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Abstract

This paper develops the "identified VAR" models of France and Spain with German monetary variables to identify monetary policy shocks during the period when the exchange rate is controlled mostly by the ERM. Different identifying assumptions on the contemporaneous policy interactions are experimented. The impulse responses to monetary policy shocks and estimated parameters of monetary reaction function suggest that the identification scheme implying unilateral contemporaneous reaction of non-German monetary policies to the exchange rate against DM and the German interest rate and the identification scheme implying contemporaneous reactions of non-German monetary authority and the German interest rate to the bilateral exchange rates seem reasonable identifying assumptions in these countries. Regarding exchange rate stabilization or policy interactions in a general sense, the results suggest that the FF/DM and the Ptas/DM exchange rates are stabilized mostly by French and Spanish monetary policy (more vigorously by Spanish monetary authority). Regarding the sources of the nominal exchange rate fluctuations, the French and Spanish monetary policy shocks are the major sources of the fluctuations of the FF/DM and the Ptas/DM exchange rates (larger contribution in Spain). This result, together with moderate contribution of German interest rate shocks on the FF/DM and Ptas/DM exchange rate fluctuations, can be interpreted as a result of the different magnitude of exchange rate stabilization in different countries.

1. Introduction

There has been extensive research to develop empirical models that identify monetary policy shocks. This literature uses VAR models with different plausible identifying restrictions to identify monetary policy shocks the basic effects of which are consistent with commonly shared prior beliefs. This paper applies the current developments in this literature to the European countries - France and Spain for the period in which the exchange rate is controlled mostly by the ERM.

After classical works in this area (for example, Friedman and Shwartz (1963), Sims (1972), and Sims (1980a and b)), most initial contributions to this literature are developed by examining the U.S. economy, for example, Bernanke and Blinder (1992), Strongin (1995), Gordon and Leeper (1994), Eichenbaum (1992), Christiano and Eichenbaum (1992), Christiano, Eichenbaum, and Evans (1996), Sims and Zha (1995), Bernanke and Milhov (1995). This research finds the series of puzzles (most notably, the "price puzzle" and the "liquidity" puzzle). The nature of this puzzle is the dynamic responses of the identified monetary policy shocks are different from our widely shared priors on the basic effects of monetary policy shocks. In the U.S. economy using closed economy models, some consensus on the effects and identification scheme has been reached to some degree after resolving those puzzles.[1]

After the initial period of examining the U.S. economy within a closed economy setup, the literature has been developed to consider open economies and non-US countries (for example Sims (1992), Eichenbaum and Evans (1995), Grilli and Roubini (1994), Kim (1996), Kim and Roubini (1995), Cushman and Zha (1995)), again producing and resolving some puzzles, notably, the "exchange rate" puzzle and the conditional "forward discount bias puzzle."[2]

Note that most puzzles in this literature can be resolved by making the identified policy shocks "exogenous" or by reasonably specifying systematic reactions of monetary policy (monetary reaction function). For example, the "price puzzle" was resolved by

[1] See Leeper, Sims, and Zha (1996) for the unifying framework and summarizing the consensus. See also Introduction of Kim (1996) for the summary of this literature.
[2] See Grilli and Roubini (1996) for the summary of the literature related to the effects of exchange rate.

considering systematic reactions of monetary policy to inflationary pressure which had not been specified before.[3] As a result, the identified monetary policy shocks become exogenous to inflationary pressure, which monetary authority systematically reacts to. So, specifying reasonable systematic reactions of monetary authority and making the identified policy shocks as exogenous are essential in identifying monetary policy shocks.[4]

Back to the developments of the literature, most past open economy models has been used the U.S. variables as the world variables, for example, Eichenbaum and Evans (1995) and Kim and Roubini (1995). One possible problem of previous research in directly applying to non-German European countries is that Germany, especially the German monetary policy or the German monetary variables have great influence on the non-German European countries. To identify exogenous domestic monetary policy shocks in these countries, it seems essential to consider policy reactions to German monetary variables. Furthermore, considering that most countries are within the ERM, and that the ERM may be considered as the system where each country pegs their currency to DM, it is essential to consider policy reactions to the exchange rate against DM and the German interest rate. Therefor, I try to construct a model including German monetary variables explicitly in the model to identify exogenous monetary policy shocks in non-German European countries.[5][6]

Then, how can we model the interaction between non-German monetary policy and German monetary policy, especially in stabilizing their bilateral exchange rate? In

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[3] See Sims (1992) and Sims and Zha (1995)

[4] See Kim (1996) for further discussion.

[5] On the other hand, since the major focus of this paper is identifying (non-German) exogenous monetary policy shocks, and examine the policy interactions, the general dependence of non-German economy to Germany may cause little problem. For example, there may not be much problem of not including German price and output directly in the model (to identify German real sector shocks) as long as the (non-German) price and output and German monetary variables well-capture the movements of German real sector shocks. Those variables will well-capture the movements of German real sector shocks, then our identified monetary policy shocks will be exogenous to German real sector shocks since they are exogenous to non-German price and output and German monetary variables.

However, this may cause some problem of interpreting German interest rate shocks as representing German monetary policy shocks. I will discuss this point again in Section 6.

[6] There have been some previous works for non-German European countries including German monetary variables in the model, for example, Kim (1996) constructed a model for Italy, France, and the U.K. where

this paper, I experiment different hypotheses on contemporaneous policy interactions. And based on these models' estimated structural parameters (whether they can be interpreted as stabilization movements) and the dynamic responses (whether the responses to monetary policy shocks can match the basic effects of monetary policy shocks), we infer which model is more reasonable. Based on those models, we examine the effects of monetary policy shocks. Then, the results are compared to the previous research that does not consider the German variables explicitly.

The above experiments suggest how to model contemporaneous monetary policy interactions. However, more interesting issue is analyzing policy interactions in general. For the current context, there are several interesting questions: which country tries to stabilize the bilateral exchange rate, non-German countries or Germany, especially during the ERM period? Do they respond to shocks destabilizing exchange rate? How do they respond to foreign monetary policy shocks? Does Germany care about intra-European exchange rates? We can answer these questions since we also identify monetary reaction functions in addition to monetary policy shocks. I try to answer this question by examining impulse responses to external structural shocks destabilizing exchange rate and inferring policy reactions.[7]

I examine two largest countries – France and Spain. France has been within the ERM for a reasonably long period. Though Spain joined the ERM in 1989, it may be interesting to compare the results with those of France since we expect more unilateral dependence of Spanish monetary policy on Germany.[8]

The structure of the paper is as follows. In Section 2, I summarize the identified VAR modeling method and present the basic identifying assumptions. In Section 3, I examine the estimated structural parameters and the impulse responses of monetary policy shocks to evaluate different models. In Section 4, I explore the extent of exchange rate stabilization from Germany and non-German countries by examining the impulse

the German interest rate is included, and Shioji (1997) constructed a model for Spain where the Ptas/DM exchange rate is considered explicitly.

[7] Related to these types of questions, Montalvo and Shioji (1997) analyzed the reactions of non-German countries to German monetary policy shocks. Smets (1997) also examines how much weights German and other European countries put on exchange rates.

responses. In section 5, I examine the role of monetary policy shocks and compare to the previous research. In Section 6, I summarize our results and discuss the implications.

2. Identification Scheme

2.1. Identified VAR Modeling.

We assume the economy is described by a structural form equation

$$(1) \qquad G(L)y_t = e_t$$

where G(L) is a matrix polynomial in the lag operator L, y_t is an $n\times 1$ data vector, and e_t is an $n\times 1$ structural disturbances vector. e_t is serially uncorrelated and $var(e_t)=\Lambda$. Λ is a diagonal matrix where diagonal elements are the variances of structural disturbances, so structural disturbances are assumed to be mutually uncorrelated.

We can estimate a reduced form equation (VAR)

$$(2) \qquad y_t = B(L)y_t + u_t,$$

where B(L) is a matrix polynomial (without the constant term) in lag operator L and $var(u_t)= \Sigma$.

There are several ways of recovering the parameters in the structural form equations from the estimated parameters in the reduced form equation. Some methods give restrictions on only contemporaneous structural parameters. A popular and convenient method is to orthogonalize reduced form disturbances by Cholesky decomposition (as in Sims (1980a and b) and Bernanke and Blinder (1992) among others). However, in this approach to identification we can assume only a recursive structure, that is, a Wold-causal chain. Blanchard and Watson (1986), Bernanke (1986), and Sims (1986) suggest a generalized method (identified VAR) in which non-recursive

[8] I also experiment another largest country, Italy, but I drop the results since the results are sensitive to the estimation period, which may be due to the currency crisis in early 90's.

structures are allowed while still giving restrictions only on contemporaneous structural parameters.

Let G_0 be the coefficient matrix (non-singular) on L^0 in G(L), that is, the contemporaneous coefficient matrix in the structural form, and let $G^0(L)$ be the coefficient matrix in G(L) without contemporaneous coefficient G_0. That is,

$$G(L) = G_0 + G^0(L). \tag{3}$$

Then, the parameters in the structural form equation and those in the reduced form equation are related by

$$B(L) = - G_0^{-1} G^0(L), \tag{4}$$

In addition, the structural disturbances and the reduced form residuals are related by

$$e_t = G_0 u_t, \tag{5}$$

which implies

$$\Sigma = G_0^{-1} \Lambda G_0^{-1\prime}. \tag{6}$$

Maximum likelihood estimates of Λ and G_0 can be obtained only through sample estimates of Σ. The right-hand side of equation (6) has $n \times (n+1)$ free parameters to be estimated. Since Σ contains $n \times (n+1)/2$ parameters, we need at least $n \times (n+1)/2$ restrictions. By normalizing n diagonal elements of G_0 to 1's, we need at least $n \times (n-1)/2$ restrictions on G_0 to achieve identification. In the VAR modeling with Cholesky decomposition, G_0 is assumed to be triangular. However, in the generalized structural VAR approach G_0 can be any structure as long as it has enough restrictions.

2.2. Identification Scheme

I include the minimum set of variables to examine the issue under consideration. The data vector is {R, M, CPI, IP, R(G), E(·/DM)}, where R is a short-term interest rate, M is a monetary aggregate, CPI is the consumer price index, IP is the industrial production, R(G) is the German short-term interest rate, and E(·/DM) is the exchange rate expressed as units of domestic currency for one unit of German Mark. For monetary aggregate, I use M2 for France, ALP (similar to M4) for Spain since there are substantial documentation suggesting that those monetary aggregates are intermediate targets in those countries during the most estimation period.[9]

The interest rate, money, price, and output are well-known variables in monetary business cycle literature. These variables seem essential to identify monetary policy in any countries.[10] The other variables, the German interest rate and the exchange rate against DM, are the minimum set of variables that are relevant to current analysis identifying monetary policy in relation to German monetary variables and considering policy interactions. In general, they are important variables for identifying monetary policy in European countries. During the estimation period, the exchange rate of France and Spain is mostly controlled by the ERM, which may be regarded as a peg to DM. Moreover, as a leader of ERM, German monetary variables affect the monetary policy actions in these countries. These German monetary variables are introduced to control for the component of domestic monetary policy that is a reaction to German monetary shocks or the value of domestic currency, which lead to inflationary outcome or destabilization of the exchange rate.

The basic identification scheme is similar to the one that has been used by previous analysis which has been successful in identifying monetary policy shocks the basic effects of which are consistent with our widely shared priors, for example, Gordon and Leeper (1994) and Sims and Zha (1995) for the U.S., Kim (1996) and Kim and

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9 See Melitz (1991) and Batten et al (1990) for France and Ayuso and Escriva (1997) for Spain.

10 We may proceed with the model without money, but inclusion of money is essential to isolate monetary policy shocks and shocks from the financial market by adding monetary aggregate.

Roubini (1995) for the G-7 countries.[11] On top of the basic identifying assumptions, I consider different identifying assumptions on the policy interactions.

The following is the restrictions on the contemporaneous structural parameters G_0, based on $e_t = G_0 u_t$.

$$\begin{bmatrix} e_{MS} \\ e_F \\ e_{CPI} \\ e_{IP} \\ e_E \\ e_{R(G)} \end{bmatrix} = \begin{bmatrix} 1 & g_{12} & 0 & 0 & g_{15} & g^*_{16} \\ g_{21} & 1 & g_{23} & g_{24} & 0 & g_{26} \\ 0 & 0 & 1 & g_{34} & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 \\ g_{51} & g_{52} & g_{53} & g_{54} & 1 & g_{56} \\ g^*_{61} & 0 & 0 & 0 & g^*_{65} & 1 \end{bmatrix} \begin{bmatrix} u_R \\ u_M \\ u_{CPI} \\ u_{IP} \\ u_{E(\backslash DM)} \\ u_{R(G)} \end{bmatrix} \tag{7}$$

where e_{MS}, e_M, e_{CPI}, e_{IP}, $e_{R(G)}$, $e_{E(/DM)}$ are the structural disturbances, that is, money supply shocks, shocks in financial or money market (or M shocks), CPI shocks, IP shocks, E(/DM) shocks, and R(G) shocks, respectively, and u_R, u_M, u_{CPI}, u_{IP}, $u_{E(/DM)}$, and $u_{R(G)}$ are the residuals in the reduced form equations, which represent unexpected movements (given information in the system) of each variable.

Here, the 1's, 0's, and g's without '*' are the identifying restrictions that are the common restrictions for all models while g's with '*' are the identifying restrictions that are different across models. First, I will briefly explain the common restrictions. Before we explain the details of our identifying restrictions, it is worth noting again that the following relations are contemporaneous restrictions on structural parameter G_0 without further restriction on lagged structural parameters.

The first equation is the money supply equation. It is assumed to be the reaction function of the monetary authority, which sets the interest rate after observing the current value of money and the exchange rate (and the German interest rate if g_{16} is non-zero) but not the current values of output and the price level. This assumption is based on the

[11] There may be some possibility that other structural shocks, rather than monetary policy shocks, may produce similar impulse responses to monetary policy shocks in those models, and the identified monetary policy shocks in those models may not represent the "true" monetary policy shocks. However, there have not been any serious challenge to the identification scheme suggesting this possibility and we do not have

assumption of information delays - data on money and exchange rates (and the German interest rate) are available within a month, but those on the output and the price level are not.

The third and fourth equations represent the sluggish real sector. Real activity is assumed to respond to price and financial signals (interest rates and exchange rates) only with a lag. The interest rates, money, the U.S. interest rate, and the exchange rate are assumed not to affect the level of real activity contemporaneously. One motivation for this identifying assumption is that firms do not change their output and price unexpectedly in response to unexpected changes in financial signals or monetary policy within a month due to inertia, adjustment costs and planning delays.

The second and fifth equations are block of arbitrage equations describing financial market equilibrium. In most past research, the fifth equation is regarded as an arbitrage equation describing exchange rate market, but the second equation is regarded as the money demand equation by imposing a zero restriction on g_{26}., for example, Kim and Roubini (1995). Here, I do not impose any restrictions (but normalization) on the second equations. The monetary aggregates considered here are broad ones, and the demand for these financial assets may be influenced by exchange rate and foreign interest rate, especially when uncovered interest rate parity does not exactly holds.[12] In general, I interpret these two equations as financial market equations (money, financial assets, and exchange rate) and I do not give any clear structural interpretations.

The assumptions on the second, third, fourth, and fifth equations representing two different sectors - the real sector and the financial sector - are the generalization of difference in the response of the financial sector and the real sector. That is, the financial sector is thought to respond quickly to the shocks (including real sector shocks) while real sectors are thought to respond sluggishly to the shocks.

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any alternative models that have been as successful as those (especially in non-US countries). Therefore, I proceed with those models.

[12] In many cases, additional zero restriction on g26 does not change the result much. But in some cases, especially in France, with the zero restriction, the response of monetary policy shocks are difficult to be justified. In addition, in some cases, the estimated contemporaneous parameters are difficult to be interpreted as money demand equation. These results make me to generalize the second equation as one equation in a financial sector equation.

Finally, in the last equations, the German interest rate is contemporaneously exogenous to the domestic real variables and money.

Next, I explain the different identifying assumptions on the policy interactions between domestic monetary policy, German interest rate, and exchange rate. Though I do not carefully identify monetary policy in Germany, I use the German interest rate as a proxy for the German monetary policy. The first hypothesis is that within a month, German monetary policy does not respond to monetary and exchange rate developments in the other countries. This amounts to the assumption that German interest rate is contemporaneously exogenous (zero restrictions on g_{61} and g_{65}). Depending on contemporaneous reaction of non-German countries to German interest rate, that is, the restrictions on g_{16}, (in addition to exchange rate), there are two different models. I call them the NG-RGE model (no German reaction, the German interest rate excluded) and the NG-RGI model (no German reaction, the German interest rate included).

Before moving to other hypothesis, I briefly explain the restrictions on g_{16} in comparison to Kim and Roubini (1995) giving zero restrictions on the similar parameter. In a similar system, they did not allow contemporaneous reaction of the G-7 countries against the US interest rate while allowing contemporaneous reaction of the G-7 to the exchange rate against the U.S. The rationale for their identifying assumption is: within a month, monetary authority cares more about unexpected changes in exchange rate against the U.S rather than the unexpected changes in the U.S. interest rate per se, and within a month, the U.S. interest rate does not have additional information for non-U.S. monetary authorities after they consider their exchange rate against the U.S. dollar. In contrast, within the nearly fixed exchange rate regime of the ERM, the German interest rate may have additional within-a-month information in constructing a proper monetary reaction function of non-German European countries. For example, if the monetary authority increases the interest rate very quickly in response to a German interest rate increase and the following exchange rate depreciation, then exchange rate will be back to the original value shortly. Then, the monthly average data will show small exchange rate depreciation but large interest rate increases, which may not capture reactions of the monetary authority very well. If we allow contemporaneous reaction to the German interest rate, then since similar increases in the German interest rate are observed, the monetary reaction function would capture the reactions better. So, I also experiment with the system including the German interest rate.

The alternative hypothesis is that the German monetary authority cares about the financial developments in other countries, especially the exchange rate against them, within a month. This amounts to allowing feedback from the exchange rate (and non-German interest rate) in the German interest rate equation, which implies no restrictions on g_{65} (and g_{61}). I consider three cases. First, both authorities react to the exchange rate, but not the interest rate of the other - zero restrictions on g_{16} and g_{61}. I call this the SG-RSE model (symmetric German reaction, interest rates are excluded). Second, both authorities react to both exchange rate and the interest rate of the other, which implies no zero restrictions on g_{16}, g_{61} and g_{65} - the SG-RSI model (symmetric German reaction, interest rates are included). Third, non-German monetary authorities react more quickly (allowing reactions to both interest rate and exchange rate), but the German monetary authority reacts also (allowing reactions to only exchange rate), which implies zero restrictions on g_{16} - the PG model (partial German reaction).

In summary, I consider five different models depending on German reactions to financial developments in non-German country and contemporaneous extra information on current interest rate.

All variables were used in logarithm form except for interest rates. Complete seasonal dummies were used in all estimations. Monthly data are used. For France, I consider the period of ERM, from 79:3.[13] For Spain, I consider the period when the Bank of Spain cares about the exchange rate developments, from 1984.[14] I used different lag structures for the different length of the estimation periods.[15]

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[13] For France, the estimation period is 79:3-95:12.

[14] The estimation period is 1984-1995. See Ayuso and Escriva (1997) for the documentation of developments of Spanish monetary policy.

[15] I use {1,2,3,4,6,12} for France and {1,3,6,12} for Spain. Different lag structure does not change the results much. Since the estimation period is short, using including more number of lags does not make much sense. By including the 12th lag, I try to capture some long run effects. And the lag-length test suggests that the first lag is very significant in all estimation. As a rule of thumb, for each estimation, I include the

3. Estimates of the Structural Parameters and Impulse Responses to Monetary Policy Shocks

In this section, I examine which models show reasonable estimates of structural parameters of monetary reaction functions and reasonable impulse responses to monetary policy shocks. First, I examine whether the estimated structural parameters can be interpreted as the monetary authority's reaction to stabilize the exchange rate. When the estimated structural parameters are difficult to be interpreted as an exchange rate stabilization, I regard the model as mis-specified. For example, when the estimates of g_{15} and g_{16} show the positive signs, which are interpreted as the exchange rate dis-stabilization, I regard the model as mis-specified since I do not find any plausible reason that the monetary authority tries to systematically destabilize the exchange rate contemporaneously.[16] Second, I examine whether the impulse responses to monetary policy shocks can match the basic effects of monetary policy shocks.

3.1. Estimates of the Structural Parameters in Monetary Reaction Functions

In Table 1, I report the estimated coefficients for the monetary reaction functions and the German interest rate equation for the French models.[17] The numbers in the parenthesis are standard errors. The estimated values of g_{12} and g_{15} show the negative sign in all cases. This implies that the monetary authority increases the interest rate when it observes an increase in the monetary aggregate and an exchange rate depreciation. That

number of lags which makes the ratio of estimated parameters to observation roughly one-quarter. Results are not sensitive to the structure of the medium-term lags.

[16] This is a very informal way of selecting a model. First, if we include different variables, the result may change. Second, the standard errors of estimated parameters are very large. For the first criticism, I experimented some other models as in Section 6, but the major results do not change much. (Of course, further investigation may be worthwhile)

There are some justifications against the second criticism. If the standard errors are so large that two different models produce almost similar results after counting standard errors of results, then there will be no problem of choosing one over the other (since the results are similar). If the results are quite different, then we would choose the results from one model over those from the other. In this case, we do need a criterion to choose one model over the other, and the sign of structurally interpretable parameters seem to be a reasonable reference. In addition, the large standard errors are due to multi-collinearity to the some extent. In this case, interpreting the estimates is more meaningful.

is, monetary authority takes a contractionary position when faced with inflationary pressures and tries to stabilize the exchange rate.

For the other parameters, g_{16} shows negative signs in the NG-RGI and the SG-RSI models, which implies that the monetary authority increases the interest rate (to stabilize the exchange rate) when it observes an increase in the German interest rate (which leads to an exchange rate depreciation), which is consistent with the stabilization of the exchange rate. However, in the PG model, the opposite sign shows, which suggests a possible mis-specification of the model. By a similar reasoning, if the German monetary authority tries to stabilize the exchange rate, we would observe the negative sign of g_{61} and the positive sign of g_{65}. In this respect, the PG and the SG-RSE model show the proper sign of g_{65}, but the SG-RSI model shows the opposite sign of g_{61} and g_{65}. In terms of the signs of the estimated coefficients, the PG and the SG-RSI model seem difficult to be justified.

In Table 2, I report the estimated coefficients for the monetary reaction function and the German interest rate equation for the Spanish models. The estimated values of g_{15} are negative in all cases but the values of g_{12} are positive in most cases with large standard errors. The positive and not-significant g_{12} seems resulted from partial accommodation of monetary authority to money demand shocks, though it seems difficult to be verified in the present analysis.[18] For the other parameters, the signs of all parameters are the same as the French case, which suggests the PG and the SG-RSI model seem difficult to be justified. Also notice that we find very large standard errors in the coefficients of the monetary reaction function in the NG-RGE model, the PG model, and the SG-RSI model.

3.2. Impulse Responses to Monetary Policy Shocks

[17] I do not report other estimated parameters since they do not have any clear structural interpretations.

[18] This may be resulted from sample instability. When I estimate the model from 1986, the estimates show the negative sign. And there is a rational for estimating from 1986 since there is a documentation suggesting the Bank of Spain did not pay much attention to exchange rate until 1986 though it officially monitored the exchange rate from 1984. However, I do not shorten the period since the estimation period is still short even without dropping the period 1984 -1986. And major results do not change.

In Figure 1, we display the estimated impulse responses to a contractionary monetary policy shocks. Each column of the figure gives the impulse responses (over 48 months) to a one-standard-deviation monetary policy shock (monetary contraction). The responding variables are named at the far left of each row. The upper and lower dashed lines plotted in each graph are one-standard-error bands.[19] The response graphs in a given row all have the same scale, with the maximum and minimum heights shown on any graph in the row noted to the left of the graph.[20] In addition, for easier comparison between movements of the German interest rate and the domestic interest rate, I use the same scale for the responses of the German interest rate and the domestic interest rate.

The impulse responses are very similar across models. In response to a monetary policy shock, initially the interest rate rises and money stock declines. The price level fall significantly for a long time. The output falls significantly, then go back to the initial level in about three or four years. We also find the impact appreciation of exchange rate. Then, the exchange rate depreciate over time. All these responses are consistent with widely shared priors on the effects of monetary policy.

In Figure 2, I display the estimated impulse responses to a contractionary monetary policy shocks in Spain.[21] Like French models, the impulse responses are very similar across models. In response to a monetary policy shock, initially the interest rate rises. Money stock declines few months later. The price level fall significantly for a long time. The output does not respond much. We also find the impact appreciation of exchange rate. These responses are consistent with widely shared priors on the effects of monetary policy.

3.3. Comparison

In France, it seems to be difficult to conclude which model can identify monetary policy shocks better since all responses are very similar across models. In terms of the

[19]They were generated from three thousand draws by Monte Carlo Integration following Sims and Zha (1994); a Bayesian method which employs a Gaussian approximation to the posterior of G_0.

[20] The scale of interest rate graph is the deviations in basis point, while the scale of other variables is percentage deviations.

[21] I cannot calculate the standard errors for the NG-RGE model since a0 matrix is almost singular which is represented in huge standard errors in the monetary reaction function.

estimated coefficients, the PG and the SG-RSI models are difficult to be justified. If we examine the impulse responses more carefully, we find more similarity between the other models (and the similarity between the PG and the SG-RSI models). In these two models, the initial interest rate increases are negligible and the big drops in interest rate are found in few months. Though we can justify the big drops in the interest rate by deflation following monetary contraction, the exchange rate response seems to difficult to be justified in the light of the responses of domestic interest rate and the German interest rate, which makes me to give more credit on the other models. Similarly, the exchange rate movements of the NG-RGE model seems difficult to be justified since we observe larger depreciation with very small increase in interest rate (which last for a very short period).

In Spain, responses from all models are very similar across models as in France. In terms of the estimated coefficients, the PG and the SG-RSI models are difficult to be justified. If we examine the impulse responses more carefully, we find the "delayed overshooting" (as in Eichenbaum and Evans (1995)) in the PG model. So, I would give less credit to the PG model. Finally, considering huge standard errors, the NG-RGE model may be regarded as less satisfactory.

In summary, the PG and the SG-RSI models show the wrong sign of the estimated structural parameters in interpreting them as policy reactions to stabilize the exchange rate. So, I will not consider results from these two models in the later analyses. Based on impulse responses, the NG-RGI and the SG-RSE models can deliver reasonable response as those of monetary policy shocks. The SG-RSE model also shows equally plausible responses while the NG-RGE model seems a bit less satisfactory. In the following sections, I will give more weights on the results of the NG-RGI and the SG-RSE models.

On the other hand, similar impulse responses across models suggest that the small modifications on the interaction between monetary authority does not make much differences (especially the effects on the exchange rate), which in turn leads to the effects of monetary policy presented here seems to be quite robust under different assumptions on the contemporaneous monetary interactions.

4. Policy Towards Exchange Rate Stability and Policy Interactions: Who Stabilizes the Exchange Rate?

The different models under consideration make different assumptions on the contemporaneous policy interactions and on the contemporaneous policy reactions to exchange rate. But in many cases, impulse responses are similar across models, not sensitive to the slight modifications of the identifying assumptions. In relation to this result, I would like to emphasize that different identifying assumptions on the contemporaneous policy interactions do not necessarily imply different implications on the policy interactions in general. First, the restriction that I impose is the zero restriction, but the opposite case is giving no restriction. So, the finding that not imposing a specific zero restriction produces more reasonable dynamics does not necessarily imply that the corresponding policy reaction is significant. Second, the contemporaneous restrictions are only on the contemporaneous reactions. To consider overall policy reactions, we should consider all lagged parameters in the monetary reaction functions.

For example, suppose that the estimated g_{65} shows the right sign (as a German reaction to stabilize exchange rate) and that the resulting impulse responses show better responses to those responses from the model giving zero restrictions on g_{65}, as responses to monetary policy shocks. This does not necessarily imply that the German role of stabilizing exchange rate is substantial (especially compared to the non-German's), though allowing contemporaneous reactions is important for identifying monetary policy shocks. In this section, we explore the policy interactions and policy reactions towards exchange rate stabilization in a general sense.

As I discussed previously, identifying monetary policy shocks also implies identifying monetary reaction functions. Since we identify monetary reaction functions in the current analysis, we can answer the type of questions on the policy interactions. One problem is that the estimated policy reaction function is complicate, so it is difficult to interpret them. There are three possible ways to proceed. The first one is constructing more intuitive form of monetary policy rule. For example, Clarida and Gertler (1996) transformed the monetary reaction function to the one similar to the "Taylor Rule". The second one is "counter-cyclical experiments." For example, Sims and Zha (1995) and Kim (1996) experimented different monetary policy rules by changing monetary reaction function. The third one is examining the estimated impulse responses, and infer the policy reactions. Many previous researchers interpreted impulse responses with policy reactions, though not many emphasized it.

I proceed with the third way since the first and second ways need some additional assumptions. The first one needs a form of monetary policy rule which will give additional restrictions on the model. The second one needs an additional assumption that other structural parameters does not change, which may not be reasonable for some variables which are strongly affected by expectation changes (for example, the exchange rate). A possible problem of the third way is that sometimes it may be difficult to separate the responses of economy to structural shocks and responses of economy to policy reactions. But I proceed with this way, since sometimes we can infer policy reactions and this method does not need any further assumptions.

From the impulse responses of monetary policy shocks in Figure 1, we can examine the German policy reactions to non-German monetary policy shocks and the resulting exchange rate instability. We indeed observe a very small increase in the German interest rate for the first few months (the NG-RGE, the NG-RGI, and the SG-RSE models), which can be interpreted as exchange rate stabilization.[22] But the changes in the German interest rate are very small compared to changes in the French interest rate, which results a large appreciation of the French Franc against the DM. (Notice that the scales of the French interest rate and the German interest rate are the same.) This suggest that there does not seem to be a strong reaction of the German monetary authority to the exchange rate destabilization due to the French monetary policy shocks.

In contrast, the response of the French to the German interest rate shocks is noticeable. In Figure 3, I report the impulse response to the German interest rate shocks. In response to the German interest rate shocks, the French interest rate increases significantly. As a result, we cannot observe any strong depreciation of the FF against the

[22] I do not have any clear interpretation on subsequent drop in the German interest rate. This may suggest that possible endogeneity of the identified monetary policy shocks, which makes me construct extended models later.

DM. Though other responses suggest that the German interest rate shocks may represent world negative supply shocks (I will discuss this possibility later), the French reaction to the German interest rate shocks in stabilizing the exchange rate seems remarkable.

To further examine the possibility of the reactions of both monetary authorities to destabilizing movements in exchange rate, I report the impulse responses to the exchange rate shocks (from the fifth equation in (7)) in Figure 4. This exchange rate shocks do not have any clear structural interpretation, but by construction, it represent the exchange rate movements that cannot be explained by any innovations in the model. So, they naturally represent shocks destabilizing the exchange rate. Again, we do not find much evidence that German monetary policy tries to stabilize the exchange rate, and most movements for exchange rate stabilization comes from the French monetary policy. In response to an exchange rate depreciation (FF/DM), the French interest rate goes up significantly on impact, which may be interpreted as a policy reaction to stabilize the exchange rate against the exchange rate depreciation. In contrast, we do not find much significant changes in the German interest rate, though we find a small decreases in the German interest rate, which can be interpreted as a policy reaction to stabilize the exchange rate against the DM/FF appreciation.

For Spain, in response to Spanish monetary policy shocks, the German interest rate increases slightly, which suggests some stabilization but the magnitude is quite small. In response to German interest rate shocks, we find much larger stabilization movements, which is represented by subsequent increases in Spanish interest rate and not much effects on exchange rate (Figure 5). In response to exchange rate shocks, we find large stabilization movements from Spain, but very little or no German stabilization (depending on the model) (Figure 6).

In summary, the exchange rate stabilization of Germany against French Franc and Spanish Pesetas seem quite minor. In most cases, we cannot find much evidence that Germany tries to stabilize the exchange rate against FF and Spanish Pesetas vigorously.

On the other hand, we observe substantial evidence that Spain and Germany try to stabilize the exchange rate against the DM.[23]

We can also compare the degree of exchange rate stabilization in Spain and France. If we compare Figures 5 and 6, and Figures 7 and 8, we can see that the responses of Spanish interest rates are far larger than responses of French interest rates. These results suggest that the Spanish monetary authority is more vigorously stabilize the exchange rate, compared to the French monetary authority.

This result is consistent with the finding by Montalvo and Shioji (1997). They examined the responses of EMS countries to the German monetary policy shocks and found that much of the German monetary policy shocks are stabilized by non-German countries. Smets (1997) suggested that France puts much weights on the exchange rate against DM, which is consistent with the results of this paper. He also suggested that the Bundesbank puts much weights on intra-European exchange rate stabilization. Since he used composite index against many European countries, his finding is not necessarily inconsistent with my results.

5. Variance Decomposition

Based on the previous models, we can examine the role of monetary policy shocks and the German interest rate shocks on the fluctuation of the variables. The role of monetary policy shocks on output and price fluctuations has been widely documented in the previous research, for example, Gordon and Leeper (1994), Sims and Zha (1994) for the US, Kim (1996) and Kim and Roubini (1995) for the G-7 countries, Jareno, Sebastian, and Valles (1997) and Shioji (1997) for Spain. And the result of this paper does not produce much difference. I report the results in Tables 3 and 4.

As can be easily seen in the tables, monetary policy shocks are not the major sources of output and price fluctuations. In France, they explain 10 - 20 % of output fluctuations and less than 10 % of price fluctuations. These results are consistent with Kim (1996) and Kim and Roubini (1995). In Spain, monetary policy shocks explain 6 -16

[23] It may be interesting to policy reactions to other structural shocks in the model. But from responses to

% of output fluctuations and 19 - 30 % of price fluctuations at the peak. These results are consistent with Jareno, Sebastian, and Valles (1997) and Shioji (1997).

Then I examine the role of monetary policy shocks and Gennan interest rate shocks on the exchange rate fluctuations. The domestic monetary policy shocks are the major sources of the nominal exchange rate fluctuations. In France, the contribution is 32 - 54 % at the peak. In Spain, the contribution is even larger, 51 -82 % at the peak, which suggest that the Spanish monetary policy shocks are the dominant source of the Ptas/DM exchange rate. The Gennan interest rate shocks also explain some of nominal exchange rate fluctuations. They explain more or less 10 % of the FF/DM fluctuations and more or less 20 % the Ptas/DM at the peak. If we interpret the German interest rate shocks as the German monetary policy shocks, then both monetary policy shocks explain more than half of the nominal exchange rate fluctuations.

One interesting result is that domestic monetary policy shocks and German interest rate shocks explain quite different proportion of the exchange rate fluctuations in different countries. The Spanish monetary policy shocks have a very large contribution. The French monetary policy shocks explain a lot, but less than the Spanish monetary policy shocks. German interest rate shocks less than the French and Spanish monetary policy shocks.

First possible explanation is that the size of typical monetary policy shocks are different across countries, but this does not seem to explain the difference. In the Figures I and 2, we can see that the typical monetary policy shocks are represented as about .2 basis point increases in interest rate (based on the NG-RGI model). From Figures 3 and 5, we can also find that the typical German interest rate shocks is a similar magnitude increase in the Gennan interest rate. Therefore, the size of typical monetary policy shocks do not seem able to explain the different contributions across countries.

There are some other possible explanation like different transmission mechanism in different countries and different size of other structural shocks in different countries, which is not verified in current analysis.

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other shocks, it seems difficult to separate the policy reactions.

Here, I give an interpretation of this result related to policy interactions or the different magnitude of exchange rate stabilization in different countries. Germany do not stabilize much of exchange rate disturbances due to French and Spanish monetary policy shocks against French Franc and Spanish Pesetas. In contrast, France and Spain stabilize the exchange rate disturbances due to German interest rate shocks. As a result, the French and Spanish monetary policy shocks explain much portion of exchange rate fluctuations while German interest rate shocks explain less.[24]

In addition, the larger contribution of the Spanish monetary policy shocks (compared to that of the French monetary policy shocks) may be interpreted as a result of larger degree of exchange rate stabilization in Spain. That is, since Spanish monetary authority vigorously stabilize exchange rate movements resulted from other structural shocks, the contribution of other structural shocks become smaller and that of monetary policy shocks become larger.

6. Extended Models

I considered some extended models to examine the robustness of previous results. As we may infer from the responses of the German interest rate shocks, the German interest rate shocks may not represent the German monetary policy shocks, rather it may represent the endogenous response to the world shocks, especially world negative supply shocks. So, first, I consider the model including a proxy of the world negative supply shocks - the world oil price. A similar system is studied by Kim and Roubini (1997). Second, I develop a model including the US interest rate. By making the US interest rate as contemporaneously exogenous, and making the German interest rate shock as contemporaneously endogenous to the US interest rate, I try to exclude the endogenous response to the world shocks. A similar system is studied by Kim (1996). Third, I include the US dollar-German exchange rate since there are some evidence that the German monetary policy respond to the exchange rate.[25] A similar system is studied by Shioji

[24] Similar explanation was given by Montalvo and Shioji (1997) interpreting the contribution of the German monetary policy shocks.
[25] This point is documented by Clarida and Gertler (1996) and Smets (1997).

(1997). These three models also helps further exclude systematic responses of non-German countries' monetary policy to identify exogenous monetary policy shocks.

On the other hand, the asymmetric result between Germany and non-German countries may result from the built-in asymmetry in the model. So, I construct a German model where monetary variables of other countries are included additionally. This model itself may not be as attractive as the asymmetric model considered before, but I experiment this model to check the robustness of results under different built-in asymmetry in the model.

I do find some identification schemes that can produce reasonable dynamics and estimates of monetary reaction functions in some cases, but in other cases, it is not easy to find an identification scheme for the extended model that can produce reasonable dynamics and estimates of structural parameters of monetary reaction functions. The results from the identification scheme that I experimented and that produced the plausible signs of estimated structural parameters and reasonable responses of monetary policy shocks are similar to the previous results.

7. Conclusion

I construct different models representing different identifying assumptions on contemporaneous policy interactions between non-German European countries and Germany to identify monetary policy shocks in non-German European countries - France and Spain. Some identification schemes show the plausible value of the estimated structural parameters and deliver the reasonable dynamic responses of monetary policy shocks. Based on these models, I examine the role of monetary policy shocks in those countries. In addition, I examine which country tries to stabilize the intra-European exchange rate.

The results on variance decomposition on output and price are consistent with the previous researchers' finding that monetary policy shocks are not the dominant sources of output and price fluctuations. The result on variance decomposition on the nominal exchange rate suggests that the French and the Spanish monetary policy shocks are the major sources of the fluctuations of the FF/DM and Ptas/DM exchange rate, while the German interest rate shocks have a moderate contribution to the fluctuations of the exchange rates. On the other hand, the impulse responses to the non-German monetary policy shocks, the German interest rate shocks, and the exchange rate shocks suggest that the French and Spanish monetary policies stabilize the exchange rate against the DM vigorously (the lesser degree in the France) and that the German monetary policy stabilizes the FF/DM and Ptas/DM exchange rates very weakly. The cross country differences in the magnitude of exchange rate stabilization, which are inferred from the evidence on the impulse responses, may explain the cross country differences in the contribution of monetary policy shocks on the exchange rate fluctuations, which are inferred from the evidence on the variance decomposition.

Another interesting result of this paper is that slight modifications of identifying assumptions in the "identified VAR" models generate very similar responses in some cases. One of the previous critiques on the "identified VAR" models (compared to unrestricted VAR models) is that the result is sensitive to slight modifications of identifying assumption. But the results of French and Spanish models suggest that this is not necessarily the case. More specifically, the similarity on the effects on the price level and output is less surprising since the basic identification scheme has produced the similar results in the previous research. In contrast, the similarity of the effects on the exchange rate and the responses of policy authority seem to deserve more attention considering very different identifying assumptions on the contemporary policy interactions, which possibly result the substantial difference in the effects of monetary policy shocks, are assumed on the top of the basic identification scheme.

Finally, by experimenting different identification schemes on contemporaneous policy reactions between non-German countries and Germany, we can infer some interesting points in modeling monetary policy in non-German countries. In particular, the NG-RGI model and the SG-RSE model can deliver reasonable responses in all countries. This suggests that assuming contemporaneous unilateral reaction of non-German countries to the exchange rate against DM and the German interest rate and assuming contemporaneous reaction of non-German countries and German interest rates to bilateral exchange rates seem reasonable schemes to identify non-German monetary policy in association with German monetary variables.

Table 1. Contemporaneous Coefficients on Monetary Reaction Function and German Interest Rate Equation, France

	No German Reaction		**Partial**	**Symmetric**	
Model	**NG-RGE**	**NG-RGI**	**PG**	**SG-RSE**	**SG-RSI**
info. on R's	**R(G) excl.**	**R(G) incl.**	**R excl.**	**R's excl.**	**R's incl.**
zero rest. on 61,65,16	**61,65,16**	**61,65**	**61**	**16,61**	**no restrions**
g_{12}	-20.3	-63.6	-15.56	-63.7	-169.6
std. error	*19.7*	*86.4*	*25.46*	*103.2*	*333.0*
g_{15}	-321.2	-74.3	-25.11	-94.7	-129.5
std. error	*83.8*	*142.3*	*22.60*	*162.3*	*374.7*
g_{16}	---	-.28	.67	---	-3.01
std. error	---	*.21*	*1.75*	---	*5.45*
g_{61}	---	---	---	---	.74
std. error	---	---	---	---	*1.10*
g_{65}	---	---	286.0	6.32	-29.0
std.error	---	---	*528.3*	*17.33*	*72.0*

Table 2. Contemporaneous Coefficients on Monetary Reaction Function and German Interest Rate Equation, Spain

	No German Reaction		Partial	Symmetric	
Model	**NG-RGE**	**NG-RGI**	**PG**	**SG-RSE**	**SG-RSI**
info. on R's	**R(G) excl.**	**R(G) incl.**	**R excl.**	**R's excl.**	**R's incl.**
zero rest. on 61,65,16	**61,65,16**	**61,65**	**61**	**16,61**	**no rest.**
g_{12}	8463	118.8	-4.36	48.2	565.5
std. error	*116798*	*202.5*	*75.92*	*78.4*	*4402.3*
g_{15}	-5191	-155.5	-6.67	-60.8	-689.4
std. error	*71620*	*263.5*	*37.04*	*82.9*	*5327.6*
g_{16}	---	-3.10	2.80	---	-24.8
std. error	---	*4.32*	*3.01*	---	*208.8*
g_{61}	---	---	---	---	.37
std. error	---	---	---	---	*.43*
g_{65}	---	---	37.0	6.55	-3.36
std.error	---	---	*51.6*	*3.52*	*29.7*

Table 3. Forecast Error Variance Decomposition due to Monetary Policy Shocks and the German Interest Rate Shocks in France

1) Consumer Price Index (due to Monetary Policy Shocks)

	No German Reaction		Symmetric
Model	**NG-RGE**	**NG-RGI**	**SG-RSE**
info. on R's	**R(G) excl.**	**R(G) incl.**	**R's excl.**
Zero rest.	**61,65,16**	**61,65**	**16,61**
12 m	4.7 (3.5)	3.8 (4.5)	3.2 (2.8)
24 m	7.1 (5.1)	7.2 (7.4)	6.3 (5.7)
48 m	9.0 (6.2)	11.7 (10.7)	9.2 (6.6)

2) Industrial Production (due to Monetary Policy Shocks)

	No German Reaction		Symmetric
Model	**NG-RGE**	**NG-RGI**	**SG-RSE**
info. on R's	**R(G) excl.**	**R(G) incl.**	**R's excl.**
Zero rest.	61,65,16	**61,65**	**16,61**
12 m	11.6 (8.0)	18.6 (11.0)	3.4 (2.5)
24 m	13.0 (9.0)	21.5 (12.9)	9.2 (6.6)
48 m	10.4 (6.1)	17.7 (10.9)	22.1 (8.2)

3) Exchange Rate

		No German Reaction		Symmetric
Model		**NG-RGE**	**NG-RGI**	**SG-RSE**
info. on R's		**R(G) excl.**	**R(G) incl.**	**R's excl.**
Zero rest.		**61,65,16**	**61,65**	**16,61**
MS	**0 m**	2.6 (2.2)	27.1 (16.4)	20.2 (13.5)
	6 m	56.1(19.9)	30.6 (18.6)	42.2 (18.5)
	12 m	54.4(19.1)	32.1 (16.2)	44.2 (17.8)
	24 m	38.5(13.0)	23.8 (11.3)	32.4 (14.1)
	48 m	26.3(11.7)	16.8 (8.6)	22.0 (10.8)
R(G)	**0 m**	3.1 (2.7)	4.2 (2.8)	5.2 (3.2)
	6 m	3.3 (2.5)	3.5 (2.7)	8.4 (6.6)
	12 m	3.8 (2.5)	4.7 (4 1)	6.9 (5.3)
	24 m	5.6 (4.3)	6.7 (5.7)	8.4 (5.8)
	48 m	11.7 (7.3)	9.4 (7.6)	9.4 (6.8)

Table 4. Forecast Error Variance Decomposition due to Monetary Policy Shocks and the German Interest Rate Shocks in Spain

1) Consumer Price Index (due to Monetary Policy Shocks)

	No German Reaction		**Symmetric**
Model	**NG-RGE**	**NG-RGI**	**SG-RSE**
info. on R's	**R(G) excl.**	**R(G) incl.**	**R's excl.**
Zero rest.	**61,65,16**	**61,65**	**16,61**
12 m	11.2	19.1 (10.9)	30.0 (13.8)
24 m	14.4	16.0 (11.6)	26.9 (14.5)
48 m	19.3	16.7 (13.3)	25.2 (14.3)

2) Industrial Production (due to Monetary Policy Shocks)

	No German Reaction		**Symmetric**
Model	**NG-RGE**	**NG-RGI**	**SG-RSE**
info. on R's	**R(G) excl.**	**R(G) incl.**	**R's excl.**
Zero rest.	**61,65,16**	**61,65**	**16,61**
12 m	0.9	2.6 (2.4)	6.2 (4.4)
24 m	1.7	6.2 (4.9)	8.3 (5.2)
48 m	6.4	10.0 (7.1)	15.8 (7.5)

3) Exchange Rate

		No German Reaction		**Symmetric**
Model		**NG-RGE**	**NG-RGI**	**SG-RSE**
info. on R's		**R(G) excl.**	**R(G) incl.**	**R's excl.**
Zero rest.		**61,65,16**	**61,65**	**16,61**
MS	**0 m**	76.7	17.8 (13.8)	49.2 (21.6)
	6 m	81.9	67.7 (12.6)	51.4 (22.2)
	12 m	59.4	49.0 (12.3)	43.6 (16.7)
	24 m	33.1	31.4 (13.9)	37.7 (12.3)
	48 m	22.4	23.8 (13.4)	27.9 (13.6)
R(G)	**0 m**	6.4	4.3 (3.1)	3.2 (3.1)
	6 m	2.2	4.8 (3.5)	9.4 (8.2)
	12 m	7.8	10.9 (7.3)	11.7 (6.9)
	24 m	19.5	18.2 (11.5)	20.9 (12.7)
	48 m	19.7	18.6 (11.3)	24.1 (16.1)

Figure 1. Impulse Resonses to Monetary Policy Shocks, France

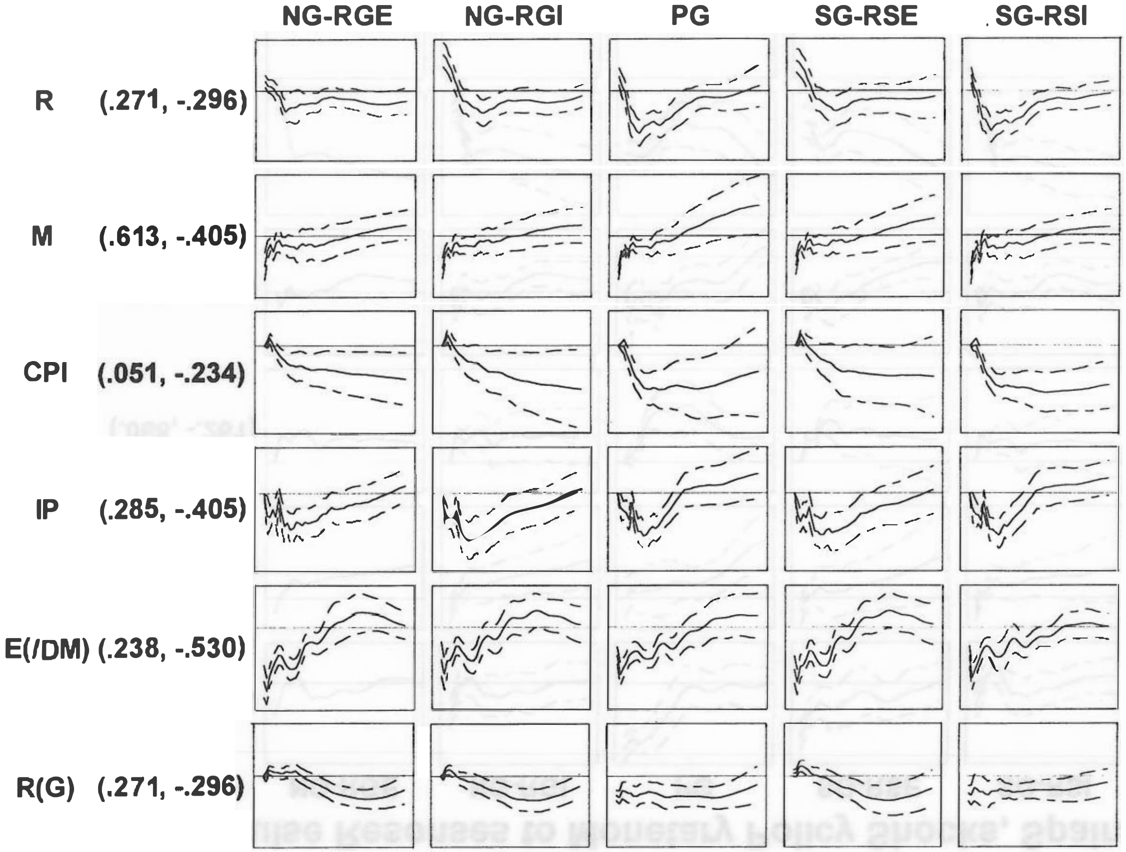


Figure 2. Impulse Resonses to Monetary Policy Shocks, Spain

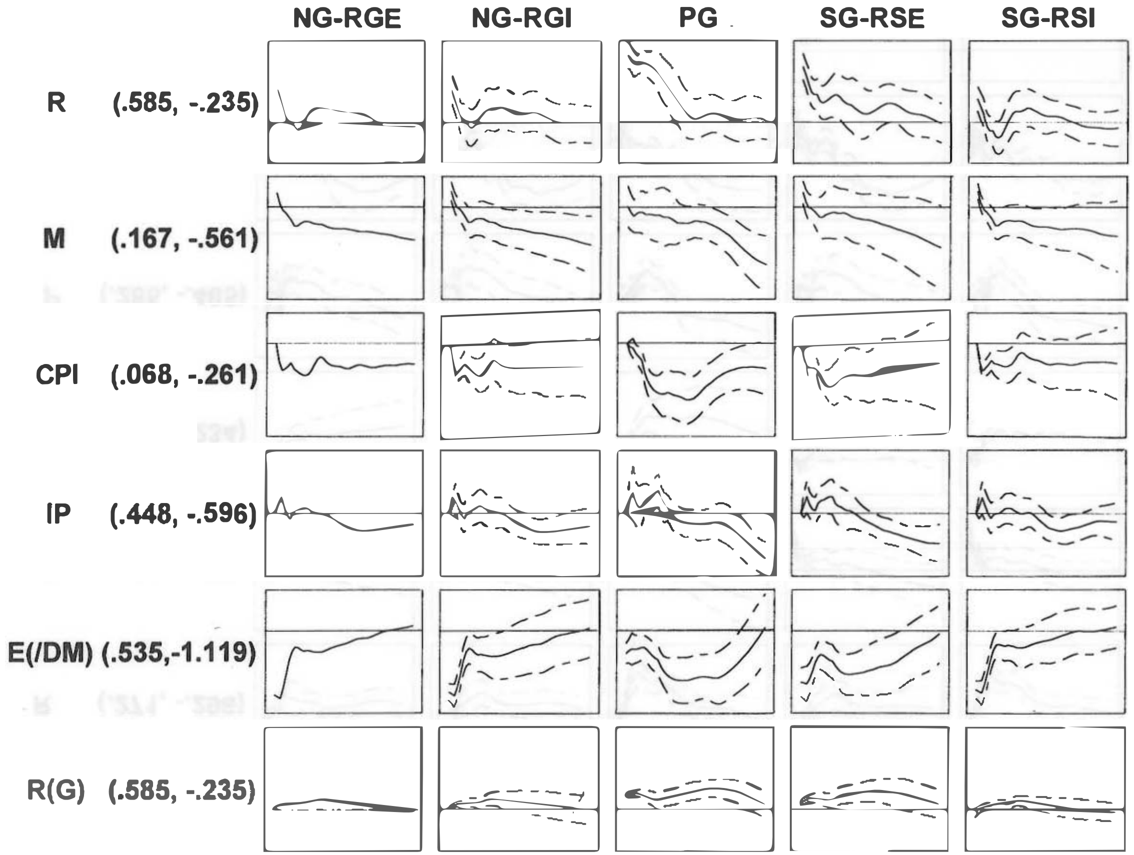


Figure 3. Impulse Resonses to German Int. Rate Shocks, France

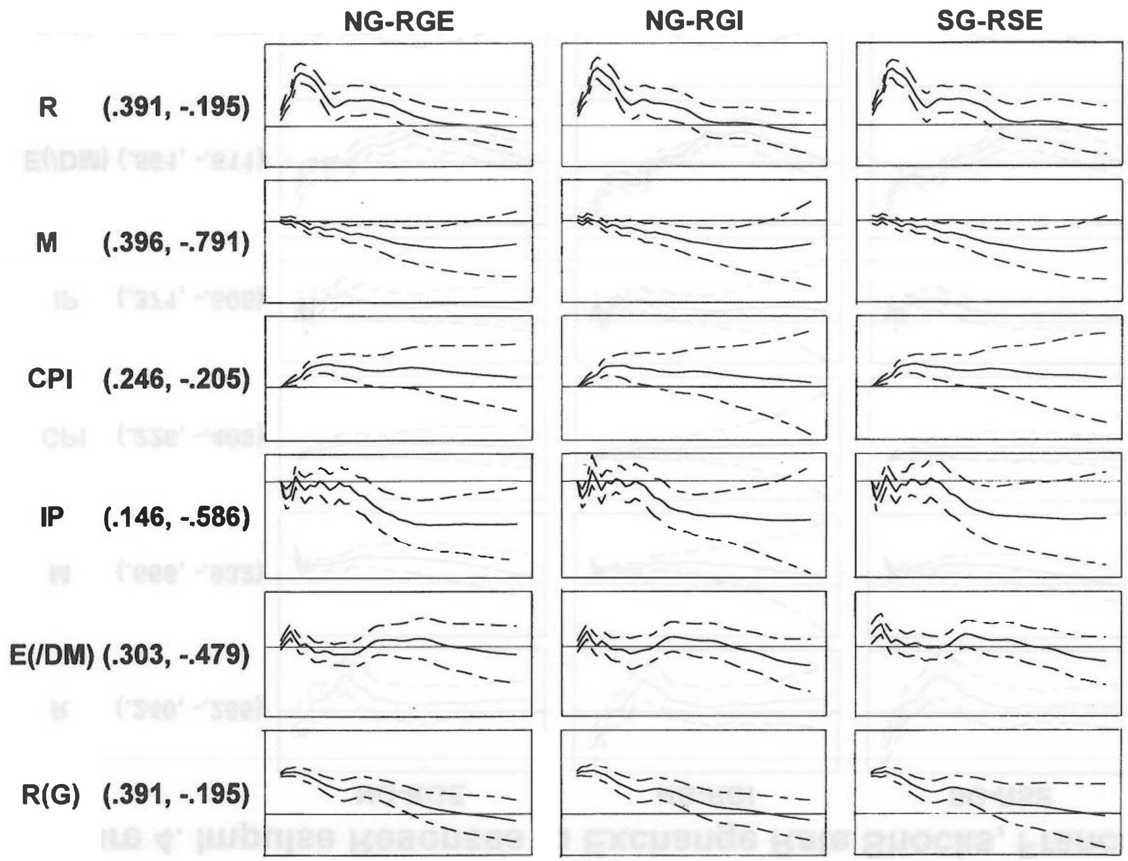


Figure 4. Impulse Resonses to Exchange Rate Shocks, France

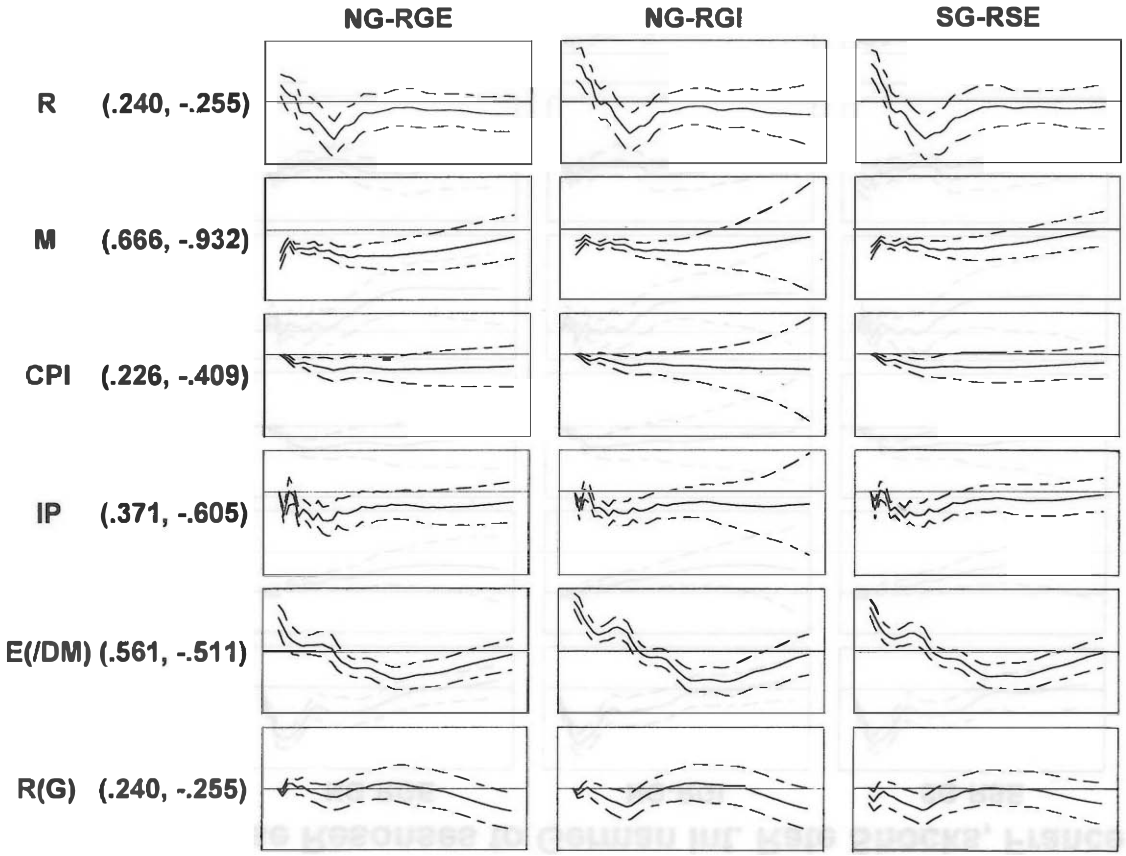


Figure 5. Impulse Resonses to German Int. Rate Shocks, Spain

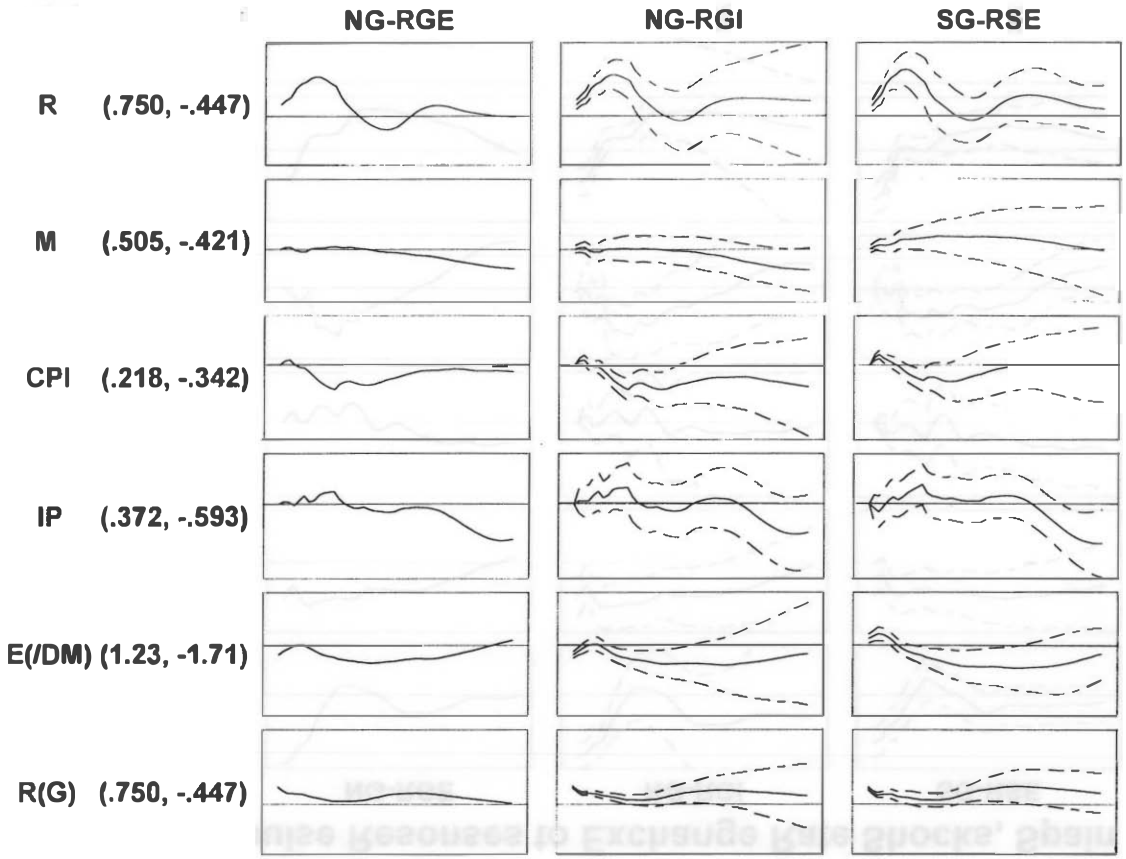
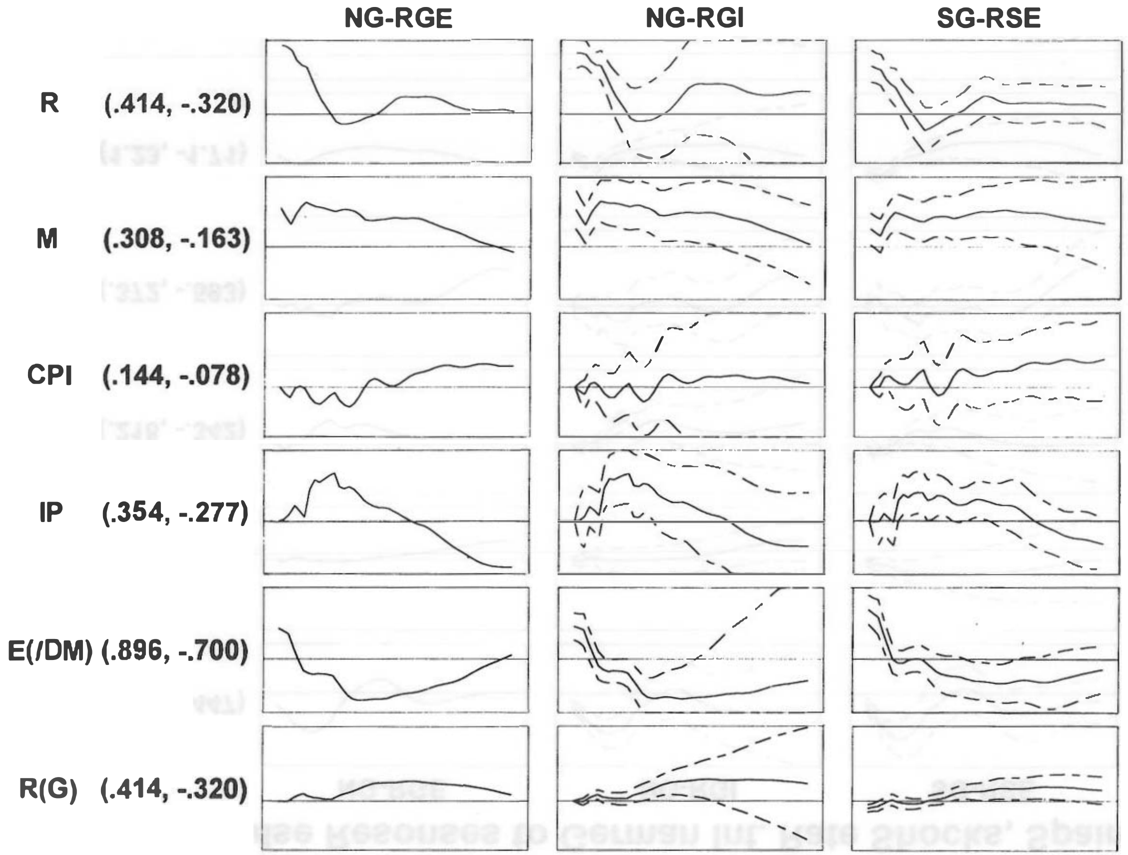


Figure 6. Impulse Resonses to Exchange Rate Shocks, Spain



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WORKING PAPERS (1)

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