ISCTE Business School
Instituto Universitário de Lisboa

Monetary Transmission Mechanism: Portuguese Comparison Before and After Joining the Euro, With Poland as a Counter-Factual

Albino José Rocha Muchacho

Dissertation submitted as partial requirement for the conferral of:
Master in Economics

Supervisor:
Prof. Sérgio Lagoa, Prof. Auxiliar, ISCTE-IUL Escola de Ciências Sociais e Humanas, Departamento de Economia Política

Co-supervisor:
Prof. Ryszard Kokoszczyńsk, Assistant Professor, University of Warsaw, Faculty of Economic Sciences, Division of Quantitative Finance

September, 2018

ISCTE Business School
Instituto Universitário de Lisboa

MONETARY TRANSMISSION MECHANISM: PORTUGUESE COMPARISON BEFORE AND AFTER JOINING THE EURO, WITH POLAND AS A COUNTER-FACTUAL

Albino José Rocha Muchaco

Abstract

This dissertation aims to present and discuss the empirical evidence of the transmission mechanisms of monetary policy in Portugal before and after the Euro and use Poland as a counter-factual.

The analysis focus in the interest rate channel of transmission of monetary policy. The VAR model is used to simulate the effects of a change in interest rates in the economy.

Two conclusions can be drawn, firstly there is a clear difference in the Portuguese responses and explanatory power of interest rate before and after the adoption of Euro, since the responses are stronger in the Pre-Euro model. Finally, there are similarities between Portugal and Poland as they share similar responses.

Keywords: Exogenous Block, Monetary Transmission Mechanism, VAR

JEL code: E53 and E58

Resumo

O objetivo desta dissertação é apresentar e discutir as evidencias empíricas sobre os mecanismos de transmissão da política monetária em Portugal, antes e depois do Euro e comparar com a Polonia, que é usada como contra factual.

A análise foca-se no canal da taxa de juro do mecanismo de transmissão da política monetária. O modelo VAR é utilizado para estimar e simular o efeito que a alteração da taxa de juro tem sobre a economia.

Duas conclusões principais podem ser retiradas, primeiro, existe uma clara diferença nas respostas e no poder explicativo da taxa de juro nos modelos para Portugal antes e depois da adoção do Euro, uma vez que as repostas no modelo Pre-euro são de uma magnitude maior do que no modelo Pos-Euro. Por último, existem semelhanças entre a economia Portuguesa e Polaca, pois ambas demonstram respostas similares a choques na taxa de juro.

Palavras-chave: Bloco Exógeno, Mecanismos de Transmissão Monetária, VAR

Código JEL: E53 e E58

Acknowledgements

I would first like to thank my thesis supervisors Professor Ryszard Kokoszczyńsk of the Faculty of Economic Sciences at University of Warsaw and Professor Sergio Lagoa of ISCTE-IUL. The doors to Prof. Kokoszczyńsk and Professor Lagoa offices were always open whenever I ran into a trouble spot or had a question about my research or writing. He consistently allowed this paper to be my own work but steered me in the right the direction whenever he thought I needed it.

Finally, I must express my very profound gratitude to my parents, grandparents and to my girlfriend for providing me with unfailing support and continuous encouragement throughout my years of study and through the process of researching and writing this thesis. This accomplishment would not have been possible without them.

Thank you.

Albino Muchacho

Contents

List of Figures

List of Tables

Chapter 1

Introduction

Since the beginning of the Euro in 1999 that there is the question if a unique monetary policy is the best policy for the individual countries that belong to the European Monetary Union, especially for the more peripheric countries such as Portugal and Greece which are small peripheric economies with poor economic performances when compared to the core of Euro-Zone [1].

A major branch in monetary policy literature has been devoted to the study of this topic showing that despite the differences in terms of size and timing of the reaction to changes in interest rate across countries, in aggregate terms the monetary policy followed for the European Central Bank for the European Monetary Union is adequate [2].

Therefore, the objective of this study is not to evaluate if the monetary policy conducted by the European Central Bank is optimal for Portugal but rather if the relationship between six key macroeconomic variables [3] and the interest rates have changed or not as a consequence of the loss of monetary independence. This will be done by evaluating this changes and by how much these values shift.

Additionally, since some changes occurred in the Portuguese economy, apart from the loss of monetary policy independence, the analysis of Portugal was divided into two periods [4]. Three main changes happened, the decrease in the relative weight of the agricultural and industrial sectors and finally the increase in the relative weight of services in terms of total GDP.

Furthermore, the rest of the world, and in a closer look, the monetary transmission mechanisms have changed as a result of globalization and the increase of capital movements around the world, which caused an increase in the speed and size of the shocks that are spread worldwide. As a consequence of the 2008 financial crises and then the 2010 European sovereign debt crisis lead to the adoption of unconventional monetary policy tools. As purchasing of European bonds by the European Central Bank in order to increase banks liquidity avoiding the liquidity trap. This dissertation, although not explicitly, also takes into consideration this unconventional monetary policy by adding credit to the model.

To take all of this into account, an exogenous block was introduced in the vector autoregressive model to capture changes occurred worldwide. In addition, Poland

[1] Germany, France and Italy

[2] (Ehrmann, Gambacorta, Martinez-Pagés, Sevestre, & Worms, 2003)

[3] Unemployment, GDP, Inflation, Interest Rate, Credit and Exchange Rate

[4] Pre-Euro period (1986Q1-1998Q4) and Post-Euro period (1999Q1-2017Q1)

is used as a counter-factual [5] for the Portuguese Post-Euro period, since it shares similar economic traces and has an autonomous and independent monetary policy.

The structure of this dissertation is the following: in Chapter 2, is presented the objectives of three monetary authorities [6] and the main four transmission channels of monetary policy.

In Chapter 3, a summarized literature review on one hand to stylize facts for small and open economies in another hand some studies for Portugal and Poland are revised. In Chapter 4, it is presented the reasons for choosing the variables, a series of experiments to test the stationarity variables of the model are conducted, followed by a discussion of the identification scheme.

In Chapter 5, consists on the presentation of the empirical results of the analysis, this is comprised of the impulse responses and the variance decomposition. Finally, in Chapter 6, it is showcased the synthesized conclusions of the empirical results.

[5] Although some caution is needed when analysing the results since the economies are similar but not equal

[6] Banco de Portugal, European Central Bank and Narodowy Bank Polski

Chapter 2

Monetary Transmission Mechanism

The objective of this chapter is to explain how the monetary transmission mechanism (MTM) operates and influences the economy through their channels. Each channel will be described in detail to highlight its importance in the economic activity.

2.1 Main Objectives of the Monetary Authorities

2.1.1 Banco de Portugal

The main objective of the monetary policy of Banco de Portugal (BdP), during the period 1986 to 1999 was too decrease the inflation rate and obtain price stability. With this objective in mind the exchange rate policy began to be gradually less accommodative regarding the foreign shocks which caused an appreciation of the Portuguese escudo and generated positive real interest rates. The end of the crawling-peg policy in 1985, lead to the adoption of a policy that ensures exchange rate stability as a means of achieving price stability. This commitment of BdP was reinforced when the Portuguese escudo entered in the European Exchange Rate Mechanism in 1992 [1].

2.1.2 Narodowy Bank Polski and European Central Bank

Both Narodowy Bank Polski (NBP) polish central bank and European Central Bank (ECB) share a common main objective, price stability in the medium-run and support sustainable economic growth with low levels of unemployment [2]. Since the ECB began to implement monetary policy in euro area as of 1999 it has the objective of achieving an inflation rate below, but close to 2% . In a similar manner, in 2003 NBP started to target an inflation rate of 2.5% with a permissible fluctuation band of +/- 1 percentage points [3].

[1] (Abreu, 2005)
[2] (Issing, 2001)
[3] (Trembińska, 2010)

2.2 Relevance of Monetary Transmission Mechanism

It is assumed that both monetary authorities, ECB and NBP, will behave in a similar manner since they share a similar objective, price stability by targeting the inflation rate to a specific value and use the interest rate as a tool to reach this goal. Therefore, the analysis will focus on ECB. To achieve the inflation objective the ECB must monitor all relevant developments in the 19-member states in the Euro area and act according to these developments, changing or not the current monetary policy. It is then crucial for the monetary authority, in this case the ECB, to understand the economic mechanism that generate adjustments in prices and output due to changes in the interest rate made by it.

Nevertheless, it is important to outline that each of the 19-member states have economic and financial systems operating at different stages. Thus, when the ECB decides to apply a specific monetary policy, different countries will react in different ways. Therefore, the monetary transmission mechanism has become much more complex due to different responses to one same policy.

2.2.1 Theoretical Foundation

It will be presented in a simple example, based in (Clements, Kontolemis, & Levy, 2001) and (Dornbusch, Favero, & Giavazzi, 1998) which allows for a simple and theoretical reaction function similar to the one used by ECB. For understanding processes it is assumed in the model that there are only two countries or two large set of countries that share similar characteristics. It is also assumed that during the design of the monetary policy, the ECB, wants to minimize a loss function identical to:

$$L = \pi_{eu}^2 = [\theta\pi_1 + (1-\theta)\pi_2]^2 \tag{2.1}$$

where π_{eu} represent the inflation in the euro area, π_1 and π_2 represent respectively the inflation in country 1 and in country 2. The weight of the aggregation of indicators for member states is given by θ which varies between 0 and 1. The policy tool used by ECB is the interest rate which is used in the interbank money market as a reference. It is presumed that the relation between this special interest rate and the inflation for each country is given by:

$$\pi_1 = -\gamma_1 r + \epsilon_1 \qquad\qquad \pi_2 = -\gamma_2 r + \epsilon_2 \tag{2.2}$$

r is the interest rate controlled by ECB, ϵ_1 and ϵ_2 represent the specific shocks of each country and γ_1 and γ_2 are the transmission mechanism associated with a particular country.

Substituting (2.1) in (2.2) and solving $\frac{\partial L}{\partial r} = 0$ in order to r. Obtaining the rule that minimizes the loss function:

$$r = \frac{\theta\epsilon_1 + (1-\theta)\epsilon_2}{\theta\gamma_1 + (1-\theta)\gamma_2} \tag{2.3}$$

which implies that a response of the interest rate to a shock in the inflation in country 1 will be given by:

$$\frac{\partial r}{\partial \epsilon_1} = \frac{\theta}{\theta\gamma_1 + (1-\theta)\gamma_2} \tag{2.4}$$

As it is possible to showcase, the response of the monetary policy of ECB, due to the shock ϵ_1 will depend on the relative weight that country 1 has in the total of the Euro area (which will also determine the importance of this shock in the final aggregated shock). Furthermore, the response of the monetary policy will also depend on the impact that it has on the two countries.

If country 1 has a small economy with a strong transmission mechanism (high γ), then if only country 2 suffer an inflation shock, the effect on inflation in country 1 will become bigger as γ_1 increase. As it is shown by the following equations:

$$r = \frac{(1-\theta)\epsilon_2}{\theta\gamma_1 + (1-\theta)\gamma_2}; \quad \frac{\partial r}{\partial \epsilon_2} = \frac{(1-\theta)}{\theta\gamma_1 + (1-\theta)\gamma_2}; \quad \pi_1 = -\frac{1}{\frac{\theta}{1-\theta} + \frac{\gamma_2}{\gamma_1}}\epsilon_2$$

With these simple theoretical derivations, it is possible to observe that economic and monetary unions (EMU) will have difficulties to respond in an optimal manner to a shock. Specially, in a small country because it is unpredictable what the outcome might be. This is due to the fact that a big shock in a small economy will have a small influence on the aggregate indicators of the EMU. Therefore, the change in the interest rate will be insufficient to accommodate the big shock that happened in the small country. So, the change in the interest rate made by the monetary authority of the EMU will be smaller than the change that would happen in a Pre-EMU scenario, where the monetary policy was independent.

It will also be presented the case of independent monetary policy, exemplifying for the country 1. For sake of simplicity in the analysis, the assumptions made in the EMU case are still valid, especially the one that states the objective of monetary authority and the relation between inflation and interest rate. Then the reaction function of the independent monetary authority and the change of the interest rate needed to accommodate the shock in inflation will be given respectively by:

$$r_1 = \frac{\epsilon_1}{\gamma_1} \tag{2.5}$$

$$\frac{\partial r_1}{\partial \epsilon_1} = \frac{1}{\gamma_1} \tag{2.6}$$

With this simple theoretical model is possible to illustrate that if different countries with a non-homogeneous economic structure share a common monetary policy, the smallest countries will be the ones that will suffer the most in terms of output and inflation, the reaction of output and inflation will be even stronger for those small countries if they also have a strong monetary policy transmission mechanism.

2.3 Problems in the Study of Monetary Transmission Mechanism

In the previous sub-chapter, it was presented why it is relevant and important to study the MTM. However, as any other topic in economics and other sciences, there are some issues in the study of this topic.

Those difficulties arise mainly from two sources[4], the so-called problem of simultaneity and the effects of the different channels in MTM.

The simultaneity problem arises from the difficulties in the identification of the true effects induced in the economy due to changes in the monetary policy. This happens because monetary authorities adjust their policy to better accommodate the shock in the economy[5]. Therefore, it is hard to claim that a specific macroeconomic variable changed just because of the intervention of monetary authority, having into account that the monetary authority might have just been responding to that shock.

The following example can illustrate this problem, in the economy exists an inflationary pressure, the monetary authority will then tend to increase the interest rate, to cool down the economy, reducing the inflationary pressure. However, the prices will continue to increase, due to rigidities in the economy. Furthermore, there will be a positive correlation between the increase in the interest rate and in prices. Nevertheless, this increase in prices are linked to the past tendency and not because of the increase in the interest rates. In this case, simultaneous problem arises because it is hard to separate the two effects, the one that increases prices due to the previous tendency and the one caused by the changes in the interest rate.

A common approach to overpass this problem is to study the effects of an unexpected change in monetary policy, that is, a monetary policy shock. Nevertheless, this approach has some problems as well. With some authors claiming that empirical research shows that these unexpected shocks are not one of the main reasons for the changes in the prices and output. Although, the same authors state that despite the small contributions in the variation in prices and output it cannot be said that monetary policy is not relevant [6].

The second difficulty referred above is associated with the complexity of the transmission mechanism that influence the economy. Since there are multiple channels by which the monetary policy is transmitted to a particular variable, the fundamental concern is in the correct identification of the effects that each channel has on a particular macroeconomic variable.

2.4 Transmission Channels of Monetary Policy

The study of the transmission mechanism and its' channels is crucial for the understanding of how the transmission of monetary policy influences the economy during the different stages in the economic cycle. This study is fundamental for a correct planning and implementation of the monetary policy. The final effect of these policies are difficult to forecast, these difficulties are due to the time lag that exists between the implementation of the policy and the effects, also the magnitude of effects tends to be long and variable [7].

There are four main channels of transmission of monetary policy identified in the literature [8] namely, the ***interest rate channel***, the ***exchange rate channel***, the ***credit channel*** and finally the ***other assets prices channel***.

[4](Kuttner, Mosser, et al., 2002)
[5](Leeper, Sims, Zha, Hall, & Bernanke, 1996)
[6](Leeper et al., 1996) and (Christiano, Eichenbaum, & Evans, 1999)
[7](Friedman, 1995)
[8]see for example: (Koop, Leon-Gonzalez, & Strachan, 2009) and (Mishkin, 1995)

2.4.1 Interest Rate Channel

The interest rate channel is the primary channel by which the monetary policy is transmitted to the economy, in particular in the Keynesian models. This channel assumes that there is some degree of rigidity in prices in the short-medium run. Therefore, the monetary authority can influence real interest rate by manipulating the nominal interest rates, since prices are sticky by assumption. Thus, the inflation will not react instantaneously.

The increase in the nominal interest rate, due to a contraction in monetary policy, will lead to an increase in the real interest rate. The increase in the interest rate leads to a decrease in consumption and increase in the consumers' savings, since now the savings are rewarded with the higher interest rate, which reduces the domestic demand for goods and services.

The consumer effect in this channel contributes to a decrease in the output of the economy.

2.4.2 Exchange Rate Channel

This channel explains how changes in the interest rate affect the exchange rate and by this the trade balance.

The adjustment in the interest rate causes a change in the nominal exchange rate due to the relative variation in the rewards of the assets denominated in the national and foreign currency. The adjustment of the real exchange rate will be similar to the change in the nominal exchange rate at least in primary stages. This occurs because of the nominal rigidity in the national economy in the short run.

Therefore, an increase in the nominal interest rate by the monetary authority will lead to an increase in the relative rewards on assets denominated in the national currency, this will cause an inflow of capital to the home economy. However this inflow is in the national currency, so the demand for national currency in the international money markets will increase which will lead to an increase in the nominal exchange rate which will be passed to the real exchange rate. The main consequence of this increase in the real exchange rate is to make the products of the national currency to become more expensive for consumers abroad, therefore, there will be a decrease in the exports of the country. At the same time, the products that are based on foreign currency become now cheaper, which will reduce inflation so, the imports of the country will increase. These two effects will cause a deterioration on the trade balance which will cause a decrease in output.

This channel is particularly important for countries that have a small and open economies, such as, Portugal in the pre-EMU and Poland. However, due to the relatively big size of the Euro-Zone economy, this channel should not play an important role in the transmission of the monetary policy of ECB in theory since the Euro-Zone is a relatively closed economy.

2.4.3 Other Assets Prices Channel

This channel explains how the wealth of families and firms' investment is influenced by the monetary policy. Therefore, there are two effects in this channel on one hand the change of wealth of families and on the other hand the change in firms' investment, measured by the Tobin q affect [9].

A contraction in monetary policy will increase the interest rates, which will lead to a decrease in the prices of financial (e.g. stocks and bonds) and real (e.g. real estate) asset that economic agents hold. Therefore, the decrease in the prices of those assets will reduce the consumption and investment.

The mechanism of transmission behind the first sub-channel is the assumption that the wealth is an important determinant of consumer expenditure. Therefore, a reduction in the wealth will reduce the level of consumption, which will lead to a decrease in output. It is expected that adjustments in real assets prices have a stronger effect than in financial asset prices. This happens because in countries such as Portugal and Poland the stock market has a lower importance in the aggregate saving of consumers.

The investment theory of Tobin (q effect) suggests a transmission mechanism that influences the stock market. The ratio q is defined as the market value of the firm divided by the cost of renewing capital, there is a positive correlation between this measure and the investment expenditure of firms [10]. So, when there is an increase in the interest rates by the monetary authority, the cost of renewing capital will increase, which will lead to a decrease in q, therefore, there will be a decrease in investment. Additionally, this increase in the interest rate will decrease the number of profitable projects which will decrease investment even more.

2.4.4 Credit Channel

The credit channel highlights the crucial role that banks have in the economic and financial systems. The effect of this channel is inversely correlated with the stage of development of financial and stock markets since, if these markets are on the early stage of development this means that most of the economy is financed via banks. This is exactly what happens in the Portuguese and Polish economy where the stock and financial markets are not the principal sources for financing the economy when compared with countries such as USA and United Kindom[11], due to the fact that Portugal and Poland are countries that are bank dominated, due to historical reasons and the lower development of financial markets in these countries.

The existence of credit rationing is caused by the operation of this channel. Furthermore, moral hazard and adverse selection problems faced by the banks during a contraction of monetary policy will increase credit rationing, causing a even stronger credit rationing which will lead to a decrease in investment and consumption. Therefore, a decrease in output. Nevertheless, this effect is independent of the demand for loans which is caused by the interest rate channel [12].

According to (Bernanke & Blinder, 1988), the credit channel assumes that there are frictions in the credit market, which will lead to the existence of the external finance premium. For this authors, the direct effects of the monetary policy in the interest rates are aggravated by the endogenous response of the external finance premium.

[9] (Mishkin, 1995)
[10] (Bolton, Chen, & Wang, 2011)
[11] (Allen & Gale, 2000)
[12] (Afonso & St Aubyn, 1998)

In the literature are identified two main sub-channels in this channel, the Narrow Credit Channel and the Broad Credit Channel.

In the Narrow Credit Channel, the changes in external finance premium are due to changes in the supply of credit.

The increase in the compulsory legal reserves held in the central bank will reduce the amount available for credit. This reduction in the banking credit will increase its' cost. Therefore, the aggregate expenditure of consumers will decrease due to the increase in the cost of credit. This effect will be bigger as the alternative sources of financing the economy are smaller.

The Broad Credit Channel operates throughout the monetary policy that influences the financial position of the economic agents. Changes in monetary policy will influence the value of the collateral, therefore, the amount of credit given to the economic agents. In this way, an increase in the interest rate will lead to a decrease in the value of the collateral, which increases the default risk, due to problems such as, adverse selection and moral hazard. So, the creditor will increase the risk premium and reduce the amount of credit which will have negative effects on consumption and investment.

Furthermore, this mechanism can also be view in the perspective of the consumer's expenditure. In this case, due to the decrease in the value of asset held by the consumers and the subsequent drop in cash-flows, it is expected that consumers decrease the consumption of durable goods, which normally are bought with credit so, the amount of credit demanded decreases.

Chapter 3

Literature Review

The use of vector autoregressive models (VAR) has become a popular tool to analyse the Monetary Policy Transmission Mechanism. This type of model was firstly introduced by (Sims, 1980), in the famous article *Macroeconomics and Reality.* Due to the characteristics of this model, namely the fact that it does not require a specific or well define economic structure and the fact that the model does not require that variables are exogenous since it allows for the current values of a specific variable being affected by its own lag values and lag values of other variables the VAR models have become particularly suitable for the study of MTM.

Although the VAR models are one of the mostly used tools to study MTM, there are other approaches to study monetary transmission mechanisms, namely, DSGE and more refined models from the VAR family[1]. However, these models require more data and a well define economic structure. This definition of economic structure is important for DSGE models, where all the economic structure and interactions among economic agents must be modelled.

As mentioned in the previous chapter, the understanding of MTM from the central bank is fundamental for a proper management of monetary policy, with this objective in mind ECB create the Eurosystem Monetary Transmission Network (EMTN) to study at the national and aggregate level the MTM in the Euro-Zone. This organism based their research in VAR models [2]. Furthermore, NBP publishes a two-yearly report called *Monetary policy transmission mechanism in Poland* in these reports the study of monetary policy is made by using (S)VAR models[3], the same models used by EMTN.

Another interesting feature in VAR models is that by design the model is able to only captures the response of endogenous variables to an unexpected change in monetary policy. For this reason and due to the model simplicity, this will be the empirical model that will be used to estimate how does the economy reacts to changes in the interest rate, that is, the impulse response function (IRF) of the Portuguese and Polish economy.

[1] For example SVAR and FAVAR models

[2] See for example (Van Els, Locarno, Morgan, & Villetelle, 2001), (Mojon & Peersman, 2001) and (Peersman & Smets, 2001)

[3] See for example (Kapuściński et al., 2016), (Kapuściński et al., 2014) and (Demchuk et al., 2012)

3.1 Short History of Monetary Policy Study With VAR Models

As previously stated, the study of monetary policy with VAR was introduced by (Sims, 1980) with the study of US MTM case. Other authors try to replicate this study for other countries. Nevertheless, some puzzles appeared, namely, price, liquidity, exchange rate, and output puzzles. To try to solve these puzzles more variables were included in the VAR models. A successful example of this was the case of (Duguay, 1994) where the commodity index was introduced, and the puzzling results disappeared. This approach was followed by some authors by introducing a commodity index in the VAR models, even though, the economic intuition for the use of this variable was not always present. Nowadays, most of the study of MTM focus on SOE, by exploring the role of Exchange Rate and Credit channels in the economy.

3.2 Monetary Transmission Mechanism in Small Open Economies

This section will be devoted to present the most common techniques and findings in the research on MTM in SOE.

Despite the lack of agreement between researchers regarding which is the best identification scheme to identify the effects of monetary policy in the economy, there is a consensus that there should be an exogenous block in the VAR models if the country is small and open to capture the fact that, the country has a relatively small impact on the world economy but is influenced by the world conditions through the financial markets and international trade. In general, the variables used on this exogenous block are the US GDP, as a proxy for the world demand and supply. Another variable commonly used in this block is the US inflation rate as a proxy for the world inflation [4]. Another possibility is the use of the same variables for a local partner which the country is dependent via trade or financial markets.

As mentioned above, there is some discussion regarding which is the best identification scheme. Nevertheless, there is in the literature a dominant approached developed by (Christiano et al., 1999) which assumes for example a endogenous vector of the following type [5] $Y_t = [y_t, p_t, m_t, i_t, e_t]$ where Y_t is the vector of endogenous variables, y_t is the real GDP, p_t is the inflation rate, m_t is a monetary aggregate, i_t policy interest rate and e_t is the exchange rate. With this recursive ordering, it is assumed that interest rate shocks do not have a contemporaneous impact on GDP, inflation and the monetary aggregate. Furthermore, it is assumed that changes in the interest rate will have a contemporaneous effect on the exchange rate. That is, it is assumed that the monetary authority observes at the beginning of the period the variables GDP, inflation and monetary aggregate and choose the interest rate according to the behaviour of those variables.

When the relative importance of the different channels of transmission of monetary policy is considered some stylized fact are well known, namely, the fact that the

[4] See for example (Cushman & Zha, 1997) and (Beier & Storgaard, 2006)
[5] For example (Peersman & Smets, 2001)

exchange rate channel is one of the most important channels of transmission of monetary policy to a small economy, particularly if the country is a small open economy. The role of the credit channel is inversely linked with the stage of development of the financial markets in that country since credit is an alternative source for financing the economic activity. Therefore, when the financial markets are not well-developed, the banking sector will have a higher influence on the economy. On the other hand, if the financial markets are well developed the other assets price channel will be more important for the transmission of monetary policy to the economy, because of the wealth effect present in this specific channel. Furthermore, it is possible to claim that there is a negative relationship between the relative importance of the other assets price channel and credit channel.

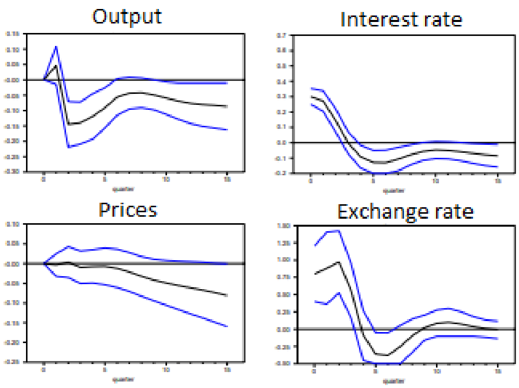

Figure 3.1: Typical response to a positive monetary policy shock in SOE

Regarding the impulse response functions in most cases, they have the shape and signals that it is expected from them. As it can be seen in figure 3.1 for some variables, namely, output, prices, interest rate and exchange rate. With a tightening of monetary policy research and economic intuition show that there will be a decrease in GDP, in the money demand, on the amount of credit given to economic agents, and on inflation. Also, consistent with the overshooting hypothesis of (Dornbusch, 1976) there will be an increase in the exchange rate. Furthermore, typical response from economic and financial variables reach the pick after 4-8 quarters after the change in the monetary policy.

3.3 VAR Studies for Portugal

The VAR studies in Portugal were relatively uncommon before the integration of Portugal in the European Monetary Union. However, with the creation of EMTN by the European Central Bank, Portugal was included in most of the research in MTM done by this organization.

A good example is a research done by (Cecchetti, McConnell, & Quiros, 1999) for the EMU. The aim of the paper was to try to infer the relative weight that national central banks have been placing on output and inflation in the formulation of their policies, as well as, the trade-off coefficient of inflation-output implicit on the economic structure of each country.

The authors choose seven of the eleven countries that were the founders of the EMU, namely, Belgium, France, Germany, Ireland, Italy, Portugal, Spain and three non-EMU countries to be able to make comparisons, Denmark, U.K., and Sweden.

The authors then built a structural VAR with four variables: output, inflation, interest rate and exchange rate. Then the authors compute and analyse the impulse response functions (IRF) of output and inflation to a shock on the interest rate. The conclusion was that the IRFs were not similar across countries. The authors also analysed the relative weight of inflation and output for the formulation of the monetary policies in each of the countries. The main findings were once more that the policy standards were not equal across countries, with countries such as Portugal and Spain to put more weight on the output variability and countries such as Germany, Belgium, and France more preoccupied with the variability of inflation.

The main conclusion of the paper was that the process of obtaining inflation stability will be more costly for some countries than others since the transmission of monetary policy affects economies differently seeing that it is stronger in some countries than in others.

Similar findings are reported in (Ehrmann et al., 2003), in the set of studies done by EMTN. One of the examples of this studies published in the book is the study by (Ehrmann et al., 2003) for the period from 1980 until 1998 using output inflation and interest rate as endogenous variables,which shows that in aggregate terms the response of the Euro area was in line with the literature. Nevertheless, on a country level, in small countries such as Portugal output and inflation reaction were much stronger than in countries such as Germany or France, one of the explanations that the authors gave is that this result arises from the fact that this Portugal is a small country with strong transmission mechanism of monetary policy.

In a recent paper (Sousa, 2014) the author wants to study the financial markets and how monetary policy can influence them. For that, he uses data from 1947Q1 until 2007Q4 with the normal three endogenous variables plus commodity price index and stock price index. One of the main conclusions is that an increase in the interest rate will lead to a strong increase in unemployment, the drop in commodity price is faster than the inflation but both of them decrease strongly. Additionally, the author also shows that the Portuguese money demand is characterized by low output and interest rate elasticities.

Another study by (Georgiadis, 2015) builds a general VAR with every country from EMU using data from 1999Q1 until 2009Q4 with the following variables in the endogenous block: output, inflation, interest rate and exchange rate. However, the monetary policy instrument, the interest rate, is modelled as a function of the aggregate Euro area output and inflation. With this model, the author is able to show that due to rigidities in the unemployment and labour market, Portuguese output and inflation is particularly sensitive to changes in the interest rate.

3.4 VAR Studies in Poland

As previously referred, the NBP publishes every two years a report in which it analysis the monetary transmission mechanism in Poland. The reports started in 2011 and the last available is from 2017. Although some variables are introduced and drop in each report, the core variables are always presented, namely, GDP, inflation, interest rate, and the exchange rate. Furthermore, in every report, the data is collected from the first quarter of 1998 until the year of the report. Therefore, it is possible to follow the different changes in the variables to a monetary shock and claim that this reactions are due to the recent adjustments in the Polish economy.

In (Demchuk et al., 2012) the authors built a structural VAR with the following variables on the endogenous vector: Consumer price index, investment, consumption, GDP, 1-month interest rate, and nominal effective exchange rate. After analysing the results from the model, the authors claim that the responses of the key macroeconomic variables to monetary policy were consistent with the structural features of the Polish economy and similar to the responses of the Euro area in aggregate terms. Although the financial system is less developed than in the Euro area, Polish economy is characterized by a lower degree of rigidities and more frequent price adjustments.

The same methodology is used in (Kapuściński et al., 2014). Also, the data set is expanded until the first quarter of 2013. Nevertheless, the order of the endogenous variables is different, with the investment and consumption being dropped from the model and the exchange rate is now real instead of nominal. An interesting result from the comparison between this report and (Demchuk et al., 2012) is the fact that the exchange rate channel seems to have decreased its relative strength and effectiveness, the authors argue that this shift is due to changes in the production process, related to the growing share of production by international firms. Another interesting result is that the response of inflation to changes in the monetary policy was now much stronger than what was reported in the previous study.

In (Kapuściński et al., 2016) same methodology was used as in the previous reports. The dataset was extended until the first quarter of 2015. In this report, the variable amount of loans denominated in zloty is included on the endogenous vector. Similar conclusions regarding the decrease of the relative importance of the exchange rate channel are found in this report. The inflation response to interest rate seems to be stable since similar responses were found in the previous report. One interesting result that comes from this study is that the authors tried to estimate the effect of the credit channel to the Polish economy and found that this particular channel has become relatively important to the transmission of NBP monetary policy to the economy.

As mention in the introduction, the objective of this study and therefore the research question is whether the responses of the Portuguese domestic variables have changed to shocks in the monetary policy due to the transference of monetary policy decision from Banco de Portugal to the European Central Bank. This evaluation it will in two steps, in the first step, there will be made a comparison before and after Portugal joined the Euro. In the second step, the responses of Portuguese and Polish domestic variables to shocks in the monetary policy will be compared.

It is expected that the reactions of Portuguese domestic variables to shocks in monetary policy to be different before and after the adoption of Euro, since if the European Central Bank increases the interest rates during a Portuguese recession this increase will depresses even more the economy. On the other hand, if this increase in the interest rate is made when Portugal is near the full employment this change will have a small impact on the economy.

Chapter 4

Empirical VAR Model

The goal of this dissertation is to evaluate if the reaction of Portuguese economy to shocks in the monetary policy has changed after Portugal joined the Euro-Zone. Furthermore, a step further is made and compare the responses of Portugal with a European country that has autonomous and independent monetary policy.

This European country must be in the European Union, but outside of the Euro-Zone, additionally, it must have autonomous and independent monetary policy, that is, fluctuant exchange rate regime with inflation targeting, a country with a diversified economy with the agriculture to be relatively important in the 80s and 90s and same major commercial partners, to be as similar to Portugal as possible. With this characteristics, three countries emerge Sweden, Poland and Romania. However due to GDP per capita, Sweden is drop because it is too hight when compared with Portugal, similarly, Romania is dropped because GDP per capita in Portugal is too high. Therefore, the country that will be used to compare with Portugal is Poland.

The methodology used for measuring the response of key macroeconomic variables to shocks in the monetary policy is based on VAR models, it was considered the more adequate methodology since they are widely used for the study of unexpected monetary policy shocks, it allows for the endogeneity of the variables, it is simple to implement and does not required a well specified economic structured as well as big data samples.

The data for Portugal was collected from the first quarter of 1986 until the first quarter of 2017. However, to make it possible the comparison between the response of key macroeconomic variables to shocks in monetary policy before the adoption of Euro and after the adoption of Euro, the sample is divided into two different periods. Although the number of observations is not the same in the two periods for Portugal, it is not expected that differences in responses are caused by this difference in the number of observations.

From the first quarter of 1986 until the fourth quarter of 1998 which will be denominated "Pre-Euro" during this period Portugal had an independent monetary policy [1]. Also during this period, the Portuguese economy was characterized by high-interest rates, high level of inflation and high growth rate of real GDP (except for the recession of 1993). The other period, the "Post-Euro" period the monetary policy was not independent since it was controlled by ECB. The Post-Euro data is from the first quarter of 1999 until the first quarter 2017, in this period the Portuguese economy was characterized by low-interest rates, low level of inflation

[1] Although the escudo was linked to Deutsch Mark

and low growth rate of real GDP.

The data for Poland was collected from the first quarter of 1999 until the first quarter of 2017. Furthermore, to make the comparison possible between Portugal and Poland the same variables are used in both models.

The data was collected from Federal Reserve of Saint Louis-Federal Reserve Economic Data for all the endogenous and exogenous variables with the exception of exchange rate which was collected from International Monetary Fund and Organization for Co-operation and Development.

4.1 Changes Occurred in Portuguese Economy

Apart from the loss in monetary policy independence, several other characteristics have changed in the Portuguese economy before and after joining the Euro.

One of these changes was the decrease in terms of contribution for the total GDP in the 80's and 90's from sectors such as agriculture and fisheries which represented around 5.58% of the GDP and industrial sectors which accounts for 18.41% of GDP and after almost two decades the shares decreased to 1.85% and 13.11% respectively. On the other hand, the sector of services has increased the contribution share of GDP from 35.6% to 42.96%.

Another change that occurred was the fact that before the adoption of the Euro Portuguese economy was characterised by high inflation and as a consequence of that high interest rates. On the contrary, after the adoption of the Euro, the inflation was stable in low values which allowed to decrease the interest rates. This decrease in interest rates had two major consequences in the behaviour of families. On one hand, it created an incentive to increase credit which was given with lower interest rates than before. On the other hand, the decrease in the interest rates implied a decrease in the rewards of saving which decreased the families' savings.

Finally, another changed that occur was the harmonization of the supervision rules among countries bellowing to the European Monetary Union by which commercial banks were supervised since this responsibility was passed to the European Central Bank which supervises the entire Euro system in coordination with national central banks.

4.2 Endogenous Variables

This study tries to evaluate the effect of monetary policy in the economy through three of four channels presented in the literature, namely, the interest rate channel, the exchange rate channel, and the credit channel. For this reason, six variables are collected: the real growth rate of GDP, unemployment rate, inflation rate, interbank interest rate, total credit, and real effective exchange rate.

The variable ***GDP*** is the real growth rate of the gross domestic product, measured as the percentage change from the same period one year ago, this variable is also seasonally adjusted. This variable has been chosen since it is common that monetary authorities react to changes in output. Additionally, it is one of the objectives of ECB and NBP to contribute to a sustainable economic growth if the inflation target value is not at risk.

The variable ***Un*** is the total harmonized unemployment rate seasonally adjusted. This variable has been chosen to control for the business cycle and it is effected by the rigidities present in Portuguese and Polish economies on the unemployment and labour market.

The variable ***Inf*** is the percentage change of consumer price index for all goods in relation to the same period one year ago and it is seasonally adjusted. This variable has been chosen due to the fact that is the most important key macroeconomic variable that the monetary authority targets and reacts to influence its future behaviour.

The variable ***Interbank*** is the 90 days interbank interest rate adjusted for brakes. This variable has been chosen since it is the key instrument that the monetary authorities in most advanced economies use to influence the economy and the economic behaviour.

The variable ***Cred*** is the percentage change from the same period one year ago of the total amount of credit given to non-financial corporations adjusted for brakes as well as seasonally adjusted. This variable has been chosen due to the fact that the credit channel has an important role in the Portuguese and Polish economy. Since those economies are banking dominated.

Finally, the variable ***Exch*** [2] is the real effective exchange rate index, based on unit labour cost. This variable has been chosen due to the fact that both economies are relatively small and open. Therefore, the reaction of key macroeconomic variables will also depend on the exchange rate.

The descriptive statistics, as well as the graphs for Portuguese variables, are presented in Appendix A and for Polish variables in Appendix B.

4.3 Exogenous Variables

As been mentioned, Portugal and Poland can be considered small open economies. To capture the idea that Portugal and Poland will react to shocks, for example, in German economy but this economy will not react to shocks in the Portuguese and Polish economy, it will be introduced in the VAR model an exogenous block.

In this block, there are two economic variables, GDP which is the real GDP as a measure of demand for national exports and supply for national imports. The other variable is inflation rate which is a proxy for the future foreigner inflation rate.

Two obvious countries can be representative for the rest of the world for Portuguese and Polish economies, US and Germany. The use of both countries to represent the rest of the world can be easily justified. In the case of US as the biggest economy in the world, it can be seen as a good proxy for world economic environment. On the other hand, Germany is the biggest commercial partner for both imports and exports to Portugal and Poland.

Therefore, some perspective analysis was made for the Portuguese model with U.S. and Germany for the Pre-Euro period, the response of key macroeconomic variables to changes in monetary policy was not that different. The analysis was then made for the Post-Euro period, here the conclusions were different. The responses of the key variables were much better the case where the rest of the world is represented by German economy. Same conclusions came from the Polish model.

[2] The increase on this index means an appreciation of the currency in use.

Consequently, the country that will be used in the exogenous block in the VAR model will be Germany. The summary statistics, as well as the graphs for these two variables, can be consulted in Appendix C.

4.4 Stationarity Analysis

Before the estimation of the VAR model, it is important to study if the variables are stationary since VAR assumes that series are stationary.

To evaluate if a series is stationary there are multiple tests available. Nevertheless, there will be used two different stationary tests to ensure robust results, namely, the augmented Dickey-Fuller test (ADF) and the Phillips-Perron test (PP). These tests measure the degree of integration of a variable. Furthermore, both tests have the null hypothesis that the variable has a unit root, that is, is not stationary.

It will be now analysed the output generated by the econometric software EViews for all the variables in the analysis for the Portuguese and Polish economy as well as the exogenous variables [3]. The lags associated with both ADF and PP tests were automatically chosen by the software. Furthermore, it was chosen the level of 1% significance level as a threshold to establish if a series is stationary. Also, if any of the tests show that the variable is not stationary first-difference operator will be applied to that variable to make it stationary.

4.4.1 Portugal

The ADF and PP test (in Appendix D) shows that none of the variables for the Portuguese economy is stationary, as it is possible to observe in table 4.1 .

Table 4.1: Results of Portuguese stationarity tests

Variable	ADF (p-value)	PP (p-value
Un	0.4751	0.6552
GDP	0.1559	0.0882
Inf	0.5705	0.2601
Interbank	0.7127	0.4577
Cred	0.0919	0.1037
Exch	0.2242	0.2086

Since none of the variables seems to be stationary, first-difference operator is applied to all variable, once more, the output of Eviews can be consulted in Appendix D, which are summarized in table 4.2.

[3] Most of the variables are in percentage change for this reason the option with no trend was used.

Table 4.2: First-difference results of Portuguese stationary tests

Variable	ADF (p-value)	PP (p-value
D Un	0.0037	0.0000
D GDP	0.0000	0.0000
D Inf	0.0000	0.0000
D Interbank	0.0000	0.0000
D Cred	0.0000	0.0000
D Exch	0.0000	0.0000

As it is possible to observe in the table 4.2 the null hypothesis can be rejected for all the variables, that is, now all the variables are stationary in first-differences.

4.4.2 Poland

As in the case of the Portuguese variables, none of the variables are stationary with 99% confidence in both ADF and PP tests. Table 4.3 summarizes the results present in Appendix E.

Table 4.3: Results of Polish stationary tests

Variable	ADF (p-value)	PP (p-value
Un	0.7902	0.8686
GDP	0.0149	0.0192
Inf	0.1462	0.2986
Interbank	0.4871	0.6031
Cred	0.0337	0.0376
Exch	0.0126	0.0395

However, since VAR models require that all the variables are stationary, the first-difference operator will be applied to all variables that have a unit root. The results are available in Appendix E, which are summarized in table 4.4.

Table 4.4: First-difference results of Polish stationary tests

Variable	ADF (p-value)	PP (p-value
D Un	0.0089	0.0022
D GDP	0.0001	0.0000
D Inf	0.0002	0.0002
D Interbank	0.0003	0.0003
D Cred	0.0000	0.0000
D Exch	0.0000	0.0000

As it is possible to observe in the table 4.4 the null hypothesis can be rejected for all the variables, that is, now all the variables are stationary.

4.4.3 German Exogenous Variables

The ADF and PP test (in Appendix F) shows that only the variable ***GDP Germ*** is stationary, as it is possible to observe in the table 4.5.

Table 4.5: Results of German stationary tests

Variable	ADF (p-value)	PP (p-value
GDP Germ*	0.0000	0.0032
Inf Germ	0.1975	0.0992

* Stationary with 99% confidence for both tests in levels.

It is then needed to apply the first-difference operator to the German inflation variable that is not stationary in levels. The results are available in Appendix F which are summarized in table 4.6.

Table 4.6: First-difference results of German stationary tests

Variable	ADF (p-value)	PP (p-value
GDP Germ*	0.0000	0.0032
D Inf Germ	0.0000	0.0000

* Stationary with 99% confidence for both tests in levels.

As it is possible to observe in the table 4.6 the null hypothesis can be rejected for all the variables, that is, now all the exogenous variables are stationary.

4.5 Optimal Lag Length

Another step that is required to build a VAR model is to establish which is the adequate number of lags in the VAR model. The definition of a proper leg length is fundamental due to several aspects. On one hand, the optimal number of lags will ensure that the residuals of the model are stationary. On the other hand, the number of lags is what allows the VAR model to capture the economic dynamics of the country.

To guarantee robust results five criteria will be used to select the optimal lag length, namely, Likelihood-Ratio (**LR**), Final Prediction Error (**FPE**), Akaike Information Criterium (**AIC**), Schwarz Information Criterium (**SC**), and Hannan-Quinn Information Criterium (**HQ**) [4].

The results are available in Appendix G and are summarized in table 4.7.

Table 4.7: Optimal lag length

Model	LR	FPE	AIC	SC	HQ
Portuguese 1986Q1-1998Q4	4	4	4	0	0
Portuguese 1999Q1-2017Q1	4	4	4	0	0
Polish 1999Q1-2017Q1	4	4	4	0	1

[4]The maximum number of lags put in the test was 4 since the data is quarterly.

As it is possible to observe not all the criteria give the same optimal lag. Nevertheless, three out of five criteria point that the optimal lag length is four quarters. Additionally, as a robustness check, a VAR model was estimated with three and five lags, the results were conclusive. The VAR with three lags were not able to generate IRFs with enough dynamics. In opposition, VAR with five lags demonstrate IRFs with much more volatility. Therefore, it is possible to conclude that the optimal number of lags is four.

4.6 VAR Model

As mentioned before, the VAR model will be a VAR model with four lags, VAR(4) with six endogenous variables and two exogenous variables. This VAR(4) can be represented by equation 4.1:

$$Y_t = A_0 + A_1 Yt - 1 + \ldots + A_4 Y_{t-4} + B_0 + X_t + \ldots + B_4 X_{t-4} + \epsilon_t \tag{4.1}$$

Which can be rewritten in the reduced form given by equation 4.2.

$$Y_t = A_0 + \sum_{i=1}^{4} A_i Y_{t-i} + \sum_{i=0}^{4} B_i X_{t-i} + \epsilon_t \tag{4.2}$$

Where:
Y_t is a vector (6 x 1) with the endogenous variables of interest;
A_0 is a vector (6 x 1) with the constant terms;
A_i is a matrix (6 x 6) with the endogenous coefficients;
B_i is a matrix (2 x 2) with the exogenous coefficients;
X_{t-i} is a vector (2 x 1) with the exogenous variables of interest;
ϵ_t is a vector (6 x 1) with random terms, with mean 0, constant variance, identically and independently distributed and not correlated.

4.7 Identification Scheme

As mention in the literature review, the identification scheme developed by (Christiano et al., 1999) is widely used in the literature. Therefore, the identification scheme that will be used is inspired by those authors. The vector Y_t has the order represented by expression 4.3:

$$Y_t = \begin{bmatrix} \boldsymbol{D\ Un}_t \\ \boldsymbol{D\ GDP}_t \\ \boldsymbol{D\ Inf}_t \\ \boldsymbol{D\ Interbank}_t \\ \boldsymbol{D\ Cred}_t \\ \boldsymbol{D\ Exch}_t \end{bmatrix} \tag{4.3}$$

In this setting, it is assumed that firstly, there is no contemporaneous impact of monetary policy on the unemployment rate, real GDP growth and inflation rate.

That is, the monetary policy tool, interest rate, does not influence the current values of those three variables just its future values. However, there is a possibility of credit and exchange rate to react contemporaneously to changes in the monetary policy tool.

In other words, the monetary authority observes the variables unemployment rate, real GDP growth and inflation rate and chose an interest rate that minimizes a similar loss function as shown in 2.2.1 and the remaining variables will react contemporaneously to this change in monetary policy.

Two main critics that can be made to this model. The use of many endogenous variables and the particular order of the endogenous vector Y_t.

One of the principal problems of using too many endogenous is the fact that IRFs are not statistically significant. However, even in the most reduced VAR which only uses three endogenous variables, namely, GDP, inflation and the interest rate the statistical significance of the responses of the key macroeconomic variables to monetary shocks are similar to the model that is proposed.

Regarding the identification scheme of the endogenous variables, alternative schemes were tested. One of this tested schemes was similar to the one that is presented with the exception of the order of credit and interest rate. In this identification scheme the growth rate of credit came before the interest rate, this identification scheme is sometimes used in the literature to capture the idea that the central bank reacts to changes in the credit market.

However, the result of this identification scheme and the others tested were qualitatively similar. Which indicate that the results that will be presented in the next chapter are robust to changes in the identification scheme.

As been mentioned, a natural step to build a VAR to a small open economy is to include an exogenous block to capture the idea that the economy is affected by foreign shocks but home shocks are irrelevant for foreign economies.

The exogenous block, X_{t-i}, will have the ordering describe in expression 4.4.

$$X_{t-i} = \begin{bmatrix} \boldsymbol{GDP\ Germ}_{t-i} \\ \boldsymbol{D\ Inf\ Germ}_{t-i} \end{bmatrix} \tag{4.4}$$

This will be the fully specified VAR model that will be used to estimate the effect of changes in monetary policy in six key macroeconomic variables.

Chapter 5

Empirical Results

Before analysing the impulse response functions and the variance decomposition, it is necessary to ensure that the model is well designed.

The output of the three models from the statistical software Eviews can be consulted in Appendix H.

5.1 Stability and Residuals Analysis

To verified if the properties of VAR model were respected, a series of stability test were made (Appendix I), namely, the unit circle test to verify if the VAR model is explosive, the LM test to ensure that residuals are not autocorrelated and finally, the normality of the residuals was tested.

As it is possible to observe, in the tests in Appendix I all the three models have a non-explosive behaviour since all residuals are within the unit root circle. Therefore, the results from the three models can be trusted and these results will tend to converge for the true values.

The LM test supports the idea that four lags is the optimal number of lags since it shows that there is no autocorrelation in the residuals when the model has 4 lags.

The normality test shows that the residuals are normally distributed with the exception of the residuals of the Portuguese Post-Euro model. However, the law of big numbers ensure that residuals are normally distributed.

So, it is possible to conclude that the results from the three VAR models do not suffer from any statistical bias.

5.2 Impulse Response Function Analysis

In this section, it will be made the analysis of the impulse response functions focussing on the effect of the interest rate channel. Firstly, it will be described briefly the behaviour of the IRFs for the three models. Then, it will be made a comparison between the behaviour of IRFs in the three models.

5.2.1 Portugal Pre-Euro

This period was used for verifying the ability of the identification scheme and the model to produce impulse response functions in line with the literature in small open economies since in this period Portugal had an autonomous and independent monetary policy. The model and identification scheme was able to produce good results in line with the literature. Therefore, the same identification scheme will be applied in Post-Euro period for Portugal and Poland.

The figure 5.1 shows the accumulate response of the six macroeconomic variables to a positive shock of one standard deviation point in the monetary policy tool, the interbank interest rate.

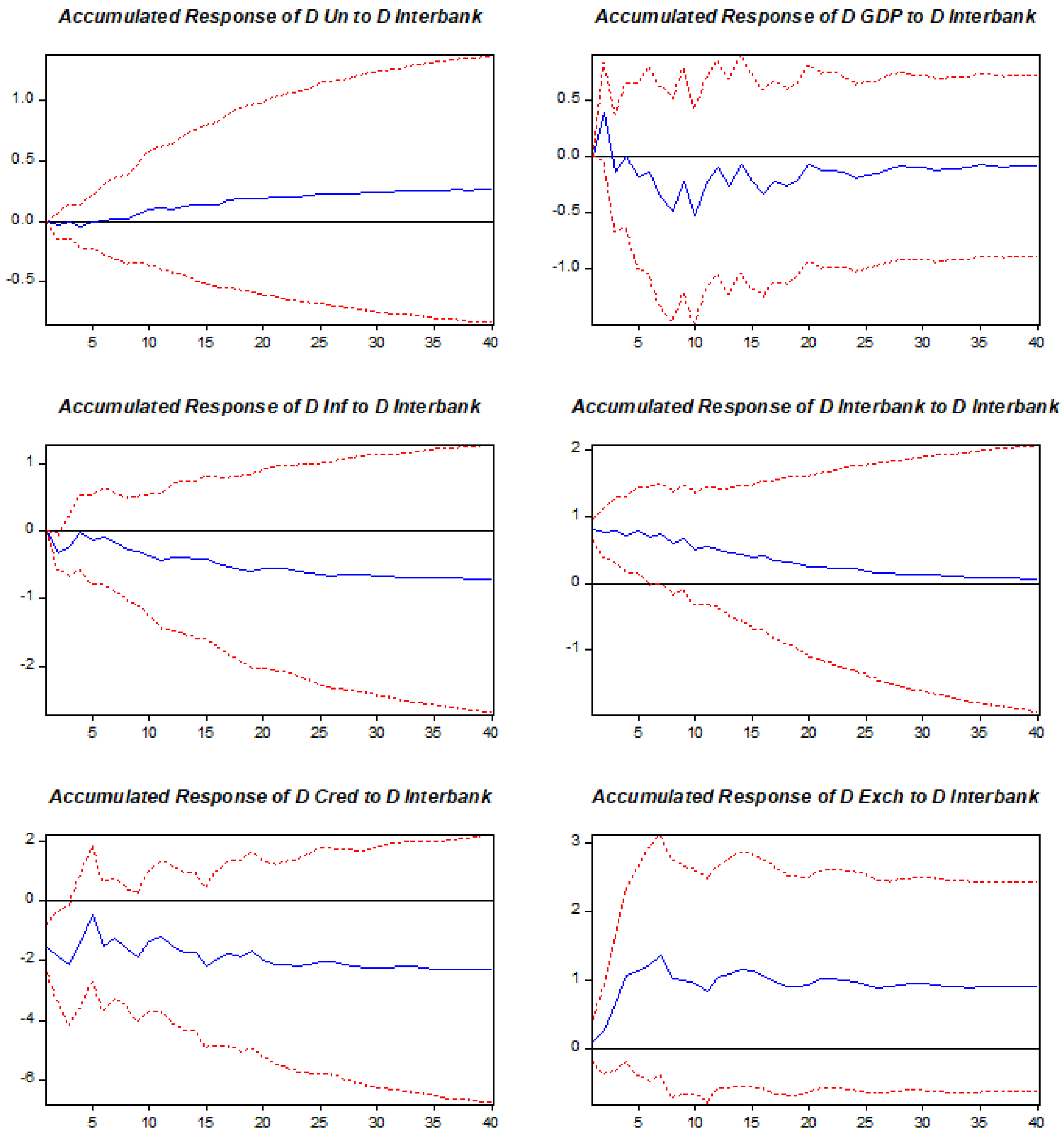

Figure 5.1: Accumulate response to a positive shock of one standard deviation point in interbank interest rate

As it is possible to see, the effect of a tightness in the interest rate will cause an increase in the unemployment rate. However, this increase will only be felt after seventh quarter, which can be explained by the rigidities in the labour market. From there, the unemployment rate increase in a slow but steady rate until it reaches the maximum of 0.25 in the thirtieth quarter. After that, the unemployment rate stabilizes around 0.24.

A tightness in monetary policy seems to have a positive effect on the growth rate of GDP, however, this puzzling result disappears after fourth quarter, which could be explained due to some rigidities in the market, namely, delivery contracts among others. Then there is a decrease in the growth rate until it reaches the maximum of -0.53 in the tenth quarter. After that, the economy starts to gradually recover from the increase in the interest rates, after thirtieth quarter the effect of monetary policy in real GDP stabilizes around -0.1.

The effect of a contractionary monetary policy will generate a decrease in the inflation rate. During the first four quarters, the inflation drops a bit but then recovers. Then it gradually decreases until it reaches the maximum of -0.6 in the twentieth quarter and stabilized around that value.

The interbank interest rate is stable in 0.8 for four quarters. From there onwards it starts to decrease until the end of the analysis.

As it would be expected, the increase in the interest rates will cause a decrease in the growth rate of credit. This decrease goes until the second quarter after that the credit increases until the sixth quarter then it starts to decrease steady but unstably until it reaches twenty-fifth quarter with the value -2.1, then it stabilizes around that value.

The response of exchange rate to an increase in the interest rate is consistent with the overshooting hypothesis of Dornbusch. That is, an increase in the interest rate will cause an increase in the exchange rate with the maximum of 1.4 in the seventh quarter. After that, it decreases and stabilizes around 0.9.

These results are summarized in table 5.1.

Table 5.1: Effect of a positive monetary policy shock

Variable	Max.	Quarters	0Q-4Q	30Q-40Q
D Un	0.25	30	0	0.24
D GDP	-0.53	10	0.1	-0.1
D Inf	-0.6	20	-0.2	-0.6
D Interbank	0.8	1	0.8*	0.1
D Cred	-2.2	3	-2*	-2.1
D Exch	1.4	7	0.7	0.9

* Statistically significant response.

The results described here are consistent and similar to the ones presented in section 3.2.

One interesting result that comes out of the analysis is that although both the GDP and interbank interest rate come back practically to zero the unemployment does not recover from the increase in the interest rates, which indicates strong rigidities in the unemployment and labour market. This finding is consistent with (Georgiadis, 2015) where the author found that Portugal is one of the countries with the biggest rigidities in unemployment and labour market among EMU countries.

5.2.2 Portugal Post-Euro

A structural change happened when Portugal join the Euro, the Portuguese monetary policy decision was transferred from Banco de Portugal to European Central

Bank which conducts the monetary policy for all the Euro-Zone. This change can be potentially harmful to small countries such as Portugal, as described in section 2.2.1, which can cause strange reaction function from the key macroeconomic variables to a monetary policy shock. Since the interest rate is determined almost exogenously due to the low weight that Portugal has on aggregated EMU macroeconomic variables.

Additionally, a correlation table (Appendix J) was made to measure the correlation between Portuguese and the aggregated EMU variables. The results show that there is a weak correlation between Portuguese and aggregate EMU variables and for some variables this correlation is even negative. This can indicate that the monetary policy followed by the ECB may not be the best one to be followed by Portugal.

The figure 5.2 shows the response of the same six macroeconomic variables to a shock of one standard deviation point in the monetary policy tool.

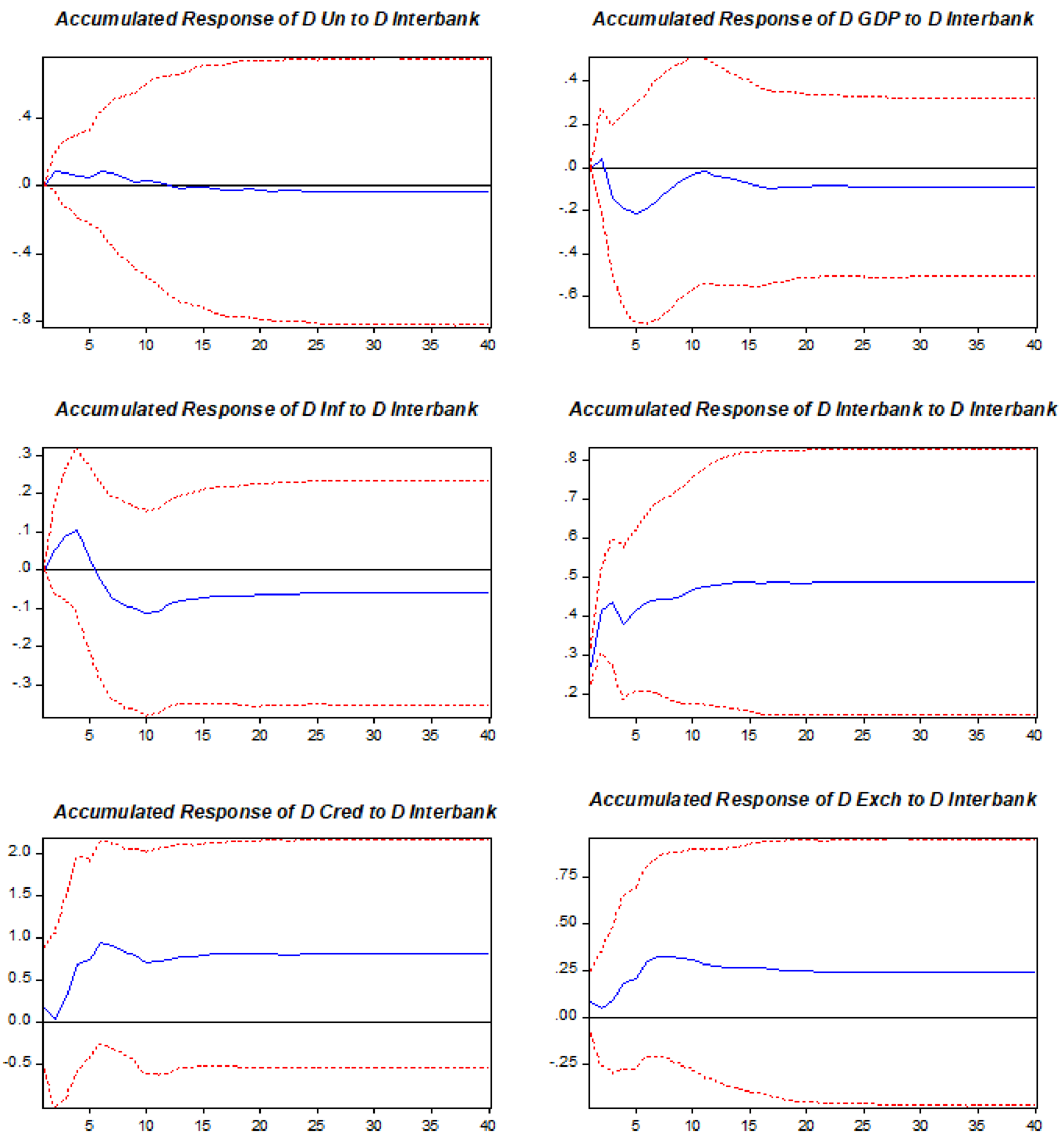

Figure 5.2: Accumulate response to a positive shock of one standard deviation point in interbank interest rate

The effect of monetary policy on the unemployment rate has now a positive effect after twelfth quarter. The effect of a contraction of monetary policy in GDP is negative and permanent. Inflation rate response is similar to the GDP response with the exception of the first five quarter where it is positive.

A temporary increase in the interest rate by the ECB seems to originate a positive and permanent effect on the Portuguese interbank interest rate.

The response of credit is not what it would be expected, since with the increase on the interest rate by the ECB now leads to an increase in the credit given, which is contrary to what the theory claims which may indicate that the monetary policy conducted by the ECB is exogenous to Portugal. Other possible explanation for this result is that with the increase in interest rates will cause a increase in the supply of credit due to the higher returns to the bank.

Finally, the overshooting hypothesis is still present in the response of the real exchange rate to an increase in the interest rate.

These findings are summarized in table 5.2.

Table 5.2: Effect of a positive monetary policy shock

Variable	**Max.**	**Quarters**	**0Q-4Q**	**30Q-40Q**
D Un	0.09	6	0.05	-0.04
D GDP	-0.21	5	-0.1	-0.09
D Inf	-0.11	10	0.05	-0.06
D Interbank	0.49*	13	0.4*	0.49*
D Cred	0.94	6	0.2	0.8
D Exch	0.325	7	0.09	0.25

* Statistically significant response.

As mentioned the response of the growth rate of total credit given can be explained by the mismatch of the monetary policy conducted by ECB to small countries such as Portugal.

5.2.3 Poland

The figure 5.3 shows the response of the same six macroeconomic variables to a shock of one standard deviation point in the interbank interest rate.

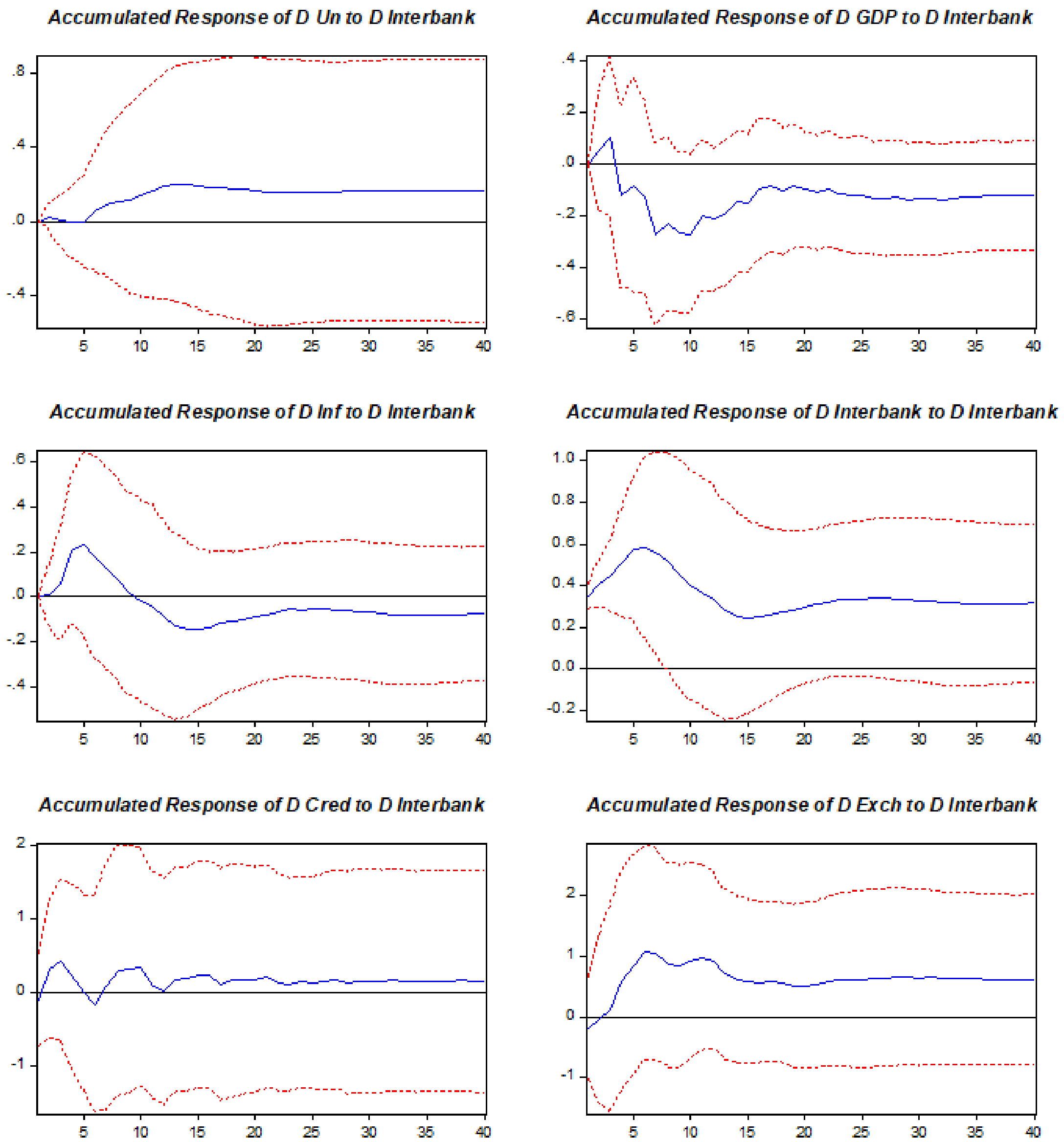

Figure 5.3: Accumulate response to a positive shock of one standard deviation point in interbank interest rate

The main findings are summarized in table 5.3.

Table 5.3: Effect of a positive monetary policy shock

Variable	Max.	Quarters	0Q-4Q	30Q-40Q
D Un	0.2	15	0	0.17
D GDP	-0.27	7	0.1	-0.12
D Inf	-0.14	14	0.15	-0.08
D Interbank	0.58*	5	0.45*	0.31
D Cred	0.4	3	0.3	0.1
D Exch	1.1	6	0.5	0.6

* Statistically significant response.

The responses of Polish key macroeconomic variables are relatively similar to the ones presented in the Portuguese Pre-Euro and Post-Euro scenario, apart from credit. This difference can be explained due to the fact that, firstly, the Polish interbank market is mainly used by banks for short-term investment due to high liquidity. Therefore, the interbank interest rate can be view as an opportunity cost for banks. Secondly, due to the positive interest rate margin that the generality of Polish banks have, an increase in interest rates will cause an increase in the profits, which will increase the equity which will allow the bank to increase the amount of credit given to non-financial economic agents.

5.2.4 Comparison Between the Three Models

To make the comparison between Portugal in the Pre-Euro period, in the Post-Euro period and in the case of Poland easier the significance bands were dropped to simplify the analysis.

The analysis will be made using the graph presented in 5.4 to analyse the differences in the shape of the response of key macroeconomic variables to the monetary shock.

Additionally, combining the information from tables 5.1, 5.2 and 5.3 it is possible to analyse the maximum absolute value cause by the effect of the change in monetary policy as well as the effect of monetary policy within one year and between thirty quarters and forty quarters.

The figure 5.4 shows the response of the three models to a shock of one standard deviation point in the interbank interest rate.

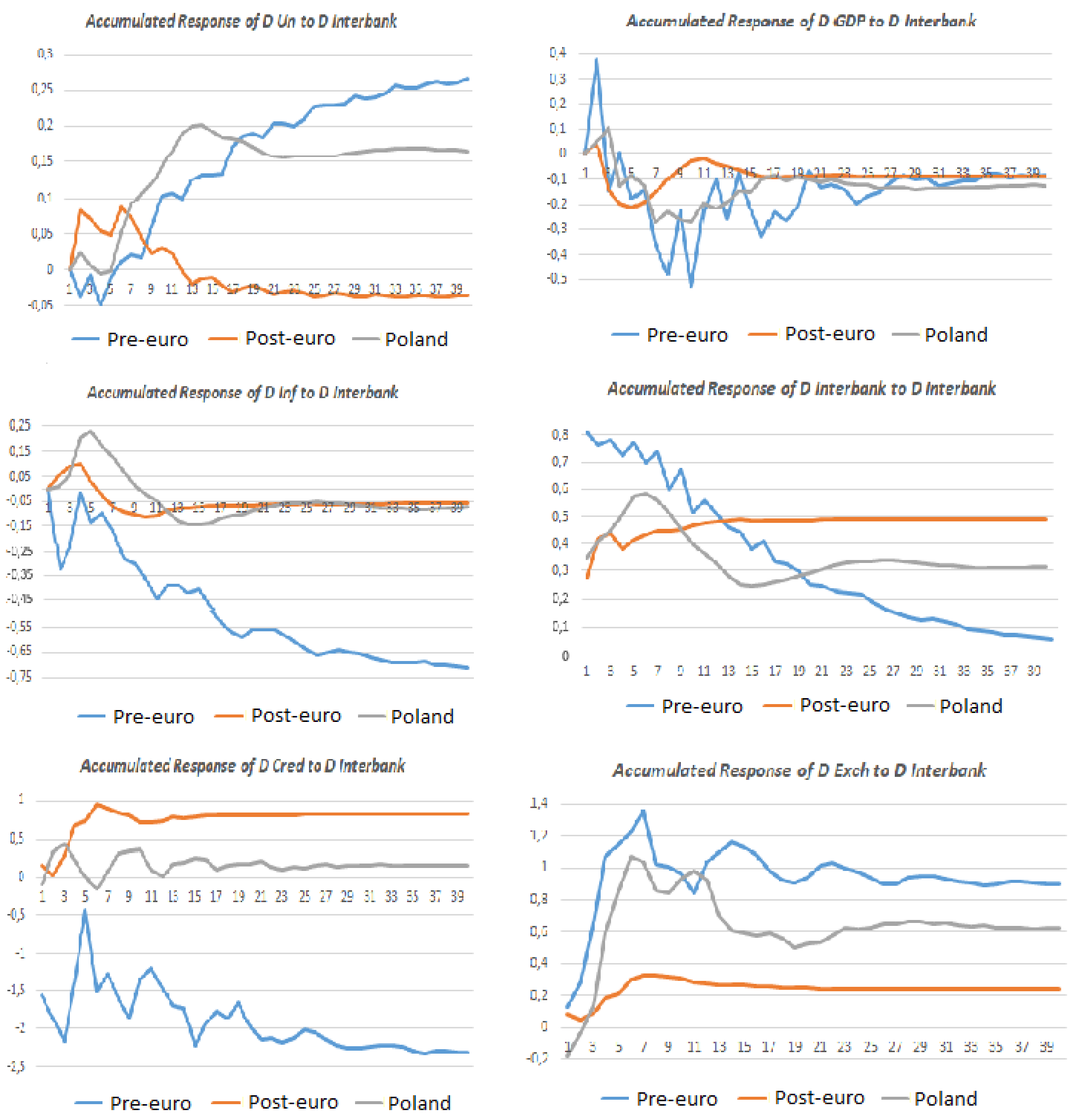

Figure 5.4: Accumulate response to a positive shock of one standard deviation point in interbank interest rate

In the case of the unemployment rate is interesting to see that the response in the Pre-Euro period is the opposite of the Post-Euro. In the Pre-Euro period, the change in interest rate cause a small decrease in the unemployment rate, however, after the fifth quarter this puzzling result disappear and the unemployment starts to gradually increase. On the opposite, during the beginning of the Post-Euro period a increase in interest rate increases unemployment, however, after the eleventh quarter, this increase in interest rate will decrease the unemployment rate. The finding that an increase in interest rate will cause a substantial increase on unemployment in the Pre-Euro period is consistent with the results obtain by (Sousa, 2014). The response of polish unemployment is similar to the Portuguese response in the Pre-Euro period. Nevertheless, the effect it is weak than in Portugal for the Pre-Euro period.

Similarities in the response behaviour of real GDP to an increase in interest rate are notorious between Portugal with independent monetary policy and Poland with both economies having a positive effect within four quarters, after they reach the maximum contraction of real GDP around seventh quarter. Nevertheless, once more the reaction of Portuguese real GDP to interest rate is much stronger than in the case of Poland. Another interesting fact is that the response of real GDP when the monetary policy is controlled by ECB is much smoother than in the case when the monetary policy was independent. Also, the maximum decrease in real GDP happens in the fifth quarter instead of seventh quarter. Despite these differences, the long-run effect seems to be similar in the two periods.

Regarding the effect of the increase in interest rate in the inflation rate is possible to see that the responses of Portugal in Post-Euro and Poland are similar and that these responses are drastically different from the Pre-Euro scenario. Despite these differences, all the three responses have a pick in the fourth quarter.

As in the case of inflation the behaviour of interest rate is different in the Pre-Euro period and Post-Euro period and in the case of Poland. In the case of the Pre-Euro period, the Portuguese interbank interest rate gradually goes back to the initial point. However, in the case of Poland and the Post-Euro period, a one period shock in the interest rate seems to have a permanent effect in the interbank market.

Once more there is a clear distinction between Pre-Euro and Post-Euro and the case of Poland. In the case of Portugal in the Post-Euro period and Poland, an increase in interest rate seems to have a positive effect on the amount of credit given to non-financial agents. On the other hand, in the Pre-Euro scenario, the same increase has a strong negative effect on the amount of credit given to non-financial agents.

Finally, the overshooting hypothesis of Dornbusch is present in all the three responses to an increase in the interest rate. However, the overshooting magnitude is different in the Pre-Euro and Post-Euro period. Nevertheless, the pick of the overshooting occurs in the seventh quarter in the three models. The response of Polish exchange rate is similar to the Portuguese Pre-Euro scenario.

Since a quantitative analysis and comparison from the graphs cannot be directly made due to the difference in the "normal" monetary policy shocks, that is, the shock of one standard deviation point is different in each of the three models. The elasticities [1] of the five variables [2] to changes in the monetary policy tool is calculated in table 5.4 for each of the variables of the three models.

Table 5.4: Elasticities to a unexpected monetary policy shock

Elasticity	0Q-10Q			11Q-20Q			21Q-30Q			31Q-40Q		
	Pre	Post	Pol	Pre	Post	Pol	Pre	Post	Pol	Pre	Post	Pol
Un	0.01	0.12	0.11	0.36	-0.02	0.64	1.22	-0.06	0.48	2.97	-0.07	0.53
GDP	-0.23	-0.24	-0.25	-0.50	-0.14	-0.48	-0.71	-0.18	-0.37	-1.12	-0.18	-0.40
Inf	-0.27	-0.02	0.18	-1.20	-0.15	-0.38	-3.42	-0.12	-0.18	-8.08	-0.12	-0.24
Cred	-2.11	1.44	0.38	-4.38	1.60	0.56	-11.82	1.65	0.46	-26.33[3]	1.65	0.50
Exch	1.25	0.52	1.27	2.53	0.54	2.32	5.29	0.49	1.89	10.58	0.48	2.00

One conclusion that can be withdrawn from the analysis of table 5.4 is that as the time passes from the unexpected shock in the interest rate the elasticities will gradually increase in absolute values for all the variables in the Portuguese Pre-Euro

[1] Dividing the cumulative response of a key variable at the time i by the cumulative response of the interest rate at the time i

[2] Un, GDP, Inf, Cred and Exch

[3] This result is caused by the small value that the interest rate was in this period.

model. Another interesting finding is that the elasticities in the Pre-Euro model are greater in absolute than in the Post-Euro model after tenth quarters for all the variables.

Other interesting aspect is that during the first ten quarters the elasticity of Pre-Euro Portuguese GDP is the smallest among the three models, however, from that moment onwards this fact changes. The elasticity of GDP in the Pre-Euro model is the biggest of the three models, which may indicate that the Portuguese economy had relatively high labour market and prices rigidities in the Pre-Euro period. This result is consistent with the literature on MTM in Portugal for the period with an autonomous monetary policy.

The variable Cred has a different behaviour before the adoption of the Euro and after the adoption of Euro, as well as in Poland. With the increase on the interest rate to cause a huge decrease in the total credit, on the other hand, the same increase will lead to an expansion of credit to economic agent after the adoption of Euro and in Poland.

One conclusion that can be made after the analysis is that the reaction from Portugal in the Pre-Euro period are stronger than in the Post-Euro period and in Poland. Additionally, it is possible to see in the figure 5.3 in the graphic of the response of interest rate to changes in the interest rate that the "normal" monetary policy shock, that is, a one standard deviation shock in the Pre-Euro period is the biggest among the three models which is expected since in this period the inflation was relatively high and volatile which implied high interest rates.

As mentioned, one explanation for the relatively smoothness of the response in the Post-Euro period when compared with the Pre-Euro is that, there is a weakly and even sometimes negative correlation between Portuguese variables and EMU aggregate variables, due to this the interest rate can be considered almost as an exogenous variable since Portugal is a small country with low impact on the aggregate EMU variables. Therefore, when the ECB observes the EMU aggregate variables and defines the interest rate according to that does not choose the optimal interest rate that Portugal would need. This can also explain the puzzling result from the credit market. Also, another explanation is the historically low interest rates due to the recent crisis.

Additionally, in the case of some shock affect the Portuguese economy in a stronger way than other EMU countries the response of ECB will be smaller than what would be needed. This implies that there will be always a mismatch of the monetary policy if the effect of the shock in the Portuguese economy is different from the shock felt in the EMU aggregates. This argument can also explain the relative smoothness of the responses of the Portuguese variables in Post-Euro period.

5.3 Variance Decomposition

In this section it will be discussed the variance decomposition with respect to interest rate effect with two purposes, to evaluate the changes in the Portuguese economy before and after the adoption of Euro and consequent loss of monetary policy independence and the comparison between Polish and Portuguese economy. Therefore, all the six variables will be evaluated and discussed.

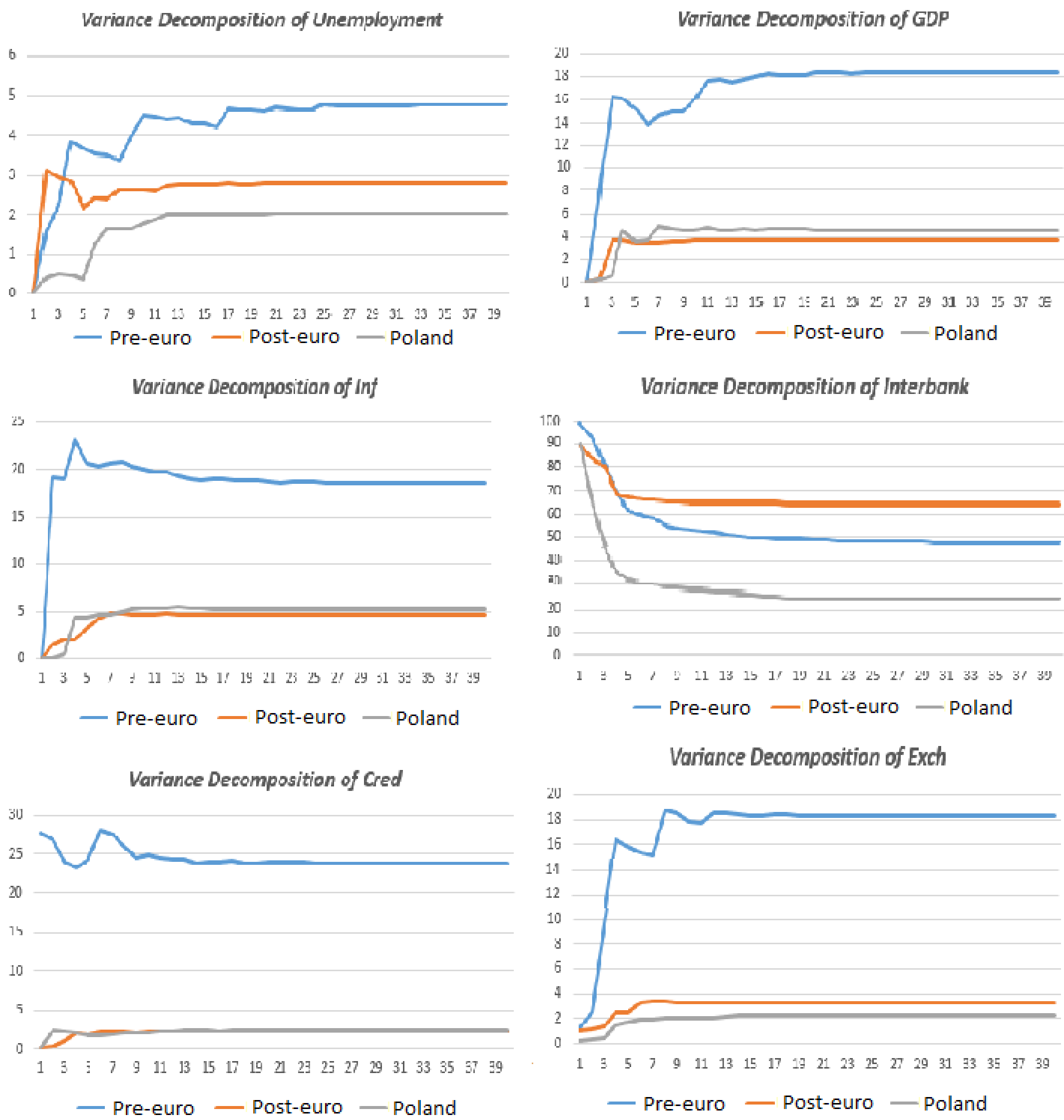

Figure 5.5: Variance decomposition with interbank effect

The results are summarized in table 5.5.

Table 5.5: Variance decomposition of a unexpected monetary policy shock

Interbank	0Q-10Q			11Q-20Q			21Q-30Q			31Q-40Q		
	Pre	Post	Pol	Pre	Post	Pol	Pre	Post	Pol	Pre	Post	Pol
Un	3.01	2.36	0.96	4.47	2.73	1.98	4.72	2.77	2.02	4.76	2.77	2.02
GDP	12.98	2.91	3.12	17.92	3.74	4.58	18.26	3.74	4.55	18.27	3.74	4.54
Inf	18.42	3.21	3.4	19.15	4.69	5.33	18.7	4.67	5.27	18.65	4.67	5.27
Interbank	68.242	71.71	41.04	50.09	64.80	25.45	48.00	64.59	24.28	47.62	64.57	24.19
Cred	25.69	1.64	1.82	24.13	2.16	2.31	23.98	2.16	2.34	23.92	2.16	2.34
Exch	13.14	2.52	1.39	18.30	3.26	2.16	18.30	3.25	2.23	18.29	3.25	2.23

From the analysis of the figure 5.5 and table 5.5, it is possible to conclude that, apart from the decomposition of Interbank, in all other variables the explanatory power of interbank interest rate (used as a reference for the rest of the economy) is greater in the Pre-Euro model than in the other two models. This result can explain the relatively strong reaction functions of the Portuguese variables in the Pre-Euro model.

A surprising fact is that the interest rate does not have a particularly important role in the explanation of the variation of unemployment, especially for the Pre-Euro and Polish model, where the monetary policy was independent. Perhaps this result can be explained by the fact that interest rate can influence indirectly unemployment by variables such as GDP, exchange rate and credit which seems to be the case, at least for the Portuguese Pre-Euro model. Also, the variable unemployment is influenced by structural factors that are not covered in the analysis which could explain this result.

In the case of GDP, the interest rate can explain around 18% of the variation in the case of the Pre-Euro model. A surprising fact is that Polish interest rate can only explain 3.74% of the changes in GDP. This is an unexpected result since it is known that NBP targets inflation as well as GDP. Therefore, it would be expected that the explanatory power of the Polish interest rate would be higher.

Regarding inflation, in the Pre-Euro model as it would be expected interest rate can explain around 18% of the variation in inflation. Furthermore, as in the other variables, the interest rate can only explain around 5% of the variation in the other two models, this can be explained by the fact that there is a greater economic integration throughout trade and financial ties which implies that a most of the inflation is defined by factors that are exogenous to Polish economy. Similar explain can be used for the Post-Euro model. Additionally, the interest rate defined by ECB does not consider the Portuguese inflation but the aggregate EMU inflation.

In the case of interbank, there is a distinction between the models with autonomous monetary policy and the model after the adoption of Euro since at least half of the variation in the interest rate can be explained by the other five variables. This result was expected since with autonomous monetary policy the interest rate is determined according to domestic variables. On the other hand, in the Post-Euro model, the interest rate is determined by ECB almost exogenously from Portuguese domestic variables due to its small size relative to the EMU aggregates.

As in the case of GDP and inflation, in the variable credit there is a substantial difference between the Pre-Euro model and the other two models. This result can be perhaps explained by the fact that during the Pre-Euro period the interest rate required for banks to give credit was relatively high compared with the Post-Euro period and the Polish model.

Finally, in the case of the exchange rate, there is a clear difference between the Pre-Euro model and the other two models. This difference is unexpected in the Polish model where the explanatory power of interest rate is only of 2.2% and the theory suggest that interest rate should be one of the main causes for the changes in the exchange rate. Both the results for Portugal are what it would be expected with the explanatory power of interest rate being around 18% when the monetary policy was conducted autonomously and around 2% when the monetary policy is conducted by ECB.

From the graphs presented in appendix K it is possible to conclude that there are clear similarities between the Portuguese economy in the Pre-Euro model and Polish economy currently, especially in the variables such as unemployment and interbank interest rate.

If the explanatory power of the interbank interest rate is isolated as presented in figure 5.5 and summarized in table 5.5 it is possible to see that there is a clear similarity between Poland and the Post-Euro model. A possible explanation of the relatively low explanatory power of interbank interest rate in these two models is that from the 2008 crises the interest rate has been historically low and other unconventional monetary policy tools, such as quantitative easing, have been used by the central bank to avoid the liquidity trap.

Now that the analysis of IRF and variance decomposition have been made some general conclusions can be presented:

The stronger reactions of the responses of Portuguese variables to a positive shock in the interest rate in the Pre-Euro period can be linked to the strong transmission mechanism of monetary policy, especially due to the interest rate channel which is present and relatively strong in all variables with the exception of the unemployment rate. This result is consistent and similar to the findings in (Ehrmann et al., 2003).

In another hand, it is possible to assure that after the adoption of Euro the explanatory power of interest rate on the other variables decreased in the variance decomposition. This may indicate that the monetary policy implemented by ECB is exogenous to Portuguese economy. As it has been mention the correlation between Portuguese aggregates and EMU aggregates are weak and sometimes even negative which can generate some difficulties in the Portuguese economy. Also, the size of change will be hardly optimum for a small country as Portugal. Although some changes occurred in Portuguese economy in the last decades [4] it is not reasonable to assume that the changes caused all of the alterations in responses and in the source of variation.

Finally, from the analysis is possible to conclude that Polish and Portuguese economies share enough common characteristics for the comparison to be valid.

[4] During the Pre-Euro period agriculture and fisheries represented 5.6% of GDP and services 35.6% of GDP in the Pre-Euro period agriculture and fisheries represented only 1.8% of GDP and services 43% of GDP

Chapter 6

Conclusions

This dissertation focuses on the relationship between domestic variables and the interest rate in Portugal in the Pre-Euro and Post-Euro period and in Poland. Specially if the transference of monetary policy from Banco de Portugal to the European Central Bank have changed this relationship

The main conclusion that can be withdrawn from the analysis within periods for the Portuguese variables is that after the adoption of Euro the domestic variables respond much smoother than in the Pre-Euro period. Also, the explanatory power of the interest rate decreases strongly from the Pre-Euro to the Post-Euro period. Furthermore, the elasticities after the tenth quarters are bigger in the Pre-Euro period than in the Post-Euro period.

These results can be explained by the fact that, the monetary policy that is conducted by the ECB will hardly be optimal for Portugal since Portugal is a small country when compared with the EMU and ECB only reacts to changes in the EMU aggregates. To give support to this argument the correlation between Portuguese variables and the EMU aggregate variables was calculated. The results were that there is a weak correlation and sometimes even negative correlation between Portuguese and EMU variables which indicate that when a change occurred in the EMU aggregates it is unlikely that the same exact change occurred in the Portuguese variables. This implies that the monetary policy of ECB is almost exogenous from Portugal.

Regarding the comparison between Portugal and Poland, in the Post-Euro period, it is possible to conclude that there are some similarities between how the domestic variables in each country respond to changes in the interest rate. Nevertheless, the elasticities after the tenth quarter start to diverge. This result would be expected since Polish monetary policy is autonomous and independent which causes to the response of interest rate to be greater than if the monetary policy is defined to the Euro-Zone. Additionally, the reduced explanatory power of interest rate to changes in the domestic variables is similar in the two models[1].

These results can perhaps be explained by the fact that during the period in analysis the monetary authorities decreased the interest rate to historically low levels and used unconventional monetary policy tools which would explain the relative smoothness in the responses of domestic variables to changes in interest rates and the relatively low explanatory power of interest rates to explain the changes in the

[1]Which can indicate that the effort of NBP to keep the exchange rate in small fluting band is relatively large.

domestic variables.

These results are in line with the existent literature in VAR models for the two countries as it is mention in chapter 5 where the results are discussed.

One limitation of this study is the fact that although the Portuguese and Polish economy shares some characteristics their economies are not equal. Therefore, the comparison between them must be made with some caution.

Regarding future work, a possible extension to this study is to try to evaluate and quantify what was the impact that the crises of 2008 and the consequent European Sovereign Debt Crisis had on the transmission mechanisms.

Finally, a natural implication of this study it would be to recommend for Portugal to exit the Euro due to the inability of the ECB monetary policy to accommodate demand and supply shocks in small economies such as Portugal. However, this implication is too radical and it could bring huge costs to the Portuguese economy. Therefore, what it would be proposed is that ECB should use in articulation with convention monetary policy tools, unconventional monetary policy tools in small countries to mitigate the perverse effects that the conventional monetary policy of ECB has in small economies.

References

Abreu, M. (2005). Inflação e política monetária em portugal antes da adopção do euro. *Boletim Económico do Banco de Portugal, Primavera de*.

Afonso, A., & St Aubyn, M. (1998). Credit rationing and monetary transmission: Evidence for portugal.

Allen, F., & Gale, D. (2000). *Comparing financial systems*. MIT press.

Beier, N. C., & Storgaard, P. E. (2006). *Identifying monetary policy in a small open economy under fixed exchange rates* (Tech. Rep.). Danmarks Nationalbank Working Papers.

Bernanke, B. S., & Blinder, A. S. (1988). *Credit, money, and aggregate demand*. National Bureau of Economic Research Cambridge, Mass., USA.

Bolton, P., Chen, H., & Wang, N. (2011). A unified theory of tobin's q, corporate investment, financing, and risk management. *The journal of Finance*, *66*(5), 1545–1578.

Cecchetti, S. G., McConnell, M. M., & Quiros, G. P. (1999). *Policymakers' revealed preferences and the output-ination variability trade-off: Implications for the european system of central banks*. Citeseer.

Christiano, L. J., Eichenbaum, M., & Evans, C. L. (1999). Monetary policy shocks: What have we learned and to what end? *Handbook of macroeconomics*, *1*, 65–148.

Clements, B., Kontolemis, Z. G., & Levy, J. (2001). Monetary policy under emu differences in the transmission mechanism?

Cushman, D. O., & Zha, T. (1997). Identifying monetary policy in a small open economy under flexible exchange rates. *Journal of Monetary economics*, *39*(3), 433–448.

Demchuk, Oksana, y., Tomasz, P., Jan, S., Ewa, S., Anna, W., & Ewa. (2012). *Monetary policy transmission mechanism in poland: What do we know in 2011?* Narodowy Bank Polski. Departament Edukacji i Wydawnictw.

Dornbusch, R. (1976). Expectations and exchange rate dynamics. *Journal of political Economy*, *84*(6), 1161–1176.

Dornbusch, R., Favero, C., & Giavazzi, F. (1998). Immediate challenges for the european central bank. *Economic Policy*, *13*(26), 16–64.

Duguay, P. (1994). Empirical evidence on the strength of the monetary transmission mechanism in canada: An aggregate approach. *Journal of Monetary Economics*, *33*(1), 39–61.

Ehrmann, M., Gambacorta, L., Martinez-Pagés, J., Sevestre, P., & Worms, A. (2003). The effects of monetary policy in the euro area. *Oxford Review of Economic Policy*, *19*(1), 58–72.

Friedman, M. (1995). The role of monetary policy. In *Essential readings in economics* (pp. 215–231). Springer.

Georgiadis, G. (2015). Examining asymmetries in the transmission of monetary policy in the euro area: Evidence from a mixed cross-section global var model. *European Economic Review*, *75*, 195–215.

Issing, O. (2001). *Monetary policy in the euro area: strategy and decision-making at the european central bank.* Cambridge University Press.

Kapuściński, Mariusz, K., Andrzej, K., Halina, y., Tomasz, P., Jan, S., ... Ewa (2016). *Monetary policy transmission mechanism in poland: What do we know in 2015?* Narodowy Bank Polski. Departament Edukacji i Wydawnictw.

Kapuściński, Mariusz, y., Tomasz, P., Jan, S., Ewa, S., Anna, W., & Ewa. (2014). *Monetary policy transmission mechanism in poland: What do we know in 2013?* Narodowy Bank Polski. Departament Edukacji i Wydawnictw.

Koop, G., Leon-Gonzalez, R., & Strachan, R. W. (2009). On the evolution of the monetary policy transmission mechanism. *Journal of Economic Dynamics and Control*, *33*(4), 997–1017.

Kuttner, K. N., Mosser, P. C., et al. (2002). The monetary transmission mechanism: some answers and further questions. *Federal Reserve Bank of New York Economic Policy Review*, *8*(1), 15–26.

Leeper, E. M., Sims, C. A., Zha, T., Hall, R. E., & Bernanke, B. S. (1996). What does monetary policy do? *Brookings papers on economic activity*, *1996*(2), 1–78.

Mishkin, F. S. (1995). Symposium on the monetary transmission mechanism. *Journal of Economic perspectives*, *9*(4), 3–10.

Mojon, B., & Peersman, G. (2001). A var description of the effects of monetary policy in the individual countries of the euro area.

Peersman, G., & Smets, F. (2001). The monetary transmission mechanism in the euro area: more evidence from var analysis (mtn conference paper).

Sims, C. A. (1980). Macroeconomics and reality. *Econometrica: Journal of the Econometric Society*, 1–48.

Sousa, R. M. (2014). The effects of monetary policy in a small open economy: the case of portugal. *Applied Economics*, *46*(2), 240–251.

Trembińska, J. (2010). Goals of national bank of poland monetary policy and inflation targeting strategy in relation to the european central bank policy.

Van Els, P., Locarno, A., Morgan, J., & Villetelle, J.-P. (2001). Monetary policy transmission in the euro area: What do aggregate and national structural models tell us?

Appendix A

Descriptive Statistics and Graphs for Portuguese Variables

Sample: 1986Q1 2017Q1

	UN	GDP	INF	M3	INTERBANK	CRED	EXCH
Mean	8.344000	2.000480	4.540191	7.584742	6.316880	7.405130	93.70834
Median	7.400000	2.080000	3.053750	7.314434	4.210000	8.068250	95.96319
Maximum	17.80000	9.170000	14.30206	26.60777	18.01000	22.61034	103.7788
Minimum	3.900000	-4.470000	-1.511660	-9.198027	-0.330000	-6.223380	73.93856
Std. Dev.	3.358461	2.759602	4.096508	7.600193	5.912249	6.956592	8.262769
Skewness	0.915976	-0.279052	0.973006	0.159668	0.713588	-0.176240	-1.235970
Kurtosis	3.012414	3.038225	2.768148	2.685294	2.039625	1.943131	3.480872
Jarque-Bera	17.48022	1.629907	20.00375	1.046955	15.41223	6.464651	33.02980
Probability	0.000160	0.442660	0.000045	0.592457	0.000450	0.039466	0.000000
Sum	1043.000	250.0600	567.5239	948.0928	789.6100	925.6413	11713.54
Sum Sq. Dev.	1398.628	944.3098	2080.891	7162.604	4334.382	6000.877	8465.896
Observations	125	125	125	125	125	125	125

Figure A.1: Descriptive statistics for Portuguese variables

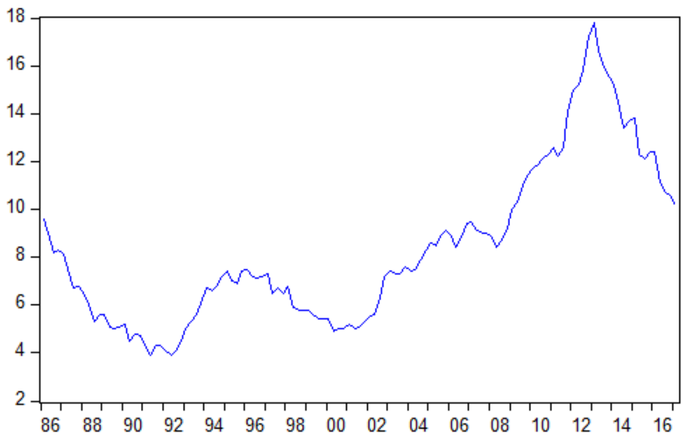

Figure A.2: Portuguese Unemployment rate

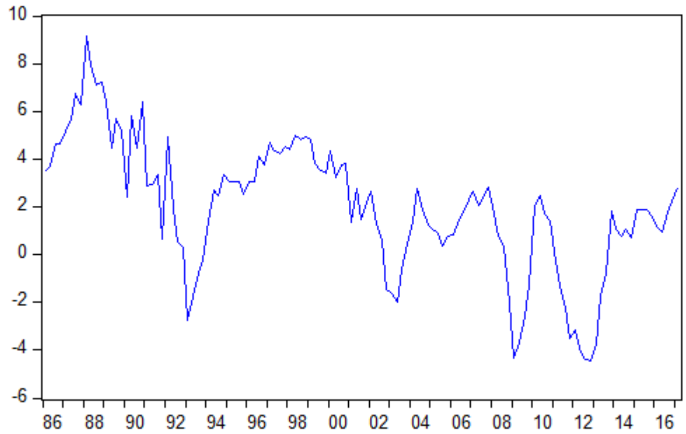

Figure A.3: Portuguese real GDP growth

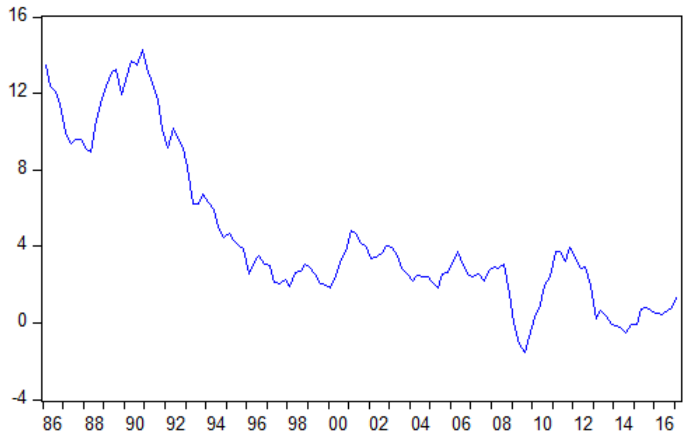

Figure A.4: Portuguese inflation rate

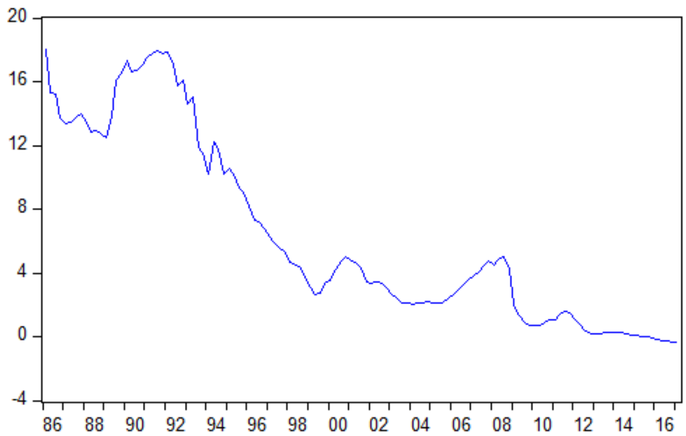

Figure A.5: Portuguese 90 days interbank interest rate

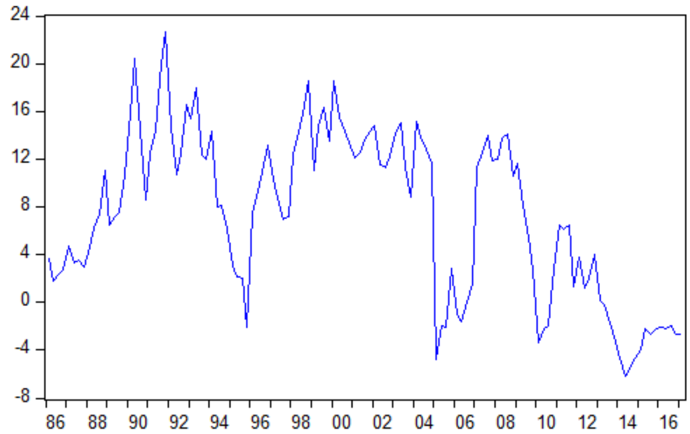

Figure A.6: Portuguese growth rate of total credit given to non-financial corporations

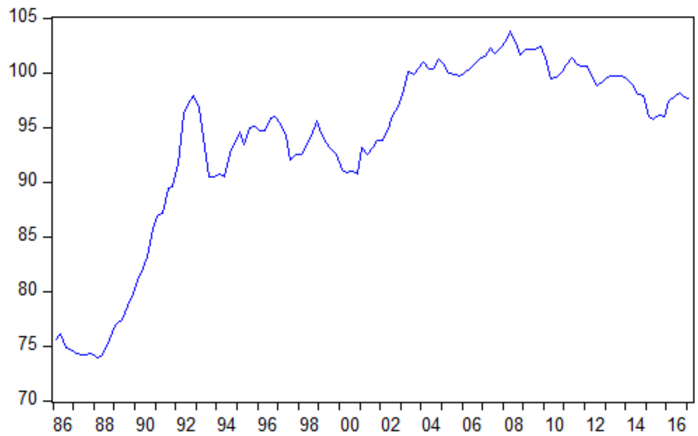

Figure A.7: Portuguese real effective exchange rate index based on unit labor cost

Appendix B

Descriptive Statistics and Graphs for Polish Variables

Sample: 1999Q1 2017Q1

	UN	GDP	INF	INTERBANK	CRED	EXCH
Mean	12.44521	3.660635	2.891196	6.440822	10.90577	94.97788
Median	10.30000	3.521854	2.431270	4.730000	8.443880	96.15731
Maximum	20.50000	8.637222	10.60147	19.68000	35.61260	117.1578
Minimum	5.200000	0.004363	-1.206580	1.680000	-11.19069	79.94890
Std. Dev.	4.790530	1.920200	2.740134	4.896157	9.568347	7.196856
Skewness	0.373046	0.350983	0.890786	1.511280	0.263214	0.169618
Kurtosis	1.646189	2.719267	3.655044	4.178291	2.876869	3.858019
Jarque-Bera	7.267935	1.738517	10.95937	32.01124	0.889044	2.589300
Probability	0.026411	0.419262	0.004171	0.000000	0.641131	0.273994
Sum	908.5000	267.2264	211.0573	470.1800	796.1210	6933.385
Sum Sq. Dev.	1652.341	265.4761	540.6000	1726.010	6591.835	3729.221
Observations	73	73	73	73	73	73

Figure B.1: Descriptive statistics for Polish variables

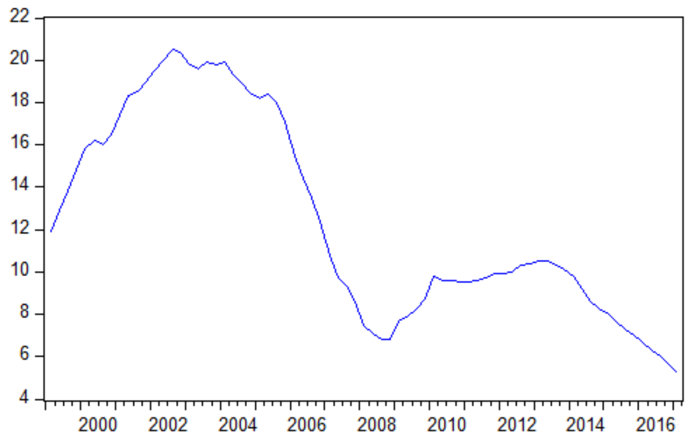

Figure B.2: Polish Unemployment rate

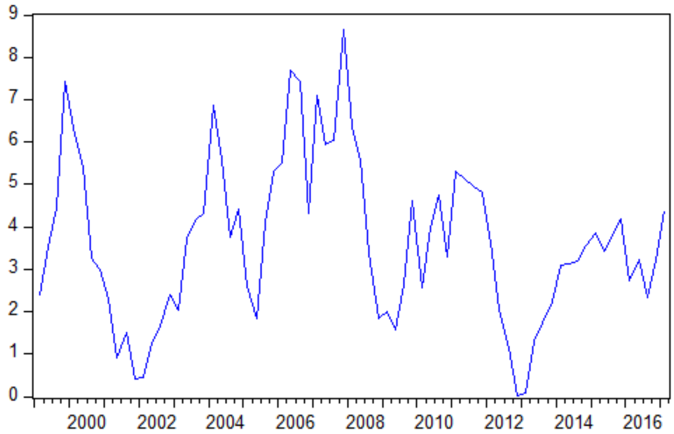

Figure B.3: Polish real GDP growth

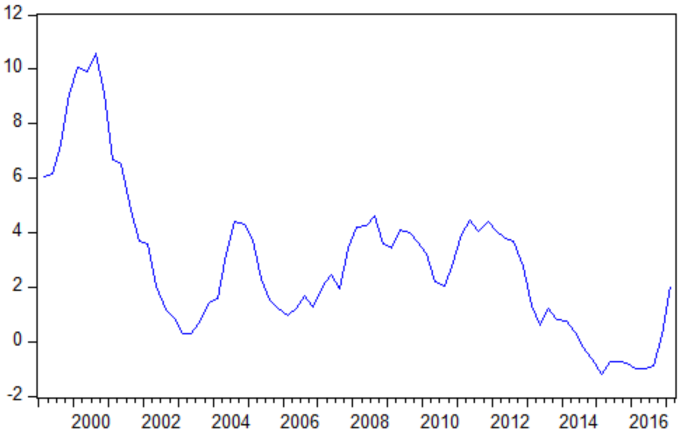

Figure B.4: Polish inflation rate

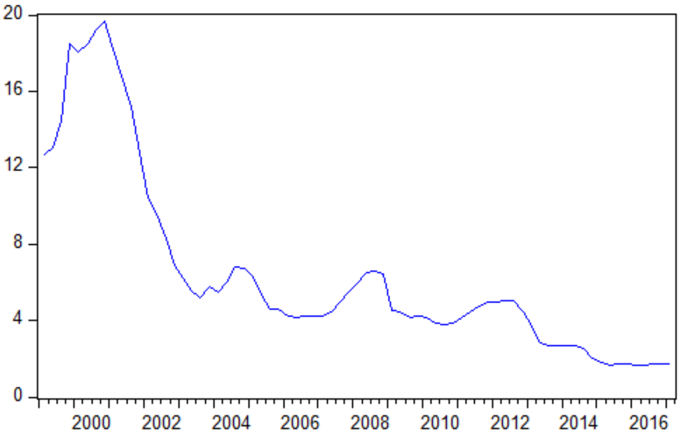

Figure B.5: Polish 90 days interbank interest rate

Figure B.6: Polish growth rate of total credit given to non-financial corporations

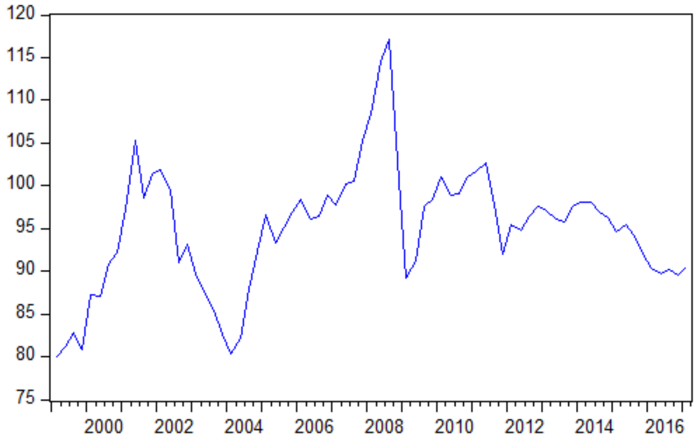

Figure B.7: Polish real effective exchange rate index based on unit labor cost

Appendix C

Descriptive Statistics and Graphs for German Exogenous Variables

Sample: 1986Q1 2017Q1

	GDP_GERM	INF_GERM
Mean	1.797840	1.742194
Median	1.860000	1.556370
Maximum	7.440000	6.088960
Minimum	-6.930000	-0.918450
Std. Dev.	2.191997	1.260000
Skewness	-0.953987	1.074774
Kurtosis	6.539603	4.808607
Jarque-Bera	84.21432	41.10216
Probability	0.000000	0.000000
Sum	224.7300	217.7742
Sum Sq. Dev.	595.8015	196.8623
Observations	125	125

Figure C.1: Descriptive statistics for German exogenous variables

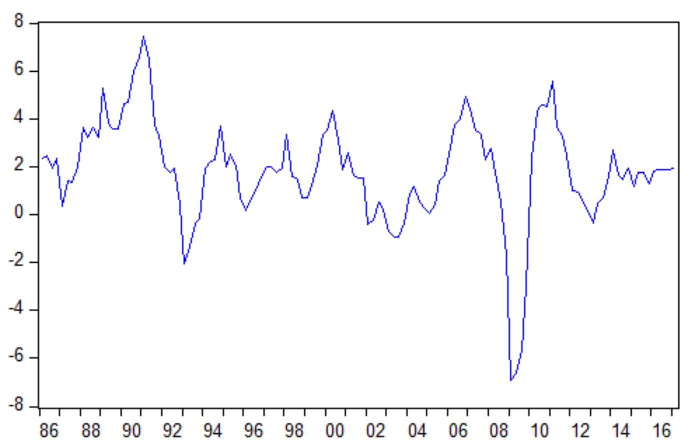

Figure C.2: German real GDP growth

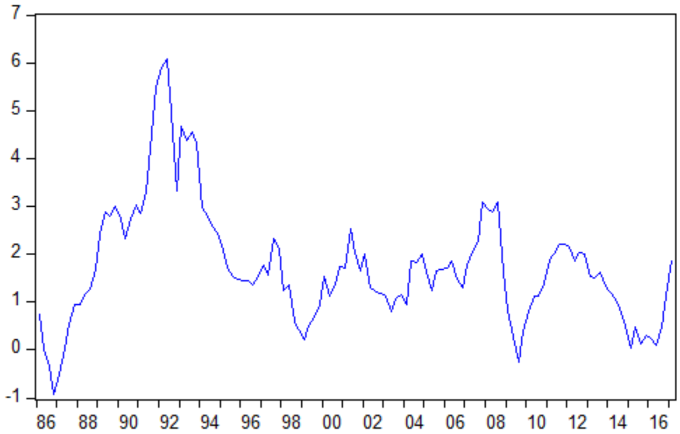

Figure C.3: German inflation rate

Appendix D

Stationary Tests for Portuguese Variables

Null Hypothesis: UN has a unit root
Exogenous: Constant
Lag Length: 5 (Automatic - based on SIC, maxlag=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.608553	0.4751
Test critical values:	1% level	-3.486064	
	5% level	-2.885863	
	10% level	-2.579818	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(UN)
Method: Least Squares
Date: 05/25/18 Time: 17:25
Sample (adjusted): 1987Q3 2017Q1
Included observations: 119 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
UN(-1)	-0.016206	0.010075	-1.608553	0.1105
D(UN(-1))	0.448578	0.087456	5.129191	0.0000
D(UN(-2))	-0.082563	0.081845	-1.008778	0.3153
D(UN(-3))	0.059576	0.081917	0.727265	0.4686
D(UN(-4))	0.580654	0.083445	6.958528	0.0000
D(UN(-5))	-0.334051	0.091191	-3.663207	0.0004
C	0.141196	0.089240	1.582210	0.1164

R-squared	0.466465	Mean dependent var	0.024370
Adjusted R-squared	0.437883	S.D. dependent var	0.474425
S.E. of regression	0.355698	Akaike info criterion	0.827551
Sum squared resid	14.17034	Schwarz criterion	0.991029
Log likelihood	-42.23931	Hannan-Quinn criter.	0.893935
F-statistic	16.32009	Durbin-Watson stat	2.120193
Prob(F-statistic)	0.000000		

Figure D.1: Augmented Dickey-Fuller test for Portuguese unemployment rate

Null Hypothesis: GDP has a unit root
Exogenous: Constant
Lag Length: 4 (Automatic - based on SIC, maxlag=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.358278	0.1559
Test critical values:	1% level	-3.485586	
	5% level	-2.885654	
	10% level	-2.579708	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(GDP)
Method: Least Squares
Date: 05/25/18 Time: 17:17
Sample (adjusted): 1987Q2 2017Q1
Included observations: 120 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GDP(-1)	-0.097638	0.041402	-2.358278	0.0201
D(GDP(-1))	-0.045730	0.084656	-0.540183	0.5901
D(GDP(-2))	0.307223	0.084609	3.631067	0.0004
D(GDP(-3))	0.161659	0.087063	1.856812	0.0659
D(GDP(-4))	-0.349686	0.087440	-3.999146	0.0001
C	0.171620	0.130318	1.316935	0.1905

R-squared	0.267202	Mean dependent var	-0.019417
Adjusted R-squared	0.235062	S.D. dependent var	1.274605
S.E. of regression	1.114779	Akaike info criterion	3.103896
Sum squared resid	141.6714	Schwarz criterion	3.243271
Log likelihood	-180.2338	Hannan-Quinn criter.	3.160497
F-statistic	8.313621	Durbin-Watson stat	2.061047
Prob(F-statistic)	0.000001		

Figure D.2: Augmented Dickey-Fuller test for Portuguese real GDP growth

Null Hypothesis: INF has a unit root
Exogenous: Constant
Lag Length: 5 (Automatic - based on SIC, maxlag=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.419684	0.5705
Test critical values:	1% level	-3.486064	
	5% level	-2.885863	
	10% level	-2.579818	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(INF)
Method: Least Squares
Date: 05/25/18 Time: 17:20
Sample (adjusted): 1987Q3 2017Q1
Included observations: 119 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
INF(-1)	-0.020344	0.014330	-1.419684	0.1585
D(INF(-1))	0.396309	0.092765	4.272165	0.0000
D(INF(-2))	-0.081521	0.092541	-0.880914	0.3803
D(INF(-3))	0.205095	0.090684	2.261648	0.0256
D(INF(-4))	-0.365547	0.092376	-3.957161	0.0001
D(INF(-5))	0.167612	0.090646	1.849085	0.0671
C	0.044691	0.084635	0.528040	0.5985

R-squared	0.228638	Mean dependent var	-0.066943
Adjusted R-squared	0.187315	S.D. dependent var	0.665616
S.E. of regression	0.600046	Akaike info criterion	1.873402
Sum squared resid	40.32620	Schwarz criterion	2.036880
Log likelihood	-104.4674	Hannan-Quinn criter.	1.939785
F-statistic	5.532951	Durbin-Watson stat	1.996550
Prob(F-statistic)	0.000047		

Figure D.3: Augmented Dickey-Fuller test for Portuguese inflation rate

Null Hypothesis: INTERBANK has a unit root
Exogenous: Constant
Lag Length: 2 (Automatic - based on SIC, maxlag=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.104172	0.7127
Test critical values:	1% level	-3.484653	
	5% level	-2.885249	
	10% level	-2.579491	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(INTERBANK)
Method: Least Squares
Date: 05/25/18 Time: 17:22
Sample (adjusted): 1986Q4 2017Q1
Included observations: 122 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
INTERBANK(-1)	-0.010450	0.009464	-1.104172	0.2718
D(INTERBANK(-1))	0.129700	0.087983	1.474150	0.1431
D(INTERBANK(-2))	0.254137	0.082702	3.072934	0.0026
C	-0.007630	0.081572	-0.093536	0.9256

R-squared	0.111292	Mean dependent var	-0.127213
Adjusted R-squared	0.088698	S.D. dependent var	0.632313
S.E. of regression	0.603620	Akaike info criterion	1.860493
Sum squared resid	42.99412	Schwarz criterion	1.952428
Log likelihood	-109.4901	Hannan-Quinn criter.	1.897834
F-statistic	4.925694	Durbin-Watson stat	1.914808
Prob(F-statistic)	0.002932		

Figure D.4: Augmented Dickey-Fuller test for Portuguese 90 days interbank interest rate

Null Hypothesis: CRED has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.618915	0.0919
Test critical values:	1% level	-3.483751	
	5% level	-2.884856	
	10% level	-2.579282	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(CRED)
Method: Least Squares
Date: 05/25/18 Time: 17:04
Sample (adjusted): 1986Q2 2017Q1
Included observations: 124 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CRED(-1)	-0.113412	0.043305	-2.618915	0.0099
C	0.798408	0.440809	1.811235	0.0726

R-squared	0.053227	Mean dependent var	-0.050613
Adjusted R-squared	0.045466	S.D. dependent var	3.404335
S.E. of regression	3.326044	Akaike info criterion	5.257442
Sum squared resid	1349.633	Schwarz criterion	5.302930
Log likelihood	-323.9614	Hannan-Quinn criter.	5.275920
F-statistic	6.858714	Durbin-Watson stat	1.948987
Prob(F-statistic)	0.009940		

Figure D.5: Augmented Dickey-Fuller test for Portuguese total credit given to non-financial corporations

Null Hypothesis: EXCH has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.154234	0.2242
Test critical values:	1% level	-3.484198	
	5% level	-2.885051	
	10% level	-2.579386	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(EXCH)
Method: Least Squares
Date: 05/25/18 Time: 17:07
Sample (adjusted): 1986Q3 2017Q1
Included observations: 123 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
EXCH(-1)	-0.023222	0.010780	-2.154234	0.0332
D(EXCH(-1))	0.356503	0.083508	4.269067	0.0000
C	2.288115	1.016545	2.250874	0.0262

R-squared	0.170180	Mean dependent var	0.173831
Adjusted R-squared	0.156349	S.D. dependent var	1.053747
S.E. of regression	0.967872	Akaike info criterion	2.796653
Sum squared resid	112.4130	Schwarz criterion	2.865243
Log likelihood	-168.9942	Hannan-Quinn criter.	2.824514
F-statistic	12.30481	Durbin-Watson stat	2.030881
Prob(F-statistic)	0.000014		

Figure D.6: Augmented Dickey-Fuller test for Portuguese real effective exchange rate

Null Hypothesis: D(UN) has a unit root
Exogenous: Constant
Lag Length: 4 (Automatic - based on SIC, maxlag=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.376139	0.0037
Test critical values:	1% level	-3.486064	
	5% level	-2.885863	
	10% level	-2.579818	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(UN,2)
Method: Least Squares
Date: 05/25/18 Time: 17:26
Sample (adjusted): 1987Q3 2017Q1
Included observations: 119 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(UN(-1))	-0.376762	0.111595	-3.376139	0.0010
D(UN(-1),2)	-0.159927	0.126223	-1.267022	0.2078
D(UN(-2),2)	-0.252703	0.114736	-2.202477	0.0297
D(UN(-3),2)	-0.202428	0.100261	-2.019007	0.0459
D(UN(-4),2)	0.367955	0.089343	4.118465	0.0001
C	0.007643	0.032945	0.232005	0.8170

R-squared	0.583383	Mean dependent var	0.003361
Adjusted R-squared	0.564949	S.D. dependent var	0.543051
S.E. of regression	0.358187	Akaike info criterion	0.833584
Sum squared resid	14.49770	Schwarz criterion	0.973708
Log likelihood	-43.59825	Hannan-Quinn criter.	0.890484
F-statistic	31.64650	Durbin-Watson stat	2.146425
Prob(F-statistic)	0.000000		

Figure D.7: First-difference augmented Dickey-Fuller test for Portuguese unemployment rate

Null Hypothesis: D(GDP) has a unit root
Exogenous: Constant
Lag Length: 3 (Automatic - based on SIC, maxlag=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.854235	0.0000
Test critical values:	1% level	-3.485586	
	5% level	-2.885654	
	10% level	-2.579708	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(GDP,2)
Method: Least Squares
Date: 05/25/18 Time: 17:19
Sample (adjusted): 1987Q2 2017Q1
Included observations: 120 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(GDP(-1))	-1.117201	0.162994	-6.854235	0.0000
D(GDP(-1),2)	0.037506	0.149422	0.251006	0.8023
D(GDP(-2),2)	0.309926	0.128798	2.406300	0.0177
D(GDP(-3),2)	0.411421	0.085068	4.836372	0.0000
C	-0.020175	0.103825	-0.194316	0.8463

R-squared	0.664056	Mean dependent var	0.000833
Adjusted R-squared	0.652371	S.D. dependent var	1.927869
S.E. of regression	1.136673	Akaike info criterion	3.134862
Sum squared resid	148.5829	Schwarz criterion	3.251007
Log likelihood	-183.0917	Hannan-Quinn criter.	3.182029
F-statistic	56.82975	Durbin-Watson stat	2.102509
Prob(F-statistic)	0.000000		

Figure D.8: First-difference augmented Dickey-Fuller test for Portuguese real GDP growth

Null Hypothesis: D(INF) has a unit root
Exogenous: Constant
Lag Length: 3 (Automatic - based on SIC, maxlag=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.394862	0.0000
Test critical values:	1% level	-3.485586	
	5% level	-2.885654	
	10% level	-2.579708	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(INF,2)
Method: Least Squares
Date: 05/25/18 Time: 17:21
Sample (adjusted): 1987Q2 2017Q1
Included observations: 120 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(INF(-1))	-0.825871	0.129146	-6.394862	0.0000
D(INF(-1),2)	0.172251	0.121998	1.411920	0.1607
D(INF(-2),2)	0.121158	0.104912	1.154853	0.2505
D(INF(-3),2)	0.310765	0.086864	3.577597	0.0005
C	-0.059889	0.056830	-1.053833	0.2942

R-squared	0.422469	Mean dependent var	0.017575
Adjusted R-squared	0.402381	S.D. dependent var	0.785001
S.E. of regression	0.606851	Akaike info criterion	1.879708
Sum squared resid	42.35088	Schwarz criterion	1.995853
Log likelihood	-107.7825	Hannan-Quinn criter.	1.926875
F-statistic	21.03087	Durbin-Watson stat	1.895476
Prob(F-statistic)	0.000000		

Figure D.9: First-difference augmented Dickey-Fuller test for Portuguese inflation rate

Null Hypothesis: D(INTERBANK) has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.567768	0.0000
Test critical values:	1% level	-3.484653	
	5% level	-2.885249	
	10% level	-2.579491	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(INTERBANK,2)
Method: Least Squares
Date: 05/25/18 Time: 17:24
Sample (adjusted): 1986Q4 2017Q1
Included observations: 122 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(INTERBANK(-1))	-0.615562	0.110558	-5.567768	0.0000
D(INTERBANK(-1),2)	-0.256076	0.082759	-3.094222	0.0025
C	-0.072315	0.056816	-1.272782	0.2056

R-squared	0.457190	Mean dependent var	0.001066
Adjusted R-squared	0.448067	S.D. dependent var	0.813242
S.E. of regression	0.604176	Akaike info criterion	1.854379
Sum squared resid	43.43834	Schwarz criterion	1.923330
Log likelihood	-110.1171	Hannan-Quinn criter.	1.882385
F-statistic	50.11480	Durbin-Watson stat	1.913164
Prob(F-statistic)	0.000000		

Figure D.10: First-difference augmented Dickey-Fuller test for Portuguese 90 days interbank interest rate

Null Hypothesis: D(CRED) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-11.40172	0.0000
Test critical values:	1% level	-3.484198	
	5% level	-2.885051	
	10% level	-2.579386	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(CRED,2)
Method: Least Squares
Date: 05/25/18 Time: 17:06
Sample (adjusted): 1986Q3 2017Q1
Included observations: 123 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(CRED(-1))	-1.034696	0.090749	-11.40172	0.0000
C	-0.037679	0.308975	-0.121950	0.9031

R-squared	0.517927	Mean dependent var	0.015401
Adjusted R-squared	0.513943	S.D. dependent var	4.914537
S.E. of regression	3.426308	Akaike info criterion	5.316970
Sum squared resid	1420.490	Schwarz criterion	5.362697
Log likelihood	-324.9937	Hannan-Quinn criter.	5.335544
F-statistic	129.9991	Durbin-Watson stat	2.000929
Prob(F-statistic)	0.000000		

Figure D.11: First-difference augmented Dickey-Fuller test for Portuguese total credit given to non-financial corporations

Null Hypothesis: D(EXCH) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-7.438727	0.0000
Test critical values:	1% level	-3.484198	
	5% level	-2.885051	
	10% level	-2.579386	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(EXCH,2)
Method: Least Squares
Date: 05/25/18 Time: 17:08
Sample (adjusted): 1986Q3 2017Q1
Included observations: 123 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(EXCH(-1))	-0.628184	0.084448	-7.438727	0.0000
C	0.106565	0.089881	1.185622	0.2381

R-squared	0.313805	Mean dependent var	-0.007082
Adjusted R-squared	0.308134	S.D. dependent var	1.180984
S.E. of regression	0.982325	Akaike info criterion	2.818337
Sum squared resid	116.7603	Schwarz criterion	2.864063
Log likelihood	-171.3277	Hannan-Quinn criter.	2.836911
F-statistic	55.33466	Durbin-Watson stat	2.032909
Prob(F-statistic)	0.000000		

Figure D.12: First-difference augmented Dickey-Fuller test for Portuguese real effective exchange rate

Null Hypothesis: UN has a unit root
Exogenous: Constant
Bandwidth: 8 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-1.240824	0.6552
Test critical values:	1% level	-3.483751	
	5% level	-2.884856	
	10% level	-2.579282	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.227354
HAC corrected variance (Bartlett kernel)	0.590168

Phillips-Perron Test Equation
Dependent Variable: D(UN)
Method: Least Squares
Date: 05/25/18 Time: 17:25
Sample (adjusted): 1986Q2 2017Q1
Included observations: 124 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
UN(-1)	-0.009474	0.012870	-0.736128	0.4631
C	0.083746	0.115559	0.724707	0.4700

R-squared	0.004422	Mean dependent var	0.004839
Adjusted R-squared	-0.003738	S.D. dependent var	0.479813
S.E. of regression	0.480709	Akaike info criterion	1.388887
Sum squared resid	28.19188	Schwarz criterion	1.434376
Log likelihood	-84.11102	Hannan-Quinn criter.	1.407366
F-statistic	0.541884	Durbin-Watson stat	1.268402
Prob(F-statistic)	0.463066		

Figure D.13: Phillips-Perron test for Portuguese unemployment rate

Null Hypothesis: GDP has a unit root
Exogenous: Constant
Bandwidth: 6 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-2.637769	0.0882
Test critical values:	1% level	-3.483751	
	5% level	-2.884856	
	10% level	-2.579282	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	1.486658
HAC corrected variance (Bartlett kernel)	1.537207

Phillips-Perron Test Equation
Dependent Variable: D(GDP)
Method: Least Squares
Date: 05/25/18 Time: 17:18
Sample (adjusted): 1986Q2 2017Q1
Included observations: 124 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GDP(-1)	-0.103985	0.040016	-2.598563	0.0105
C	0.201599	0.136203	1.480136	0.1414

R-squared	0.052446	Mean dependent var	-0.005726
Adjusted R-squared	0.044679	S.D. dependent var	1.257656
S.E. of regression	1.229239	Akaike info criterion	3.266666
Sum squared resid	184.3456	Schwarz criterion	3.312154
Log likelihood	-200.5333	Hannan-Quinn criter.	3.285144
F-statistic	6.752528	Durbin-Watson stat	2.169807
Prob(F-statistic)	0.010515		

Figure D.14: Phillips-Perron test for Portuguese real GDP growth

Null Hypothesis: INF has a unit root
Exogenous: Constant
Bandwidth: 1 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-2.062827	0.2601
Test critical values:	1% level	-3.483751	
	5% level	-2.884856	
	10% level	-2.579282	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.434151
HAC corrected variance (Bartlett kernel)	0.572823

Phillips-Perron Test Equation
Dependent Variable: D(INF)
Method: Least Squares
Date: 05/25/18 Time: 17:20
Sample (adjusted): 1986Q2 2017Q1
Included observations: 124 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
INF(-1)	-0.030401	0.014597	-2.082755	0.0394
C	0.041780	0.089439	0.467131	0.6412

R-squared	0.034335	Mean dependent var	-0.097013
Adjusted R-squared	0.026420	S.D. dependent var	0.673233
S.E. of regression	0.664280	Akaike info criterion	2.035773
Sum squared resid	53.83474	Schwarz criterion	2.081261
Log likelihood	-124.2179	Hannan-Quinn criter.	2.054251
F-statistic	4.337867	Durbin-Watson stat	1.345342
Prob(F-statistic)	0.039363		

Figure D.15: Phillips-Perron test for Portuguese inflation rate

Null Hypothesis: INTERBANK has a unit root
Exogenous: Constant
Bandwidth: 6 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-1.642892	0.4577
Test critical values:	1% level	-3.483751	
	5% level	-2.884856	
	10% level	-2.579282	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.431560
HAC corrected variance (Bartlett kernel)	0.761973

Phillips-Perron Test Equation
Dependent Variable: D(INTERBANK)
Method: Least Squares
Date: 05/25/18 Time: 17:23
Sample (adjusted): 1986Q2 2017Q1
Included observations: 124 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
INTERBANK(-1)	-0.017260	0.010112	-1.706912	0.0904
C	-0.037948	0.087675	-0.432828	0.6659

R-squared	0.023325	Mean dependent var	-0.147903
Adjusted R-squared	0.015319	S.D. dependent var	0.667427
S.E. of regression	0.662295	Akaike info criterion	2.029787
Sum squared resid	53.51347	Schwarz criterion	2.075275
Log likelihood	-123.8468	Hannan-Quinn criter.	2.048265
F-statistic	2.913549	Durbin-Watson stat	1.584251
Prob(F-statistic)	0.090382		

Figure D.16: Phillips-Perron test for Portuguese 90 days interbank interest rate

Null Hypothesis: CRED has a unit root
Exogenous: Constant
Bandwidth: 16 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-2.562018	0.1037
Test critical values:	1% level	-3.483751	
	5% level	-2.884856	
	10% level	-2.579282	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	10.88414
HAC corrected variance (Bartlett kernel)	10.43164

Phillips-Perron Test Equation
Dependent Variable: D(CRED)
Method: Least Squares
Date: 05/25/18 Time: 17:04
Sample (adjusted): 1986Q2 2017Q1
Included observations: 124 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CRED(-1)	-0.113412	0.043305	-2.618915	0.0099
C	0.798408	0.440809	1.811235	0.0726

R-squared	0.053227	Mean dependent var	-0.050613
Adjusted R-squared	0.045466	S.D. dependent var	3.404335
S.E. of regression	3.326044	Akaike info criterion	5.257442
Sum squared resid	1349.633	Schwarz criterion	5.302930
Log likelihood	-323.9614	Hannan-Quinn criter.	5.275920
F-statistic	6.858714	Durbin-Watson stat	1.948987
Prob(F-statistic)	0.009940		

Figure D.17: Phillips-Perron test for Portuguese total credit given to non-financial corporations

Null Hypothesis: EXCH has a unit root
Exogenous: Constant
Bandwidth: 3 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-2.196785	0.2086
Test critical values:	1% level	-3.483751	
	5% level	-2.884856	
	10% level	-2.579282	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	1.044403
HAC corrected variance (Bartlett kernel)	1.861787

Phillips-Perron Test Equation
Dependent Variable: D(EXCH)
Method: Least Squares
Date: 05/25/18 Time: 17:16
Sample (adjusted): 1986Q2 2017Q1
Included observations: 124 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
EXCH(-1)	-0.026826	0.011207	-2.393642	0.0182
C	2.689641	1.053929	2.552013	0.0119

R-squared	0.044857	Mean dependent var	0.176652
Adjusted R-squared	0.037028	S.D. dependent var	1.049925
S.E. of regression	1.030303	Akaike info criterion	2.913581
Sum squared resid	129.5060	Schwarz criterion	2.959069
Log likelihood	-178.6420	Hannan-Quinn criter.	2.932059
F-statistic	5.729521	Durbin-Watson stat	1.279429
Prob(F-statistic)	0.018206		

Figure D.18: Phillips-Perron test for Portuguese real effective exchange rate

Null Hypothesis: D(UN) has a unit root
Exogenous: Constant
Bandwidth: 9 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-8.079076	0.0000
Test critical values:	1% level	-3.484198	
	5% level	-2.885051	
	10% level	-2.579386	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.198341
HAC corrected variance (Bartlett kernel)	0.263170

Phillips-Perron Test Equation
Dependent Variable: D(UN,2)
Method: Least Squares
Date: 05/25/18 Time: 17:26
Sample (adjusted): 1986Q3 2017Q1
Included observations: 123 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(UN(-1))	-0.644775	0.084628	-7.618959	0.0000
C	0.006868	0.040493	0.169613	0.8656

R-squared	0.324206	Mean dependent var	0.001626
Adjusted R-squared	0.318621	S.D. dependent var	0.543966
S.E. of regression	0.449021	Akaike info criterion	1.252630
Sum squared resid	24.39596	Schwarz criterion	1.298357
Log likelihood	-75.03677	Hannan-Quinn criter.	1.271204
F-statistic	58.04854	Durbin-Watson stat	1.916855
Prob(F-statistic)	0.000000		

Figure D.19: First-difference Phillips-Perron test for Portuguese unemployment rate

Null Hypothesis: D(GDP) has a unit root
Exogenous: Constant
Bandwidth: 8 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-12.84509	0.0000
Test critical values:	1% level	-3.484198	
	5% level	-2.885051	
	10% level	-2.579386	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	1.549427
HAC corrected variance (Bartlett kernel)	1.337051

Phillips-Perron Test Equation
Dependent Variable: D(GDP,2)
Method: Least Squares
Date: 05/25/18 Time: 17:18
Sample (adjusted): 1986Q3 2017Q1
Included observations: 123 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(GDP(-1))	-1.142474	0.090063	-12.68534	0.0000
C	-0.008591	0.113164	-0.075913	0.9396

R-squared	0.570797	Mean dependent var	0.003577
Adjusted R-squared	0.567250	S.D. dependent var	1.907773
S.E. of regression	1.255005	Akaike info criterion	3.308283
Sum squared resid	190.5795	Schwarz criterion	3.354009
Log likelihood	-201.4594	Hannan-Quinn criter.	3.326857
F-statistic	160.9178	Durbin-Watson stat	1.944515
Prob(F-statistic)	0.000000		

Figure D.20: First-difference Phillips-Perron test for Portuguese real GDP growth

Null Hypothesis: D(INF) has a unit root
Exogenous: Constant
Bandwidth: 9 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-7.777978	0.0000
Test critical values:	1% level	-3.484198	
	5% level	-2.885051	
	10% level	-2.579386	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.399755
HAC corrected variance (Bartlett kernel)	0.354457

Phillips-Perron Test Equation
Dependent Variable: D(INF,2)
Method: Least Squares
Date: 05/25/18 Time: 17:20
Sample (adjusted): 1986Q3 2017Q1
Included observations: 123 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(INF(-1))	-0.679340	0.085806	-7.917141	0.0000
C	-0.056268	0.058155	-0.967556	0.3352

R-squared	0.341250	Mean dependent var	0.013743
Adjusted R-squared	0.335805	S.D. dependent var	0.782184
S.E. of regression	0.637465	Akaike info criterion	1.953493
Sum squared resid	49.16981	Schwarz criterion	1.999219
Log likelihood	-118.1398	Hannan-Quinn criter.	1.972067
F-statistic	62.68112	Durbin-Watson stat	1.987942
Prob(F-statistic)	0.000000		

Figure D.21: First-difference Phillips-Perron test for Portuguese inflation rate

Null Hypothesis: D(INTERBANK) has a unit root
Exogenous: Constant
Bandwidth: 5 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-10.14042	0.0000
Test critical values:	1% level	-3.484198	
	5% level	-2.885051	
	10% level	-2.579386	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.382806
HAC corrected variance (Bartlett kernel)	0.485266

Phillips-Perron Test Equation
Dependent Variable: D(INTERBANK,2)
Method: Least Squares
Date: 05/25/18 Time: 17:23
Sample (adjusted): 1986Q3 2017Q1
Included observations: 123 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(INTERBANK(-1))	-0.846323	0.084287	-10.04102	0.0000
C	-0.104509	0.057631	-1.813432	0.0722

R-squared	0.454518	Mean dependent var	0.021545
Adjusted R-squared	0.450010	S.D. dependent var	0.841147
S.E. of regression	0.623806	Akaike info criterion	1.910171
Sum squared resid	47.08516	Schwarz criterion	1.955898
Log likelihood	-115.4755	Hannan-Quinn criter.	1.928745
F-statistic	100.8220	Durbin-Watson stat	2.047756
Prob(F-statistic)	0.000000		

Figure D.22: First-difference Phillips-Perron test for Portuguese 90 days interbank interest rate

Null Hypothesis: D(CRED) has a unit root
Exogenous: Constant
Bandwidth: 86 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-15.31288	0.0000
Test critical values:	1% level	-3.484198	
	5% level	-2.885051	
	10% level	-2.579386	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	11.54870
HAC corrected variance (Bartlett kernel)	2.437050

Phillips-Perron Test Equation
Dependent Variable: D(CRED,2)
Method: Least Squares
Date: 05/25/18 Time: 17:05
Sample (adjusted): 1986Q3 2017Q1
Included observations: 123 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(CRED(-1))	-1.034696	0.090749	-11.40172	0.0000
C	-0.037679	0.308975	-0.121950	0.9031

R-squared	0.517927	Mean dependent var	0.015401
Adjusted R-squared	0.513943	S.D. dependent var	4.914537
S.E. of regression	3.426308	Akaike info criterion	5.316970
Sum squared resid	1420.490	Schwarz criterion	5.362697
Log likelihood	-324.9937	Hannan-Quinn criter.	5.335544
F-statistic	129.9991	Durbin-Watson stat	2.000929
Prob(F-statistic)	0.000000		

Figure D.23: First-difference Phillips-Perron test for Portuguese total credit given to non-financial corporations

Null Hypothesis: D(EXCH) has a unit root
Exogenous: Constant
Bandwidth: 2 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-7.444552	0.0000
Test critical values:	1% level	-3.484198	
	5% level	-2.885051	
	10% level	-2.579386	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.949271
HAC corrected variance (Bartlett kernel)	0.953131

Phillips-Perron Test Equation
Dependent Variable: D(EXCH,2)
Method: Least Squares
Date: 05/25/18 Time: 17:15
Sample (adjusted): 1986Q3 2017Q1
Included observations: 123 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(EXCH(-1))	-0.628184	0.084448	-7.438727	0.0000
C	0.106565	0.089881	1.185622	0.2381

R-squared	0.313805	Mean dependent var	-0.007082
Adjusted R-squared	0.308134	S.D. dependent var	1.180984
S.E. of regression	0.982325	Akaike info criterion	2.818337
Sum squared resid	116.7603	Schwarz criterion	2.864063
Log likelihood	-171.3277	Hannan-Quinn criter.	2.836911
F-statistic	55.33466	Durbin-Watson stat	2.032909
Prob(F-statistic)	0.000000		

Figure D.24: First-difference Phillips-Perron test for Portuguese real effective exchange rate

Appendix E

Stationary Tests for Polish Variables

Null Hypothesis: UN has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.876554	0.7902
Test critical values:	1% level	-3.525618	
	5% level	-2.902953	
	10% level	-2.588902	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(UN)
Method: Least Squares
Date: 05/25/18 Time: 23:06
Sample (adjusted): 1999Q3 2017Q1
Included observations: 71 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
UN(-1)	-0.008342	0.009517	-0.876554	0.3838
D(UN(-1))	0.765490	0.076396	10.02002	0.0000
C	0.064211	0.128810	0.498493	0.6197

R-squared	0.598512	Mean dependent var	-0.108451
Adjusted R-squared	0.586704	S.D. dependent var	0.581807
S.E. of regression	0.374033	Akaike info criterion	0.912387
Sum squared resid	9.513228	Schwarz criterion	1.007994
Log likelihood	-29.38976	Hannan-Quinn criter.	0.950407
F-statistic	50.68499	Durbin-Watson stat	2.148134
Prob(F-statistic)	0.000000		

Figure E.1: Augmented Dickey-Fuller test for Polish unemployment rate

Null Hypothesis: GDP has a unit root
Exogenous: Constant
Lag Length: 7 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.389248	0.0149
Test critical values:	1% level	-3.534868	
	5% level	-2.906923	
	10% level	-2.591006	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(GDP)
Method: Least Squares
Date: 05/25/18 Time: 22:33
Sample (adjusted): 2001Q1 2017Q1
Included observations: 65 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GDP(-1)	-0.325415	0.096014	-3.389248	0.0013
D(GDP(-1))	0.172875	0.129731	1.332561	0.1881
D(GDP(-2))	0.310691	0.126532	2.455432	0.0172
D(GDP(-3))	0.641967	0.122337	5.247553	0.0000
D(GDP(-4))	-0.376358	0.113924	-3.303580	0.0017
D(GDP(-5))	-0.049995	0.112014	-0.446325	0.6571
D(GDP(-6))	0.093721	0.113141	0.828357	0.4110
D(GDP(-7))	0.356591	0.112561	3.167973	0.0025
C	1.185465	0.367502	3.225740	0.0021

R-squared	0.527797	Mean dependent var	0.021533
Adjusted R-squared	0.460339	S.D. dependent var	1.294385
S.E. of regression	0.950876	Akaike info criterion	2.865022
Sum squared resid	50.63328	Schwarz criterion	3.166091
Log likelihood	-84.11321	Hannan-Quinn criter.	2.983813
F-statistic	7.824120	Durbin-Watson stat	1.857333
Prob(F-statistic)	0.000001		

Figure E.2: Augmented Dickey-Fuller test for Polish real GDP growth

Null Hypothesis: INF has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.397192	0.1462
Test critical values:	1% level	-3.525618	
	5% level	-2.902953	
	10% level	-2.588902	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(INF)
Method: Least Squares
Date: 05/25/18 Time: 22:36
Sample (adjusted): 1999Q3 2017Q1
Included observations: 71 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
INF(-1)	-0.076452	0.031892	-2.397192	0.0193
D(INF(-1))	0.503011	0.108749	4.625425	0.0000
C	0.201103	0.126737	1.586773	0.1172

R-squared	0.265310	Mean dependent var	-0.058485
Adjusted R-squared	0.243702	S.D. dependent var	0.836147
S.E. of regression	0.727158	Akaike info criterion	2.241989
Sum squared resid	35.95561	Schwarz criterion	2.337596
Log likelihood	-76.59063	Hannan-Quinn criter.	2.280009
F-statistic	12.27805	Durbin-Watson stat	2.030414
Prob(F-statistic)	0.000028		

Figure E.3: Augmented Dickey-Fuller test for Polish inflation rate

Null Hypothesis: INTERBANK has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.580697	0.4871
Test critical values:	1% level	-3.525618	
	5% level	-2.902953	
	10% level	-2.588902	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(INTERBANK)
Method: Least Squares
Date: 05/25/18 Time: 23:00
Sample (adjusted): 1999Q3 2017Q1
Included observations: 71 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
INTERBANK(-1)	-0.028243	0.017868	-1.580697	0.1186
D(INTERBANK(-1))	0.532754	0.101428	5.252537	0.0000
C	0.104525	0.145175	0.719991	0.4740

R-squared	0.300294	Mean dependent var	-0.159155
Adjusted R-squared	0.279715	S.D. dependent var	0.857326
S.E. of regression	0.727609	Akaike info criterion	2.243230
Sum squared resid	36.00024	Schwarz criterion	2.338836
Log likelihood	-76.63466	Hannan-Quinn criter.	2.281249
F-statistic	14.59186	Durbin-Watson stat	2.144463
Prob(F-statistic)	0.000005		

Figure E.4: Augmented Dickey-Fuller test for Polish 90 days interbank interest rate

Null Hypothesis: CRED has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.066491	0.0337
Test critical values:	1% level	-3.525618	
	5% level	-2.902953	
	10% level	-2.588902	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(CRED)
Method: Least Squares
Date: 05/25/18 Time: 20:20
Sample (adjusted): 1999Q3 2017Q1
Included observations: 71 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CRED(-1)	-0.143240	0.046711	-3.066491	0.0031
D(CRED(-1))	0.365045	0.106941	3.413516	0.0011
C	1.312694	0.658208	1.994345	0.0501

R-squared	0.219575	Mean dependent var	-0.349230
Adjusted R-squared	0.196621	S.D. dependent var	3.999833
S.E. of regression	3.585106	Akaike info criterion	5.432788
Sum squared resid	874.0031	Schwarz criterion	5.528394
Log likelihood	-189.8640	Hannan-Quinn criter.	5.470808
F-statistic	9.566002	Durbin-Watson stat	2.030029
Prob(F-statistic)	0.000218		

Figure E.5: Augmented Dickey-Fuller test for Polish total credit given to non-financial corporations

Null Hypothesis: EXCH has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.443477	0.0126
Test critical values:	1% level	-3.525618	
	5% level	-2.902953	
	10% level	-2.588902	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(EXCH)
Method: Least Squares
Date: 05/25/18 Time: 22:24
Sample (adjusted): 1999Q3 2017Q1
Included observations: 71 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
EXCH(-1)	-0.214079	0.062169	-3.443477	0.0010
D(EXCH(-1))	0.288953	0.112452	2.569576	0.0124
C	20.48472	5.933539	3.452361	0.0010

R-squared	0.183239	Mean dependent var	0.132127
Adjusted R-squared	0.159217	S.D. dependent var	3.896800
S.E. of regression	3.573140	Akaike info criterion	5.426102
Sum squared resid	868.1785	Schwarz criterion	5.521708
Log likelihood	-189.6266	Hannan-Quinn criter.	5.464121
F-statistic	7.627860	Durbin-Watson stat	1.975404
Prob(F-statistic)	0.001026		

Figure E.6: Augmented Dickey-Fuller test for real Polish effective exchange rate

Null Hypothesis: D(UN) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.292683	0.0089
Test critical values:	1% level	-3.525618	
	5% level	-2.902953	
	10% level	-2.588902	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(UN,2)
Method: Least Squares
Date: 05/25/18 Time: 23:08
Sample (adjusted): 1999Q3 2017Q1
Included observations: 71 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(UN(-1))	-0.246835	0.074965	-3.292683	0.0016
C	-0.041621	0.044811	-0.928795	0.3562

R-squared	0.135791	Mean dependent var	-0.019718
Adjusted R-squared	0.123266	S.D. dependent var	0.398791
S.E. of regression	0.373404	Akaike info criterion	0.895454
Sum squared resid	9.620720	Schwarz criterion	0.959192
Log likelihood	-29.78863	Hannan-Quinn criter.	0.920801
F-statistic	10.84176	Durbin-Watson stat	2.114459
Prob(F-statistic)	0.001567		

Figure E.7: First-difference augmented Dickey-Fuller test for Polish unemployment rate

Null Hypothesis: D(GDP) has a unit root
Exogenous: Constant
Lag Length: 9 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.161720	0.0001
Test critical values:	1% level	-3.540198	
	5% level	-2.909206	
	10% level	-2.592215	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(GDP,2)
Method: Least Squares
Date: 05/25/18 Time: 22:35
Sample (adjusted): 2001Q4 2017Q1
Included observations: 62 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(GDP(-1))	-2.113839	0.409522	-5.161720	0.0000
D(GDP(-1),2)	0.928956	0.355882	2.610290	0.0118
D(GDP(-2),2)	1.082785	0.321955	3.363157	0.0015
D(GDP(-3),2)	1.564325	0.314270	4.977653	0.0000
D(GDP(-4),2)	0.813249	0.304077	2.674481	0.0100
D(GDP(-5),2)	0.343759	0.242668	1.416583	0.1627
D(GDP(-6),2)	0.308450	0.186443	1.654397	0.1042
D(GDP(-7),2)	0.757829	0.176975	4.282121	0.0001
D(GDP(-8),2)	0.579191	0.166331	3.482156	0.0010
D(GDP(-9),2)	0.236110	0.120849	1.953761	0.0562
C	0.065612	0.114612	0.572470	0.5695

R-squared	0.826424	Mean dependent var	0.008807
Adjusted R-squared	0.792390	S.D. dependent var	1.974483
S.E. of regression	0.899659	Akaike info criterion	2.785929
Sum squared resid	41.27872	Schwarz criterion	3.163323
Log likelihood	-75.36378	Hannan-Quinn criter.	2.934103
F-statistic	24.28196	Durbin-Watson stat	1.939326
Prob(F-statistic)	0.000000		

Figure E.8: First-difference augmented Dickey-Fuller test for Polish real GDP growth

Null Hypothesis: D(INF) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.784828	0.0002
Test critical values:	1% level	-3.525618	
	5% level	-2.902953	
	10% level	-2.588902	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(INF,2)
Method: Least Squares
Date: 05/26/18 Time: 00:55
Sample (adjusted): 1999Q3 2017Q1
Included observations: 71 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(INF(-1))	-0.532835	0.111359	-4.784828	0.0000
C	-0.020399	0.089677	-0.227465	0.8207

R-squared	0.249140	Mean dependent var	0.023042
Adjusted R-squared	0.238258	S.D. dependent var	0.861333
S.E. of regression	0.751753	Akaike info criterion	2.294947
Sum squared resid	38.99414	Schwarz criterion	2.358684
Log likelihood	-79.47061	Hannan-Quinn criter.	2.320293
F-statistic	22.89458	Durbin-Watson stat	1.941358
Prob(F-statistic)	0.000009		

Figure E.9: First-difference augmented Dickey-Fuller test for Polish inflation rate

Null Hypothesis: D(INTERBANK) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.661478	0.0003
Test critical values:	1% level	-3.525618	
	5% level	-2.902953	
	10% level	-2.588902	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(INTERBANK,2)
Method: Least Squares
Date: 05/25/18 Time: 23:03
Sample (adjusted): 1999Q3 2017Q1
Included observations: 71 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(INTERBANK(-1))	-0.477022	0.102333	-4.661478	0.0000
C	-0.078277	0.088707	-0.882426	0.3806

R-squared	0.239497	Mean dependent var	-0.004507
Adjusted R-squared	0.228475	S.D. dependent var	0.837315
S.E. of regression	0.735468	Akaike info criterion	2.251146
Sum squared resid	37.32304	Schwarz criterion	2.314883
Log likelihood	-77.91568	Hannan-Quinn criter.	2.276492
F-statistic	21.72938	Durbin-Watson stat	2.102623
Prob(F-statistic)	0.000015		

Figure E.10: First-difference augmented Dickey-Fuller test for Polish 90 days interbank interest rate

Null Hypothesis: D(CRED) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.929464	0.0000
Test critical values:	1% level	-3.525618	
	5% level	-2.902953	
	10% level	-2.588902	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(CRED,2)
Method: Least Squares
Date: 05/25/18 Time: 20:23
Sample (adjusted): 1999Q3 2017Q1
Included observations: 71 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(CRED(-1))	-0.668156	0.112684	-5.929464	0.0000
C	-0.222245	0.452697	-0.490935	0.6250

R-squared	0.337548	Mean dependent var	0.033435
Adjusted R-squared	0.327948	S.D. dependent var	4.631864
S.E. of regression	3.797147	Akaike info criterion	5.534142
Sum squared resid	994.8644	Schwarz criterion	5.597879
Log likelihood	-194.4620	Hannan-Quinn criter.	5.559488
F-statistic	35.15855	Durbin-Watson stat	1.986998
Prob(F-statistic)	0.000000		

Figure E.11: First-difference augmented Dickey-Fuller test for Polish total credit given to non-financial corporations

Null Hypothesis: D(EXCH) has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.090417	0.0000
Test critical values:	1% level	-3.527045	
	5% level	-2.903566	
	10% level	-2.589227	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(EXCH,2)
Method: Least Squares
Date: 05/25/18 Time: 22:26
Sample (adjusted): 1999Q4 2017Q1
Included observations: 70 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(EXCH(-1))	-0.927095	0.152222	-6.090417	0.0000
D(EXCH(-1),2)	0.160425	0.120559	1.330674	0.1878
C	0.108146	0.460347	0.234922	0.8150

R-squared	0.415320	Mean dependent var	-0.006126
Adjusted R-squared	0.397866	S.D. dependent var	4.958628
S.E. of regression	3.847760	Akaike info criterion	5.574771
Sum squared resid	991.9521	Schwarz criterion	5.671135
Log likelihood	-192.1170	Hannan-Quinn criter.	5.613048
F-statistic	23.79626	Durbin-Watson stat	2.024563
Prob(F-statistic)	0.000000		

Figure E.12: First-difference augmented Dickey-Fuller test for Polish real effective exchange rate

Null Hypothesis: UN has a unit root
Exogenous: Constant
Bandwidth: 6 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-0.576157	0.8686
Test critical values:	1% level	-3.524233	
	5% level	-2.902358	
	10% level	-2.588587	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.344220
HAC corrected variance (Bartlett kernel)	1.515821

Phillips-Perron Test Equation
Dependent Variable: D(UN)
Method: Least Squares
Date: 05/25/18 Time: 23:06
Sample (adjusted): 1999Q2 2017Q1
Included observations: 72 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
UN(-1)	0.008759	0.014880	0.588670	0.5580
C	-0.202948	0.199415	-1.017716	0.3123

R-squared	0.004926	Mean dependent var	-0.093056
Adjusted R-squared	-0.009289	S.D. dependent var	0.592280
S.E. of regression	0.595025	Akaike info criterion	1.826958
Sum squared resid	24.78384	Schwarz criterion	1.890199
Log likelihood	-63.77049	Hannan-Quinn criter.	1.852134
F-statistic	0.346533	Durbin-Watson stat	0.454613
Prob(F-statistic)	0.557977		

Figure E.13: Phillips-Perron test for Polish unemployment rate

Null Hypothesis: GDP has a unit root
Exogenous: Constant
Bandwidth: 5 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-3.285447	0.0192
Test critical values:	1% level	-3.524233	
	5% level	-2.902358	
	10% level	-2.588587	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	1.529016
HAC corrected variance (Bartlett kernel)	1.785817

Phillips-Perron Test Equation
Dependent Variable: D(GDP)
Method: Least Squares
Date: 05/25/18 Time: 22:34
Sample (adjusted): 1999Q2 2017Q1
Included observations: 72 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GDP(-1)	-0.238179	0.077048	-3.091304	0.0029
C	0.897323	0.317723	2.824231	0.0062

R-squared	0.120118	Mean dependent var	0.027876
Adjusted R-squared	0.107549	S.D. dependent var	1.327489
S.E. of regression	1.254074	Akaike info criterion	3.318057
Sum squared resid	110.0891	Schwarz criterion	3.381298
Log likelihood	-117.4500	Hannan-Quinn criter.	3.343233
F-statistic	9.556162	Durbin-Watson stat	1.925380
Prob(F-statistic)	0.002860		

Figure E.14: Phillips-Perron test for Polish real GDP growth

Null Hypothesis: INF has a unit root
Exogenous: Constant
Bandwidth: 4 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-1.971509	0.2986
Test critical values:	1% level	-3.524233	
	5% level	-2.902358	
	10% level	-2.588587	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.658428
HAC corrected variance (Bartlett kernel)	1.325216

Phillips-Perron Test Equation
Dependent Variable: D(INF)
Method: Least Squares
Date: 05/26/18 Time: 00:58
Sample (adjusted): 1999Q2 2017Q1
Included observations: 72 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
INF(-1)	-0.053970	0.035419	-1.523755	0.1321
C	0.100976	0.141350	0.714368	0.4774

R-squared	0.032104	Mean dependent var	-0.055709
Adjusted R-squared	0.018277	S.D. dependent var	0.830571
S.E. of regression	0.822946	Akaike info criterion	2.475533
Sum squared resid	47.40682	Schwarz criterion	2.538773
Log likelihood	-87.11918	Hannan-Quinn criter.	2.500709
F-statistic	2.321830	Durbin-Watson stat	1.043499
Prob(F-statistic)	0.132075		

Figure E.15: Phillips-Perron test for Polish inflation rate

Null Hypothesis: INTERBANK has a unit root
Exogenous: Constant
Bandwidth: 5 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-1.347390	0.6031
Test critical values:	1% level	-3.524233	
	5% level	-2.902358	
	10% level	-2.588587	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.708024
HAC corrected variance (Bartlett kernel)	1.881891

Phillips-Perron Test Equation
Dependent Variable: D(INTERBANK)
Method: Least Squares
Date: 05/25/18 Time: 23:01
Sample (adjusted): 1999Q2 2017Q1
Included observations: 72 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
INTERBANK(-1)	-0.020260	0.020676	-0.979862	0.3305
C	-0.020685	0.167962	-0.123153	0.9023

R-squared	0.013531	Mean dependent var	-0.152500
Adjusted R-squared	-0.000562	S.D. dependent var	0.853138
S.E. of regression	0.853378	Akaike info criterion	2.548155
Sum squared resid	50.97773	Schwarz criterion	2.611396
Log likelihood	-89.73359	Hannan-Quinn criter.	2.573332
F-statistic	0.960130	Durbin-Watson stat	0.943622
Prob(F-statistic)	0.330529		

Figure E.16: Phillips-Perron test for Polish 90 days interbank interest rate

Null Hypothesis: CRED has a unit root
Exogenous: Constant
Bandwidth: 3 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-3.021179	0.0376
Test critical values:	1% level	-3.524233	
	5% level	-2.902358	
	10% level	-2.588587	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	14.24041
HAC corrected variance (Bartlett kernel)	23.37025

Phillips-Perron Test Equation
Dependent Variable: D(CRED)
Method: Least Squares
Date: 05/25/18 Time: 20:22
Sample (adjusted): 1999Q2 2017Q1
Included observations: 72 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CRED(-1)	-0.132025	0.047227	-2.795556	0.0067
C	1.037286	0.687054	1.509759	0.1356

R-squared	0.100432	Mean dependent var	-0.411581
Adjusted R-squared	0.087581	S.D. dependent var	4.006649
S.E. of regression	3.827176	Akaike info criterion	5.549516
Sum squared resid	1025.310	Schwarz criterion	5.612757
Log likelihood	-197.7826	Hannan-Quinn criter.	5.574693
F-statistic	7.815132	Durbin-Watson stat	1.288656
Prob(F-statistic)	0.006682		

Figure E.17: Phillips-Perron test for Polish total credit given to non-financial corporations

Null Hypothesis: EXCH has a unit root
Exogenous: Constant
Bandwidth: 3 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-3.000695	0.0395
Test critical values:	1% level	-3.524233	
	5% level	-2.902358	
	10% level	-2.588587	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	13.26214
HAC corrected variance (Bartlett kernel)	16.34670

Phillips-Perron Test Equation
Dependent Variable: D(EXCH)
Method: Least Squares
Date: 05/25/18 Time: 22:25
Sample (adjusted): 1999Q2 2017Q1
Included observations: 72 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
EXCH(-1)	-0.171659	0.060640	-2.830786	0.0061
C	16.46196	5.779590	2.848293	0.0058

R-squared	0.102718	Mean dependent var	0.147645
Adjusted R-squared	0.089899	S.D. dependent var	3.871500
S.E. of regression	3.693380	Akaike info criterion	5.478346
Sum squared resid	954.8738	Schwarz criterion	5.541586
Log likelihood	-195.2204	Hannan-Quinn criter.	5.503522
F-statistic	8.013351	Durbin-Watson stat	1.504614
Prob(F-statistic)	0.006056		

Figure E.18: Phillips-Perron test for Polish real effective exchange rate

Null Hypothesis: D(UN) has a unit root
Exogenous: Constant
Bandwidth: 9 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-3.231288	0.0022
Test critical values:	1% level	-3.525618	
	5% level	-2.902953	
	10% level	-2.588902	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.135503
HAC corrected variance (Bartlett kernel)	0.127030

Phillips-Perron Test Equation
Dependent Variable: D(UN,2)
Method: Least Squares
Date: 05/25/18 Time: 23:07
Sample (adjusted): 1999Q3 2017Q1
Included observations: 71 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(UN(-1))	-0.246835	0.074965	-3.292683	0.0016
C	-0.041621	0.044811	-0.928795	0.3562

R-squared	0.135791	Mean dependent var	-0.019718
Adjusted R-squared	0.123266	S.D. dependent var	0.398791
S.E. of regression	0.373404	Akaike info criterion	0.895454
Sum squared resid	9.620720	Schwarz criterion	0.959192
Log likelihood	-29.78863	Hannan-Quinn criter.	0.920801
F-statistic	10.84176	Durbin-Watson stat	2.114459
Prob(F-statistic)	0.001567		

Figure E.19: First-difference Phillips-Perron test for Polish unemployment rate

Null Hypothesis: D(GDP) has a unit root
Exogenous: Constant
Bandwidth: 4 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-9.056812	0.0000
Test critical values:	1% level	-3.525618	
	5% level	-2.902953	
	10% level	-2.588902	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	1.731964
HAC corrected variance (Bartlett kernel)	1.706109

Phillips-Perron Test Equation
Dependent Variable: D(GDP,2)
Method: Least Squares
Date: 05/25/18 Time: 22:35
Sample (adjusted): 1999Q3 2017Q1
Included observations: 71 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(GDP(-1))	-1.086026	0.119981	-9.051639	0.0000
C	0.013366	0.158439	0.084358	0.9330

R-squared	0.542841	Mean dependent var	0.000528
Adjusted R-squared	0.536216	S.D. dependent var	1.960270
S.E. of regression	1.334978	Akaike info criterion	3.443471
Sum squared resid	122.9695	Schwarz criterion	3.507209
Log likelihood	-120.2432	Hannan-Quinn criter.	3.468818
F-statistic	81.93217	Durbin-Watson stat	1.998045
Prob(F-statistic)	0.000000		

Figure E.20: First-difference Phillips-Perron test for Polish real GDP growth

Null Hypothesis: D(INF) has a unit root
Exogenous: Constant
Bandwidth: 4 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-4.803251	0.0002
Test critical values:	1% level	-3.525618	
	5% level	-2.902953	
	10% level	-2.588902	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.549213
HAC corrected variance (Bartlett kernel)	0.555946

Phillips-Perron Test Equation
Dependent Variable: D(INF,2)
Method: Least Squares
Date: 05/25/18 Time: 22:38
Sample (adjusted): 1999Q3 2017Q1
Included observations: 71 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(INF(-1))	-0.532835	0.111359	-4.784828	0.0000
C	-0.020399	0.089677	-0.227465	0.8207

R-squared	0.249140	Mean dependent var	0.023042
Adjusted R-squared	0.238258	S.D. dependent var	0.861333
S.E. of regression	0.751753	Akaike info criterion	2.294947
Sum squared resid	38.99414	Schwarz criterion	2.358684
Log likelihood	-79.47061	Hannan-Quinn criter.	2.320293
F-statistic	22.89458	Durbin-Watson stat	1.941358
Prob(F-statistic)	0.000009		

Figure E.21: First-difference Phillips-Perron test for Polish inflation rate

Null Hypothesis: D(INTERBANK) has a unit root
Exogenous: Constant
Bandwidth: 3 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-4.613324	0.0003
Test critical values:	1% level	-3.525618	
	5% level	-2.902953	
	10% level	-2.588902	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.525677
HAC corrected variance (Bartlett kernel)	0.505458

Phillips-Perron Test Equation
Dependent Variable: D(INTERBANK,2)
Method: Least Squares
Date: 05/25/18 Time: 23:01
Sample (adjusted): 1999Q3 2017Q1
Included observations: 71 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(INTERBANK(-1))	-0.477022	0.102333	-4.661478	0.0000
C	-0.078277	0.088707	-0.882426	0.3806

R-squared	0.239497	Mean dependent var	-0.004507
Adjusted R-squared	0.228475	S.D. dependent var	0.837315
S.E. of regression	0.735468	Akaike info criterion	2.251146
Sum squared resid	37.32304	Schwarz criterion	2.314883
Log likelihood	-77.91568	Hannan-Quinn criter.	2.276492
F-statistic	21.72938	Durbin-Watson stat	2.102623
Prob(F-statistic)	0.000015		

Figure E.22: First-difference Phillips-Perron test for Polish 90 days interbank interest rate

Null Hypothesis: D(CRED) has a unit root
Exogenous: Constant
Bandwidth: 1 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-5.928860	0.0000
Test critical values:	1% level	-3.525618	
	5% level	-2.902953	
	10% level	-2.588902	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	14.01217
HAC corrected variance (Bartlett kernel)	14.00353

Phillips-Perron Test Equation
Dependent Variable: D(CRED,2)
Method: Least Squares
Date: 05/25/18 Time: 20:22
Sample (adjusted): 1999Q3 2017Q1
Included observations: 71 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(CRED(-1))	-0.668156	0.112684	-5.929464	0.0000
C	-0.222245	0.452697	-0.490935	0.6250

R-squared	0.337548	Mean dependent var	0.033435
Adjusted R-squared	0.327948	S.D. dependent var	4.631864
S.E. of regression	3.797147	Akaike info criterion	5.534142
Sum squared resid	994.8644	Schwarz criterion	5.597879
Log likelihood	-194.4620	Hannan-Quinn criter.	5.559488
F-statistic	35.15855	Durbin-Watson stat	1.986998
Prob(F-statistic)	0.000000		

Figure E.23: First-difference Phillips-Perron test for Polish total credit given to non-financial corporations

Null Hypothesis: D(EXCH) has a unit root
Exogenous: Constant
Bandwidth: 8 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-6.611810	0.0000
Test critical values:	1% level	-3.525618	
	5% level	-2.902953	
	10% level	-2.588902	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	14.36011
HAC corrected variance (Bartlett kernel)	8.402662

Phillips-Perron Test Equation
Dependent Variable: D(EXCH,2)
Method: Least Squares
Date: 05/25/18 Time: 22:25
Sample (adjusted): 1999Q3 2017Q1
Included observations: 71 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(EXCH(-1))	-0.797999	0.117886	-6.769216	0.0000
C	0.105020	0.456473	0.230068	0.8187

R-squared	0.399071	Mean dependent var	-0.002066
Adjusted R-squared	0.390362	S.D. dependent var	4.923201
S.E. of regression	3.844001	Akaike info criterion	5.558669
Sum squared resid	1019.568	Schwarz criterion	5.622407
Log likelihood	-195.3328	Hannan-Quinn criter.	5.584016
F-statistic	45.82228	Durbin-Watson stat	1.935051
Prob(F-statistic)	0.000000		

Figure E.24: First-difference Phillips-Perron test for Polish real effective exchange rate

Appendix F

Stationary Tests for German Exogenous Variables

Null Hypothesis: GDP_GERM has a unit root
Exogenous: Constant
Lag Length: 2 (Automatic - based on SIC, maxlag=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.042100	0.0000
Test critical values:	1% level	-3.484653	
	5% level	-2.885249	
	10% level	-2.579491	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(GDP_GERM)
Method: Least Squares
Date: 05/26/18 Time: 00:00
Sample (adjusted): 1986Q4 2017Q1
Included observations: 122 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GDP_GERM(-1)	-0.241279	0.047853	-5.042100	0.0000
D(GDP_GERM(-1))	0.310546	0.084562	3.672420	0.0004
D(GDP_GERM(-2))	0.249746	0.089023	2.805411	0.0059
C	0.433789	0.127969	3.389791	0.0010

R-squared	0.236220	Mean dependent var	0.000164
Adjusted R-squared	0.216802	S.D. dependent var	1.186140
S.E. of regression	1.049716	Akaike info criterion	2.967154
Sum squared resid	130.0246	Schwarz criterion	3.059089
Log likelihood	-176.9964	Hannan-Quinn criter.	3.004495
F-statistic	12.16494	Durbin-Watson stat	2.070540
Prob(F-statistic)	0.000001		

Figure F.1: Augmented Dickey-Fuller test for German real GDP growth

Null Hypothesis: INF_GERM has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.228175	0.1975
Test critical values:	1% level	-3.483751	
	5% level	-2.884856	
	10% level	-2.579282	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(INF_GERM)
Method: Least Squares
Date: 05/26/18 Time: 00:11
Sample (adjusted): 1986Q2 2017Q1
Included observations: 124 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
INF_GERM(-1)	-0.075549	0.033906	-2.228175	0.0277
C	0.140763	0.072870	1.931698	0.0557

R-squared	0.039103	Mean dependent var	0.009224
Adjusted R-squared	0.031227	S.D. dependent var	0.483312
S.E. of regression	0.475706	Akaike info criterion	1.367965
Sum squared resid	27.60817	Schwarz criterion	1.413454
Log likelihood	-82.81385	Hannan-Quinn criter.	1.386444
F-statistic	4.964765	Durbin-Watson stat	1.559920
Prob(F-statistic)	0.027701		

Figure F.2: Augmented Dickey-Fuller test for German inflation rate

Null Hypothesis: D(INF_GERM) has a unit root
Exogenous: Constant
Lag Length: 3 (Automatic - based on SIC, maxlag=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.557994	0.0000
Test critical values:	1% level	-3.485586	
	5% level	-2.885654	
	10% level	-2.579708	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(INF_GERM,2)
Method: Least Squares
Date: 05/26/18 Time: 00:19
Sample (adjusted): 1987Q2 2017Q1
Included observations: 120 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(INF_GERM(-1))	-0.987028	0.150508	-6.557994	0.0000
D(INF_GERM(-1),2)	0.178547	0.135646	1.316279	0.1907
D(INF_GERM(-2),2)	0.213060	0.114807	1.855806	0.0660
D(INF_GERM(-3),2)	0.341108	0.087278	3.908294	0.0002
C	0.014872	0.041217	0.360816	0.7189

R-squared	0.481977	Mean dependent var	0.002846
Adjusted R-squared	0.463959	S.D. dependent var	0.616232
S.E. of regression	0.451173	Akaike info criterion	1.286843
Sum squared resid	23.40909	Schwarz criterion	1.402989
Log likelihood	-72.21058	Hannan-Quinn criter.	1.334010
F-statistic	26.74947	Durbin-Watson stat	1.902420
Prob(F-statistic)	0.000000		

Figure F.3: First-difference augmented Dickey-Fuller test for German inflation rate

Null Hypothesis: GDP_GERM has a unit root
Exogenous: Constant
Bandwidth: 3 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-3.847392	0.0032
Test critical values:	1% level	-3.483751	
	5% level	-2.884856	
	10% level	-2.579282	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	1.276891
HAC corrected variance (Bartlett kernel)	2.110684

Phillips-Perron Test Equation
Dependent Variable: D(GDP_GERM)
Method: Least Squares
Date: 05/26/18 Time: 00:02
Sample (adjusted): 1986Q2 2017Q1
Included observations: 124 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GDP_GERM(-1)	-0.143392	0.046673	-3.072276	0.0026
C	0.254406	0.132281	1.923219	0.0568

R-squared	0.071812	Mean dependent var	-0.003226
Adjusted R-squared	0.064204	S.D. dependent var	1.177653
S.E. of regression	1.139221	Akaike info criterion	3.114563
Sum squared resid	158.3345	Schwarz criterion	3.160052
Log likelihood	-191.1029	Hannan-Quinn criter.	3.133042
F-statistic	9.438883	Durbin-Watson stat	1.401032
Prob(F-statistic)	0.002620		

Figure F.4: Phillips-Perron test for German real GDP growth

Null Hypothesis: INF_GERM has a unit root
Exogenous: Constant
Bandwidth: 4 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-2.583102	0.0992
Test critical values:	1% level	-3.483751	
	5% level	-2.884856	
	10% level	-2.579282	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.222647
HAC corrected variance (Bartlett kernel)	0.310388

Phillips-Perron Test Equation
Dependent Variable: D(INF_GERM)
Method: Least Squares
Date: 05/26/18 Time: 00:17
Sample (adjusted): 1986Q2 2017Q1
Included observations: 124 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
INF_GERM(-1)	-0.075549	0.033906	-2.228175	0.0277
C	0.140763	0.072870	1.931698	0.0557

R-squared	0.039103	Mean dependent var	0.009224
Adjusted R-squared	0.031227	S.D. dependent var	0.483312
S.E. of regression	0.475706	Akaike info criterion	1.367965
Sum squared resid	27.60817	Schwarz criterion	1.413454
Log likelihood	-82.81385	Hannan-Quinn criter.	1.386444
F-statistic	4.964765	Durbin-Watson stat	1.559920
Prob(F-statistic)	0.027701		

Figure F.5: Phillips-Perron test for German inflation rate

Null Hypothesis: D(INF_GERM) has a unit root
Exogenous: Constant
Bandwidth: 11 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-9.056098	0.0000
Test critical values:	1% level	-3.484198	
	5% level	-2.885051	
	10% level	-2.579386	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.221934
HAC corrected variance (Bartlett kernel)	0.172693

Phillips-Perron Test Equation
Dependent Variable: D(INF_GERM,2)
Method: Least Squares
Date: 05/26/18 Time: 00:17
Sample (adjusted): 1986Q3 2017Q1
Included observations: 123 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(INF_GERM(-1))	-0.823257	0.089488	-9.199634	0.0000
C	0.014690	0.042828	0.342993	0.7322

R-squared	0.411574	Mean dependent var	0.012084
Adjusted R-squared	0.406711	S.D. dependent var	0.616650
S.E. of regression	0.474976	Akaike info criterion	1.365023
Sum squared resid	27.29792	Schwarz criterion	1.410750
Log likelihood	-81.94894	Hannan-Quinn criter.	1.383597
F-statistic	84.63327	Durbin-Watson stat	2.010704
Prob(F-statistic)	0.000000		

Figure F.6: Phillips-Perron test for German inflation rate

Appendix G

Optimal Lag Length Tests

VAR Lag Order Selection Criteria
Endogenous variables: D(UN) D(GDP) D(INF) D(INTERBANK) D(CRED) D(EXCH) D(
Exogenous variables: GDP_GERM D(INF_GERM)
Date: 05/26/18 Time: 01:34
Sample: 1986Q1 1998Q4
Included observations: 47

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-472.9289	NA	2.352779	20.72038	21.27148*	20.92776*
1	-425.0465	77.42684	2.550534	20.76793	23.24792	21.70117
2	-393.5937	41.49090	6.344324	21.51462	25.92349	23.17371
3	-343.2777	51.38654	9.351269	21.45863	27.79637	23.84356
4	-238.2742	75.96000*	2.335746*	19.07550*	27.34211	22.18628

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Figure G.1: Optimal lag length for Portuguese model with German exogenous variables 1986Q1-1998Q4

VAR Lag Order Selection Criteria
Endogenous variables: D(UN) D(GDP) D(INF) D(INTERBANK) D(CRED) D(EXCH) D(
Exogenous variables: GDP_GERM D(INF_GERM)
Date: 05/26/18 Time: 01:35
Sample: 1999Q1 2017Q1
Included observations: 73

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-581.3973	NA	0.028645	16.31226	16.75152*	16.48731*
1	-525.3349	98.30128	0.023812*	16.11876*	18.09546	16.90651
2	-494.7395	47.77910	0.041109	16.62300	20.13713	18.02344
3	-458.2360	50.00482	0.064283	16.96537	22.01693	18.97850
4	-391.5938	78.50995*	0.048712	16.48202	23.07102	19.10785

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Figure G.2: Optimal lag length for Portuguese model with German exogenous variables 1999Q1-2017Q1

VAR Lag Order Selection Criteria
Endogenous variables: D(UN) D(GDP) D(INF) D(INTERBANK) D(CRED) D(EXCH) D(
Exogenous variables: GDP_GERM D(INF_US)
Date: 05/26/18 Time: 01:22
Sample: 1999Q1 2017Q1
Included observations: 68

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-776.1218	NA	29.19082	23.23888	23.69583*	23.41994
1	-688.5202	152.0145	9.481381	22.10353	24.15984	22.91831*
2	-659.7160	44.05345	18.08864	22.69753	26.35319	24.14601
3	-595.2407	85.33501	13.08306	22.24237	27.49738	24.32457
4	-500.6828	105.6823*	4.448181*	20.90244*	27.75680	23.61834

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Figure G.3: Optimal lag length for Polish model with German exogenous variables 1999Q1-2017Q1

Appendix H

Regression Output

Vector Autoregression Estimates
Date: 05/30/18 Time: 14:57
Sample (adjusted): 1987Q2 1998Q4
Included observations: 47 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	D(UN)	D(GDP)	D(INF)	D(INTERBAN	D(CRED)	D(EXCH)
D(UN(-1))	-0.187461	0.521765	-0.456857	-0.402532	-0.569204	-0.510671
	(0.14174)	(0.54380)	(0.31315)	(0.40992)	(1.51237)	(0.60125)
	[-1.32253]	[0.95949]	[-1.45893]	[-0.98199]	[-0.37636]	[-0.84935]
D(UN(-2))	0.044322	0.374955	-0.321416	-0.197398	-3.492011	-0.560791
	(0.13933)	(0.53451)	(0.30780)	(0.40292)	(1.48656)	(0.59099)
	[0.31812]	[0.70149]	[-1.04423]	[-0.48992]	[-2.34906]	[-0.94891]
D(UN(-3))	0.096868	0.676727	0.635444	-0.049694	-3.430502	1.179304
	(0.13196)	(0.50628)	(0.29154)	(0.38163)	(1.40802)	(0.55976)
	[0.73404]	[1.33668]	[2.17962]	[-0.13021]	[-2.43640]	[2.10679]
D(UN(-4))	0.729054	0.031246	-0.445688	-0.366857	0.029353	-0.495987
	(0.13735)	(0.52695)	(0.30344)	(0.39722)	(1.46552)	(0.58262)
	[5.30786]	[0.05930]	[-1.46876]	[-0.92357]	[0.02003]	[-0.85130]
D(GDP(-1))	-0.082656	-0.799363	-0.067154	0.077406	0.423923	0.180475
	(0.05390)	(0.20679)	(0.11908)	(0.15588)	(0.57510)	(0.22863)
	[-1.53350]	[-3.86566]	[-0.56395]	[0.49659]	[0.73713]	[0.78937]
D(GDP(-2))	-0.131769	-0.029940	-0.079008	0.053521	0.315898	-0.047545
	(0.06003)	(0.23030)	(0.13262)	(0.17360)	(0.64050)	(0.25463)
	[-2.19506]	[-0.13001]	[-0.59575]	[0.30830]	[0.49321]	[-0.18672]
D(GDP(-3))	-0.079929	0.434310	-0.043308	-0.156516	-0.451378	-0.123827
	(0.05070)	(0.19449)	(0.11200)	(0.14661)	(0.54090)	(0.21504)
	[-1.57666]	[2.23307]	[-0.38668]	[-1.06759]	[-0.83449]	[-0.57584]
D(GDP(-4))	0.004314	0.074026	0.056082	-0.308637	-0.890886	-0.327861
	(0.05667)	(0.21741)	(0.12520)	(0.16389)	(0.60465)	(0.24038)
	[0.07612]	[0.34049]	[0.44795]	[-1.88324]	[-1.47338]	[-1.36391]
D(INF(-1))	-0.017989	-0.349340	0.283670	-0.010385	0.847569	0.254571
	(0.09359)	(0.35905)	(0.20676)	(0.27065)	(0.99857)	(0.39699)
	[-0.19221]	[-0.97295]	[1.37197]	[-0.03837]	[0.84878]	[0.64126]
D(INF(-2))	0.112733	0.059680	-0.178252	0.358201	-1.301646	-0.250267
	(0.08219)	(0.31532)	(0.18158)	(0.23769)	(0.87694)	(0.34863)
	[1.37162]	[0.18927]	[-0.98170]	[1.50703]	[-1.48431]	[-0.71786]
D(INF(-3))	-0.057678	-0.490382	0.481411	0.180523	0.228142	0.152034
	(0.09750)	(0.37406)	(0.21540)	(0.28197)	(1.04031)	(0.41358)
	[-0.59156]	[-1.31098]	[2.23495]	[0.64023]	[0.21930]	[0.36761]
D(INF(-4))	-0.058053	-0.568345	-0.433953	0.491324	2.376377	-0.473056
	(0.09692)	(0.37183)	(0.21412)	(0.28028)	(1.03410)	(0.41111)
	[-0.59898]	[-1.52852]	[-2.02671]	[1.75294]	[2.29800]	[-1.15068]
D(INTERBANK(-1))	-0.070933	0.563796	-0.331820	-0.249673	0.133778	-0.028303
	(0.07209)	(0.27658)	(0.15927)	(0.20849)	(0.76922)	(0.30581)
	[-0.98390]	[2.03843]	[-2.08337]	[-1.19753]	[0.17391]	[-0.09255]
D(INTERBANK(-2))	0.036790	0.141682	0.164971	-0.077959	-0.759022	0.369767
	(0.07049)	(0.27042)	(0.15572)	(0.20385)	(0.75209)	(0.29899)
	[0.52193]	[0.52392]	[1.05938]	[-0.38244]	[-1.00922]	[1.23670]
D(INTERBANK(-3))	0.016419	0.038164	0.399096	-0.128453	-0.871648	0.262147
	(0.05510)	(0.21137)	(0.12172)	(0.15933)	(0.58786)	(0.23370)
	[0.29801]	[0.18055]	[3.27882]	[-0.80619]	[-1.48275]	[1.12170]
D(INTERBANK(-4))	-0.039307	0.251050	0.076718	0.112520	0.013192	-0.145687
	(0.05690)	(0.21828)	(0.12570)	(0.16454)	(0.60706)	(0.24134)
	[-0.69086]	[1.15013]	[0.61035]	[0.68385]	[0.02173]	[-0.60366]
D(CRED(-1))	-0.009945	0.023904	0.018796	-0.059256	0.118707	-0.072497
	(0.01660)	(0.06368)	(0.03667)	(0.04800)	(0.17709)	(0.07040)
	[-0.59917]	[0.37540]	[0.51260]	[-1.23452]	[0.67031]	[-1.02973]
D(CRED(-2))	-0.010301	0.199710	-0.040826	0.019065	-0.225948	0.023820
	(0.01770)	(0.06789)	(0.03910)	(0.05118)	(0.18882)	(0.07507)
	[-0.58210]	[2.94147]	[-1.04423]	[0.37252]	[-1.19661]	[0.31731]
D(CRED(-3))	0.003242	0.020642	0.092093	-0.128001	-0.363969	-0.041545
	(0.02048)	(0.07855)	(0.04523)	(0.05921)	(0.21847)	(0.08685)
	[0.15831]	[0.26277]	[2.03589]	[-2.16168]	[-1.66601]	[-0.47834]
D(CRED(-4))	-0.013653	0.090699	-0.008476	-0.002143	-0.409519	-0.062297
	(0.01574)	(0.06039)	(0.03478)	(0.04552)	(0.16795)	(0.06677)
	[-0.86734]	[1.50189]	[-0.24374]	[-0.04707]	[-2.43830]	[-0.93301]
D(EXCH(-1))	0.019638	-0.228094	-0.113562	0.156325	-0.200383	0.383533
	(0.05137)	(0.19709)	(0.11350)	(0.14857)	(0.54814)	(0.21791)
	[0.38227]	[-1.15730]	[-1.00059]	[1.05221]	[-0.36557]	[1.76002]
D(EXCH(-2))	-0.042510	-0.388914	-0.032173	0.141786	0.719522	0.213244
	(0.05752)	(0.22068)	(0.12708)	(0.16635)	(0.61375)	(0.24400)
	[-0.73902]	[-1.76232]	[-0.25317]	[0.85233]	[1.17234]	[0.87396]
D(EXCH(-3))	0.019143	-0.196927	-0.059612	-0.172587	-0.178419	-0.054608
	(0.05883)	(0.22570)	(0.12997)	(0.17013)	(0.62771)	(0.24955)
	[0.32539]	[-0.87251]	[-0.45866]	[-1.01442]	[-0.28424]	[-0.21883]
D(EXCH(-4))	-0.006972	-0.066565	-0.202916	-0.184260	0.006492	-0.236975
	(0.05687)	(0.21816)	(0.12563)	(0.16445)	(0.60674)	(0.24121)
	[-0.12260]	[-0.30512]	[-1.61520]	[-1.12045]	[0.01070]	[-0.98244]
GDP_GERM	-0.007499	0.093218	0.021133	-0.009448	0.036516	0.148923
	(0.01768)	(0.06781)	(0.03905)	(0.05112)	(0.18860)	(0.07498)
	[-0.42424]	[1.37464]	[0.54117]	[-0.18483]	[0.19362]	[1.98625]
D(INF_GERM)	0.025207	-0.084518	-0.104500	0.441101	-1.710954	0.118729
	(0.14138)	(0.54241)	(0.31235)	(0.40887)	(1.50851)	(0.59971)
	[0.17829]	[-0.15582]	[-0.33456]	[1.07883]	[-1.13420]	[0.19798]
R-squared	0.762705	0.783976	0.699685	0.607660	0.685282	0.650538
Adj. R-squared	0.480211	0.526805	0.342167	0.140588	0.310618	0.234511
Sum sq. resids	1.636729	24.08990	7.988305	13.68834	186.3289	29.44898
S.E. equation	0.279176	1.071045	0.616762	0.807357	2.978726	1.184201
F-statistic	2.699898	3.048458	1.957062	1.300998	1.829059	1.563693
Log likelihood	12.20991	-50.98377	-25.04414	-37.70044	-99.05821	-55.70414
Akaike AIC	0.586812	3.275905	2.172091	2.710657	5.321626	3.476772
Schwarz SC	1.610298	4.299391	3.195577	3.734143	6.345112	4.500258
Mean dependent	-0.048936	-0.005106	-0.146953	-0.205745	0.294097	0.451888
S.D. dependent	0.387227	1.556997	0.760431	0.870893	3.587573	1.353493

Determinant resid covariance (dof adj.)	0.119442
Determinant resid covariance	0.000950
Log likelihood	-236.6117
Akaike information criterion	16.70688
Schwarz criterion	22.84780
Number of coefficients	156

Figure H.1: Eviews output for Portuguese model with exogenous German block 1986Q1-1998Q4

Vector Autoregression Estimates
Date: 05/30/18 Time: 14:58
Sample: 1999Q1 2017Q1
Included observations: 73
Standard errors in ( ) & t-statistics in [ ]

	D(UN)	D(GDP)	D(INF)	D(INTERBAN	D(CRED)	D(EXCH)
D(UN(-1))	0.411787	-0.193804	-0.010513	0.032612	0.021114	-0.145098
	(0.13416)	(0.26711)	(0.13963)	(0.09420)	(1.01221)	(0.26080)
	[3.06943]	[-0.72555]	[-0.07529]	[0.34618]	[0.02086]	[-0.55635]
D(UN(-2))	-0.323613	-0.195574	0.044417	-0.075658	0.139217	0.486918
	(0.14247)	(0.28366)	(0.14828)	(0.10004)	(1.07492)	(0.27696)
	[-2.27146]	[-0.68946]	[0.29954]	[-0.75627]	[0.12951]	[1.75808]
D(UN(-3))	0.250497	0.009695	0.004919	0.124346	-0.541055	-0.266506
	(0.13623)	(0.27124)	(0.14179)	(0.09566)	(1.02785)	(0.26483)
	[1.83877]	[0.03574]	[0.03469]	[1.29988]	[-0.52640]	[-1.00632]
D(UN(-4))	0.368265	0.167339	-0.211563	-0.077376	0.070336	0.536530
	(0.13522)	(0.26922)	(0.14074)	(0.09495)	(1.02019)	(0.26286)
	[2.72353]	[0.62156]	[-1.50327]	[-0.81494]	[0.06894]	[2.04113]
D(GDP(-1))	-0.117016	0.162084	0.038115	0.041743	0.378441	-0.031210
	(0.07025)	(0.13988)	(0.07312)	(0.04933)	(0.53005)	(0.13657)
	[-1.66563]	[1.15875]	[0.52126]	[0.84617]	[0.71397]	[-0.22852]
D(GDP(-2))	-0.091124	0.250396	0.017665	0.024993	-0.004460	0.089860
	(0.06937)	(0.13812)	(0.07220)	(0.04871)	(0.52339)	(0.13485)
	[-1.31361]	[1.81291]	[0.24466]	[0.51309]	[-0.00852]	[0.66635]
D(GDP(-3))	-0.041371	-0.035523	-0.075963	0.032179	-0.018384	-0.049996
	(0.06759)	(0.13457)	(0.07035)	(0.04746)	(0.50993)	(0.13139)
	[-0.61212]	[-0.26398]	[-1.07986]	[0.67804]	[-0.03605]	[-0.38052]
D(GDP(-4))	0.018424	-0.365682	0.039100	-0.030500	0.306352	0.176014
	(0.06412)	(0.12766)	(0.06673)	(0.04502)	(0.48374)	(0.12464)
	[0.28736]	[-2.86457]	[0.58592]	[-0.67747]	[0.63329]	[1.41218]
D(INF(-1))	0.113791	-0.180187	0.204819	0.080330	-0.763520	-0.157109
	(0.11406)	(0.22711)	(0.11872)	(0.08010)	(0.86061)	(0.22174)
	[0.99760]	[-0.79340]	[1.72522]	[1.00293]	[-0.88719]	[-0.70853]
D(INF(-2))	-0.042168	-0.295107	-0.008953	-0.105982	0.040963	0.145084
	(0.11415)	(0.22727)	(0.11881)	(0.08015)	(0.86124)	(0.22190)
	[-0.36941]	[-1.29846]	[-0.07536]	[-1.32224]	[0.04756]	[0.65382]
D(INF(-3))	0.200220	-0.191583	0.185358	0.000520	-1.012524	-0.176954
	(0.11743)	(0.23380)	(0.12222)	(0.08246)	(0.88597)	(0.22827)
	[1.70508]	[-0.81943]	[1.51661]	[0.00631]	[-1.14285]	[-0.77518]
D(INF(-4))	-0.045335	-0.072154	-0.277639	-0.057589	2.591493	0.297800
	(0.10932)	(0.21767)	(0.11379)	(0.07677)	(0.82483)	(0.21252)
	[-0.41469]	[-0.33149]	[-2.44004]	[-0.75019]	[3.14186]	[1.40126]
D(INTERBANK(-1))	0.328194	0.041800	0.221707	0.506511	-0.309086	-0.213816
	(0.20413)	(0.40644)	(0.21247)	(0.14334)	(1.54017)	(0.39683)
	[1.60774]	[0.10284]	[1.04350]	[3.53362]	[-0.20068]	[-0.53880]
D(INTERBANK(-2))	-0.337418	-0.551319	-0.034311	-0.221755	1.320471	0.406059
	(0.22324)	(0.44448)	(0.23235)	(0.15676)	(1.68434)	(0.43398)
	[-1.51145]	[-1.24036]	[-0.14767]	[-1.41463]	[0.78397]	[0.93566]
D(INTERBANK(-3))	0.131973	0.322179	0.058577	-0.031175	0.901447	-0.166534
	(0.21633)	(0.43072)	(0.22516)	(0.15190)	(1.63218)	(0.42054)
	[0.61006]	[0.74800]	[0.26016]	[-0.20523]	[0.55230]	[-0.39600]
D(INTERBANK(-4))	-0.174033	-0.006634	-0.207401	0.168707	0.863923	0.225555
	(0.18388)	(0.36611)	(0.19138)	(0.12912)	(1.38735)	(0.35746)
	[-0.94645]	[-0.01812]	[-1.08368]	[1.30661]	[0.62271]	[0.63099]
D(CRED(-1))	0.005941	-0.041090	0.011918	0.020191	-0.205945	0.031971
	(0.01589)	(0.03164)	(0.01654)	(0.01116)	(0.11990)	(0.03089)
	[0.37386]	[-1.29859]	[0.72050]	[1.80934]	[-1.71757]	[1.03484]
D(CRED(-2))	-0.020844	0.005025	-0.030590	-0.004234	0.057724	0.004622
	(0.01647)	(0.03280)	(0.01715)	(0.01157)	(0.12430)	(0.03203)
	[-1.26520]	[0.15320]	[-1.78398]	[-0.36602]	[0.46439]	[0.14431]
D(CRED(-3))	0.014852	-0.027379	-0.012048	0.006809	-0.256060	-0.003245
	(0.01739)	(0.03463)	(0.01810)	(0.01221)	(0.13122)	(0.03381)
	[0.85397]	[-0.79064]	[-0.66557]	[0.55753]	[-1.95135]	[-0.09598]
D(CRED(-4))	0.002937	-0.025133	0.006316	0.012638	-0.309134	0.027772
	(0.01625)	(0.03235)	(0.01691)	(0.01141)	(0.12257)	(0.03158)
	[0.18076]	[-0.77700]	[0.37352]	[1.10786]	[-2.52201]	[0.87936]
D(EXCH(-1))	-0.102468	0.449975	-0.096165	0.013018	-0.122213	0.222811
	(0.07674)	(0.15279)	(0.07987)	(0.05389)	(0.57898)	(0.14918)
	[-1.33529]	[2.94506]	[-1.20401]	[0.24158]	[-0.21108]	[1.49358]
D(EXCH(-2))	0.003659	-0.106459	0.064236	0.025047	-0.948666	-0.056243
	(0.09123)	(0.18164)	(0.09495)	(0.06406)	(0.68830)	(0.17735)
	[0.04011]	[-0.58611]	[0.67652]	[0.39099]	[-1.37827]	[-0.31714]
D(EXCH(-3))	-0.038835	-0.190051	-0.090267	-0.161443	1.382355	0.174116
	(0.09094)	(0.18107)	(0.09466)	(0.06386)	(0.68616)	(0.17679)
	[-0.42702]	[-1.04958]	[-0.95362]	[-2.52807]	[2.01461]	[0.98485]
D(EXCH(-4))	0.155219	-0.046160	-0.112040	0.044865	-0.420931	-0.216499
	(0.08628)	(0.17179)	(0.08981)	(0.06059)	(0.65100)	(0.16773)
	[1.79895]	[-0.26869]	[-1.24759]	[0.74050]	[-0.64659]	[-1.29073]
GDP_GERM	-0.020031	0.016624	0.005161	0.043768	0.070745	-0.028255
	(0.02655)	(0.05286)	(0.02763)	(0.01864)	(0.20032)	(0.05161)
	[-0.75445]	[0.31447]	[0.18678]	[2.34757]	[0.35315]	[-0.54741]
D(INF_GERM)	-0.155535	0.573774	0.671345	0.063327	2.570762	0.010764
	(0.15165)	(0.30193)	(0.15784)	(0.10648)	(1.14415)	(0.29480)
	[-1.02565]	[1.90033]	[4.25343]	[0.59471]	[2.24687]	[0.03651]
R-squared	0.596215	0.608722	0.657004	0.636842	0.436514	0.300944
Adj. R-squared	0.381436	0.400596	0.474560	0.443672	0.136787	-0.070894
Sum sq. resids	8.073596	32.00599	8.746173	3.980867	459.5947	30.51110
S.E. equation	0.414462	0.825214	0.431380	0.291031	3.127077	0.805712
F-statistic	2.775944	2.924773	3.601116	3.296807	1.456374	0.809343
Log likelihood	-23.21461	-73.48693	-26.13524	2.594521	-170.7383	-71.74105
Akaike AIC	1.348345	2.725669	1.428363	0.641246	5.390091	2.677837
Schwarz SC	2.164125	3.541449	2.244143	1.457026	6.205871	3.493617
Mean dependent	0.060274	-0.028630	-0.022482	-0.055616	-0.290718	0.025962
S.D. dependent	0.526978	1.065876	0.595112	0.390189	3.365733	0.778586

Determinant resid covariance (dof adj.)	0.006132
Determinant resid covariance	0.000437
Log likelihood	-339.1251
Akaike information criterion	13.56507
Schwarz criterion	18.45975
Number of coefficients	156

Figure H.2: Eviews output for Portuguese model with exogenous German block 1999Q1-2017Q1

Vector Autoregression Estimates
Date: 05/30/18 Time: 15:05
Sample (adjusted): 2000Q2 2017Q1
Included observations: 68 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	D(UN)	D(GDP)	D(INF)	D(INTERBAN	D(CRED)	D(EXCH)
D(UN(-1))	0.411813	-0.247287	0.244144	0.113393	-0.595490	-1.122618
	(0.13697)	(0.44593)	(0.23836)	(0.16555)	(1.23063)	(1.73964)
	[3.00661]	[-0.55454]	[1.02428]	[0.68496]	[-0.48389]	[-0.64531]
D(UN(-2))	0.074057	-0.295971	-0.196631	-0.217558	2.034109	-1.244439
	(0.14854)	(0.48359)	(0.25848)	(0.17952)	(1.33455)	(1.88655)
	[0.49858]	[-0.61203]	[-0.76071]	[-1.21186]	[1.52419]	[-0.65964]
D(UN(-3))	-0.014398	0.244971	-0.415306	-0.260372	-0.500937	-0.117686
	(0.15187)	(0.49445)	(0.26429)	(0.18356)	(1.36452)	(1.92891)
	[-0.09480]	[0.49545]	[-1.57140]	[-1.41849]	[-0.36712]	[-0.06101]
D(UN(-4))	0.360752	0.023294	-0.081650	0.229257	-1.515172	1.932987
	(0.11090)	(0.36105)	(0.19299)	(0.13403)	(0.99638)	(1.40850)
	[3.25303]	[0.06452]	[-0.42309]	[1.71044]	[-1.52068]	[1.37237]
D(GDP(-1))	-0.041089	-0.114551	0.092986	0.138549	0.016084	1.412528
	(0.04254)	(0.13849)	(0.07402)	(0.05141)	(0.38218)	(0.54025)
	[-0.96598]	[-0.82717]	[1.25619]	[2.69496]	[0.04208]	[2.61457]
D(GDP(-2))	-0.071986	-0.073104	0.024352	0.125974	0.762605	0.276731
	(0.04019)	(0.13085)	(0.06994)	(0.04858)	(0.36110)	(0.51046)
	[-1.79113]	[-0.55870]	[0.34818]	[2.59338]	[2.11190]	[0.54212]
D(GDP(-3))	-0.118716	0.226761	0.016943	0.064160	0.196104	0.026065
	(0.03905)	(0.12712)	(0.06795)	(0.04719)	(0.35082)	(0.49593)
	[-3.04037]	[1.78377]	[0.24935]	[1.35951]	[0.55898]	[0.05256]
D(GDP(-4))	-0.063269	-0.357120	-0.121694	0.047637	0.411425	-0.678170
	(0.03794)	(0.12353)	(0.06603)	(0.04586)	(0.34090)	(0.48191)
	[-1.66750]	[-2.89098]	[-1.84307]	[1.03880]	[1.20688]	[-1.40727]
D(INF(-1))	0.056140	0.154699	0.347080	0.289441	-0.138928	-0.521829
	(0.08209)	(0.26725)	(0.14285)	(0.09921)	(0.73753)	(1.04258)
	[0.68391]	[0.57886]	[2.42969]	[2.91738]	[-0.18837]	[-0.50051]
D(INF(-2))	0.151311	-0.198324	-0.008179	0.015757	-0.670120	0.326893
	(0.08646)	(0.28150)	(0.15047)	(0.10450)	(0.77685)	(1.09817)
	[1.75001]	[-0.70453]	[-0.05436]	[0.15078]	[-0.86262]	[0.29767]
D(INF(-3))	-0.056777	0.008703	0.199442	0.109858	0.501396	0.213856
	(0.08305)	(0.27039)	(0.14453)	(0.10038)	(0.74619)	(1.05483)
	[-0.68364]	[0.03219]	[1.37996]	[1.09444]	[0.67194]	[0.20274]
D(INF(-4))	0.011319	-0.172839	-0.423587	0.069263	-0.078402	-0.566508
	(0.08123)	(0.26447)	(0.14137)	(0.09818)	(0.72987)	(1.03176)
	[0.13933]	[-0.65352]	[-2.99638]	[0.70546]	[-0.10742]	[-0.54907]
D(INTERBANK(-1))	0.039804	0.137750	0.030089	0.178191	1.217934	0.433068
	(0.10239)	(0.33336)	(0.17819)	(0.12376)	(0.91998)	(1.30051)
	[0.38873]	[0.41321]	[0.16886]	[1.43985]	[1.32387]	[0.33300]
D(INTERBANK(-2))	-0.015903	0.177846	0.018810	0.006503	0.166317	0.425490
	(0.07268)	(0.23661)	(0.12647)	(0.08784)	(0.65298)	(0.92306)
	[-0.21881]	[0.75163]	[0.14873]	[0.07403]	[0.25471]	[0.46095]
D(INTERBANK(-3))	0.008695	-0.685808	0.303138	0.043108	-0.697512	0.691753
	(0.07157)	(0.23301)	(0.12455)	(0.08650)	(0.64302)	(0.90899)
	[0.12149]	[-2.94331]	[2.43396]	[0.49836]	[-1.08474]	[0.76101]
D(INTERBANK(-4))	0.000660	0.171896	0.031972	0.173518	-1.167423	1.691314
	(0.07205)	(0.23457)	(0.12538)	(0.08708)	(0.64733)	(0.91508)
	[0.00916]	[0.73283]	[0.25501]	[1.99264]	[-1.80345]	[1.84827]
D(CRED(-1))	-0.034228	-0.023736	0.067122	0.020084	0.062210	-0.216046
	(0.01622)	(0.05281)	(0.02823)	(0.01960)	(0.14574)	(0.20602)
	[-2.11018]	[-0.44947]	[2.37791]	[1.02443]	[0.42687]	[-1.04869]
D(CRED(-2))	0.008464	-0.032900	0.031812	-0.000821	-0.040849	0.173182
	(0.01694)	(0.05515)	(0.02948)	(0.02047)	(0.15219)	(0.21514)
	[0.49971]	[-0.59660]	[1.07922]	[-0.04011]	[-0.26841]	[0.80499]
D(CRED(-3))	-0.006827	-0.072854	-0.049270	-0.039467	0.315760	-0.222433
	(0.01650)	(0.05372)	(0.02872)	(0.01994)	(0.14825)	(0.20958)
	[-0.41372]	[-1.35614]	[-1.71581]	[-1.97893]	[2.12985]	[-1.06134]
D(CRED(-4))	0.025253	-0.021052	-0.071090	-0.003746	-0.325176	0.122360
	(0.01681)	(0.05472)	(0.02925)	(0.02032)	(0.15102)	(0.21348)
	[1.50241]	[-0.38469]	[-2.43039]	[-0.18439]	[-2.15322]	[0.57316]
D(EXCH(-1))	-0.033281	-0.018295	-0.019792	0.012376	0.002681	0.163634
	(0.01330)	(0.04331)	(0.02315)	(0.01608)	(0.11952)	(0.16896)
	[-2.50178]	[-0.42242]	[-0.85497]	[0.76973]	[0.02243]	[0.96848]
D(EXCH(-2))	0.013025	-0.007328	-0.021721	-0.021364	0.174026	-0.184068
	(0.01449)	(0.04718)	(0.02522)	(0.01751)	(0.13020)	(0.18405)
	[0.89886]	[-0.15533]	[-0.86135]	[-1.21980]	[1.33665]	[-1.00011]
D(EXCH(-3))	0.010767	-0.091035	-0.047811	-0.062096	0.512662	-0.252091
	(0.01453)	(0.04730)	(0.02528)	(0.01756)	(0.13053)	(0.18453)
	[0.74112]	[-1.92461]	[-1.89105]	[-3.53629]	[3.92742]	[-1.36616]
D(EXCH(-4))	-0.001519	0.038380	-0.081583	-0.009260	0.337158	0.242652
	(0.01775)	(0.05780)	(0.03089)	(0.02146)	(0.15951)	(0.22549)
	[-0.08557]	[0.66402]	[-2.64067]	[-0.43153]	[2.11373]	[1.07613]
GDP_GERM	-0.006066	-0.032183	0.011235	-0.034258	-0.215767	0.261992
	(0.01786)	(0.05814)	(0.03108)	(0.02158)	(0.16045)	(0.22681)
	[-0.33968]	[-0.55355]	[0.36153]	[-1.58727]	[-1.34480]	[1.15512]
D(INF_GERM)	0.003848	-0.877337	-0.071367	-0.169723	-1.068718	0.564804
	(0.08576)	(0.27921)	(0.14924)	(0.10365)	(0.77053)	(1.08924)
	[0.04487]	[-3.14223]	[-0.47820]	[-1.63743]	[-1.38699]	[0.51853]
R-squared	0.803448	0.629489	0.720745	0.813090	0.709681	0.374750
Adj. R-squared	0.686452	0.408947	0.554521	0.701834	0.536871	0.002578
Sum sq. resids	3.944340	41.80841	11.94496	5.761855	318.4071	636.2825
S.E. equation	0.306452	0.997717	0.533295	0.370388	2.753384	3.892247
F-statistic	6.867348	2.854277	4.335999	7.308280	4.106731	1.006926
Log likelihood	0.317866	-79.94987	-37.35508	-12.56738	-148.9778	-172.5164
Akaike AIC	0.755357	3.116173	1.863385	1.134335	5.146406	5.838718
Schwarz SC	1.603992	3.964808	2.712020	1.982970	5.995041	6.687353
Mean dependent	-0.155882	-0.028587	-0.118219	-0.240441	-0.232872	0.048485
S.D. dependent	0.547282	1.297758	0.799014	0.678309	4.045908	3.897273

Determinant resid covariance (dof adj.)	0.165088
Determinant resid covariance	0.009166
Log likelihood	-419.3885
Akaike information criterion	16.92319
Schwarz criterion	22.01500
Number of coefficients	156

Figure H.3: Eviews output for Polish model with exogenous German block 1999Q1-2017Q1

Appendix I

Stability Tests

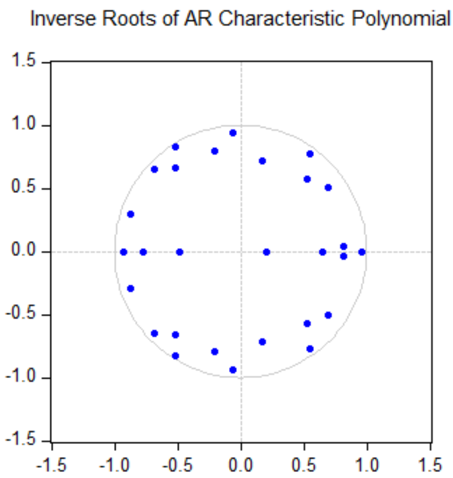

Figure I.1: Unit circle stability figure for Portuguese model with exogenous German block 1986Q1-1998Q4

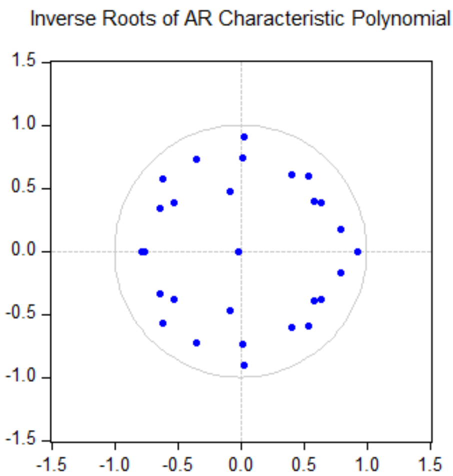

Figure I.2: Unit circle stability figure for Portuguese model with exogenous German block 1999Q1-2017Q1

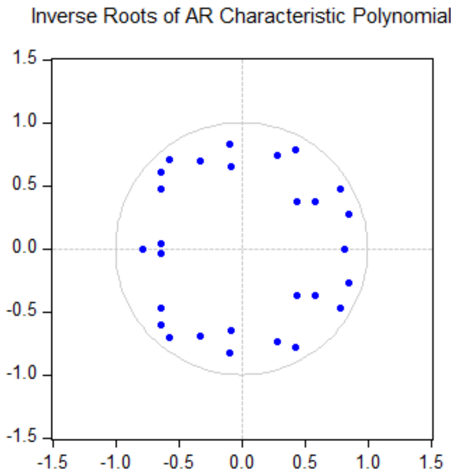

Figure I.3: Unit circle stability figure for Polish model with exogenous German block 1999Q1-2017Q1

VAR Residual Serial Correlation LM Tests
Date: 05/27/18 Time: 15:08
Sample: 1986Q1 1998Q4
Included observations: 47

Null hypothesis: No serial correlation at lag h

Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	43.52224	49	0.6940	0.739621	(49, 24.7)	0.8185
2	48.68653	49	0.4858	0.880253	(49, 24.7)	0.6569
3	40.29490	49	0.8076	0.659082	(49, 24.7)	0.8941
4	49.30557	49	0.4609	0.898144	(49, 24.7)	0.6353

Null hypothesis: No serial correlation at lags 1 to h

Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	43.52224	49	0.6940	0.739621	(49, 24.7)	0.8185
2	950.2222	98	0.0000	NA	(98, NA)	NA
3	NA	147	NA	NA	(147, NA)	NA
4	NA	196	NA	NA	(196, NA)	NA

*Edgeworth expansion corrected likelihood ratio statistic.

Figure I.4: Autocorrelation LM test for Portuguese model with exogenous German block 1986Q1-1998Q4

VAR Residual Serial Correlation LM Tests
Date: 05/27/18 Time: 15:14
Sample: 1999Q1 2017Q1
Included observations: 73

Null hypothesis: No serial correlation at lag h

Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	42.74892	49	0.7232	0.856203	(49, 156.7)	0.7321
2	49.30421	49	0.4610	1.006398	(49, 156.7)	0.4729
3	59.95112	49	0.1358	1.262287	(49, 156.7)	0.1437
4	54.78988	49	0.2643	1.136353	(49, 156.7)	0.2752

Null hypothesis: No serial correlation at lags 1 to h

Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	42.74892	49	0.7232	0.856203	(49, 156.7)	0.7321
2	98.05543	98	0.4794	0.982018	(98, 154.4)	0.5340
3	164.9467	147	0.1479	1.105194	(147, 117.7)	0.2867
4	222.8437	196	0.0915	1.009957	(196, 73.3)	0.4914

*Edgeworth expansion corrected likelihood ratio statistic.

Figure I.5: Autocorrelation LM test for Portuguese model with exogenous German block 1999Q1-2017Q1

VAR Residual Serial Correlation LM Tests
Date: 05/27/18 Time: 15:18
Sample: 1999Q1 2017Q1
Included observations: 68

Null hypothesis: No serial correlation at lag h

Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	79.38071	49	0.0039	1.795150	(49, 131.3)	0.0047
2	63.83560	49	0.0756	1.367648	(49, 131.3)	0.0831
3	39.84544	49	0.8215	0.786636	(49, 131.3)	0.8303
4	32.92211	49	0.9622	0.635029	(49, 131.3)	0.9646

Null hypothesis: No serial correlation at lags 1 to h

Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	79.38071	49	0.0039	1.795150	(49, 131.3)	0.0047
2	114.5503	98	0.1213	1.197353	(98, 122.8)	0.1716
3	162.2597	147	0.1842	1.040694	(147, 84.3)	0.4254
4	226.7348	196	0.0654	0.857037	(196, 39.2)	0.7541

*Edgeworth expansion corrected likelihood ratio statistic.

Figure I.6: Autocorrelation LM test for Polish model with exogenous German block 1999Q1-2017Q1

VAR Residual Normality Tests
Orthogonalization: Cholesky (Lutkepohl)
Null Hypothesis: Residuals are multivariate normal
Date: 05/27/18 Time: 15:09
Sample: 1986Q1 1998Q4
Included observations: 47

Component	Skewness	Chi-sq	df	Prob.*
1	-0.367974	1.060670	1	0.3031
2	-0.014982	0.001758	1	0.9666
3	0.237590	0.442184	1	0.5061
4	0.484280	1.837128	1	0.1753
5	0.239096	0.447808	1	0.5034
6	0.100547	0.079193	1	0.7784
7	0.397364	1.236870	1	0.2661
Joint		5.105611	7	0.6471

Component	Kurtosis	Chi-sq	df	Prob.
1	3.052482	0.005394	1	0.9415
2	3.161263	0.050928	1	0.8215
3	2.734725	0.137809	1	0.7105
4	3.318121	0.198185	1	0.6562
5	3.436322	0.372821	1	0.5415
6	2.182545	1.308623	1	0.2526
7	2.375356	0.764102	1	0.3820
Joint		2.837863	7	0.8996

Component	Jarque-Bera	df	Prob.
1	1.066064	2	0.5868
2	0.052686	2	0.9740
3	0.579993	2	0.7483
4	2.035313	2	0.3614
5	0.820630	2	0.6634
6	1.387816	2	0.4996
7	2.000972	2	0.3677
Joint	7.943474	14	0.8923

*Approximate p-values do not account for coefficient estimation

Figure I.7: Normal distribution errors test for Portuguese model with exogenous German block 1986Q1-1998Q4

VAR Residual Normality Tests
Orthogonalization: Cholesky (Lutkepohl)
Null Hypothesis: Residuals are multivariate normal
Date: 05/27/18 Time: 15:13
Sample: 1999Q1 2017Q1
Included observations: 73

Component	Skewness	Chi-sq	df	Prob.*
1	-0.541785	3.571292	1	0.0588
2	-0.591577	4.257889	1	0.0391
3	-0.419178	2.137810	1	0.1437
4	-0.235422	0.674318	1	0.4116
5	-0.946384	10.89697	1	0.0010
6	-0.477411	2.773040	1	0.0959
7	-0.296899	1.072482	1	0.3004
Joint		25.38381	7	0.0006

Component	Kurtosis	Chi-sq	df	Prob.
1	2.946820	0.008602	1	0.9261
2	2.849025	0.069330	1	0.7923
3	2.692277	0.288026	1	0.5915
4	2.850161	0.068291	1	0.7938
5	6.146626	30.11631	1	0.0000
6	3.389728	0.461991	1	0.4967
7	3.093089	0.026358	1	0.8710
Joint		31.03891	7	0.0001

Component	Jarque-Bera	df	Prob.
1	3.579894	2	0.1670
2	4.327220	2	0.1149
3	2.425836	2	0.2973
4	0.742608	2	0.6898
5	41.01329	2	0.0000
6	3.235031	2	0.1984
7	1.098840	2	0.5773
Joint	56.42272	14	0.0000

*Approximate p-values do not account for coefficient estimation

Figure I.8: Normal distribution errors test for Portuguese model with exogenous German block 1999Q1-2017Q1

VAR Residual Normality Tests
Orthogonalization: Cholesky (Lutkepohl)
Null Hypothesis: Residuals are multivariate normal
Date: 05/27/18 Time: 15:19
Sample: 1999Q1 2017Q1
Included observations: 68

Component	Skewness	Chi-sq	df	Prob.*
1	-0.070166	0.055798	1	0.8133
2	-0.752638	6.419924	1	0.0113
3	0.049659	0.027948	1	0.8672
4	-0.160822	0.293121	1	0.5882
5	-0.072500	0.059571	1	0.8072
6	-0.333338	1.259297	1	0.2618
7	-0.504468	2.884193	1	0.0895
Joint		10.99985	7	0.1386

Component	Kurtosis	Chi-sq	df	Prob.
1	2.541534	0.595543	1	0.4403
2	3.948960	2.551489	1	0.1102
3	2.564529	0.537298	1	0.4636
4	2.353553	1.184033	1	0.2765
5	2.993147	0.000133	1	0.9908
6	2.546621	0.582398	1	0.4454
7	3.126985	0.045688	1	0.8307
Joint		5.496581	7	0.5996

Component	Jarque-Bera	df	Prob.
1	0.651340	2	0.7220
2	8.971413	2	0.0113
3	0.565247	2	0.7538
4	1.477154	2	0.4778
5	0.059704	2	0.9706
6	1.841695	2	0.3982
7	2.929880	2	0.2311
Joint	16.49643	14	0.2840

*Approximate p-values do not account for coefficient estimation

Figure I.9: Normal distribution errors test for Polish model with exogenous German block 1999Q1-2017Q1

Appendix J

Correlation Table

Covariance Analysis: Ordinary
Date: 05/30/18 Time: 17:21
Sample: 2000Q1 2017Q1
Included observations: 69

Correlation Probability	UN_PT	UN_EURO	GDP_PT	GDP_EURO	INF_PT	INF_EURO	INT_PT	INT_EURO	CRED_PT	CRED_EURO	EXCH_PT	EXCH_EURO
UN_PT	1.000000											

UN_EURO	0.835383	1.000000										
	0.0000	-----										
GDP_PT	-0.518469	-0.395738	1.000000									
	0.0000	0.0008	-----									
GDP_EURO	-0.356867	-0.296292	0.786277	1.000000								
	0.0026	0.0134	0.0000	-----								
INF_PT	-0.557416	-0.567703	0.108632	0.441183	1.000000							
	0.0000	0.0000	0.3743	0.0001	-----							
INF__EURO	-0.377269	-0.535213	-0.031657	0.235303	0.831804	1.000000						
	0.0014	0.0000	0.7962	0.0516	0.0000	-----						
INT__PT	-0.776036	-0.868158	0.322547	0.306748	0.667260	0.681727	1.000000					
	0.0000	0.0000	0.0069	0.0104	0.0000	0.0000	-----					
INT_EURO	-0.776138	-0.868372	0.322831	0.306884	0.667062	0.681613	0.999999	1.000000				
	0.0000	0.0000	0.0068	0.0103	0.0000	0.0000	0.0000	-----				
CRED_PT	-0.705492	-0.674231	0.102296	0.054750	0.571330	0.560254	0.776536	0.776525	1.000000			
	0.0000	0.0000	0.4029	0.6550	0.0000	0.0000	0.0000	0.0000	-----			
CRED_EURO	-0.789299	-0.815930	0.420357	0.412814	0.631974	0.540877	0.869650	0.869680	0.622244	1.000000		
	0.0000	0.0000	0.0003	0.0004	0.0000	0.0000	0.0000	0.0000	0.0000	-----		
EXCH_PT	0.392856	-0.021777	-0.429617	-0.377381	-0.228246	0.095393	-0.156803	-0.156573	-0.175544	-0.304094	1.000000	
	0.0008	0.8590	0.0002	0.0014	0.0593	0.4356	0.1982	0.1989	0.1491	0.0111	-----	
EXCH_EURO	0.017499	-0.283239	-0.232913	-0.283135	-0.129620	0.187625	0.154725	0.154965	0.099420	-0.010104	0.874995	1.000000
	0.8865	0.0184	0.0541	0.0184	0.2885	0.1226	0.2043	0.2036	0.4163	0.9343	0.0000	-----

Figure J.1: Correlation between Portuguese and EMU aggregated variables

Appendix K

Variance Decomposition

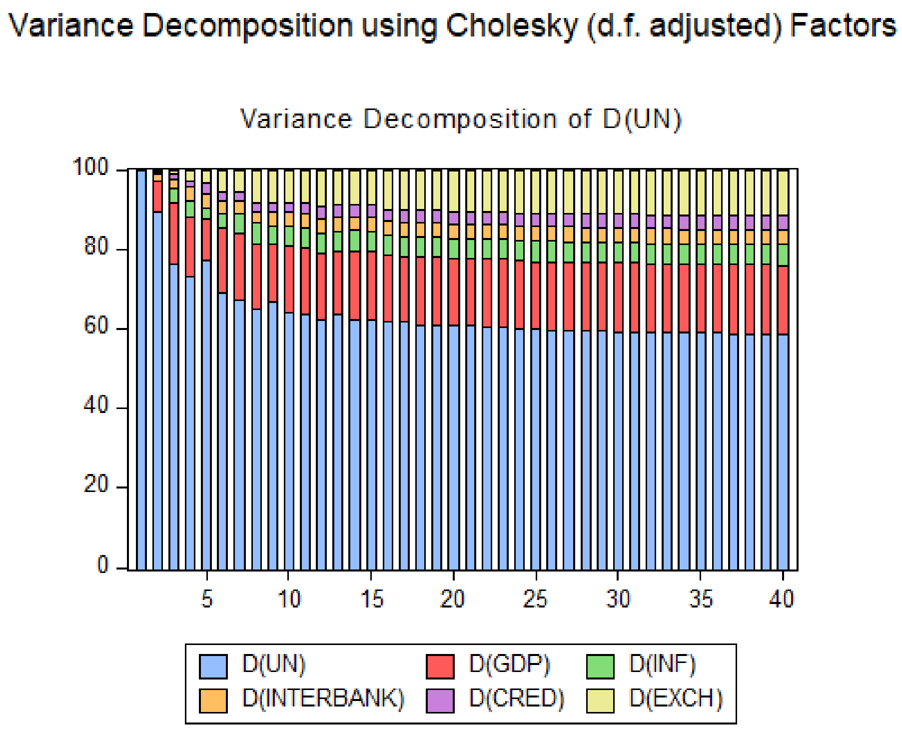

Figure K.1: Variance decomposition of unemployment in the Portuguese Pre-Euro model

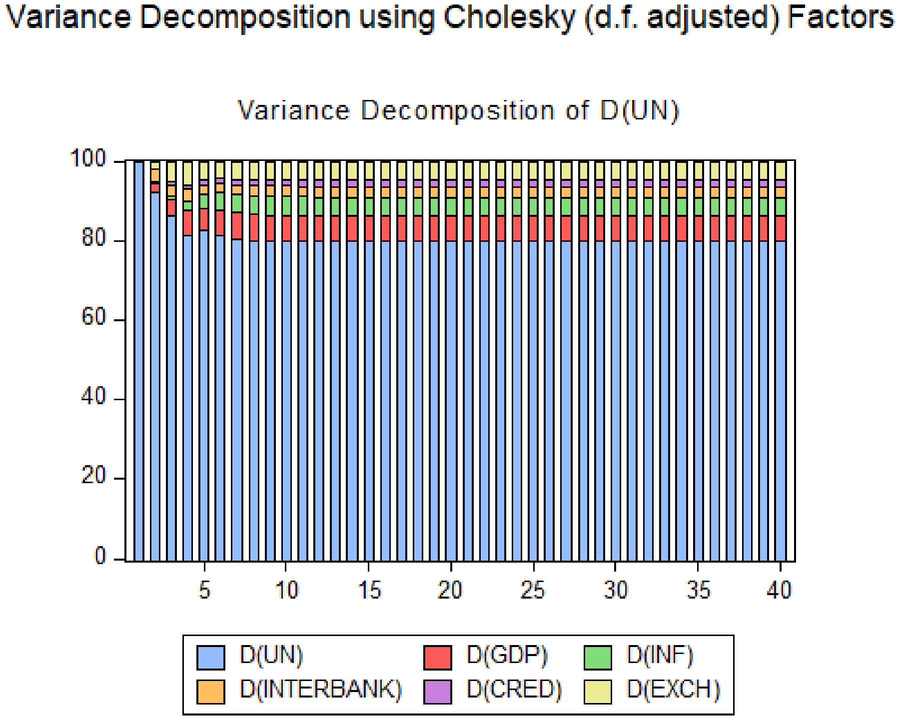

Figure K.2: Variance decomposition of unemployment in the Portuguese Post-Euro model

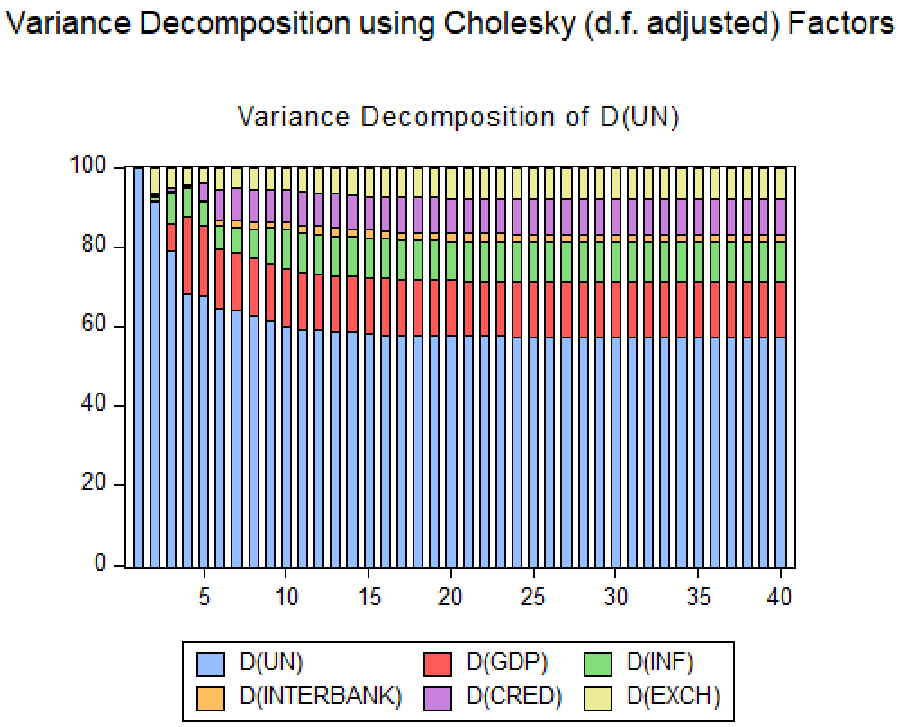

Figure K.3: Variance decomposition of unemployment in the Polish model

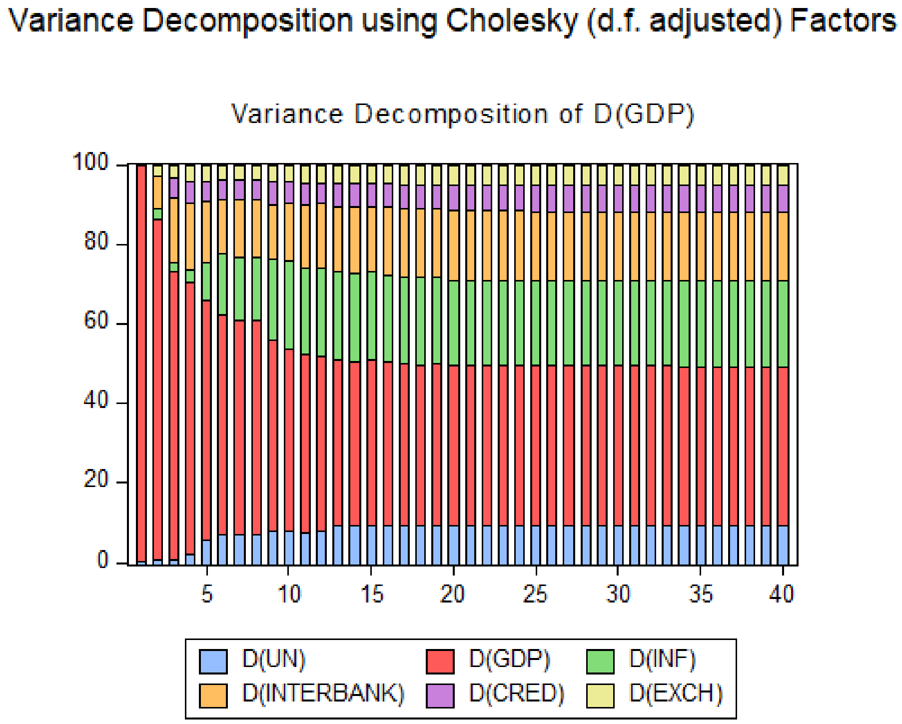

Figure K.4: Variance decomposition of GDP in the Portuguese Pre-Euro model

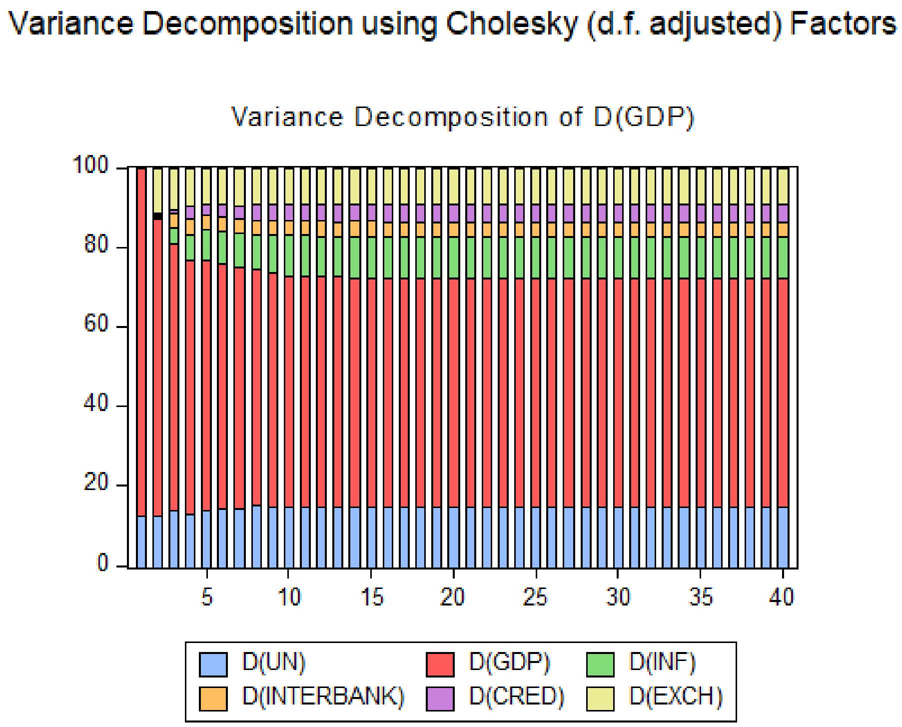

Figure K.5: Variance decomposition of GDP in the Portuguese Post-Euro model

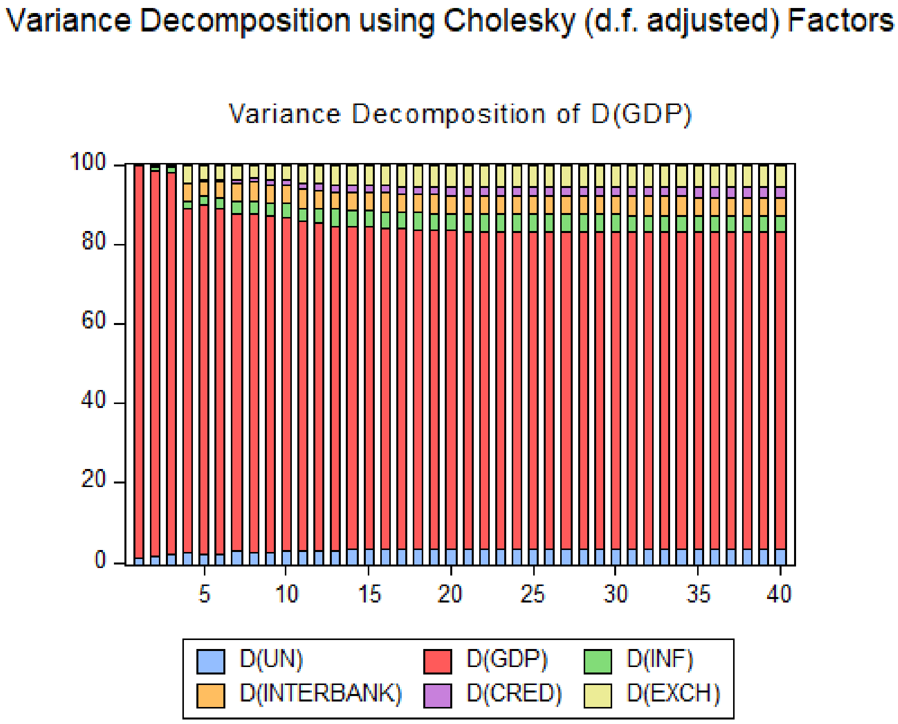

Figure K.6: Variance decomposition of GDP in the Polish model

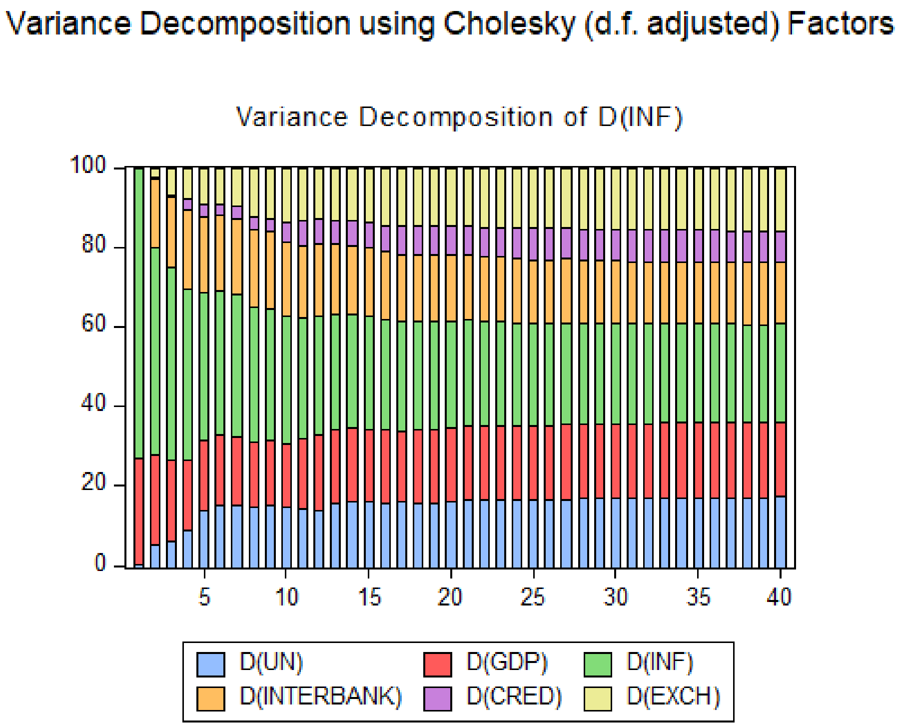

Figure K.7: Variance decomposition of inflation in the Portuguese Pre-Euro model

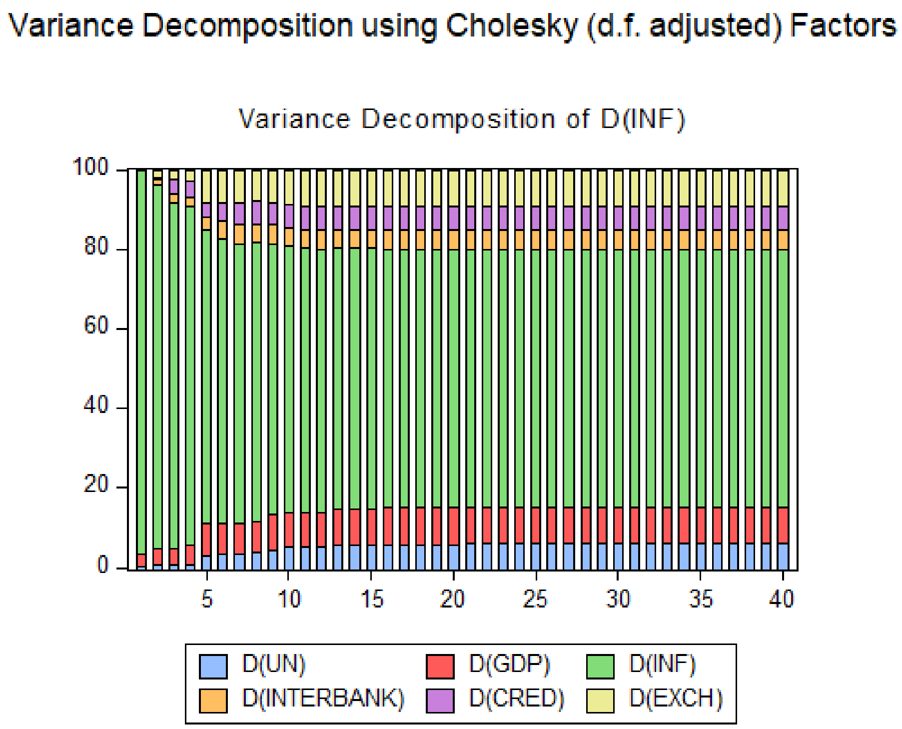

Figure K.8: Variance decomposition of inflation in the Portuguese Post-Euro model

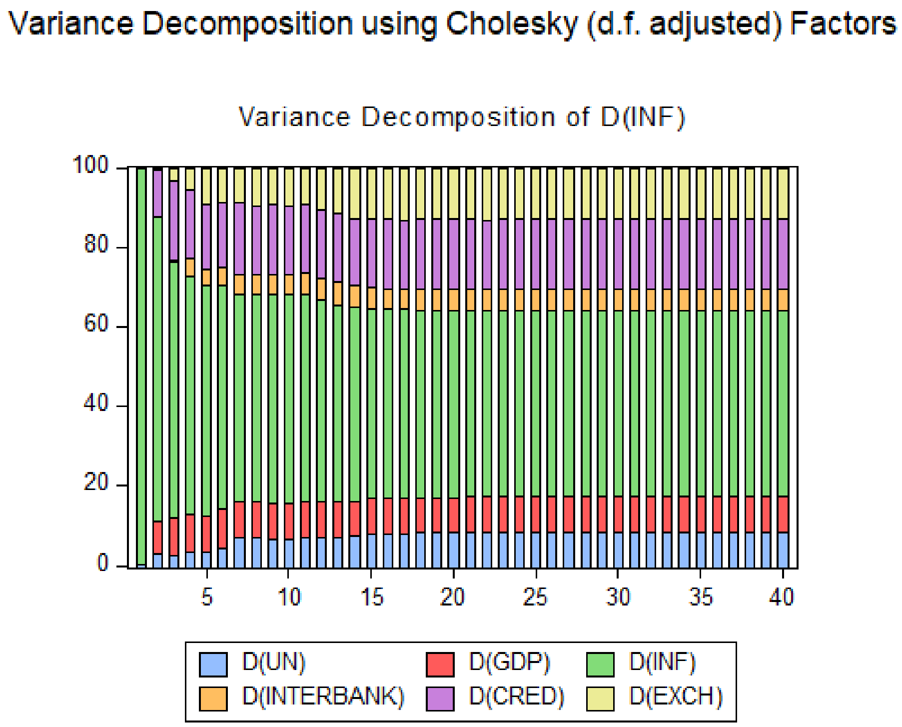

Figure K.9: Variance decomposition of inflation in the Polish model

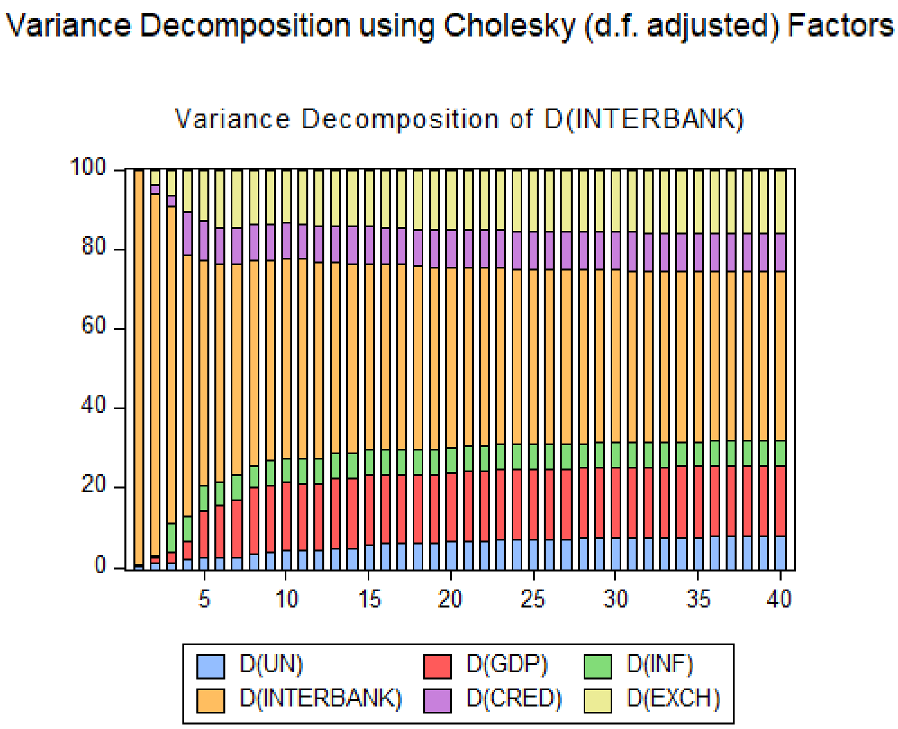

Figure K.10: Variance decomposition of interbank interest rate in the Portuguese Pre-Euro model

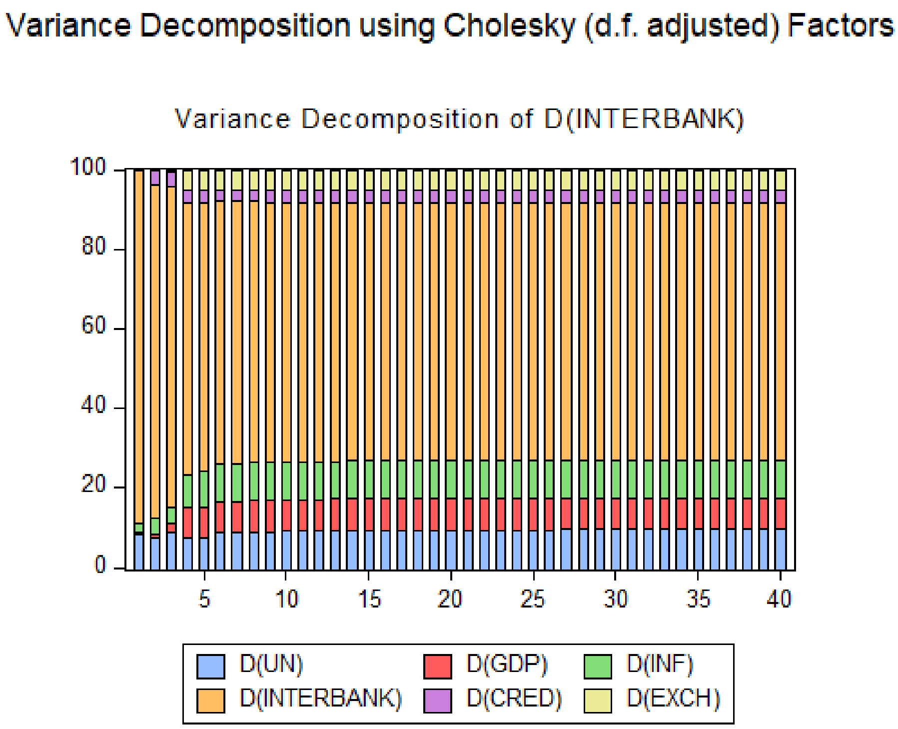

Figure K.11: Variance decomposition of interbank interest rate in the Portuguese Post-Euro model

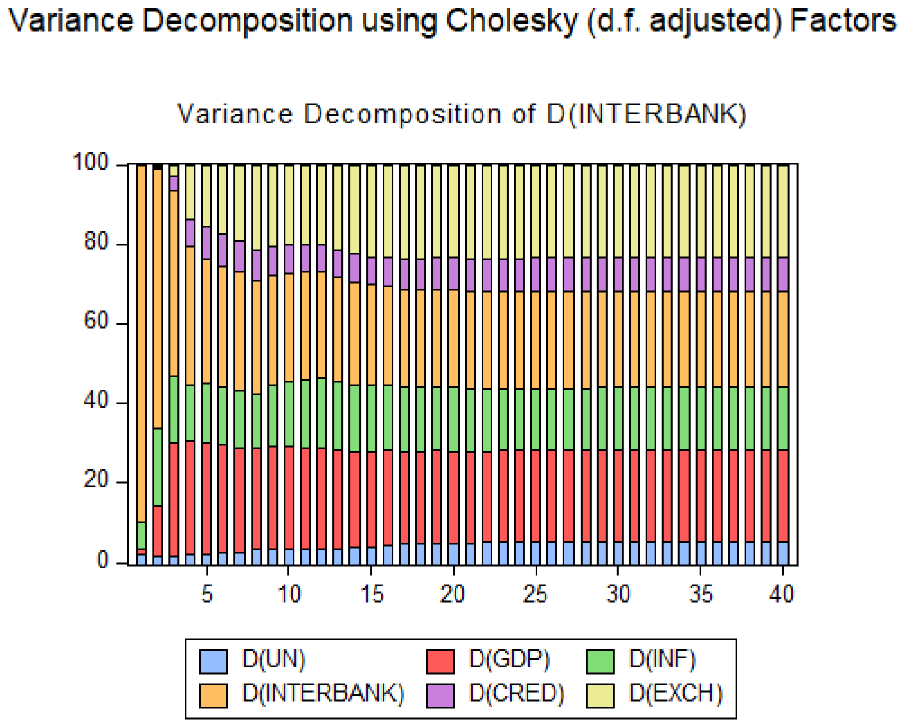

Figure K.12: Variance decomposition of interbank interest rate in the Polish model

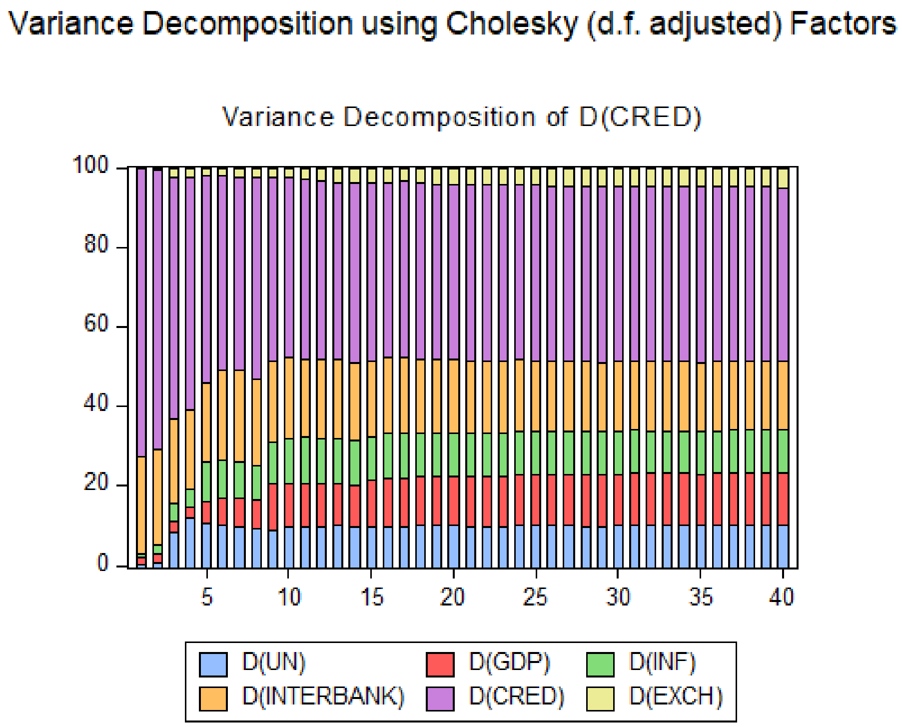

Figure K.13: Variance decomposition of credit in the Portuguese Pre-Euro model

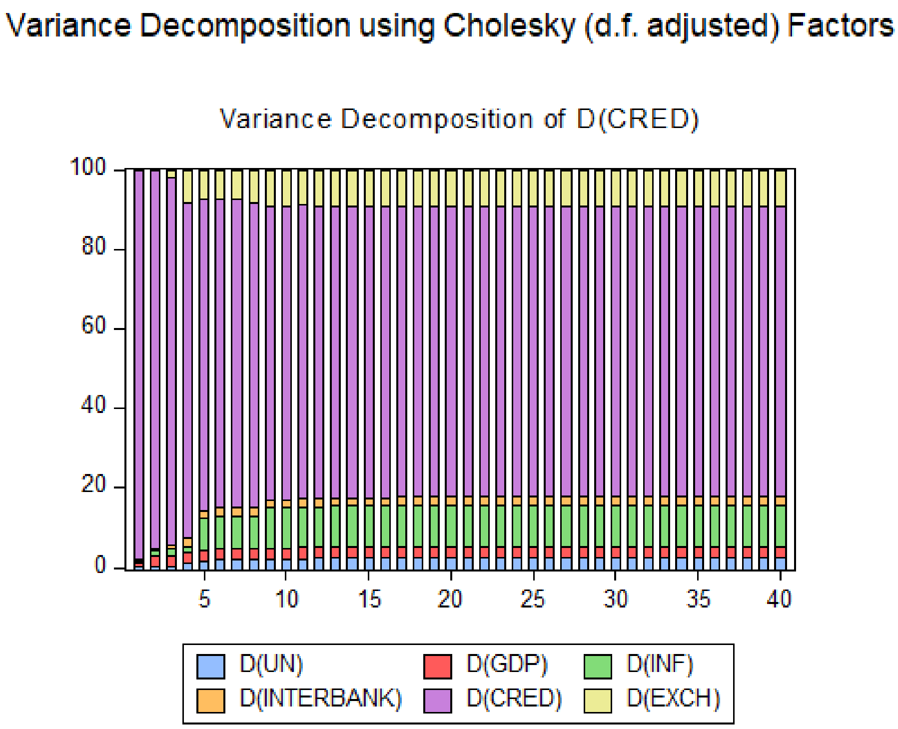

Figure K.14: Variance decomposition of credit in the Portuguese Post-Euro model

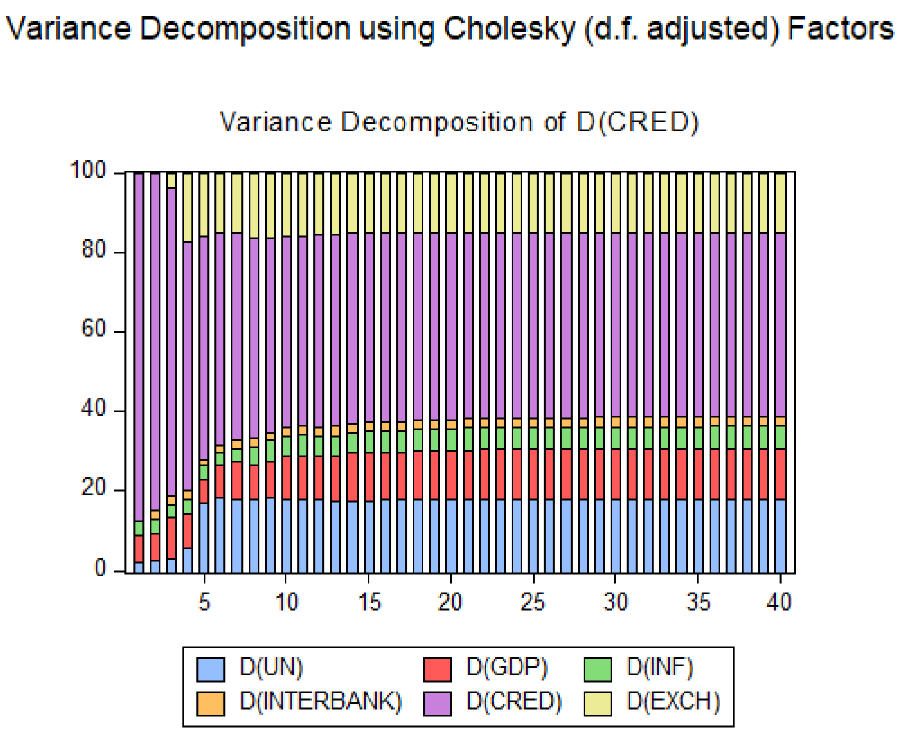

Figure K.15: Variance decomposition of credit in the Polish model

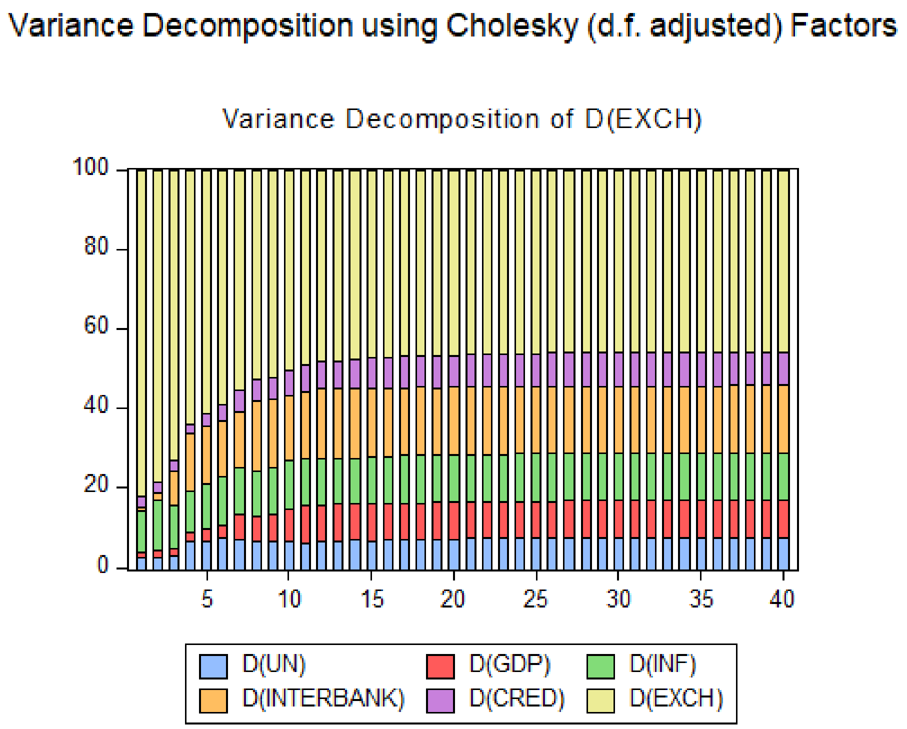

Figure K.16: Variance decomposition of exchange rate in the Portuguese Pre-Euro model

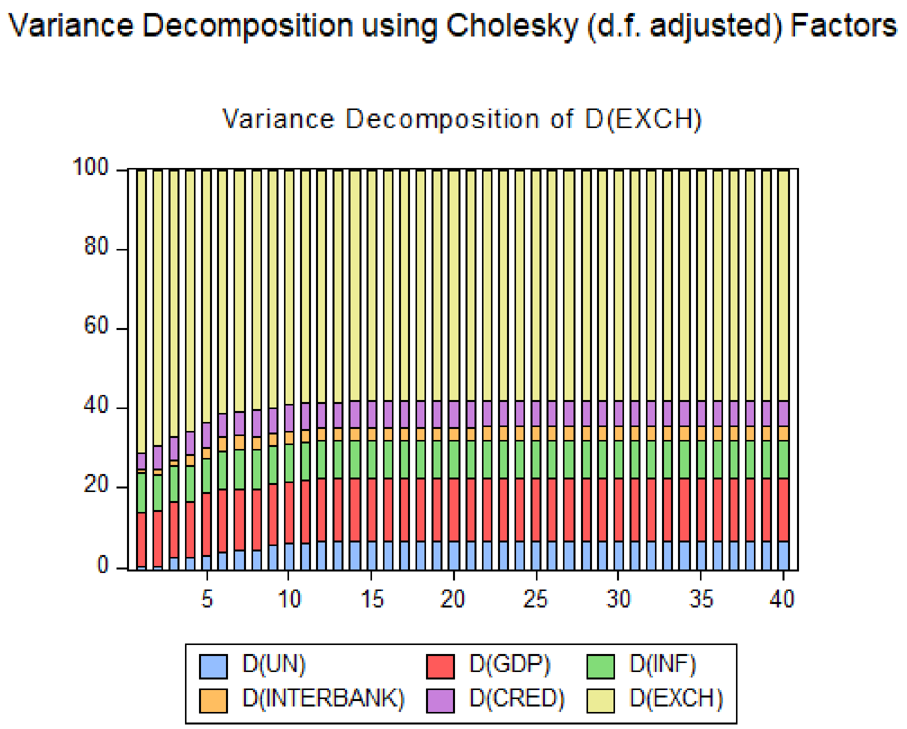

Figure K.17: Variance decomposition of exchange rate in the Portuguese Post-Euro model

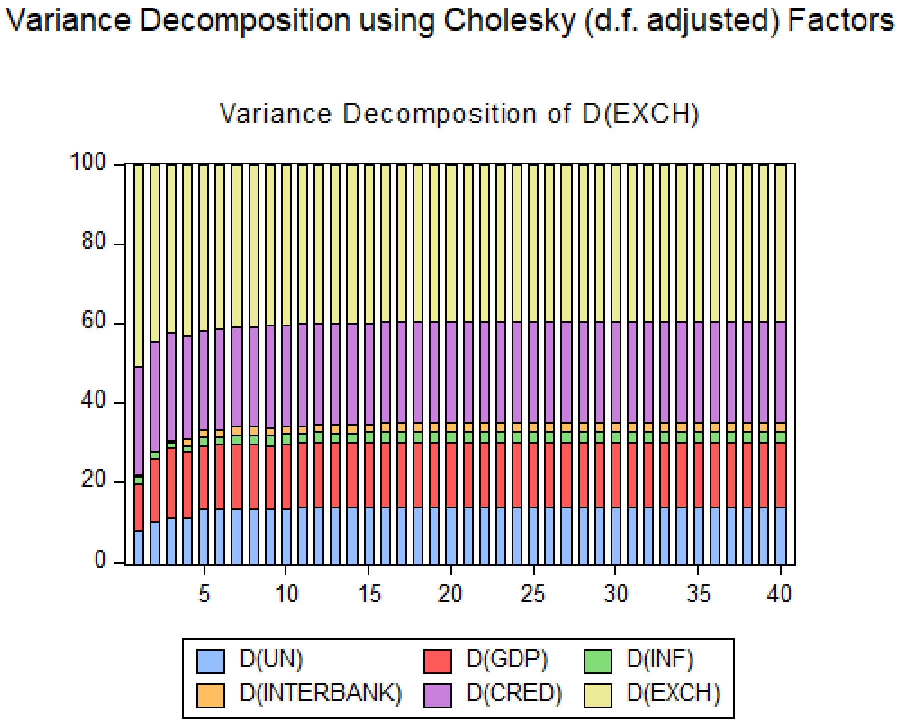

Figure K.18: Variance decomposition of exchange rate in the Polish model