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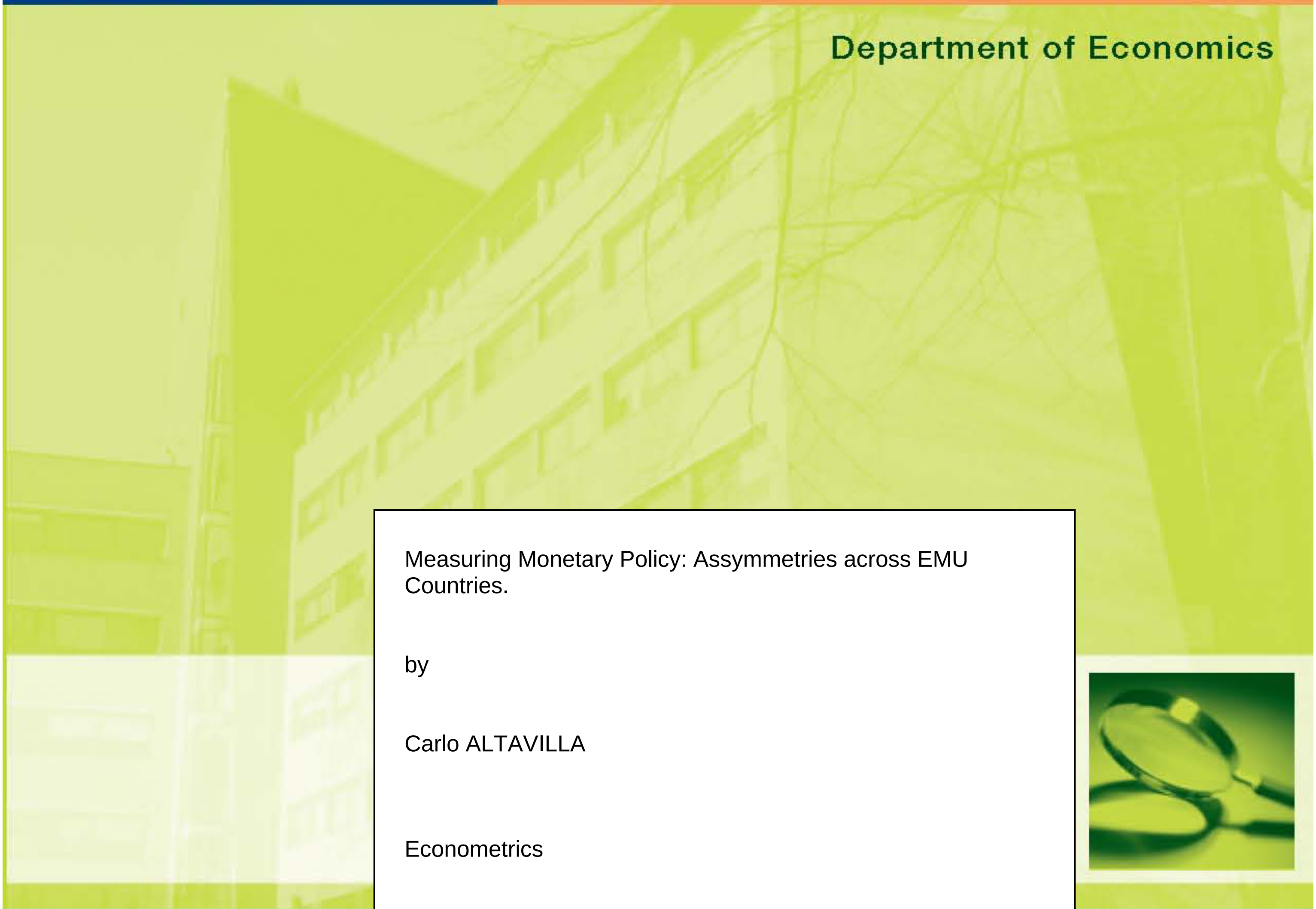

Measuring Monetary Policy: Assymmetries across EMU Countries.

by

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DISCUSSION PAPER

Measuring Monetary Policy Asymmetries across EMU Countries

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Abstract

The paper compares the different timing and magnitude of monetary shocks across European countries. The problem the European Central Bank faces in setting a single monetary policy rule is analyzed starting from the differences in the monetary transmission mechanism across EMU members. The econometric methodology applied is the Structural Vector Autoregression with constraints both on contemporaneous and long term relationships among the variables of the estimated models. The results suggest the presence of asymmetric response to a monetary policy shock. In contrast with some empirical studies, the comparative analysis of the EMU members' response to a contractionary monetary policy shock does not lead to an unambiguous positive relationship between country size and response widht.

Keywords: EMU, S-VAR, Monetary Transmission Mechanisms

JEL Classification: E52,C32

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1 Introduction

The paper addresses the problem of the different reactions of EMU members to a single monetary policy. If this is the case, asymmetry will arise from the behavior of European Central Bank (ECB).This analysis builds on the literature aimed at explaining the fundamental sources of monetary policy asymmetries across European countries. The aim is to asses whether the different economic environment the ECB has to face will create frictions concerning the implementation of a centralized monetary policy. In other words, the problem is whether the regional divergence in the Euro zone will become less pronounced over the time as a result of a single monetary orientation or, on the contrary, the ECB conduct will magnify or at least generate asymmetries. The econometric methodology applied in the empirical analysis is a Structural Vector Autoregression (henceforth S-VAR) with constraints both on the contemporaneous and long run relationships among the considered variables.

The remainder of the paper is organized as follows:

- Section 2: The possible frictions of having asymmetric response to a monetary policy shock across EMU members are suggested.
- Section 3: A brief literature review of the previous studies searching for monetary policy asymmetries is presented.
- Section 4: The methodology applied in the empirical study is discussed. In particular, the identification issues involved in identifying the effects of a contractionary monetary policy shock are considered.
- Section 5: The main results of the Simulation Analysis are presented.
- Section 6: Concluding remarks end the paper.

2 Formulating the Problem

Since the beginning of 1999 the monetary policy regime in Europe has changed substantially. The centralization of the EMU-members' monetary policy has resulted in a single decision process that prevents national monetary authorities from pursuing systematic policy to offset country-specific shocks. In this scenario, if the practical implementation of this unique decision making process will collide with national needs, asymmetries in the monetary policy transmission mechanisms will arise, amplifying the divergences of the members concerning the way to achieve the ultimate monetary policy goal: the price stability. Moreover, even in a context of perfect agreement about how the price stability has to be reached, the non-alignment of member countries' business cycles and the differences in the size and timing of the monetary shocks propagation will contribute to create frictions among the members of the monetary union.

The main difficulties in detecting and assessing the asymmetric behavior of the monetary policy lie in the consideration of the monetary regime switch occurred with the creation of the ECB. In this respect, on the one hand, we do not have sufficient evidence to analyze Euroland as a whole, on the other hand the institutional changes might render the single-country past evidence no longer informative. Concerning this point, if the well documented gradual adjustment behavior of the economic agents is the case, the evidence on how the different transmission channels have operated in the past regime should provide useful information, at least for the near period, about the manner each channel will operate once the structural break, i.e. the single monetary policy regime, realized.

Other sources of the different impacts to the monetary policy actions in Euroland can be found analyzing the heterogeneous way each channel of Monetary Policy Transmission might work in a Single Central Bank Environment. In this respect, despite the close relationships among the channels, it is possible to recover some frictions coming from the heterogeneity of those channels due to national peculiarity. In the following, the effects of monetary policy actions on input and prices, i.e. the monetary policy transmission, is seen to operate through four main channels. First of all, the Interest Rate Channel. The study of this channel involves both the role of the policy interest rates before the launch of EURO in EMU-countries and the different Propagation of monetary impulse over the Term Structure of Interest Rates; this kind of study is able to achieve useful information not only on the different timing and intensity of a monetary policy shocks but also on the credibility of the single national central banks. As stressed in Corsetti-Pesenti(1999), there are at least three factors that can generate asymmetries. The first one could be the wide-spread of consumer borrowing: as borrowing increases the consumption sensitivity to interest rates, a monetary policy action is likely to have a larger impact on the aggregate demand of the country where the consumer credit is much diffuse: in this case, for instance, an interest rate shock will have a stronger impact in the North European countries rather than in Italy or France. Another source leading to an heterogeneous work of this channel might be the public debt level: a monetary policy tight, leading to a rise in the household's interest income, will probably increase(not decrease) spending in the high-debt country. Moreover the public debt will also affect the longer segment of interest rate term structure introducing some friction in the term structure of interest rates. Finally, the differences among the countries in the percentage of short-term debt in private sector financial liabilities could generate further asymmetries. A second channel through which the monetary policy operates is the Credit Channel. This channel is commonly divided in Balance Sheet Channel and Bank Lending Channel. Both of those are influenced by the External Finance Premium. In order to recognize how this channel work, a Financial System Analysis seems to be necessary. In fact, the cross-country financial system heterogeneity seems to be the key-point to evaluate whether the monetary policy authorities will be capable to implement non-asymmetric actions or they will contribute to amplify the actual divergences. The analysis of the countries' financial system helps in assessing the divergences in the following chain:

$$\text{Central Bank} \Rightarrow \text{Financial System} \Rightarrow \text{Real Economy}$$

Many studies, as for example Cecchetti(1999), Gertler-Gilchrist(1993), ù et al.(1999), Schmidt(1999) and Bernanke B. and Gertler M.(1995), conducted on this topic, after the seminal contribution of Bernanke and Blinder(1992), suggest the reaction to monetary policy will be stronger in the country with small firms and small banks. Moreover, a very different bank lending rate response, both in timing and intensity, to policy rates shock seems to characterize the work of this channel: slower and smaller in Italy than in Germany or in UK. A third channel summarizing the effect of the monetary policy on the real activity is the Stock Market Channel. Due to the increasing bank financing alternatives in the European financial market, the credit channel strength, strictly correlated to the bank-dependent borrowers, is likely to decline. On the other hand, the stock market seems to have a growing importance as a private-sector income catalyst. This consideration assigns an important role to stock markets in the monetary policy transmission. There are three main questions related to this channel: How important is its role? Should the regional stock markets to be considered as another likely source of asymmetry over the EMU countries? How will the ECB be able to reduce the possible divergence in a context of single stock market absence?

The two previous channels will not be considered in the following analysis, the paper focusing on the interest rate and exchange rate channels.

Finally, a fourth channel considers the way the Exchange Rate can in‡uence output. The traditional explanation of this channel goes as follow: a contractionary monetary policy shock leads to an appreciation in the nominal exchange rate, which, given a certain degree of nominal rigidities, is re‡ected into a short-run appreciation of the real exchange rate. The Euro has been experienced a signi…cant depreciation against the US-Dollar since its take o¤. According to many economists this weakness has to be addressed to an unprepared environment in which the new currency has taken place. The main problem in assessing the future role of this channel on the whole transmission process is to evaluate how the extra-EMU channel (once the intra-EMU channel does not exist any more) will work, taking into account the ECB decision about not to specify any target for the exchange rate.

The issues outlined above are analyzed focusing on how each member-country responds to an exogenous monetary policy shock rather than considering the systematic behavior of the monetary authorities. This choice is supported by considering that the analysis of the monetary authorities' systematic response to the state of the economy, synthesized in the feedback rule, re‡ects, in part, non-monetary developments in the economy. Moreover, the optimal currency area theory states the symmetry of shocks and structure across participating countries as a necessary condition for a good performance of a single currency area. Finally, conducting shock experiments is possible to evaluate the empirical plausibility of competing structural models of monetary transmission[1].

A preliminary descriptive study, following Bjorksten N. and Syrjanen M.(1999), is performed by using the Convergence Barometer. The use of this graphic analysis helps to recognize the possible sources of a monetary policy asymmetric e¤ect. For each country the last observation available concerning In‡ation, Credit Growth, GDP growth, Unemployment rate, Fiscal Balance and the Debt/GDP ratio is compared with the same variables referred to a weighted Euro Area average. The values in the …gure refer to the last observations available from the OECD Economic Outlook. This six key

[1] See Christiano et al.(1998) for an explanation of the so-called Lucas Programme.

variables show some structural and cyclical divergences among the European countries. The GDP growth di¤erences are quite large: the good performance of the European periphery tends to amplify those asymmetries. In particular, the positive trend of Finland, Netherlands and Ireland seem to be o¤set by the lower GDP growth of Italy. Those asymmetries emerge also by looking at the in‡ation rate: the high-growth countries, like Ireland, Spain, Portugal and Netherlands are experimenting a higher in‡ation with respect to the core European countries such as Germany or France. Consider, …nally, the extent of unemployment and public debt di¤erences in EMU: while, concerning the former, Italy and Spain seems to be the countries with more di¢culties in recovering their employment rate, for the latter Belgium together with Italy are the countries where there are more pressure for a public debt downward trend.

The weakness, emerging from …gures1 to 4, suggests that each country needs a speci…c policy to recover its economic system. But while, before the start of the monetary union, an independent monetary policy could pursue a speci…c objective in order to avoid the development of their weaknesses, now it can't be done anymore. So the point is whether, in the new monetary policy environment, other device, like a ‡exible …scal or labor policy, will be able to o¤set this lack.

Insert Figure 1 to 4

3 Literature Review

The questions examined here have been reviewed in Britton-Whitley(1997), Dornbush et al.(1998), Kieler-Saarenheimo(1998) and Guiso et al.(1999). In the spirit of those papers the existing empirical evidence is divided into the following categories:

² Large-scale Macroeconometric Models: this category is composed by

a. Single-country Models

The analysis conducted by Smets(1995), enclosed in a BIS study, reveals an almost identical response of output to a monetary shock in Germany, Italy and France.

b. Multi-country Models

This kind of model tends to impose a similar structure across the countries. Examples of those models are the IMF's MULTIMOD used in Hallett and Piscitelli(1999) and the US Federal Reserve's MCM model(reported in BIS(1995)): the results underline the smaller e¤ect of monetary policy on output in Italy with respect to the reaction of output in France and Germany.

² Small-scale Structural Models

Using a small structural model, Britton and Whitley(1997) detect non-signi…cant di¤erences of the output reaction in Germany and France. Here also the response of the United Kingdom seems to be larger.

² Single Equation Models:

Dornbush et al.(1998) stress that while the impact-e¤ect of a change in monetary policy is similar in Germany,France and United Kingdom and smaller in Sweden and Italy, the full e¤ect of the coordinated monetary policy movement is, however, lower in UK than in France and Germany: a result consistent with Britton and Whitley(1997)

² Structural VAR(SVAR) Models

Ramaswamy and Sloek(1998) assert the e¤ect on output in Germany, Austria, Belgium, Finland and Netherlands takes longer to occur but is almost twice as large as in France, Italy, Spain, Sweden, Portugal and Denmark. Gerlach and Smets(1995-97) using long-run identifying restrictions …nd a response of Germany larger than the one of France and Italy. Ehrmann(1998) detects a substantial heterogeneity in the magnitude of response: small response in small economies are opposed to large reactions in large countries. Finally, Kiler and Saaranheimo(1998), emphasizing how the results of those experiments are dependent on the speci…c identi…cation scheme, declare the non-possibility to detect cross-country di¤erences in the monetary transmission mechanisms of France, Germany and United Kingdom.

4 SVAR Methodology

The investigation of the different impact on the economy of an exogenous monetary policy shock is implemented by means of the Structural Vector Autoregression framework. The main issue one faces in applying the SVAR methodology is to find a solution to the Identification problem. In fact, as the macroeconomic variables involved in the monetary transmission are endogenous variables, reflecting both monetary policy actions and state of economy changes, one has to be able to distinguish the share in the variable movements owing to exogenous shift in the policy stance from the share reflecting the endogenous response to the state of the economy. Moreover, the problem is widened taking into account the selection between competing set of identifying assumptions adopted to measure the exogenous component of monetary policy changes. In fact, a preliminary choice concerns whether to adopt short run restrictions, like Sims(1992), Bernanke-Blinder(1992) and Christiano-Eichembaum(1992), or to concentrate on the long run restrictions, applied for example in the work of Blanchard and Quah(1989). The literature has not yet converged to a particular set of assumptions for identifying the effect of an exogenous monetary policy shock. Nevertheless, in the following, like in Gali(1992), a class of identifying restrictions that allows for a combination of short term and long term restrictions is adopted.

The econometric analysis is performed for ten member states of the European Monetary Union: Luxemburg is not considered[2]. The data are quarterly and are taken from IFS statistics. The sample period, for most countries, goes from 1979:1 to 1998:4. The length of the sample period is justified with the needs of having a single monetary policy regime involved in the estimations.

4.1 Identifying the Contemporaneous Relations

In the present empirical analysis, following Eichenbaum-Evans(1995) and Christiano et al.(1998), a monetary shock is interpreted as the disturbance term in the monetary policy instrument equation:

$$i_t = f(\Omega_t) + \varepsilon_t^i \quad (1)$$

[2] In fact, the monetary union between Belgium and Luxembourg has not arisen asymmetry problem.

where i is the monetary instrument, Ω_t the information set the monetary authorities have at time t; f can be thought as a feedback rule obtained as a result of an infinite horizon optimal control problem in which the monetary authorities minimize the expected value of a quadratic loss function subject to the constraint given by the state of the economy. In this interpretation ε_t^i reflect exogenous shocks to the monetary authorities' preferences, an example being a change in the relative weight the policy makers attach to unemployment and inflation. The above equation belongs to a structural dynamic linear model of the form:

$$A\begin{pmatrix} P_{1t} \\ i_t \\ P_{2t} \end{pmatrix} = C(L)\begin{pmatrix} P_{1t-1} \\ i_{t-1} \\ P_{2t-1} \end{pmatrix} + B\begin{pmatrix} \varepsilon_t^{P_1} \\ \varepsilon_t^{i} \\ \varepsilon_t^{P_2} \end{pmatrix} \tag{2}$$

where P_{1t} is a vector of non-policy variables whose contemporaneous value appear in Ω_t while the value of the variables contained in the P_{2t} vector do not; i_t is a short-term interest rate indicating the stance of monetary policy; $C(L)$ is a finite-order lag polynomial matrix and ε the vector of structural disturbances. The contemporaneous relations among the variables are described in the A matrix. Since the monetary policy shock has been identified as the disturbance to the interest rate equation, the response of the variables in the system to an interest rate shock is interpreted as the structural response of those variables to an unanticipated change in monetary policy.

The structural model has a VAR representation:

$$\begin{pmatrix} P_{1t} \\ i_t \\ P_{2t} \end{pmatrix} = A^{-1}C(L)\begin{pmatrix} P_{1t-1} \\ i_{t-1} \\ P_{2t-1} \end{pmatrix} + \begin{pmatrix} u_t^{P_1} \\ u_t^{i} \\ u_t^{P_2} \end{pmatrix} \tag{3}$$

with $E\left(u_t u_t'\right) = \Sigma$

the identification of the structural parameters has solved imposing linear restriction[3] on the elements of A and B taking into account the following relation between VAR innovations and structural disturbances:

[3] More technically (see Giannini,1997) the restrictions imposed take the following form: $vec(A \mid B) = \begin{bmatrix} S_A & [0] \\ [0] & S_B \end{bmatrix}\begin{bmatrix} \gamma_A \\ \gamma_B \end{bmatrix} + \begin{bmatrix} S_A \\ S_B \end{bmatrix}$

$$A\begin{pmatrix} u_t^{P_1} \\ u_t^{i} \\ u_t^{P_2} \end{pmatrix} = B\begin{pmatrix} \varepsilon_t^{P_1} \\ \varepsilon_t^{i} \\ \varepsilon_t^{P_2} \end{pmatrix} \tag{4}$$

Starting from the $\frac{n(n+1)}{2}$ free elements of $\hat{\Sigma}$, where n refers to the number of dependent variables, the lack of identification emerges from the estimation of $n^2 + n^2$ parameters contained in A and B. The S-VAR approach solves the identification problem starting from a theoretical model that drives the researcher in imposing a particular set of restrictions. The reference model constructed to outline the contemporaneous relations is a small open macroeconomic model based on the following equations:

$$y_t = \alpha_1(i_{t-1} - E_{t-1}\pi_t) + \alpha_2 q_{t-1} + \sum_{n=1} \mu_n(y_{t-n}) + u_t^y \tag{5}$$

$$\pi_t = \beta_1 y_t + \beta_2 q_{t-1} + \beta_3 Pcom_t + E_{t-1}\pi_t + u_t^{\pi} \tag{6}$$

where:

$$E_{t-1}\pi_t = \lambda_1\pi_{t-1} + \lambda_2\pi_{t-2} + ... + \lambda_k\pi_{t-k} \tag{7}$$

thus the equation (6) can be written as:

$$\pi_t = \beta_1 y_t + \beta_2 q_{t-1} + \beta_3 Pcom_t + \sum_{n=1} \lambda_n \pi_{t-n} + u_t^{\pi} \tag{8}$$

$$i_t = \gamma_1 y_t + \gamma_2 \pi_t + \sum_{n=1} \theta_n i_{t-n} + u_t^i \tag{9}$$

$$e_t = E_t e_{t+1} - i_t + i_t^f + u_t^e \tag{10}$$

$$q_t \equiv e_t + p_t^f - p_t \tag{11}$$

$$q_t = E_{t-1}(q_t) + E_{t-1}\left(\pi_t^f - E_{t-1}(\pi_t) + i_t^f - i_t + u_t^q\right) \tag{12}$$

The monetary authorities' information set consistent with this model is then:

$$\Omega_t = \left\{ \begin{array}{c} y_t; y_{t-1}; \ldots; y_{t-k} \\ Pcom_t; Pcom_{t-1}; \ldots; Pcom_{t-k} \\ \pi_t; \pi_{t-1}; \ldots; \pi_{t-k} \\ i_{t-1}; i_{t-2}; \ldots; i_{t-k} \\ q_{t-1}; q_{t-2}; \ldots; q_{t-k} \end{array} \right\} \quad (13)$$

where y_t is the real industrial production; π_t is the percentage of the annual CPI inflation rate, i.e. $100(\log(cpi_t) - \log(cpi_{t-4}))$; $Pcom_t$ is the annual change of the commodity price index in percentage point, i.e. $100(\log(Pcom_t) - \log(Pcom_{t-4}))$; i_t is a nominal short term interest rate ; e_t is the logarithm of the nominal exchange rate of each country against US Dollar; q_t identifies the real exchange rate. The superscript f refers to foreign country variables while E_t denotes the expectation conditional on the information available at time t. Moreover, in each country the specific lag structure of the system is selected through Akaike, Hann-Quinn and Shwartz information criteria and Goodfriend "portamentau" test[4].

Equation (5) identifies the aggregate demand equation. This equation underlines the interest rate does not influence the aggregate demand within the quarter. Equation (6) represents the aggregate supply equation: the inclusion of the commodity price index is due to their specific features. In fact, as they are determined in auction market they react much faster to news about future inflation than industrial or consumer price. For this reason, they have been included in the system to control for the expected future inflation. Moreover, the empirical evidence suggests that conducting VAR analysis without using commodity price as leading indicator of inflation leads to the so-called Price Puzzle: a contractionary monetary policy shock results in an increase in the price level. Equation(7) shows the autoregressive expectation mechanism formation: in this sense the model is backward looking. Equation (9) identifies the monetary policy reaction function. The monetary policy authorities are supposed to react to the current real output, current inflation and to some lagged values, chosen following econometric criteria, of the interest rate itself. Equation (10) and (11) are respectively an uncovered interest rate parity and a real exchange rate equation. Equation (12) relates real exchange rate and real interest rates.

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[4] The statistics of the maximum lag analysis, normality and cointegration are not reported for saving space. They are available on request.

Those statistics like the estimations and simulations are performed by using RATS.The cointegration analysis is implemented by using MALCOLM, a routine written for RATS.

The timing of the model can be summarized as follows: a shock to the monetary policy instruments i_t in period t immediately affects the real exchange rate, the output and inflation being predetermined; in period t + 1 the aggregate supply change resulting from the monetary shock leads to a decrease in output through both real exchange rate and real interest rate channel.

In the light of the above model the relation (4) can be written as:

$$A \begin{pmatrix} u_t^y \\ u_t^{Pcom} \\ u_t^{\pi} \\ u_t^i \\ u_t^q \end{pmatrix} = B \begin{pmatrix} \varepsilon_t^y \\ \varepsilon_t^{Pcom} \\ \varepsilon_t^{\pi} \\ \varepsilon_t^i \\ \varepsilon_t^q \end{pmatrix} \qquad (14)$$

This relation stresses that a simultaneous feedback is allowed from monetary variables to macroeconomic variables but not the viceversa. This identification problem is then faced restricting A to be lower triangular and B diagonal. This solution, imposes a recursive structure to the economy resulting in a particular causal ordering on the variables of the system. In that sense, the class of identifying restrictions considered assume the unanticipated change in monetary policy be measured by some orthogonalized component of the monetary instrument innovations. Those components, reflecting different assumptions about the variables whose contemporaneous value appear in the information set for setting the interest rate, are selected following the assumption of the outlined model. The validity of the selected causal order has been confirmed by applying a standard Granger-causality test to the variable.

4.2 Identifying the Cointegration Space

The likely misinterpretation of the long-run relationship among the nonstationary variables, resulted from forcing those variables to be stationary by differencing them, is faced by taking the cointegration properties of the integrated variables into account.

First of all, the univariate unit root analysis, implemented by means of the Augmented Dickey-Fuller and Phillips-Perron integration test, suggest all the series are I(1). Then, rewriting the VAR(p) model described above as:

$$\vec{y}_t = \vec{a}_0 + A_1 \vec{y}_{t-1} + \dots + A_p \vec{y}_{t-p} \tag{15}$$

if there is cointegration among the variables the matrix of total multiplier,

$$A(1) = I - A_1 - A_2 - \dots - A_p \tag{16}$$

has rank r(r standing for the number of cointegrating relations founded in the system). In this case is useful reparametrize A(1) as a product of two nxr matrix:

$$A(1) = HC' \tag{17}$$

where H is called loading matrix and C' cointegrated matrix. The S-VAR model has a convenient S-VEC (Structural Vector Error-Correction) representation:

$$A\Delta\vec{y}_t = A\vec{a}_0 + AHC'\vec{y}_{t-1} + AF_1\Delta\vec{y}_{t-1} + \dots + AF_{p-1}\Delta\vec{y}_{t-p+1} + B\varepsilon_t \tag{18}$$

where

$$F_i = -(A_{i+1} + \dots + A_p); \quad i = 1, \dots, p-1 \tag{19}$$

Following Giannini et al.(1995), the identification of the cointegration space is achieved imposing suitable restrictions on the C' matrix. In particular r normalizing restrictions (one for each row) and $r^2 - r$ restrictions ($r - 1$ for each row) assure the exact identification of C'. No restrictions on the loading matrix have been imposed. Notice that in each estimated model there is no trend component, as it is theoretically inconsistent with the presence of the interest rate in the analysis; on the contrary, the models allow for a linear trend in the I (1) component by leaving the constant unrestricted.

Moreover, in all systems one of the cointegrating relationships is assumed to be the monetary policy reaction function. Following Johansen(1995) and Amisano-Giannini(1997), in all the models, the homogeneous linear restrictions imposed on the monetary rule vector have the following form:

$$C = [G_1 b_1, \dots, G_r b_r] \tag{20}$$

where $b_i (i = 1, \dots, r)$ are unknown coefficients to be estimated, and $G_i (i = 1, \dots, r)$ are the matrices which describe the restrictions. In particular, the monetary policy rule, supposed to be a function of the current real output and inflation, is restricted as follow:

$$G = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & 0 & 0 \end{bmatrix} \qquad (21)$$

Another restriction imposed in all the models is the long-run neutrality of interest rate shocks on output. In other word, in line with a large number of theoretical models, the monetary policy shocks are constrained not to have a long-run effect on output.

The estimation of the structural models, whose main features are shown in Table(2) have been performed by using the FILM technique[5].The normality and whiteness of the residuals are checked through the Jarque-Bera normality test.The cointegrating vector and the estimated coefficients are reported with the associated standard errors in Table (1). Figure (5) represents the graphic counterpart of the estimated reaction functions. The short-term interest rates used in the empirical analysis are shown as the solid lines. The dashed lines represent the estimated monetary policy reaction functions obtained from the cointegrated vector. In all the models, the interest rate response coefficient on the inflation rate are above the stability threshold of one. This evidence, stressed by Taylor(1998)[6], is a crucial feature for having a dynamically stable monetary policy. In this sense, the empirical evidence suggests that the European Central Bank can achieve a good performance by using the interest rate as its policy instruments.

Insert Figure 5 and Table 2

[5] See Johansen(1990) and Giannini(1997) for the Maximum Likelihood algorithm used in the analysis.

[6] In his paper, Taylor gives also a theoretical basis for this result. Essentially, he argues that having a response coefficient lower than one, resulted in a positively sloped aggregate demand curve, cause the output to decrease in response to an inflation shock, which is destabilizing.

5 Simulation Analysis

Having solved the identi…cation of both contemporaneous and long-run relationships among the variables, it is then possible to apply the Impulse Response Analysis. The natural object of this analysis is to measure the time pro…le of the incremental e¤ect of variables' innovation on the future state of the economy. In other words, once the monetary rule has been estimated, the S-VAR approach focus on the response of the macroeconomic variables to a deviation from the rule.

The estimated responses to a 1%, i.e. contractionary, monetary policy shock are reported in …gure(6 to 9). Each response is provided with the associated asymptotic con…dence bounds. The pattern of the responses are similar in all the countries. The contractionary monetary policy shock seems to lead to the following response in the variables:

1. Real Output: in all the countries, a positive monetary policy shock result in an output decrease. Moreover, after an initial delay it shows a hump-shaped response function who reaches the maximum decline after roughly a year to a year and half. The timing and size di¤erences across the European countries depicted in …gure(6 to 9)are summarized in …gure (10), where the average responses of output are shown, and …gure (13), in which the maximum impact of the monetary policy shock on the output is outlined. Both …gures seem to stress the larger response of the broader countries(France, Finland, Germany, Italy, Portugal), an exception being the small response of the output in Spain. Small countries, like Austria, Belgium, Ireland, Netherlands, experiment a lower response.

2. In‡ation Rate: common to all the countries, the in‡ation slightly falls after a monetary shock. The inclusion of the commodity price in the analysis, as leading indicator of the expected future in‡ation, succeeds in not generating a Price Puzzle. In other words, it is not the case where the policy shock associated with a rise in the in‡ation is actually confounded with non-policy innovations that signal future increase in in‡ation. The asymmetries across the countries are displayed in …gure(6 to 9). In almost all the countries the in‡ation response is initially very low: this result is consistent with the presence of nominal rigidities. The average response and the maximum impact of a contractionary monetary policy shock are shown in …gure (11) and (14)

respectively. The evidence emerging from those …gures suggests the non-existence of a clear relationship between country size and response to monetary shock. The strongest responses happen in Ireland and Portugal. With the important exception of Spain, whose reaction is very small, in general the high-growth countries' response are the largest.

3. Exchange Rate: a contractionary shock to a monetary policy leads, in all the countries, to a persistent appreciation in the real exchange rate. This evidence is supported by a number of studies including exchange rate in the VAR system: despite the di¤erences in the class of identifying assumption they have used, Eichembaum-Evans(1995), Grilli-Roubini(1995), Clarida-Gertler(1997) and Cushman-Zha(1997) found the exchange rate persistently appreciates in response to a monetary policy contractionary shock.

   The main divergences in the time pattern of estimated responses are shown in …gures(6 to 9). Evidence from the diverging behavior of the EMU countries is emphasized in …gure (12) and (15). The average responses suggest a similar behavior of Germany and France. In general, the responses are quite small for all the countries and do not lead to an unambiguous relation among the countries' responses.

Insert Figure 6 to 15

6 Concluding Remarks

Both descriptive and econometric analysis suggest the presence of structural and cyclical divergences across EMU members. Those asymmetries, concerning the interest rate and exchange rate channel, will probably not be so large to determinate frictions for the EMU. From the empirical analysis applied in the paper emerge that while the e¤ect of a monetary shock on output depends mostly from the size of the countries, there is a positive relationship between GDP growth and in‡ation response to a contractionary monetary policy. Moreover, the evidence concerning the exchange rate response to a monetary shock seems to suggest that the actual weakness of the EURO, especially against the US dollar, is probably related to the strength of the US economy rather than to an incompatible system linking the European countries.

Other channels, not considered here, could be a cause for concern. In fact, although the di¤erences in the …nancial systems are decreasing, some divergences remain. Moreover, the consistent concentrations in the bank system of all the countries, together with the recent mergers of some national stock exchanges, will, most probably, change the way the credit and stock market channels work. All those reasons increase the di¢culties in recognizing the new European system challenger. However, the constraints imposed by the take-o¤ of the common monetary policy press for a higher ‡exibility of alternative device, such as …scal and labor policy, capable of counterbalancing the loss of independence in pursuing national goals. The coordinated monetary policy will be successful if, on the one hand, the member countries' …nancial systems become more homogeneous, and, on the other hand, the national policy authorities improve the ‡exibility of other policy instruments in order to compensate the lack of monetary independence resulting from the EMU.

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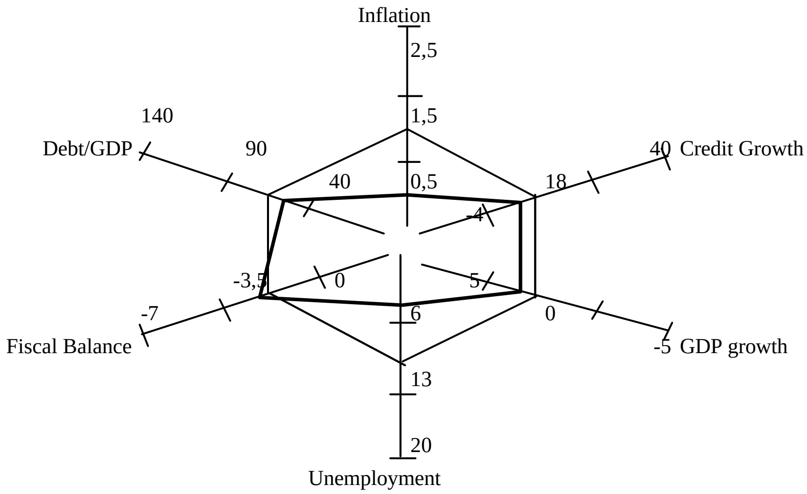
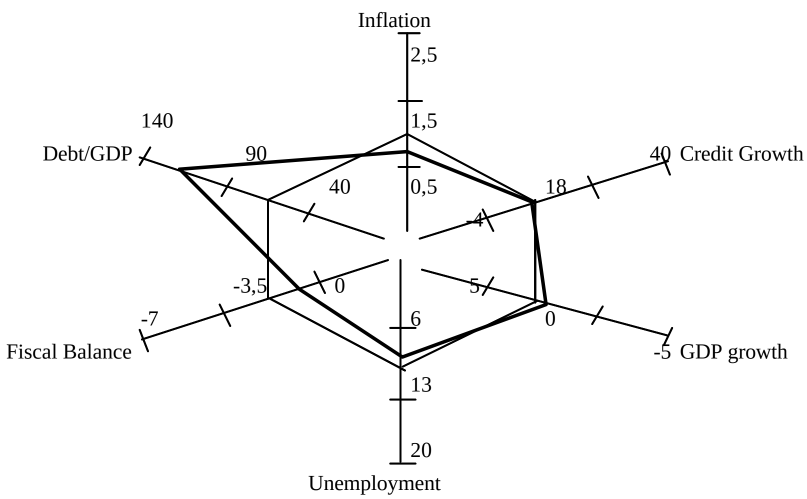
Figure 1: Convergence Barometer for Euro-Area Countries

Austria



Belgium



Finland

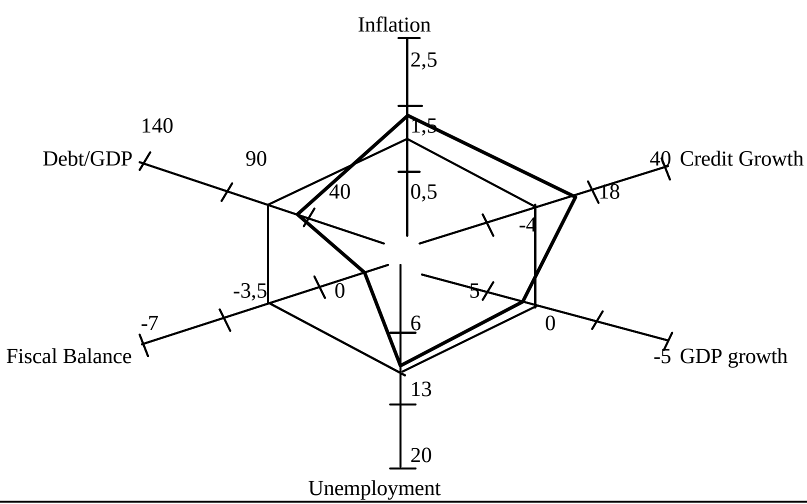


Figure 2: Convergence Barometer for Euro-Area Countries

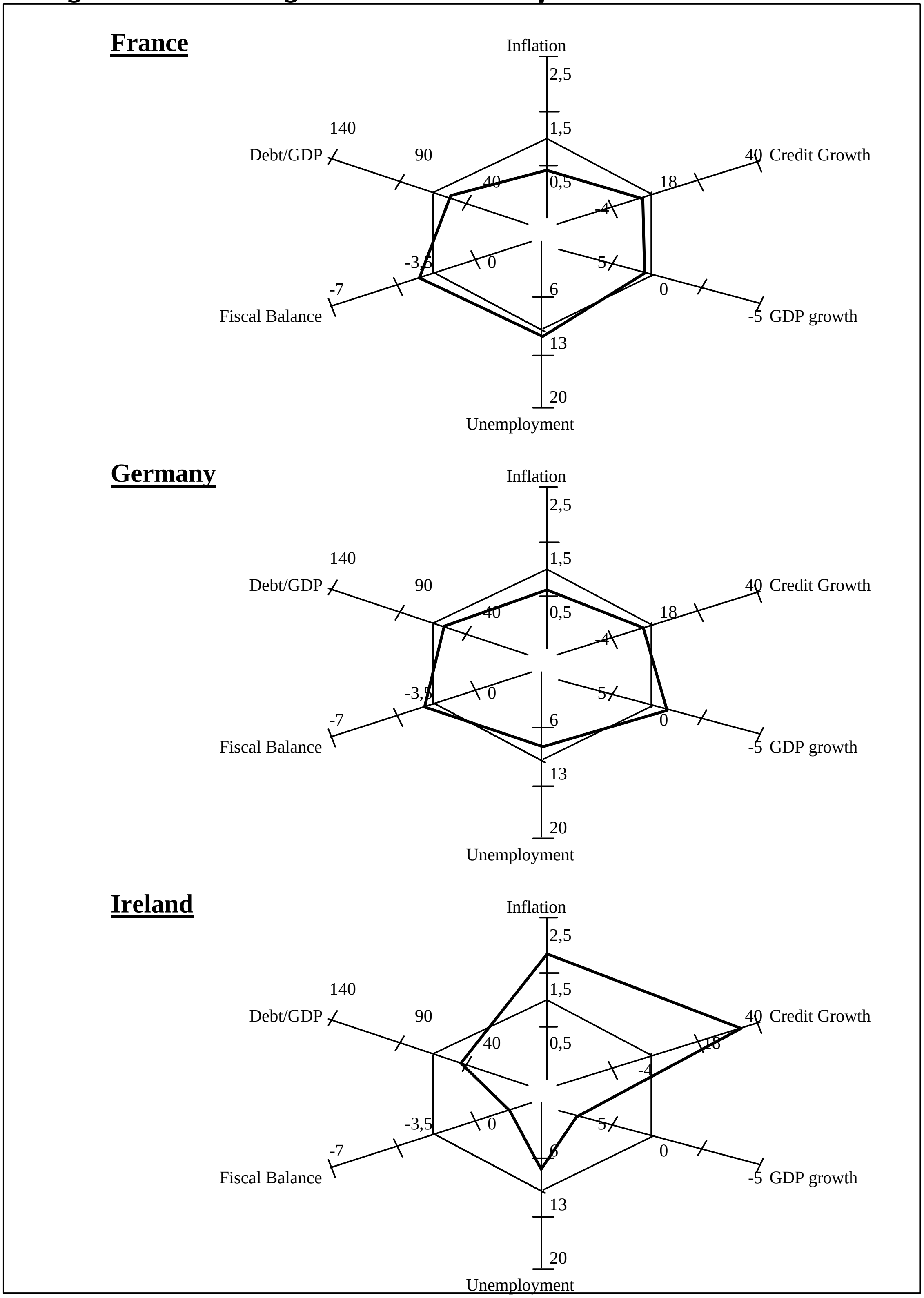


Figure 3: Convergence Barometer for Euro-Area Countries

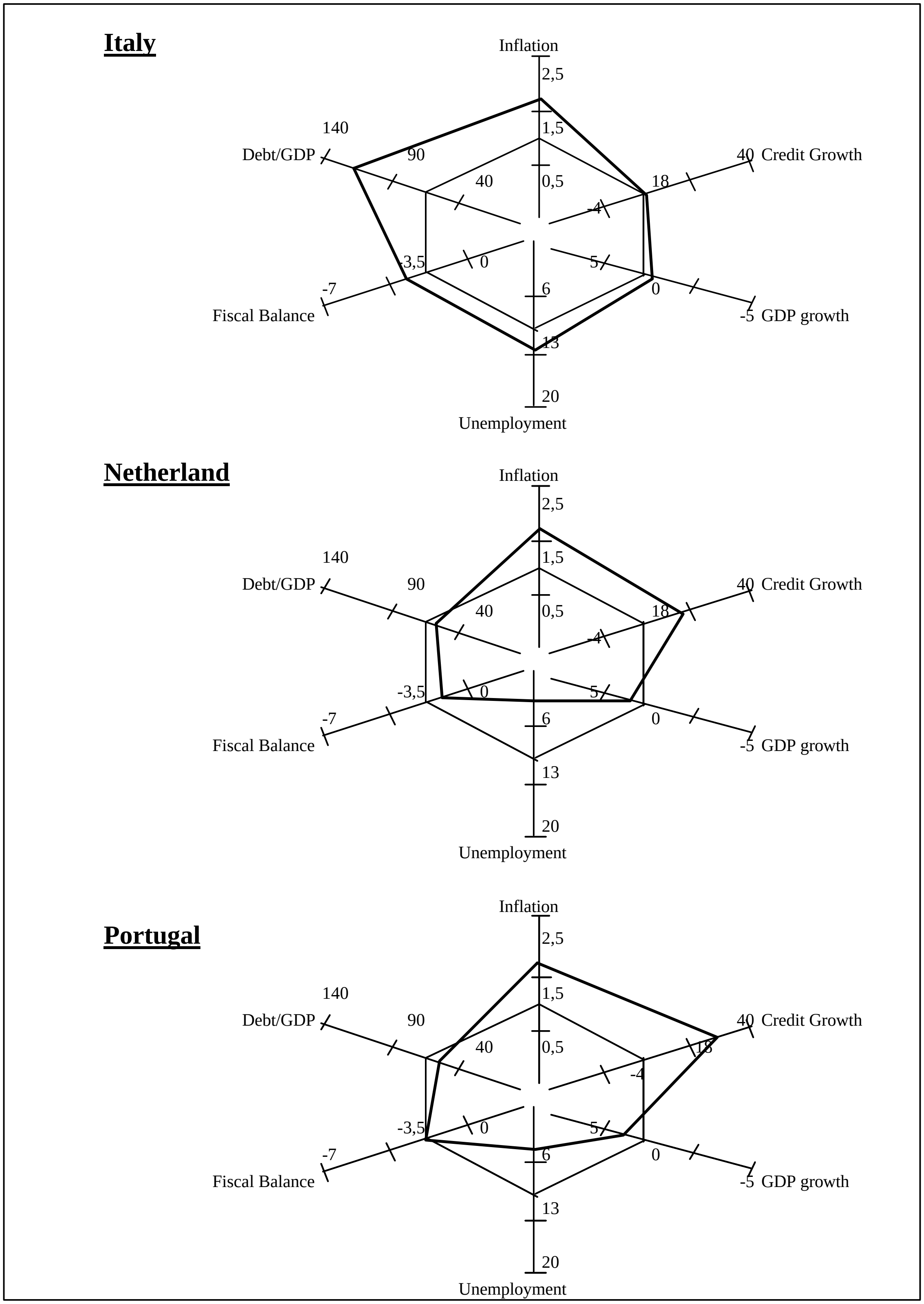


Figure 4: Convergence Barometer for Euro-Area Countries

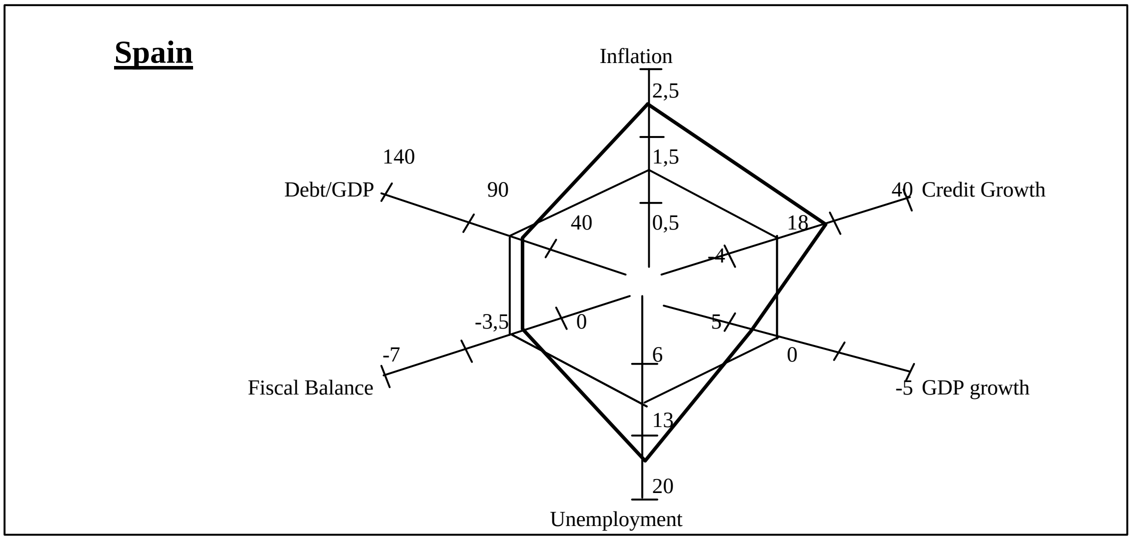
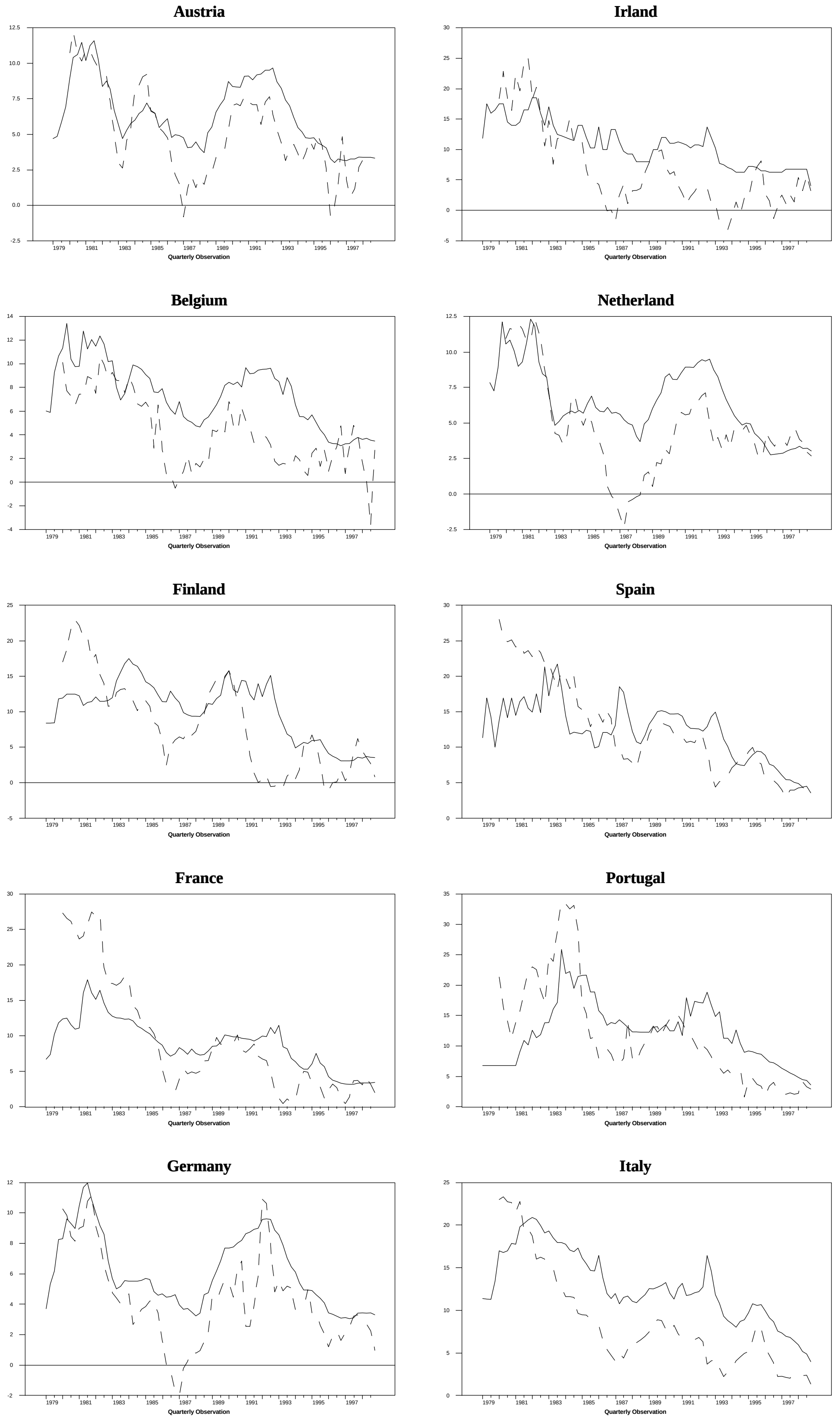


Figure 5: Estimated vs. Actual Interest Rates



Note: the short-term interest rates used in the empirical analysis are shown as the solid lines. The dashed lines represent the estimated monetary policy reaction function obtained from the cointegrated vector.

Figure 6: Response to a Contractionary Monetary Policy Shock

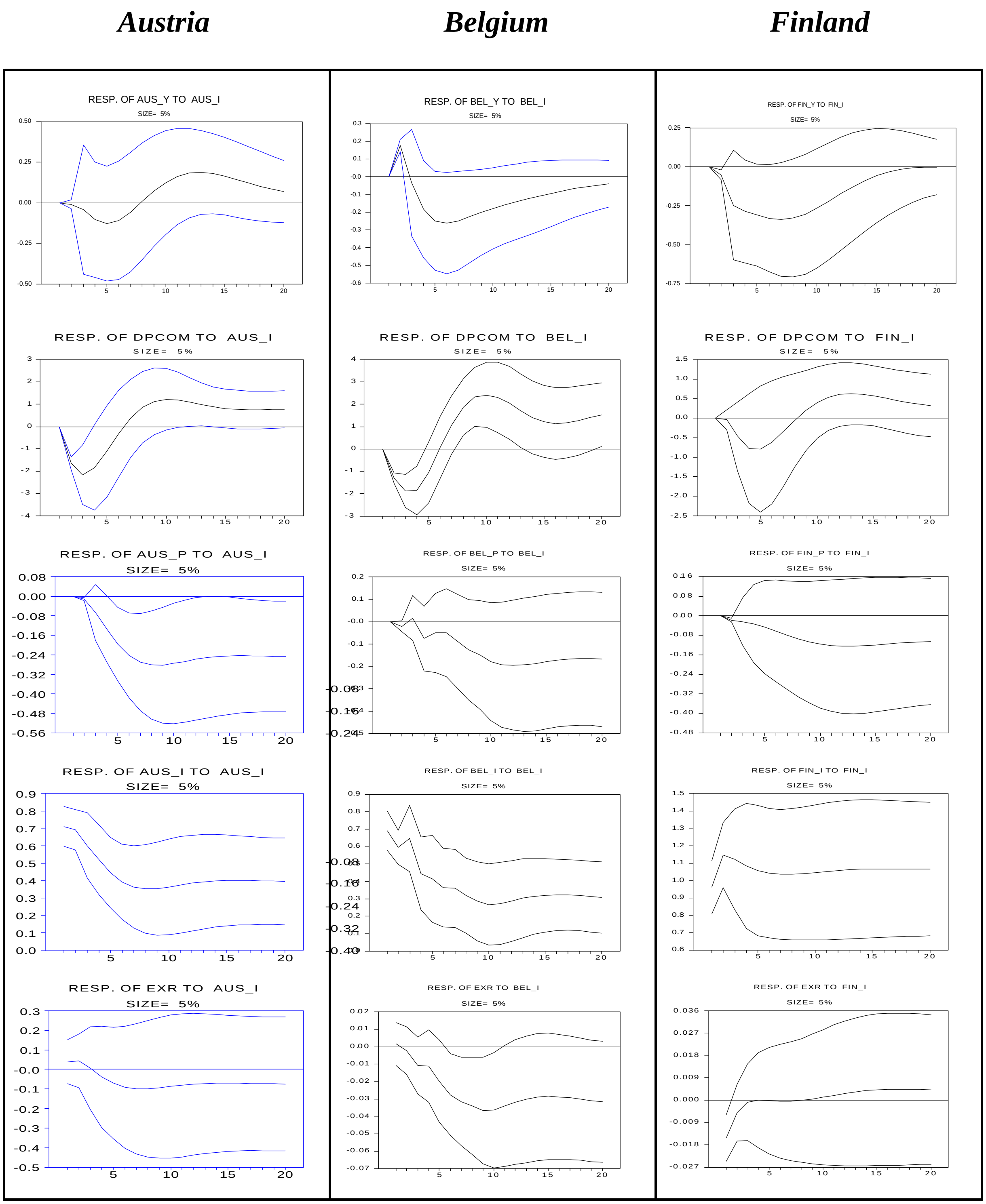


Figure 7: Response to a Contractionary Monetary Policy Shock

France ***Germany*** ***Ireland***

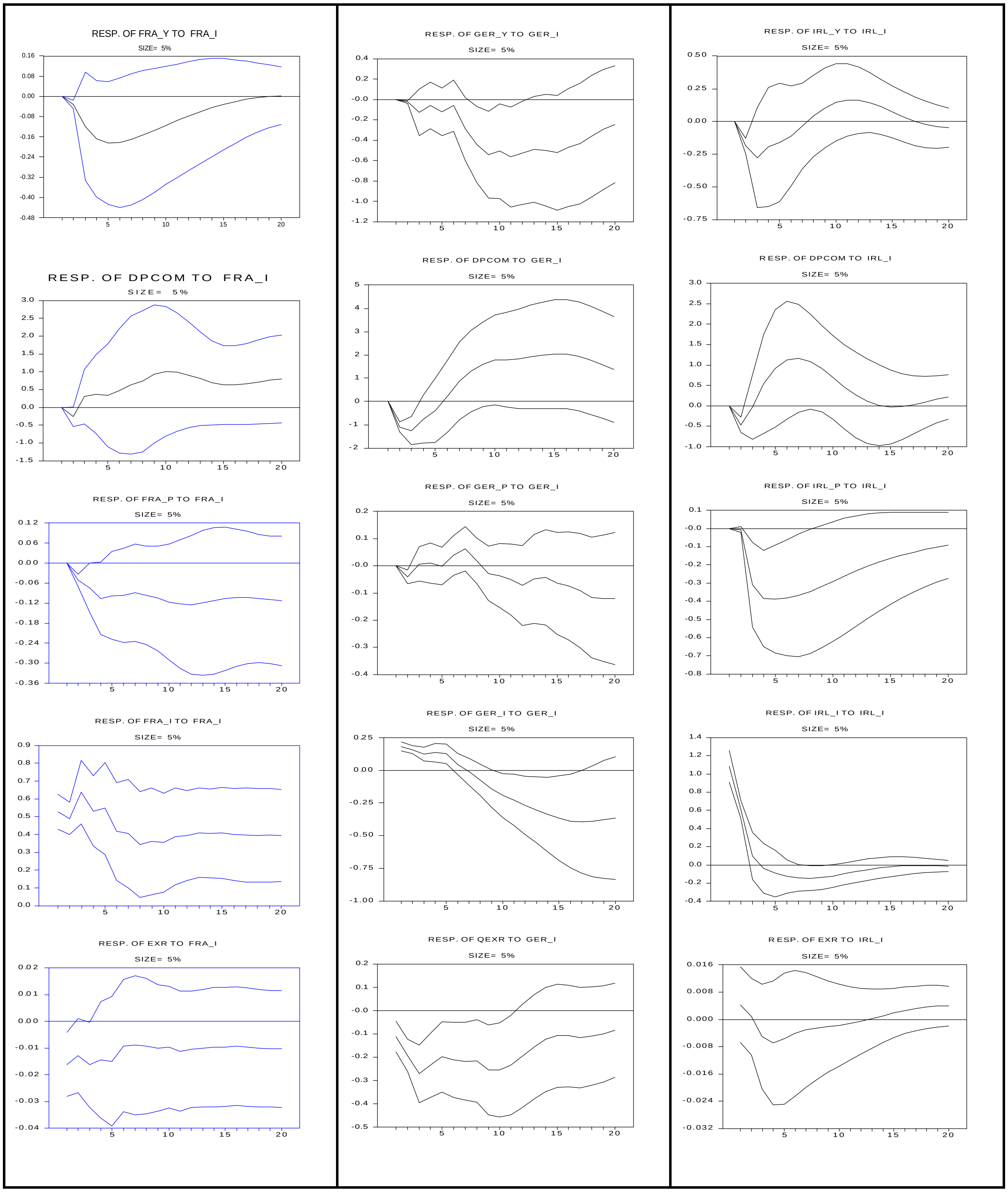


Figure 8: Response to a Contractionary Monetary Policy Shock

Italy ***Netherlands*** ***Portugal***

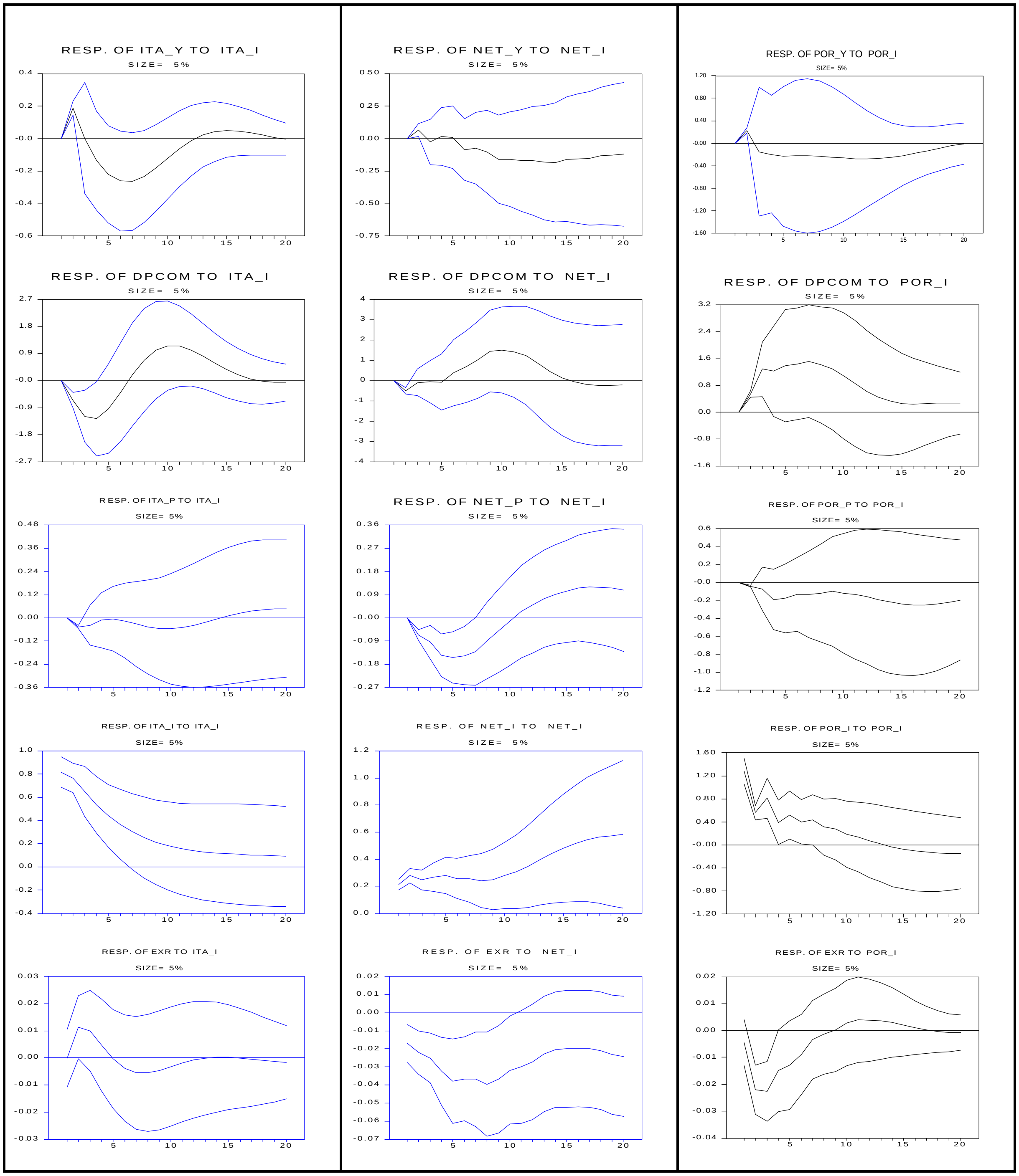


Figure 9: Response to a Contractionary Monetary Policy Shock

Spain

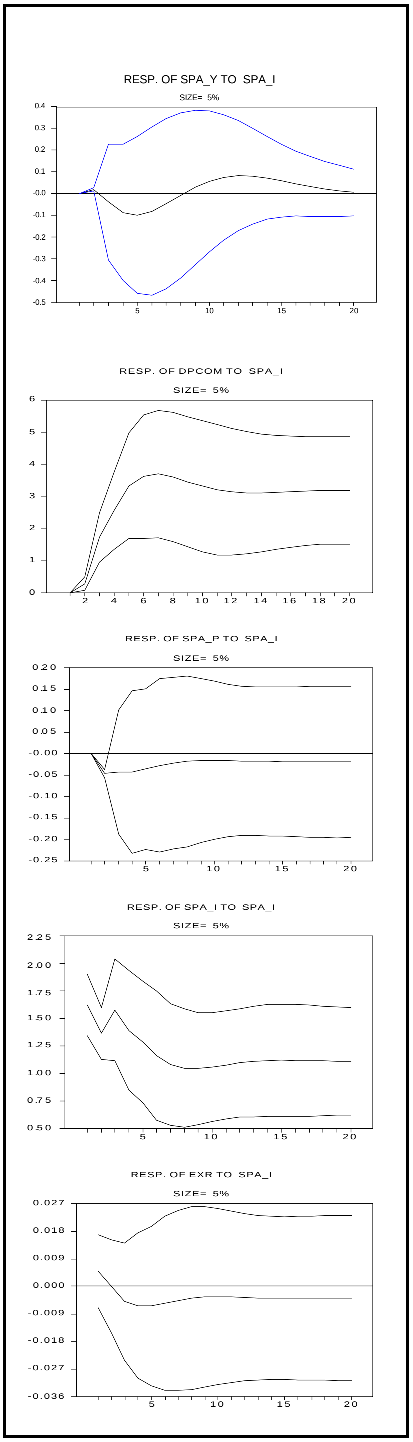


Fig.10 Average Response of Output

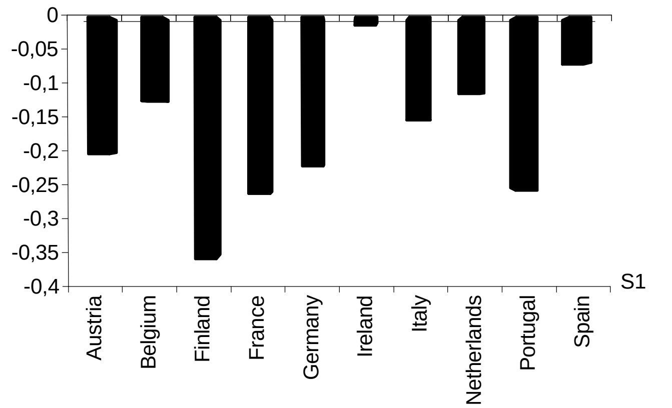


Fig.11 Average Response of Inflation

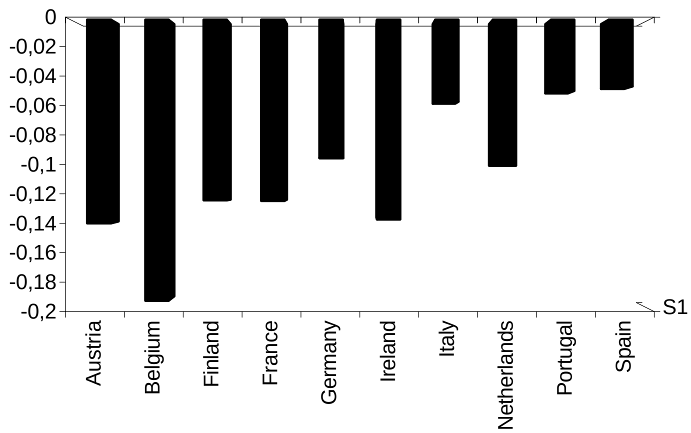


Fig.12 Average Response of Exchange Rate

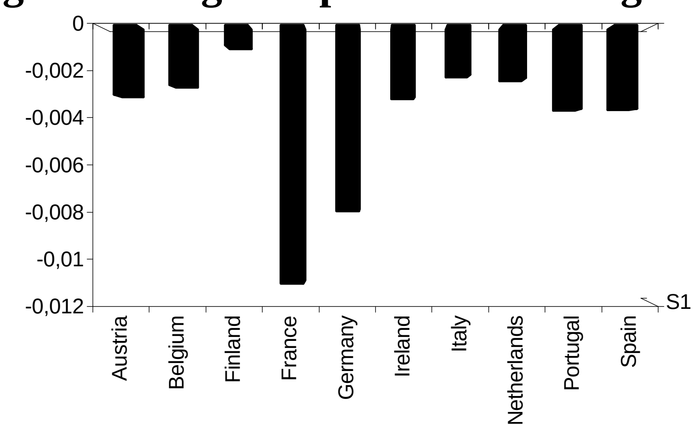


Fig.13 Maximum Impact on Output

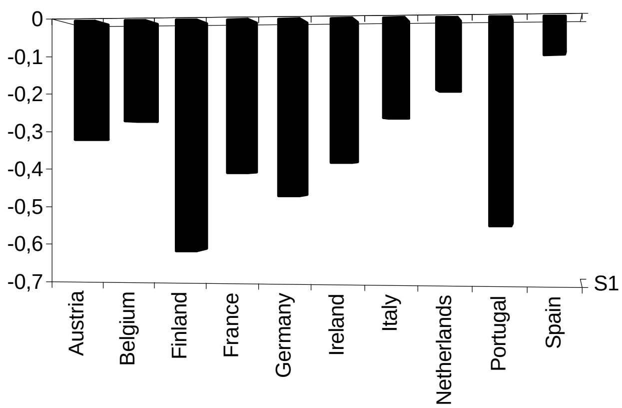


Fig.14 Maximum Response of Inflation

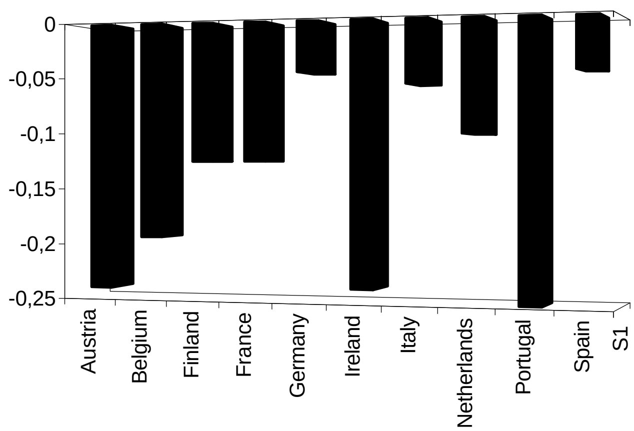


Fig.15 Maximum Response of Exchange Rate

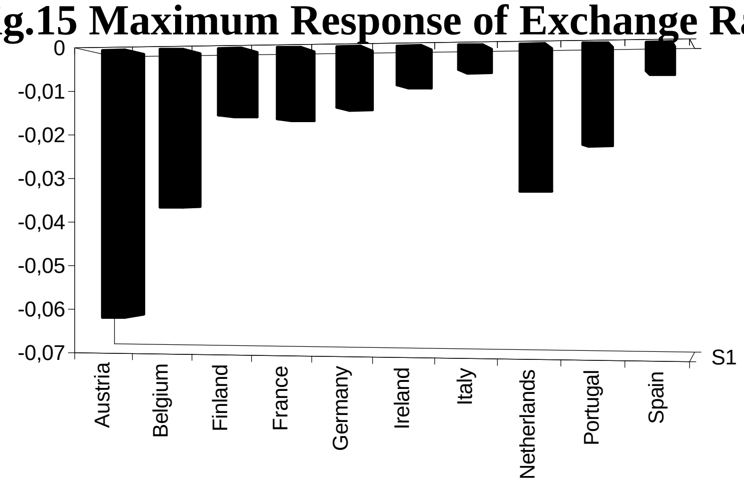


Table 1:Estimated Monetary Rules

Country	Estimated Reaction Functions
Austria	$Aus\_i = \underset{(0.16)}{1.574} \bullet Aus\_p + \underset{(0.09)}{0.592} \bullet Aus\_y$
Belgium	$Bel\_i = \underset{(0.15)}{1.177} \bullet Bel\_p + \underset{(0.07)}{0.413} \bullet Bel\_y$
Finland	$Fin\_i = \underset{(0.18)}{1.683} \bullet Fin\_p + \underset{(0.19)}{0.764} \bullet Fin\_y$
France	$Fra\_i = \underset{(0.26)}{1.988} \bullet Fra\_p + \underset{(0.18)}{0.981} \bullet Fra\_y$
Germany	$Ger\_i = \underset{(0.13)}{1.601} \bullet Ger\_p + \underset{(0.07)}{0.388} \bullet Ger\_y$
Ireland	$Irl\_i = \underset{(0.17)}{1.202} \bullet Irl\_p + \underset{(0.13)}{0.782} \bullet Irl\_y$
Italy	$Ita\_i = \underset{(0.14)}{1.121} \bullet Ita\_p + \underset{(0.08)}{0.421} \bullet Ita\_y$
Netherlands	$Net\_i = \underset{(0.16)}{1.751} \bullet Net\_p + \underset{(0.12)}{0.321} \bullet Net\_y$
Portugal	$Por\_i = \underset{(0.09)}{1.041} \bullet Por\_p + \underset{(0.13)}{0.221} \bullet Por\_y$
Spain	$Spa\_i = \underset{(0.24)}{1.751} \bullet Spa\_p + \underset{(0.19)}{0.441} \bullet Spa\_y$

The estimated coefficient are provided with the associated standard error. The annex _i, _p, _y, _exr refer respectively to interest rate, inflation, real output and exchange rate. This notation is kept in the Impulse Response Analysis.

Table 2: Main Feature of the Estimated Models

Country	Sample	Lag	Cointegration Rank
Austria	1979:1-1998:4	2	1
Belgium	1979:1-1998:4	4	3
Finland	1979:1-1998:4	2	2
France	1982:1-1998:4	4	1
Germany	1979:1-1998:4	4	2
Ireland	1979:1-1998:4	2	1
Italy	1979:1-1998:4	2	1
Netherlands	1979:1-1998:4	4	1
Portugal	1981:1-1998:4	4	2
Spain	1979:1-1998:4	3	1

The maximum lag analysis has been performed through the followin statistics: *Akaike Hann-Quinn* and *Shwartz* information criteria and the "*Goodfriend Portamentau test*". The cointegration rank has been selected by applying the *Trace test*.

Table 3: Respose of Output

	Aus	Bel	Fin	Fra	Ger	Irl	Ita	Net	Por	Spa
t+1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
t+2	-0,01	0,18	-0,05	-0,03	-0,11	-0,12	0,19	0,05	0,23	0,02
t+3	-0,04	-0,03	-0,25	-0,12	-0,35	-0,08	0,00	0,06	-0,15	-0,04
t+4	-0,10	-0,18	-0,29	-0,17	-0,27	-0,20	-0,14	0,02	-0,19	-0,09
t+5	-0,13	-0,25	-0,31	-0,18	-0,37	-0,28	-0,22	-0,03	-0,23	-0,10
t+6	-0,11	-0,26	-0,33	-0,18	-0,34	-0,31	-0,26	-0,07	-0,22	-0,08
t+7	-0,06	-0,25	-0,34	-0,17	-0,19	-0,23	-0,26	-0,10	-0,22	-0,05
t+8	0,01	-0,23	-0,33	-0,15	-0,21	-0,12	-0,23	-0,12	-0,23	-0,01
t+9	0,07	-0,20	-0,31	-0,13	-0,18	-0,01	-0,18	-0,12	-0,24	0,03
t+10	0,12	-0,18	-0,27	-0,11	-0,14	0,10	-0,12	-0,12	-0,26	0,06
t+11	0,16	-0,16	-0,22	-0,10	-0,19	0,19	-0,06	-0,12	-0,27	0,07
t+12	0,18	-0,14	-0,18	-0,08	-0,21	0,24	-0,01	-0,12	-0,28	0,08
t+13	0,19	-0,13	-0,13	-0,06	-0,19	0,26	0,02	-0,11	-0,27	0,08
t+14	0,18	-0,11	-0,09	-0,04	-0,23	0,25	0,04	-0,11	-0,25	0,07
t+15	0,16	-0,09	-0,06	-0,03	-0,25	0,22	0,05	-0,10	-0,22	0,06
t+16	0,14	-0,08	-0,03	-0,02	-0,24	0,16	0,05	-0,09	-0,18	0,05
t+17	0,12	-0,07	-0,02	-0,01	-0,26	0,10	0,04	-0,09	-0,13	0,03
t+18	0,10	-0,06	-0,01	0,00	-0,26	0,04	0,02	-0,08	-0,09	0,02
t+19	0,08	-0,05	0,00	0,00	-0,24	-0,01	0,01	-0,08	-0,04	0,01
t+20	0,07	-0,04	0,00	0,00	-0,24	-0,05	0,00	-0,07	-0,01	0,01

Table 4: Response of Inflation

	Aus	Bel	Fin	Fra	Ger	Irl	Ita	Net	Por	Spa
t+1	0	0	0	0	0	0	0	0	0	0
t+2	-0,0032407	-0,0208	-0,018	-0,0511	0,0575	0,1149	-0,0475	-0,0619	-0,0404	-0,0461
t+3	-0,0476	0,017	-0,0239	-0,074	0,0381	-0,0727	-0,0372	-0,0545	-0,0708	-0,0434
t+4	-0,104	-0,0754	-0,0325	-0,1056	-0,0007102	-0,1395	-0,012	-0,0926	-0,1884	-0,0423
t+5	-0,1572	-0,0493	-0,0458	-0,0975	-0,0289	-0,1871	-0,004553	-0,0919	-0,1732	-0,0357
t+6	-0,1985	-0,049	-0,0624	-0,0965	-0,0422	-0,2181	-0,0144	-0,1009	-0,131	-0,0273
t+7	-0,225	-0,0887	-0,0798	-0,0888	-0,0454	-0,2331	-0,0314	-0,0856	-0,133	-0,0216
t+8	-0,238	-0,1246	-0,0957	-0,0961	-0,0442	-0,2379	-0,0468	-0,0603	-0,1175	-0,0175
t+9	-0,2407	-0,1494	-0,1085	-0,1053	-0,0423	-0,2357	-0,0558	-0,0451	-0,0991	-0,0157
t+10	-0,2369	-0,1784	-0,1175	-0,1168	-0,0411	-0,2297	-0,0568	-0,011	-0,1207	-0,0153
t+11	-0,2301	-0,1929	-0,1229	-0,1222	-0,0406	-0,2222	-0,0502	0,0209	-0,1324	-0,0157
t+12	-0,2229	-0,1939	-0,1249	-0,1252	-0,0406	-0,215	-0,0378	0,0544	-0,1544	-0,0165
t+13	-0,2169	-0,1923	-0,1244	-0,1195	-0,0408	-0,2091	-0,022	0,0917	-0,1896	-0,0173
t+14	-0,2127	-0,1878	-0,1222	-0,113	-0,0409	-0,2049	-0,0050742	0,1198	-0,2162	-0,018
t+15	-0,2104	-0,1784	-0,1191	-0,1068	-0,041	-0,2022	0,011	0,1457	-0,2358	-0,0185
t+16	-0,2095	-0,1705	-0,1156	-0,1037	-0,041	-0,2005	0,0247	0,1653	-0,2492	-0,0188
t+17	-0,2097	-0,1664	-0,1123	-0,1033	-0,041	-0,199	0,0353	0,1762	-0,2493	-0,0189
t+18	-0,2105	-0,1642	-0,1095	-0,1064	-0,041	-0,197	0,0426	0,1831	-0,2394	-0,0189
t+19	-0,2114	-0,1648	-0,1073	-0,1099	-0,041	-0,1938	0,0468	0,1844	-0,221	-0,0188
t+20	-0,2123	-0,168	-0,1058	-0,113	-0,041	-0,189	0,0484	0,182	-0,1955	-0,0186

Table 5: Response of Exchange Rate

	Aus	Bel	Fin	Fra	Ger	Irl	Ita	Net	Por	Spa
t+1	0,0511	0,0016	-0,0153	-0,0162	-0,0007	0,0048	-0,0001	-0,0012	-0,0046	0,0049
t+2	0,0630	-0,0022	-0,0051	-0,0129	-0,0093	0,0035	0,0113	-0,0031	-0,0219	-0,0001
t+3	0,0315	-0,0109	-0,0008	-0,0163	-0,0139	0,0006	0,0100	-0,0084	-0,0226	-0,0049
t+4	-0,0061	-0,0112	-0,0001	-0,0145	-0,0132	-0,0011	0,0048	-0,0187	-0,0150	-0,0063
t+5	-0,0353	-0,0196	-0,0002	-0,0149	-0,0108	-0,0018	-0,0004	-0,0238	-0,0128	-0,0064
t+6	-0,0534	-0,0276	-0,0004	-0,0091	-0,0087	-0,0028	-0,0039	-0,0265	-0,0089	-0,0055
t+7	-0,0615	-0,0315	-0,0005	-0,0090	-0,0076	-0,0041	-0,0055	-0,0301	-0,0035	-0,0046
t+8	-0,0623	-0,0340	-0,0001	-0,0093	-0,0071	-0,0056	-0,0056	-0,0330	-0,0013	-0,0039
t+9	-0,0587	-0,0366	0,0004	-0,0100	-0,0071	-0,0071	-0,0046	-0,0316	0,0002	-0,0035
t+10	-0,0533	-0,0365	0,0012	-0,0096	-0,0072	-0,0083	-0,0032	-0,0296	0,0029	-0,0034
t+11	-0,0479	-0,0341	0,0020	-0,0112	-0,0073	-0,0089	-0,0019	-0,0292	0,0040	-0,0034
t+12	-0,0435	-0,0319	0,0027	-0,0106	-0,0074	-0,0089	-0,0007	-0,0274	0,0038	-0,0036
t+13	-0,0405	-0,0303	0,0034	-0,0100	-0,0074	-0,0082	0,0000	-0,0254	0,0036	-0,0037
t+14	-0,0390	-0,0289	0,0038	-0,0097	-0,0074	-0,0070	0,0002	-0,0245	0,0031	-0,0038
t+15	-0,0385	-0,0285	0,0042	-0,0096	-0,0074	-0,0054	0,0002	-0,0237	0,0020	-0,0039
t+16	-0,0388	-0,0288	0,0044	-0,0093	-0,0074	-0,0036	-0,0001	-0,0231	0,0011	-0,0039
t+17	-0,0395	-0,0293	0,0044	-0,0097	-0,0074	-0,0018	-0,0006	-0,0228	0,0003	-0,0039
t+18	-0,0402	-0,0301	0,0044	-0,0100	-0,0074	0,0000	-0,0010	-0,0230	-0,0003	-0,0038
t+19	-0,0408	-0,0310	0,0043	-0,0102	-0,0074	0,0015	-0,0014	-0,0233	-0,0007	-0,0038
t+20	-0,0413	-0,0316	0,0042	-0,0103	-0,0074	0,0026	-0,0016	-0,0238	-0,0008	-0,0038