

## The Asymmetric Effects of a Common Monetary Policy in Europe

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### Abstract

*This paper examines the monetary transmission mechanism in six EU member states. It provides useful empirical evidence for assessing the impact of a common monetary policy in the early stages of EMU, and enables us to form a view on how the regime change represented by EMU is likely to be translated into changes in policy multipliers in the various EU countries. The empirical analysis applies techniques recently developed by Wickens and Motto (2001) for identifying shocks by estimating a VECM for the endogenous variables, and a stationary VAR in first differences for the exogenous variables. Our findings suggest that there are significant differences between EU countries in the transmission mechanism of monetary policy.*

- **JEL Classification :** C32, E40
- **Key Words:** monetary shocks, asymmetries, common monetary policy, identification, VECM, VAR

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## I. Introduction

There is a wide consensus in the macroeconomics literature that monetary policy can significantly influence the real economy. For instance, Taylor (1995) and Maclennan *et al.* (1999) report that monetary policy actions cause movement in real output lasting for over two years. However, there is less agreement on the nature of the transmission mechanism, which could vary across countries. Moreover, the empirical literature provided many evidences of the effect of monetary shocks on individual country rather than a common monetary shock. Barran, Coudert and Mojon (1997), Kouparitsas (1999) estimated country specific VARs and conducted impulse response analysis on how unexpected monetary shock affects the other variables in the system.

This paper aims to shed further light on the monetary transmission mechanism in various EU member states by investigating the possibly asymmetric effects of unanticipated common monetary shocks. We employ techniques recently developed by Wickens and Motto (2001) for identifying shocks. Their approach is based on adopting for the endogenous variables a VECM specification, which incorporates long-run restrictions derived from economic theory, and estimating a VAR model in first differences for the exogenous variables. Impulse responses to the *structural* shocks can then be estimated without requiring any arbitrary restrictions other than those necessary for identifying the shocks to the exogenous variables. Such impulse responses lend themselves to economic interpretation and are suitable for policy analysis, in contrast to alternative methods used in the earlier empirical literature.

The reminder of this paper is structured as follows. Section II reviews briefly the previous literature on the channels through which monetary policy can affect the real economy. Section III discusses the identification of monetary shocks and outlines the econometric approach taken in the present study. Section V presents the empirical findings. Section VI offers some concluding remarks and highlights the policy implications of our findings.

## II. Differences in the Monetary Transmission Mechanism

Various authors have pointed out that the transmission mechanisms of monetary policy can vary substantially, owing, *e.g.*, to differences in financial structures (see MPC, 1999). It is well known that central bank preferences differ across European

countries (see Clarida *et al.*, 1999). One reason might be that central banks face different economic environments. In countries where loans and bonds are imperfect substitutes, a rise in interest rates not only reduces the supply of loans, but also increases the cost of external finance, as firms have to pay a higher premium on bonds (see Bernanke and Gertler, 1995). Therefore the effects on the real economy of a given degree of monetary tightening are greater.

Changes in interest rates can also have asymmetric income effects, if the net asset positions of consumers differ. In high-debt economies more consumers will become liquidity constrained as a result of a tighter monetary stance, which will depress consumption to a greater extent. Jappelli and Pagano (1994) studied how credit access conditions vary using a sample of 30 countries covering the period 1981-1987. The maximum loan-to-value ratio applied to individuals seeking a loan to buy a house was used as an indicator of credit access. Their study found that the minimum down-payment required to buy a dwelling was especially high in Italy, Portugal, and Austria compared to France, Germany and the UK. Trautwein (2000) and Clements *et al.* (2001) looked at the role of credit channel in explaining cross countries differences in the strength of the monetary transmission mechanism. Using a sample of 12 European countries Clements *et al.* (2001) found that monetary policy can affect output through its effects on credit. Barran *et al.* (1997) showed how an *access indicator* (households' access to credit) is correlated with the availability of consumer credit relative to GDP. The argument is that different bank practices and regulations across countries lead to some differences in the response of the final demand components. Kneeshaw (1995) examined this relationship and found that asymmetries persist. Relative to disposable income, in Italy households have low debt levels. On the other hand, households in France, and Germany are highly indebted. Changes in interest rates can also affect agents' income and wealth. A rise in interest rates affects the net flows of interest payments and the value of shares and bonds. The impact varies from one country to another owing to differences in agents' financial positions. Cusson (1992) found that in France, for example, a fall in interest rates lowers households' potential earnings and increases corporate sector potential earnings. This is because the more financial assets households own, the less effective monetary policy will be, as a rise in the rate of interest tends to increase income rather than constrain spending. In the UK, for example, where households hold a substantial proportion of their assets in shares, they will tend to save at times when interest rates are high to maximize their financial wealth. As the distribution of wealth and households'

financial position varies across countries, so will the effect of monetary policy. Based on pre-European Monetary Union evidence from Germany, France, Italy and Spain Ciccarelli and Rebucci (2006) employed a time-varying panel VAR model to investigate the transmission mechanism on European monetary policy and to analyse its evolution over time. The empirical framework they used lets the parameters of the transmission mechanism differ both across countries and over time periods. However, the framework used over imposes restrictions on the model because of the large number of parameters involved.

The transmission mechanisms of monetary policy can also vary substantially owing to differences in credit indexation practices. In countries, such as the UK, where mortgage credit is allocated using floating rates and loans are made at rates that may be revised at the discretion of the lender, a rise in interest rates will lower households' aggregate spending and bank lending. In France just 30 percent of the loans are at rates that may be revised and the rest are at re-negotiable rates; therefore, a rise in interest rates has a weaker effect on households' aggregate spending. Fiorentini and Tamborini (2002) studied the monetary transmission mechanism in Italy, and found strong evidence that the credit transmission mechanism is more important than the money transmission mechanism.

Finally, the shape of the yield curve might differ across countries. Borrowing might be mainly short-term in some of them, but long-term in others. Under such circumstances a decision by the ECB to raise short rates, which could actually result in a fall in long rates, is likely to have asymmetric impacts on the national economies. Additional transmission mechanisms are analysed by Taylor (1995). Besides the standard interest rate effects on consumption and investment and the credit channel already mentioned, he discusses the transmission channel operating through exchange rate effects on net exports, and other asset price effects, such as the lower Tobin's  $q$  and level of investment which are caused by the lower equity prices resulting from a monetary contraction. Other possible interest rate effects include indirect effects on consumer expenditure via income uncertainty or volatility (see MacLennan *et al.*, 1999). Chiades and Gambacorta (2000) tested for an exchange rate channel in addition to the traditional money and credit channels of monetary policy in the context of a structural VAR (SVAR), using data from 1984 to 1998, and found that, in the short run, monetary policy shocks are transmitted through the two former channels, whilst the exchange rate does not respond to interest rate shocks, giving rise to an exchange rate "puzzle".

The existence of significant institutional differences across the EU member

states is highlighted, *inter alia*, by Maclennan *et al.* (1999), who focus on barriers to convergence in financial systems after EMU. They conclude that European countries tend to have a cluster of high or low response characteristics to interest rate changes (see also Ramaswamy and Sloek, 1997), which could result in tensions within EMU, and makes it essential to implement appropriate institutional reforms. Giovannetti and Marimon (1998) also showed that conflicts of interest might arise in the pursuit of a common monetary policy if differences in the relative efficiency of financial intermediaries across the EU countries persist.

A study by Fatas (1998), for the period 1960 to 1996, suggests that there are significant asymmetric shocks, which have lasting effects on the GDP of individual countries relative to the EU average (see also Arrowsmith *et al.*, 1999). However, the available evidence on differences in monetary policy multipliers is contradictory (see Dornbusch *et al.*, 1998). The findings based on large macro-econometric models indicate that asymmetries might be significant, whilst the results obtained using small reduced-form VAR specifications are less supportive of this idea. (There is also evidence from the optimal currency areas literature suggesting that impulse response functions vary considerably across countries, even when the shocks are symmetric). Both approaches have been criticised for their shortcomings (for instance, the lack of transparency of large models, and the difficulties in achieving identification in the context of VARs), and neither of them addresses the issue of the stability over time of the estimated relationships.

### III. Identifying Monetary Shocks

Despite the evidence presented in Bagliano and Favero (1998) in favour of standard “benchmark” VAR models, serious objections can be raised against the standard VAR methodology used to analyse monetary shocks. Firstly, there is the issue of misspecification because of the omission of important variables. This means that the estimated “monetary” residuals will in fact be a mixture of monetary and other shocks. Secondly, the Lucas critique is even more relevant in the context of VAR specifications, which do not model the underlying behavioural relationships. The third problem is the identification of the structural parameters. It is standard practice to achieve it by assuming that there is simultaneous feedback only from monetary to macro variables (and not *vice versa*), which is consistent with a number of theoretical models, and by imposing restrictions on the monetary block which reflect institutional features. To compute the impulse response

functions the disturbances from the moving average (reduced form) representation of the model are then orthogonalised using the Choleski decomposition. Forecast error variance decomposition is also routinely carried out. Peersman (2004) used a near-VAR system to estimate a Euro area block and individual country block but policy shock in both blocks was identified through a standard Choleski decomposition with predetermined of blocks and endogenous variables within the blocks. There are two obvious problems with this approach (see Pesaran and Smith, 1998). Firstly, the impulse responses are obtained using *orthogonalised* errors, not the *structural* or even *reduced form* errors. Secondly, this procedure involves choosing a particular ordering of variables. Consequently, different estimates of the impulse responses will be obtained depending on what ordering is adopted. In fact, the assumptions needed in this context in order to identify the responses are equivalent to traditional identification assumptions. A possible alternative is to impose *a priori* restrictions on the covariance matrix of the structural errors and the contemporaneous and/or long-run impulse response functions themselves, as in the *Structural VAR* approach. However, this method typically involves assuming that the structural errors are uncorrelated, which is not plausible in many cases, and requires a high number of restrictions, which makes its implementation possible only in the case of very small systems.

Recent methodological developments aim at addressing the issues highlighted above. In particular, Garratt, Lee, Pesaran and Shin (2000) and Peersman (2004) have attempted to tackle the identification problem, namely the fact that in the presence of multiple cointegrating vectors the estimated vectors cannot be interpreted as identifiable long-run relations unless additional restrictions are imposed. Their approach is to restrict the cointegrating space and then use a constrained maximum likelihood estimator instead of the standard Johansen estimator. However, this leaves the problem of identifying the shocks unsolved. Pesaran and Shin (1998) have recently advocated *generalized impulse response* analysis for unrestricted vector autoregressive (VAR) and cointegrated VAR models. This has two major advantages, namely: (i) it does not require orthogonalisation of the shocks; (ii) it is invariant to the ordering of the variables in the VAR. The derived impulse responses are unique, and also take into account the historical patterns of correlations observed amongst the different shocks. They coincide with the orthogonalised responses only in the special case when the variance/covariance matrix is diagonal -usually, they are substantially different.

However, as pointed out by Wickens and Motto (2001), it is not possible to give

an economic interpretation to the “persistence profiles” (i.e. the response of the error correction terms to shocks to the disturbances of the cointegrating VAR - CVAR) estimated in this way. This would require imposing restrictions on the disturbances of the CVAR, so as to be able to compute impulse responses to the structural shocks. They suggest, therefore, an alternative methodology. Specifically, this involves adopting for the endogenous variables a VECM specification, which incorporates long-run restrictions derived from economic theory, and estimating a VAR model in first differences for the exogenous variables. The full system then includes both sets of equations, and can be used to compute impulse responses to the *structural* shocks, without requiring any arbitrary restrictions other than those necessary for identifying the shocks to the exogenous variables. The long-run restrictions approach, introduced by Blanchard and Quah (1989) and Shapiro and Watson (1998) does not impose restrictions on contemporaneous relationships among the model variables. Instead, restrictions on the long-run relations among the variables are imposed. Assumptions about the long-run neutrality of money then used to identify monetary policy shocks. In this study we use short-term interest rates rather than the usual money shocks to identify monetary policy shocks (see the arguments in Bernanke and Blinder, 1992). The estimated impulse responses then have an economic interpretation and are suitable for policy analysis. The basic idea is to assume that it is possible to decide which variables are endogenous and which are exogenous. The assumption is that the endogenous variables are determined by a structural simultaneous equation model (SEM):

$$B(L)y_t + C(L)x_t + Rd_t = e_t \quad (1)$$

where  $y_t$  is a  $\rho \times 1$  vector of endogenous variables,  $x_t$  is a  $q \times 1$  vector of exogenous variables, both being  $I(1)$ , and  $d_t$  represents a vector of deterministic variables.

If  $s_t$  is an  $r \times 1$  vector of stationary endogenous variables, equation (1) becomes

$$F(L)s_t + B(L)y_t + C(L)x_t = e_t \quad (2)$$

Assuming that the equations for the stationary variables takes the form

$$J(L)\Delta s_t + G(L)\Delta y_t + H(L)\Delta x_t + M_{s_{t-1}} + K\beta' z_{t-1} = \varepsilon_t \quad (3)$$

where  $Z_t = (y' x')'$  and the roots of  $[j(L)(1 - L) + ML] = 0$  lie outside the unit

circle.

and assuming that the exogenous variables are generated by

$$D(L)\Delta x_t + E(L)\Delta y_{t-1} = Sd_t + \varepsilon_t \quad (4)$$

Defining the vectors  $y_t^* = (s_t' y_t')'$  and  $Z_t^* = (s_t' y_t' x_t')'$  allows (2) to be written as

$$[F(0)B(0)C(0)]\Delta z_t^* = [F(1)I]\beta' z_{t-1}^* + [\tilde{F}(L)\tilde{B}(L)\tilde{C}(L)]\Delta z_{t-1}^* + e_t \quad (5)$$

$$\text{where } \beta^{*'} = \begin{bmatrix} I & 0 \\ 0 & \beta' \end{bmatrix}$$

The long-run structure is then  $\tilde{\beta}' z_t^* = [F(1)I]w_t^*$  where  $w_t^* = [s_t' w_t']$ .  $\tilde{\beta}' = [F(1)B(1)C(1)] = [F(1)\beta']$  and is the long-run coefficient matrix.

The complete system is given by combining (4) and (5), and can be written as the CVAR

$$\Delta z_t^* = -\alpha^* \beta^{*'} z_{t-1}^* + A^*(L)\Delta z_{t-1}^* + v_t^* \quad (6)$$

Equation (6) is not a standard cointegrated VAR, as it contains equations for the stationary as well as the non-stationary variables.

The sub-system of equations for the combined stationary and non-stationary endogenous variables can then be written as

$$\Delta z_t^* = -B^*(0)^{-1}C^*(0)\Delta x_t - B^*(0)^{-1}w_{t-1}^* + B^*(0)^{-1}[\tilde{B}^*(L)\tilde{C}^*(L)]\Delta z_{t-1}^* + e_t^* \quad (7)$$

Both equation (7) and the equations for the exogenous variables can then be estimated by OLS, and impulse response functions can be calculated from equation (6).

#### IV. Empirical Results

The study examines six core countries of the ERM-system. The selected countries are Austria, Denmark, France, Germany, Netherlands, and Italy. The model is estimated using quarterly data for the period 1981q1 to 1998. All variables are in logarithms, except the interest rates, which are in levels. The data are taken from the IMF's International Financial Statistics and the OECD's quarterly accounts.

ADF tests indicate that the interest rates are stationary or I (0) variables, whilst the other series variables are non-stationary or I (1). The Johansen and Juselius (1989) tests do not reject the null of a single cointegrating vector in each case among the I (1) variables (see appendix, Table 1). We use the Akaike Information Criterion (AIC) and the Schwarz Bayesian Information Criterion (BIC) to determine the appropriate lag length (or order) of the VAR, selecting the model with the lowest AIC and BIC values. In case of contradicting results, we give preference to the AIC criterion as suggested by Stock (1994).

In order to implement the procedure of identifying monetary policy shocks and identify the impulse response functions, we estimate a VAR model using four different specifications as explained below. The four identified VARs comprising output, prices, long-term interest rates, investment and exchange rate. The aim of the analysis is to explain the movements in these endogenous variables in terms of a common monetary shock. Following the work of Peersman (2004) the identified exogenous variables are: a world commodity price index, US real GDP, and US short-term interest rate. Unlike Peersman (2004) the model analysis the short run as well as the long run behaviour of the economies. The impulse response functions are reported for a horizon of 20 quarters with 90 percent confidence bands.

### A. The Responses to a Monetary Shock

In the first VAR specification the variables are included in the following order: GDP at 1995 constant prices, the consumer price index, the exchange rate, and the money market interest rate. First we trace the effect of a one standard deviation shock to (increase in) the call money market rate (i.e. short-term interest rate). The impulse response functions for this model (see Chart 1, Appendix) show that such a shock to the system results in a fall in output in all countries under study. However, the decline in output varies across countries. In the case of Germany and to less extent in Italy and the Netherlands output falls soon after the occurrence of the shock, which appears to have a strong effect. The immediate effect of the shock is apparent in quarter one and two. Furthermore, it is relatively big in some of these countries, namely Austria. By contrast, output is affected much later in Austria, Denmark, and the France, and the effects of the shock are weak, particularly in Denmark and France, where they appear to die out quickly. With the exception of Germany, the maximum effects on output are reached between eight and eighteen quarters. One possible reason for the time lag in Germany response is the fact that most households' debts are indexed with short-term interest rates. The impact of

monetary policy on output is also dependent on the credibility of the central bank. One could argue that the impact on output is much higher in countries where monetary policy is less credible (Clements *et al.*, 2001). These results are in contrast to those of Barran *et al.* (1997), who found that the maximum effects occur between four and ten quarters in most countries under study. Their study also finds the biggest impact in Germany, where output begins to fall immediately after the interest rate shock. As in Barran *et al.* (1997), we find that Germany is the country most affected.

To shed light on how individual components of output are affected by monetary shocks, a second VAR model that includes the main components of final demand (i.e., consumption, private investment and residential investment) was also estimated. One would expect a larger effect on private investment expenditure than on household consumption since the corporate sector is generally a net borrower (see Barran *et al.*, 1997). Overall, the results of the impulse response analysis (see Chart 2, Appendix) support this argument, suggesting that a monetary policy shock will contract investment expenditure more than household consumption, and are consistent with the fact that aggregate private consumption constitutes only 20 percent of aggregate consumption. The decline of investment expenditure and household consumption varies across countries. In Germany investment falls much more sharply than in France, and Denmark. High indebtedness levels of the corporate sector may explain this strong sensitivity to interest rates. The influence of monetary policy on firms depends on their liabilities. High indebtedness can cause high negative cash-flow effects and intensify credit constraints. Indebtedness is rather high in Germany - accordingly, German firms should suffer comparatively more than those in France and Denmark. Also, the decline in household consumption is greater in Denmark than in Italy, Germany, and France. Except for Germany and Italy, the adjustment pattern is very similar, with the trough occurring after fifteen quarters. In Italy and Germany the relatively weak response of households' consumption to a monetary shock may reflect the fact that households hold a substantial proportion of their assets in bonds and shares, and hence have less money available to spend on consumer goods and services.

The channels through which monetary policy is affecting economic activity were investigated next using a third specification, which included different possible transmission variables, namely, exchange rates, long-term interest rates (government bond yield) and credit to the private domestic sector. The third model also includes all the variables of the first one. For an exchange rate channel to

exist, two conditions have to be fulfilled. First, an interest rate shock should lead to a currency appreciation (decrease in the exchange rate). Second, the appreciation should result in a fall in both output and prices. Chart 3 shows the response to an interest rate shock. The results show that in most countries this leads to a currency appreciation (decrease in the exchange rate). Moreover, a positive exchange rate shock (depreciation) leads to a significant fall in output in the Netherlands, while the response seems rather small in all other countries. It also results in higher prices, except in Germany. Exchange rate fluctuations affect spending in two ways: firstly, through a price effect on imported goods, with a direct impact on consumer prices; secondly, through their impact on trade. We find that an exchange rate channel is in operation in Germany and the Netherlands, where the two conditions are fulfilled, and are in contrast to those of Barran *et al.* (1997), who reported that there is no exchange rate channel in all countries under study apart from Spain. Our findings do not confirm the view that the exchange rate channel operates mainly in largely open economies.

The same model was also used to assess the effects of shocks to the long-term interest rate (government bond yield) on economic activity. A one standard deviation shock (increase) is considered. This is found to result in a decline in output in various countries such as Austria, the Netherlands, Germany, Italy and Denmark, France being the single exception. The fall of output in Germany is significant with the maximum effects reached between 10 and 14 quarters. It is interesting to note that in countries where monetary policy was more closely aligned to German monetary policy, such as Austria and the Netherlands, the degree of persistence and the size of the effects of long-term interest rate shock are similar to the German ones. By contrast, in Barran *et al.* (1997) a shock to the long-term interest rate makes output decline in all countries apart from the UK and Italy; this is rather implausible, as one would expect that in Italy, where a sizeable amount of credit is indexed using the long-term interest rate (in Italy, 49 percent of all credit is allocated at long term or adjustable rate see Borio, 1995), a shock of this type will have a negative impact on the economy.

The fourth model assesses the responses of credit and money supply to a change in the call money market rate. Credit rapidly decreases after a monetary shock in all countries with a significant response in Germany and Italy in particular. Barran *et al.* (1997) found instead that in Germany and Spain credit continues to rise for several quarters. One would expect an interest rate shock to affect credit much more than money. The impulse response functions show that indeed the former

falls much more sharply than money does in response to such a shock in all countries under study. One plausible explanation for this result might be that the direct effects of the monetary policy shock are amplified by changes in the external financial premium. This might account for the strength of monetary policy effects on total credit. Monetary policy affects the external finance premium by shifting the supply of credit, particularly loans by commercial banks. Decreasing the supply of credit will increase it and reduce real economic activity. The importance of credit for monetary transmission reflects the fact that lenders, in the case of short-term loans, can pass on interest rate changes or withdraw the loans to reduce lending. This increases the speed of monetary transmission. Hence monetary policy can affect the real economy without much variation in the open market interest rate. Moreover, it can influence investment decisions, and have distributional effects for lenders and borrowers.

## V. Conclusions

In this paper we have investigated whether there are differences between six EU member states in the transmission mechanism of monetary policy. Specifically, we have examined the effects of monetary shocks on real economic activity, exchange rates, credit to private domestic sector and monetary aggregates. Our empirical findings suggest that indeed there are asymmetric effects of such shocks on the economies of the six countries under study. A common monetary shock affects member countries in a very different way, with the timing and depth of responses varying considerably from country to another.

This implies that the costs of a common monetary policy (see von Hagen, 1997, for a detailed description of the ECB's policy framework) are not evenly distributed between EU countries. For example, the effects of a monetary shock on real output in France and Spain are sizeable. By contrast, Germany, Italy, the Netherlands are affected with a significant time lag. This suggests that a common monetary policy could worsen the cyclical positions of countries such as France and Spain. On the other hand, the sensitivity of the exchange rate to a monetary shock is higher in smaller than in larger economies, suggesting that the latter will react relatively more strongly and rapidly to monetary shocks. Consequently, an appreciation of the effective exchange rate has a more dramatic effect on real output in smaller rather than in larger economies. This will have negative consequences on aggregate demand, and hence economic growth, in smaller

economies. Moreover, some monetary transmission channels might be more important in some countries relative to others. Smaller economies appear to be more sensitive to monetary policy shocks, which have a stronger and more immediate effect on real output and investment. By contrast, larger EU economies absorb such shocks more easily and their economic activity is less affected.

Our results suggest that the costs of joining EMU could have been considerably higher than previously thought for some countries, and that appropriate policies might be required in such cases. In particular, they highlight the importance of measures to make financial systems more integrated, and therefore the monetary policy transmission mechanism more similar in the EMU countries. For instance, further harmonisation of capital market and banking (as well as trading) regulations might be desirable.

Our sample period is roughly the same as in other related studies such as Peersman (2004), Giuliodori (2005) and Ciccarelli and Rebucci (2006). As in their case, our results shed light on the pre-EMU period and essentially represent an ex-ante evaluation of whether EMU might qualify as an optimum currency area (OCA). Although the introduction of a common currency represented a regime change, and hence one has to be cautious drawing conclusions about the future by looking backwards, it is plausible to think that the factors influencing the monetary transmission mechanism would not have changed across Europe immediately after the start of EMU: in the period under examination the EMS was in place and hence exchange rates were relatively fixed, which is not entirely different from the post-1999 scenario of a common currency. However, to what extent the reaction of the European economies to a common shock has in fact changed after the adoption of the euro is an issue which is indeed worth investigating in order to obtain valuable economic information. A thorough study of the period after the start of EMU (and ex-post assessment of whether it can be characterised as an OCA), as well as a comparison with the preceding one, is beyond the scope of the present paper but will be the object of future work.

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## Appendix

**Table 1.** Co-integration Tests

Countries	CV	First VAR		Second VAR		Third VAR		Fourth VAR	
		Eigen Value	Trace	Eigen Value	Trace	Eigen Value	Trace	Eigen Value	Trace
Austria	r=0	23.13*	43.36*	25.14*	45.37*	65.23*	71.05*	87.31*	91.04*
	r<=1	19.46	20.56	13.76	21.00	22.42	31.41	53.91	63.95
	r<=2	5.34	5.34	4.41	4.41	3.01	3.01	6.30	6.30
Denmark	r=0	45.76*	43.05*	119.07*	138.52*	78.19*	83.94*	82.72*	94.45*
	r<=1	21.71	22.42	17.51	23.77	26.92	32.61	32.91	36.91
	r<=2	6.42	6.42	7.27	7.27	6.03	6.03	8.26	8.26
France	r=0	92.05*	51.07*	111.54*	88.10*	66.20*	69.92*	81.11*	92.28*
	r<=1	56.73	16.70	75.51	54.01	41.21*	51.82*	55.23*	62.22*
	r<=2	4.87	4.87	2.61	2.61	2.04	2.04	3.33	3.33
Germany	r=0	88.06*	133.03*	81.04*	141.08*	61.21*	67.81*	71.11*	86.92*
	r<=1	39.47	61.45	45.27	61.45	20.21	23.52	34.11	42.51
	r<=2	12.86	12.86	17.41	17.41	9.24	9.24	6.92	6.92
Netherlands	r=0	72.37*	87.04*	79.19*	96.04*	82.97*	97.11*	87.44*	94.33*
	r<=1	9.55	14.61	13.07	17.29	43.29	52.06	51.09	61.19
	r<=2	4.55	4.55	5.37	5.37	12.74	12.74	9.07	9.07
Italy	r=0	67.45*	80.07*	63.01*	79.68*	63.22*	71.11*	75.08*	82.07*
	r<=1	11.81	19.37	14.63	19.01	25.43	39.72	49.72	53.29
	r<=2	6.57	6.57	8.82	8.82	4.03	4.03	6.03	6.03

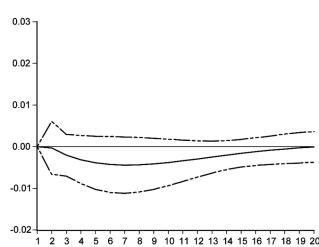
\* indicates statistical significance at the 5 percent level.

- In case of contradicting results between Eigenvalue and Trace Statistic, we tend to use maximum Eigenvalue test as suggested by Johansen and Juselius (1990) to be better than the Trace tests, as specification tests show that the series do not suffer from serial correlation problem.

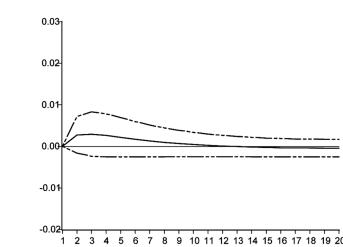
**Chart 1**  
**Model 1**

**AT**

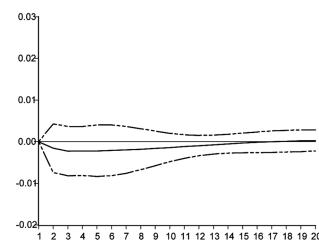
Response of output to an interest rate shock



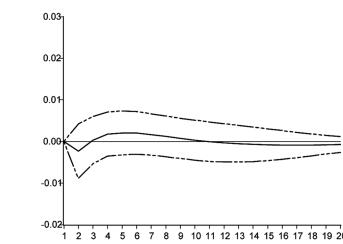
Response of prices to an interest rate shock

**DE**

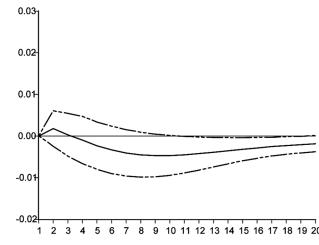
Response of output to an interest rate shock



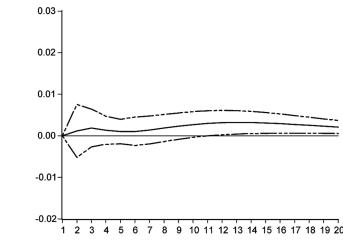
Response of prices to an interest rate shock

**IT**

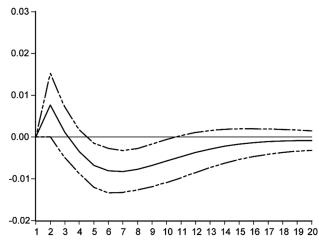
Response of output to an interest rate shock



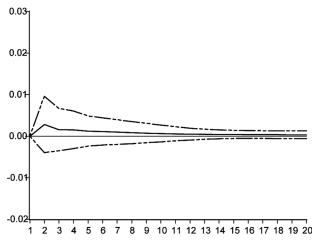
Response of prices to an interest rate shock

**GR**

Response of output to an interest rate shock

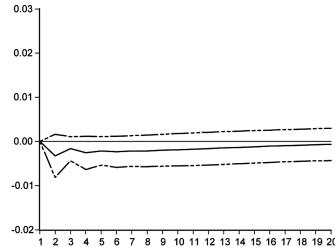


Response of prices to an interest rate shock

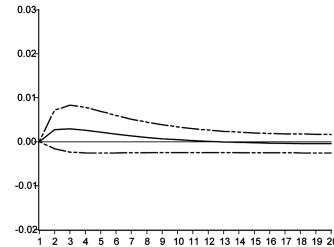


**FR**

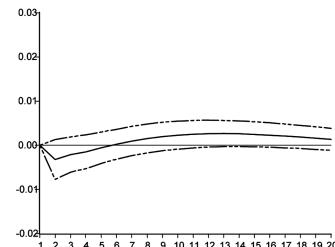
Response of output to an interest rate shock



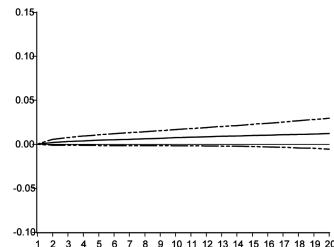
Response of prices to an interest rate shock

**NL**

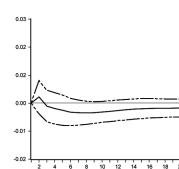
Response of output to an interest rate shock



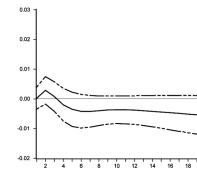
Response of prices to an interest rate shock

**Chart 2****Model 2****DE**

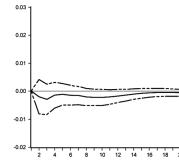
Response of private investment to an interest rate shock

**GR**

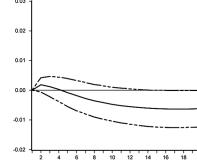
Response of private investment to an interest rate shock



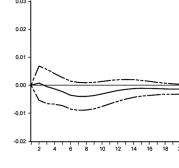
Response of consumption to an interest rate shock



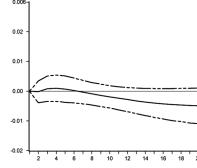
Response of consumption to an interest rate shock

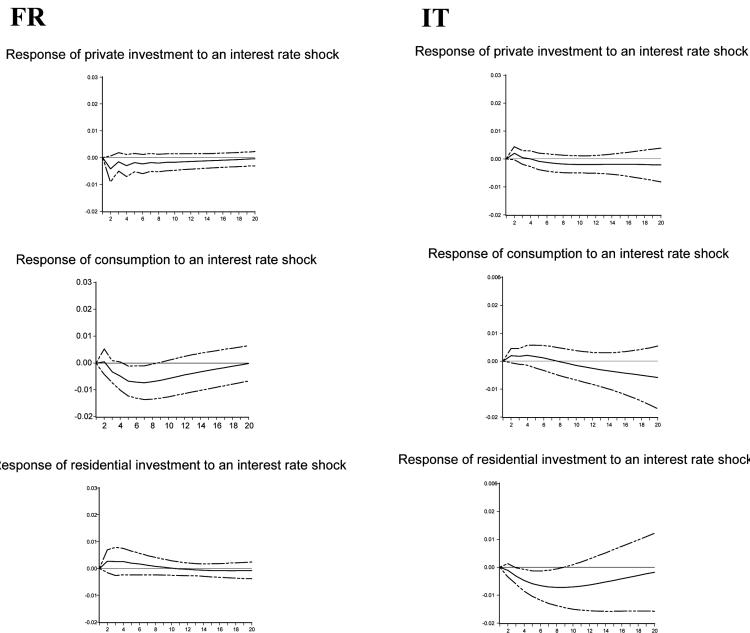


Response of residential investment to an interest rate shock

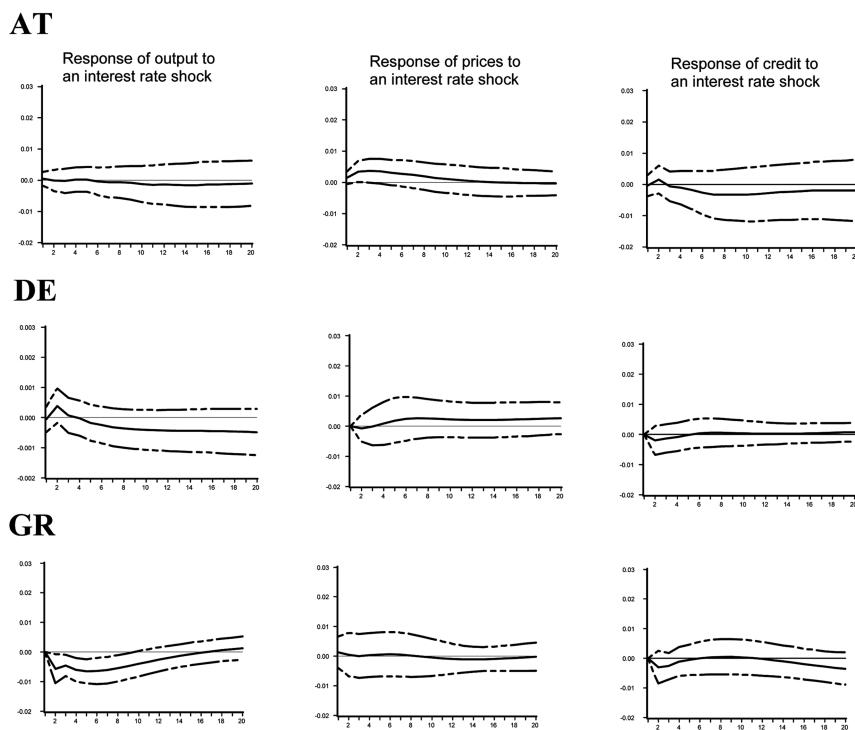


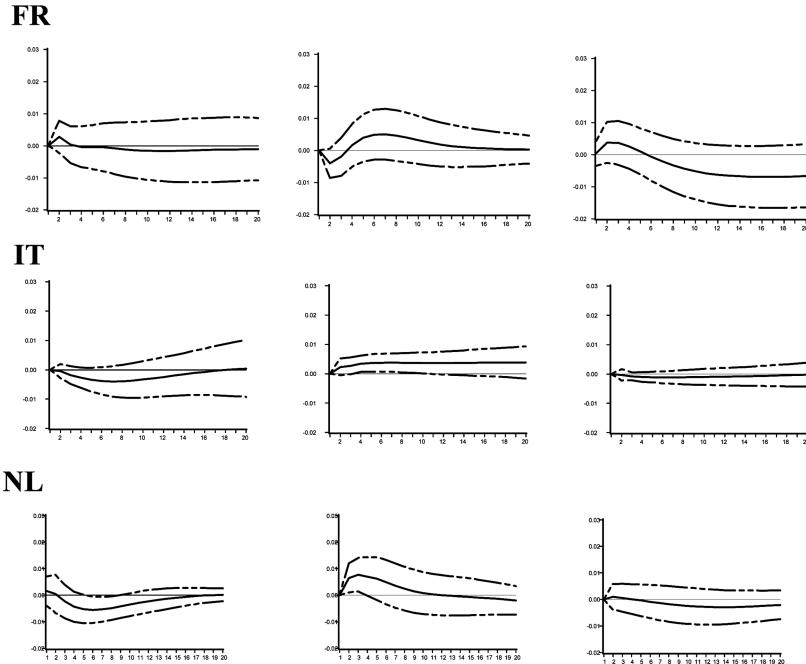
Response of residential investment to an interest rate shock



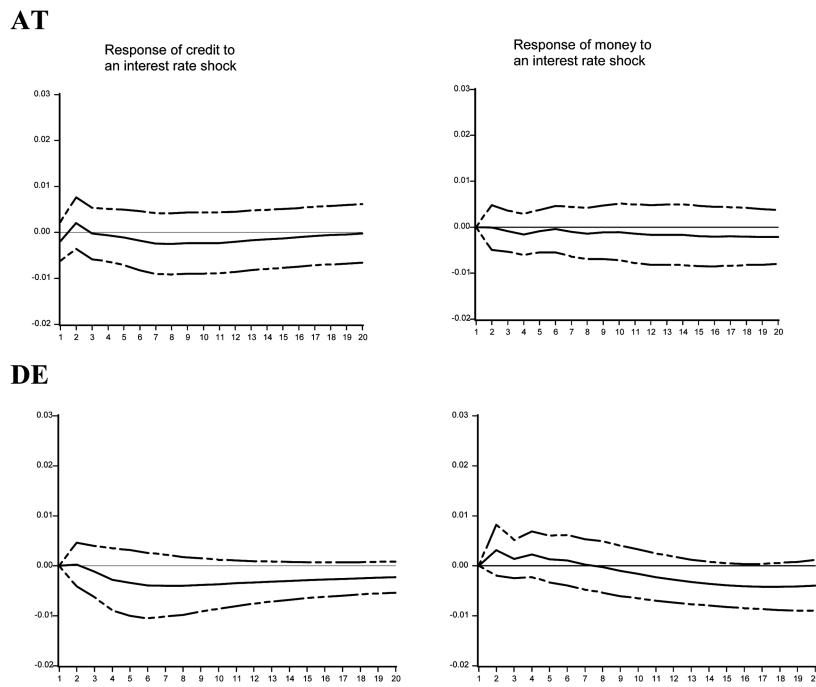


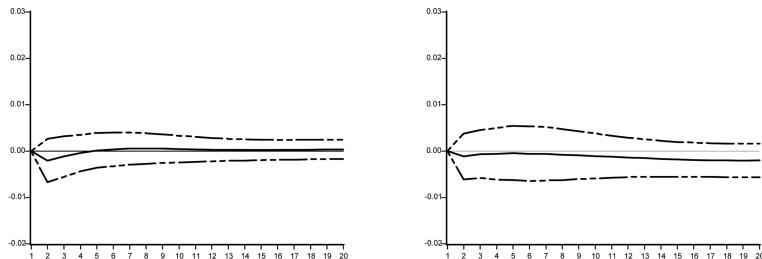
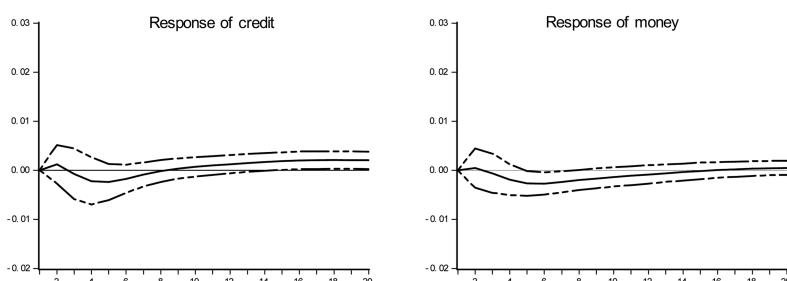
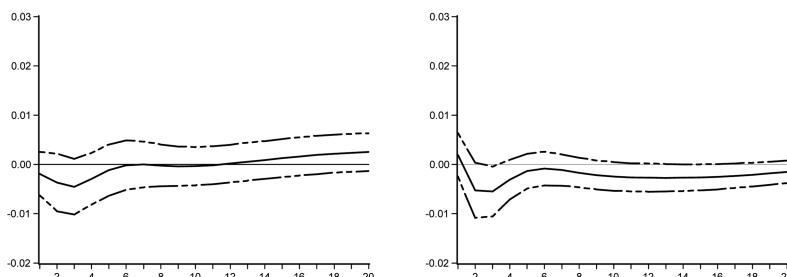
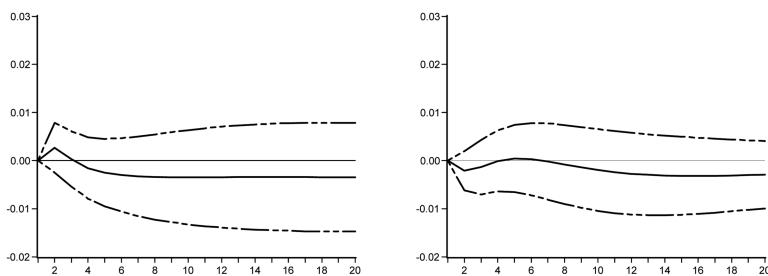
**Chart 3**  
**Model 3**





**Chart 4**  
**Model 4**



**GR****FR****IT****NL**

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