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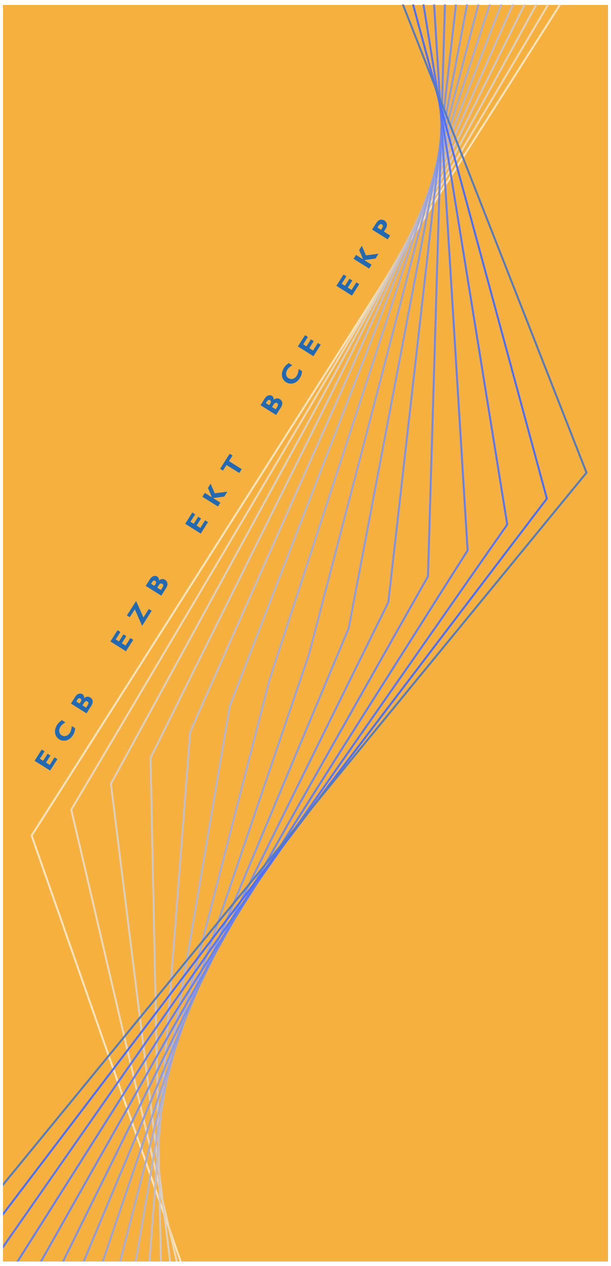

EUROSYSTEM MONETARY TRANSMISSION NETWORK

WORKING PAPER NO. 92

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A VAR DESCRIPTION OF THE EFFECTS OF MONETARY POLICY IN THE INDIVIDUAL COUNTRIES OF THE EURO AREA*

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* *Benoît Mojon: European Central Bank, e-mail: benoit.mojon@ecb.int. Gert Peersman: Bank of England and Ghent University, e-mail: gert.peersman@bankofengland.co.uk.* *This paper was prepared in the context of the ECB's Monetary Transmission Network. We thank the members of the MTN for valuable inputs. Gert Peersman worked on this paper while being in the ECB's Graduate Research Programme. We thank Andres Manzanares for outstanding research assistance and Frank Smets, Don Bredin and Lutz Kilian for helpful discussions and Ignazio Angeloni, Paul Butzen, Fabio Canova, Fiorella de Fiore, Catherine Fuss, Ignacio Hernando, Carlos Robalo, Daniele Terlizzese and Raf Wouters for comments on a previous draft of this paper.*

The Eurosystem Monetary Transmission Network

This issue of the ECB Working Paper Series contains research presented at a conference on "Monetary Policy Transmission in the Euro Area" held at the European Central Bank on 18 and 19 December 2001. This research was conducted within the Monetary Transmission Network, a group of economists affiliated with the ECB and the National Central Banks of the Eurosystem chaired by Ignazio Angeloni. Anil Kashyap (University of Chicago) acted as external consultant and Benoît Mojon as secretary to the Network.

The papers presented at the conference examine the euro area monetary transmission process using different data and methodologies: structural and VAR macro-models for the euro area and the national economies, panel micro data analyses of the investment behaviour of non-financial firms and panel micro data analyses of the behaviour of commercial banks.

Editorial support on all papers was provided by Briony Rose and Susana Sommaggio.

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ISSN 1561-0810

Contents

Abstract: This paper presents a complete set of results describing the effects of monetary policy in 10 countries of the euro area for the pre-EMU period. For each country, we impose one of three identification schemes depending on its monetary integration with Germany, the nominal anchor of the ERM. The first identification scheme applies to Germany, the second to countries of the core EMS (Austria, Belgium and the Netherlands) and the third to all the other countries. An unexpected rise in the short-term interest rate leads to a decrease in GDP, (with investment and exports falling more than consumption) and a gradual decrease in prices for all countries. We also show that, given the width of the error bands around the estimate, we cannot reject that the effects of monetary policy on GDP and on prices are broadly similar in the individual countries of the euro area.

JEL classification system: E52.

Keywords: Euro area countries, monetary policy, VARs.

Non-technical summary

This paper analyses the transmission mechanism of monetary policy in 10 countries (Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, the Netherland and Spain) that are now members of the euro area. We use VAR models, which is the most widely used empirical methodology to analyse the transmission mechanism. In Europe, the perspective of EMU led a large part of the literature to use VARs to evaluate cross-country differences in the transmission mechanism. The typical paper in this literature imposes the same identification of monetary policy shocks across countries, in spite of the differences in monetary policy regime of each country within the European Monetary System (EMS). For instance, Germany could follow an independent monetary policy as the de facto anchor of the EMS while the interest rate of a country like Austria was tied by the fixed exchange rate with the Deutsche Mark during most of the past 20 years. We propose instead to estimate for each country a model that accounts for the EMS constraint to which the country was subject during the sample period. We form three groups of “monetary policy regime-like countries” depending on their monetary integration with Germany. As the anchor of the EMS, Germany is a group on its own for obvious reasons. Austria, Belgium and the Netherlands form the second group. We model their monetary policy as if they were in a "fixed" exchange rate regime with respect to Germany. It follows that they do not have autonomous monetary policy shocks. All the other countries are modelled as open economies with a flexible exchange rate vis-à-vis Germany. The influence of German monetary policy is taken into account by including the German interest rate and the bilateral Deutsche Mark exchange rate in the model. Although the German interest rate is then a major argument of the reaction function of the central bank, there is room for “autonomous” domestic monetary policy in the adjustment of domestic interest rate around the German interest rate.

The contribution of the paper with respect to the existing VAR literature on the transmission mechanism in euro area countries is threefold. First, we show that imposing one of three relatively simple identification schemes, depending on our knowledge of the monetary policy decision process in the EMS, obtain well-behaved and qualitatively consistent effects of the monetary policy shocks in all the countries. While our models are fairly similar and comparable, we avoid the implausible uniformity of approaches that characterises most of the VAR literature on international comparisons of the transmission mechanism. We also avoid the multiplication of models that confuses the cross-country comparison. The results of our model are consistent with the consensus view on the transmission mechanism. A contractionary monetary policy shock is defined as a positive deviation of the interest rate from the average reaction function of the central bank for the sample period. It leads to a temporary fall in GDP that peaks typically around four quarters after the shock and to a gradual decrease in the price level. We also show that for most countries, M1 initially decreases and that the response of investment is larger than the one of consumption. Second, the results of our estimations at the country level are compared to the results obtained in a VAR estimated with euro area aggregates by Peersman and Smets (2001). We show that the effects of monetary policy on prices and on output estimated for each country are usually qualitatively similar to the ones obtained when the model is estimated on the aggregate euro area economy. Third, we compare the "artificial" monetary policy shocks measured for the euro area with the ones of the individual countries. The euro area shocks seem to be dominated by the French, the Italian and the Spanish monetary policy shocks. In particular, the early 1990s appear as a contraction for the euro area and for most of the individual countries while the Deutsche Bundesbank was just reacting to the reunification boom.

Finally, the paper stresses that, given that the confidence bands around the responses are generally large, one can not use VAR models to conclude that some countries are characterised by larger effects of monetary policy than others.

1. Introduction

Understanding the transmission mechanism of monetary policy in the euro area is of primary importance for the implementation of the Eurosystem's monetary policy strategy. Although the Eurosystem targets price stability for the area as a whole, country level evidence should not be neglected for two reasons. First, the analysis of the transmission mechanism is usually carried out within models that assume a reaction function of the central bank. This assumption is somewhat artificial when considering the euro area economy as a whole before the start of EMU. Therefore estimating central bank reaction functions at the country level seems more appropriate. Second, economists are still uncertain about the effects of monetary policy on economic activity and prices. Recent empirical and theoretical studies, mainly focused on the US economy, tend to converge on the view that contractionary monetary policy shocks lead to a temporary decrease in output and to a gradual decline in prices. These results are convincing, and therefore policy relevant, mainly because they are derived from models that imbed a plausible description of the monetary policy decision process. While uncertainty on the transmission mechanism is even more critical in the context of EMU, the experience of each country before EMU provides additional empirical evidence, which can be used to reduce uncertainty about the transmission of monetary policy.

This paper analyses the transmission mechanism of monetary policy in 10 countries that are now members of the euro area[1]. We use VAR models, which is the most widely used empirical methodology to analyse the transmission mechanism. The use of VARs for the analysis of monetary policy started with the seminal work of Sims (1980). Recently, Leeper, Sims and Zha (1998) and Christiano, Eichenbaum and Evans (1998) have reviewed what one has learned from this extensive literature regarding the monetary transmission mechanism in the United States. In Europe, the perspective of EMU led a large part of the literature to use VARs to evaluate cross-country differences in the transmission mechanism. The typical paper in this literature imposes the same identification of monetary policy shocks across countries, in spite of the differences in monetary policy regime of each country within the European Monetary System (EMS). For instance, Germany could follow an independent monetary policy as the de facto anchor of the EMS while the interest rate of a country like Austria was tied by the fixed exchange rate with the German Mark during most of the past 20 years. We propose instead to estimate for each country a model that accounts for the EMS constraint to

[1] Luxembourg is not modelled because it formed a monetary union with Belgium, and had no independent monetary policy. Portugal is also excluded because of data limitations.

which the country was subject during the sample period. We form three groups of "monetary policy regime-like countries" depending on their monetary integration with Germany. As the anchor of the EMS, Germany is a group on its own for obvious reasons. Austria, Belgium and the Netherlands form the second group. We model their monetary policy as if they were in a "fixed" exchange rate regime with respect to Germany. It follows that they do not have autonomous monetary policy shocks. All the other countries are modelled as open economies with a flexible exchange rate vis-à-vis Germany. The influence of German monetary policy is taken into account by including the German interest rate and the bilateral Deutsche Mark (DM) exchange rate in the model. Although the German interest rate is then a major argument of the reaction function of the central bank, there is room for "autonomous" domestic monetary policy in the adjustment of domestic interest rate around the German interest rate.

The contribution of the paper with respect to the existing VAR literature on the transmission mechanism in euro area countries is threefold. First, we show that imposing one of three relatively simple identification schemes, depending on our knowledge of the monetary policy decision process in the EMS,[2] obtain well-behaved and qualitatively consistent effects of the monetary policy shocks in all the countries. While our models are fairly similar and comparable, we avoid the implausible uniformity of approaches that characterises most of the VAR literature on international comparisons of the transmission mechanism. We also avoid the multiplication of models that confuses the cross-country comparison. The results of our model are consistent with the consensus view on the transmission mechanism. A contractionary monetary policy shock is defined as a positive deviation of the interest rate from the average reaction function of the central bank for the sample period. It leads to a temporary fall in GDP that peaks typically around four quarters after the shock and to a gradual decrease in the price level We also show that for most countries, M1 initially decreases and that the response of investment is larger than the one of consumption. Second, the results of our estimations at the country level are compared to the results obtained in a VAR estimated with euro area aggregates by Peersman and Smets (2001). We show that the effects of monetary policy on prices and on output estimated for each country are usually qualitatively similar to the ones obtained when the model is estimated on the aggregate euro area economy. Third, we show how the monetary policy shocks defined at the euro area level relate to the particular episodes of the domestic monetary policy shocks of the different countries.

[2] See also Clements, Kontomelis and Levy (2001) for a complementary point of view on the role of the EMS in the transmission mechanism. Their study focuses on the effects of the German monetary policy shock on all the other countries of the euro area.

The paper is structured as follows. Section 2 provides an overview of the literature. Section 3 describes the three identification schemes chosen and section 4 the results of their implementation. Finally, section 5 concludes.

2. The empirical analysis of the effects of monetary policy in the individual countries of the Euro area

In this section, we review the empirical literature on the macroeconomic effects of monetary policy shocks in the euro area countries. We briefly describe the modelling framework chosen in the different studies. It appears that most of the cross-country comparison studies based on VARs do not model the EMS context of monetary policy.

First, the BIS (1995) reports simulation exercises from macroeconometric models, either country models developed by the central banks or the multi-country model of the Federal Reserve Board. The report presents the effects of a temporary 100 basis points increase in the policy rate for eight quarters, after which the policy rate would return to baseline. Second, Britton and Whitley (1997) simulate a variant of the Mundell-Flemming model to analyse the transmission mechanism in the UK, France and Germany. Third, Dornbusch, Favero and Giavazzi (1998) use a small simultaneous model for output in different countries. The impact of monetary policy on output is simulated with fixed exchange rates within Europe. In the same spirit, Peersman and Smets (1999) simulate the effects of a German monetary policy shock while allowing for the interaction effects among the countries. Fourth, Sala (2001) implements a dynamic factor model for six countries of the euro area. He estimates three common components to the six countries and identifies one of them as a “common” monetary policy shock. He then reports the effects of this shock on individual countries.

Fifth, a vast majority of studies used VAR models. These studies differ in terms of the variables included in the VAR, the number of euro area countries covered and the identification strategy chosen. Gerlach and Smets (1995) used a VAR approach with a combination of short run and long run restrictions for the G7-countries. Only three variables are included in their VAR: output, the price level and the interest rate. Ramaswamy and Sloek (1997) estimate a simple three-variable (output, the price level and the interest rate) VAR for 12 EU-countries[3]. Dedola and Lippi (2000) estimate the effects of a one-percentage point increase in the short-term interest rate using an VAR containing industrial production, commodity prices, the price level, the money stock and

[3] See also the recent paper by Mihov (2001) for a comparable model estimated for 5 countries of the euro area.

the short-term interest rate. Barran, Coudert and Mojon (1997) estimate several VARs including combinations of GDP, prices, DM exchange rate, world price index, money, credit and the long term interest rate for nine European countries. Ehrmann (2000) estimates a VAR of industrial production, prices, an exchange rate, an interest rate and, when appropriate, another variable that is relevant for the specific monetary policy context of the country.

One important shortcoming of the VAR papers above is that the EMS context of monetary policy is either not modelled or limited to the inclusion of the DM exchange rate in the model (Barran et al. or Ehrmann). Most of the VAR studies that have explicitely modelled the EMS context focus on one or on a small number of countries.[4] Smets (1997) focuses on Germany, Italy and France, Kim (1998) investigates the cases of Spain and France, De Arcangelis and Di Giorgio (1998) and Gaiotti (1999) concentrate on Italy, Shioji (1997) on Spain while Levy and Halikias (1997) and Mojon (1999) focus on France. These studies[5] show that over the last two decades, the monetary policy interest rate of Spain, France and Italy was largely, albeit not entirely driven by the German interest rate. While the room for a domestic monetary policy existed for these three countries, not accounting for the German leading role in the EMS leads to mis-identification of monetary policy shocks. For instance, periods of rising German interest rates could be wrongly interpreted as periods of domestic monetary policy tightening.

In this paper, we implement a monetary policy identification scheme that accounts for the EMS context for all the countries of the euro area, for which quarterly national account data are available. This is the purpose of the next section.

3. Identification

This section discusses in turn the three identification schemes we propose to describe monetary policy in each of the three groups of countries mentioned in the introduction. It then recalls the specification of the benchmark Peersman and Smets (2001) model of the euro area.

[4] Two related recent studies use VAR models to evaluate the effect of the single monetary policy in each of the countries. Clements et al. (2001) report the effect of monetary policy shocks when the reaction function is constrained to be similar across countries and the intra-EU exchange rates are fixed. Peersman (2001) estimates the effects of area-wide monetary policy shocks on the individual countries.

[5] See Mojon (1999) for a survey of these studies.

3.1 VAR models for the individual countries in the euro area

In this section we present VAR models for all euro area countries except Luxembourg and Portugal. We discuss the features of the model that are necessary to fit the individual country experiences. In doing so, our objective is to limit the differences in the models that apply to the different countries, so as to preserve comparability in the outcome of the estimates. We distinguish three groups. The first group contains Germany, which played a special role as the de facto anchor within the EMS system. The second group of countries consists of Austria, Belgium and the Netherlands. These countries have maintained their fixed exchange rate parity against the DM during most of the sample period. All the other countries (Finland, France, Greece, Ireland, Italy and Spain) can be described by a similar VAR model. Most of these countries have participated in fixed, but adjustable exchange rate regimes during large parts of the sample period, but nevertheless experienced quite large parity changes. With the exception of France and Ireland, each of these countries also went through a floating exchange rate period during the sample period.

3.1.1 Germany

For Germany, we estimate the following VAR model, comparable with the benchmark model of Peersman and Smets (2001).

[1] $$Y_t = A(L)Y_{t-1} + B(L)X_t + \mu_t$$

The variables included in the model can be divided into two groups.[6] The first group of variables, X_t, contains a world commodity price index (cp_t), US real GDP (y_t^{US}), and the US short-term nominal interest rate (s_t^{US}). These variables are included to control for changes in world demand and inflation. Moreover, the inclusion of these variables helps to solve the so-called price puzzle (i.e. the empirical finding in the VAR literature that prices rise following an interest rate tightening).[7] In all of the results reported below, we assume that this group of variables is exogenous to the rest of the VAR-model. In other words, these variables influence the other variables of the model, Y_t, but there is no feedback from the other variables to these variables. Further, we also allow for a contemporaneous impact of the exogenous variables on the endogenous variables.

[2] $$X_t' = [\ cp_t \quad y_t^{US} \quad s_t^{US}\ ]$$

[6] Each of the VAR models contains also a constant and a linear trend.
[7] See for example the results of Sims (1992).

The endogenous variables of the benchmark model, Y_t, consist of real GDP (y_t), consumer prices (p_t), the domestic short-term nominal interest rate (s_t) and the real effective exchange rate (x_t):

[3] $$Y_t^{'} = \begin{bmatrix} y_t & p_t & s_t & x_t \end{bmatrix}$$

The main difference of this model with the standard VAR model used to identify monetary shocks either for the US, but also for Germany, is that we do not include money in the model. This omission is mainly motivated by our aim to estimate models that would be as similar as possible across countries. Because most countries now in EMU had a DM exchange rate target during the period preceding the introduction of the single currency, monetary aggregates have had a secondary role in the monetary policy strategy of these countries. This is why we do not include a money aggregate in our benchmark model, neither for these countries, nor for Germany, nor for the Peersman and Smets (2001) euro area results reported in this paper[8]. Sensitivity analyses indicated that the inclusion of money in the model did not affect the impact of the German interest rate shock on output and prices. In addition, we also show that the identification of the benchmark model implies that a contractionary monetary policy shock is followed by a fall in money for most of the countries. In other words, our monetary shocks identified in a model without money do not produce a liquidity puzzle.

Turning to the identification of a monetary policy shock, we allow for a contemporaneous interaction between the German interest rate and the real effective exchange rate. Assuming that there is no contemporaneous reaction of the central bank to an exchange rate shock may be appropriate for relatively closed economies such as the euro area and the US, but is less justifiable for an open economy such as Germany. For example, both Bernanke and Mihov (1997) and Clarida and Gertler (1997) have found a significant contemporaneous response of German interest rates to changes in the exchange rate. Similarly, Smets and Wouters (1999) show that allowing for such a response helps to avoid a price puzzle. Following Smets and Wouters (1999), we solve the simultaneity problem by estimating the reaction coefficient on the exchange rate using the spread between the French and the German long-term interest rate and US dollar/Yen exchange rate as instruments.[9]

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[8] See also in Peersman and Smets (2001) for a comparison of the response of GDP and prices using alternative identification strategies.
[9] See Smets and Wouters (1999) for an explanation on the implementation of this two-step methodology.

3.1.2 Austria, Belgium and the Netherlands

During most of the sample period, Austria, the Netherlands and, to a lesser extent, Belgium, have maintained a fixed central exchange rate parity vis-à-vis the DM.[10] This implies that in these countries the scope for an independent monetary policy was extremely limited and that it is unlikely that we are able to get precise estimates of the effects of *domestic* monetary policy shocks. Instead, most of the policy shocks are likely to be driven by policy innovations in the German interest rate. Moreover, these countries are relatively small neighbours of Germany and strongly influenced by economic conditions in Germany. In this case, we therefore modify the benchmark model by including German output, prices, real effective exchange rate and short-term interest rate in the list of endogenous variables and replacing the effective exchange rate with the bilateral rate versus the DM. In addition, we assume that there is no feedback from the smaller country to Germany. The monetary policy shock is identified as the shock to the German interest rate. We can represent this as follows:

[4] $$\begin{bmatrix} Y^{DE}{}_t \\ Y^j{}_t \end{bmatrix} = \begin{bmatrix} A(L) & 0 \\ C(L) & D(L) \end{bmatrix} \begin{bmatrix} Y^{DE}{}_{t\text{-}1} \\ Y^j{}_{t\text{-}1} \end{bmatrix} + \begin{bmatrix} B(L) \\ E(L) \end{bmatrix} Xt + \sigma \begin{bmatrix} \varepsilon_t^{DE} \\ \varepsilon_t^j \end{bmatrix}$$

with

[5] $$Y_t^{DE} = \left[y_t^{DE} \quad p_t^{DE} \quad s_t^{DE} \quad x_t^{DE} \right]$$

[6] $$Y_t^j = \left[y_t^j \quad p_t^j \quad x_t^j \quad s_t^j \right], j = AT, NL \text{ or } BE$$

This implies that we estimate the same monetary policy shocks as in the German case. The response of the German variables to this monetary policy shock is also unchanged. The block-recursive structure of this two countries model closely resembles the one applied by Cushman and Zha (1997) to model the influence of the US economy on Canada. Cushman and Zha consider the effects of an independent monetary policy because of the flexible exchange rate regime that characterises Canada. In contrast, because there was hardly any variation of the DM exchange rate during most of the sample period, we focus on the effects of the German monetary policy shock in Autria, Belgium and the Netherlands.

[10] The central parity within the EMS changed only in the early 1980s for the Netherlands, and in 1982, 1983, 1986 and 1987 for Belgium. The Austrian exchange rate did fluctuate in a very narrow band for the whole sample period.

3.1.3 The other countries: Finland, France, Greece, Ireland, Italy and Spain

For all the other countries, we modify the German model in two respects. First, we include the German short-term interest rate in the block of endogenous variables. Second, we replace the real effective exchange rate with the nominal bilateral DM exchange rate given its prominence in the EMS.[11] This leads to the following set of endogenous variables:

[7] $$Y_t^{'} = \left[y_t \quad p_t \quad s_t^{DE} \quad x_t \quad s_t \right]$$

The German interest rate is included in addition to the bilateral DM exchange rate in order to describe the role of Germany as an anchor of the ERM. The domestic interest rate may respond to the German one without any impact on the exchange rate, as it would be the case in a fixed exchange rate regime. This can turn out to be important when estimating a model at a quarterly frequency, while exchange rates and interest rates interact continuously. Basically, we assume that domestic monetary policy shocks are defined as deviations of the domestic interest rate from the German interest rate[12]. In other words, we describe the effects of monetary shocks taken in the process of nominal convergence, which took place before EMU. We obtain that the estimated domestic policy shocks lead to a decrease in prices. It is interesting to note that neglecting the German interest rate in the model results in a price puzzle for many of these countries. The reason is that if one does not control for increases in the domestic interest rate that are a response to increases in the German rate, such changes may be associated with a depreciation of the exchange rate. This in turn puts upward pressure on prices. As before, the domestic policy shock is identified using a standard recursive identification scheme, which corresponds to the ordering of the variables in [7]. This means that there is a contemporaneous impact of all the endogenous variables on the monetary policy variable. On the other hand, there is no immediate impact of a monetary policy shock on the other variables. The ordering of the bilateral DM exchange rate before the domestic interest rate is plausible since there was a fixed exchange rate regime during most of the estimation period. However, the results are robust with respect to a reverse ordering of the domestic interest rate and the bilateral DM exchange rate. Also allowing for a two-way interaction between the exchange rate and the domestic interest rate did not significantly affect the results.

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[11] Using an effective exchange rate does not change the estimated effect of monetary policy shocks on prices and on output in any significant way. We prefer to include the bilateral DM exchange rate in order to model the specific situation of the EMS.

[12] The macro-econometric model of the Banque de France also defines the reaction function in terms of deviations from the German interest rate.

It is important to bear in mind that in the case of Greece, monetary policy was implemented through “quantity rationing of the banks” so that the three month interest rate was left unchanged for long periods during the 1980’s. The results for this country should therefore be taken with extra caution.

3.2 The specification of the benchmark VAR-model for the euro area

The VAR-model from Peersman and Smets (2001) that we use to analyse the effects of a monetary policy shock in the euro area has the same representation as the one presented for Germany above. The only difference is that the policy shock for the euro area is identified through a standard Choleski-decomposition with the variables ordered as mentioned above.[13] The underlying assumption is that policy shocks have no contemporaneous impact on output and prices, but may affect the exchange rate immediately. However, the policy interest rate does not respond to contemporaneous changes in the effective exchange rate. The latter assumption is appropriate for a large, relatively closed, economy such as the euro area as a whole. [14]

4. Results

4.1 Estimation

Unless otherwise mentioned, each of the VAR-models is estimated in levels over the period 1980-1998, which corresponds approximately to the start of the EMS.[15] In the case of Germany, for which we consider that the monetary policy decision process is independent of the EMS, we estimated the model for the longest period of data availability, i.e. 1970-1998. In this paper we do not perform an explicit analysis of the long run behaviour of the economy. By doing the analysis in levels we allow for implicit cointegrating relationships in the data (Chap. 18 in Hamilton, 1994). A more explicit analysis of the long-run behaviour of the various variables is limited by the relatively short sample available.[16] The data are seasonally adjusted logs, except the interest rates, which are in levels. We use the three-month interest rate[17] as the monetary policy rate as this is the only short-term interest rate that is available for all countries over the whole

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[13] As in Sims (1980) and Christiano et al (1998).

[14] Eichenbaum and Evans (1995) make the same assumption for the US. One can argue that the euro area as a whole is more like the US in terms of openness than like any of its individual members.

[15] Also, we took 1980 as a starting date because some of the data series used are only available from that year.

[16] See Ehrmann (2000) for an explicit cointegration analysis of VAR models for the countries of the euro area.

[17] Except in Greece where we use the three-month average of the overnight rate.

sample period. Standard likelihood ratio tests are used to determine the lag-order of the VARs, which usually turns out to be of order two or three.

Chow break tests did not reject the overall stability of the various VARs at the 5% confidence level. However, in some countries instability was detected in some of the equations of the VAR. This was in particular the case for Italy where overall stability is rejected at the 10% confidence level. Both the Italian output and exchange rate equation appear to be subject to a significant break in the third quarter of 1992 coinciding with the outbreak of the EMS crisis and the floating of the Italian lira. Also in Finland there is some evidence of instability in the exchange rate equation in the early 1990s. In the case of Germany, it turns out that a longer sample period helps to reduce the weight of the reunification episode, when the monetary policy tightening in the early 1990s coincided with a big positive demand shock due to direct government spending and tax incentives. Estimating the model just for the 1980’s and 1990’s renders the identification of plausible effects of German monetary policy extremely tedious.

The results shown for Austria, Belgium and the Netherlands are computed by simulating the effects of the identified German monetary policy shock, i.e. the impulse responses of the variables in the German VAR estimated of 1970-1998, on the Austrian, Belgian and Dutch variables respectively as in [4]. The latter equations are estimated for the period of the EMS (1980-1998), when these countries where in a de facto fixed exchange rate regime with Germany.

Finally, both in Ireland and Greece we include a dummy variable for unusual interest rate increases of more that 10 %. The Irish spike took place in the fourth quarter of 1992 and the Greek one in the first quarter of 1994.

4.2 Discussion of the results

The results of the identification schemes described in section 3 for each of the individual countries and the euro area are shown in Graph 1. These graphs summarise for each of the countries the effects of a one-standard deviation monetary policy shock on domestic real GDP, domestic consumer prices, the exchange rate (effective real exchange rate in the case of the euro area and Germany, the bilateral DM exchange rate in the case of the other countries), and the domestic short-term interest rate. We report the OLS estimate based impulse response function together with 90 percent confidence bands[18]. Graph 1 shows

[18] These confidence bands reported are constructed as the impulse response plus or minus 1.65 standard deviations of 200 bootstrapped replications of the impulse response. These confidence bands are very similar, though somewhat narrower than the ones obtained by Monte Carlo simulations as proposed by Sims and Zha (1999).

that in each of the countries, a monetary policy tightening eventually leads to a fall in output and prices[19]. It is remarkable that these fairly simple identification schemes allowed us to compile well-behaved responses of GDP and of prices to a domestic monetary policy shock. Moreover, these responses are consistent with the area-wide results. However, some additional features are worth noting.

First, the effects on output and on prices tend to be larger when measured at the country level than what they appear to be at the euro area level. This may reflect that the effects on output and prices triggered by monetary policy in the period before EMU worked through the quantity or price adjustment of trade with other members of EMU. These effects are expected to disappear in the new monetary policy regime. Second, while the overall pattern for output and prices is quite similar across countries, the effects on the exchange rate are less consistent across countries and generally less significant. For Belgium and the Netherlands the lack of response of the exchange rate to the German monetary policy shock reflects the full credibility of the EMS for those countries. In France, Ireland, Greece, Germany and Austria the monetary policy shock triggers an appreciation of the exchange rate. Finally, in Italy and Spain, we find the so-called exchange rate puzzle, i.e. a tightening of the monetary policy stance leads to a (only slightly significant) depreciation of the exchange rate (Grilli and Roubini, 1995). Given the shifts in exchange rate regime in these countries, the finding of erratic exchange rate responses should not be too much of a surprise.[20] More interesting is that the different patterns in the exchange rate responses are not reflected in the responses of prices and output. It is likely that the exchange rate response for one country has often coincided with a similar change of the exchange rate of other European countries in a similar direction so that the effective exchange rate of the country was less affected. Moreover, the last two decades were characterised by a negative correlation between the DM exchange rate and the dollar exchange rate of the European currencies.

Third, we show that in the countries of the third group, domestic monetary policy shocks that were orthogonal to the German interest rate have had the “typical” effects of monetary policy both on output and on prices. These effects reflect the actions taken by central banks in these countries to stimulate nominal convergence with Germany. They

[19] The exception is the impact of monetary policy on output in Ireland. This can be due to the specific situation of that country with respect to the UK. Moreover, we do not find this erratic behaviour if we use industrial production instead of GDP and we observe that both consumption and investment decrease after a monetary tightening. Bredin and O’Reilly (2000) show that taking into account the influence of the UK on the Irish business cycle helps solving this output puzzle.

[20] While some studies (Smets, 1997; Gaiotti, 1999; Hernando, 2000) have shown that other identification schemes can alleviate this exchange rate puzzle, we prefer to stick to our "simple" model that performs well in terms of GDP and prices, for the sake of comparability with the other countries.

may also pick up the effects of the EMS crisis on the 1993 recession and dis-inflation that followed.

Fourth, the comparison of our results to the estimates of a representative set of previous studies indicates that taken globally, the literature does not point to any country as experiencing either weaker or larger effects of monetary policy than the loose average of the countries. This is consistent with our (and Kieler and Saarenheimo's, 1998) finding of qualitatively similar results across countries and high uncertainty on the size of the effects. There is no black sheep. Most studies report that, overall, a majority of countries experience a fall in output (either GDP or industrial production) after a contractionary monetary policy shock. An overview of the maximum impact on output is provided in Table 1. The studies present, however, different rankings of the potency of monetary policy across countries. Some countries are documented to be more sensitive to a monetary policy shock in one study, but less in another. For example, Barran et al. (1997) find the largest impact in Germany and the weakest impact in Italy, while Peersman and Smets (1999) find the opposite.

The problem with most of these cross-country comparisons is that the size of the estimated monetary policy shock differs across countries. In this paper, for example, a one standard deviation monetary policy shock is a rise in the short-term interest rate of 48 basis points for Germany, while it is 59 basis points for Italy, and 84 basis points for Spain. Moreover, this also implies that each individual country has its own monetary policy reaction function. Thus, even if the same initial disturbance is analysed (e.g. as done by Dedola and Lippi, 2000), the monetary policy responses would not be harmonised.[21] This is illustrated by the two variants of Gerlach and Smets (1995). In the first case (a one standard deviation monetary policy shock), the response of output looks similar across Germany, France and Italy, while in the second case (a one percentage point, eight-quarters sustained increase of the interest rate), German GDP moves by almost twice as much as that of France and Italy. To justify this latter type of analysis, however, we have to assume that the estimated parameters of the model are invariant to the specification of the policy rule, and we are confronted with the Lucas critique.

Again, one should also note that, for any of these studies, the confidence bands around these responses are such that the differences across countries are likely to be not significant. In addition, Kieler and Saarenheimo (1998) show that screening the full space of observationally equivalent identifications of monetary policy shocks for Germany,

[21] See also Guiso et al. (2000) for a discussion of this problem.

France and the United Kingdom, one can build very similar impulse responses of GDP and prices to monetary policy shocks.

Given these criticisms on the limited power of quantitative comparisons of impulse responses to monetary policy shocks across countries, one can conclude that the evidence of cross-country differences in the transmission brought about by any single paper is not robust across studies. This is partially confirmed by a recent study that has attempted to test formally the cross-country differences in the transmission mechanism. Ciccarelli and Rebucci (2001) estimate a dynamic heterogeneous panel on a sample that pools macroeconomic data for Germany, France, Italy and Spain. They show that the cumulative impact of monetary policy on economic activity is not significantly different across countries.

Table 1: Effect of monetary policy on output

	DE	FR	IT	ES	FI	BE	NL	AT	IR	PT
Mojon and Peersman	-0.20	-0.20	-0.12	-0.14	-0.44	-0.32	-0.45	-0.25	-0.32	-0.08
BIS: National central banks [b]	-0.37	-0.36	-0.44	-0.25		-0.23	-0.18	-0.14		
BIS: FRB multi-country [b]	-0.72	-0.70	-0.44							
Gerlach and Smets 1	-0.28	-0.19	-0.31							
Gerlach and Smets 2 [b]	-1.00	-0.50	-0.50							
Barran et al.	-0.65	-0.46	-0.30	-0.55	-0.36		-0.35	-0.48		
Britton and Whitley	-0.60	-0.62								
Ramaswamy and Sloek	-0.75	-0.48	-0.50	-0.28	-0.85	-0.95	-0.60	-0.70		
Ehrmann [a]	-0.90	-0.40	-0.42	-0.22	-0.60	-0.36	-0.10	-0.05	-0.30	-0.40
Dedola and Lippi [a c]	-1.61	-0.66	-1.07							
Dornbusch et al.	-1.40	-1.54	-2.14	-1.54						
Mihov [b]	-0.55	-0.35	-0.40				-0.30	-0.35		
Peersman and Smets	-0.87	-1.15	-1.85			-1.80	-1.00	-0.93		
Clements et al.	-0.80	-2.20	-1.10	-1.30	-1.70	-1.40	-1.10	-1.00	-1.20	-0.30
Peersman	-0.28	-0.19	-0.17	-0.22		-0.18	-0.11	-0.17		

Note: maximum impact; data not comparable across studies. DE = Germany, FR = France, IT = Italy, ES = Spain, FI = Finland, BE = Belgium, NL = the Netherlands, AT = Austria, IR = Ireland, PT = Portugal.
[a]: effect of monetary policy on industrial production.
[b]: effect of a 100 basis points, eight quarters sustained increase of the interest rate.
[c]: effect of a 1 percentage point increase in the short-term rate.

4.3 Pre-EMU "euro area monetary policy" and national monetary policy histories

One interesting outcome of a monetary policy identification exercise is that it allows a retrospective view on when the monetary policy shock contributed to the evolution of the variables of the model. More importantly, we want to be able to relate the evolution of the monetary policy stance of the euro area in the pre-EMU period of the sample to the monetary policy histories of the individual countries.

Graph 2 plots the estimated policy shocks and their historical contribution to the domestic interest rate for each of the countries. In the left panel of each graph, the full line is the first difference of the interest rate, and the bars are the monetary policy shocks. In the right panel, the bars are the contribution of the monetary policy shocks to the (domestic) short term interest rate, whereas the full line is the contribution of the accumulation of all shocks to the short term interest rate.

The contribution of those shocks to interest rate developments differs across countries. For the euro area as a whole, it is clear that the years 1982, 1987, 1990 and 1992-93 are identified as periods of relatively tight monetary policy, whereas in 1984 and 1991 policy is estimated to be relatively loose. The mixed experience of the individual countries during the EMS crisis is striking. Monetary policy tightening in France, in Italy, and also in other countries except in Germany add up into a sharp tightening at the euro area level. On the contrary, German monetary policy was not too restrictive during the period 1992-93. This means that the high interest rate in Germany after the re-unification can be explained by the endogenous response of the Bundesbank to a booming economy. However, the stance of monetary policy for the other countries, which kept a fixed exchange rate vis-à-vis Germany, was too restrictive in view of the recession they were in. Another remarkable feature is that the proportion of the monetary policy shocks to the accumulated shocks of all the variables is very low in Germany compared to the other main countries of the Eurosystem. The reaction of monetary policy to price and output shocks was much more important in Germany. On the other hand, this proportion is also very low for Belgium, the Netherlands and Austria. For these countries, the reaction to exchange rate shocks is very important.

The cross-country comparison of the shocks is put into sharper focus in Table 2, which reports the correlations of the identified monetary policy shocks, and the first difference of the interest rate, across countries and with the euro area. The monetary policy of Italy, France and Spain contributes largely to the euro area aggregate. The correlation of the domestic monetary policy shock with the area-wide shock is respectively 0.51, 0.49, and 0.46. On the contrary, the German monetary policy shock, which is identified on a sample period which also includes the 1970s, is much less correlated to the euro area shock. It is worth noting that looking at the correlation of the first difference of the policy rate shows that both Italy, France and Spain, but also countries of the core EMS see their interest rate highly correlated to the euro area one.

Table 2: Correlations of monetary policy shocks and interest rates across countries

Domestic monetary policy shocks

	Ea	De	It	Fr	Es	Fi	Gr	Ir
Euro area	1.00	0.08	0.51	0.49	0.46	0.13	-0.11	-0.08
Germany		1.00	0.10	-0.08	0.02	-0.02	0.19	-0.35
Italy			1.00	0.34	0.30	0.08	-0.16	-0.07
France				1.00	0.21	0.01	0.03	0.00
Spain					1.00	0.07	0.02	-0.06
Finland						1.00	-0.05	-0.01
Greece							1.00	-0.04
Ireland								1.00

Policy interest rates

	Ea	De	It	Fr	Es	Fi	Nl	Be	At	Gr	Ir
Euro area	1.00	0.73	0.71	0.79	0.42	0.37	0.68	0.57	0.65	-0.14	0.36
Germany		1.00	0.29	0.48	0.04	0.22	0.80	0.53	0.70	-0.20	0.09
Italy			1.00	0.35	0.22	0.40	0.25	0.33	0.42	-0.13	0.24
France				1.00	0.23	0.16	0.48	0.61	0.44	-0.07	0.46
Spain					1.00	0.04	0.16	-0.19	-0.05	-0.08	0.08
Finland						1.00	0.26	0.28	0.35	-0.18	0.04
Netherlands							1.00	0.36	0.73	-0.18	0.12
Belgium								1.00	0.52	-0.20	0.30
Austria									1.00	-0.20	0.15
Greece										1.00	-0.37
Ireland											1.00

4.4 Further evidence on the effects of monetary policy shocks

In this section, we discuss the influence of a monetary policy shock on other macroeconomic variables that are not included in the basic model. We have done this by estimating the following equations:

$$
[8] \qquad \begin{bmatrix} \mathrm{Y_t} \\ \mathrm{Z_t} \end{bmatrix} = \begin{bmatrix} A(L) & 0 \\ C(L) & D(L) \end{bmatrix} \begin{bmatrix} \mathrm{Y_{t\text{-}1}} \\ \mathrm{Z_{t\text{-}1}} \end{bmatrix} + \begin{bmatrix} \mathrm{B(L)} \\ \mathrm{E(L)} \end{bmatrix} \mathrm{X_t} + \begin{bmatrix} \mu_t^Y \\ c\mu_t^Y + \mu_t^Z \end{bmatrix}
$$

The system of equations [8] is very similar to [1]. X_t is still the block of exogenous variables and Y_t the endogenous block. Let Z_t be another macro-economic variable (for example investment). Again, we suppose that neither contemporaneous nor lagged values of the endogenous variables have an influence on the exogenous block. This is also the case for our variable of interest. However, we suppose the same for our macro-economic variable, Z_t, with respect to our endogenous block of variables, Y_t, i.e. there is no impact of the variable under investigation on the other variables in the system. This assumption ensures that the shocks are invariant to the choice of the macroeconomic variable added to the original model. We show in Graph 3 for a few examples that this modelling assumption obtains the same impulse response as if the variable was included in the VAR.

4.4.1 The impact on GDP components

Graphs 4a, 4b and 4c present for each individual country the response of investment, consumption and exports respectively to a monetary policy shock. With the notable exception of Greece and Ireland, the response of investment is at least twice as large as the response of consumption. Investment response is, however, insignificant in both countries, and the response of consumption is insignificant for Greece. These results are broadly consistent with the ones of Barran et al. (1997) for models estimated on a sample period spanning from 1975 to 1993. They reflect the fact that consumption is smoother than investment over the business cycle, but also possibly the income effects of monetary policy, whereby net-debtor investors revise their expenditure plans more than net-creditors consumers. These results are also consistent with the area-wide results obtained in Peersman and Smets (2001).

For most countries, we find a strong impact of a monetary policy shock on exports. For instance, Austrian, Belgian and Dutch exports are affected by the appreciation of the real effective German exchange rate, while their nominal exchange rate vis-à-vis Germany hardly moves (Belgium and the Netherlands) or slightly depreciates (Austria). In these three countries, as well as in France, the dampening effect of contractionary monetary policy shocks on exports is larger than the one observed on GDP. In Finland, exports decrease as well and this fall is slower and smaller than the one observed for GDP. Finally, for Italy and Spain, we do not find a negative impact of contractionary monetary policy shocks on exports. The impact is even significantly positive in the latter country. This finding is not necessarily surprising given the exchange rate puzzle in these countries. However, the positive response of exports is not large enough to make the response of Spanish and Italian GDP deviate from the "typical" responses of GDP observed in most countries and at the Euro area level.

4.4.2 No liquidity puzzle

We have not considered money in our identification of monetary policy shocks because it had a much less important role than the exchange rate for all the countries, which were targeting a fixed exchange rate with the DM within the EMS. We nevertheless check that our identification is not characterised by a "liquidity puzzle". This "puzzle" stresses the risk of confusing money demand shocks and money supply shocks. A positive shock to money, which would be accompanied by a rise in the interest rate, is more likely to correspond to a money demand shock than to a monetary policy shock.

We estimated the response of M1 to the monetary policy shock identified in section 3. The central bank can better control this narrow aggregate than M3 because the yield on time deposits and on money mutual funds, which are the main components of "M3-M1" is correlated to the short-term interest rate. Hence a contractionary monetary policy shock triggers an increase in the yield of time deposits and money mutual funds so that M3 decreases less than M1[22]. As expected, the monetary policy shock triggers an immediate fall of M1 in all countries except France, Greece and Ireland (Graph 5). This further confirms the correctness of our identification scheme.

5. Concluding remarks

In this paper, we have used VAR models to analyse the effects of a monetary policy shock in the individual countries of the euro area in the pre-EMU period. First, we show that three, relatively simple identification schemes, depending on the monetary policy decision process in the ERM, obtain well behaved and qualitatively consistent effects of the monetary policy shocks in all the individual countries of the euro area. We confirm that, for these countries, the qualitative effects of monetary policy are quite similar to the ones described in a large literature for the US and by Peersman and Smets (2001) for the euro area aggregates. A contractionary monetary policy shock leads to a temporary fall in GDP that peaks typically around four quarters after the shock and a gradual decrease in the price level. The investment response and the export response are generally larger than the one of GDP while the response of consumption is smaller. We show also that the shocks

[22] See the appendix where the response of M3-M1 to monetary policy shocks is reported.

are initially accompanied by a decline in a narrow monetary aggregate. The effect on the exchange rate is somewhat more mixed. For some countries, we are confronted with an exchange rate puzzle. However, the temporary depreciation of the DM exchange rate observed in some countries does not seem to affect the response of GDP nor the response of prices. Second, this analysis allows us to compare the “artificial” monetary policy shocks measured for the euro area with the ones of the individual countries. The euro area shocks seem to be dominated by the French, the Italian and the Spanish monetary policy shocks. In particular, the early 1990s appear as a contraction for the euro area and for most of the individual countries while the Bundesbank was just reacting to the reunification boom.

Finally, the paper stresses that, given that the confidence bands around the responses are generally large, one can not use VAR models to conclude that some countries are characterised by larger effects of monetary policy than others. Another problem with this approach is that the size of the estimated monetary policy shocks and the reaction function of the central bank differ across countries. One way to solve this is to standardise the monetary policy shock across countries and to use the same reaction function for all countries. However, to justify this type of analysis, we have to assume that the estimated parameters of the model are invariant to the specification of the policy rule, and we are confronted with the Lucas critique. Further research that will build formal tests of the cross-country differences in the transmission mechanism is certainly useful.

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Appendix: The effects of monetary policy on components of M3, bank loans and bank retail interest rates.

In this appendix we describe the responses of components of M3, bank loans and bank retail interest rates[23] to a monetary policy shock. These responses were computed adding in turn each variable of interest to the country VAR, as described in section 4.5 of the text for GDP components.

Components of M3

The two panels of Graph A1 report the responses of various types of deposits and interest rates to a monetary shock. Three features are worth underlining.

First, as shown in the upper panel, while M1 decreases on impact with the monetary policy shock, M3-M1 increases for at least a few quarters in most countries. The movement of the latter aggregate, which is mostly composed of time deposits and money mutual funds, indicates that in all of the countries except Greece and Italy the banks are seeking to raise alternative funds to offset the contraction in demand deposits. This pattern is similar to the result obtained by Peersman and Smets (2001) for the euro area aggregate of M3-M1.

Second, the lower panel shows the interest rate moves that accompany the quantity changes. The time deposit rate which is effectively the "own interest yield" of M3-M1 increases at least in the short run in all countries except in Greece (where M3-M1 is decreasing)[24]. The similarity of the pattern of responses of the "own yield" and of the M3-M1 aggregate within the year following the monetary policy shock is striking in several countries. Third, we observe in a majority of countries (Germany, Belgium, France, the Netherlands, Greece and Ireland) that the response of M3-M1 reflects the change in the spread between the interest rate on time deposits and the one of government bond yield. Moreover, we know that in Italy, most of the short-term securities are treasury bills, which are not part of M3. This may explain why the increase in the Italian time deposits interest rate is not accompanied by an increase of M3-M1.

[23] See appendix 2 of Agresti and Mojon (2001) for a description of the data sources.

[24] The interest rate on Austrian time deposits is not available for a long enough sample to measure its response to a monetary policy shock.

Bank loans

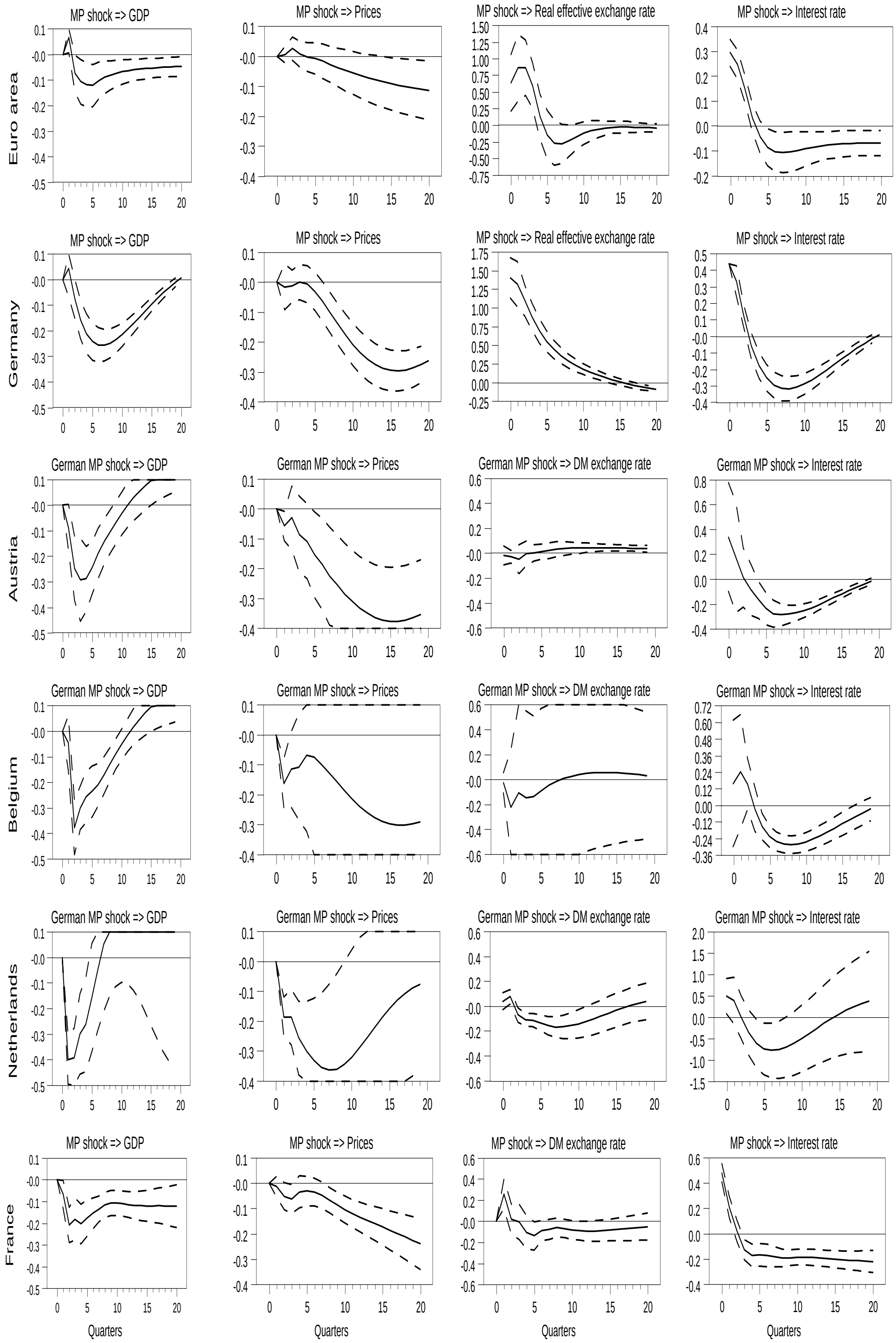
The responses of different categories of loans and bank loan rates to the monetary policy shock are shown the various panels of Graph A2. The upper panel shows the responses of bank loans to the private sector and where available separates the responses into loans to households and loans to businesses. Loans to the private sector decrease after a monetary policy shock in all countries except in Ireland. However, this decrease occurs only after about four quarters in France and in Spain and after two years in Austria. More importantly, the decline in loans peaks about a year after the peak decline in GDP (see Graph 1). We also notice that loans to firms and loans to households have very different responses to monetary policy in France and in Germany. In France, loans to firms decrease more markedly than loans to households (which actually increase), while in Germany, loans to firms decrease less than loans to households.

The remaining two panels report on mortgage rates and short-term loan rates to businesses. With a few exceptions (the Belgian and Greek mortgage rates) the retail banks interest rate on loans, either short-term loans to firms or mortgage loans, increase following a monetary policy tightening. The response of bank retail rates on short-term credit to firms is generally smaller than the response of the money market interest rate. This interest rate smoothing by banks is compatible with either banks restricting loans to the low credit risk segment of the market or shielding their customers from interest rate shock. The relative response of mortgage rates and government bond rates is more diversified across countries. The response of the former is smoother than the one of the latter only in half of the countries.

Summing up, we find that a contractionary monetary policy shock increases the marginal cost of raising deposits for banks and the interest rates on bank loans. This is accompanied by a decline in loans. Unfortunately, our reduced form approach do not permit to evaluate to what extent this decline is mainly driven by the normal shift of loan demand to the increase of bank interest rates or if it is amplified by a contraction of the supply of loans.

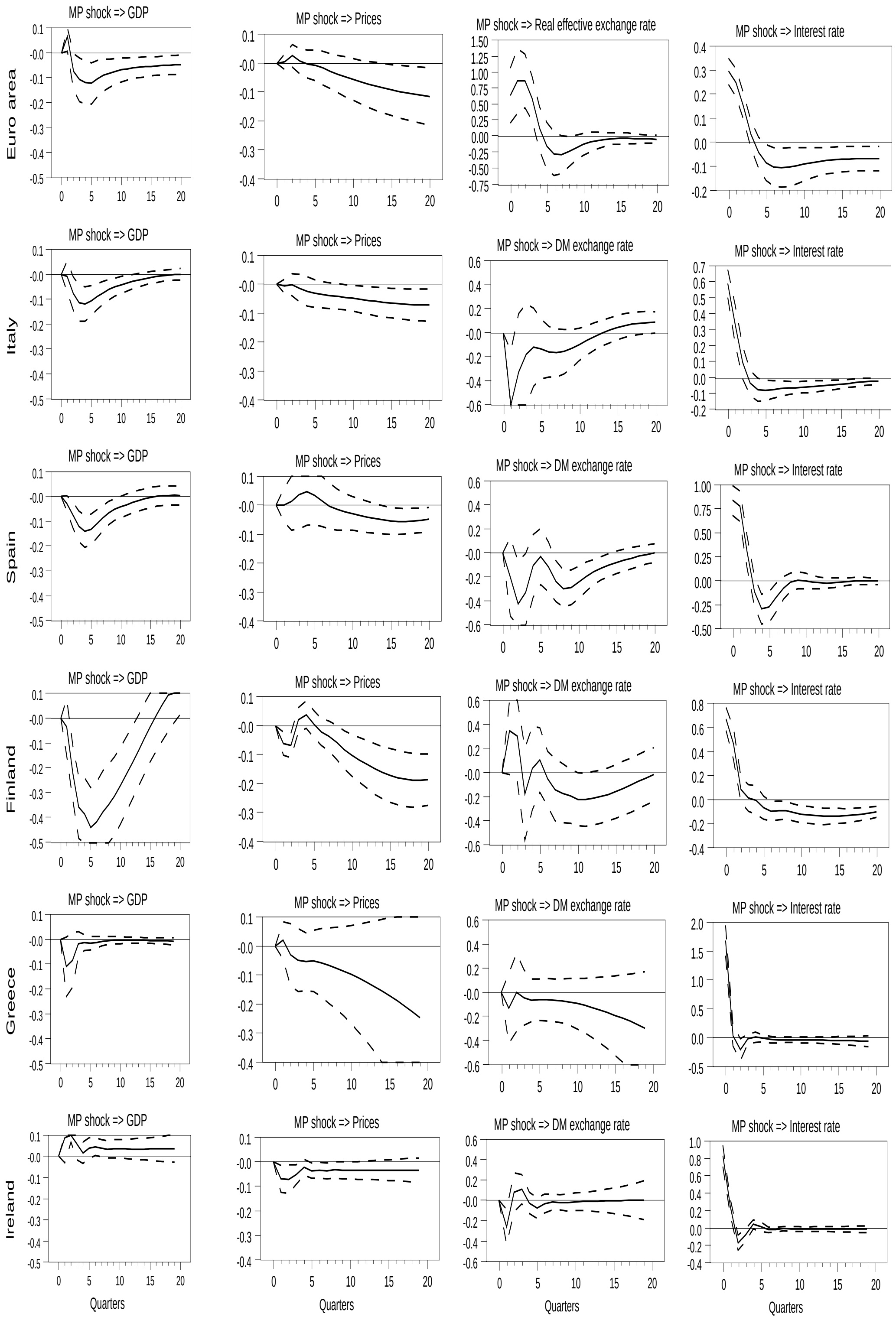
Graph 1a: Identification of Monetary policy shocks

(Dotted lines = 0.05 and 0.95 percentiles; full line = IRF)



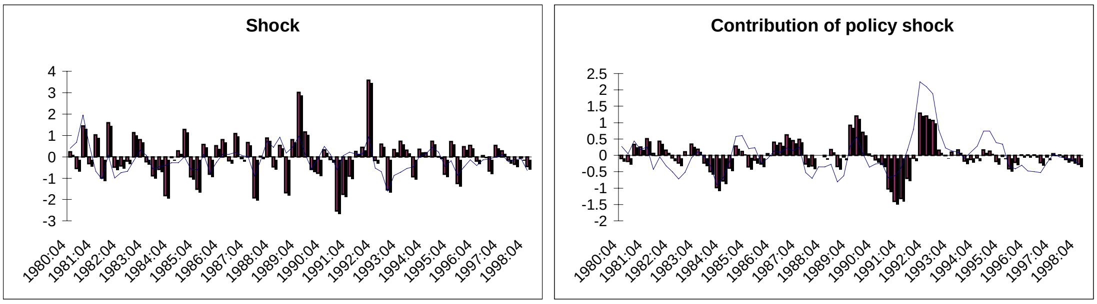
Graph 1b: Identification of Monetary policy shocks

(Dotted lines = 0.05 and 0.95 percentiles; full line = IRF)

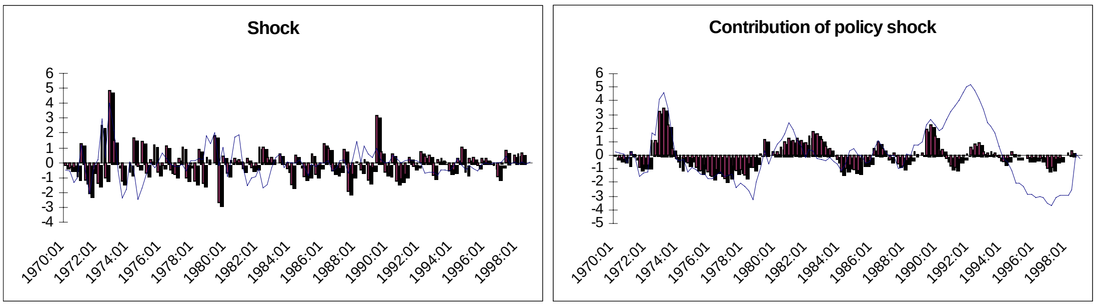


Graph 2: Monetary policy shocks and their contribution to the short-term interest rate for the euro area, Germany, France, Italy, Spain

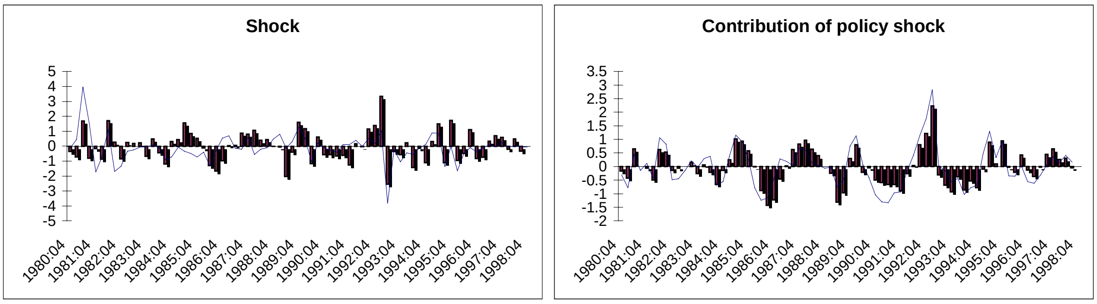
Euro area



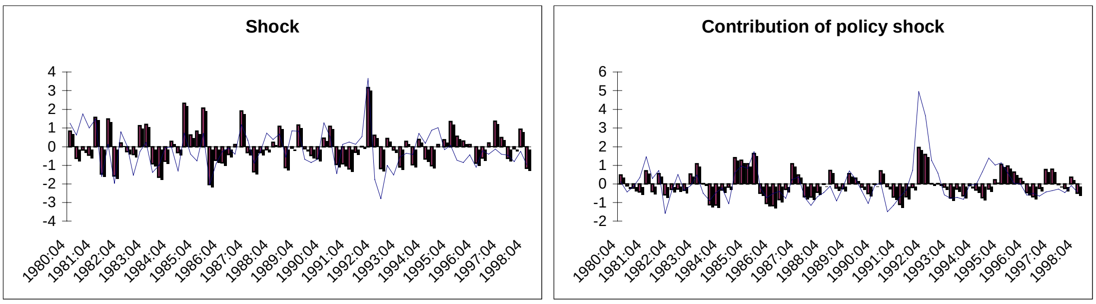
Germany



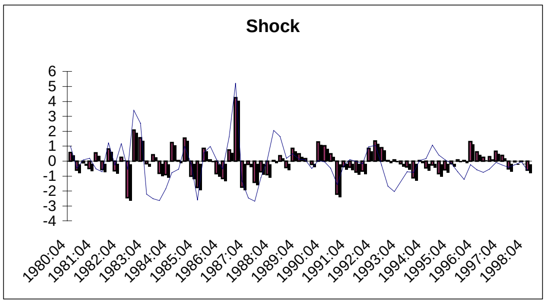
France

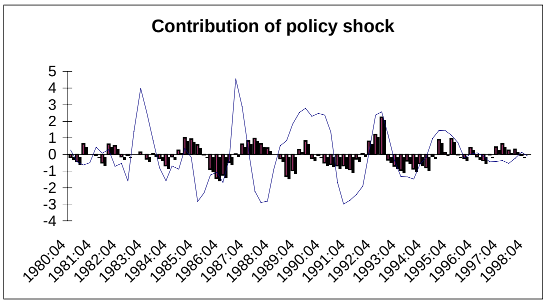


Italy



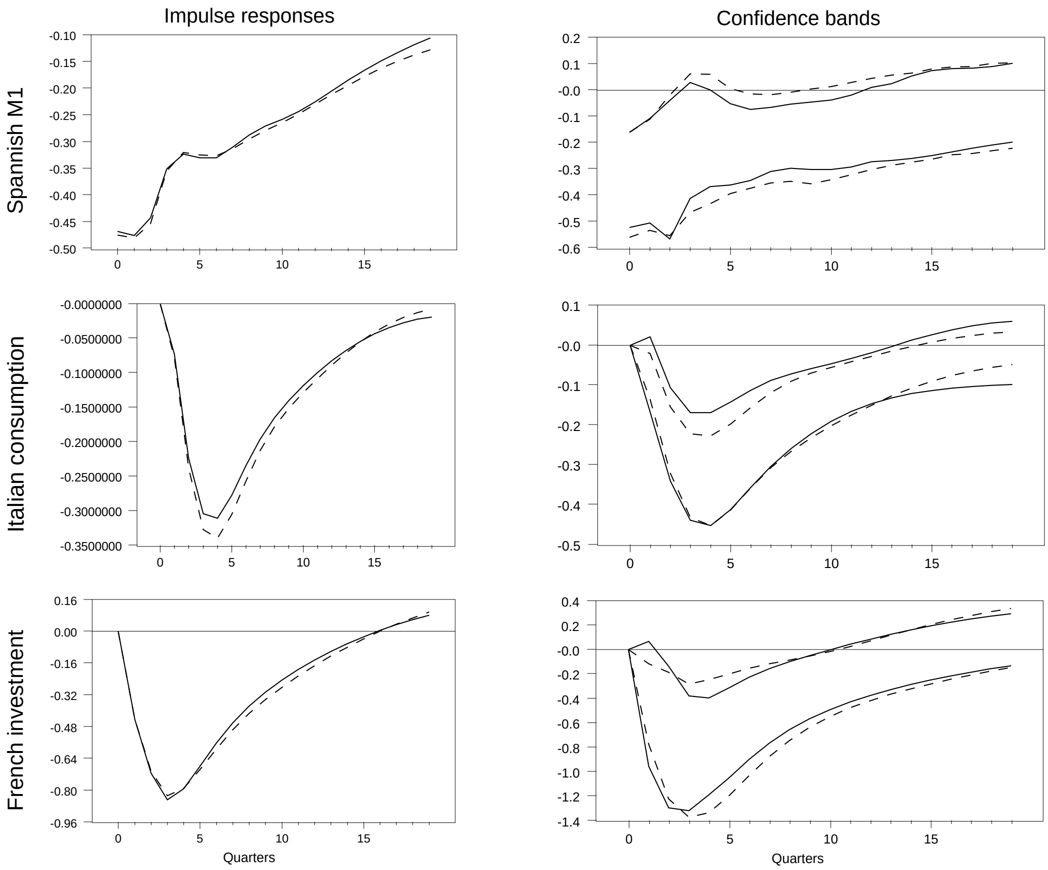
Spain





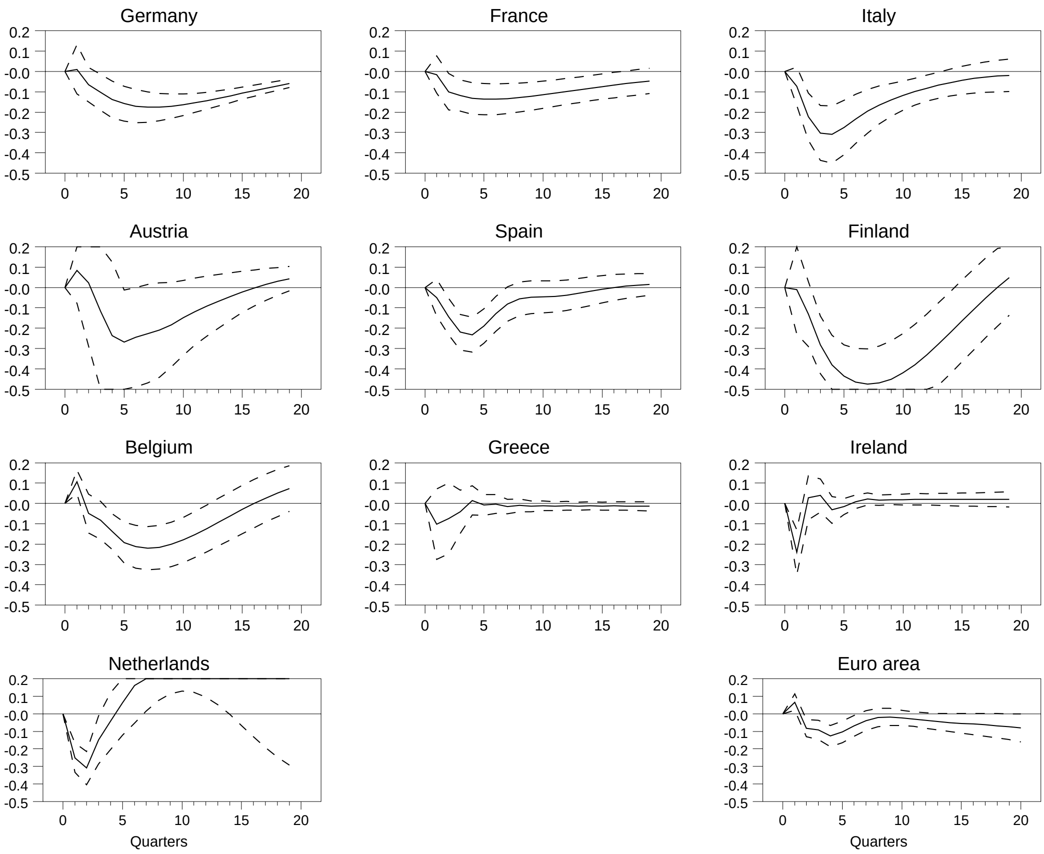
Note: left panel, the full line is the first difference of the interest rate, and the bars are the monetary policy shocks. Right panel, the bars are the contribution of the monetary policy shocks to the (domestic) short term interest rate, whereas the full line is the contribution of the accumulation of (all) past shocks to the short term interest rate.

Graph 3: Block recursive VAR (full line) and standard VAR (dotted line)
(response to an monetary policy shock and associated confidence bands)



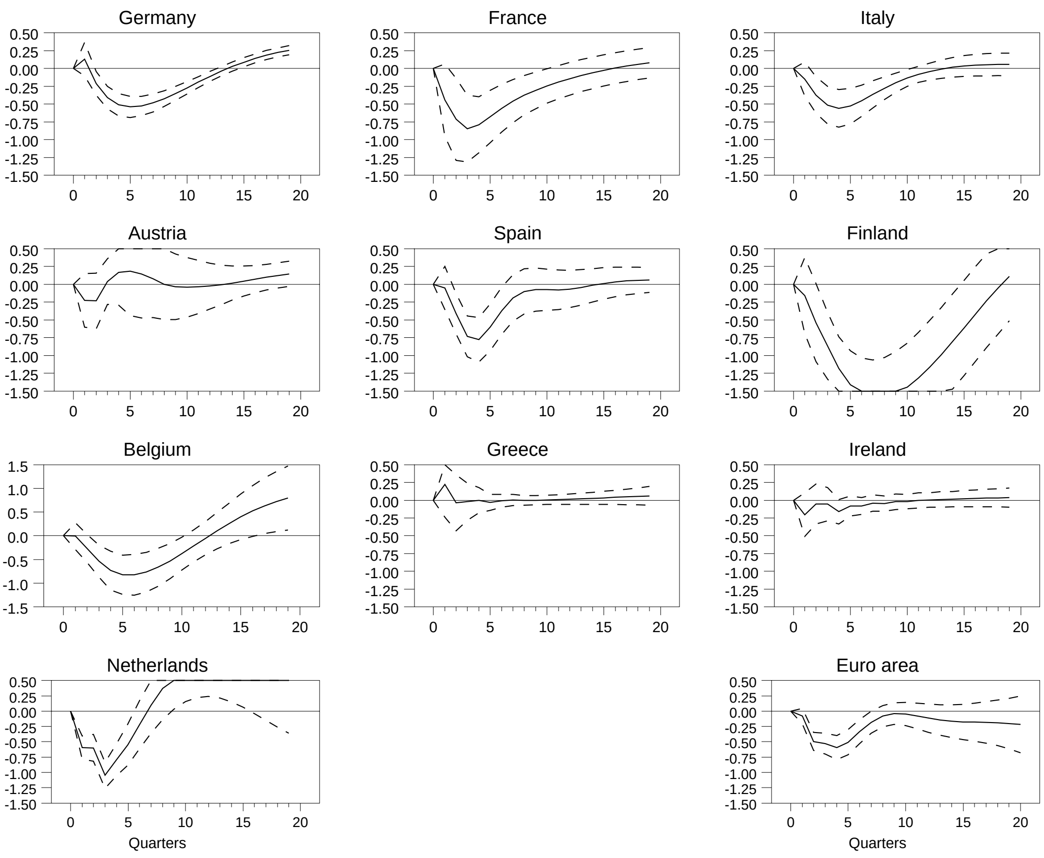
Graph 4a: Consumption

(Dotted lines = 0.05 and 0.95 percentiles; full line = IRF)



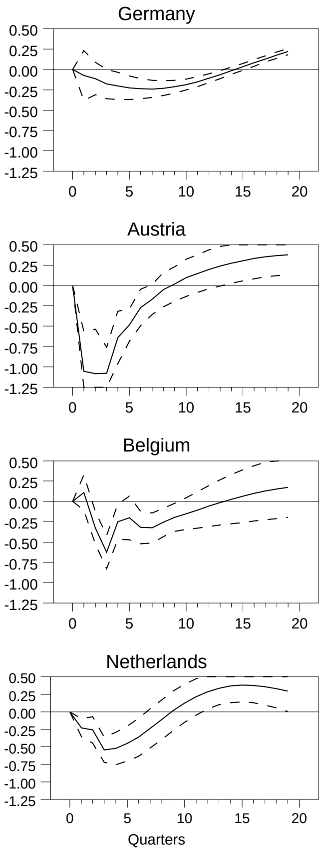
Graph 4b: Investment

(full lines = 0.05 and 0.95 percentiles; dotted line = IRF)



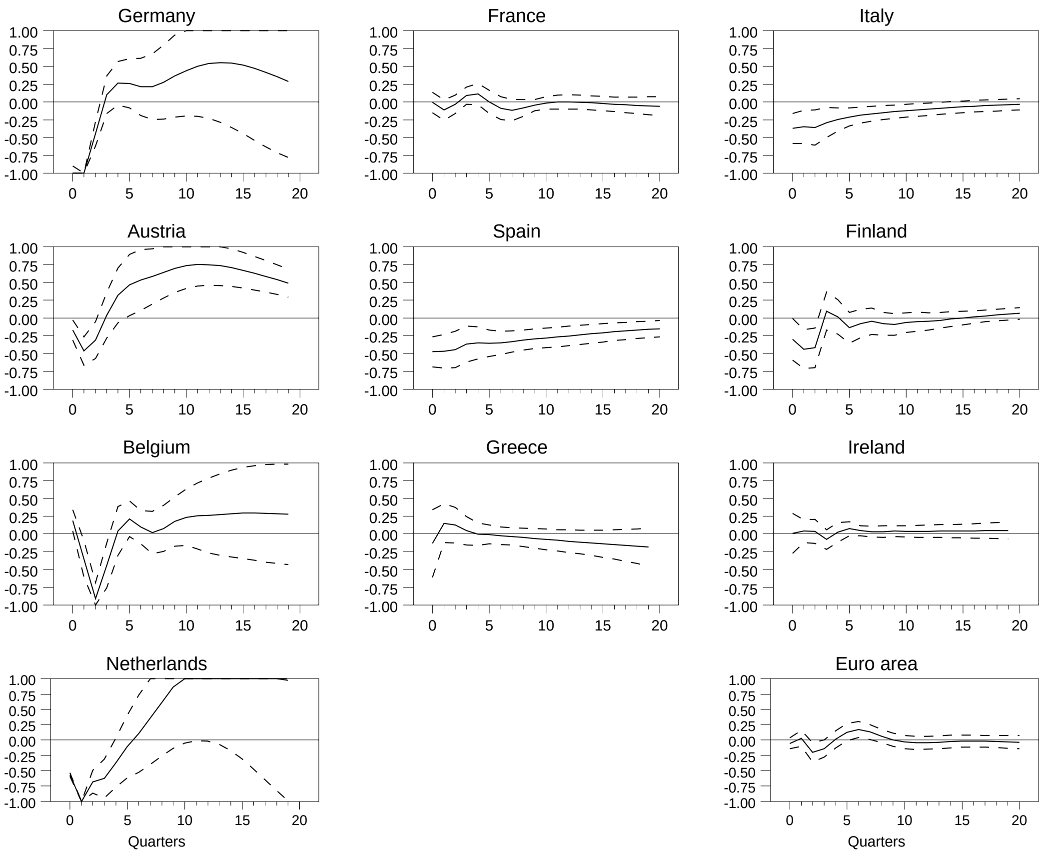
Graph 4c: Exports

(Dotted lines = 0.05 and 0.95 percentiles; full line: IRF)

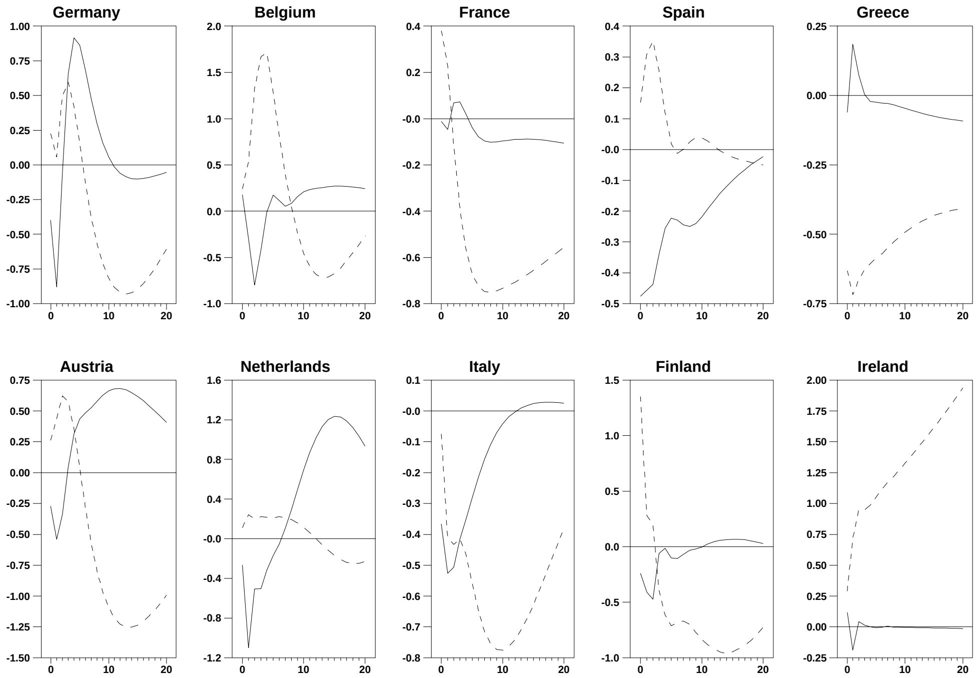


Graph 5: Money (M1)

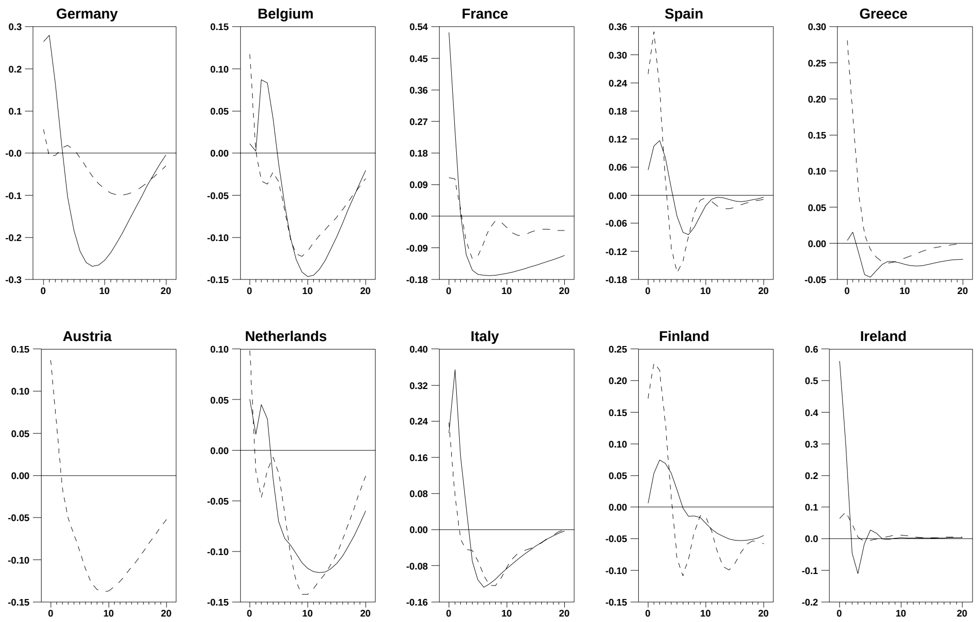
(Dotted lines = 0.05 and 0.95 percentiles; full line = IRF)



Graph A1a: Responses of M1 (full lines) and M3-M1 (dotted lines) to a monetary policy shock*

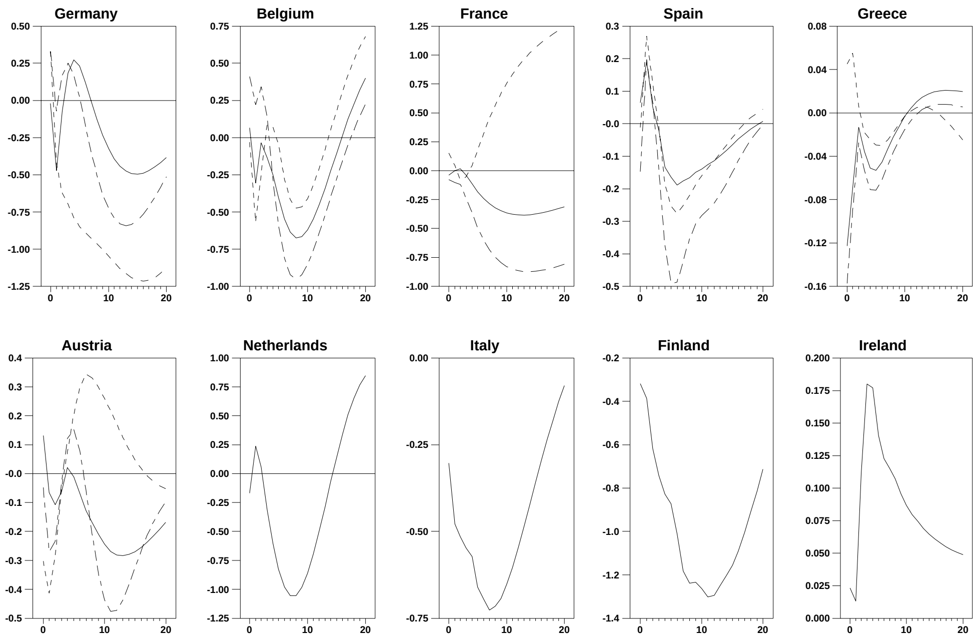


Graph A1b: Responses of time deposits rates (full lines) and government bond rates (dotted lines) to a monetary policy shock

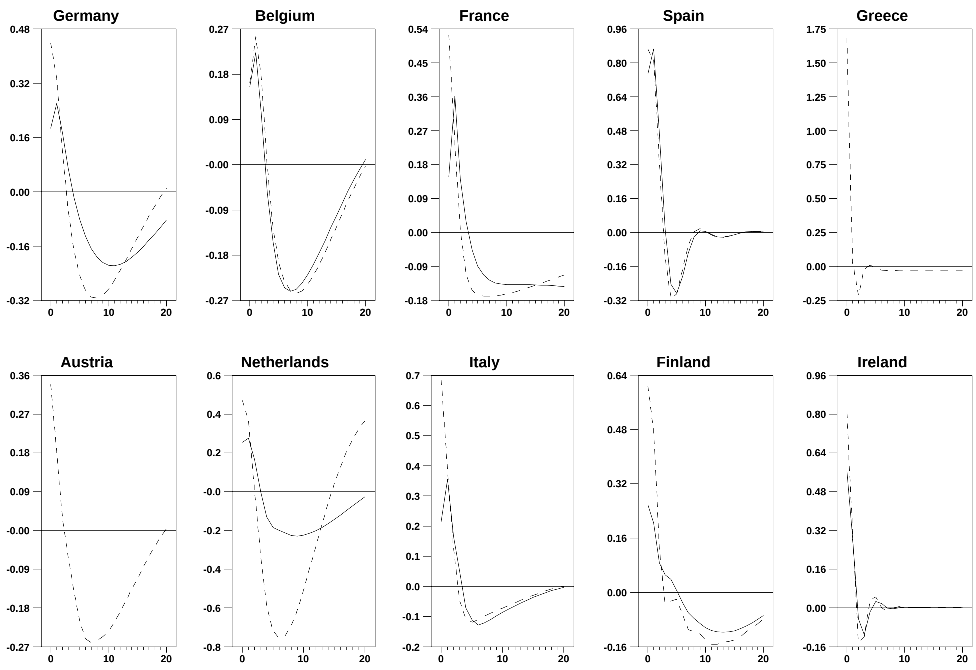


* Graph A1 and A2: See the text for the presentation of the VARs estimated for each country.

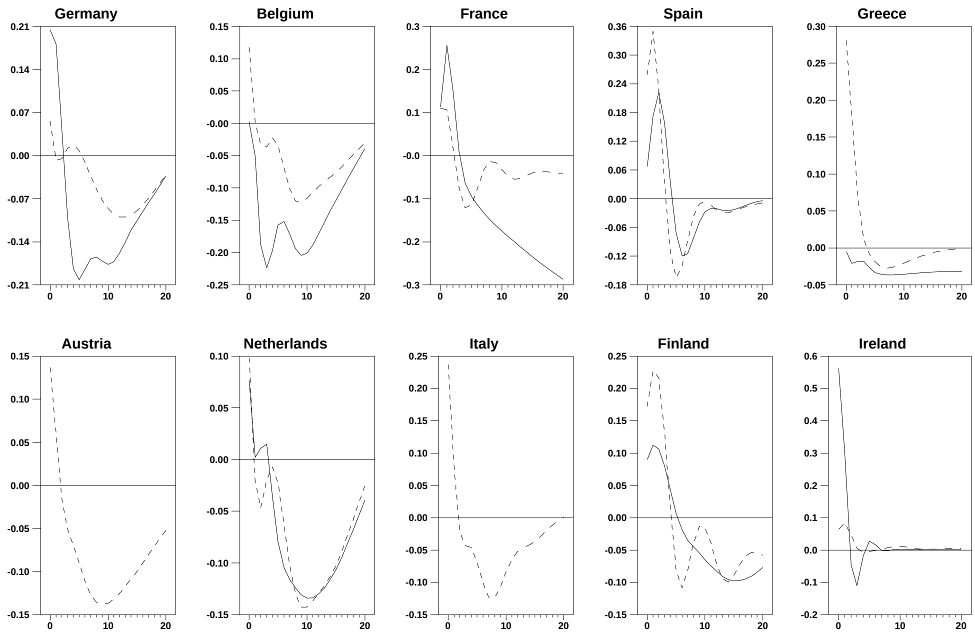
Graph A2a: Responses of bank loans to the private sector (full lines), loans to households (dotted lines) and loans to firms (broken lines) to a monetary policy shock



Graph A2b: Responses of the rates on short-term loans to firms (full lines) and 3 months money market rates (dotted lines) to a monetary policy shock



Graph A2c: Responses of mortgage rates (full lines) and government bond rates (dotted lines) to a monetary policy shock



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