount.

Brno, 2014 ______________________________

Abstract

LE, T. T., Identification of Shocks and Imbalances in the European Union. Master Diploma Thesis. Brno: Mendel University, 2014.

The main objective of the thesis is to examine the asymmetric shocks and imbalances among the countries in the European Union. The shocks are identified with their nature and estimated in magnitudes by using the Vector Autoregressive models. From these models, the filtered residuals representing economic shocks were displayed on correlation matrices in order to assess the similarity level of their impacts on respective member states' economies. The empirical studies led to the conclusion that there exist some certain asymmetries in the EU and enabled some policy implications.

Keywords

Asymmetric shocks, Euro zone, demand shocks, supply shocks, VAR models

Abstrak

LE, T. T., Identification of Shocks and Imbalances in the European Union. Magisterská práce. Brno: Mendelova univerzita v Brně, 2014.

Hlavním cílem této práce je zkoumat asymetrické šoky a nerovnováhy mezi členy Evropské Unie. Pomocí vektoru autoregresivních modelů jsou šoky rozpoznány a je odhadován jejich význam a velikost. Rezidua zastupující hospodářské šoky, která byla filtrovaná z těchto modelů, byla zobrazena na korelačních maticích s cílem posoudit míru podobnosti dopadů na ekonomiky jednotlivých členských států. Empirické studie vedly k závěru, že existují jisté asymetrie mezi členy EU a umožnily představení možných strategií.

Klíčová slova

Asymetrické šoky, eurozóna, poptávkových šoků, nabídkových šoků, modely VAR

Table of Contents

List of Pictures

List of Tables

1 Introduction

The European Monetary Union (EMU) has long been considered a very ambitious project that has caught attention of many economists and academic scholars. Even though the EMU has recently overcome some critical financial crises over the past few years, one may still question its existence, and more often, its expansion limitation. Ever since the beginning of this union, there have been arguments that it will not happen – or if it does, it cannot work. Yet the EMU has been established and its stability and crises have been very profoundly controversial themes for economic debates and researches.

The reason why this is one of the most often discussed topics is that once a country enters the European union, it is expected to be eventually joining the EMU and share the Euro with the contemporary 18 member states; yet the questions of the cost versus benefits for an accession country remain. Of the EU's 15 older member states, 12 (Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, The Netherlands, Portugal, and Spain) had joined the economic and monetary union (EMU), replaced their own national currencies with the euro, and approved the European Central Bank (ECB) to monitor the single currency. Some of the 10 countries that joined in 2004 have pegged their currency to Euro as well. Except from the UK and Denmark, the rest of the member states are still under the expectation of adopting the mechanisms in order to join the Euro area. Yet, will giving up their currencies improve the national economy or worsen the situation?

Besides the institutional conditions set up for accessing countries, there are various theoretical debates around the topic of one EU member state joining the Euro zone. Is it connected to the reason why so many economies fell into financial crises where others have to bail them out via the common budget? And after all does EMU meet all the criteria of an optimum currency area, let alone the institutional criteria? In a theoretical approach, besides the question about the level of factor mobility, the openness of the economies, the flexibility of wages and prices, etc; the most controversial arguments are about the asymmetry of the economic shocks. Some economists have maintained that, in the absence of the ability to alter the exchange rates, and given that there will be a single monetary policy for the whole area; no credible mechanism will manage to vanish the asymmetric shocks – the disturbances that generate varying economic effects on different parts of the area. Many have attempted to prove this argument via models with logical modelling thinking, and some others did so via empirical analysis. Once again, this paper attempts to contribute some empirical studies based on similarly conducted works in order to assess the asymmetries aforementioned.

The famous economist Robert Mundell has stated that one of the conditions for an optimum currency area to be viable is that the group of countries should not be hit by shocks that are too asymmetric. The main objective of the thesis is to figure out whether the economic shocks are asymmetric and if there are imbalances in the European Union from observable data, by using a structural vector autoregressive model (SVAR). Through the model, we are able to extract the responses of different variables (for instance: output and inflation) to shocks, thus they help demonstrate the imbalances existing in the European Union. By studying the OCA theories whilst focusing on one criterion, which is: symmetric shocks and convergences of the countries joining an optimum currency area and by studying the method of using structural vector autoregressive model to identify aggregate demand and supply shocks to real output, so as to apply effectively to the data collected; it enabled us to test the results of the data collected and interpreted them in a way that help answer to the research question and decide whether the hypothesis is correct.

The thesis consists of 4 main parts. Chapter 2 introduces the author's objectives, applied methodology and data. Chapter 3 reviews some related literatures before chapter 4 describes the data and the empirical study in details and provides all possible interpretations. Lastly, chapter 5 and 6 discuss the findings and contribute some policy implications.

2 Objectives and Methodology

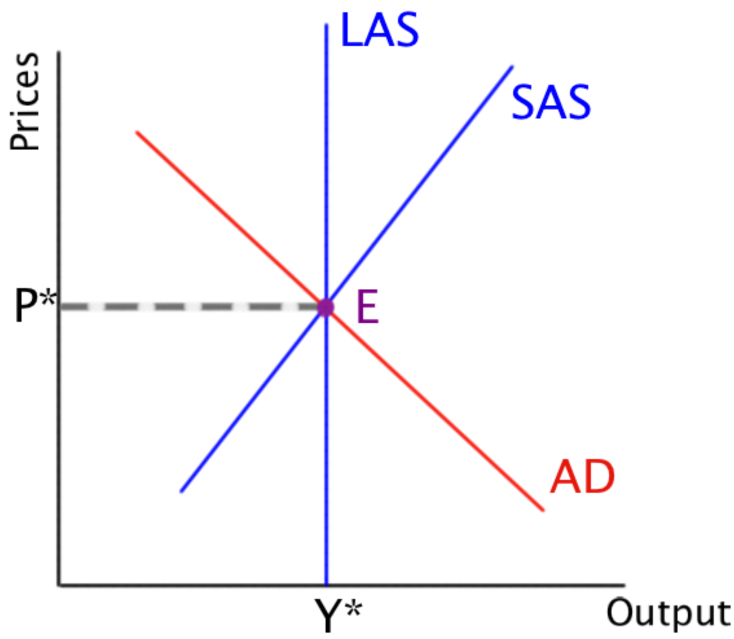
The main objective of this diploma thesis is to elaborate an assessment of the asymmetric shocks and imbalances in the EU. This final goal was supported by three partial objectives: the assessment identified, estimated and pointed out how similar the shocks had been and what type of shocks they were in terms of supply and demand ones. This can help us see to what extend there exists a harmony between the business cycles of the EU countries and thus form an opinion on the existence and expansion of the European Monetary Union.

The first partial objective is to identify the economic shocks by detecting the disturbances overtime in the economies of the countries in question. To achieve this, the method used was Vector Autoregression (VAR) models on the quarterly data of GDP growth (or growth rate) and the data of HICP collected from 1996 to 2013 from the national accounts database of Eurostat. The subjects of data collection are the 28 EU countries, the EU as a whole, the Euro area as a whole (EA) and the current 18 countries of the Euro zone as a whole (EA18), which made 31 time series for each variable.

In order to ensure the validity of the empirical results, cointegration tests were conducted then data were derived and re-tested for stationarity (which is a criterion for VAR model) as well as displayed on their correlograms for validation. The author ran all the time series through the VAR models and collected the residuals for each country/zone to identify the shocks and their nature. All statistical works were operated on the two computer programs Gretl and Excel.

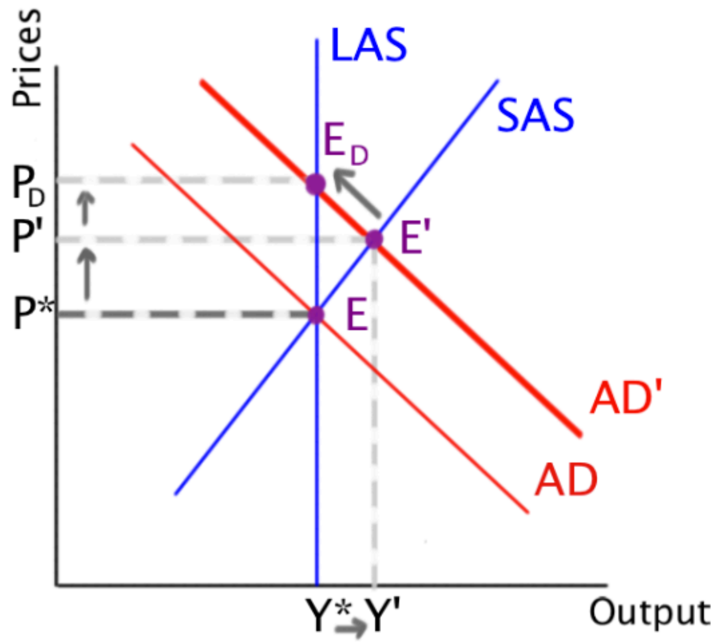
The next two paragraphs **(1)** and **(2)** explain the reason why these data and model can enable us to detect the shocks overtime in the EU by showing the relationship between output or inflation with economic shocks. This method of estimation and assessment was first used by Blanchard and Quah (1989) then enhanced by Bayoumi and Eichengreen (1992) and once more used by Fidrmuc and Korhonen (2002).

(1) The aggregate Demand and Supply Model is a macroeconomic model where, based on the relationship aggregate demand and aggregate supply, price level and output are explained. It was first developed by Keynes (1936) and for the purpose of studying the economic shocks, it was very clearly reproduced and demonstrated in the working paper of Bayoumi and Eichengreen (1992) by three charts and simple explanation as quoted below.



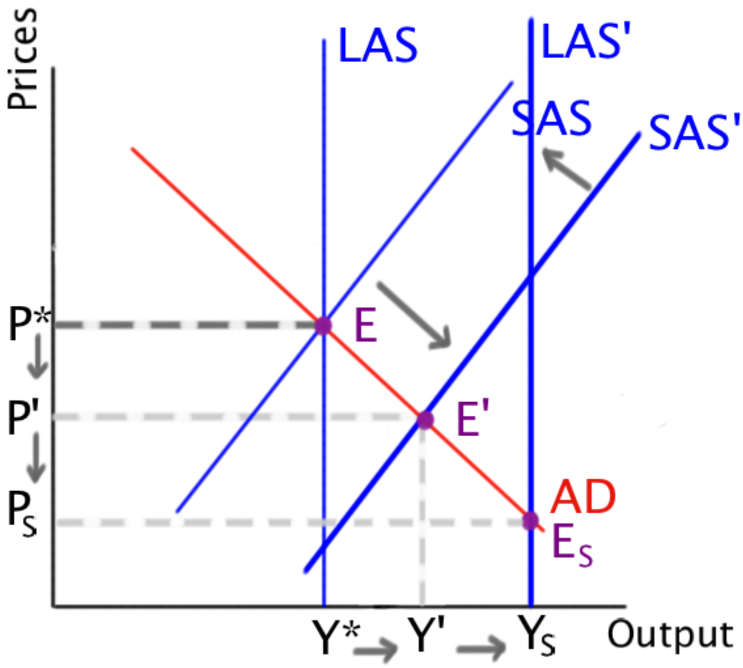
Pic. 1 The Aggregate Demand and Supply Model

In the charts included from Pic. 1 to Pic. 3, the horizontal axis represents the aggregate output produced by the economies, the vertical axis shows the prices and there are 3 curves respectively depicting Aggregate Demand (AD), Short term Aggregate Supply (SAS) and Long term Aggregate Supply (LAS). AD has a downward trend implying that prices decrease will boost demand; and because wages are assumed to be sticky, hence the higher the prices mean the lower real wages, the SAS curve is upward sloping. As in reality, real wages adjust to changes in prices over time; the SAS has a tendency toward the vertical LAS. At the equilibrium point E, the level of output Y* and prices P* are optimal.



Pic. 2 Adjustment to a Demand shock

In Pic. 2, a positive demand shock is depicted: the AD curve shifts to the position of AD', creating a new equilibrium E'. At the moment of the E' equilibrium, we observe an increase in both price (P moves up to P') and output (Y* moves to Y'). As the SAS curve becomes vertical over time, E' will move up to the new equilibrium point E_D. At this point, the price increased further (P' moves up to P_D) but the output has decreased to the initial point (Y' moves back to Y*). In summary, after a demand shock, there is a short-term rise in output and a permanent rise in price.



Pic. 3 Adjustment to a Supply shock

The Pic. 3 illustrates a positive supply shock. The event of SAS moving toward the right hand side and becoming SAS' creates the new equilibrium point E'. At this point, price decreases (P moves down to P') and output increases (Y* moves to Y'). However, E' will slowly move toward E_S over time as SAS' becomes the vertical line LAS'. At the same time, price will continue to descend (P' becomes P_S) and output keeps going up (Y' becomes Y_S).

(2) From the explanation of the 3 charts in part **(1)**, we may form a method how to identify Supply and Demand Shocks using empirical data as based on observation, both types of shocks leave permanent effects on price: the demand shocks make it rise and the supply one does the opposite. However, the effects on outputs in term of the resistance are quite distinguishable: whilst the demand shocks have only transitory effects on output, the supply shocks generate permanent ones.

Consequently, Economic shocks can be detected if we run the time series data of output and inflation over VAR models. The residuals recorded from the models' equations represent the disturbances that imply the shocks. As illustrated from the charts above, one of the most effective variables to detect supply shocks is output and in the case of demand shocks, inflation. Thus, in this study, quarterly GDP (in current prices of gross domestic products) indices were used to estimate the supply side and quarterly HICP indices were used for the demand side of shocks across the EU. The data were explained in more details in the empirical study in chapter 4.

The second partial objective is to study the nature of the identified shocks and estimate their magnitudes. Not only did the residuals collected from the VAR models mentioned above can show that certain economic shocks occurred, but they could also show if they shocks are from supply or demand sides of the economy and illustrate how strong the effects of the disturbances were in respective countries. From the explanation above in the sub-paragraphs **(1)** and **(2)**, one can use the residuals from the GDP indices to study more about supply shocks and HICP ones for demand shocks. Based on the value of these residuals, the magnitude of the shocks could be estimated and grouped to serve the purpose of further estimation and comparisons. Grouping was done simply in excel sheets, which sorted the economies in question based on the order of their residuals values. The nature and magnitude of shocks showed certain patterns, which led to some possible groups of economies with more or less similar behaviour under shocks.

The last partial objective is to study the similarity of the identified shocks. Comparing these shocks using the contemporary data collected in this study helped the author comment on the level of balance or imbalance among the economies of the EU member states. Also, comparing the level of similarity from the data of correlation retrieved in this study with relevant findings from Bayoumi and Eichengreen (1992) gave more perspectives to the interpretation and led to further discussions. For the possible groups of economies mentioned in the previous paragraph, running their data through VAR models helped to find out if the level of correlation/symmetries could be improved in such a group and whether the results would lead to an implication of potential sub-Euro-areas.

3 Literature Reviews

This part sketches out the history and the milestones of changes and development of the OCA theories as well as typical examples presented by the existing monetary unions. This serves as the background of the studies through out the thesis since it summarizes the essential conditions of an optimum currency area and sets some anchor criteria to compare the EMU to. Nevertheless, it is also an incentive to conduct this study since there are various ideas, opinions and arguments through time that contributed to the many aspects of the theories and inspire further assessments. The main authors and their related studies mentioned in this part area Mundell (1961), Blanchard and Quah (1989), Bayoumi and Eichengreen (1992) and Fidrmuc and Korhonen (2002).

3.1 Overview of The Literature Reviews

Literature reviews mentions some studies concerning this topic. The key authors Mundell (1961), Blanchard and Quah (1989), Bayoumi and Eichengreen (1992) and Fidrmuc and Korhonen (2002) and their related studies is mentioned in this part together with various authors who have contributed certain interesting opinions in the topic of asymmetric shocks in EMU. The aim of this chapter is to present an introduction of the basic theories of the optimum currency areas (OCA), so that it can indirectly support the main goal.

The history and the milestones of changes and development of the OCA theories area sketched out as well as typical examples presented by the existing monetary unions in chronological order. Not only does this serve as the background of the studies through out the thesis, it also points out that there are various ideas, opinions and arguments through time that contributed to the many aspects of the theories and inspire further assessments.

3.2 Origins and Development of the OCA theories

The OCA theories dated back in 1961 by Mundell when he examined possible mechanisms of adjustment when neighbour regions face exogenous country-specific shocks. He conjectured that when the business cycles of a group of countries are highly correlated, they would find it more advantageous to peg the external value of their currencies. This initial formulation was inspired by the questions he posed in particular reference to the US and Canada. In this study, Mundell suggested that:

- A monetary union (a region with fixed exchange rates) should be appropriate if the impact of shocks on its particular areas is similar. This is also referred to as symmetric shocks.
- In the cases where these areas face asymmetric shocks, there are certain prerequisites as high labour mobility and/or wage flexibility.

Mundell's analysis was later on elaborated by McKinnon (1963) and by Kenen (1969). McKinnon (1963) added a main criterion about the degree of openness in an economy as this factor can influence the effectiveness of an autonomous monetary policy. Kenen contributed more toward the asymmetric shocks theory by setting a requirement of high degree of product diversification. He believed that asymmetric shocks can be avoided if the different parts of a currency area produce a similar mix of goods since the more a group of countries or regions specialised in the production of distinctive goods, the more likely it would be that they have to face asymmetric effects when external shocks occur.

In the 1960s, it was possible to distinguish two major streams of the optimum currency area literature (Horvath and Komanek, 2002) which were: the one to find the crucial economic characteristics to determine where the borders for exchange rates should be drawn lasting from 1960s to 1970s; and the second one lasting from 1970s until their current date which assumed that any single country which could fulfil completely the requirements to make it an optimal member of a monetary union. Later on, OCA literature took into account the "Lucas critique", the endogeneity of the optimum currency area criteria, various extensions to OCA criteria and other modern macroeconomic theories.

3.3 Currency area

It was stressed that if countries are highly integrated in financial trading, then capital flows can smooth temporary asymmetric shocks (Ingram, 1987). In the long term, there is a wealth effect caused by the capital flows: the surplus region accumulating net claims increases expenditures and the deficit region lowers them, thereby contributing to real adjustment.

McKinnon (1963) argued that the lower the benefits of flexible exchange rates can be the consequence if the more the country is open to the world. Any exchange rates variation in a highly open country is without any impact on the terms of trade and real wages, because the change in the price of the currency can affect both the export price of domestic products and the import price of foreign products.

In 1969, Kenen proposed the idea that the higher the product diversification is the lower the extent of asymmetric shocks occurrence because the shocks would affect a relatively small part of the economy. There were also other criteria suggested, such as coordination of central banks, political integration, similarity of preferences of the national consumption, inflation and unemployment, and theory of the optimum currency areas was becoming a framework for discussion about monetary integration. In costs versus benefits debates of joining the monetary union, on interesting aspect is that the relevant benefits are usually at microeconomic level, while costs at macroeconomic level. Some viewed that the loss of power to affect a national money supply explained by the fact that in an integrated market, all member countries will jointly control their monetary policy.

One of the most important costs of joining a currency area is the loss of a country's ability to use the exchange rate and monetary policy for stabilization but this is surely not the case for small open economies, because maintaining free capital mobility is impossible while maintaining an independent monetary policy together. These countries with the mentioned features often link their currencies to their main trading partners in order to gain higher exchange rate stability. This reduces their independence of monetary policy, thus the point about the risk of losing monetary and exchange rate policies was especially emphasized in the early 1970s when the negatively sloped Phillips curve was in concerns of various authors.

In 2002, R. Horvath and L. Komanek conducted a study of the OCA theories overtime, which was quite solid and well elaborated with strong arguments. In their introduction, the OCA theory was referred as a topic that discussed "the optimal number of currencies to be used in one region." This interesting view, according to Horvath and Komanek, led to "a low operational precision of OCA theory" and they implied that for this reason, the main purpose of the OCA theory is actually a discussion about monetary integration. To back up this view, they summarized theoretical issues from the classical contributions to the OCA literature in the 1960s to the modern day (till 2002) and conducted also a shore empirical survey of the studies that were related to this discussion, focusing mainly on their own national economy (Czech Republic) and other 3 subjects. The main goal was to point out that there could be contradictory conclusions in the framework of benefit-cost ratio of implementing common currency for a pair of the countries. By choosing different benchmark countries, the result for a decision making process could be completely reversed.

3.4 The Identification of Economic Shocks in EU

3.4.1 Aggregate Demand and Supply Model

In the macroeconomic model of Aggregate Demand and Supply, price level and output are explained, based on the relationship aggregate demand and aggregate supply. It was first developed by Keynes (1936) and for the purpose of studying the economic shocks; it was very clearly reproduced and demonstrated in the working paper of Bayoumi and Eichengreen (1992). Later on, the model is the anchor methodology and has been quoted in many other papers; among which, the working paper of Fidrmuc and Korhonen once again explained the model in a simple way and applied it effectively to back up their studies conducted to compare the asymmetries of shocks of the accession countries with the EU as a whole. The model was described briefly in the second chapter of Objectives and Methodology of this paper.

3.4.2 Identification of Supply and Demand Shocks

The first key background study of this thesis was the VAR model applied effectively by Blanchard and Quah (1998) where they interpreted GNP and unemployment fluctuations as caused by two types of disturbances: the ones with permanent effect and the ones without.

Later on, the second critical study of Bayoumi and Eichengreen (1992), with output and prices from each country, tried to explain the shocking aspects in some European countries by analyzing their symmetries and compare the correlation level with the anchor group. This key threshold was set by doing the same study on a presumably functioning OCA, which was the USA, as Bayoumi and Eichengreen (1992) analyzed the same data of some states in the USA.

The idea is to base on the behaviour explained in the earlier paragraphs of aggregate demand and supply model, which showed the link between the fluctuations of these 2 variables result from supply and demand shocks. Whilst supply shocks have a permanent effect on output, demand shocks have transitory effects; and both have permanent effects on Price level: for supply shock, it depresses the price level and in the case of demand shocks, the consequence is the increase in price level.

3.4.3 Identification of Asymmetric Shocks

General comparisons and findings that can be found from these comparisons of the natures of shocks and how symmetric they relatively are while being compared with a control group. In the study on Bayoumi and Eichengreen (1992), the crucial finding was that the core countries in Europe shared a higher level of symmetries, yet it was not as high as the control group. The findings also pointed out that the underlying demand shocks are more difficult and less significant to measure than the supply ones.

In their study of measuring the level of asymmetries between the potential accessions countries to the Euro zone, by doing pair wise comparison and VAR models, Fidrmuc and Korhonen (2002) found that the conclusions of Bayoumi and Eichengreen was still to date validated by the data. The study also added some surprising results and arguments where they recorded some countries might not share as much symmetries as they were considered to be, even though sharing very similar history, size and policies. For instant, it was symmetric level were discussed to compare the data of Slovakia to the core countries and with Czech Republic.

3.5 The VAR model

The model was developed by Blanchard and Quah in 1998 working paper, using the theoretical background of Aggregate Demand and Supply Shock explained in the previous chapters. The main function of the VAR model is as follow.

$$X_t = A_0 e_t + A_1 e_{t-1} + \ldots = \sum_{j=0}^{\infty} A_j e_{t-j}$$

The two variables of GDP and prices is written as an infinite moving average representation of supply and demand shocks, where X_t is a vector of differences of logs of output and prices, e is a vector of demand and supply disturbances and Aj are the matrices that transmit the effects of the shocks to the variables. Based on the theoretical macroeconomic background, the demand shocks are recorded, as they do not affect the level of output, yet they influence the prices level. Whilst the cumulative effect of demand shocks on the change of output is zero; the supply shocks can impose permanent effects.

Fidrmuc and Korhonen (2002) summarized the methods applied by Blanchard and Quah and developed by Bayoumi and Eichengreen with four crucial restrictions. The first two are simply normalizations defining the variances of the shocks and the disturbances. The third restriction is the assumption that demand and supply shocks are orthogonal and lastly, the long-run response of GDP to demand shocks is zero. These four restrictions of the VAR model are the key factors to enable to recover supply and demand shocks from the residuals of an estimated one.

Vector Autoregressions (VAR) is a multivariate, linear representation of a vector of observables on its own lags and (possibly) other variables as a trend or a constant. This type of mode can make explicit identifying assumptions to isolate estimates of policy and/or private agents' behaviour and its effects on the economy while keeping the model free of the many additional restrictive assumptions needed to give every parameter a behavioral interpretation. Sims (1980) introduced SVARs, which have been used to document the effects of money on output (Sims and Zha, 2005). Also, the model was used later on as well to assess the relative importance of supply and demand shocks on business cycles (Blanchard and Quah, 1989), the effects of fiscal policy (Blanchard and Perotti, 2002), or the relation between technology shocks and worked hours (Galí, 1999), among many other applications.

3.5.1 Stationarity or Covariance stationary

The variables of the time series data in question should be stationary or at least covariance stationary. In order to assess if there exists a unit-root there is the cointegration test named Engle-Granger. The null hypothesis in the Engle-Granger procedure is no-cointegration and the alternative is cointegration. According to Baum (2013), estimation of the parameters of the VAR requires that the variables are covariance stationary, with their first two moments finite and time-invariant. If the variables are not covariance stationary, but their first differences are, they may be modelled with a vector error correction model, or VECM.

3.5.2 Lag order

The typical lag used for the purpose on running data through a VAR model is lag order 2. The lag order is very important because it affects the number of equations hence the size of the VAR model. With each additional lag order, 1 more equation will be added for each variable. If the number of the equations are too large and the length of the observation's time series are not large enough to support it, one may face overparameterization problem.

In the anchor studies of Bayoumi and Eichengreen (1992) and Fidrmuc and Korhonen (2002), the lags number was set to 2, since the Schwartz Bayesian information criterion indicated that all the models had an optimal lag length of either one or two. However, they also stated that the lag length could be above 2 in some of the models based on the Akaike information and when trying with lag length of 3, very similar results were produced.

3.5.3 Tests of validity of lag length for VARs models

If the lag length were smaller than it should be, there would be problems with

- serial autocorrelation
- heteroskedasticity
- and non-normal distribution

In order to confirm the estimated lags length to be optimal, each VARs model has to be run through the estimated lags length then tested for these three criteria. If the criteria are not met, the length of lags had to be increased and the models had to be run again with the adjusted lags order.

4 The Data Analysis

4.1 Descriptive Statistics

The data of GDP and HICP (Harmonized Index of Consumer Prices) were collected from the Eurostat database (in seasonally adjusted figures) and afterward were worked on to produce the desirable forms.

There were 31 regions that were included: 28 EU countries individually, the EU as a whole, the Euro area in respective time periods and the current Euro area as a whole. In the table below, the abbreviations of the countries are quoted, together with some particular legends if necessary.

1. Austria	**AT**	6. Czech Republic	**CR**
2. Belgium	**BE**	7. Denmark	**DK**
3. Bulgaria	**BG**	8. Estonia	**EE**
4. Croatia	**HR**	9. Finland	**FI**
5. Cyprus	**CY**	10. France	**FR**
11. Germany	**DE**	Until 1990: former territory of the FRG	
12. Greece	**EL**	20. Netherlands	**NI**
13. Hungary	**HU**	21. Poland	**PL**
14. Ireland	**IR**	22. Portugal	**PG**
15. Italy	**IT**	23. Romania	**RO**
16. Latvia	**LV**	24. Slovakia	**SL**
17. Lithuania	**LT**	25. Slovenia	**SI**
18. Luxembourg	**LU**	26. Spain	**ES**
19. Malta	**MT**	27. Sweden	**SE**
28. **UK**	United Kingdom		
29. **EA18**	Current Euro area (18 countries)		
30. **EA**	EA11-2000, EA12-2006, EA13-2007, EA15-2008, EA16-2010, EA17-2013		
31. **EU**	European Union (28 countries)		

Table 1. Abbreviations of names of regions used in the study

There are some other abbreviations applied by the author in order to organize the data better on Gretl and Excel programs that are interpreted if shown on the tables and graphs of the coming parts of this thesis.

4.1.1 Challenges from the Datasets

In general, the missing data from the HICP database might cause the VAR models to be less accurate since estimation had to include some trends in order to make the modeling possible. However this was not such a severe issue as data are collected on a quarterly basis, which enhanced the number observations by 4 times than the annual ones and thus the accuracy was compensated.

The other issue this data analysis has to face is the number of observations compared to the large amount of countries in question. Each country participating in the analysis in the VAR model generated an equation and consequently the number of observations do not allow lag order 2, thus it might not ensure that the chosen lag 1 is optimal; but the author did all the necessary tests to make sure the model is valid and trustworthy.

4.1.2 GDP Statistics

The first statistic used was the GDP and main components – Current prices (namq_gdp_c), which can be found in the Quarterly national accounts of Eurostat. Table 2 below shows the summary of quarterly GDP growth rate calculated by the author in a nutshell with concrete periods, means, medians, maximal and minimal values and standard deviations for each member state or region in question. The data was collected in seasonally adjusted figures of quarterly GDP in Millions of ECU up to 31st December 1998 and in Million of Euro from 1st January 1999.

In table 2, the unit displayed is percentage showing how much the volume of output had increased on an average, as a median, at the maximal and at the minimal level. For instance, in Austria, between the first quarter of 1996 and the last one of 2013, the average rate of quarterly increase in output volume is 0.75%. In other word, if in the previous quarter the output volume were 10000 Million of

Euros, in the current quarter the figure would be 10075 Million of Euros on an average.

Subject[1]	Period	Mean (%)	Median (%)	Max (%)	Min (%)	St. Dv. (%)
AT	1996:1-2013:4	0.753071782	0.908292108	1.86908591	-1.49083562	0.717562641
BE	1996:1-2013:4	0.795354146	0.885926212	2.15797581	-2.010550527	0.750177282
BG	1997:2-2013:4	2.925660233	2.577905505	38.31669925	-3.986952909	5.46183654
HR	2000:2-2013:4	1.189281248	1.46680532	6.270564755	-4.27991491	2.023614768
CY	1996:1-2013:4	1.150967839	1.324338543	3.611097754	-2.953121773	1.437042797
CR	1996:1-2013:4	1.679640423	2.127774279	6.559447047	-8.320100692	2.955315821
DK	1996:1-2013:4	0.797636902	0.863364106	4.308612235	-3.527496196	1.318801119
EE	1996:1-2013:4	2.533808764	2.850470952	7.649583439	-6.03837909	2.443102952
FI	1996:1-2013:4	0.899692874	1.040179557	3.449731156	-4.493324579	1.33935497
FR	1996:1-2013:4	0.734919268	0.859240731	1.933704653	-1.808994864	0.635519662
DE	1996:1-2013:4	0.499619082	0.569223219	2.065619604	-3.954393862	0.90843913
EL	2000:2-2011:1	1.114594817	1.414966851	4.281624418	-3.342940679	1.430594232
HU	1996:1-2013:3	1.522541372	1.647185333	11.37320814	-12.61135824	3.577497425
IR	1997:2-2013:3	1.427530167	1.221104272	8.804596206	-4.829891023	2.951221691
IT	1996:1-2013:4	0.772235772	0.693263291	6.36656922	-2.54312266	1.118640209
LV	1996:1-2013:4	2.635381665	2.668504861	10.84801762	-7.872255152	3.669732694
LT	1996:1-2013:4	2.656569989	2.685313828	13.30615891	-12.04157555	3.788945586
LU	1996:1-2013:3	1.453426037	1.251784152	7.415966867	-4.477969349	2.461897908
MT	2000:2-2013:4	1.032293358	0.881019588	6.24134429	-5.075171635	2.05725613
NI	1996:1-2013:4	0.863761524	0.855556091	2.994907483	-2.668825439	0.898397022
PL	1996:1-2013:4	1.933070635	2.608099812	10.94565242	-14.63753386	4.416548837
PG	1996:1-2013:4	0.863046445	0.901046873	3.099998482	-2.249635432	1.12164808
RO	2000:2-2013:3	2.570425752	2.279852393	10.03107183	-16.52848004	4.223284203
SL	1996:1-2013:4	2.231703149	1.926567349	8.956245945	-6.642257837	2.560534563
SI	1996:1-2013:4	1.107382144	1.238292912	5.397098598	-3.847363342	1.439836175
ES	1996:1-2013:4	1.084482802	1.530193605	2.743986404	-1.730970457	1.087516173
SE	1996:1-2013:3	1.011521821	1.466230882	7.434665738	-9.441437766	2.857559171
UK	1996:1-2013:3	1.116008053	1.672266866	8.835804256	-10.15162128	3.233903079
EA18	1996:1-2013:3	0.74298092	0.933239091	1.639142627	-2.740029867	0.671869877
EA	1996:1-2013:3	0.777794444	0.899478352	3.719126231	-2.015239158	0.715468243
EU	1996:1-2013:4	0.852953889	1.061006323	2.439130431	-4.610520804	0.998527899

Table 2. Summary of quarterly growth rate
of GDP of 31 chosen subject regions from 1996 to 2013

[1] **Euro Area countries** are quoted in bold characters.

In order to get the rates, the author took the figures in Millions of Euro and applied the quarter-on-quarter calculation of GDP growth rates formula below. The reason why quarter-on-quarter formula was chosen is explained in the next part: 4.1.3.

GDP growth rates formula is as follow.

$$r_t = (\frac{GDP_t}{GDP_{t-1}} - 1) \times 100$$

r: the rate of the quarter-on-quarter GDP increase in the current quarter
GDP: the value of output in current prices retrieved from Eurostat
t and t -1: the current quarter and the previous quarter

The author desired to collect all the statistics of all 28 countries and 3 groups mentioned from the first quarter of 1996 to the fourth one of 2013; however, some data were missing for certain periods for 11 countries, which are Bulgaria, Croatia, Greece, Hungary, Ireland, Luxembourg, Malta, Portugal, Romania, Sweden and United Kingdom. Among those, only the missing data of the 4 countries Croatia, Greece, Malta and Romania seem critical as the figures only start from the year 2000. This might have probably influenced the interpretation of the results because it is rather more interesting to assess the performance of these countries (regardless Greece) before their accession process into the EU. Yet, based on this dataset retrieved, we can only observe a very short period before their entries into EU and during these periods, actions and policies to adjust the economies and enable successful accession may have an effect on the statistics and create a strong correlation to the current EU member states at that time. Necessary tests and econometrical remedies were applied in order to avoid any issues possible, hence ensure the validity of the analysis.

The operation on Gretl is described further in 4.2.1 where the author explained how the growth rates were used in their first differences to ensure the models' validity. Difference time series were named by abbreviations presented in Table 1, with "_d" at the end (please find more details in 4.2.2 or on the second page of Annexes). In the analysis, for each indicator there are 31 sets of time series representing 28 countries and 3 zones that concern the study: EU, EA18 and EA, thus each generate 31 time series of the first difference.

4.1.3 Calculation of quarterly GDP growth rates

This section explains why the author calculated the GDP growth rate as quarter on quarter formula even though there are also other methods of dealing with data like quarterly national accounts at annualized growth rates, for instance. Diverse calculation methods often generate a different magnitude in the US growth rates published in the news than the European ones. For instance, the US GDP growth rate in 2009Q3 was 2.2% (seasonally adjusted at annual rates) according to the news release issued by the Bureau of Economic Analysis whilst the Eurostat published for the EU27 a seasonally adjusted GDP growth rate in the same quarter of 0.3%. These two figures are not comparable.

Eurostat publishes quarterly GDP (and other national accounts') growth rates compared with the previous period and the corresponding period of the previous year, respectively. Hence, these data can be calculated from both seasonally adjusted and from unadjusted data, because the comparison between similar quarters in different years supposedly removes most of the seasonal effect.

In this study, the GDP growth rate was calculated as quarter-on-quarter growth rates, which has an advantage that a change in the phase of the business cycle is visible in the numerical values quite early. Annualizing quarterly growth rates is an attempt to combine both advantages in a single growth rate, yet it comes at the price of sometimes-dramatic volatility.

As an example, Eurostat provided a hypothetical seasonally adjusted time series and some calculation for 2009Q3 as follow.

The quarter-on-quarter growth rate is (125/115-1) = 8.7%

The year-on-year growth rate is (125/100-1) = 25.0%

The annualized growth rate is ((125/115)^4-1) = 39.6%

2008Q3	100
2008Q4	101
2009Q1	105
2009Q2	115
2009Q3	125

The author supported the first method and applied it to calculate the GPD growth rates in 31 zones to prepare the data for the VAR model.

4.1.4 HICP Statistics

Harmonized Index of Consumer Prices (HICP) was also collected in order to assess the economic shocks in EU countries. Processed data are displayed and described as below.

The data were retrieved from Eurostat database, of the table named HICP (2005 = 100) - monthly data (monthly rate of change) (prc_hicp_mmor). On each time series of HICP for 31 zones, monthly rates of change in HICP were transformed into quarterly data by taking the average of every three monthly indices in Excel and their summary is presented in the Table 3 above with some essential indices: average rate, the median of the rates, the maximal and minimal values and the standard deviations.

The numbers present the rates of quarterly changes in Consumer prices of all subjects. For instance, between the first quarter in 1996 and the last quarter in 2013, the average rate of quarterly inflation in Austria is 0.16 %. In other word, on an average, if the price in the current quarter is 10016 units of currency, it means the previous quarter was worth 10000 units of currency.

Subject[2]	Period	Mean (%)	Median (%)	Max (%)	Min (%)	St. Dv. (%)
AT	1996:1-2013:4	0.15555556	0.16666667	0.63333333	-0.16666667	0.15922347
BE	1996:1-2013:4	0.17013889	0.15833333	0.63333333	-0.33333333	0.19546777
BG	1997:1-2013:4	1.93284314	0.45000000	99.70000000	-1.60000000	12.05846797
HR	1998:1-2013:4	0.24348958	0.26666667	0.96666667	-0.40000000	0.29105745
CY	1996:1-2013:4	0.19236111	0.30000000	0.90000000	-0.83333333	0.38355207
CR	1996:1-2013:4	0.26435185	0.20000000	1.43333333	-0.33333333	0.35002018
DK	1996:1-2013:4	0.16018519	0.13333333	0.66666667	-0.33333333	0.21175464
EE	1996:1-2013:4	0.40439815	0.38333333	2.45000000	-0.50000000	0.44519688
FI	1996:1-2013:4	0.16064815	0.11666667	0.90000000	-0.26666667	0.20641711
FR	1996:1-2013:4	0.14189815	0.13333333	0.55000000	-0.30000000	0.15572017
DE	1996:1-2013:4	0.13217593	0.13333333	0.46666667	-0.16666667	0.13676129
EL	1996:1-2013:4	0.26921296	0.25000000	1.35000000	-0.26666667	0.26762825
HU	1996:1-2013:4	0.57962963	0.53333333	2.60000000	-0.30000000	0.56749609
IR	1996:1-2013:4	0.17870370	0.13333333	0.70000000	-0.40000000	0.23472460
IT	1996:1-2013:4	0.18634259	0.16666667	0.56666667	-0.10000000	0.15504874
LV	1996:1-2013:4	0.38148148	0.36666667	1.83333333	-0.63333333	0.49011796
LT	1996:1-2013:4	0.30231481	0.23333333	2.30000000	-0.56666667	0.44137807
LU	1996:1-2013:4	0.20046296	0.20000000	0.73333333	-0.86666667	0.25438213
MT	1996:1-2013:4	0.22222222	0.15000000	1.90000000	-1.33333333	0.81359728
NI	1996:1-2013:4	0.18171296	0.08333333	1.16666667	-0.46666667	0.36208360
PL	1996:1-2013:4	0.40509259	0.33333333	1.86666667	-0.20000000	0.44576462
PG	1996:1-2013:4	0.19652778	0.16666667	1.00000000	-0.46666667	0.26143545
RO	1996:1-2013:4	1.72569444	0.81666667	21.03333333	-0.36666667	2.75104609
SL	1996:1-2013:4	0.39699074	0.23333333	2.33333333	-0.13333333	0.52154914
SI	1996:1-2013:4	0.39421296	0.40000000	1.35000000	-0.53333333	0.36998244
ES	1996:1-2013:4	0.21944444	0.20000000	0.80000000	-0.36666667	0.24550736
SE	1996:1-2013:4	0.13333333	0.13333333	0.63333333	-0.30000000	0.16243453
UK	1996:1-2013:4	0.18310185	0.15000000	0.70000000	-0.23333333	0.17296759
EA18	1996:1-2013:4	0.17337963	0.16666667	0.66666667	-0.20000000	0.13504360
EA	1996:1-2013:4	0.16898148	0.16666667	0.76666667	-0.20000000	0.14244966
EU	1996:1-2013:4	0.17500000	0.16666667	0.76666667	-0.20000000	0.14106126

Table 3. Summary of quarterly growth rate
of HICP of 31 chosen subject regions from 1996 to 2013

From these data, the greatest concern falls on the data for Bulgaria, as the figures for the first 3 months in 1997 are exceptionally large causing quite a high quarterly average and overall standard deviation. The issue of data missing is not as critical compared to that of the GDP growth statistics mentioned above because

[2] **Euro Area countries** are quoted in bold characters.

it occurs to only the statistics of Bulgaria and Croatia for a low number of missing observations. For Bulgaria, the figures started from the first quarter in 1997 and for Croatia, data could be collected from the same time in 1998.

4.2 Modelling and Estimation

4.2.1 Cointegration – Variables Stationarity

One of the criteria to use the VAR model is that the variables of the time series data in question should be stationary or at least covariance stationary. In order to assess if there exists a unit-root there is the cointegration test named Engle-Granger. The null hypothesis in the Engle-Granger procedure is no-cointegration and the alternative is cointegration. According to Baum (2013), estimation of the parameters of the VAR requires that the variables are covariance stationary, with their first two moments finite and time-invariant. If the variables are not covariance stationary, but their first differences are, they may be modelled with a vector error correction model, or VECM.

By applying the Engle-Granger test on the data collected, it is proven that the data collected and calculated for GDP growth rates are not stationary for most of the countries (that of 20 member states[3]) so the first difference of data for each country was taken and added to the analysis. These new variables have been tested again for cointegration and the non-stationarity issue has been eliminated[4]. Variables of the first difference are stationary and using VAR model is appropriate to proceed with the analysis.

[3] Austria, Bulgaria, Croatia, Estonia, Finland, France, Germany, Greece, Ireland, Italy, Latvia, Lithuania, the Netherlands, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden and United Kingdom.

[4] In fact, the p-values from the Engle-Granger cointegration test for Austria, Estonia, Slovenia and United Kingdom still go slightly above 0.05; however, when the values were projected on a correlogram, stationarity was reflected.

4.2.2 Variables

As described in chapter 2, the variables chosen for the study are quarterly GDP growth rates and quarterly changes of HICP for all 31 subjects. However, as explained in 4.2.1, all these figures were derived in Gretl and stay as the indirect variables to work on. The variables that were fitted directly on Gretl were the first differences of quarterly GDP and quarterly changes of HICP. There were 62 time series included, named as “ZZ_d” for GDP variables and “ZZ_p_d” for HICP variables, where “ZZ” should be replaced by the country codes presented in Table 1 and d implies the first difference.
In the VAR models, all variables in questions were input as simultaneously endogenous as all the economies had been interacting mutually overtime.

4.2.3 Running the VAR models

Choosing a lag order

Even though it was mentioned in the Literature Review that the typical lag used for the purpose on running data through a VAR model is lag order 2, in this study it is not possible to use this level of lag due to the large number of the time series involved. Among 28 countries and 3 regions concerned, each is represented by a times series of GDP growth rates and another one of HICP rate, which means there are 31 variables for each VAR model, where each series had only 72 or less observations, which made less than 2232 observations in total.

When running 31 time series on the VAR models for this study, we have a large system with 31 variables. If lag order were 2, each equation would have 62 parameters (representing the influence of the current year – lag 1 and that of the previous year – lag 2) to estimate and thus there were 1922 parameters to estimate overall, which the number of observations collected could not support for lag order 2. This is one of the major problems with VAR models, called overparameterization.

To identify supply and demand disturbances for individual subject, the author estimated bivariate VARs for the European Union as well as the 18 countries of EMU as a whole and for each country in the sample. In all cases, the number of lags was determined based on the anchor studies of Bayoumi and Eichengreen (1992) and Fidrmuc and Korhonen (2002) as well as the test of significance of coefficient run by the author. In the aforementioned study in 1992 of Bayoumi and Eichengreen, the lags number was set to 2, since the Schwartz Bayesian information criterion indicated that all the models had an optimal lag length of either one or two. However, they also stated that the lag length could be above 2 in some of the models based on the Akaike information and when trying with lag length of 3, very similar results were produced. In this study, the data retrieved are in quarters, not annual ones; hence the lags length should be chosen taking into account the relevant intervals. If the lags length of annual data was found to be optimal at 2, the optimal lags length of quarterly data can go up to 8 as we look for the response of the economies ideally up to 2 years after a significant shocks. Interestingly, the author has tested the VARs model with various lags lengths and based on the validity tests, the ideal lags length for bivariate VARs models is found at 8, namely 2 years of lag.

Tests of validity of lag length for VARs models

If the lag length were smaller than it should be, there would be problems with serial autocorrelation, heteroskedasticity and non-normal distribution. In order to confirm the estimated lags length to be optimal, each VARs model was run through the estimated lags length then tested for these three criteria. If the criteria are not met, the length of lags had to be increased and the models had to be run again with the adjusted lags order.

Determination of disturbances

Running data through VAR models generate equations in the formula described in 3.2.4. From these equations, one can extract the residuals' values and save them as a time series for each variable. These time series of residuals represent the so-called economic disturbances or shocks. Later on, the residuals time series retrieved from the VAR models were tested for stationarity or unit roots for validation.

4.2.4 Economic Disturbances – Identification and Measurement

The assessment for Economic disturbances (identification and measurement) for Individual Countries of the EU is facilitated by the estimations of two-variable vector autoregressive (VAR) models for all the individual countries within the EU. As explained before, the variables are quarterly changes in GDP (in the first difference) and prices (also in the first difference). All variables were endogenous. All data are seasonally adjusted and stationary and based on the Akaike information criterion, the lag length was chosen as 1 or 2 years. From this VAR models, the underlying demand and supply shocks are recovered as explained previously in chapter 2.

The very first results coming out show there exist some unexplained shocks in every country/region represented by the residuals filtered from the VAR models. Results are presented and interpreted in 4.3.1.

4.2.5 Assessment of Similarity of Shocks

Previously, Bayoumi and Eichengreen focused on the comparision of shocks in the "core" countries area against the control group formed by some states in the USA, then Fidrmuc and Korhonen (2002) were more concerned about the pair wise correlation vis-à-vis the Euro zone as they assumed the economic situation of Germany in 1990 might have been unique due to its historical and political aspects The correlation level of similarity in shocks that occurred in the EU, demonstrated in the tables below in 4.3.2.

4.3 Empirical Results

In nearly every case the estimation and simulation results accord with the aggregate-demand-aggregate-supply framework discussed in chapter 2 – Objectives and Methodology. Similar to the work of Bayoumi and Eichengreen (1992), positive aggregate demand shocks are associated with increases in prices (and vice versa with negative ones) whilst aggregate supply shocks are linked with decreased in prices as illustrated by the data.

4.3.1 Identification and Estimation of Shocks across the countries

This part of the analysis looks at the underlying Economic shocks in term of Aggregate Demand Shocks and Aggregate Supply Shocks considering their frequency, magnitudes and length of impacts for each nation involved. To enable this, 28 countries' and 3 regions' time series were assessed individually to analyze the underlying economic shocks depicted by the residuals filtered from the bivariate VAR model. Next, the author took note of the concrete years of the underlying Demand and Supply shocks, the significance of the disturbances so that it would be possible to compare and comment on the similarity between the subject countries in the following parts.

The empirical study produced two sets of time series of residuals representing unexplained economic shocks across the EU countries. The complete time series' graphs are displayed in the Annexes. In the Table 4 and Table 5, the summaries of these time series are displayed.

The gradient spread on Table 4 indicates the 3 ranges of magnitudes of Demand Shocks. The results yielded 3 main ranges where in the first group (the lightest shaded cells) the residuals of the VAR equations are critically low and in the last group (the darkest shaded cells) they are significantly high implying the strong volatility of the business cycles over time. This is the base for the analysis of group A, B and C in the later chapter 4.3.2.

Subject[5]	**Period**	**Mean**	**Median**	**Max**	**Min**	**St. Dv.**
DE	1996:1-2013:4	-4.4056e-19	0.018944	0.27112	-0.33796	0.13631
DK	1996:1-2013:4	-1.2666e-18	0.0015107	0.32057	-0.53067	0.14454
EU	1997:1-2013:4	-5.5071e-18	0.0096963	0.36138	-0.33763	0.12273
HR	1998:1-2013:4	6.0578e-18	0.0012026	0.36149	-0.37154	0.13869
FR	1996:1-2013:4	3.6203e-18	0.027341	0.40861	-0.42681	0.21926
EA18	1996:1-2013:4	1.3217e-18	-0.0038401	0.48037	-0.32528	0.14915
IR	1996:1-2013:4	5.9476e-18	-0.0091272	0.50870	-0.32272	0.13042
EA	1996:1-2013:4	9.7388e-18	-0.0030738	0.50901	-0.42523	0.18083
LU	1996:1-2013:4	1.3658e-17	-0.0051057	0.51467	-0.36393	0.13156
AT	1996:1-2013:4	1.7907e-18	0.020315	0.51970	-0.83314	0.24556
BE	1996:1-2013:4	9.1417e-18	-0.013694	0.56350	-0.31663	0.15224
CR	1996:1-2013:4	-4.1854e-18	-0.0027854	0.59764	-0.39688	0.17872
NI	1996:1-2013:4	-2.0707e-17	-0.0022356	0.63101	-0.55061	0.24546
FI	1996:1-2013:4	-5.2868e-18	-0.0092157	0.64247	-0.27612	0.15966
RO	1996:1-2013:4	-4.1854e-18	0.015842	0.64583	-0.41810	0.16622
LT	1996:1-2013:4	4.5315e-18	0.10426	0.67154	-0.95319	0.38106
SE	1996:1-2013:4	4.4056e-18	-0.026650	0.67516	-0.58876	0.25098
PL	1996:1-2013:4	-6.7151e-18	0.0017646	0.71744	-0.48750	0.17313
EE	1996:1-2013:4	2.6434e-18	-0.015568	0.73738	-0.62779	0.24739
LV	1996:1-2013:4	1.5860e-17	0.017310	0.76443	-0.50400	0.27434
HU	1996:1-2013:4	3.7284e-18	-0.050876	0.77056	-1.0806	0.33042
ES	1996:1-2013:4	1.4085e-17	-0.036762	0.78387	-0.54756	0.30742
BG	1996:1-2013:4	-1.2776e-17	-0.016737	0.80393	-0.36383	0.21283
MT	1996:1-2013:4	1.9142e-18	0.042553	0.81157	-1.5152	0.42729
SI	1996:1-2013:4	5.9282e-17	0.037269	0.81711	-0.43284	0.26048
CY	1996:1-2013:4	1.6301e-17	-0.033120	0.86942	-0.60426	0.25256
PT	1996:1-2013:4	-1.5860e-17	0.010248	1.0028	-0.83129	0.38060
IT	1996:1-2013:4	1.3878e-17	-0.0046748	1.0584	-0.71913	0.27450
EL	1996:1-2013:4	-7.0490e-18	0.016396	1.3109	-0.43017	0.22700
SK	1996:1-2013:4	-1.5067e-17	-0.014744	1.5554	-0.47654	0.33460

Table 4. Summarized Residuals of Demand Shocks

The gradient spreading on Table 5 is split into only two shades, as there are only two types of behaviour detected. Either the residuals fell into the very low rate or very high rate. There were barely any figures in between. This is the base for further interpretation in chapter 4.3.3.

[5] **Euro Area countries** are quoted in bold characters.

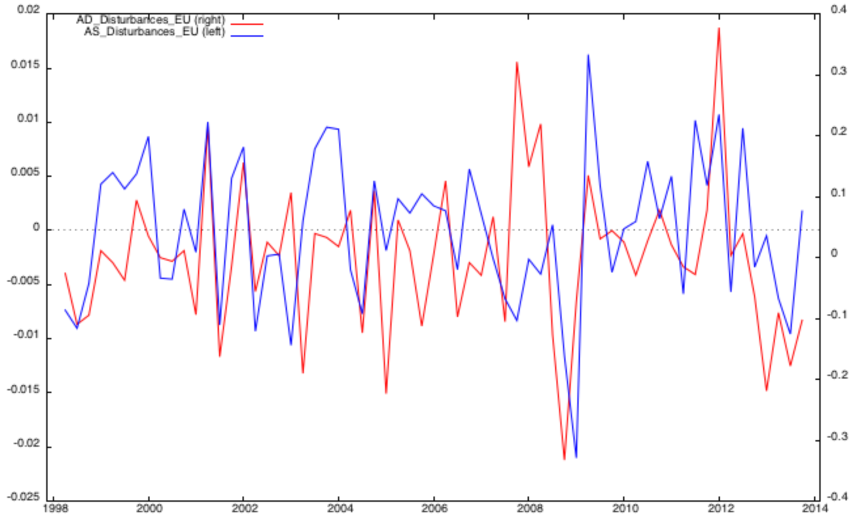
Subject[6]	**Max (%)**	**Min (%)**	**St. Dv. (%)**
FR	0.27112	-0.33796	0.13631
AT	0.32057	-0.53067	0.14454
IT	0.36138	-0.33763	0.12273
ES	0.36149	-0.37154	0.13869
NI	0.40861	-0.42681	0.21926
DE	0.48037	-0.32528	0.14915
FI	0.50870	-0.32272	0.13042
BE	0.50901	-0.42523	0.18083
PT	0.51467	-0.36393	0.13156
SI	0.51970	-0.83314	0.24556
EL	0.56350	-0.31663	0.15224
UK	0.59764	-0.39688	0.17872
EE	0.63101	-0.55061	0.24546
HR	0.64247	-0.27612	0.15966
CY	0.64583	-0.41810	0.16622
DK	0.67154	-0.95319	0.38106
BG	0.67516	-0.58876	0.25098
MT	0.71744	-0.48750	0.17313
CR	0.73738	-0.62779	0.24739
LU	0.76443	-0.50400	0.27434
IR	0.77056	-1.0806	0.33042
SE	0.78387	-0.54756	0.30742
SK	0.80393	-0.36383	0.21283
LT	0.81157	-1.5152	0.42729
LV	0.81711	-0.43284	0.26048
RO	0.86942	-0.60426	0.25256
PL	1.0028	-0.83129	0.38060
HU	1.0584	-0.71913	0.27450

Table 5. Summarized Residuals of Supply Shocks

Picture 4 below depicts the overall results: It shows the output and price disturbances through the residuals of the VAR model for the European union as a whole (EU)[7]. As the whole, the magnitude of the underlying demand and supply shocks of the EU is relatively low as observed throughout the analysis.

[6] **Euro Area countries** are quoted in bold characters.

[7] These results are obtained by running VARs on aggregate data for these regions as a whole, retrieved from the database of Eurostat, not by summing up the retrieved data of the countries in the Euro zone.



Pic. 4 Aggregate Demand and Supply shocks for the EU

4.3.2 Demand Shocks Analysis and Its Significant Findings

Based on the nature of shock, we now drive attention to the Aggregate Demand shocks in this analysis. Demand shocks recorded in this study can be distinguished into 3 groups based on their magnitude demonstrated by the range of fluctuation of the residuals filters after running the data through a bivariate VAR model for every particular subject country. Through the demand shocks recorded in 3 respective groups, certain findings can be conjured.

They reflect surprisingly well the countries grouped by years of entries.

Group A: 5 out of 6 ECSC countries are presented in this group: Belgium, France, Germany, Luxembourg and the Netherlands. Except for Croatia, the rest of the countries all have their entries in the early years: Austria (1995), Denmark (1973), Ireland (1973) and UK (1973).

Group B: 6 out of 9 countries in this group marked their entries in 2004: Czech Republic, Estonia, Hungary, Latvia, Lithuania and Poland. Romania joined in 2007, also in the later era of EU. And there are 2 exceptions, which are Finland and Sweden, where the latter one is not a member of the Euro zone. This may show that base on the relative size and the nature of economic shocks, there is a group of countries that share a potentially higher degree of symmetry. Also being a member of the EU may have changed and harmonized these economies in away that make them share the same magnitude of demand shocks. The presence of Finland and Sweden in this group triggers an assumption that besides the history of accession into EU, there might be other underlying factors that influence the level of demand shocks.

They reflect effectively the reality:

As observed in Group A: the countries presented in this group are very often considered strong and economies in normal time and even in crises, thus the fact that the empirical results could filter them in the same range actually proved the data's validity. Moreover, this group includes 5 out of 6 ECSC countries (except for Italy), which implies a significant remark of the result: the countries that show similar magnitudes of effects from economic disturbances tend to be the one that share either the size, the structure or the histories of the economies.

Group A (0,7 – 1,4)[8]			**Group B (1,4 – 2,0)**			**Group C (1,4 – 3,5)**		
State	***h***[9]	***l***[10]	***State***	***h***	***l***	***State***	***h***	***l***
AT	0.56350	-0.31663	CR	0.63101	-0.55061	BG	0.81157	-1.5152
BE	0.59764	-0.39688	EE	0.76443	-0.50400	CY	1.0028	-0.83129
HR*	0.40861	-0.42681	FI*	0.64583	-0.41810	ELI	1.5554	-0.47654
DK	0.32057	-0.53067	HU	0.78387	-0.54756	IT	1.3109	-0.43017
FR	0.48037	-0.32528	LV	0.77056	-1.0806	MT	0.81711	-0.43284
DE	**0.27112**	-0.33796	LT	0.67516	-0.58876	PT	1.0584	-0.71913
IE	0.50901	-0.42523	PL	0.73738	-0.62779	SK	1.6701	-1.3094
LU	0.51970	-0.83314	RO	0.67154	-0.95319	SI	0.86942	-0.60426
NI	0.64247	-0.27612	SE*	0.71744	-0.48750	ES	0.80393	-0.36383
UK	0.36149	-0.37154						

Table 6. Groups of countries with potential symmetries formed by Demand Shocks analysis

[8] The minimum and maximum gaps between the high ends and the low ends in respective countries

[9] The high ends on graphs or the maximums of residuals

[10] The low ends on graphs or the minimums of residuals

When one looks into the figures more closely, it is shown that the h index of Denmark, France, Germany and UK are critically close to each other at very low numbers, showing the stability of these significantly strong economies. This can help make it less challenging to impose a policy for such group of countries that are more likely to be affected in similar trends.

The validity of the result is more strongly confirmed when observing the indicator h for Germany, which turned out to be the lowest in this study. Germany's economy is considered most of the time to be the core of EU and their indices are most of the time the anchor for different analysis for accessions countries. Thus, when the indicator h reflects a low magnitude of Demand shocks in the observed period, the result tends to be more relevant to that of other studies of the same topic. In addition to that, the gap between h and l indices of Germany is the smallest range of fluctuation, showing the smallest relative size of the underlying demand shocks. This makes a lot of sense as Germany's economy has many times been chosen as the anchor threshold or criterion to assess an accession country in many studies.

The data resulting the appearance of Croatia in the group A can be the explained by the process of accession where the country has to adjust their economy to satisfy the conditions. In Group B and Group C, the countries share very similar history of accession and the sizes of the economies as well as the openness are to some extents symmetric. More discussions about small and open economies are vividly written in *Economics of monetary union* by Paul De Grauwe and further opinions can also be found in the working paper of Fidrmuc and Korhonen (2002).

4.3.3 Size of Supply Shocks and Its Important Findings

One interesting advantage of using VAR models is the possibility of measuring the size of Shocks. The methodology employed in this study does not only allow us to look at the symmetry or correlation of shocks across the respective regions, it can also be used to estimate their relative size. In the previous chapter of discussions for the nature of shocks across the countries, it was often mentioned by the term "magnitude", yet only in this section, this aspect finally contributes to some important findings.

In the table below, the relative sizes of the supply shocks depicted by the high and low ends values of the residuals filtered out after running bivariate VAR models for each particular member state are listed in an ascending trend.

Group X						**Group Y**		
State	***h***[11]	***l***[12]	***State***	***h***	***l***	***State***	***h***	***l***
FR	0.0086922	-0.0083098	**PT**	0.017253	-0.015006	BG	0.040843	-0.052850
AT	0.0088663	-0.011059	**SI**	0.018180	-0.029327	**MT**	0.042930	-0.030919
IT	0.011670	-0.012183	**ELI**	0.019600	-0.020561	CR	0.044061	-0.064482
ES	0.012845	-0.010048	UK	0.020127	-0.022982	**LU**	0.050384	-0.047441
NI	0.013505	-0.019210	**EE**	0.022582	-0.025348	**IE**	0.055880	-0.053202
DE	0.014132	-0.025889	HR	0.023080	-0.043928	SE	0.063124	-0.067654
FI	0.015613	-0.025612	**CY**	0.026210	-0.024579	**SK**	0.064246	-0.079354
BE	0.016278	-0.013223	DK	0.032795	-0.025266	LI	0.075892	-0.078506
						LV	0.082420	-0.069067
						RO	0.083508	-0.14958
						PL	0.084852	-0.13537
Note: The countries in bold are members of Euro zone.						HU	0.097831	-0.10476

Table 7. Groups of countries with potential symmetries formed by Supply Shocks analysis

As it was mentioned in the working paper of Bayoumi and Eichengreen (1992), the larger the size of the underlying shocks, the more difficult it may be to maintain a fixed exchange rate, and the more compelling may be the case for an independent economic policy to response. They stressed out that this is particu-

[11] The highest peaks on graphs or the maximums of residuals

[12] The lowest peaks on graphs or the minimums of residuals

larly true of supply shocks, which may require more painful adjustment. Once again, based on the results related to the underlying disturbances of Supply shocks, this point is proven with surprisingly relevant outcomes.

4.3.4 Correlation of Economic Shocks

Estimation of Correlation among EU countries regarding Economic Shocks

This is done by running the VAR model for data from all the countries in the EU as a whole and with respective natures of shocks. From the outcomes, the EU shows very low symmetry in the disturbances of aggregate demand and supply. Results are fully depicted in the Annexes, where we can find the mean of correlation coefficients and the medians of correlation coefficients for aggregate demand and supply shocks summarized as follow.

Correlation coefficients'	Demand Shocks	Supply Shocks
Means	0.2375	0.2407
Medians	0.2006	0.2413
Maximum	0.8427	0.9330
Minimum	-0.3303	-0.3235

Table 8. Summary of the Correlation Matrix of EU countries

Compared to the next paragraph and the ones in section 4.3.5 where certain EU countries are analyzed into group of similar history[13], natures and relative sizes, these figures are significantly low, showing that there are very obvious asymmetries in the EU as a whole.

Estimation of Correlation for ECSC countries regarding Economic shocks

In 1952, the first six countries joining EU were Belgium, France, Germany, Italy, Luxembourg and the Netherlands. In the study of assessing the shocking as-

[13] The author made an assumption that countries entering the EU in the same period of time should share some similar business cycle as they fulfill EMU criteria at about the same time and their economies benefit from the EMU from the same milestones. Thus, it should be considered as well when grouping the countries.

pects of EMU in 1992, Bayoumi and Eichengreen named these countries as the core countries and once again in this study, they share a considerably high level of symmetries based on the correlation retrieved from the VARs residuals. The table below demonstrates the correlation matrix for these 6 countries, with means of 0,35 and median of 0,36.

Compared to the previous headline of this section, it is obvious that the figures are slightly larger, showing higher degree of correlation between the countries that have joint from the beginning form of the European Union. This can be well explained by common economic policies and high integration of economies' developments through trades and cooperation.

BE[14]	**FR**	**DE**	**IT**	**LU**	**NL**	
1	0,5799	0,5260	0,3558	0,0376	0,3010	**BE**
	1	**0,6450**	0,4409	0,2075	0,5134	**FR**
		1	0,3952	0,1522	0,5104	**DE**
			1	0,0350	0,3181	**IT**
				1	0,2551	**LU**
					1	**NL**

Table 9. The correlation matrix of 6 ECSC countries

4.3.5 Estimation of Correlation for different groups A, B, C, X & Y

In this part, the residuals time series of the suggested group A, B and C put on 3 new correlation matrices that showed interesting symmetries in group A and B and critical asymmetries in group C.
Original displays of Gretl can be found on page 79, in the Annex section.

Group A

Table 10 shows the correlation matrix of supply shocks residuals recorded for countries of the presumed group A base on the selection of the author. The selection was made based on Table 4.

[14] Countries abbreviation can be found in the Annexes.

In this graph, there appears critically high correlation degree, especially between France and Germany where it is calculated as 0,7183. This can prove that, for the countries of group A, the benefits of joining a currency area can win over the costs of this action since some countries, as depicted in this table, do share critically high level of symmetries based on the effects of Economic shocks upon their economies during the observed period.

This can be explained also from the aspect of some certain common policies that they have been imposing together since 5 countries in this group have in been in a consistent union since 1952, thus the symmetric behaviour of their business cycles are expected.

AT	**BE**	**HR**	**DK**	**FR**	**DE**	**IE**	**LU**	**NI**	**UK**	
1	0,5095	0,0830	0,4445	0,6612	0,3795	0,0873	0,2615	-0,0271	0,4770	**AT**
	1	0,2288	0,3151	0,5193	0,5211	-0,0302	0,0194	0,1211	0,6399	**BE**
		1	0,4267	0,1209	0,2778	0,0382	0,1066	0,1628	0,4727	**HR**
			1	0,4823	0,4079	0,1564	0,2855	0,2636	0,4471	**DK**
				1	**0,7183**	0,1502	0,1954	0,4487	0,4600	**FR**
					1	0,0669	0,0834	0,3974	0,5758	**DE**
						1	0,4243	0,2083	0,2880	**IE**
							1	0,1750	0,3645	**LU**
								1	0,0301	**NI**
									1	**UK**

Table 10. Correlation Matrix of Supply Shocks of countries in group A

Group B

CR	EE	FI	HU	LV	LT	PL	RO	SE	
1	0,1507	0,4540	0,6495	0,4120	0,4702	0,6140	0,3129	0,5562	**CR**
	1	0,3314	0,2994	0,4191	0,3180	0,1836	0,3588	0,3887	**EE**
		1	0,3029	0,2834	0,2510	0,4769	0,3617	0,4999	**FI**
			1	0,5458	0,4753	0,6533	0,5475	0,5445	**HU**
				1	0,4403	0,4173	0,3078	0,4093	**LV**
					1	0,6180	0,6325	0,6025	**LT**
						1	0,5874	0,6828	**PL**
							1	0,4860	**RO**
								1	**SE**

Table 11. Correlation Matrix of Supply Shocks of countries in group B

The correlation shown in Table 11 is not critically different from the one recorded in the data processing of the whole EU; however the figures are indeed higher showing that the symmetries between the countries in group B when compared together can be notably higher when put together with all the rest of EU. This does not suggest that they may form a monetary union, but it has effectively proved that symmetries can exist among carefully selected grouped countries.

There are no negative value on Table 11, which can imply that there should be an interlink among these economies. Assessing the size, they are no core countries or significantly large economies detected in this group. A lot of those actually made the entrance to EU in the same year 2004, which can be an argument for the moderate symmetries among them. The highest coefficient is 0,68 between Poland and Sweden and the second ones are 0,65 between Hungary and Poland, then Czech Republic. These figures, yet, have not reached the maximums found on the correlation matrix of the whole VAR model, or the maximum in group A; but they are moderately high. This suggest that certain cluster of countries can be formed from those sharing the correlation coefficients from 0,4~ to 0,6~ and those that share the same indicator of under 0,4.

Group C

BG	CY	ELI	IT	MT	PT	SK	SI	ES	
1	0,0523	-0,3803	0,3193	0,5233	0,4270	0,1258	0,5657	0,5848	**BG**
	1	-0,1831	-0,1334	0,5209	0,3593	0,3326	0,0372	0,1397	**CY**
		1	0,2115	-0,1777	0,0081	0,0116	0,0930	-0,1048	**ELI**
			1	0,0278	0,4279	0,1503	0,4535	0,6335	**IT**
				1	0,1489	0,3277	0,4044	0,3544	**MT**
					1	0,3197	0,2565	0,3285	**PT**
						1	0,4659	0,2180	**SK**
							1	0,4749	**SI**
								1	**ES**

Table 12. Correlation Matrix of Supply Shocks of countries in group C

Different from the figures from Table 10 and Table 11, those of Table 12 include many negative values. Moreover, the group C also shows conflicting results of some high and low correlation at the same time. This may suggest that this group consists of different economies that do not share any high symmetry either mutually or with the rest of the subject countries in this study.

The figures for Greece could be controversial as the data for it were not complete. The missing data resulted to a shorter time series of residuals, thus can lead to a even lower correlation coefficient with the rest of the subjects whose data were fully retrieved and yielded lengthy and uniform sized time series.

Considering those moderately higher correlation coefficients in this group, they show a possibility that some countries may respond the same way to shocks; for instant:

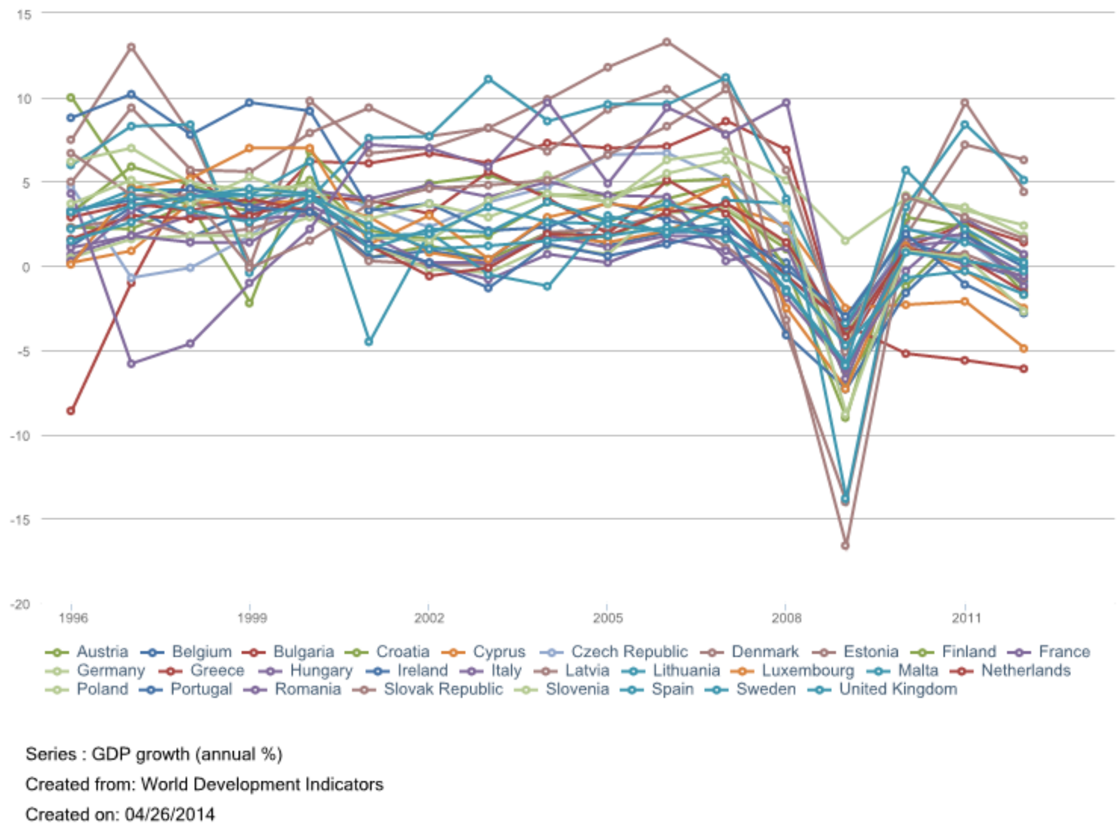
This may propose that they should not join the EMU if they have not and, if they have, the costs of joining are actually higher than the benefits.

Group X and Y

Even though it was expected to show some high symmetries based on the arguments above, the correlation of the countries in the group X is actually low. Even though most of the countries are already members of EMU, the figures proved that they do not stay under the same magnitude of impacts from Economic shocks. The correlation shown in this is not critically different from the one recorded in the data processing of the whole EU; does not suggest that they may form a monetary union, if symmetry is such an important criterion.

Similar to group X, it was also expected to show some high symmetries based on the arguments above for group Y; however, the correlation of the countries in the group Y is actually low as well. The group shows conflicting results of some high and low correlation at the same time. Like group C, this may also suggests that this group contains of different economies that do not share any high symmetries with the rest of the subject countries in this study. This may proposed that they should not join the EMU if they have not and, if they have, the costs of joining are actually higher than the benefits. In this case, countries which are under the pressure of making decisions to access the Euro zone, for instant, Czech Republic may not benefit as much as the costs they may face.

5 Discussion



Pic. 5 Annual GDP growth of 28 countries in EU from 1996 to 2013

As Picture 5 above depicted, one may find it hard to compare the countries in the EU looking at just series of GDP growth to determine the harmony and balance of the economies of the member states. This study is one of the attempts to use statistics in models to detect economic disturbances through some estimation and thus enable the discussion for the asymmetric shocks that have been proven through out the empirical results.

5.1 A comparison to the study of Bayoumi & Eichengreen (1992)

Even though this thesis has adapted the same methodology used in the paper of Bayoumi and Eichengreen (1992), the data and results presentation have some cetain differences. Bayoumi and Eichengreen attempted to compare the shocks of 10 countries to that of Germany by displaying the coefficients on a table using Germany as the anchor.

Countries	Demand Shocks	Supply Shocks
DE	1	1
FR	0,54	0,35
BE	0,61	0,33
NI	0,59	0,17
DK	0,59	0,39
UK	0,11	0,16
IT	0,23	0,17
ES	0,31	-0,07
IE	-0,06	-0,08
PT	0,21	0,21
ELI	0,14	0,19

Table 13. Correlation coefficients of Demand and Supply Shocks of EC countries with Germany during the period of 1962-1988, Bayoumi and Eichengreen(1992)

Compared to Table 8, the correlation coefficients calculated by Bayoumi and Eichengreen (1992) were much higher than the means and medians of correlation coefficients of the EU countries from 1996 to 2013; however lower than the figures in Table 9 where the coefficients are for 6 ECSC countries. The controversial point lies in the fact that the groups of countries are not the exactly the same to facilitate a precise comparison. However, the ranges of the figures suggest that symmetry is much weaker in EU as a whole compared to EC countries in the past and considering only the core countries, it seems to be significantly enhanced.

Thus, it might be incorrect to conclude that there exist no symmetry among EU countries. The more effective question to pose might be which of the EU countries will show high symmetries in response to economic shocks.

Another different between the 2 studies is the way of displaying data. The coefficients in this thesis are display mutually among all subjects of each model or each group, thus there can be some further observations beyond the mere comparisons with the anchor subjects only.

5.2 A comparison to the study of Horvath, Raftai (2004)

Country	Supply Shocks			Demand Shocks		
	DE	FR	IT	DE	FR	IT
CR	0,13	0,07	0,12	0,08	0,00	0,30
SK	-0.03	-0,09	0,44	0,10	-0,19	0,33
PL	0,16	0,08	0,21	-0,18	0,00	-0,02
HU	0,23	0,38	0,30	-0,09	0,52	0,30
SI	-0,02	0,26	0,03	0,12	0,31	0,28
EE	0,04	0,25	-0,11	-0,10	-0,06	-0,04
LV	0,08	-0,31	0,00	-0,07	0,24	0,17
LT	0,23	0,15	-0,02	-0,22	-0,34	-0,11

Table 14. The similarity of shocks among some candidate and member countries of EMU

These authors used the same methodology that was developed by Blanchard, Quah (1989) and Bayoumi, Eichengreen (1992) with the same desire to assess demamd and supply shocks. Not only focusing on that goal, they also tempted to look at the symmetry of these shocks, which is very close to the goals of this thesis. The main difference lies in the subjects studied and the period as Horvath and Raftai's study based on the time scale from the first quarter of 1993 to the third one of 2000.

The next similar point is about the quarter data. Even though the length of the series are not as large as that used in this thesis, the quarterly data could enhance precision and thus yield better findings.

Nevertheless, the results show very critical discrepancies. This might be due to the different time period where the economies experienced different incidents and were under different policies. However some same patterns could be found from the figures. The numbers are small from both studies confirming the theory that there exist a high asymmetry among these countries and the core ones.

In a nutshell, despite the certain different among the figures on a detailed scale, one may still find that the results from the two studies effectively complement each other and this can help confirm the argument that shocks in EU are partially asymmetric.

5.3 Extended Discussions on the Practical Part

Even though the findings from this study are rooted from only statistics analyses, the results and interpretation in fact do not reflect generic or theoretical characteristics. The graphs of shocks depicted very well the economies of each country subject in this study and reflect also critical occurrences that have been observed over the past few years.

The assumption that the countries analyzed can be divided into groups to strengthen symmetries reflect surprisingly well the actual positions of the economies nowadays. Through the demand shocks recorded in 3 respective groups, certain features were well reflected. In the group A: 5 out of 6 ECSC countries are presented: Belgium, France, Germany, Luxembourg and the Netherlands. Except for Croatia, the rest of the countries all have their entries in the early years: Austria (1995), Denmark (1973), Ireland (1973) and UK (1973).

Group B: 6 out of 9 countries in this group marked their entries in 2004: Czech Republic, Estonia, Hungary, Latvia, Lithuania and Poland. Romania joined in 2007, also in the later era of EU. And there are 2 exceptions, which are Finland and Sweden, where the latter one is not a member of the Euro zone. This may show that base on the relative size and the nature of economic shocks, there is a group of countries that share a potentially higher degree of symmetry. Also being a member of the EU may have changed and harmonized these economies in away that make them share the same magnitude of demand shocks. The presence of Finland and

Sweden in this group triggers an assumption that besides the history of accession into EU, there might be other underlying factors that influence the level of demand shocks.

Looking at group A: strong and economies in normal time and even in crises are depicted by the h index of Denmark, France, Germany and UK, which are significantly close and low, showing the stability of these strong economies. The indicator h is the lowest for Germany – the economy that is considered most of the time to be the anchor threshold to analyze the potential candidates of EU and their indices are most of the time the anchor for different analysis for accessions countries. The gap between h and l indices of Germany is the smallest through out the study, which is the minimum range of fluctuation, showing the smallest relative size of the underlying demand shocks.

In Group B, the countries share very similar history of accession and the sizes of the economies. All of them have very strong openness and they are strongly dependent on imports and exports, thus they can gain a lot of benefits from the flexible exchange rate regimes.

In reality, the asymmetries of shocks are more complex and depend on more variables covered by this study. This thesis may contribute to back up the arguments that most of the current EU countries do not share the symmetries they need to have in order to form an optimal currency area; yet based on other factors, the possibility of yielding benefits from the EMU is still taken into account. Thus the making decisions process on pegging a currency of the whole national economy can be discussed further on by applying different methodologies and models, or the same models but with different variables. This study can still be extended by applying the same method in GNP and unemployment rate as it was attempted by Blanchard and Quah (1998), or with many various indicators that contribute to the change of the economies like the HDI index, the R&D, impulse response functions of individual fiscal and monetary policy, etc.

From the beginning of this thesis, one of the questions was posed to see whether giving up the own currencies will improve the economy or worsen the situation of the countries in EU? From the point of view of the first criterion, and based on the statistical result, the answer may be not. And hence, it might have given a hint to answer also the second question: "And after all does EMU meet all the criteria of an optimum currency area?" This implies that **a part of the EMU and parts of the EU are facing asymmetries and imbalances regarding the influences under Economic disturbances**, and propose that in order to maintain the highest benefits desired from the monetary union, others criteria should be revised and enhanced. Many other papers also discussed that the factor of mobility and exchange may diminish the short and long term of the disadvantages caused by asymmetries and imbalances even though some maintained that, in the absence of the ability to alter the exchange rates, and given that there will be a single monetary policy for the whole area; no credible mechanism will manage to vanish the asymmetric shocks – the disturbances that generate varying economic effects on different parts of the area.

One more finding from the analysis was about the natures of shocks for individual countries. The disturbances in EU since 1996 to present days have been behaving in various frequencies and magnitudes. Based on the similarity of time periods where the certain type of Supply or Demand Shocks occurred, **we can form certain groups of countries that shared the similar effects over time.**

The groups of countries that share similar effects from similar natures of shocks may have higher possibility to gain more benefits over the costs of joining the EMU. As shown in the table of group X and Y in chapter 4, one may predict that it may yield benefit for Denmark or Croatia to join the EMU, but it may not for the rest of the countries. However, the countries that are in the concerned group that holds the Euro currency are rather new member states (Malta, Latvia and Slovakia) and the rest of the group Y in chapter 4 are not yet members of the EMU, thus there can be an argument that the asymmetries can be diminished after their accession. Even though the European Monetary Union (EMU) has recently overcome some critical financial crises over the past few years, many countries in reality are still facing the puzzles of increasing unemployment rates and instability, thus the question of its existence may still remain and the expansion limitation should be taken into account with comprehensive assessment.

6 Conclusion

The main objective of the thesis is to figure out whether the economic shocks are asymmetric and if there are imbalances in the European Union from observable data, by using a structural vector autoregressive model. **After the analysis, the hypothesis of asymmetries and imbalances cannot be rejected**. The very low correlation between the whole EU countries analysis has shown by small figures in both individual and mass data processing. With this high level of asymmetries, it is critically challenging to impose an effective and appropriate common monetary policy for the EMU.

Through four parts of the thesis, the final goal and partials goals are depicted and achieved. Based on the revisions to related literatures that scanned through the same discussion in Chapter 3, Chapter 4 described the data used in this research, and reported the process as well as the results of running the data through the models describe. The interpretation of the data has led to the conclusion that there may not be symmetry for the whole EU, but there exist symmetries in certain parts of it. Last but not least, chapter 5 brought up some discussion of the relevance and reliability of the analysis, as well and possible pursue of the matters reviewed in this paper with different approaches.

The author insists on three key conclusions. First of all there exist demand and supply shocks in the EU. Secondly, the magnitudes of these shocks vary in two or three ranges. Thirdly, there are very low symmetries among the effects of shocks toward different economies in the EU in respective natures of shocks.

These 3 points were achieved firstly based on the filtered residuals from the VAR model. The existence of demand and supply shocks were proven by the time series of the residuals that were filtered from the VAR model. Each time series represented the unexplained disturbances to the economies. These time series were also graphed and shown in the Annexes to illustrate how they fluctuated over time and indeed reflected relevant trends to reality, thus virtually displayed the magnitudes of the shocks. Even though for each country, the demand and supply shock curves behaved in various ways, all of them showed the critical crisis in 2008 and 2009. A few countries share very similar shapes, frequencies and behaviour of respective demand or supply curves, which suggests that there are certain symmetries among them. Observation of these graphs helped direct the study into more comprehensive studies of the figures to produce more precise conclusions in the following paragraph.

The second argument for the 3 anchor conclusions is by studying the properties of the residuals time series and also by using the correlation matrices to assess these numbers. The mere fact that each equation of each country could result in a time series suggests that there are economic shocks over the observed period of time for these 31 subjects. The residuals from the VAR models of GDP growth rate show the possible disturbances in term of supply shocks and that of HICP do the same in term of demand shocks. The nature of shocks was determined and this led the empirical study into two main branches so as to pursue to answering the last two questions of the second and third partial goals.

The study of the demand shocks' residuals has come up to a finding that there are about three ranges of magnitude, based on which, the countries subjects were separated in to groups A, B, C then their residuals were put on a new correlation matrix (respectively for each groups) that showed interesting symmetries in group A and B and critical asymmetries in group C. The countries of each group, moreover, shared certain similar history or sizes of the economies.

As for the supply shocks, there were merely about two ranges of fluctuation observed, which suggested that the subjects could be grouped in to groups X and Y. The correlation matrices of groups X and Y did not bring up very astounding implications; however the subject countries included in these groups reflected well the membership status toward Eurozone. This relevance can suggest that the study has a considerable validity and also, there might be a relation between using the currency Euro and the supply shocks, which might be an interesting topic to develop further.

Not only did the empirical study lead to the conclusion that there exist some certain asymmetries in the EU, it also enabled some policy implications. There is a clear warning that the EU is not quite a homogenous entity toward economic shocks since they are proven asymmetric among the member states in frequency, nature and magnitude. The EMU is also facing some Fiscal Transfer and Labor Mobility issues, thus it would be not only challenging to impose common policies, but also to move toward convergence. Regarding the imbalances detected in the EU, one may suggest that the EMU should search for different mechanism of harmonizing the economies, which in fact has already been on the go. Or else, the harmony of the business cycle if improved could help the countries face economic shocks and respond to them with more symmetry. One way to facilitate is to enhance the industrial trading to make the countries member more interlinked so as to slowly reduce the discrepancies in the performance indicators and limit the asymmetries as low as possible.

Another significant finding is that it is very probable that sub monetary unions may exist or may have been formed overtime. The figures collected have shown that the correlation coefficients' maximums have increased and their mininums have decreased compared to the calculation of earlier working paper in the same topic. This is a sign that certain economies are getting more symmetric in responding to economic shocks while some others have progressed in different directions. Thus there might be a possibility that certain countries, if formed into sub-areas may be better off and they may yield more overall as well as individual benefits compared to the costs what it takes to peg the currency.

7 References

DE GRAUWE, PAUL. *Economics of monetary union*. Oxford,United Kingdom: Oxford University Press, 2012. ISBN 978-0-19-960557-6.

FATAS, A. AND MIHOV, I., 2001a. *Fiscal Policy and Business Cycles: An Empiri- cal Investigation.* Moneda y Credito, 212, 167-210.

FATAS, A. AND MIHOV, I., 2001b. *The Effects of Fiscal Policy on Consumption and Employment: Theory and Evidence* [online]. CEPR Discussion Paper, No. 2760. Available from: [http://faculty.insead.edu/fatas/fiscal.pdf].

BAYOUMI, T. AND B. EICHENGREEN. *Shocking Aspects of European Monetary Unification.* Cambridge,Massachusetts: National Bureau of Economic Research, 1992, No. 3949.

BERGER, H. and T. MOUTOS. *Designing the new European Union. Amsterdam*, The Netherlands: Elsevier, 2007. ISBN 978-0-444-52968-8.

FRANKEL, J. A. and A. K. ROSE. *The Endogeneity of the Optimum Curren- cy Area Criteria*. Cambridge,Massachusetts: National Bureau of Economic Re- search, 1996, No. 5700

ŠTIKOVÁ, R, 2006. *Effects of Fiscal Policy in the Czech Republic: a SVAR analysis* [online]. Available from: [http://ies.fsv.cuni.cz/default/file/download/id/ 5551].

RAMEY, V. A. AND SHAPIRO., M. D., 1998. *Costly Capital Reallocation and the Effects of Government Spending [online]. Carnegie-Rochester Conference Series on Public Policy*, 48 (June), 145-194. Available from: [http://www.sciencedirect.com/science/article/B6V8D-3VNGGBF-7/2/439a0918c6f10ff2f107f16e2036b6eb].

FÜRRUTTER, M. *The Eurozone: An Optimal Currency Area?*. Innsbruck, Aus- tria: IFIER Innsbruck, 2012.

KRUGMAN, PAUL A MAURICE OBSTFELD. *International Economics: Theory&policy*. New York, NY: Pearson Addison Wesley, 2009. ISBN 978-0-321-49304-0.

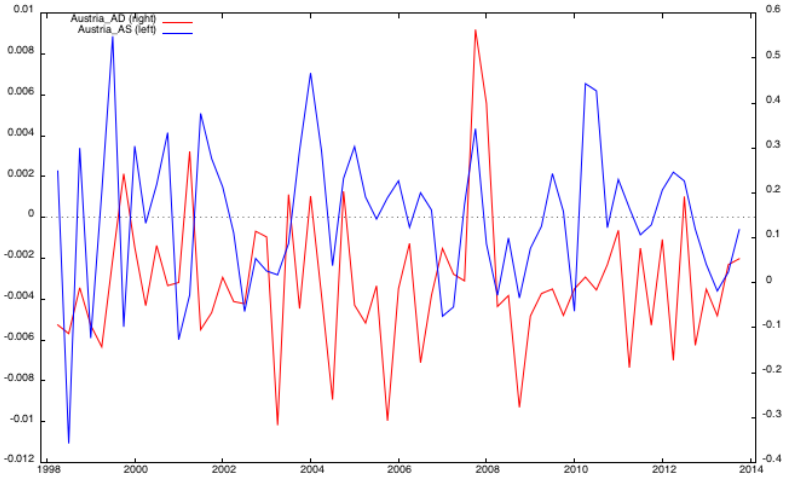
LEE, YU-FENG L. Trade, *International Business Cycles, and the Optimum Currency Area*. Carbondale, Illinois: Southern Illinois University Press, 2004.

Annexes

Detailed Countries Abbreviation

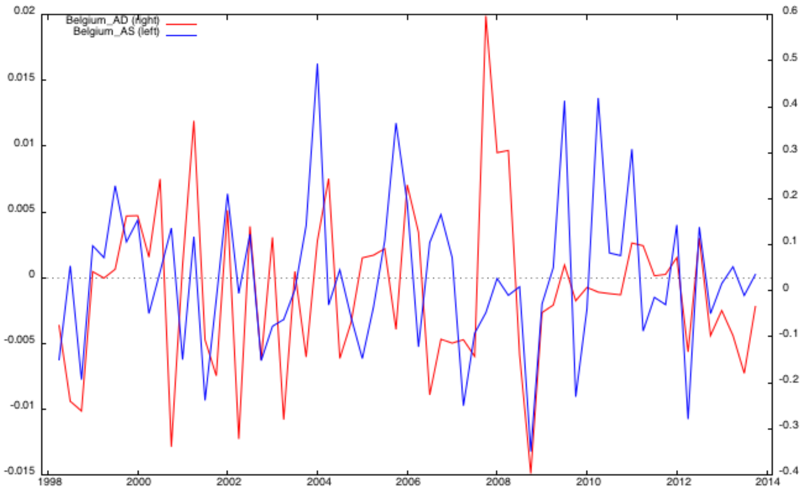
Short name (source language)	Short name (English)	Official name	Code
Belgique/België	Belgium	Kingdom of Belgium	BE
България	Bulgaria	Republic of Bulgaria	BG
Česká republika	Czech Republic	Czech Republic	CZ
Danmark	Denmark	Kingdom of Denmark	DK
Deutschland	Germany	Federal Republic of Germany	DE
Eesti	Estonia	Republic of Estonia	EE
Éire/Ireland	Ireland	Ireland	IE
Ελλάδα	Greece	Hellenic Republic	ELI
España	Spain	Kingdom of Spain	ES
France	France	French Republic	FR
Hrvatska	Croatia	Republic of Croatia	HR
Italia	Italy	Italian Republic	IT
Κύπρος	Cyprus	Republic of Cyprus	CY
Latvija	Latvia	Republic of Latvia	LV
Lietuva	Lithuania	Republic of Lithuania	LT
Luxembourg	Luxembourg	Grand Duchy of Luxembourg	LU
Magyarország	Hungary	Hungary	HU
Malta	Malta	Republic of Malta	MT
Nederland	Netherlands	Kingdom of the Netherlands	NL
Österreich	Austria	Republic of Austria	AT
Polska	Poland	Republic of Poland	PL
Portugal	Portugal	Portuguese Republic	PT
România	Romania	Romania	RO
Slovenija	Slovenia	Republic of Slovenia	SI
Slovensko	Slovakia	Slovak Republic	SK
Suomi/Finland	Finland	Republic of Finland	FI
Sverige	Sweden	Kingdom of Sweden	SE
United Kingdom	United Kingdom	United Kingdom of Great Britain and Northern Ireland	UK

Austria (1995)



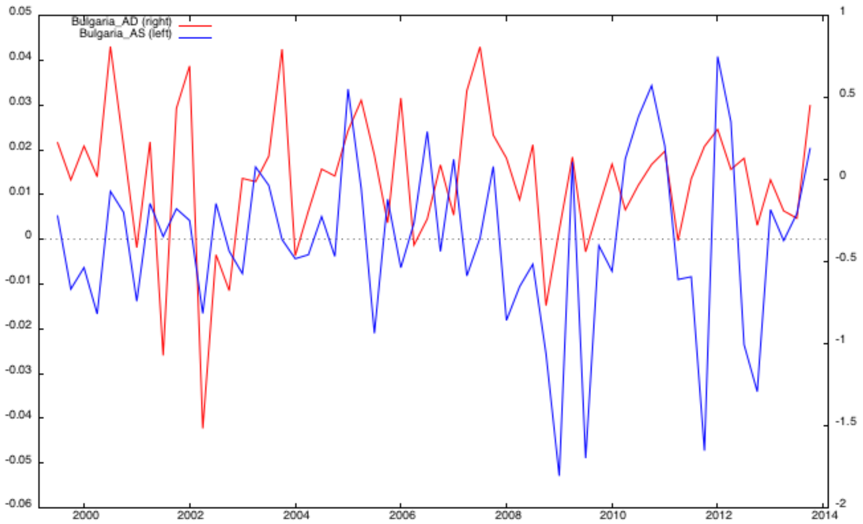
Pic. 6 Aggregate Demand and Supply shocks for Austria

Belgium (1952)



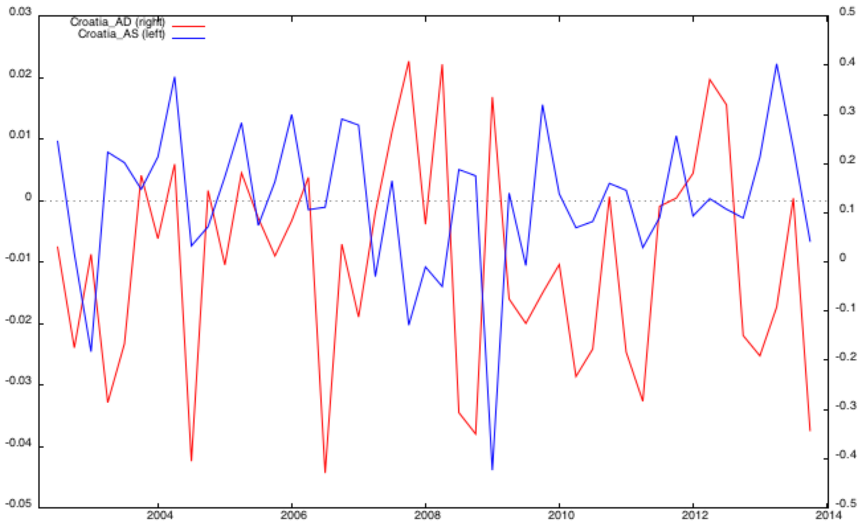
Pic. 7 Aggregate Demand and Supply shocks for Belgium

Bulgaria (2007)



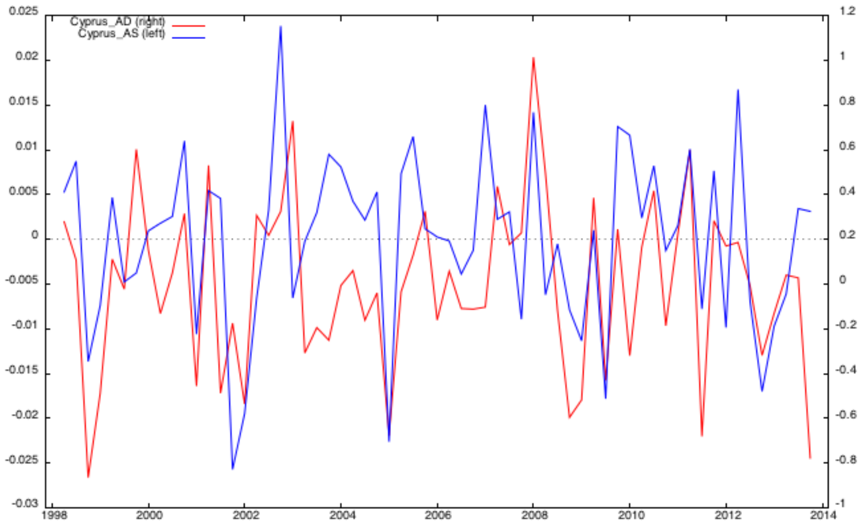
Pic. 8 Aggregate Demand and Supply shocks for Bulgaria

Croatia (2013)



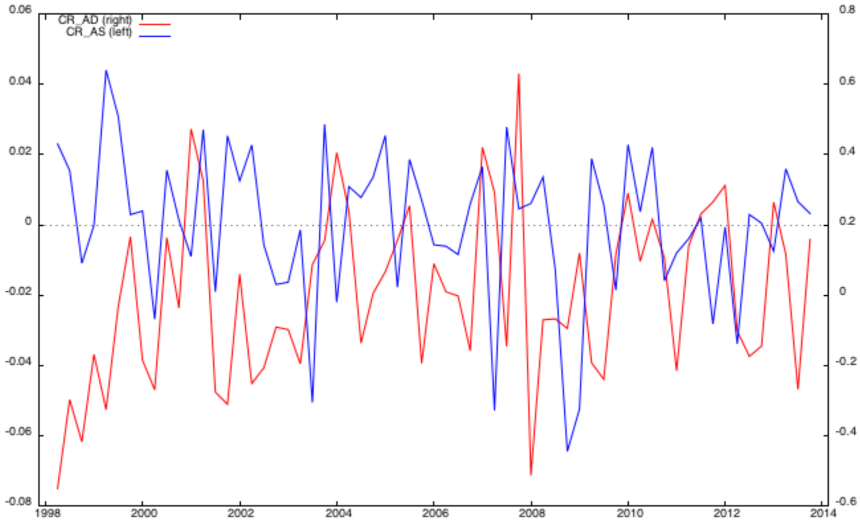
Pic. 9 Aggregate Demand and Supply shocks for Croatia

Cyprus (2004)



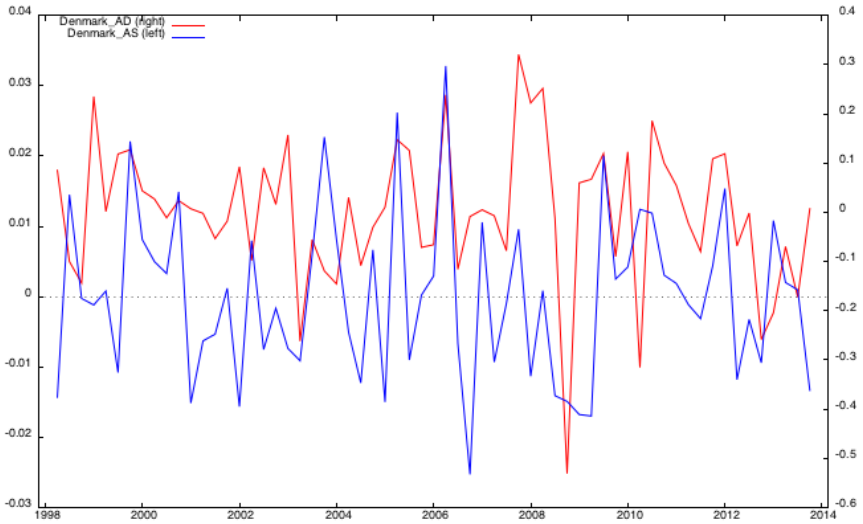
Pic. 10 Aggregate Demand and Supply shocks for Cyprus

Czech Republic (2004)



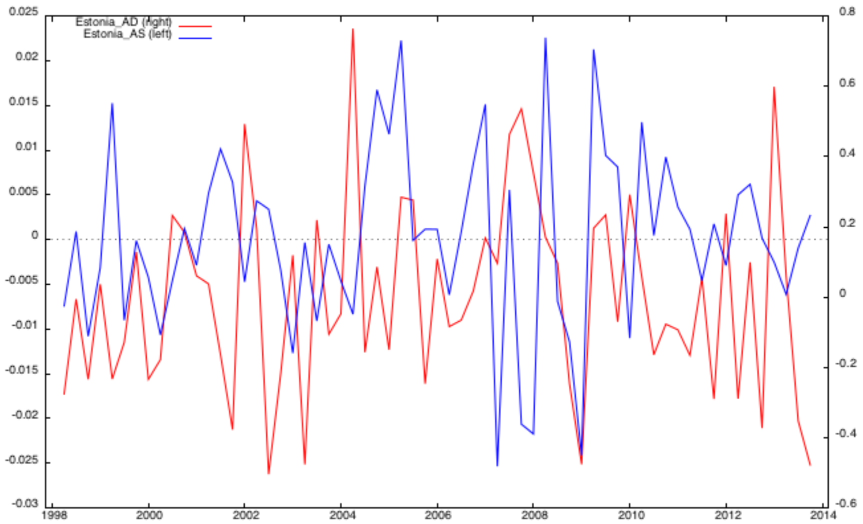
Pic. 11 Aggregate Demand and Supply shocks for Czech Republic

Denmark (1973)



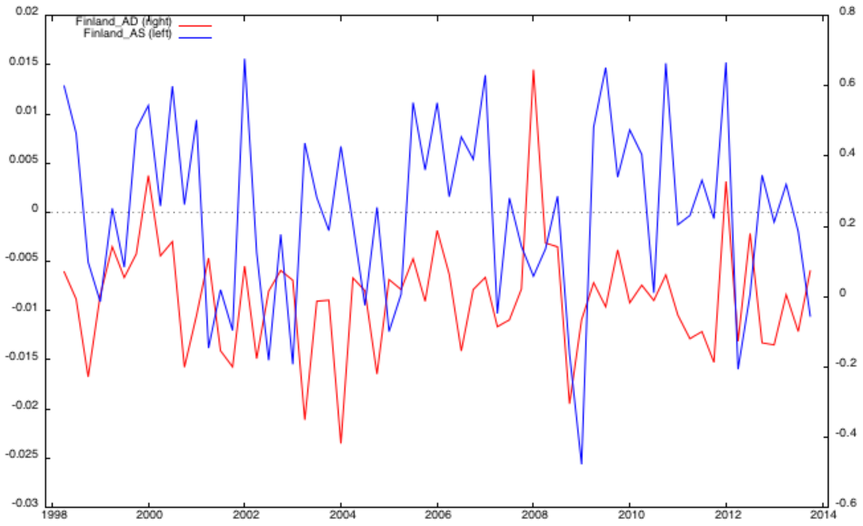
Pic. 12 Aggregate Demand and Supply shocks for Denmark

Estonia (2004)



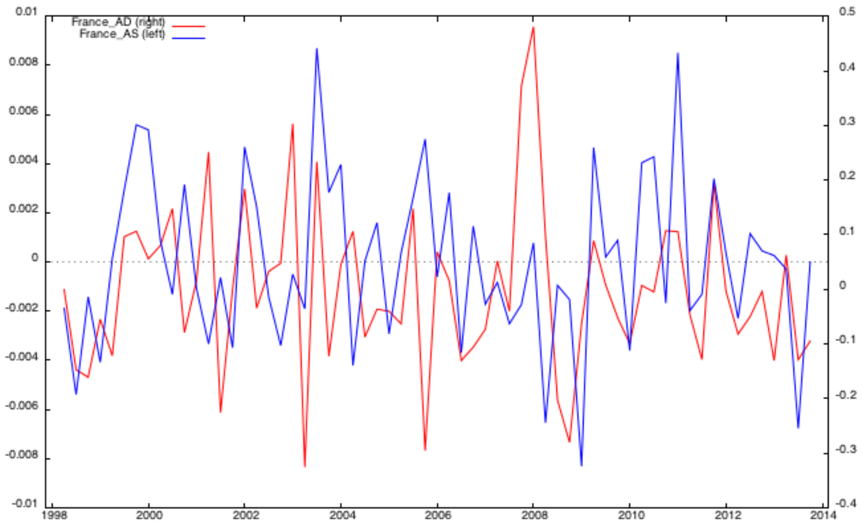
Pic. 13 Aggregate Demand and Supply shocks for Estonia

Finland (1995)



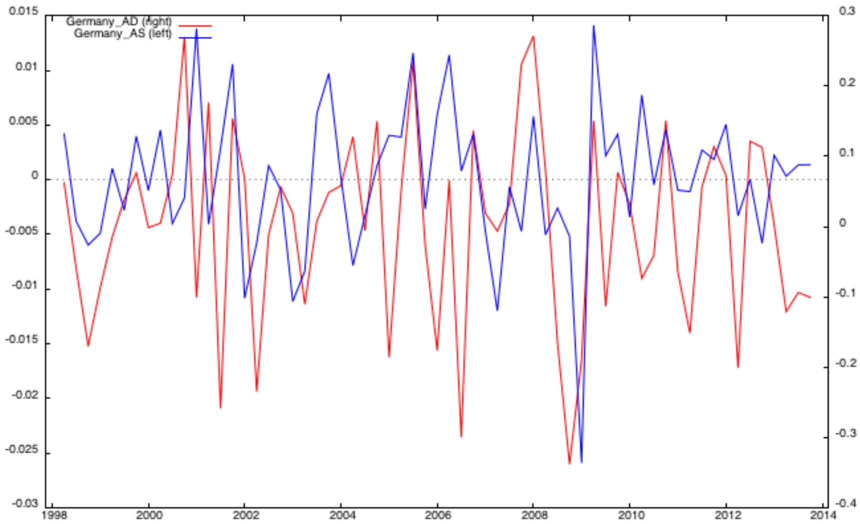
Pic. 14 Aggregate Demand and Supply shocks for Finland

France (1952)



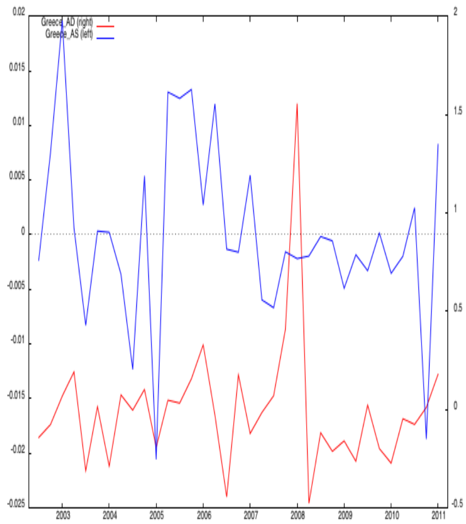
Pic. 15 Aggregate Demand and Supply shocks for France

Germany (1952)



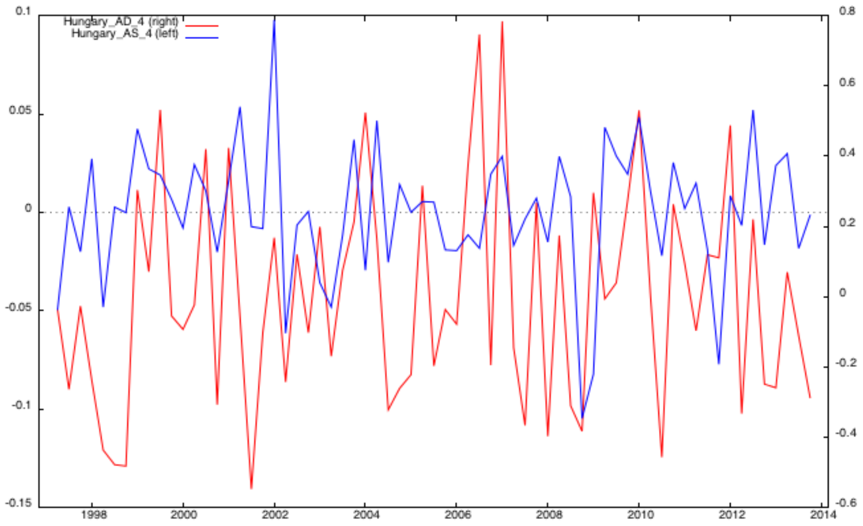
Pic. 16 Aggregate Demand and Supply shocks for Germany

Greece (1981)



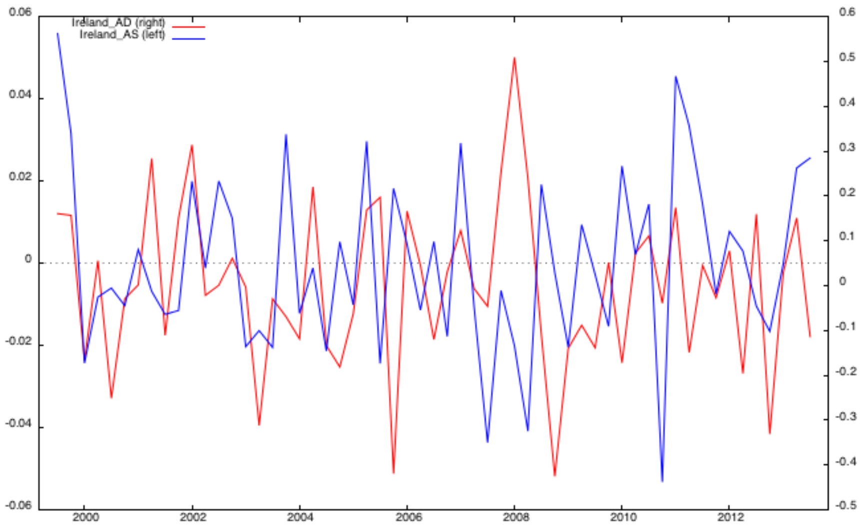
Pic. 17 Aggregate Demand and Supply shocks for Greece

Hungary (2004)



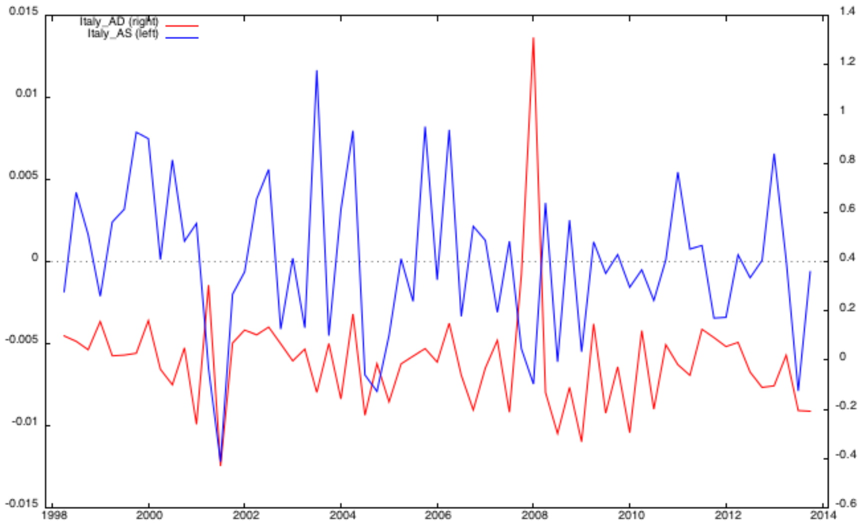
Pic. 18 Aggregate Demand and Supply shocks for Hungary

Ireland (1973)



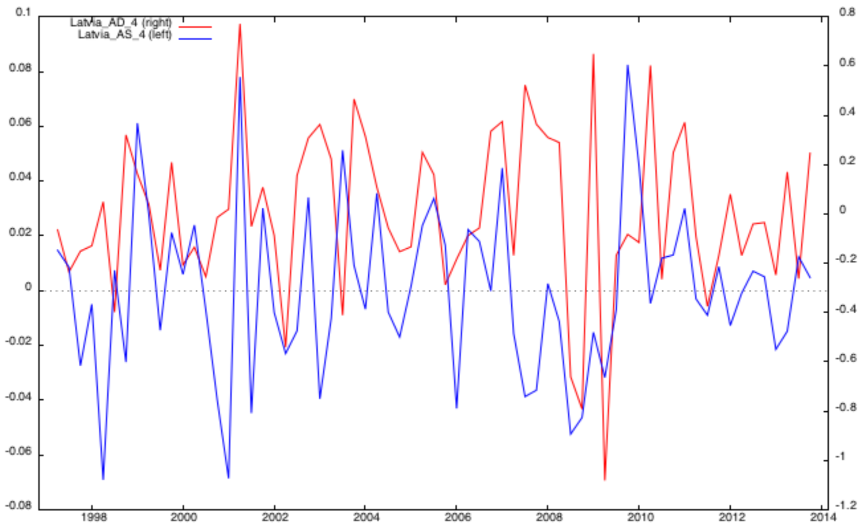
Pic. 19 Aggregate Demand and Supply shocks for Ireland

Italy (1952)



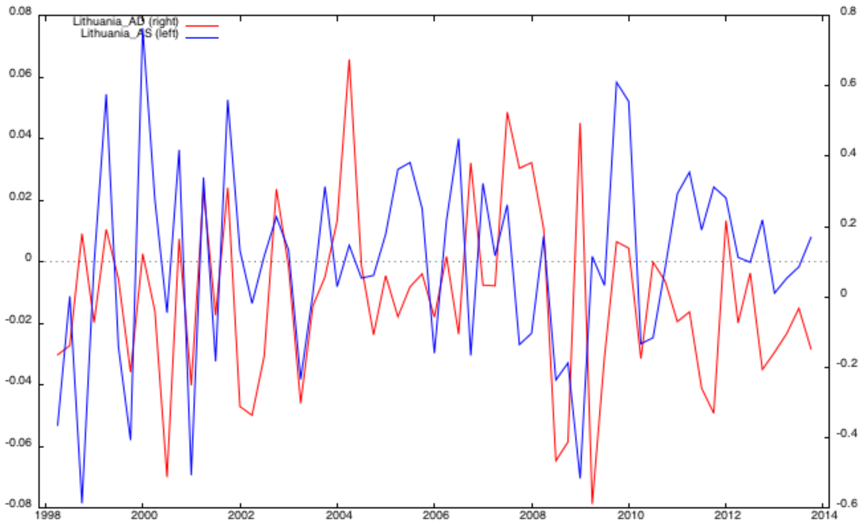
Pic. 20 Aggregate Demand and Supply shocks for Italy

Latvia (2004)



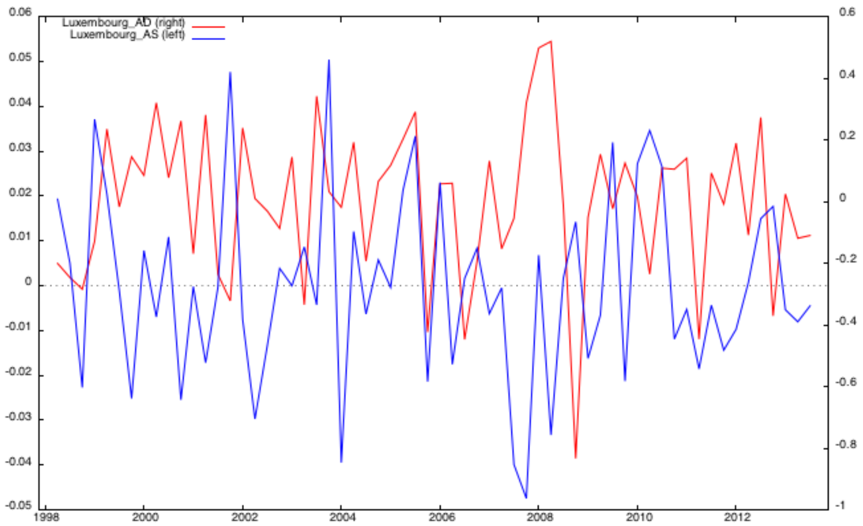
Pic. 21 Aggregate Demand and Supply shocks for Latvia

Lithuania (2004)



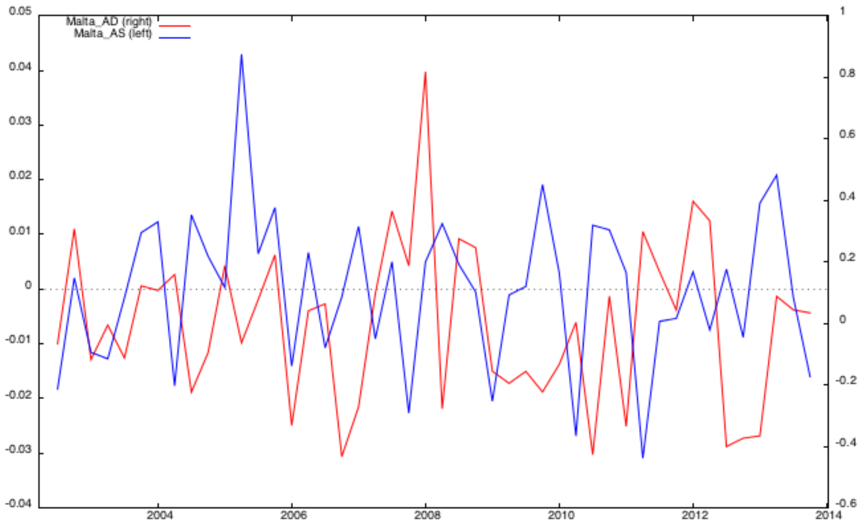
Pic. 22 Aggregate Demand and Supply shocks for Lithuania

Luxembourg (1952)



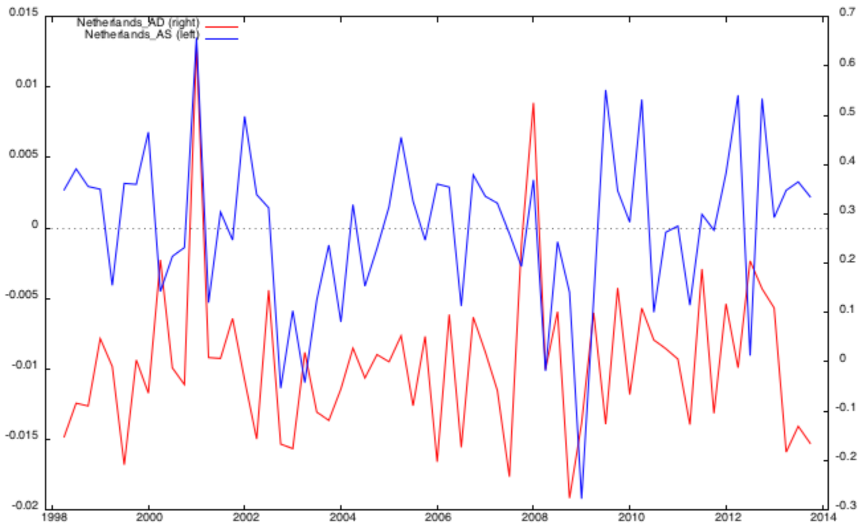
Pic. 23 Aggregate Demand and Supply shocks for Luxembourg

Malta (2004)



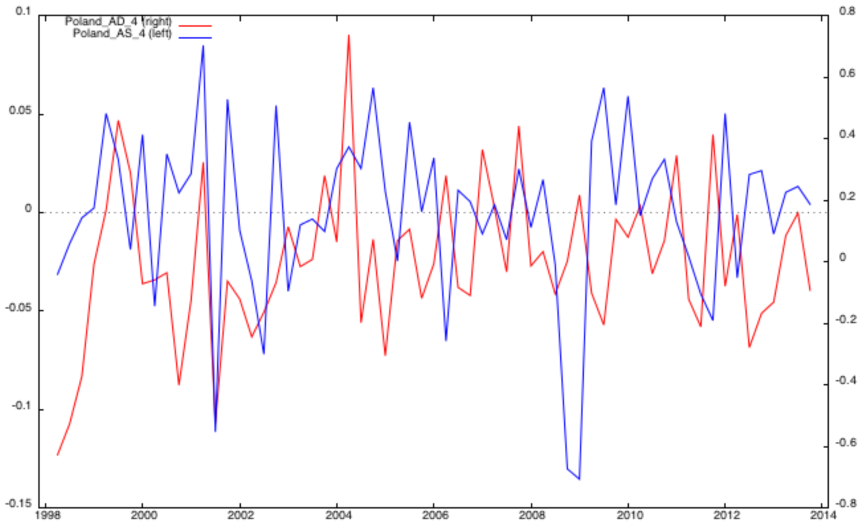
Pic. 24 Aggregate Demand and Supply shocks for Malta

Netherlands (1952)



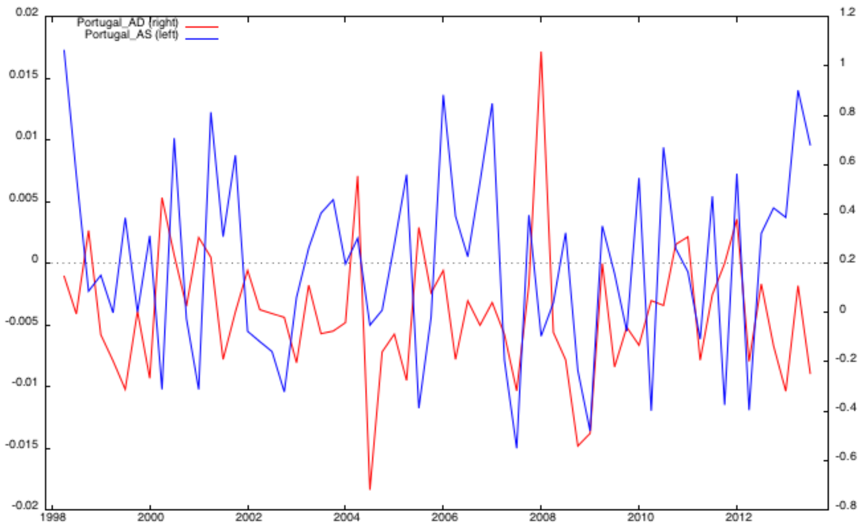
Pic. 25 Aggregate Demand and Supply shocks for the Netherlands

Poland (2004)



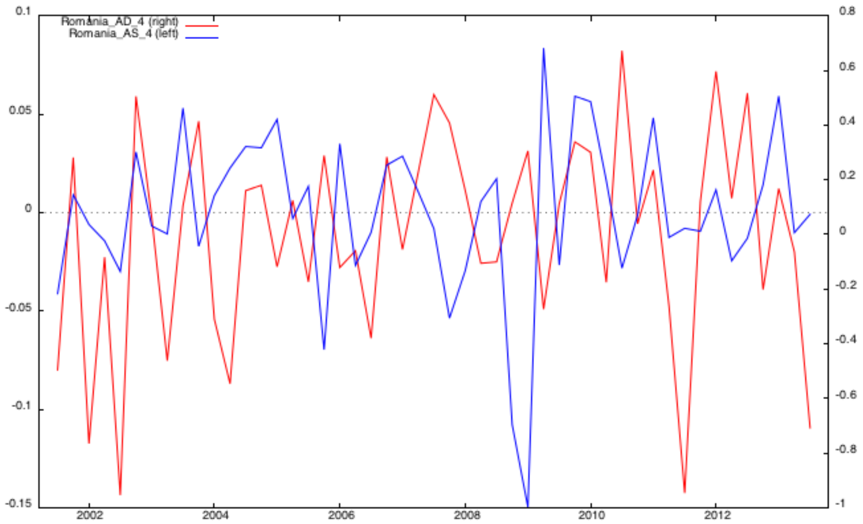
Pic. 26 Aggregate Demand and Supply shocks for Poland

Portugal (1986)



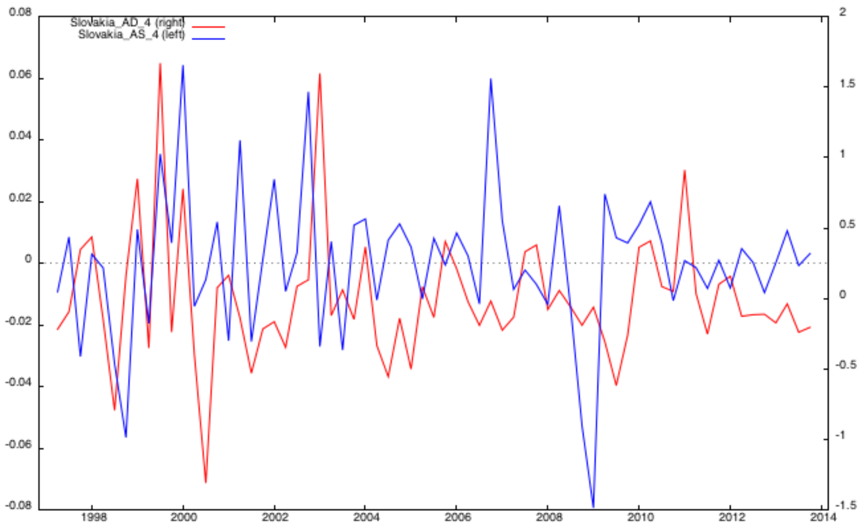
Pic. 27 Aggregate Demand and Supply shocks for Portugal

Romania (2007)



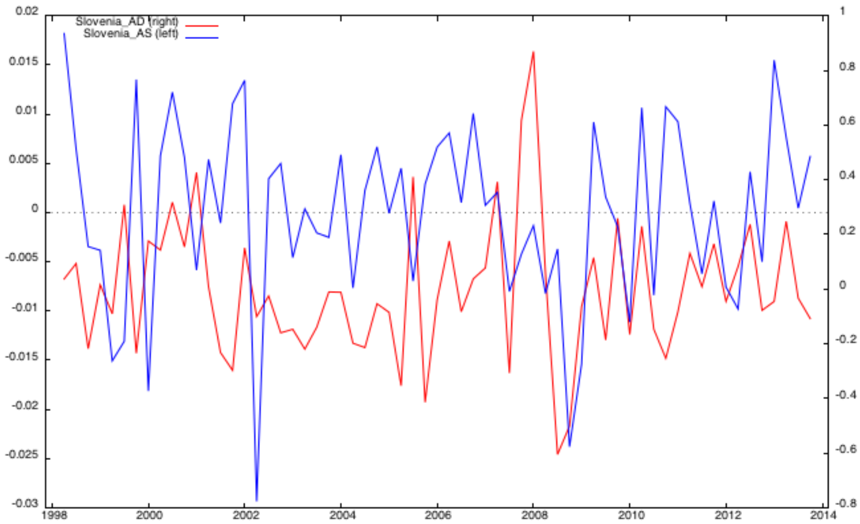
Pic. 28 Aggregate Demand and Supply shocks for Romania

Slovakia (2004)



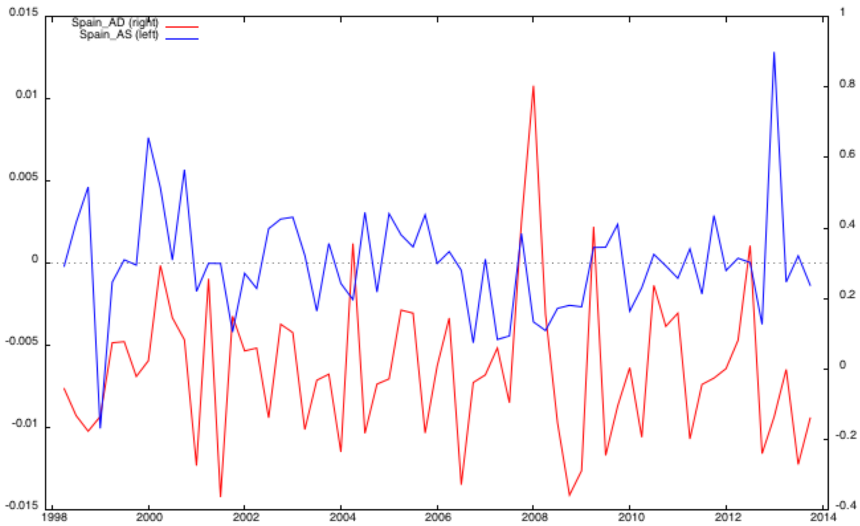
Pic. 29 Aggregate Demand and Supply shocks for Slovakia

Slovenia (2004)



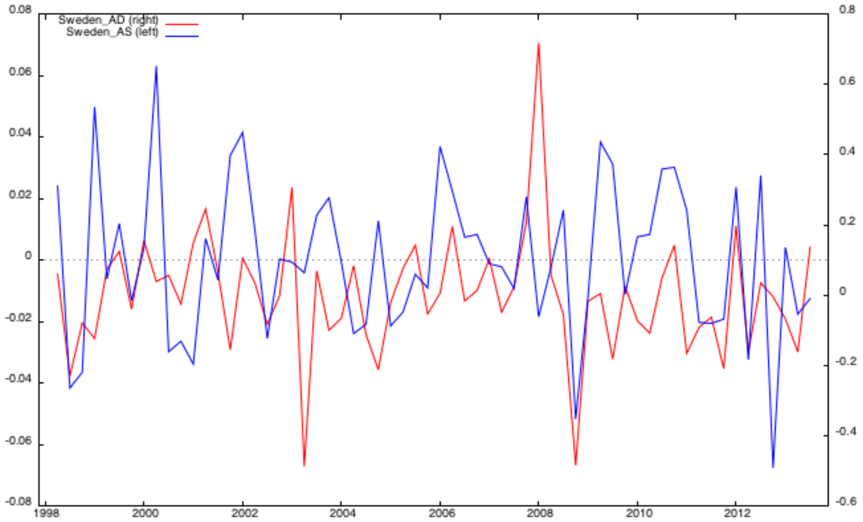
Pic. 30 Aggregate Demand and Supply shocks for Slovania

Spain (1986)



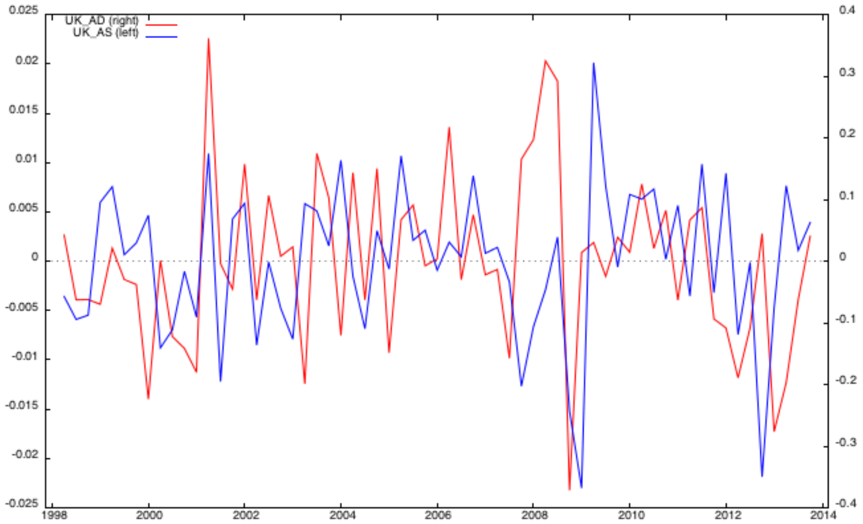
Pic. 31 Aggregate Demand and Supply shocks for Spain

Sweden (1995)



Pic. 32 Aggregate Demand and Supply shocks for Sweden

United Kingdom (1973)



Pic. 33 Aggregate Demand and Supply shocks for UK

Correlation Coefficients, using the observations 1996:1 - 2013:4
(missing values were skipped)

5% critical value (two-tailed) = 0.2759 for n = 51

AT_AS	BE_AS	HR_AS	DK_AS	FR_AS	
1.0000	0.5095	0.0830	0.4445	0.6612	AT_AS
	1.0000	0.2288	0.3151	0.5193	BE_AS
		1.0000	0.4267	0.1209	HR_AS
			1.0000	0.4823	DK_AS
				1.0000	FR_AS

DE_AS	IE_AS	LU_AS	NI_AS	UK_AS	
0.3795	0.0873	0.2615	-0.0271	0.4770	AT_AS
0.5211	-0.0302	0.0194	0.1211	0.6399	BE_AS
0.2778	0.0382	0.1066	0.1628	0.4727	HR_AS
0.4079	0.1564	0.2855	0.2636	0.4471	DK_AS
0.7183	0.1502	0.1954	0.4487	0.4600	FR_AS
1.0000	0.0669	0.0834	0.3974	0.5758	DE_AS
	1.0000	0.4243	0.2083	0.2880	IE_AS
		1.0000	0.1750	0.3645	LU_AS
			1.0000	0.0301	NI_AS
				1.0000	UK_AS

Pic. 34 Original display of Group A from Gretl

Correlation Coefficients, using the observations 1996:1 - 2013:4
(missing values were skipped)

5% critical value (two-tailed) = 0.2759 for n = 51

CR_BS	EE_BS	FI_BS	HU_BS	LV_BS	
1.0000	0.1507	0.4540	0.6495	0.4120	CR_BS
	1.0000	0.3314	0.2994	0.4191	EE_BS
		1.0000	0.3029	0.2834	FI_BS
			1.0000	0.5458	HU_BS
				1.0000	LV_BS

LT_BS	PL_BS	RO_BS	SE_BS	
0.4702	0.6140	0.3129	0.5562	CR_BS
0.3180	0.1836	0.3588	0.3887	EE_BS
0.2510	0.4769	0.3617	0.4999	FI_BS
0.4753	0.6533	0.5475	0.5445	HU_BS
0.4403	0.4173	0.3078	0.4093	LV_BS
1.0000	0.6180	0.6325	0.6025	LT_BS
	1.0000	0.5874	0.6828	PL_BS
		1.0000	0.4860	RO_BS
			1.0000	SE_BS

Pic. 35 Original display of Group B from Gretl

Correlation Coefficients, using the observations 1996:1 - 2013:4
(missing values were skipped)

5% critical value (two-tailed) = 0.3081 for n = 41

BG_CS	CY_CS	ELI_CS	IT_CS	MT_CS	
1.0000	0.0523	-0.3803	0.3193	0.5233	BG_CS
	1.0000	-0.1831	-0.1334	0.5209	CY_CS
		1.0000	0.2115	-0.1777	ELI_CS
			1.0000	0.0278	IT_CS
				1.0000	MT_CS

PT_CS	SK_CS	SI_CS	ES_CS	
0.4270	0.1258	0.5657	0.5848	BG_CS
0.3593	0.3326	0.0372	0.1397	CY_CS
0.0081	-0.0116	0.0930	-0.1048	ELI_CS
0.4279	0.1503	0.4535	0.6335	IT_CS
0.1489	0.3277	0.4044	0.3544	MT_CS
1.0000	0.3197	0.2565	0.3285	PT_CS
	1.0000	0.4659	0.2180	SK_CS
		1.0000	0.4749	SI_CS
			1.0000	ES_CS

Pic. 36 Original display of Group C from Gretl

Correlation Matrix of Residuals from VAR model for quarterly data of GDP growth

	Austria	Belgium	Bulgaria	Cyprus	CR	Denmark	Estonia	Finland	France	Germany	Hungary	Ireland	Italy	Latvia	Lithuania	Lux.	Neth.	Poland	Portugal	Slovakia	Slovenia	Spain	Sweden	UK	EU	EA	EA18
Austria	1.0000	0.3656	0.0097	-0.0311	0.5897	0.2525	0.2294	0.1390	0.3640	0.2587	0.4108	-0.1753	0.1835	0.0138	0.1939	-0.0121	0.0293	0.3925	0.2918	-0.0207	0.3473	0.3993	0.2388	0.1433	0.3214	0.0476	0.3303
Belgium		1.0000	0.3118	0.1954	0.3847	0.3374	0.3170	0.5889	0.4085	0.6323	0.5876	0.1932	0.3887	0.0511	0.1690	-0.0926	0.2965	0.4362	0.4125	0.4517	0.4922	0.3189	0.4737	0.6921	0.8305	0.3721	0.6603
Bulgaria			1.0000	0.1966	-0.0086	0.2482	0.4081	0.1610	-0.2561	0.1702	0.1961	0.0146	0.3564	0.3103	0.0870	-0.3235	-0.0288	-0.0258	0.1266	0.1454	0.1246	0.0515	0.1480	0.2668	0.2602	0.0804	0.1631
Cyprus				1.0000	0.4970	0.1942	-0.0614	0.1587	0.2560	0.0949	0.2031	-0.0714	0.0514	0.1770	0.0002	-0.2509	-0.1372	0.2439	0.0959	0.3438	0.1256	0.2349	-0.0191	-0.0166	0.1122	0.0653	0.1712
CR					1.0000	0.3976	0.0840	0.2413	0.4735	0.3832	0.3549	0.0054	0.0765	-0.1390	0.1844	0.0002	0.0908	0.5374	0.4320	0.2606	0.4888	0.3932	0.2141	0.1550	0.3856	0.2466	0.4210
Denmark						1.0000	0.3433	0.3483	0.2142	0.2185	0.0697	0.0966	0.2733	-0.0897	0.3438	0.1714	0.3015	0.1208	0.4740	0.0254	0.2662	0.4751	0.4375	0.1894	0.3492	0.0947	0.3386
Estonia							1.0000	0.2092	0.1533	0.2797	0.2405	-0.1949	0.2999	-0.1633	0.0487	-0.1210	0.3386	0.1283	0.1197	0.3795	0.3242	0.3661	0.2227	0.2333	0.3518	0.1924	0.3285
Finland								1.0000	0.6047	0.6435	0.2599	0.1467	0.5088	-0.0275	-0.0644	-0.1525	0.5477	0.3709	0.2148	0.1819	0.4652	0.3524	0.3860	0.2288	0.5377	0.6155	0.7332
France									1.0000	0.6048	0.3937	-0.1198	0.3870	-0.1350	0.0424	0.0305	0.3225	0.4665	0.1742	0.3264	0.3687	0.4846	0.3124	0.1414	0.4925	0.5807	0.7388
Germany										1.0000	0.4997	0.0683	0.6102	0.0629	0.1628	0.0667	0.4753	0.4359	0.2821	0.2490	0.6928	0.3326	0.3944	0.4308	0.7624	0.7786	0.9330
Hungary											1.0000	-0.0665	0.1657	0.2462	0.0300	-0.1780	-0.0129	0.4748	0.1320	0.3021	0.3410	0.1592	0.3446	0.4135	0.5816	0.2560	0.4515
Ireland												1.0000	-0.2695	-0.0233	-0.0659	0.2763	-0.0079	-0.0904	0.2768	0.0655	0.1083	0.0571	0.2211	0.1672	0.1333	0.1370	0.0602
Italy													1.0000	0.2208	0.0637	-0.1868	0.5035	0.0970	0.0473	-0.0147	0.3838	0.2567	0.1837	0.2397	0.4775	0.6125	0.7266
Latvia														1.0000	0.0922	-0.0426	-0.2085	-0.1207	-0.0858	-0.0116	-0.0180	-0.2690	0.1149	0.1948	0.1457	-0.1290	0.0282
Lithuania															1.0000	0.4133	-0.0853	0.3421	0.1833	0.2126	0.1326	0.1826	0.4271	0.3371	0.3649	-0.1938	0.1327
Lux.																1.0000	-0.0029	-0.0092	0.4573	0.1296	0.1053	0.1326	0.2940	0.0801	0.0876	-0.1051	0.0346
Neth.																	1.0000	0.0994	0.0664	0.0289	0.3453	0.4031	-0.0998	0.0255	0.2571	0.7047	0.5779
Poland																		1.0000	0.0408	0.3909	0.2937	0.3388	0.4384	0.3168	0.5532	0.2756	0.4273
Portugal																			1.0000	0.1030	0.2319	0.2724	0.3248	0.2700	0.3519	0.0736	0.3081
Slovakia																				1.0000	0.3362	0.1441	0.3531	0.3814	0.4448	0.0662	0.2628
Slovenia																					1.0000	0.3070	0.4055	0.3493	0.5894	0.4477	0.6522
Spain																						1.0000	0.2532	-0.1093	0.2490	0.3998	0.5460
Sweden																							1.0000	0.4979	0.6381	0.0453	0.3953
UK																								1.0000	0.8670	0.0996	0.3511
EU																									1.0000	0.4348	0.7393
EA																										1.0000	0.8311
EA18																											1.0000

Correlation Coefficients, using the observations 1996:1 - 2013:4
(missing values were skipped)

5% critical value (two-tailed) =0.2461 for n = 64

Correlation Matrix of Residuals from VAR model for quarterly data of HICP (2005=100)

	Austria	Belgium	Bulgaria	Croatia	Cyprus	Czech Rep	Denmark	Estonia	Finland	France	Germany	Greece	Hungary	Ireland	Italy	Latvia	Lithuania	Luxembourg	Malta	Netherlands	Poland	Portugal	Romania	Slovakia	Slovenia	Spain	Sweden	UK
Austria	1,0000	0,6522	0,1562	0,4042	0,5456	-0,0348	0,4287	0,2320	0,6169	0,8092	0,7361	0,6457	-0,0064	0,6201	0,7819	0,1258	0,1188	0,7720	-0,1901	0,3312	0,0947	0,7839	0,0008	-0,2284	0,6234	0,7997	0,5675	0,6427
Belgium		1,0000	0,0715	0,5673	0,2387	0,3486	0,7337	0,3095	0,6230	0,8188	0,5790	0,3261	0,1178	0,5623	0,3745	0,1220	-0,0073	0,6965	0,0253	0,3558	0,0221	0,4544	-0,0997	-0,0150	0,3747	0,6387	0,4726	0,6845
Bulgaria			1,0000	0,3512	0,1900	0,1827	0,0277	0,0790	0,1930	0,2107	0,2572	0,3190	-0,0898	0,3822	0,2237	0,4681	0,4296	0,2022	-0,1407	-0,0477	0,1628	0,0535	0,0673	0,1466	0,4004	0,3326	-0,0396	0,0369
Croatia				1,0000	0,1425	0,0884	0,4395	0,0725	0,4991	0,5389	0,4627	0,3368	0,2205	0,2460	0,2410	0,1982	0,1298	0,5316	-0,0285	0,2163	0,2006	0,2073	0,0348	-0,1091	0,2915	0,4736	0,2488	0,5079
Cyprus					1,0000	-0,0793	0,2857	0,2958	0,3601	0,5351	0,4117	0,5817	-0,0908	0,5415	0,5936	0,0240	0,0330	0,4521	-0,0434	-0,0222	0,1379	0,4825	0,2011	0,0917	0,2657	0,4773	0,4223	0,1517
Czech Rep.						1,0000	0,4862	0,2800	0,1479	0,1746	0,0835	-0,1431	0,3837	0,2169	-0,2893	0,3965	-0,0880	0,1256	0,3118	0,3258	0,2195	-0,2024	-0,2397	0,1782	0,0771	-0,1345	0,0036	0,1465
Denmark							1,0000	0,3085	0,6325	0,6179	0,4703	0,1820	0,3235	0,5945	0,1420	0,2029	-0,0033	0,6105	0,2865	0,5045	0,2723	0,1781	0,0156	0,0472	0,1675	0,4271	0,4338	0,4647
Estonia								1,0000	0,1470	0,1532	0,1416	-0,0257	0,0706	0,3236	-0,0182	0,0377	-0,0373	0,1942	0,5491	0,2177	-0,0581	0,0429	-0,0341	0,2128	-0,0069	0,2552	-0,0308	0,0619
Finland									1,0000	0,7227	0,5384	0,2709	-0,0041	0,7498	0,3684	0,0543	0,0375	0,7405	0,0971	0,4932	0,1012	0,4645	0,1029	-0,1579	0,2791	0,5982	0,6881	0,5840
France										1,0000	0,7394	0,6365	0,0185	0,6490	0,6599	0,0708	-0,0313	0,7982	-0,0677	0,3707	0,0093	0,5671	0,0636	-0,1750	0,5390	0,7667	0,6812	0,6868
Germany											1,0000	0,4714	-0,1197	0,5560	0,5382	0,1293	0,1990	0,7955	-0,2598	0,1760	-0,0257	0,5165	0,0618	-0,2773	0,3322	0,7228	0,6764	0,7256
Greece												1,0000	-0,0185	0,3913	0,8427	0,2884	0,1660	0,3819	-0,0629	0,2508	-0,0566	0,5464	0,1909	-0,1764	0,5203	0,5780	0,3885	0,2164
Hungary													1,0000	0,0412	-0,0600	0,2703	-0,0779	0,0069	0,2010	0,4100	0,5030	-0,0459	-0,1690	0,1182	0,1892	-0,1195	-0,1848	-0,1027
Ireland														1,0000	0,5188	0,3289	0,1712	0,6650	0,0789	0,3040	0,2445	0,6026	0,1099	0,0095	0,3466	0,6161	0,4451	0,3126
Italy															1,0000	0,0338	0,0845	0,5554	-0,2235	0,1629	0,0476	0,7479	0,0226	-0,1569	0,5509	0,7305	0,4418	0,2781
Latvia																1,0000	0,6137	-0,0308	0,0031	0,0430	0,2827	0,0827	0,1677	0,1798	0,1890	-0,0563	-0,0695	-0,1067
Lithuania																	1,0000	0,0320	-0,3220	-0,1227	0,0748	0,0701	-0,0082	0,3272	0,1152	0,1466	0,1531	0,1115
Luxembourg																		1,0000	-0,0624	0,2632	0,2695	0,5652	-0,1522	-0,1995	0,4362	0,7488	0,6808	0,7135
Malta																			1,0000	0,3400	-0,0191	-0,3303	0,0305	0,1204	-0,3000	-0,1377	-0,0827	-0,2702
Netherlands																				1,0000	-0,0406	0,1682	-0,0711	-0,1562	0,4118	0,3085	0,2958	0,3403
Poland																					1,0000	0,1455	-0,0744	-0,0338	0,1763	-0,0787	-0,2211	-0,1332
Portugal																						1,0000	0,0787	-0,3106	0,4955	0,6637	0,3213	0,3821
Romania																							1,0000	-0,2394	-0,2384	-0,0461	0,0235	-0,2317
Slovakia																								1,0000	-0,0176	-0,0448	-0,0511	-0,2483
Slovenia																									1,0000	0,5661	0,1885	0,3926
Spain																										1,0000	0,5388	0,5963
Sweden																											1,0000	0,6214
UK																												1,0000

Correlation Coefficients, using the observations 1996:1 - 2013:4
(missing values were skipped)

5% critical value (two-tailed) = 0.2500 for n = 62