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Real Exchange Rates and Monetary Policy Effectiveness in EMU.

by

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DISCUSSION
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Real Exchange Rates and Monetary Policy E¤ectiveness in EMU

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Abstract

This paper extends the framework provided by De Grauwe, Dewachter and Aksoy (1998). Monetary policy e¤ectiveness of the European Central Bank (ECB) in the open economy Euroland is addressed. The optimal feedback rules for the member states with the use of the backward looking variables are derived. The role of the real exchange rate is discussed. For alternative voting mechanisms in the ECB Governing Council we simulate the monetary policy e¤ectiveness and provide some welfare analysis.

Keywords: ECB, voting rules, optimal monetary policy rules, open economy.

JEL Classi…cation: E52

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1 Introduction

The European Central Bank (ECB) started to act as of 1.1.1999. This institutional change will have substantial implications on the international money environment.

First of all, the introduction of the Euro altered the monetary policy of all the participating countries in the EMU project. Countries cannot conduct independent monetary policies, but have to rely on the decisions of the ECB Governing Council. Secondly, monetary policy is not immune from the price and output (employment) developments in the rest of the world. In this sense, foreign exchange rates play a role in the identification of the level of uncertainties in the international economic relations. Therefore, this new economic environment brings about strong challenges about the real value of the Euro, which will likely reveal the heterogenous structure of the member countries. The aim of the paper is to focus on the monetary policy of the Euroland in the open economy environment and to address some potential conflicts at the ECB Governing Council.

The Maastricht Treaty provides a framework that underlies the priorities of the ECB. The Treaty sets price stability as the primary objective of the ECB. The bulk of the economic literature agrees that ECB can work efficiently, if and only if countries constituting the EMU are more or less symmetric, i.e. share identical or very similar economic structures, monetary transmission mechanisms and national policy preferences. Recent research on the European integration process has documented that economies of EMU member states differ structurally.

Eleven countries that are constituting the EMU face at least three types of asymmetries. First of all, 11 countries in the EMU differ in the structure of their economies. Thus, the economic shocks, say inflation or output, are not perfectly correlated across countries. Secondly, evidence during the transition period into EMU suggest that target variables have responded to a change in the monetary policy (i.e. short term interest rates) in each of the member state in a different way. That is to say, the propagation of the monetary policy induced shocks (interest rates) were not synchronized across countries. Accordingly, optimal national monetary feedback rules should be different across countries. Thirdly, policymakers preferences in the conduct of the monetary policy seemed to be different.[1]

These asymmetries will be carried over to Euroland level. Obvious platform of potential tensions is the ECB Governing Council, the chief executive body of European monetary policymaking. The ECB Governing Council (GC) will consists of eleven national representatives and six members of the ECB Board, which will vote upon the suitable monetary policy for the Euroland as a whole. If at least in the initial phase of the EMU the current structure of asymmetries will continue to hold, the ECB may fail to satisfy all of its 'shareholders' interests and may face obstacles in the conduct of the monetary policy.

Surprisingly, the current stream of analysis focused on the likely impact of the switch from national currencies to the euro was mainly neglecting the fact that Europe as a whole is a large open economy. So far little analysis explore the role of international

[1] This hardly verifiable feature of national monetary policy is mainly a matter of ideology and political ambitions. In economic research it is usually taken as an exogenous parameter.

spillovers of a particular monetary policy rule the ECB will use upon starting to act. [2] If the underlying asymmetric dynamics that determine the current economic states lead to divergent price and output developments in the Euroland regions, at least one reliable measure of external competitiveness, from now onwards "post-Euro real exchange rates", may further complicate the conduct the monetary policy at the GC.

The paper is organized as follows: Section 2 discusses some evidence in line with Taylor rules and sketches the model for optimal feedback rules. Section 3 contains empirical analysis. Section 4 contains the models for alternative voting schemes we consider. Section 5 presents results for the simulation exercise for the Euroland and provide welfare discussion. Finally, section 6 concludes.

2 An Open Economy Model

The Creation of Euroland motivated extensive research. The focus was the source and the size of the asymmetries inherent within this heterogeneous institution. The literature documents at least four types of asymmetries. First of all, economies constitute the Euroland di¤er in terms of the set-up of their economic institutions and the specialization and location of their production activity. In other words, di¤erences in the production, …nancial and labor markets a¤ect crucially their relative position of their economic states. Among others, studies by Bayoumi and Prasad (1995) point to the strong country speci…c component in the variability of industrial activities.[3] Secondly, and related to the former argument, output shocks are not necessarily synchronized across the Euroland countries inducing further diversi…cation of output and in‡ation developments. Thirdly, econometric evidence stresses the asymmetric nature of the monetary transmission mechanism. Among others, Clarida, Gali and Gertler (1997), Dornbusch, Favero and Giavazzi (1998), Ramaswamy and Sloek (1998), Peersman and Smets (1998), Giovannetti and Marimon (1998), Kieler and Saarenheimo (1998) and De Grauwe et al. (1998) reported asymmetries in the size and timing of monetary transmission across European countries.[4]

According to an in‡uential paper by Taylor (1993), Central Bank's policy reactions can be deduced from a simple policy rule. His argument relies on the US Fed evidence under Greenspan chairmanship, where he derives a rough rule of thumb for the US monetary policy. Although Taylor rules are criticized substantially or updated according to new evidence, simple policy rules are by now subject to extensive research. The main motivation of the interest in such rules are their easy interpretation. If de…ned correctly any central banks policy action can be traced easily from such rules. Naturally, one expects that Central Banks make use of a wider information when they change their policy actions. As Rudebusch and Svensson (1998) put it:

[2] With the notable exceptions of Weerapana (1998), Peersman and Smets (1998) and Svensson (1998b).

[3] For analysis of the asymmetries see also Bayoumi and Eichengreen (1992).

[4] Note that these accounts do not always support each other. Results crucially depend on the identi…cation scheme of monetary shocks, data and type of modelling. For a critical analysis of the current research on monetary transmission mechanisms, see Kieler and Saarenheimo (1998).

> Every central bank uses more information than the simple rules are based on, and no central bank would voluntarily restrict itself to react mechanically in a predescribed way to new information. The role of unrestricted or simple explicit instrument rules is at best to provide a baseline and comparison to the policy actually followed.

In reality, a quick look at the literature suggests that a simple Taylor rule performs quite well in replicating most of the central banks' monetary policy actions. [5] At least there seems to be a slowly growing consensus that such a rule can be a useful benchmark in evaluating monetary policy actions.

In this paper, we will study a backwards looking version of the Rudebusch and Svensson (1998) and Svensson (1998) model. This dynamic programming framework allows us to derive country speci…c optimal feedback rules. Naturally, Lucas critique is particularly relevant in our model, since we will assume throughout the paper that the agents' decision rules will be invariant with respect to the changing monetary environment. Although recent research, in particular Fuhrer (1997a), provided some evidence in favor of backwards looking speci…cations of Phillips curve with respect to its forward looking counterparts, we do not claim any immunity to Lucas critique.[6]

In a closed economy framework, backward looking behavior implies the aggregate demand channel of transmission of policy changes. (See also Svensson, 1998) More explicitly, a change in the monetary policy a¤ects the aggregate demand with some lags which is likely passing through the …nancial sector (e.g. credit channel). In‡ation is then a¤ected by the change in the aggregate demand. Thus, Phillips curve is a¤ected via the change in the monetary policy through its e¤ect on the production decisions.

In the open economy case, however, we have additional channels of the transmission of policy changes into the aggregate economy. Indirect channels works via production process. The real exchange rate a¤ects the relative price between the domestic and foreign goods. Hence, the aggregate demand is a¤ected by the changes in the external competitiveness. Phillips Curve, i.e. the aggregate supply equation is then indirectly a¤ected by the changes in the aggregate demand (i.e. via the production decisions of the domestic …rms). On the other hand, real exchange rate induced changes in the input prices are obviously another channel of transmission of policy, which in turn a¤ects the costs of production and hence prices. Finally, shocks on the foreign demand for domestic goods will a¤ect the aggregate domestic demand and hence aggregate supply. The second type of channel has a direct impact on the Phillips Curve. (through the aggregate supply equation). Since, depending on the openness of the economy, the domestic …nal goods prices are directly a¤ected by the changes in the real exchange rates, the CPI in‡ation is a function of the real exchange rates. However, for that purpose one needs to model the real exchange rates with the use of expectations for the real exchange rates. This clearly requires incorporation of the forward looking variables. In this paper, for the sake of the internal consistency of our model,

[5] See Svensson (1998), Clarida, Gali and Gertler (1997), Peersman and Smets (1998).

[6] For forward looking closed economy models consult Svensson (1998), Rotemberg and Woodford (1997) and Fuhrer (1997b).

we will neglect the direct channels of monetary transmission mechanism on the inflation process and focus on the indirect channels of monetary policy transmission mechanism.[7]

More precisely, our model consists of an aggregate supply equation in the form of an autoregressive Phillips curve given by:

$$\pi_t = \sum_{j=1} \alpha_{\pi,j}\pi_{t-j} + \alpha_y y_{t-1} + \varepsilon_t; \tag{1}$$

Equation (1) shows that aggregate supply equation is an autoregressive process, which take into account changes in the aggregate demand with one period lag. Note that the variables $\pi_t; y_t; q_t$ represent the inflation rate, excess demand (output gap) and real exchange rate, respectively. ε_t is zero mean i.i.d. random shock. Aggregate demand equation has features of a partial-adjustment IS curve and is given such that:

$$y_t = \sum_{j=1}^{11} \beta_{y,j} y_{t-j} - \beta_i(\bar{i}_t - \bar{\pi}_t) + \sum_{j=1}^{11} \beta_{q,j}\Delta q_{t-j} + \eta_t: \tag{2}$$

where excess demand y_t is measured as deviations from its output trend component. η_t is i.i.d. zero mean random shock. Equation (2) represents aggregate demand equation as an autoregressive process, which takes into account immediate and past policy changes via the moving average of real interest rate $(\bar{i}_t - \bar{\pi}_t)$ and external competitiveness variable, lagged changes in the real exchange rates $\Delta q'$s. In equation (2); $\bar{i}_t$ and $\bar{\pi}_t$ represent a twelve month moving arithmetic average of current and past interest and inflation rates. More precisely:

$$\bar{i}_t = 1/(12)\sum_{i=0}^{11} i_{t-i} \quad \text{and} \quad \bar{\pi}_t = 1/12\sum_{i=0}^{11} \pi_{t-i}:$$

Next we have to write our exchange rate process. We specify the standard expression for the real exchange rate (in natural logarithms) as being:

$$q_t = s_t + p_t^* - p_t \tag{3}$$

where s_t stands for the nominal exchange rate, p^* for the foreign price level and p for the domestic price level. We assume that the exchange rate satisfies the uncovered interest parity condition such that:

$$i_t - i_t^* + \chi_t = \underbrace{[E[s_{t+1}] - s_{t+1}]}_{\varsigma_{t+1}} + [s_{t+1} - s_t] \tag{4}$$

[7] Note that, in their seminal papers Meese and Rogoff (1983 and 1988) provide an important test of the existing real exchange rate models. They find that the simple random walk model outperforms all existing real exchange rate models. They also find that the real interest rate differentials exhibit the theoretically anticipated sign, while being insignificant. Thus, here we will opt for a simplified case in order to avoid problems that could arise with the use of expectations.

where ς_{t+1} is the forecast error at time $t+1$ and υ_t is the risk premium at time t. Then, we can rewrite equation (4) in terms of changes. By taking first differences and substituting equation (4) into (3) we can write real exchange rate changes as being:

$$\Delta q_{t+1} = i_t - i_t^* + \pi_{t+1}^* - \pi_{t+1} + \upsilon_t - \varsigma_{t+1} \tag{5}$$

In other words, equation (5) states that changes in the real exchange rates at time t is nothing but the sum of the current inflation differential, one period lagged interest rate differential and a risk premium minus a forecast error of the nominal exchange rate. We also assume that the foreign inflation and the foreign interest rate follow stationary univariate AR(1) process such that:

$$\pi_t^* = \delta \pi_{t-1}^* + \psi_t^* \tag{6}$$

$$i_t^* = \rho i_{t-1}^* + \nu_t^* \tag{7}$$

where $0 < \delta < 1$; $0 < \rho < 1$ and ψ_t^* and ν_t^* are i.i.d. zero mean random shocks. Obviously, these assumptions are for simplification purposes and can be relaxed in more realistic ways to account for the external economies.[8]

Hence, we can now summarize the monetary transmission mechanism implied by equations (1), (2) and (5). Essentially, by assuming uncovered interest parity we endogenize the real exchange rate process. In other words, we allow the policy variable (interest rates) to affect the real exchange rates.

If there is a change in the policy instrument, the short term interest rate, the aggregate demand for domestic goods is affected immediately. In the next period, the aggregate supply is affected via the aggregate demand channel. On the other hand, if there is a shock on the external competitiveness as specified by the changes in the real exchange rate, aggregate demand is affected at the current period and aggregate supply a period after. We expect that a real exchange rate depreciation affects aggregate demand positively at the initial stage, i.e. $0 < \beta_{q,t-1} < 1$. This means that, ceteris paribus, an increase in the external competitiveness tends to create a positive output gap given that we are at the equilibrium at the initial period. Capacity overutilization affects domestic inflation positively, thus $\alpha_y > 0$.

There are basically two opposing effects, which we will call the real exchange rate channel and real interest rate channel. Real exchange rate channel works as follows. If there is an increase in the policy variable (interest rate) at time t, aggregate demand is dampened and inflation tends to decline at period $t+1$. Real exchange rate tends to depreciate from our identity (5) and external competitiveness increases, hence aggregate demand at time $t+2$. At the same time real interest channel is at work. At time $t+2$, inflation decline leads to an increase in the moving average of real interest rates, hence triggering a decrease in the output gap. Therefore, overall outcome of an policy induced change in the macroeconomic aggregates is ambiguous.

[8] By calculating the optimal feedback rules and throughout the simulations in section 5 we effectively set δ and ρ as being to 0.99, to assure convergence. We do not model the risk premium and effectively set it as being zero.

2.1 State Space Representation

In this paper we will make use of the dynamic optimization framework provided by Rudebusch and Svensson (1998) and Svensson (1998a,b) with backward looking variables. We assume that the intertemporal loss function takes the following form:

$$E_t \sum_{\tau=0}^{\infty} \delta^{\tau} L_{t+\tau}. \qquad (8)$$

Let Y_t be the (1 x n_1) vector of target variables and K the matrix of preferences. When the discount rate $\delta \to 1$; the intertemporal loss function is equivalent to the unconditional mean of the period loss functions and can be written as:

$$L_t = Y_t' K Y_t. \qquad (9)$$

where $Y_t = \begin{bmatrix} \pi \\ y \\ i_t - i_{t-1} \end{bmatrix}$: We do not assume a Central Bank aiming to stabilize the real exchange rates, as is done in Ball (1997). Thus in our set up, the Central Bank does not use a Monetary Condition Index, a composite of exchange rate and interest rate changes, to react to changes in the real exchange rate. Real exchange rate changes enter the state space as an identity (UIP) and the short term nominal interest rate is the unique policy variable of the Central Bank to affect macroeconomic aggregates.

A conventional way to describe the dynamics of economic state is given as:

$$X_t = AX_{t-1} + Bi_{t-1} + v_t; \qquad (10)$$

where $X_t \; \left(\pi_t; y_t; q_t; \pi_t^*; i_{t-1}; i_{t-1}^*\right)'$ is a (1 x n_1) vector of economic state variables, A is the (n_1 x n_1) parameter matrix, i_t is the vector of the central bank instrument variables, B is the (1 x n_2) column vector and v_{t+1} is a vector of exogenous i.i.d. shocks with zero mean and constant covariance matrix.[9]

After some manipulations in line with Rudebusch and Svensson(1998) we can write the optimal linear feedback rule as being:

$$i_t = fX_t \qquad (11)$$

where

$$f = -(R + \delta B'VB)^{-1}(U' + \beta B'VA) \qquad (12)$$

representing the optimal feedback coefficients.

Dynamics of the state variable can now be rewritten using the optimal feedback rule. Substituting i_t in (10) with optimal feedback vector f given in (12); we rewrite (10) as:

$$X_{t+1} = A + Bf + v_{t+1} \qquad (13)$$

[9] See appendix 1, for the formulation of the appropriate matrices.

3 Empirical Results

3.1 Data

Our empirical work is based on the monthly data taken from the IMF International Financial Statistics. Our estimation results are based on the time period 1979.01-1994.09.[10] We use logarithm of industrial production as a proxy for output. Output gap is generated via detrending the raw industrial production series by Hodrick Prescott filter, where $\lambda = 500000$ equivalent to a linear trending. Inflation data is the monthly CPI (converted in annual rate) data for the 11 countries in the EMU[11]. In order to calculate real exchange rates we use the end of period monthly nominal exchange vis-a-vis the US dollar, US price level and price levels of the 11 countries in the Euro project. Monthly changes in the real exchange rates exhibit high volatility. Finally, short term interest rates for the Euroland countries with the exceptions of Finland (average lending rate), Ireland (STF rate) and Portugal (lending rate). We further assume that in Luxembourg the Belgian short term interest rate holds.

3.2 Estimation

We estimate equations (1) and (2). Conventional literature on aggregate supply equation imposes the ad hoc long term restriction on the inflation coefficients. We test this theoretical argument for long term money neutrality. We find significant evidence against the null hypothesis of monetary neutrality within the sample period concerned.[12] We further test the stability of the matrix A and check the eigenvalues. We observe that for a number of countries eigenvalues are not necessarily within the unitary circle. Thus, for the sake of the subsequent simulation analysis in the following section we opt for the results of the unrestricted aggregate supply estimation (1) and derive the optimal feedback rule accordingly. (See table 1 for the statistical report).

For most of the countries moving average variable in the aggregate demand equation (2) exhibits the theoretically anticipated sign. In other words, when the moving average of real interest rates increases, output gap decreases albeit not always significant. The same holds for the output gap variable in the aggregate supply equation (1). Capacity overutilization (a positive gap) leads to an increase in the inflation rate, whereas a capacity underutilisation has the opposite effect.

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[10] Note that we restrict our attention on this period, because some output data in particular for Portugal was not consistently available after 1994.09.

[11] Austria, Belgium, Finland, France, Germany, Ireland, Italy, Luxembourg, Netherlands, Portugal and Spain.

[12] Theoretical presumption is that monetary changes can not have permanent effects, thus $\sum_{j=1}^{11} \pi_{t-j} = 1$ in equation (1). In order to see whether this hypothesis holds for our sample of countries, we also imposed the long term restriction and applied the Wald test (joint F-test). We could reject for a number of countries the hypothesis of long term monetary neutrality at the 99% interval (for Austria, Germany, Ireland, Luxembourg, Netherlands and Portugal). Therefore, we have opted not to impose long term restrictions on the coefficients. (see Table 1).

Table 1: Stability Tests

	Aus	Bel	Fin	Fra	Ger	Ire	Ita	Lux	Net	Por	Spa
A matrix Max.EV (res)	.99	1.00	1.01	1.00	1.011	.99	1.01	.996	1.01	1.01	1.00
A matrix Max.EV (unres1)	.94	.98	.97	.96	.92	.92	.99	.94	.98	.94	.99
M matrix Max EV (unres1)	.93	.98	.99	.97	.99	.94	.94	.95	.95	.96	.98
M matrix Max EV (unres2)	.93	.98	.99	.98	.99	.95	.95	.96	.96	.97	.98
M matrix Max EV (unres3)	.93	.98	.99	.98	.99	.95	.95	.96	.96	.97	.98

We present only the maximum eigenvalues of the A and M matrices. First and 2nd rows provide maximum Eigenvalue of the A matrices of the restricted (i.e. $\sum_{j=1}^{11} \pi_{tij} = 1$) and unrestricted aggregate supply equation whereas 3rd, 4th and 5th rows refer to stability of M matrices of the unrestricted equation with output stabilization preference parameter of $\lambda = .2$; $\lambda = 1.0$ and $\lambda = 5.0$ respectively.

3.2.1 Monetary Policy Changes

We present the output and in‡ation reactions with respect to a temporary one percent interest rate change at …gures 1 and 2. Our results are qualitatively in line with De Grauwe et al. (1998). We observe that in all the countries, but Belgium, Ireland and Luxembourg, in‡ation reacts with the anticipated sign. In the case of output gap responses exception is Portugal. Portuguese output gap is positively a¤ected by an increase in the interest rate. For the rest of the sample coe¢cients are right, hence when the interest rate increases output and in‡ation decrease. We …nd systematically stronger response of the output than in‡ation with respect to policy changes. In general, in‡ation reactions are inert and small across the board. Price puzzle exists in Belgium, Ireland and Luxembourg, in other words, an increase in the interest rate leads to a slight increase in the in‡ation rate.[13]

Moreover, the size and timing of the reaction of in‡ation and output di¤ers substantially across countries. In particular, in Finland, France, Germany and Netherlands both output and in‡ation seem to be rather less responsive with respect to policy changes. On the other hand, in Austria, Belgium, Ireland, Italy, Luxembourg and Portugal output reactions are more pronounced.

insert here …gures 1-2

3.2.2 Real Exchange Rate Shocks

We present in …gures 3-4, the reactions of output and in‡ation in the Euroland with respect to a 1% positive shock on real exchange rate changes. Starting from the steady state, a real depreciation of the home currency increases aggregate demand for the goods produced domestically and hence triggers positive output gap. In the subsequent period, an increase in the aggregate demand for domestic goods a¤ects in‡ation positively. However, an increase in the in‡ation rate leads to two opposing e¤ects. A real exchange rate channel

[13] See Christiano et al.(1994) on this issue.

and a real interest rate channel. First, in‡ation leads to an appreciation of the domestic currency and hence a dampening of the competitiveness of individual countries. Second, it leads to a decline in the moving average of real interest rates and an improvement in the competitive position of countries.

In most of the countries output reactions with respect to real exchange rate shocks are as expected and positive at the initial phase. There are some exceptions however. In particular in Portugal, both in‡ation and output reactions exhibit theoretically unanticipated signs. In comparison to output reactions, in‡ation reactions are unanimously weak across the board implying strong price rigidity with respect to changes in the real exchange rate. This can be interpreted as evidence for imperfect pass through of real exchange rate shocks to the domestic prices at an aggregate price level.[14]

insert here …gures 3-4

During the propagation of the shocks two opposing channels, real interest rate channel and real exchange rate channel seem to be at work. Initial competitiveness gains (because of a depreciation of the real exchange rate) seem to be reversed by the real appreciation in some countries and leads to a decline in output and in‡ation in the following periods. (e.g. Belgium, Finland, France, Germany) In some other countries the real interest rate decline seems to be superior to the real exchange rate appreciation. (e.g. Spain, Italy, Ireland, Netherlands) Thus, our results are mixed.

3.2.3 AD and AS Shocks

Throughout …gures we plot the reactions of the economies w.r.t. aggregate demand (AD) and supply shocks (AS). Overall output and in‡ation reactions with respect to a 1% positive AD or AS shock seem to converge rather quick. As one would expect an increase in the demand for the domestically produced goods (positive AD Shock) increases output gap and hence in‡ation. The price puzzle for Belgium, Luxembourg and Ireland become obvious here. The interaction term ®$_y$ exhibits wrong sign and in‡ation reactions are perverse, in other words with respect to positive output shocks domestic in‡ation decreases. Again our two opposing e¤ects, real exchange rate e¤ect and real interest rate e¤ect, are at work. A positive shock on the in‡ation equation leads to an increase in in‡ation across the board. An increase in the domestic in‡ation rate should lead to an appreciation of the real exchange rate in the following period, thus a decline in the external competitiveness and a decrease in output. At the same time the real interest rate e¤ect works via AD equation. The moving average of real interest rates declines and has a positive impact on production decisions. A look at the …gures suggest that in general the real interest rate channel seems to dominate and the output gap is positively a¤ected.

insert here …gures 5-8

[14] For a similar analysis see Peersman and Smets (1998).

3.2.4 Optimal Feedback Rules

We present first (period) optimal feedback rules throughout figures 9 to 12 for the intermediate output stabilization case.[15] Our results are basically in line with De Grauwe et al. (1998) for different parameter specifications. First of all, interest rate smoothing parameter tends to decline with the higher weight given to output stabilization. This basically implies that the high output stabilization intention makes interest rates more volatile. Secondly, output coefficients are strongly dominating inflation coefficients. This feature does not change across different preference specifications. If we look at the first feedback coefficients in intermediate output stabilization case, where $\lambda = 1; \gamma = 0.5;$ we do not observe clear-cut Taylor rules. Portugal exhibits wrong sign on the output coefficients. Thirdly, optimal feedback coefficients on the changes in the real exchange rates are low and first coefficients are in general positive.

insert here figures 9-12

3.2.5 Specification of the Asymmetric Shocks

Country specific inflation and output shocks are assumed to be captured by the residuals of their respective regressions (1) and (2). In order to see how this shocks comove across countries within the Euroland, we write for the pairwise correlation among the residuals:

$$s_{xy} = \frac{\sum_i \left(\varepsilon_{xi} - \bar{\varepsilon}_x\right)\left(\varepsilon_{yi} - \bar{\varepsilon}_y\right)}{n - 1}. \qquad (14)$$

Thus, for the covariance matrix of the European Union 11 we can write $S = [s_{ij}]$. A useful decomposition of the matrix S is the Cholesky decomposition $S = LL'$; where L representing the lower triangular matrix.

4 An Asymmetric Euroland: Framework for Simulations

Previous sections presented an attempt to account for the structural asymmetries across Euroland countries. In this section we will provide a simulation analysis on the likely functioning of the ECB and its macroeconomic implications. In the following sections we present the framework for the statistical and institutional asymmetries which will be used in the simulations.

4.1 Statistical Aspects

Three types of asymmetries will be incorporated into our simulations. First of all we assume that inflation and output shocks will continue to comove as defined in equation

[15] Full results of optimal feedback coefficients for alternative preference specifications are available upon request.

(14). This covariance structure will be recovered by constructing a vector of output and inflation shocks, namely $\eta_t = [\eta_{1;t};.....;\eta_{11;t}]' = L\delta_t$; $\varepsilon_t = [\varepsilon_{1;t};.....;\varepsilon_{11;t}]' = L\mu_t$;, where $\delta \sim N(0;1)$; and $\mu \sim N(0;1)$.

There is only one nominal exchange rate and one nominal interest rate in the Euro area. However, since inflation differentials will remain, we have to calculate new real exchange rate changes (with the use of equation (5) ; country specific price differentials with respect to the US and lagged Euro US interest rate differentials will remain) and the changes in the Euro/USD real exchange rate will be a weighted average of the changes in the post-Euro real exchange rates.[16]

Secondly, estimated coefficients and optimal feedback rules derived from the previous sections will be applied. Hence, the size and timing of the propagation of the monetary shocks are allowed to be asymmetric. And thirdly, preferences are treated exogenously and three types of output-inflation preferences will be considered. [17]

4.2 Institutional Aspects: A Median Voter Model

In this section we will briefly sketch three potential scenarios of the ECB Governing Council. The ECB consists of seventeen members. Eleven national representatives and six appointed members (ECB Board) will vote upon the conduct of the monetary policy. We will assume in each of the scenarios the median voter model will hold. In other words, among the ordered total number of 17 votes, always the median vote (the 9th) will be executed as the monetary policy decision (change in the interest rate) of the ECB. We will model the voting process as given in De Grauwe et al. (1998). Formally we write the desired interest rate of member countries as;

$$d_{t;j} = -\left(R_j + B_j'V_jB_j\right)^{-1}\left(U_j' + B_j'V_jA_j\right)X_{t;j}; \tag{15}$$

We will rank the desired interest rates for each of the 17 members[18] in ascending order, to give the ordered sequence of desired interest rates $d_t^{(1)} \leq d_t^{(2)} \leq \cdots \leq d_t^{(17)}$: The ECB Board proposes the interest rate;

$$d_{t;EMU} = \sum_{j=1}^{11} w_j d_{t;j}; \tag{16}$$

where w_j is the weight attached to country j; which is taken as the normalized share of the

[16] For that purpose we use weighted average (normalized capital share of the member countries at the European Central Bank) of country specific real exchange rates. See footnotes 19 and 20. Note that calculation of the Euro/USD real exchange rate changes have no implications on the simulations whatsoever.

[17] Three cases being medium ($\lambda = 1; \gamma = .5$); high weight on output stabilization ($\lambda = 5; \gamma = .5$) and low weight on output stabilization ($\lambda = .2; \gamma = .5$):

[18] Desired interest rates for permanent ECB members are obviously identical. More specifically they are given by $d_t = i_t^E$:

capital of the national central banks in the ECB.[19] The ninth member's desired interest rate is the Euroland interest rate.

In our …rst scenario, what we will call, the ECB Rule, the ECB Board members pose a Euro-wide perspective. In other words, the ECB Board calculates a weighted average of the desired interest rates across members countries and vote. At the same time, eleven national representatives calculate their own countries' desired interest rate and vote accordingly. Among the 17 votes (6 ECB Board votes being the same) the median vote will be applied as the Euro wide interest rate.

The second scenario, what we will call, the Nationalistic Rule, takes into account what happens when the ECB Board members also take a nationalistic perspective. In that case the votes for those countries that have an appointed member at the board doubles. Thus, equation (15) holds for the appointed members as well and according to the majority voting principle the median voter, i.e. 9 ¡ th member, gets its way. Again, the median voter's desired interest rate becomes the Euroland interest rate.[20]

Our third scenario intends to look at the e¤ect of a switch from …xed exchange rate regime, like from the EMS to a monetary union. For that purpose we will incorporate a new rule where the German desired interest rate becomes the Euro-wide interest rate. We will call this rule the EMS Rule.

5 Simulation Results

We will use all the coe¢ cients of the equations (1) ; (2) estimated and optimal feedback rules for each individual country: Naturally, all simulations start at the steady state. In a …rst instance, (since we deal with one common currency for the Euro area) i.i.d. random (common) Euro/USD nominal exchange rate shocks arrive.[21] These a¤ect the autoregressive aggregate demand equation together with the country speci…c Cholesky …ltered output gap shocks. In the following period, in‡ation levels are determined taking into consideration the changes in the aggregate demand and country speci…c Cholesky …ltered in‡ation shocks. Given the level of output gap, domestic and foreign in‡ation, foreign interest rate and changes in the real exchange rate and with the use of the optimal feedback coe¢ cients all countries calculate their desired interest rates. After having observed the desired inter-

[19] These weights are a function of the country's population and GDP in EMU-wide population and GDP. As such they can be taken as relevant proxies for the weight each country gets in the decision taken by a representative with an EMU-wide perspective. The weights are for Austria 0.0299, Belgium 0.0366, Finland 0.0177, France 0.2138, Germany 0.3093, Ireland 0.0106, Italy 0.1896, Luxemburg 0.0019, The Netherlands 0.0542, Portugal 0.0244 and Spain 0.1119.

[20] Note that appointed members consists of Finnish, French, German, Italian, Dutch and Spanish origin. In other words, if these members defend the interest of their own country of origin, new weights have to be calculated. These weights are for Austria 0.0588, Belgium 0.0588, Finland 0.1176, France 0.1176, Germany 0.1176, Ireland 0.0588, Italy 0.1176, Luxemburg 0.0588, The Netherlands 0.1176, Portugal 0.0588 and Spain 0.1176. Hence, the country speci…c weights increase for the smaller countries and decline for Germany, France and Italy in the nationalistic case.

[21] Remind that uncovered interest rate parity holds always.

est rates of each individual country, the ECB Council decides for the Euro-wide interest rate according to the voting schemes as speci…ed in Section 4:2. With the country speci…c in‡ation rates we determine country speci…c post-Euro real exchange rates (assuming US in‡ation and interest rates follow a random walk). Note that we decompose shocks on the changes in the real exchange rate into the (Cholesky …ltered) country speci…c in‡ation shocks and a common Euro/USD nominal exchange rate shock. These feed back to the AD equation and so forth. To be able to compare three scenarios, we apply across all alternative voting schemes the same country speci…c shocks for in‡ation, output and nominal exchange rates. We repeat our simulations for 5000 rounds.

5.1 Decided versus Desired Interest Rates

On the behavior of the interest rates there are mainly four points worth commenting. First of all, decided interest rate exhibits a very smooth pattern. This result holds across di¤erent preference speci…cations. In other words, our simulation results replicate the commonly observed actual smooth interest rate behavior.

Secondly, as shown in table 5, under the ECB Rule countries' desired interest rates are more highly correlated with the decided interest rates than under the Nationalistic Rule. In line with the …ndings of De Grauwe et al. (1998) we …nd that under the ECB Rule, ECB Board members are able to impose their preferred interest rates on the ECB Governing Council. In other words, 6 appointed members of the ECB Board de facto control the European monetary policy.

Thirdly, the interest rate smoothing parameter seems to play a central role in the calculated correlation between desired and decided interest rates. Countries with low degrees of interest rate smoothing coe¢cients (as for example Belgium, Luxembourg and Portugal) face a lower degree of correlation of their desired interest rates. Another observation is that those countries, having a higher weight under the ECB Rule tend to gain most in terms of the correlation. Furthermore, those large countries, in particular Germany, France and Italy, facing a reduction in their voting power with the switch from the ECB Rule to the nationalistic Rule, relatively lose in terms of the correlation of the desired and decided interest rates. This feature of the correlations is not di¢cult to understand since the voting power crucially a¤ects the decided interest rates.

insert here table 5

Moreover, this correlations decline overall as we switch from the preference speci…cation in favor of low output stabilization (¸ = 0:2), to high output stabilization (¸ = 5): This feature reveals the fact that the countries involved in the Euroland project tend to su¤er from the monetary policy decisions of the ECB when the desire to stabilize output is uniformly high.

5.2 Post-Euro Real Exchange Rates

The changes in the real exchange rates do not seem to play a central role in the determination of the Euroland interest rate in our simulations. Remember that when we calculate the post Euro real exchange rates we impose only a common nominal exchange rate shock and an country speci…c in‡ation shocks. In other words, divergence of real exchange rates can basically occur due to in‡ation divergence. Table 2 presents the results for simulated volatility of the real exchange rates. ECB and EMS Rules imply a rather smooth real exchange rate process when we compare with the Nationalistic Rule. However, as a whole, the real exchange rate volatility is rather low meaning in‡ation rates do not diverge substantially from eachother.

Table 2: Volatility of Post Euro Real Exchange Rates

	Aus	Bel	Fin	Fra	Ger	Ire	Ita	Lux	Net	Por	Sp
EMS	.0043%	.0041%	.0043%	.0043%	.0044%	.0043%	.0044%	.0043%	.0040%	.0041%	.0043
ECB	.0043%	.0042%	.0042%	.0044%	.0045%	.0042%	.0045%	.0042%	.0040%	.0041%	.0043
Nat	.0061%	.0060%	.0061%	.0064%	.0065%	.0060%	.0063%	.0060%	.0058%	.0059%	.0062

There are potential some explanations for the weak impact of real exchange rates on simulated macroeconomic aggregates. First of all, although we endogenize the real exchange rate process we do not model expectations as concerns the real exchange rates and hence expectations for the future prices. Backward looking speci…cation of our model implies that real exchange rates can have only an indirect e¤ect on the level of in‡ation in individual countries. Note that in line with De Grauwe et al.(1998) we …nd much less volatile in‡ationary environment than output across European countries. Naturally, price di¤erentials do not exhibit substantial variation, hence real exchange rates. Secondly, our set-up does not allow policy changes in the nominal exchange rate regime. In reality, however, nominal exchange rates are in the tool kit of the policymakers (although used less in recent years). Further research will focus on the forward looking behavior of the agents.

5.3 Median Voters and Welfare Analysis

Table 6 presents the median voter results for the Nationalistic and ECB Rules. Under the ECB Rule naturally the ECB Board is most frequent at the median and rather easily impose its preferences. On the other hand, under the Nationalistic Rule some countries position more frequently at the median. In particular, France, Netherlands, Spain, Italy and Germany seem to locate more often at the mid-points of the ordered desired interest rates.[22] Recall that under the Nationalistic Rule these countries occupy two seats at the ECB Governing Council. Although Finland has two seats at the GC, it becomes less often median voter, probably implying its more divergent economic structure.

Throughout tables 7 to 9 we present the results for the relative welfare losses. Our results suggest that the losses tend to increase the more countries attach weight to output stabilization. Furthermore, the ECB Rule appears to be, in general, signi…cantly welfare improving when the output stabilization desire is su¢ciently low. Basically, one can order relative success of the voting schemes as follows: ECB Rule seems to perform better under all preference speci…cations. Surprisingly, when incorporating changes in the real exchange rates Nationalistic Rule seems to be superior to the EMS Rule. In other words, Euro-wide perspective is in general welfare improving if our asymmetry speci…cations are plausible.

A comparison of country speci…c welfare changes (identi…ed as the weighted variability of in‡ation, output and interest rates) across the voting schemes discussed above is rather di¢cult. Our simulation results indicate that some countries gain and some lose with alternative voting schemes. One can argue, however, almost all countries (naturally except

[22] see De Grauwe et al.(1998) fo the same result.

Germany) prefer a weighting procedure to a dictated interest rate. Hence, the EMS Rule is not preferred across the board. The same conclusion is rather di¢cult to reach when one compares Nationalistic Rule with the ECB Rule. Some counties, such as France, Germany, Italy, the Netherlands and Spain, clearly prefer ECB Rule (irrespective of their preferences) to the Nationalistic one. Again this indicates large countries' voting power and the result is in line with the result of high correlation between desired and decided interest rates of large countries as presented in Table 5. Relative voting power (ECB Rule/Nationalistic Rule) is in general negatively correlated with the size of the relative losses (ECB Rule/Nationalistic Rule).

insert here tables 6 to 9

6 Conclusions

In this paper we assess the monetary policy implications of the regime change in the open economy Euroland and analyze the likely backward looking behavior of the ECB.

In a …rst step, we attempt to account for the asymmetries across the open economies constituting the Euroland. For that purpose, we identify the asymmetries in economic state, propagation mechanisms and output, in‡ation and exchange rate shock structures. We provide the set-up where Central Banks are backwards looking. We derive the optimal monetary response of the Euroland countries, where the Central Banks take into consideration the changes in the external competitiveness. Our proxy for the external competitiveness is the changes in the real exchange rate vis-a-vis the US Dollar.

Our results can be summarized as follows. First of all, our estimation results suggest the existence of asymmetries in size and timing in the monetary propagation mechanisms and aggregate demand, aggregate supply and real exchange rate shocks. Generally, in‡ation and output reactions with respect to policy changes tend to appear with the correct sign. However, output reactions seem to dominate in‡ation reactions. In some countries we account for the price puzzle.[23]

Secondly, incorporation of the real exchange rates complicates the analysis somewhat. Introduction of the endogenous real exchange rates imply two opposing e¤ects at the same time. The real interest rate channel and the real exchange rate channel. A positive shock on the real exchange rates (either a foreign in‡ation shock or a foreign interest rate shock) a¤ect in‡ation positively. In the following period, an increase in the in‡ation rate increases the competitiveness via real interest channel however decreases the competitiveness via real exchange rate channel. Thus our results are mixed. Output reactions are dominating in‡ation reactions, however, the pattern of convergence with respect to a temporary shock are di¤erent across countries.

Thirdly, output and in‡ation reactions with respect to aggregate demand and aggregate supply shocks seem to converge rather quickly. Output reactions with respect to AD and AS shocks exhibit the anticipated signs, however, in‡ation reactions are a¤ected by the

[23] In other words, the evidence provided by De Grauwe et al. (1998) is corroborated in the broadest sense.

price puzzle. In countries like Belgium, Ireland and Luxembourg we observe perverse in‡ation reactions with respect to AD and AS shocks.

Second part of the paper contains a simulation analysis. We incorporate our empirical accounts of asymmetries into a uni…ed set-up. Furthermore, we allow for three di¤erent types of scenarios for the ECB Governing Council. The ECB Rule, the Nationalistic Rule and the EMS Rule. Main results are in line with the …ndings of De Grauwe et al. (1998) and are following:

Firstly, the ECB Rule tends to generate higher correlation between the desired interest rates and decided interest rates than the Nationalistic Rule. Country speci…c voting power a¤ects substantially the correlation between the desired and decided interest rates. Hence, Germany and large countries tend to loose most under the Nationalistic voting scheme. As a whole, correlations tend to decline with higher desire to stabilize output across the board.

Secondly, median voters are those countries which have a high interest smoothing parameter in the optimal feedback rules and strong voting power at the GC.

Thirdly, losses tend to increase in line with the desire to stabilize output. The ECB Rule is clearly superior to the two alternatives (the Nationalistic Rule and the EMS Rule) Large countries tend to loose most with the switch from the ECB Rule to the Nationalistic Rule. In general, countries seem to be better o¤ with a weighting procedure (the ECB or the Nationalistic Rules) rather than a dictated rule (the EMS Rule).

In addition to these established results from the literature (De Grauwe et al.1998), we …nd that incorporation of the post-Euro real exchange rates into the simulations do not have very signi…cant e¤ect on the monetary policymaking. Divergences across country speci…c real exchange rates are not very substantial. Basically, removal of the country speci…c nominal exchange rates seems to trigger convergence across countries in terms of output and in‡ations. The only source of potential divergence is due to in‡ation shocks and seems to be rather weak.

References

[1] Ball, L., (1997), E¢cient Rules for Monetary Policy, NBER Working Paper 5952, March.

[2] Bayoumi, T., and Eichengreen, B., (1992), Shocking Aspects of European Monetary Uni…cation, CEPR Discussion Paper, no. 643, May.

[3] Bayoumi, T., and Prasad, E., (1995), Currency Unions, Economic Fluctuations and Adjustment: Some Empirical Evidence, CEPR Discussion Paper, no.1172, May.

[4] Clarida, R., Gali, J., and Gertler, M., (1997), Monetary Policy Rules in Practice: Some International Evidence, CEPR Discussion Paper, no. 1750.

[5] De Grauwe, P., Dewachter, H., and Aksoy, Y., (1998), The European Central Bank: Decision Rules and Macroeconomic Performance, CES Discussion Paper Series 98.34, CEPR Discussion Paper, no. 2067.

[6] Dornbusch, R., Favero, C., and Giavazzi, F., (1998), Immediate Challenges for the European Central Bank, Economic Policy, Vol. 26, pp. 15-52, April.

[7] Christiano, L.J., Eichenbaum, M., and Evans, C., (1996), The E¤ects of Monetary Policy Shocks: Some Evidence from the Flow Funds, Review of Economics and Statistics, Vol. 78, pp.16-34.

[8] Fuhrer, J.C., (1997a) The (Un)Importance of Forward-Looking Behavior of Price Speci…cations, Journal of Money, Credit and Banking, Vol. 29, No. 3, pp. 338-350.

[9] Fuhrer, J.C. (1997b), Towards a Compact, Empirically Veri…ed Rational Expectations Model for Monetary Policy Analysis, Carnegie-Rochester Conference Series on Public Policy, Vol. 47, pp.197-230.

[10] Giovannetti, G., and Marimon, R., (1998), An EMU with Di¤erent Transmission Mechanisms, CEPR Discussion Paper, no. 2016, November.

[11] Kieler, M., and Saarenheimo, T., (1998), Di¤erences in Monetary Policy Transmission? A Case not Closed, Economic Papers, No.132, European Commission.

[12] Meese, R.A., and Rogo¤, R., (1983), Empirical Exchange Rate Models of the Seventies: Do They Fit Out of Sample?, Journal of International Economics, Vol. 14, pp. 3-24.

[13] Meese, R.A., and Rogo¤, R., (1988), Was it Real? The Exchange Rate-Interest Di¤erential Relation over the Modern Floating-Rate Period, Journal of Finance, Vol. 43-4, pp.933-948.

[14] Peersman G., and Smets, F., (1998), The Taylor Rule: A Useful Monetary Policy Guide for the ECB, mimeo., University of Gent.

[15] Ramaswamy, R., and Sloek, T., (1998), The Real E¤ects of Monetary Policy in the European Union: What Are the Di¤erences?, IMF Sta¤ Papers, forthcoming.

[16] Rotemberg, J.J., and Woodford, M., (1997), An Optimization Based Econometric Framework for the Evaluation of Monetary Policy, NBER Macroeconomics Annual, pp. 297-346.

[17] Rudebusch, G.D., and Svensson, L.E.O., (1998), Policy Rules for In‡ation Targeting, Paper prepared for NBER Conference on Monetary Policy Rules.

[18] Svensson, L.E.O., (1998a), In‡ation Targeting as a Monetary Policy Rule, IIES Seminar Paper, No. 646.

[19] Svensson, L.E.O., (1998b), Open-Economy In‡ation Targeting, Journal of International Economics, forthcoming.

[20] Taylor, J., (1993), Discretion versus Policy Rules in Practice, Carnegie Rochester Conference on Public Policy, Vol. 39, pp. 195-214.

[21] Weerapana, A., (1998), The Performance of Simple Monetary Policy Rules in a Large Open Economy, mimeo., Stanford University.

Appendix 1

Economic state is given by:

$$X_t = AX_{t-1} + B i_{t-1} + v_t; \qquad (17)$$

where
$$X_t = \begin{bmatrix} \pi_t \\ \pi_{t-1} \\ \vdots \\ \vdots \\ \vdots \\ y_t \\ y_{t-1} \\ \vdots \\ \vdots \\ \vdots \\ \Delta q_t \\ \Delta q_{t-1} \\ \vdots \\ \vdots \\ i^*_{t-1} \\ i^*_{t-2} \\ \pi^*_t \\ \pi^*_{t-1} \\ i_{t-1} \\ \vdots \\ \vdots \\ i_{t-l} \end{bmatrix}; \quad A = \begin{bmatrix} \sum_{j=1}^{n} \alpha_{\pi,j} e_j + \alpha_y e_{n+1} \\ e_1 \\ \vdots \\ e_n \\ \beta_{-} e_{1:11} + \sum_{j=1}^{m} \beta_{y,j} e_{m+j} + \sum_{j=1}^{r} \beta_{q,j} e_{r+j} - \beta_{-} e_{34:48} \\ e_{n+1} \\ \vdots \\ e_{n+m} \\ e_{n+m+r+4} - e_1 + e_{n+m+r+3} - e_{n+m+r+1} \\ e_{n+m+2} \\ \vdots \\ e_{n+m+r} \\ \rho_{i^* -1} e_{n+m+r+1} \\ e_{n+m+r+1} \\ \delta_{\pi^* -1} e_{n+m+r+3} \\ e_{n+m+r+3} \\ e_0 \\ e_{n+m+r+5} \\ \vdots \\ e_{n+m+r+4+l} \end{bmatrix};$$

$$
B = \begin{bmatrix} 0 \\ 0 \\ \vdots \\ \vdots \\ 0 \\ -\frac{1}{12} \\ 0 \\ \vdots \\ \vdots \\ \vdots \\ \vdots \\ \vdots \\ \vdots \\ \vdots \\ \vdots \\ \vdots \\ \vdots \\ 0 \\ 1 \\ 0 \\ \vdots \\ \vdots \end{bmatrix}; \quad v_t = \begin{bmatrix} \varepsilon_t \\ 0 \\ \vdots \\ \vdots \\ \vdots \\ \eta_t \\ 0 \\ \vdots \\ \vdots \\ \varphi_t \\ 0 \\ \vdots \\ \vdots \\ \nu_t \\ \vdots \\ \psi_t \\ \vdots \\ \vdots \\ \vdots \\ \vdots \\ \vdots \end{bmatrix}
$$

where e_j is $(n + m + r + 4 + 11)$ vector all elements being zero except the j-th, which is equal to one and $e_{i:j}$ is a $(n + m + r + 4 + 11)$ vector with column i to j equals to $1/12$.

On the other hand loss function is given by,

$$
Y_t = C_X X_t + C_i i_t;
$$

where $C_X = \begin{bmatrix} e_{1:12} \\ e_{n+1} \\ -e_{n+m+r+4+1} \end{bmatrix}$ is a $(3 \times n + m + r + 4 + 11)$ matrix and $C_i = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}$ is a (3×1) vector. Note also that the preference matrix is defined as $K = \begin{bmatrix} 1 & 0 & 0 \\ 0 & \lambda & 0 \\ 0 & 0 & \gamma \end{bmatrix}$:

Table 3: Correlation of desired and decided interest rates (in percentage)

	Aus	Bel	Fin	Fra	Ger	Ire	Ita	Lux	Net	Por	Spa	ECB
Low Output Stabilization Case												
ECB Rule	61	70	55	89	93	81	78	55	84	64	80	99.4
Nationalistic	52	61	59	88	65	72	67	53	82	66	76	-
EMS Rule	92	90	89	97	100	98	95	88	97	89	96	-
Intermediate Output Stabilization Case												
ECB Rule	41	31	41	77	91	60	68	12	79	56	72	98.4
Nationalistic	33	34	58	74	65	53	47	20	59	47	60	-
EMS Rule	75	69	85	93	100	94	84	58	96	21	90	-
High Output Stabilization Case												
ECB Rule	23	29	38	63	87	22	43	5	52	37	37	98.3
Nationalistic	26	36	72	53	57	9	26	31	36	31	35	-
EMS Rule	29	30	64	78	100	54	60	27	83	16	53	-

Table 4: How Many Times Median Voter?All Preferences (in percentage)

	Aus	Bel	Fin	Fra	Ger	Ire	Ita	Lux	Net	Por	Spa	ECB
Low Output Stabilization Case												
ECB Rule	0.8	0.5	0.5	1.0	0.4	1.0	0.9	0.7	1.1	0.7	0.9	91.6
Nat Rule	3.5	7.6	3.5	23.4	6.1	9.1	8.1	5.6	15.6	5.4	12.4	-
Intermediate Output Stabilization Case												
ECB Rule	1.3	1.1	1.5	3.3	0.5	0.9	2.6	0.6	3.7	1.7	1.5	81.3
Nat. Rule	4.3	5.1	5.7	24.9	5.2	8.2	10.0	4.5	13.2	6.8	12.2	-
High Output Stabilization Case												
ECB Rule	1.4	0.6	1.5	2.8	0.1	1.6	1.6	0.9	1.7	1.1	2.1	84.7
Nat Rule	4.0	7.0	4.1	25.4	4.3	7.0	13.7	4.6	14.6	6.6	8.6	-

Table 5: Relative Losses :Low Output Stabilization Case

	Aus	Bel	Fin	Fra	Ger	Ire	Ita	Lux	Net	Por	Spa
EMS/ECB	167%	271%	109%	106%	92%	144%	153%	229%	150%	119%	115%
EMS/Nat	151%	235%	108%	97%	89%	129%	122%	217%	127%	128%	100%
ECB/Nat	91%	87%	99%	92%	97%	90%	79%	94%	85%	107%	87%

BM stands for Benchmark Rule, ECB stands for ECB Rule, Nat stands for Nationalistic Rule and EMS stands for EMS Rule.

Table 6: Relative Losses : Intermediate Case

	Aus	Bel	Fin	Fra	Ger	Ire	Ita	Lux	Net	Por	Spa
EMS/ECB	201%	288%	125%	109%	92%	136%	189%	351%	154%	138%	121%
EMS/Nat	227%	342%	133%	106%	81%	139%	170%	397%	148%	136%	121%
ECB/Nat	113%	119%	106%	97%	88%	102%	90%	113%	97%	98%	99%

Table 7: Relative Losses Higher Case

	Aus	Bel	Fin	Fra	Ger	Ire	Ita	Lux	Net	Por	Spa
EMS/ECB	253%	484%	181%	215%	90%	369%	424%	496%	393%	237%	293%
EMS/Nat	231%	453%	159%	178%	78%	270%	305%	392%	288%	217%	224%
ECB/Nat	91%	94%	88%	83%	87%	73%	72%	79%	73%	92%	76%

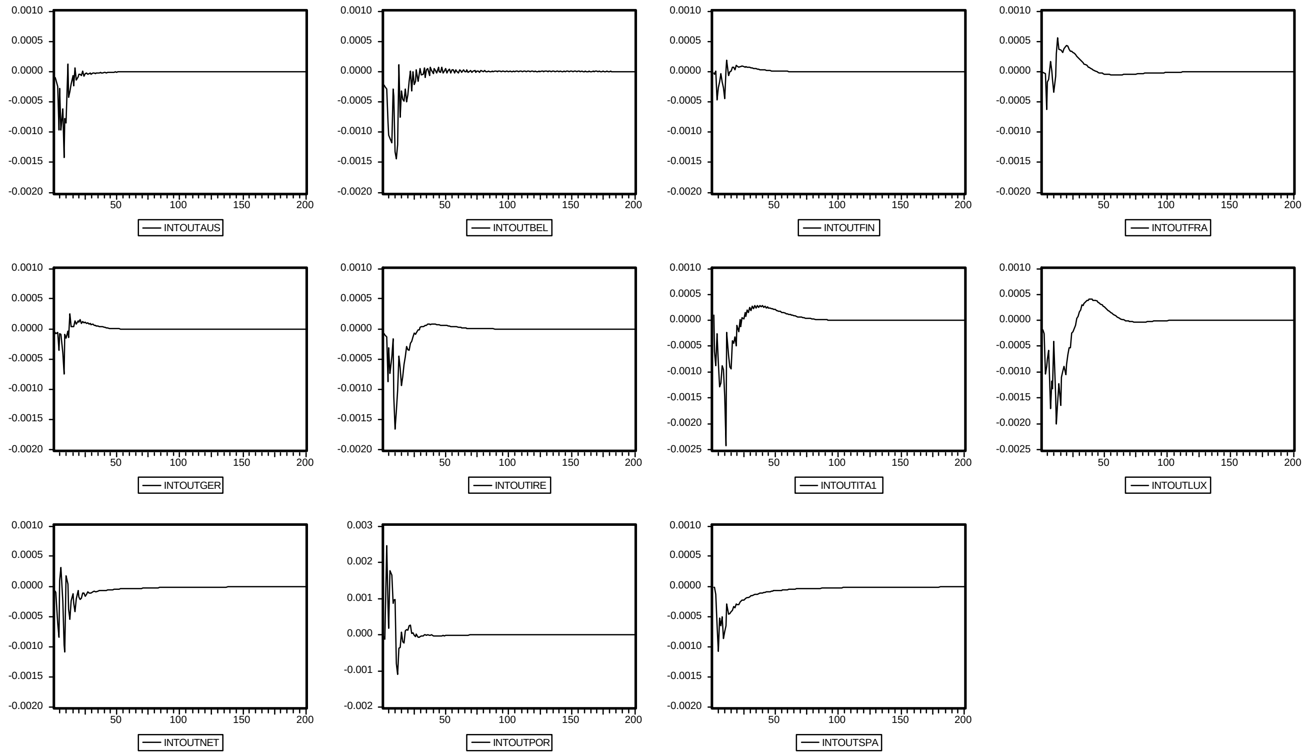

Figure 1: Output Response w.r.t. 1% Change in the Interest Rate

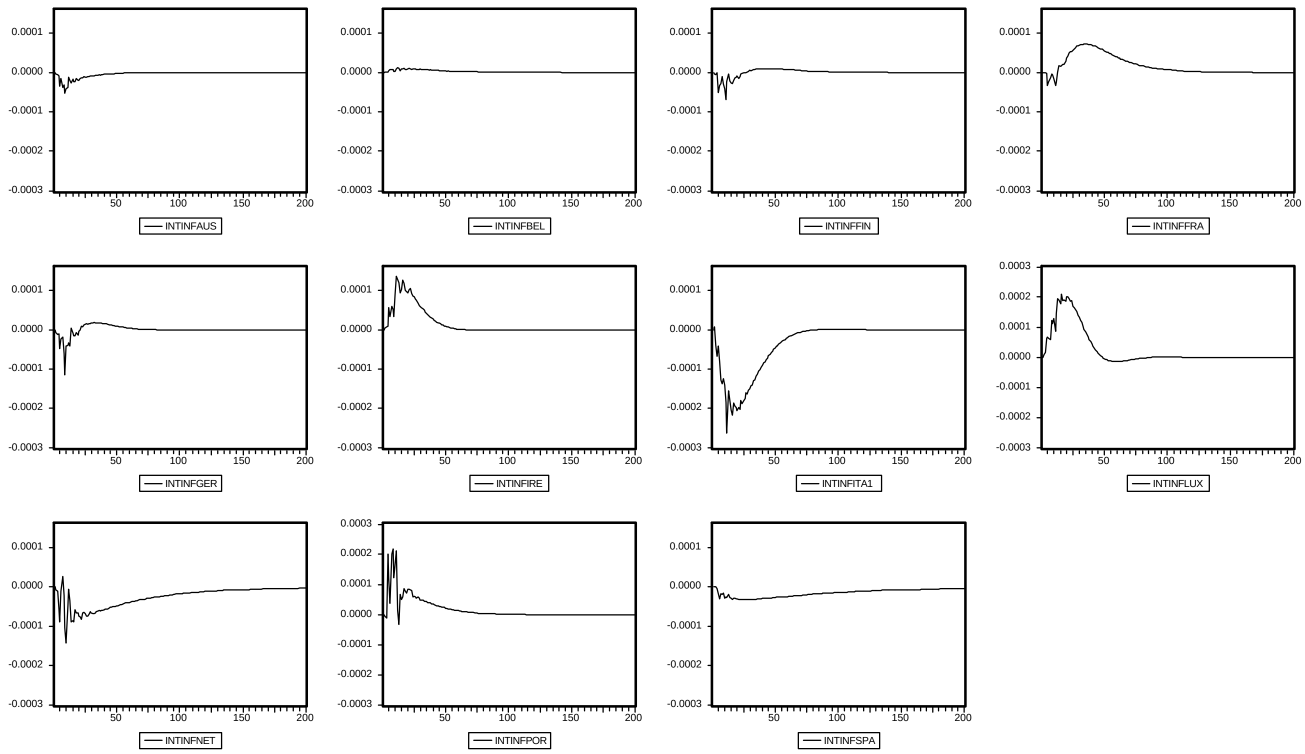

Figure 2: In‡ation Response w.r.t. 1% Change in the Interest Rate

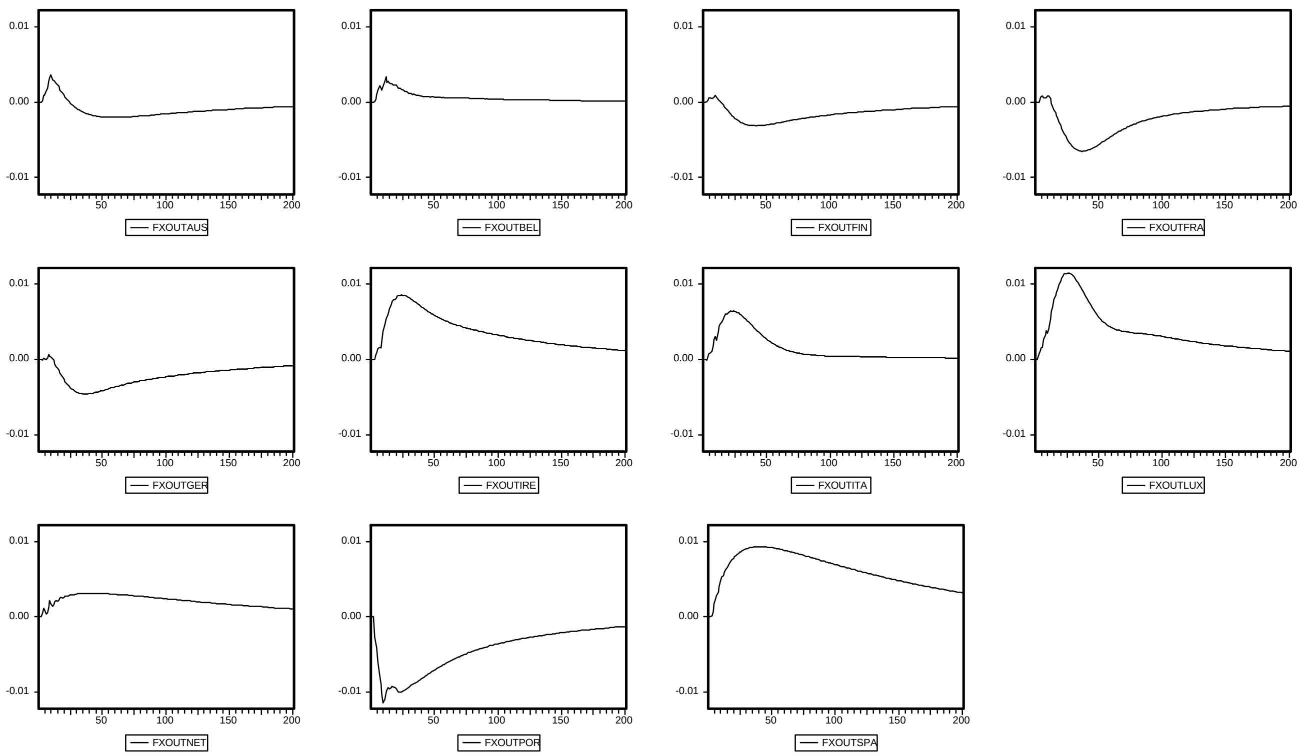

Figure 3: Output Response w.r.t. 1% Change in the Real Exchange Rate

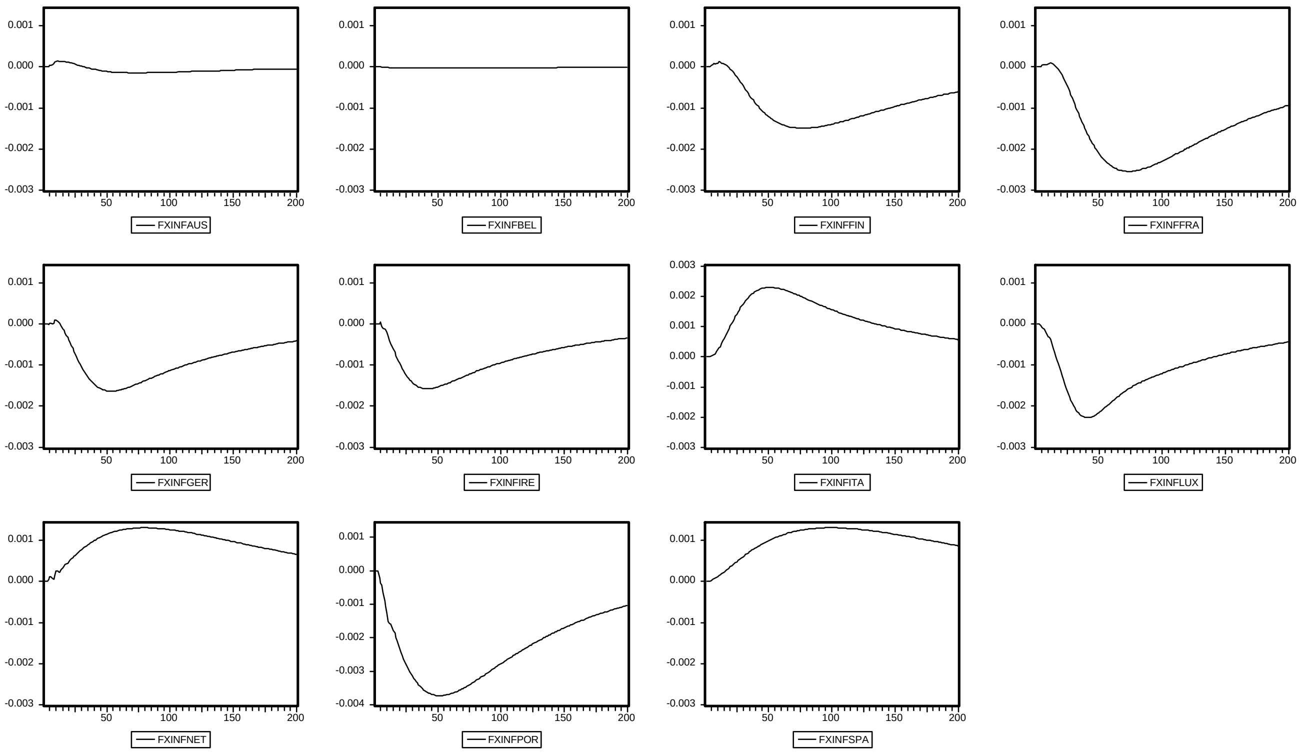

Figure 4: In‡ation Response w.r.t. 1% Change in the Real Exchange Rate

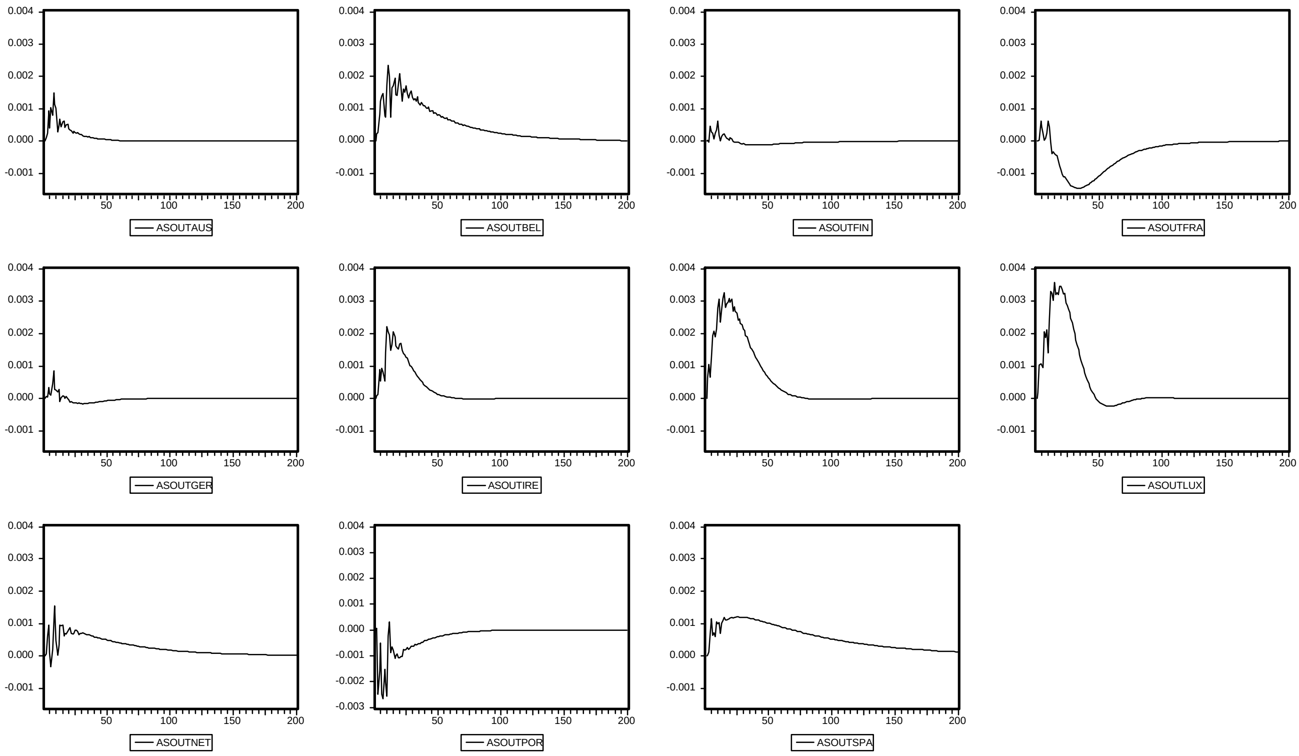

Figure 5: Output Response w.r.t. AS Shock

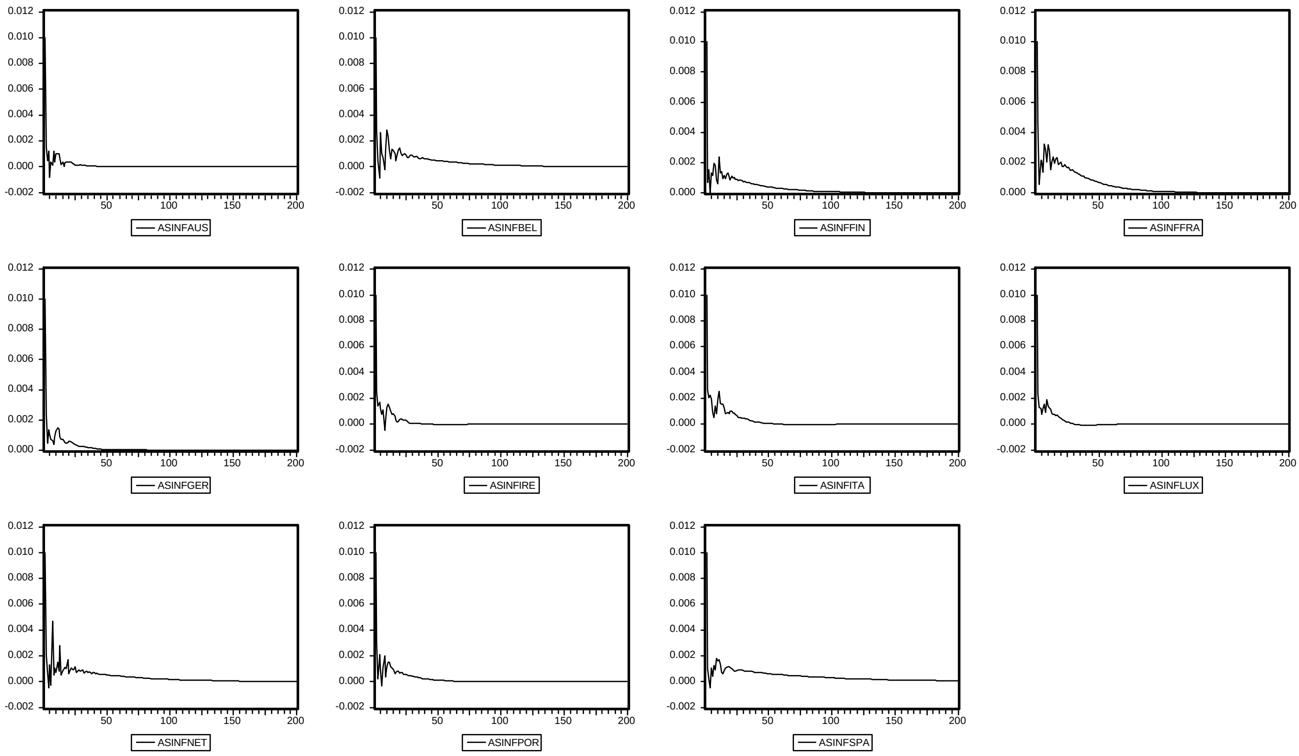

Figure 6: In‡ation Response w.r.t. AS Shock

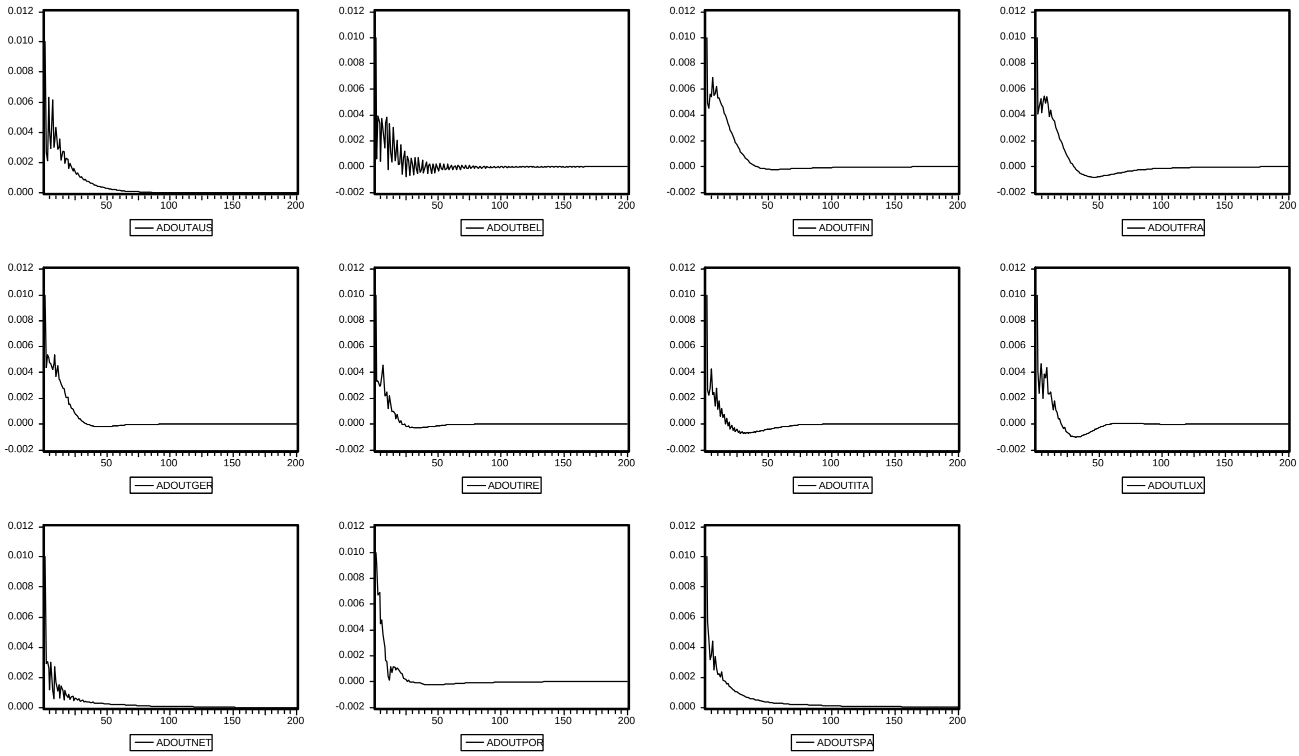

Figure 7: Output Response w.r.t. AD Shock

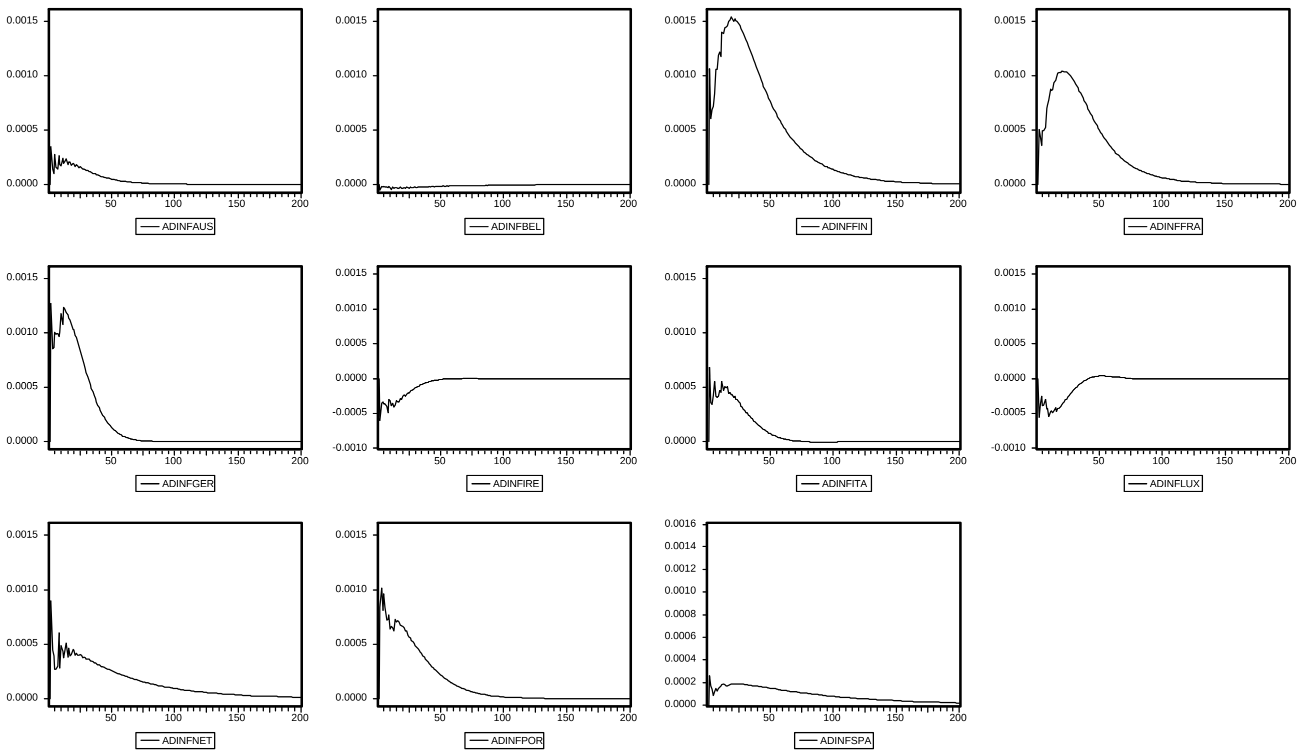

Figure 8: In‡ation Response w.r.t. AD Shock

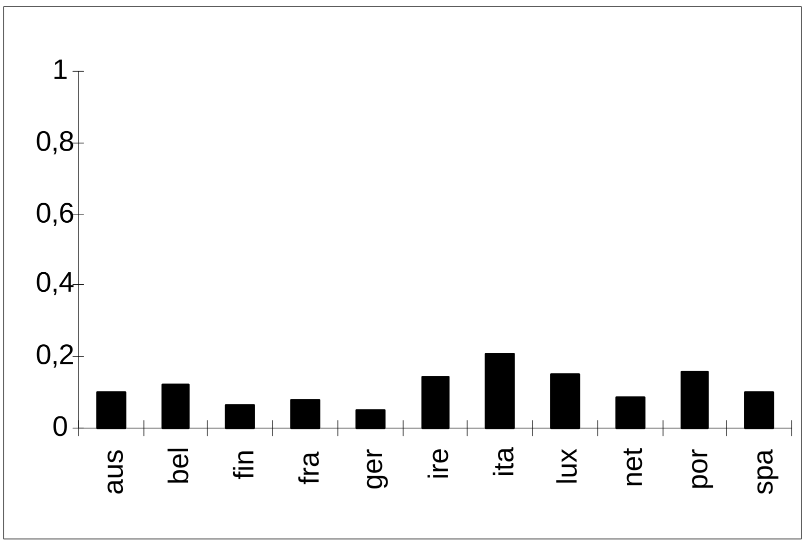

Figure 9: (First) Optimal In‡ation Coe¢cients

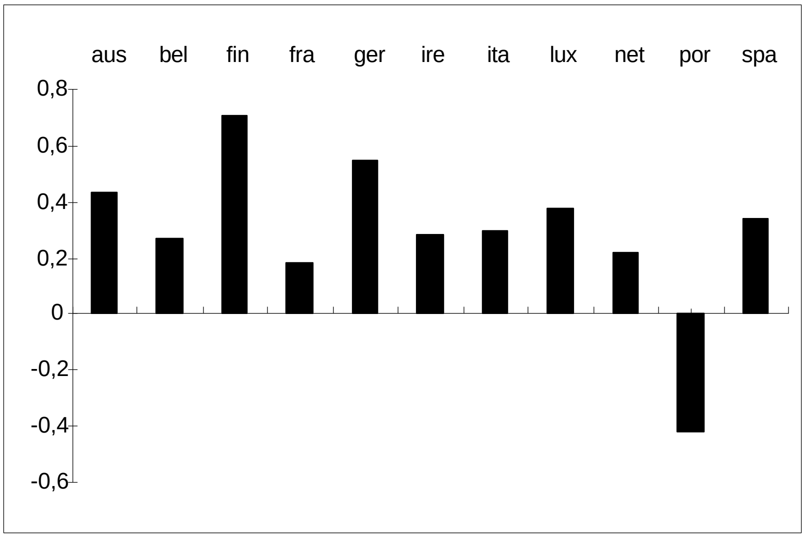

Figure 10: (Firts) Optimal Output Coe¢cients

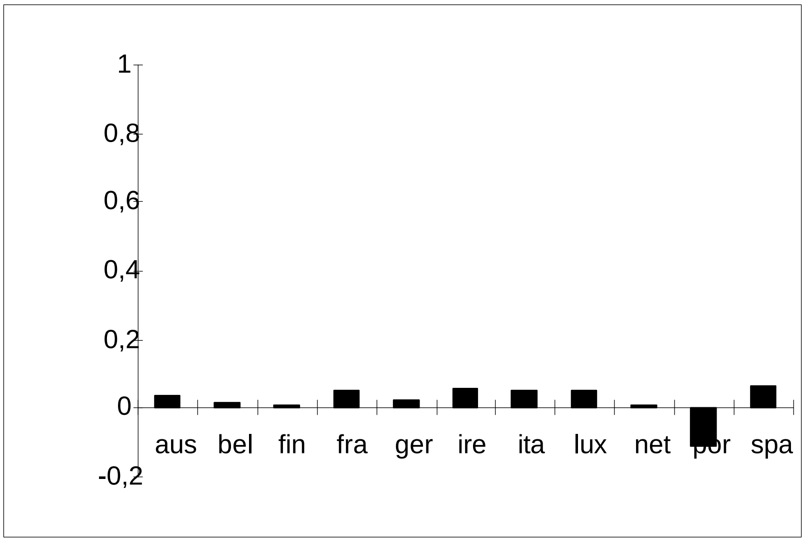

Figure 11: (First) Optimal Real dExchange Rate Coe¢cients

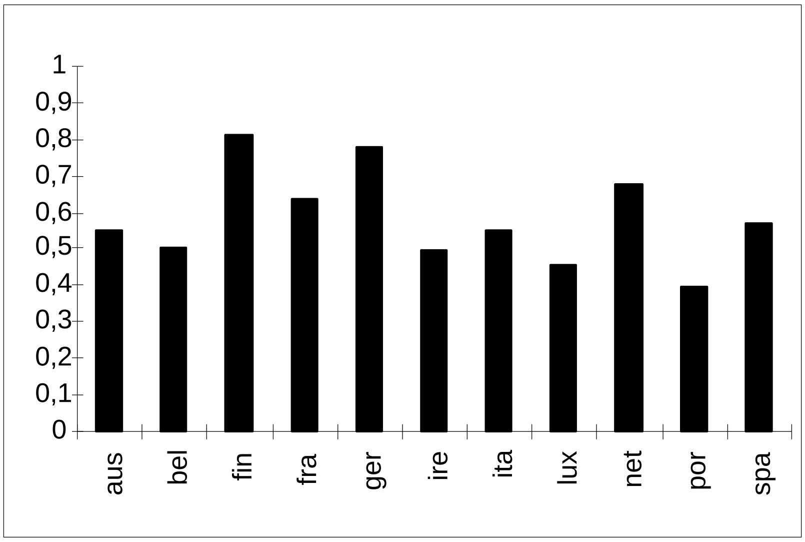

Figure 12: (First) Optimal Interest Smoothing Coe¢cients