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Monetary and fiscal policy transmission in the Euro-area: evidence from a structural VAR analysis

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Monetary and Fiscal Policy Transmission in the Euro-area: Evidence from a Structural VAR Analysis*

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Abstract

This paper studies the transmission of monetary and fiscal policy in the Euro-area. To do so, a structural VAR (SVAR) of monetary and fiscal policy transmission in the Euro-area is estimated. First, the EMU countries are considered as an aggregate entity and the SVAR model of the aggregate of EMU countries is compared with SVAR models of the US and Japan. This exercise is useful to assess the effects of monetary and fiscal policy on the aggregate EMU economy and also to have a comparison with two other major economies. Attention is also paid to interaction of macroeconomic policies and the effects of shocks in financial markets. In a next step, SVARs are estimated for the individual EMU countries to gain more insight into cross-country asymmetries in the transmission of monetary and fiscal policies. It turns out that, compared to the EMU aggregate, individual EU countries often react rather differently to monetary and fiscal policy innovations.

Keywords: EMU, Fiscal Policy, Monetary Policy

JEL Code: F31, F41, G15

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1. Introduction.

The introduction of the Economic and Monetary Union (EMU) has led to a new framework of monetary and fiscal policy in the European Union (EU). It has also stimulated a renewed interest in the design, implementation and transmission of monetary and fiscal policy in Europe. A successful design and implementation of the common monetary policy by the ECB requires a detailed knowledge of the transmission mechanisms of monetary policy and this both at an aggregate, EMU-wide level, and at the level of individual EMU countries. The first case gives insight into the effects of the common monetary policy on the Euro-area economy, the second case into the –possibly diverging- effects of the common monetary policy on individual EMU countries.

Also fiscal adjustments and their effects have received considerable interest recently. Fiscal adjustments have played a crucial role in the EMU context as the fiscal convergence criteria stipulated in the Maastricht Treaty formed an important incentive for EU countries to improve their fiscal balances. For this and other reasons, a large number of fiscal policy adjustments have been undertaken during the last decade. As a result, many countries have made progress on fiscal consolidation and implemented various reforms of government spending and taxation.

EMU has stimulated a considerable academic literature on the transmission of monetary and fiscal policy in the Euro area. One of the recent approaches to analyze the transmission of macroeconomic policies to macroeconomic variables adopts the vector autoregression (VAR) methodology. In monetary policy analysis the VAR approach has been already for a longer period a popular tool to analyze the transmission of monetary policy and demand and supply shocks[1].

This paper analyzes the macroeconomic effects of monetary and fiscal policies in the Euro area using a structural VAR (SVAR) approach. Short-run and medium term effects of monetary and fiscal policy innovations and demand and supply shocks are estimated using this approach. Insight into the possible effects of fiscal policy adjustments in the EMU is not only important in itself but it can also be useful to assess the implications of fiscal adjustments for the common monetary policy and in the context of the Stability and Growth Pact.

The effects are studied first at the EMU-aggregate level. The effects of macroeconomic and macroeconomic policy shocks are estimated for the Euro-area and a comparison with the USA and Japan is carried out. The estimations also enable to analyze the important aspect of monetary and fiscal policy interaction and to analyze the relations between government revenue and government spending policies. In a final step, attention is also devoted to the role of financial markets in the transmission of macroeconomic and macroeconomic policy shocks.

Aggregating individual EMU countries to an aggregate Euro-area economy, estimating an aggregate economic model and using it for policy analysis, nevertheless, may be problematic in particular if countries are very different in their economic structures, as may be the case in the EMU. Therefore, in a next step we consider the responses of individual EMU countries to macroeconomic and monetary and fiscal policy shocks.

The paper contributes to the literature on monetary and fiscal policy analysis by integrating the literature on monetary SVARs and that on fiscal SVARs into one framework in which both are analyzed. Our paper not only shows the importance of analyzing monetary and fiscal policy in a single SVAR model but also the relevance of distinguishing between the aggregate EMU economy and the individual EMU countries when analyzing monetary and fiscal policy adjustments in the EMU.

The paper is structured as follows: Section 2 takes a brief overview on the literature on monetary and fiscal policy SVARs. Section 3 estimates the SVAR of monetary and fiscal policy in the Euro- area and compares the results with the US and Japan. Section 4 considers the effects of financial markets by including real stock market returns into the SVAR model. Section 5 estimates the same SVAR model for the individual EMU countries in order to undertake a cross-country analysis. The conclusion summarizes the main results from the analysis.

2. Monetary and Fiscal Policy Analysis Using SVARs: A Brief Overview.

As noted in the introduction, (S)VAR models originate from monetary policy analysis where it has been used extensively to study the transmission of real and monetary shocks.[2] Structural VAR models impose identifying restrictions on an ordinary VAR model to infer structural shocks from it. Its workings can be briefly summarized as follows. Assume that an unrestricted VAR model,

$$x_t = A(L)e_t \qquad (1)$$

is estimated -written here in moving average form- where x is a vector of covariance stationary (macroeconomic) variables, $A(L)$ a polynomial matrix of lag length l, L the lag operator and e a vector of reduced-form innovations in the elements of x with variance-covariance matrix $E(e_t e_t^T) = \Sigma$. These reduced-form innovations are likely to be correlated and can, therefore, not necessarily be interpreted as purely structural innovations. To remedy this, the SVAR approach relates the vector x to a vector of structural innovations, u_t,

$$x_t = B(L)u_t \qquad (2)$$

where $B(L)$ is a polynomial matrix in L. In this SVAR, u_t is a vector of serially and contemporaneously uncorrelated, normalized structural residuals with $E(u_t u_t^T) = I$. From (1) and (2) it follows that the vector of reduced form innovations can be represented as a linear combination of the structural residuals, i.e. $e_t = Cu_t$ with $CC^T = \Sigma$. As a result, $x_t = A(L)Cu_t = C(L)u_t$ and $A(L)C = B(L)$, enabling the identification of the structural innovations from the reduced-form innovations of the reduced form VAR.[3] $C(L)$ is a lag polynomial where the C's are coefficient matrices at the respective lags of the errors. In this way the structural form (2) can be obtained from the estimates of the reduced-from representation (1), provided that the transformation matrix C is of full rank.

The structural VAR model (2), in other words, imposes identifying restrictions upon VAR estimates (1) to recover structural innovations from the estimated VAR. The identification is achieved in practice by imposing identifying short or long-run restrictions. The advantage of using long-run restrictions is that in many instances, economic theory provides more guidance about long-run relationships than about short-run dynamics. Short restrictions impose typically that the impact effect of a given shock on a certain variable is null, which can be achieved by setting the appropriate elements in $C(0)$ to zero. Long-run constraints impose typically that there is no long run effect of a shock on a variable, which is achieved by setting the appropriate elements of $C(1)$ to zero. In order to identify exactly a VAR model of n

endogenous variables, $(n^2 - n)/2$ restrictions need to be imposed in the structural model (2).

The SVAR approach was pioneered by Blanchard (1989) and Blanchard and Quah (1989) who concentrated on long-run identifying restrictions in identifying demand and supply shocks in the economy. Building upon these two papers, Gali (1992) proposes a set of identifying restrictions that contains a combination of short term and long term restrictions. In another influential analysis, Bayoumi and Eichengreen (1992) use the SVAR approach to identify aggregate demand and supply shocks in the EU and to assess to which extent the EU countries constitute and optimal currency area by distinguishing between symmetric and asymmetric shocks.

A number of studies use a SVAR approach to analyze the transmission of monetary policy in E(M)U countries. Peersman (1997) includes growth of industrial output, inflation, the German interest rate and the domestic interest rate in the estimated VAR of the UK, France, the Netherlands, Belgium, Austria, Italy and Spain. Monticelli and Tristani (1999) use a SVAR model of the aggregate EMU economy to study the transmission of aggregate demand shocks, aggregate supply shocks and monetary policy innovations. Also Ehrmann (2000) and Wehinger (2000) compare monetary policy transmission across EU countries using the SVAR approach, finding evidence for considerable heterogeneity across countries.

Structural VAR models have recently also been applied to fiscal policy analysis. Blanchard and Perotti (1998) and Fatas and Mihov (1999) use a SVAR model to characterize the dynamic effects of shocks in government spending and taxes on economic activity in the US in the post-war period. Fiscal SVAR models have also been used to study the transmission of fiscal policies in the EU. Garcia and Verdelhan (2000) study the fiscal and monetary policy transmission mechanisms in the aggregate Euro area economy. Supply shocks, nominal shocks, fiscal policy shocks and monetary policy shocks are identified and their impacts on the Euro-area economy assessed. Dalsgaard and de Serres (2000) estimate a SVAR model for 11 individual EMU countries. The four-variable VAR contains real output growth, inflation, change of private sector savings and the change in the ratio of government net lending to GDP. Using similar approaches Bruneau and de Bandt (1999), and Höppner (2000) analyze fiscal SVAR models for France and Germany.

Our SVAR model and the resulting estimations extend the aforementioned studies by its emphasis on both monetary as well as fiscal policy and by considering both the aggregate EMU economy and the individual EMU countries.

The advantage of the SVAR approach is that there is no need to build a structural model describing the economy in general and the mechanisms of fiscal and monetary policy design and transmission in particular. The SVAR model only requires a minimum number of restrictions. Moreover, like a standard VAR model, the SVAR models deliver two convenient tools in the form of impulse response functions and variance decompositions that give much information on the impact and transmission of macroeconomic shocks and policy innovations. The SVAR method is particularly suited to assess the effects of fiscal and monetary policy innovations, since it isolates the response of each variable to structural shocks and policy innovations and shows their macroeconomic transmissions over time.

At the same time, one must keep in mind some limitations: the VAR model is entirely data-driven. The underlying structure is determined by the data themselves (proponents of (S)VAR modeling, of course, argue that this is the main advantage of the VAR approach). Economic theory is only brought into the analysis in case the identifying restrictions are based on economic theory.[4] This lack of theoretical and behavioral relations may, however, also result in outcomes that seem counterintuitive. In VAR models of monetary policy, counterfactual results like the price-puzzle e.g. are well-known.

Well-known are also methodological problems relating to the estimation results under long-run restrictions and the determination of confidence intervals of the impulse response functions in SVAR models. SVARs with long-run restrictions give reliable estimation results of the long-run parameters only under restrictive conditions, according to Faust and Leeper (1997). Results can be sensitive to the ways in which models are identified: changes in the identifying assumptions can lead to changes in the estimated effects of the shocks and their relative importance over time. In contrast to unrestricted VARs, calculation of confidence intervals for SVARs is not unproblematic. Kilian (1998) finds that confidence intervals based on asymptotic theory are strongly biased in smaller samples, in particular if the variables display persistence. Sims and Zha (1999) develop Bayesian simulation procedures in an attempt to overcome the short-sample bias but like Faust and Leeper (1997) they acknowledge the difficulties to calculate correct error bands for impulse responses in SVARs.[5]

The interpretation that the monetary and fiscal policy innovations of a (S)VAR model can be represented as being true policy innovations has also been questioned repeatedly in the literature. Finally, SVAR models are subject to the Lucas-critique and can in principle not be used in the presence of structural breaks and large institutional changes in the economy.

As our paper is in the first place policy-oriented we take notice of these limitations but do not offer new results or tools that would overcome the above methodological shortcomings of the (S)VAR modeling of monetary and fiscal policy and their transmissions.

3. A SVAR Analysis of Monetary and Fiscal Policy Transmission in the Euro Area.

In this section SVAR models of monetary and fiscal policy transmissions are estimated. The EMU countries are considered as an aggregate entity and the estimated SVAR model of the EMU is compared with SVAR models for the US and Japan. This exercise is useful to assess the effects of monetary and fiscal policies on the aggregate EMU economy and also to have a comparison with two other major economies.

The vector x of macroeconomic variables that are included in the SVAR analysis consists of real output, real government revenue, real government spending, short-term interest rates and prices, i.e. $x = \begin{bmatrix} y, & t, & g, & i, & p \end{bmatrix}^T$. These variables were collected for the Euro-area aggregate, Japan, the US and the individual EU countries (the 12 EMU countries plus Denmark, Sweden and the UK, Luxembourg has been excluded) for the period 1980:I-2001:IV, whenever available. The Appendix lists the exact definitions, data-availability and other details about the data set.

Before estimating the SVAR it is of interest to summarize the observed adjustments of these variables over time. Figure 1 summarizes the adjustment patterns observed during this period.

[Insert Figure 1 here]

The graphs illustrate the well-known business-cycle patterns with hampering growth in the early 1980s and 1990s and subsequent improvements. Another well observable fact is the gradual decline of inflation and interest rates during the 1980s after which they start to fluctuate around a modest average. The considerable variation in the fiscal growth rates suggest a large number of fiscal adjustments both on the revenue and spending side during this period. The Euro-area (and also the US) experienced a period of fiscal retrenchment since 1994, as witness low growth rates of government spending and higher growth rates of government revenue. The picture of Japan is more or less opposite: growth of revenues exceeded the growth of government until 1991, since then a period with high spending growth and increasing deficits and government debt occurred.

It is appropriate to check that all series included in the SVAR model are (approximately) stationary. Table 1 provides the results of the augmented Dickey-Fuller tests of stationarity of the variables.

[Insert Table 1 here]

It turns out that in practically all cases real output, the price level, the interest rate, real government spending and real government revenue are integrated of order one but that their quarterly growth rates are stationary. Consequently; the SVAR model contains real output (GDP) growth, Δy, real government revenue growth, Δt, real government spending growth, Δg, the change in the short-term interest rate, Δi, and (CPI) inflation, Δp, as its endogenous variables[6]. It is driven by five structural shocks: an aggregate supply shock, u^s, a shock to government revenues, u^t, a government spending shock, u^g, a monetary shock, u^m, and an aggregate demand shock, u^d.

$$\begin{bmatrix} \Delta y \\ \Delta t \\ \Delta g \\ \Delta i \\ \Delta p \end{bmatrix} = B(L) \begin{bmatrix} u^s \\ u^t \\ u^g \\ u^m \\ u^d \end{bmatrix}. \qquad (3)$$

Up to four lags of all endogenous variables are included in the estimation of all the VAR models in the paper. The oil price, a constant, a trend and seasonal dummies are included as exogenous variables in the VAR. The oil price is expressed in domestic currency to take also into account exchange rate fluctuations against the US dollar. In the case of Germany (analyzed in Section 5), a German Reunification dummy for the years 1990-1991 is included.

In a way, the VAR part estimates a reduced form model of output, government revenue and government spending, interest rates and prices. The VAR estimations for the interest rate, government revenues and government spending equations could be interpreted as systematic (or automatic) or anticipated monetary and fiscal policy responses to the endogenous variables in the VAR (sometimes also interpreted as policy rules). Taken together the estimated relations between the endogenous variables included in the VAR model, determine how the identified structural shocks are transmitted in the model. The structural component of the model identifies five structural shocks. The structural monetary, government revenue and government spending shocks in this interpretation represent unanticipated monetary and fiscal policy innovations[7].

To identify the structural innovations from the VAR model, ten identifying restrictions are required. These are: (i) real government revenue shocks do not have a permanent effect on real output, (ii) real government spending shocks do not have a permanent effect on real output, (iii) real government spending shocks do not have a permanent effect on real government revenue, (iv) monetary shocks do not have a permanent effect on real output, (v) monetary shocks do not have a permanent effect on real government revenue, (vi) monetary shocks do not have a permanent effect on real government spending, (vii) demand shocks do not have a permanent effect on real output, (viii) demand shocks do not have a permanent effect on real government revenue, (ix) demand shocks do not have a permanent effect on real government spending, and (x) demand shocks do not have a permanent effect on the interest rate.

These restrictions can already be discerned from the ordering of our variables in (3)[8]. Most of these restrictions are also found in other SVAR analyses with monetary and/or fiscal policy instruments. Ideally, one would like the identifying restrictions to follow strictly from the properties of a small theoretical model of monetary and fiscal policy. In the literature often a small AD-AS model is constructed to motivate the identifying restrictions here (see e.g. Blanchard (1989) and Gali (1992) for a discussion). Most of the above restrictions will hold in that framework but a further elaboration is omitted here for space considerations.

From the estimated SVAR models, impulse response functions can be calculated which show the effects of supply, demand and macroeconomic policy innovations on output, government revenue, government spending, interest rates, and inflation. Figure 2 provides the estimated impulse response functions for the EMU-12, Japan and the US.

[Insert Figure 2]

The graphs show the accumulated effects on the endogenous variables in the VAR model -the quarterly growth rates of real output, real government revenue, real government spending, nominal interest rates and prices- to structural, one standard deviation shocks. Note that a response of 0.001 (0.01) corresponds with a 0.1% (1%) change in the variable of interest. These accumulated effects on growth rates give us also the effects we are especially interested in: the effects in each period on the levels of the endogenous variables. Also we can directly trace the implications of the restrictions we have imposed. E.g., imposing that government spending shocks do not have a permanent effect on real output, will show up in the graphs as a zero accumulated effect in the long run in the impulse response function of structural shocks on the growth rates of the endogenous variables. Because of the accumulation over time of these effects, this at the same time implies that the long-run effect of the real government shock on the level of real output equals zero.

Supply shocks result in an increase in real output and a drop in prices. Demand shocks have also a positive effect on output but increase prices. In the long-run they have by assumption (cf. restriction (vii)) no effect on real output. In the case of Japan and the US the output effect of demand shocks appears to be smaller and more short-lived than in the Euro area. The effect on prices, is also a bit stronger in the Euro-area.

The effects of fiscal policy innovations are small of size and more diverse. Not in all cases the perhaps expected Keynesian type response occurs, i.e. a positive innovation to government spending does not necessarily increase output (Japan and the US) and a positive revenue impulse does not necessarily induce a reduction in output (the US). An explanation could be that the Keynesian effects of fiscal adjustments are outweighed by non-Keynesian effects, a possibility that recently has received considerable attention in the literature on fiscal adjustments, see e.g. Giavazzi and Pagano (1997) and van Aarle and Garretsen (2001).

In the case of monetary policy innovations we observe small negative effects of interest rate increases on output in the Japan, but in the Euro-area and the US such a negative effect is absent. The interest rate innovation seems -if anything- to increase prices rather than to reduce them. This last result is line with many other VAR-studies on the monetary transmission process (known as the "price-puzzle") and leaves considerable doubt about the effectiveness of interest rate policies to control inflation.

All in all, the effects of demand and supply shocks on output and prices seem to be comparable in the Euro area, Japan and the US. Also the macroeconomic policy innovations appear to induce broadly comparable adjustments dynamics of output and prices in the Euro area, Japan and the US, not withstanding the observation that the size and persistence of the response vary.

Our SVAR model includes three macroeconomic policy variables and can be used to study the important issue of the short-run interaction of fiscal and monetary policy. EMU has raised a lot of interest on the issue of monetary and fiscal policy interaction both from a theoretical and empirical perspective. In theoretical analysis the emphasis has been on strategic elements (see e.g. Buti et al. (2001) for an overview). Empirical analysis has focused on the related question on the complementarity and substitutability of monetary and fiscal policy (see in particular Mélitz (2000)). In the first case a restrictive monetary policy is accompanied by a restrictive fiscal policy and vice versa. In the second case a restrictive monetary policy is accompanied by an expansionary fiscal policy response and vice versa.

To some extent, it is possible to analyze these interactions in our framework: these interactions are measured by the impact of monetary shocks on the fiscal variables and the impact of fiscal shocks on the interest rate. Figure 2 suggests - although the effects are rather small- that in the EMU and Japan monetary and revenue policies hardly interact, in the US there is some complementarity as interest rates rise after a revenue innovation. Monetary and government spending policies possibly act as complements in the EU: government spending decreases after a restrictive monetary policy innovation. In Japan the opposite holds. In the US, the complementarity takes the form of a negative response of interest rates to government spending innovations. The effects are, however, relatively small and often disappear after a few quarters.

We can use the SVAR model to look at another important policy interdependency, namely the one between government spending and revenues. An important question in the literature concerns the existence of any causality between government spending and taxation. This issue of causality and exogeneity can be phrased as the “tax and spend” vs. the “spend and tax” view. According to the former, changes in tax revenues cause changes in government spending, whereas the latter supposes that changes in government spending induce adjustment in tax revenues in other to match the changes in financing needs. Blanchard and Perotti (1999) and Fatas and Mihov (2000) investigate the effects of both type of causality by imposing the appropriate identifying restrictions on revenue and spending shocks in both regimes in their fiscal SVAR model. Koren and Stiassny (1998), Garcia and Henin (2000) and De Arcangelis and Lamartina (2001) also address the possible links between taxes and spending.

Figure 2 provides also some -albeit rough- information on this interaction between government revenue and spending. It turns out that a government revenue impulse goes along with an increase in government spending in the EU and Japan and that a government spending reduces government revenue in the case of Japan. Taken together, this would favor at first sight the “tax and spend” hypothesis over the “spend and tax” hypothesis. Note, however, that the restriction that we have imposed that there is no long run effect from spending innovations on revenue rules out any impact in the long-run from spending on taxation. There does not seem to be a clear causality between government revenue and spending in the case of the US.

4. The Effect of Financial Shocks.

Financial markets may play a crucial role in the macroeconomic transmission of macroeconomic shocks, including monetary and fiscal policy innovations. Shocks in the financial markets, moreover, may themselves induce important macroeconomic adjustment dynamics. A recent literature has studied the relation between financial markets and macroeconomic adjustment using a (S)VAR approach. Khil and Lee (2000) use a bivariate identified VAR model of real stock market returns and inflation. The dynamic effects of supply and demand shocks on real stock market returns and inflation are analyzed for the US and ten Pacific-Rim countries. Except for Malaysia, a negative relation between inflation and real stock market returns is found. Lee (2002) constructs a trivariate VAR model for the US to analyze the observed relations between real stock returns, real interest rates and inflation. The effects of supply, monetary and fiscal shocks on these variables are traced. Supply shocks are found to induce a negative stock return-inflation relation. Monetary shocks drive a positive stock return-inflation relationship, fiscal policy shocks a negative one. Both monetary and fiscal policy shocks induce a negative relation between real interest rates and inflation.

In the spirit of this literature, we add stock market returns to the SVAR model developed in Section 3 to analyze the relations between financial markets, macroeconomic policies and macroeconomic adjustment. In addition, we replace government revenues and expenditures by their balance, the fiscal deficit, in order to maintain a system of the same dimensions. It is of interest to consider the actual adjustment dynamics of the real stock market returns[9] and the fiscal deficit in the Euro-area, Japan and the US during the period 1980-2001.

[Insert Figure 3 here]

Real stock market returns have fluctuated widely, the correlation between the Euro-area and the US (0.27) appears stronger than the correlation with Japan (0.04). We had noted already in the previous section, the gradual reduction of deficits in the Euro-area and the US and increasing deficits in Japan. Unit root tests suggest that the real stock market return is close to stationary in levels, whereas the deficit to GDP ratio is stationary in first differences.

The adjusted SVAR model contains real output growth, the change in real stock market returns, Δr, the change in the deficit to GDP ratio, Δf, the change in the short-term interest rate and (CPI) inflation as its endogenous variables. It is driven by five structural shocks: an aggregate supply shock, u^s, a financial shock, u^r, a shock to the deficit to GDP ratio, u^f, a monetary shock, u^m, an aggregate demand shock, u^d, and a government spending shock, u^g,

$$\begin{bmatrix} \Delta y \\ \Delta r \\ \Delta f \\ \Delta i \\ \Delta p \end{bmatrix} = B(L) \begin{bmatrix} u^s \\ u^r \\ u^f \\ u^m \\ u^d \end{bmatrix} . \qquad (4)$$

Note that including the fiscal deficit in the structural VAR may in principle enable to distinguish the *cyclical* part of the deficit, i.e. the part of the VAR that represents the systematic reaction of the deficit to any other endogenous variables in the model -in particular output- and the *structural* deficit, i.e. the purely unsystematic structural fiscal shocks that come out of (3) and which reflect in this interpretation the discretionary part of fiscal policy/fiscal deficit.[10]

To identify the structural innovations, ten identifying restrictions are required also in this augmented SVAR model. These are: (i) financial shocks do not have a permanent effect on real output, (ii) fiscal deficit shocks do not have a permanent effect on real output, (iii) fiscal deficit shocks do not have a permanent effect on real stock returns, (iv) monetary shocks do not have a permanent effect on real output, (v) monetary shocks do not have a permanent effect on real stock returns, (vi) monetary shocks do not have a permanent effect on the fiscal deficit, (vii) demand shocks do not have a permanent effect on real output, (viii) demand shocks do not have a permanent effect on real stock market returns, (ix) demand shocks do not have a permanent effect on the fiscal deficit, and (x) demand shocks do not have a permanent effect on the interest rate.

Figure 4 provides the resulting impulse response functions that result.

[Insert Figure 4 here]

In the short-run, fiscal deficit shocks increase real output in the Euro-area and Japan, where they also have the strongest impact on prices; in the case of the US the effects are much smaller. In the case of Japan and the US, real stock market returns initially increase after a positive supply shock, after a few periods the effects have dissipated and even a small drop is seen. Also inflationary shocks increase real stock market returns initially but have a negative effect in the longer run, which would be consistent with the observed relation between inflation and real asset returns found by Khil and Lee (2000) and others. In the Euro-area the effects are somewhat different: output shocks have a negative effect and inflation a positive effect on real stock market returns. Positive shocks to the interest rate increase real stock market returns in the short-run. Japan displays a relatively strong negative effect from positive deficit shocks on real stock market returns.

Fiscal deficits react strongest to supply and demand shocks in the case of Japan, whereas in the Euro-area and the US the fiscal deficit does not seem to react in a strong and consistent way to supply and demand shocks. In the Euro-area and the US, interest rates decline after a fiscal deficit shock and fiscal deficits decrease after an interest rate innovation, suggesting complementarity between monetary and fiscal policy, in Japan monetary and fiscal policy act as (strategic) substitutes according to this model. In all three cases, deficit shocks are inflationary.

5. A SVAR Analysis of Monetary and Fiscal Policy Transmission in Individual EMU Countries.

Aggregating the EMU economy, as has been done in the previous sections, estimating an aggregate economic model and using that for policy analysis may be problematic in particular if countries are very different in their economic structures, as may be the case in the EU. Such an aggregation over the Euro-area, implicitly assumes that the transmission of the common monetary policy of the ECB and an aggregate fiscal policies innovation is identical across the individual EMU countries.

As Monticelli and Tristani (1999) note the features of the EMU-wide responses are an indispensable point of reference in the assessment of the single monetary policy in the EMU. But they also suggest that, due to the aggregation across countries of behavioral equations that actually have different parameters, the use of an EMU-wide model has its price. They suggest that the bias in the aggregate model due to the aggregation across countries of behavioral equations that actual have different parameters, in a way must be weighed against the possible bias that can be present in individual country estimations when failing to incorporate all the interactions with other EMU economies in a tightly integrated area like the EMU.

For these reasons, this section estimates SVARs of individual EMU countries to gain more insight into cross-country asymmetries in the transmission of monetary and fiscal policies. First, Figure 5 provides the endogenous variables for the 12 EMU countries, Denmark, Sweden and the UK.

[Insert Figure 5 here]

Figure 5 indicates at quite a considerable variation in inflation-growth performance and in fiscal and monetary policy adjustments during the 1980s and 1990s. This variation is visible both across time and across countries and an *a priori* additional important motivation for a country-by-country analysis.

Figure 6 provides the impulse response functions of output and prices to supply and demand shocks for the individual EMU countries, Denmark, Sweden and the UK.

[Insert Figure 6 here]

Given the considerable number of countries and impulse-response functions, we limit ourselves here to summarizing the main results, rather than addressing each and every case separately. The interested reader may consider the experiences of individual countries by her or himself in the graphs. While considerable variation across countries in the intensity and persistence of the effects is observed, we also see that the effects induced by demand and supply shocks are comparable across countries: supply shocks increase output and decrease prices, whereas demand shocks increase both output and prices to some extent in the short or medium-run. Comparing the results with corresponding outcomes in Figure 2, the conclusion must be that when it comes to output and prices the response of individual countries to a supply or demand shock is comparable to the effects for the Euro-area as a whole. This is good news for EMU-wide policies in so far as it suggests that the relevance of asymmetric transmission of demand and supply shocks may be limited[11]. The three non-EMU countries, Denmark, Sweden and the UK also do not seem to be outliers in this respect.

In the case of fiscal and monetary innovations far more variety in the size and persistence of the responses across countries is found according to Figure 6. As concerning monetary transmission, our results therefore confirm the results of Ehrmann (2000) and Wehinger (1999) who also found evidence of substantial differences of monetary policy transmissions across EMU countries.

This cross-country heterogeneity of effects of monetary and fiscal policy innovations has an important implication. Under those conditions, a common monetary policy or an identical fiscal impulse (e.g. in the context of a co-ordinated EMU-wide fiscal policy) may have very different effects across countries. This carries the risk to be costly from the perspective of individual countries since it is possibly transmitted in a particular country in a different way than envisaged by the policymakers based on their Euro-wide information and objectives. This problem of the asymmetric transmission of macroeconomic policy has been repeatedly stressed in the evaluation of the possible costs of monetary union. It possibly also explains the sometimes somewhat subdued response to policy innovations of the aggregate EMU-economy in the previous section (see Figure 2). Behind the observed small effects at the aggregate level, there are possibly larger ones at the level of individual country and some 'netting' of the effects occurs when only the aggregate EMU economy is considered. In other words, drawing conclusions about the effects of monetary and fiscal policy on adjustments in individual countries on the basis of the aggregate EMU economy is misleading to the extent that it neglects the heterogeneity of EMU-countries with respect to the transmission of monetary and fiscal policy. This conclusion is based on a (largely) “pre-EMU” sample period but it seems likely that the observed heterogeneity is at least also relevant in the present initial stage of EMU.

The cross-country heterogeneity with respect to monetary and fiscal policy innovations is also found in case of inflation. Take for instance the response of inflation in each of our 14 EU countries to a positive government revenue impulse. Recall from Figure 2 that for the Euro area as a whole the corresponding inflation response was very flat. Figure 4 shows that this result hides some very strong positive and negative inflation responses on the country level (e.g. compare Portugal and Ireland). Similar conclusions emerge for innovations in government spending and the interest rate.

Figure 6 also estimated the interdependencies between macroeconomic policy instruments for the individual EMU countries. Considerable differences are present here as well: monetary and fiscal policies appear to have been complements in the case of Austria, Belgium, Germany and the UK and substitutes in the case of Ireland, Portugal and Sweden. In other cases elements of both complements and substitutes are present or no clear links at all are discernible (at least not graphically). Concerning the interactions between government revenue and government spending we find signs of the "tax and spend" hypothesis (namely in case of Belgium, Germany, Ireland, Italy, the Netherlands and Portugal) where revenue innovations increase government spending most clearly. Greece, Denmark and the UK display some evidence of the "spend and tax" hypothesis: a positive revenue shock leads to an initial increase of government spending. In the remaining cases no very clear links between government spending and government revenue can be detected by this rather rough approach.

6. Conclusion

The transmission of monetary and fiscal policies is a very important issue in the analysis of macroeconomic policy in the EMU. This paper used a structural VAR model to analyze the transmission of monetary and fiscal policy in the EMU. This model allowed to trace the effects of structural supply and demand shocks and macroeconomic policy innovations on real output, prices, interest rates and fiscal balances. Attention was also devoted to the interaction of monetary and fiscal policies, to the interaction between government spending and government revenues and the role of financial markets. Both the EMU area as an aggregate economy and individual EMU countries have been analyzed.

Four results of our analysis stand out: (i) on the level of the Euro-area as a whole, the estimated adjustments to the various structural shocks are by and large found to be comparable to the case of Japan and the US; (ii) relatively similar adjustment dynamics occur across the different EMU countries in response to supply and demand shocks; however, (iii) large differences in the country adjustments are induced by monetary and fiscal policy innovations and (iv) there are also considerable cross-country differences in the interdependencies between macroeconomic policy instruments. The second result seems to imply that a symmetric supply and demand shock is transmitted in a more or less symmetric manner in the different countries. Consequently, common monetary policy and/or co-ordinated fiscal stabilization policies (be it automatic or rule-based) that seek to counteract such a demand or supply shock will not induce large divergent adjustments of output and prices. The third and fourth results are more worrisome, however, since it suggests that innovations in the common monetary policy and/or fiscal policy instruments could produce divergent adjustment dynamics of output, prices and fiscal balances across the EMU.

Appendix

The definitions of the variables used in this analysis and the data sources that have been used, are given in Table A.1.

Table A.1
Data Definitions and Sources.

Variable	Definition	Unit	Source
GDP	Gross Domestic Product	Mln n.c.	IMF IFS, OECD MEI and QNA
PPI	Producer Price Index	Index (1995=100)	IMF IFS
CPI	Consumer Price Index	Index (1995=100)	IMF IFS
i	Short Term Interest Rate	%	IMF IFS
GEX	Total Government Spending	Mln n.c.	IMF IFS, OECD MEI and QNA
REV	Total Government Revenue	Mln n.c.	IMF IFS, OECD MEI and QNA
OIL	Oil price	US $ per barrel	IMF IFS
DEF	Net Lending Government	Mln n.c.	IMF IFS, OECD MEI and QNA
SMI	Stock Market Index	Index (1995=100)	OECD MEI
y	Real GDP	Mln n.c.	$y = \log(RGDP) = \log\left(\frac{GDP*100}{CPI}\right)$
Δy	Real Output Growth	%	$\Delta y = \log(RGDP) - \log(RGDP)_{-1}$
Δp	Inflation Rate	%	$\Delta p = \log(CPI) - \log(CPI)_{-1}$
t	Real Government Revenue	Mln n.c.	$t = \log(RREV) = \log\left(\frac{REV*100}{CPI}\right)$
Δt	Real Government Revenue Growth	%	$\Delta t = \log(RREV) - \log(RREV)_{-1}$
g	Real Government Spending	Mln n.c.	$g = \log(RGEX) = \log\left(\frac{GEX*100}{CPI}\right)$
Δg	Real Government Spending Growth	%	$\Delta g = \log(RGEX) - \log(RGEX)_{-1}$
r	Real Stock Market Return	%	$r = \log\left(\frac{SMI*100}{CPI}\right) - \log\left(\frac{SMI*100}{CPI}\right)_{-1}$

The following sample period was used when estimating the SVAR for the various countries:

Table A.2

Sample period SVAR Models.

Country	*Sample/N.obs.*
EMU-12	1981:4 - 2000:3, 76 obs.
Japan	1981:1 - 2001:2, 82 obs.
USA	1983:1 - 2001:3, 75 obs.
Austria	1981:1 - 2000:3, 79 obs.
Belgium	1981:1 - 2000:3, 79 obs.
Denmark	1981:1 - 1999:4, 76 obs.
Finland	1981:1 - 2001:1, 81 obs.
France	1981:1 - 2000:3, 79 obs.
Germany	1981:1 - 2001:1, 81 obs.
Greece	1981:1 - 2000:4, 80 obs.
Ireland	1981:1 - 2000:3, 79 obs.
Italy	1980:3 - 2000:4, 82 obs.
The Netherlands	1981:1 - 2000:4, 80 obs.
Portugal	1982:1 - 2000:4, 76 obs.
Spain	1981:1 - 2001:1, 81 obs.
Sweden	1981:1 - 2001:1, 81 obs.
United Kingdom	1981:3 - 1999:4, 74 obs.

Euro area prices and interest rates were directly available. Euro area output, government revenue and government spending were calculated by aggregating across the individual countries output, revenue and spending, using ECU/Euro exchange rates to convert the values into a common currency.

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Table 1
Unit Root Tests.

	y	Δy	p	Δp	i	Δi	t	Δt	g	Δg
Euro area	-1.59	-3.25**	1.26	-2.57**	-1.80	-5.02***	2.76	-5.00***	1.77	-3.11***
Japan	-0.89	-1.81*	-2.35	-2.15**	-1.50	-5.07***	1.69	-5.22***	-2.89	-6.53***
USA	-2.56	-2.89**	-2.98	-3.15**	-2.34*	-5.20***	-2.31	-2.64***	-2.44	-6.34***
Austria	-2.38	-3.43**	-1.27	-2.02**	-2.30	-6.28***	-2.76	-7.04***	-2.34	-6.55***
Belgium	-2.78	-2.23**	0.88	-1.81*	-2.41	-9.65***	-0.35	-3.19***	-0.44	-8.53***
Finland	-2.29	-2.07**	1.65	-2.40**	-2.93	-7.24***	2.27	-5.06***	4.64	-6.54***
France	-2.03	-2.34**	-2.30	-5.85***	-2.48	-5.23***	-1.68	-4.24***	-3.04	-6.57***
Germany	-1.83	-3.27**	-3.26*	-2.87***	-3.45*	-4.65***	-1.70*	-3.91***	-2.68	-2.78***
Greece	-3.21*	-2.92***	-0.47	-2.79*	-1.10	-9.71***	-1.59	-5.69***	-0.09	-9.73***
Ireland	-0.75	-2.73*	-1.91	-5.13***	-3.91**	-5.23***	3.16	-5.04***	-0.13	-3.92**
Italy	-0.96	-2.53**	-1.47	-3.68***	-2.96	-7.49***	-1.94	-8.38***	-2.09	-4.61***
TheNeth-erlands	-2.62	-1.63*	-1.69	-1.87*	-2.59	-5.52***	-2.98	-3.71***	-2.34	-5.24***
Portugal	-1.73	-2.34**	-2.11	-2.99*	-2.33	-11.20***	-2.59	-2.96***	-3.22*	-3.09***
Spain	-1.99	-2.04*	-2.48	-3.03***	-2.95	-5.23***	3.06	-6.92***	3.07	-5.64**
Denmark	-2.97	-2.94**	-2.72*	-3.24***	-3.25*	-4.36***	-3.02	-2.76*	-2.80	-1.79*
Sweden	-2.60	-2.28**	0.95	-3.42*	-3.07	-5.68***	-1.15	-2.12**	-2.17	-4.73***
UK	-3.07	-2.71*	1.65	-2.82*	-2.19	-10.06***	-3.08	-4.86***	2.51	-4.20***

Note: Augmented Dickey Fuller Test on stationarity containing -if significant- a trend, a constant and up to four lags in its specification. *,**,*** denotes that the null hypothesis that a variable contains a unit root is rejected at a 10%, 5%, 1% significance level, respectively. See the Appendix for the samples that have been used for the different countries.

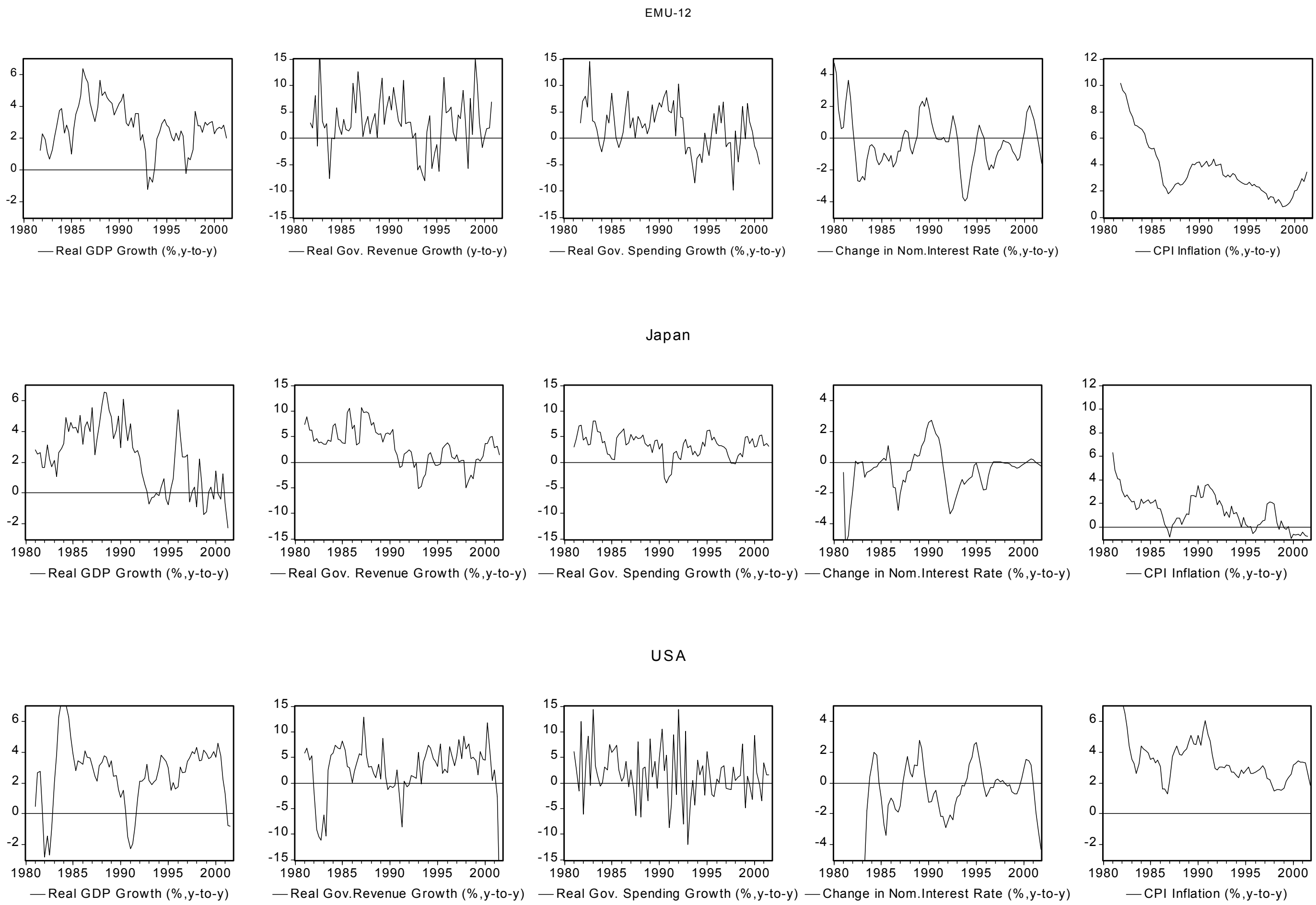

Figure 1
Real GDP Growth, Real Government Revenue Growth, Real Government Spending Growth, Changes in Short-Term Interest Rates and Inflation: Euro area, Japan and the US.

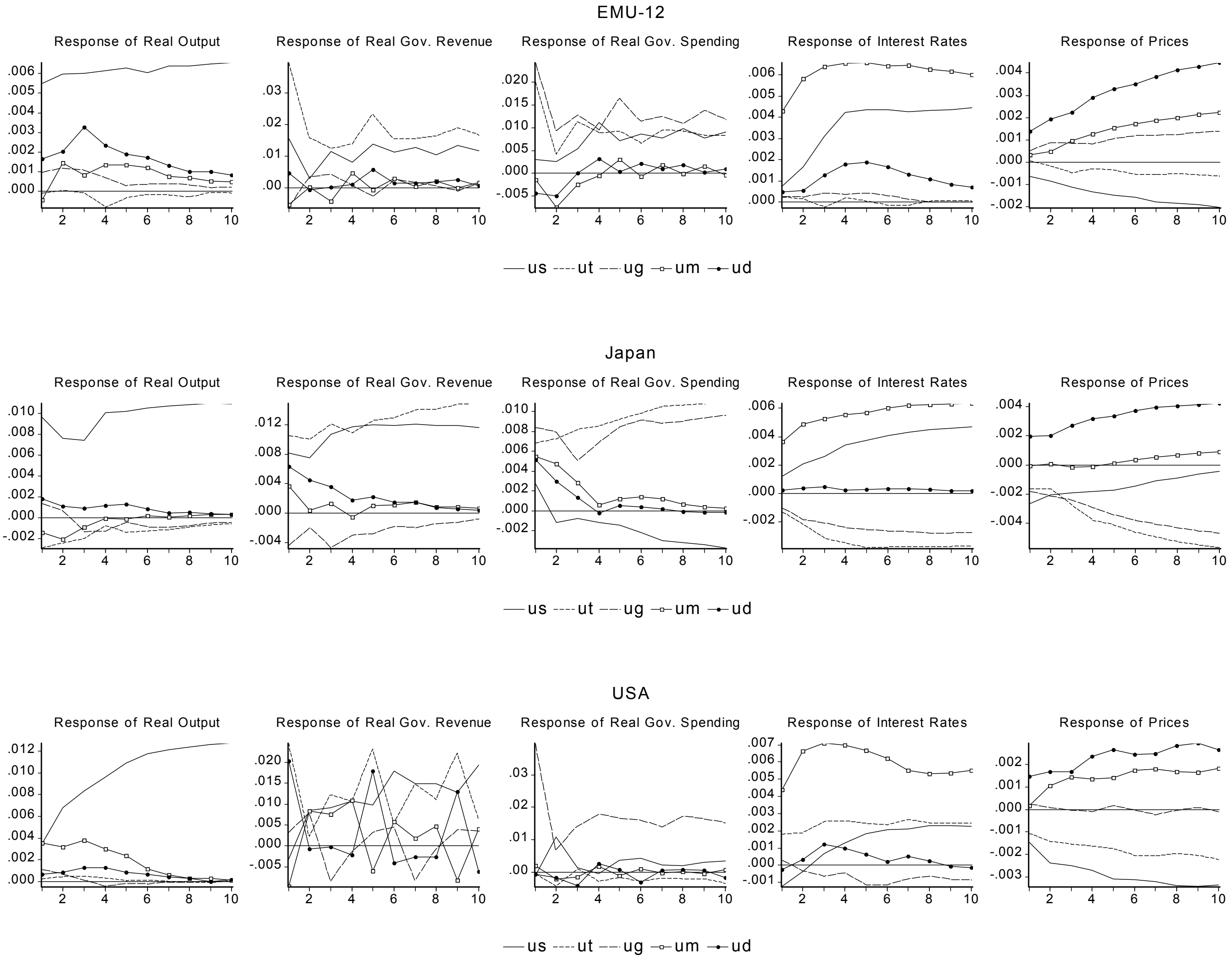

Figure 2
IRFs SVAR model: EMU-12, Japan and the USA.

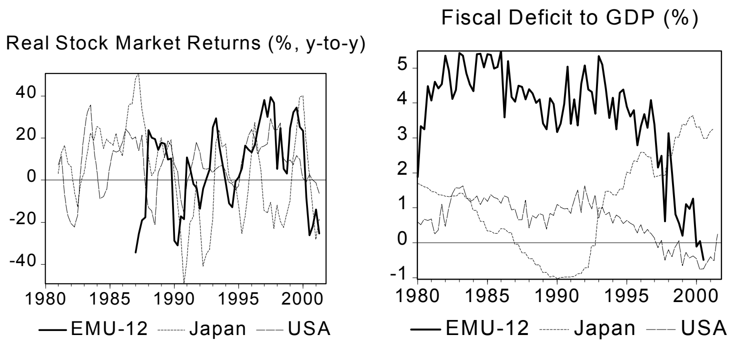

Figure 3
Fiscal Deficit to GDP and Real Stock Market Returns, EMU-12, Japan and the US.

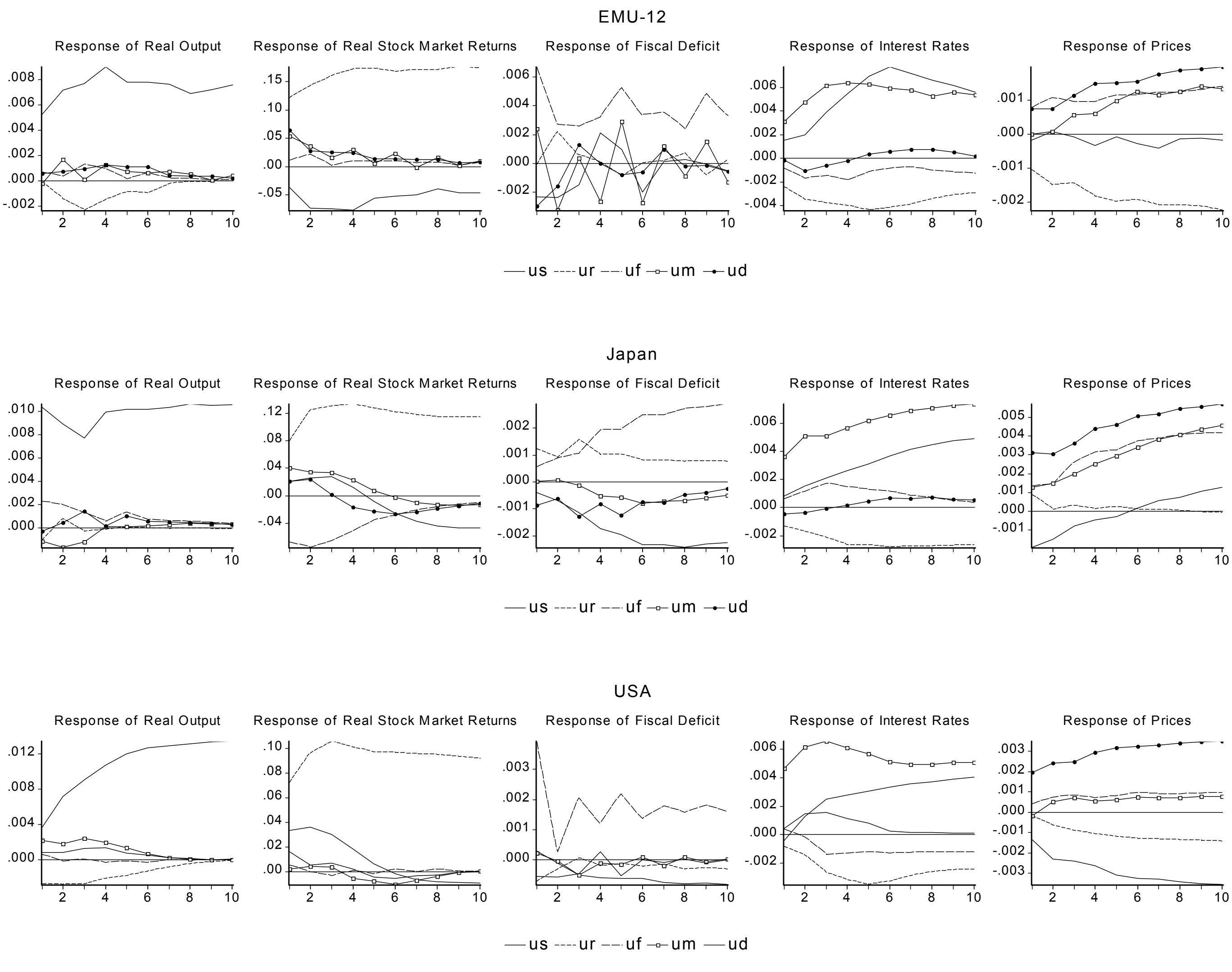

Figure 4
IRFs augmented SVAR model: EMU-12, Japan and the USA.

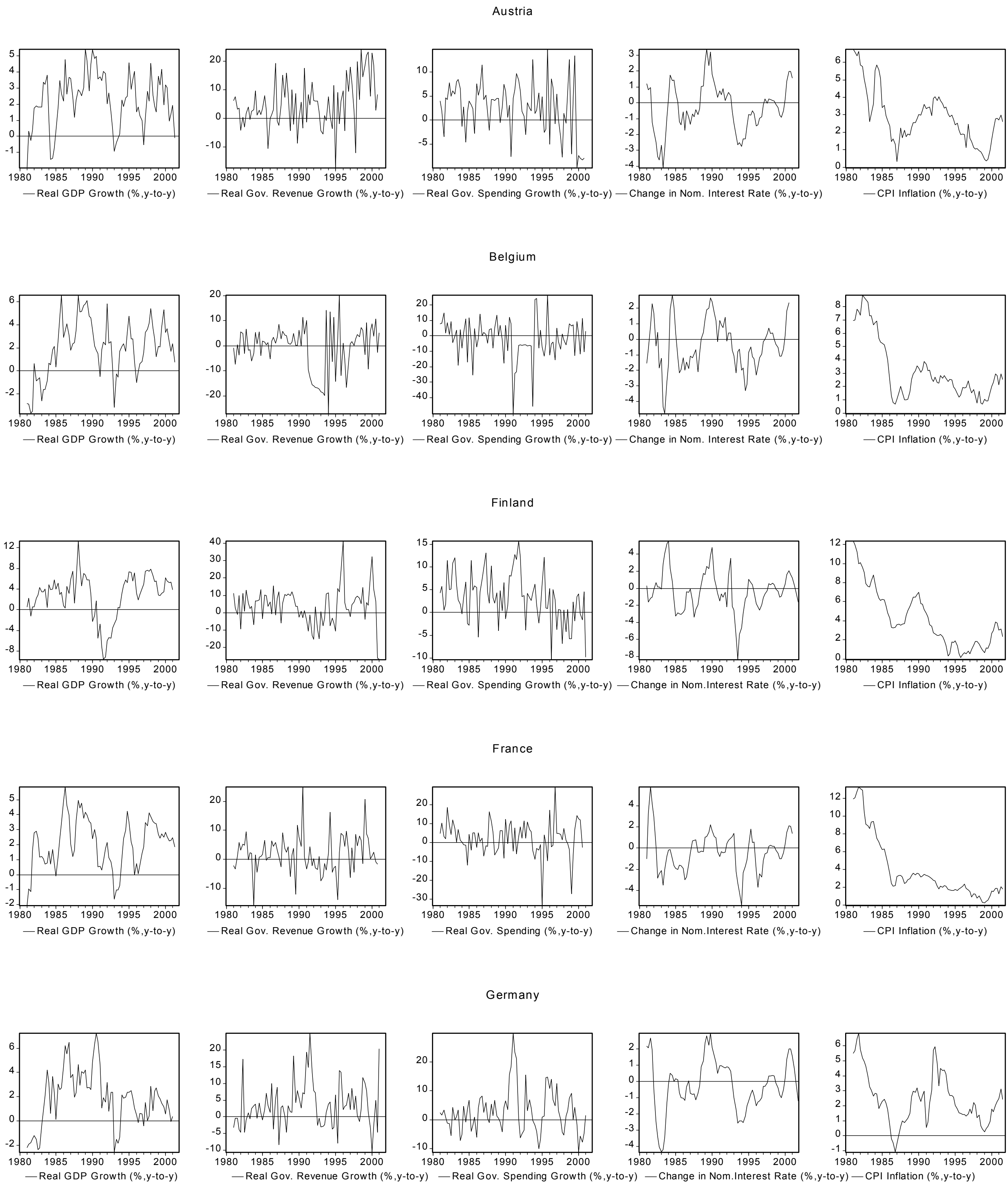

Figure 5
Real GDP Growth, Real Government Revenue Growth, Real Government Spending Growth, Changes in Short-Term Interest Rates and Inflation: EMU countries, Denmark, Sweden and the UK.

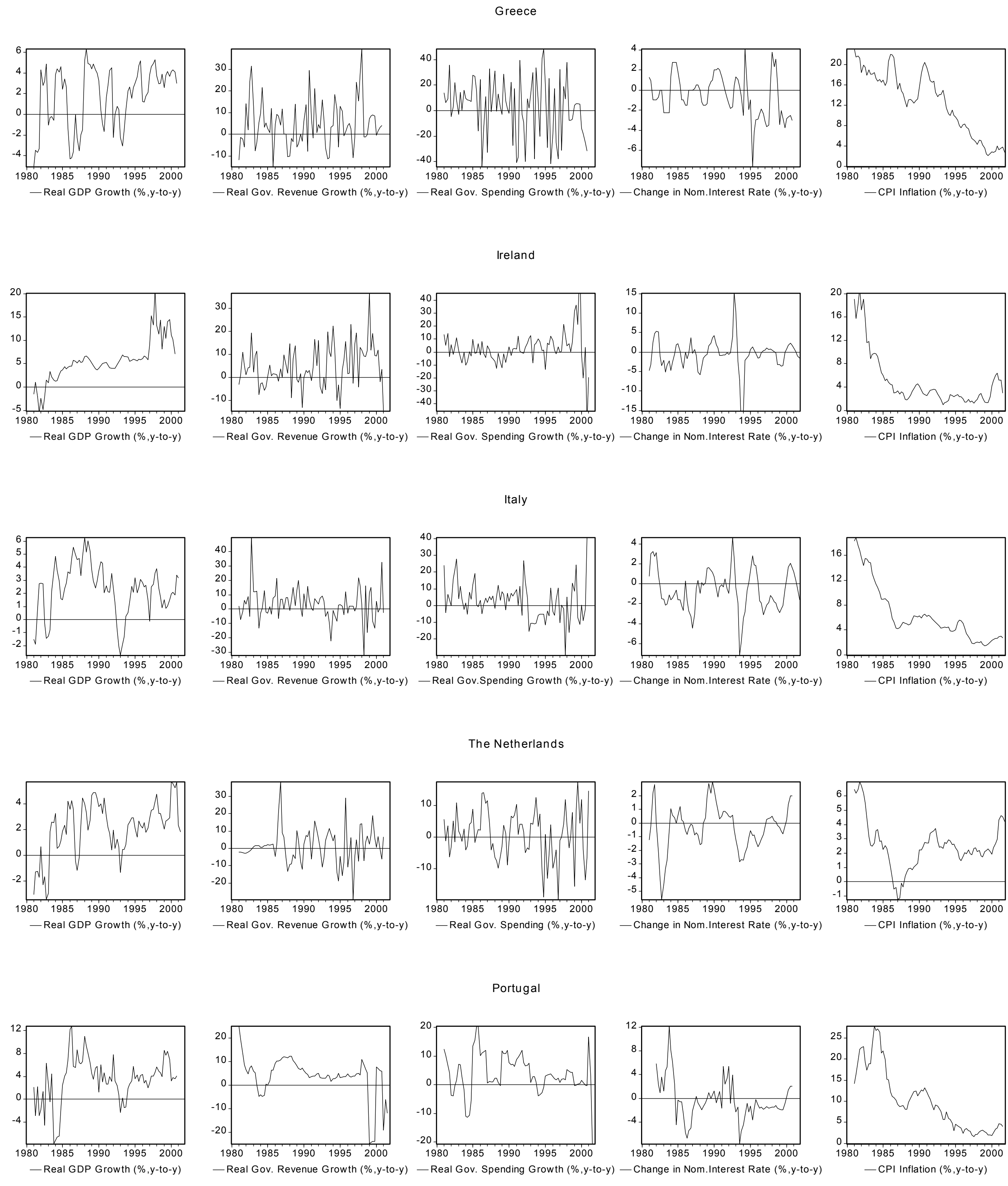

Figure 5 (cont.)
Real GDP Growth, Real Government Revenue Growth, Real Government Spending Growth, Changes in Short-Term Interest Rates and Inflation: EMU countries, Denmark, Sweden and the UK.

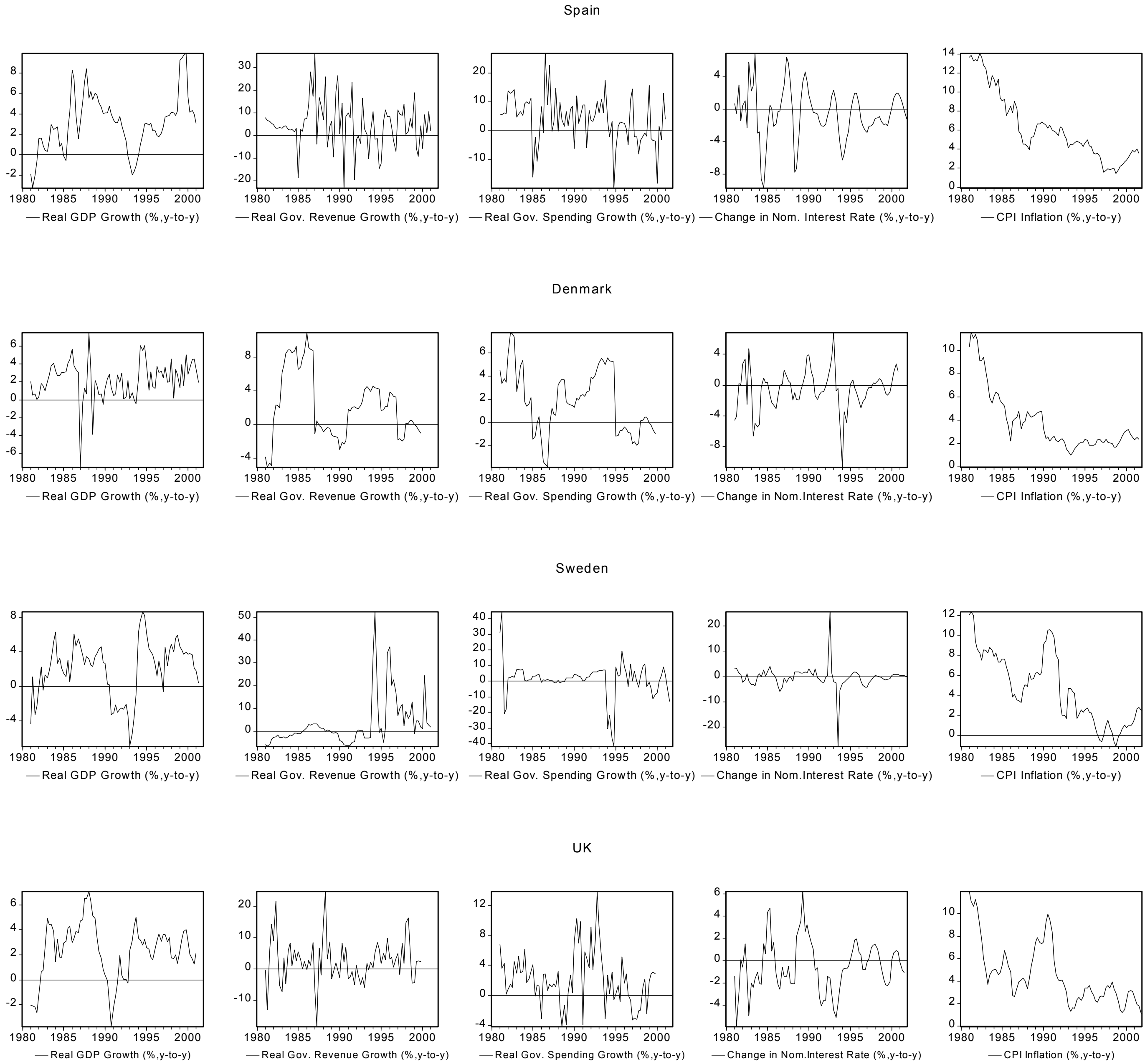

Figure 5 (cont.)
Real GDP Growth, Real Government Revenue Growth, Real Government Spending Growth, Changes in Short-Term Interest Rates and Inflation: EMU countries, Denmark, Sweden and the UK.

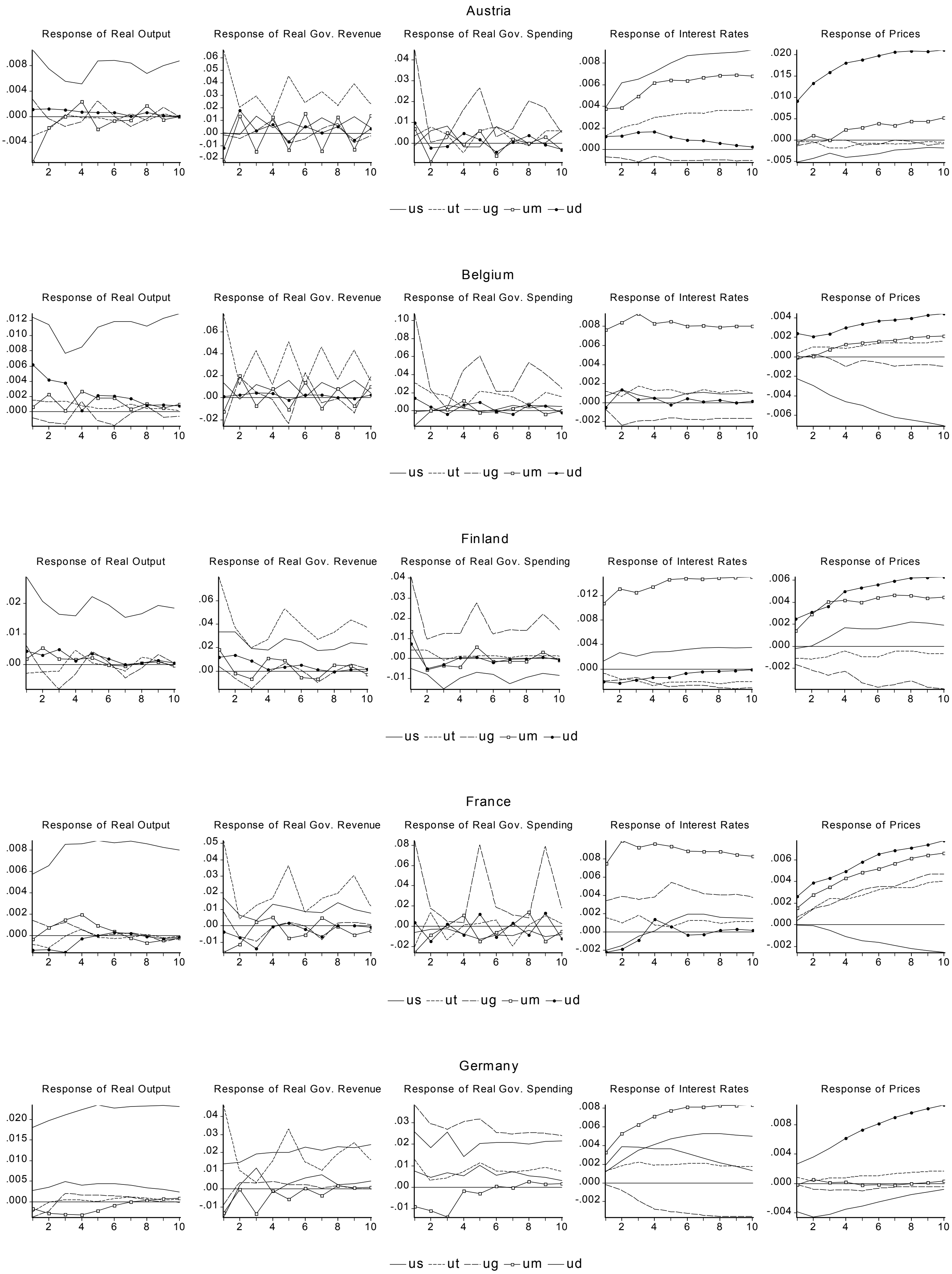

Figure 6
IRFs SVAR model: EMU Countries, Denmark, Sweden and the UK.

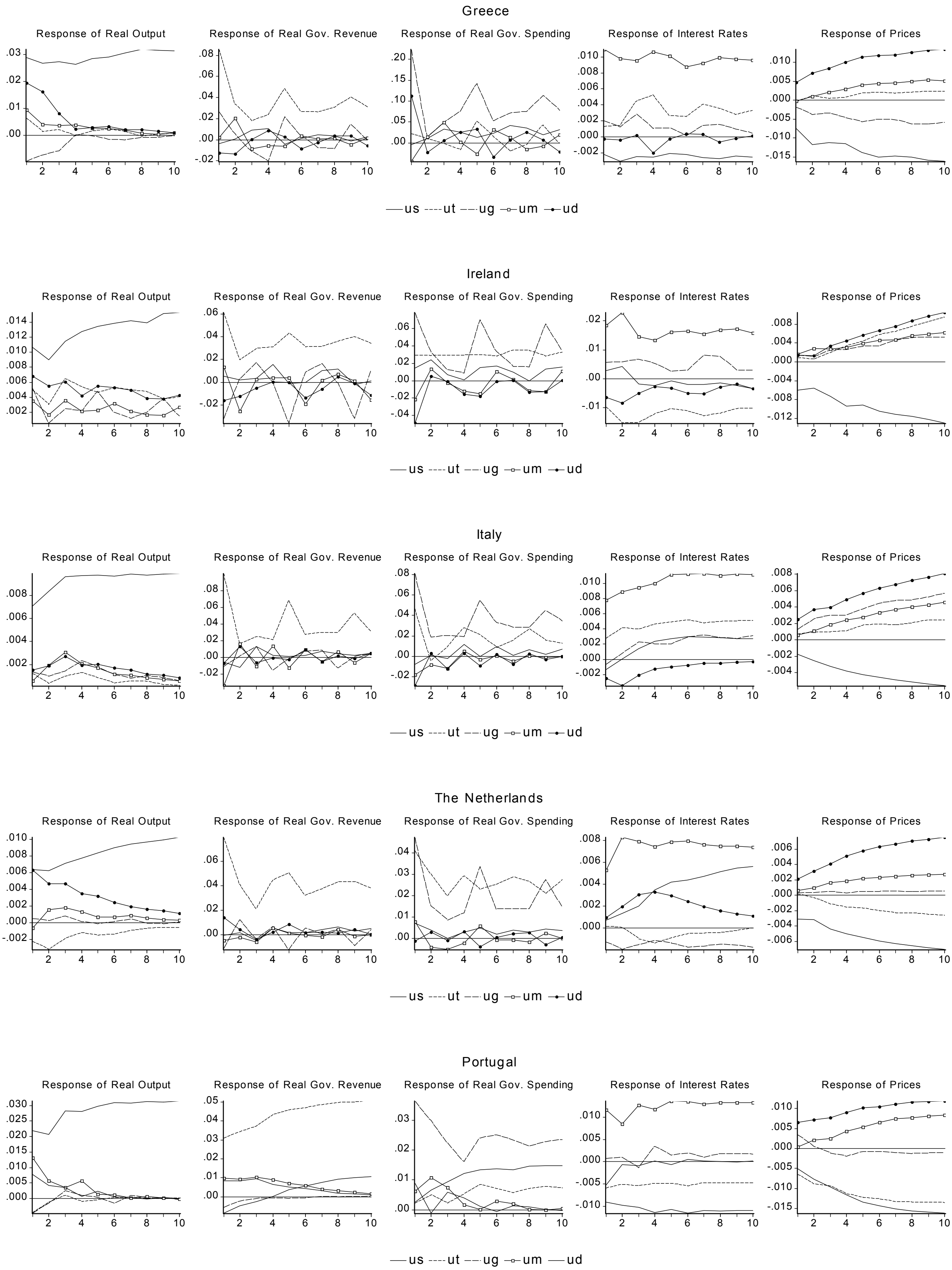

Figure 6
IRFs SVAR model: EMU Countries, Denmark, Sweden and the UK.(cont.)

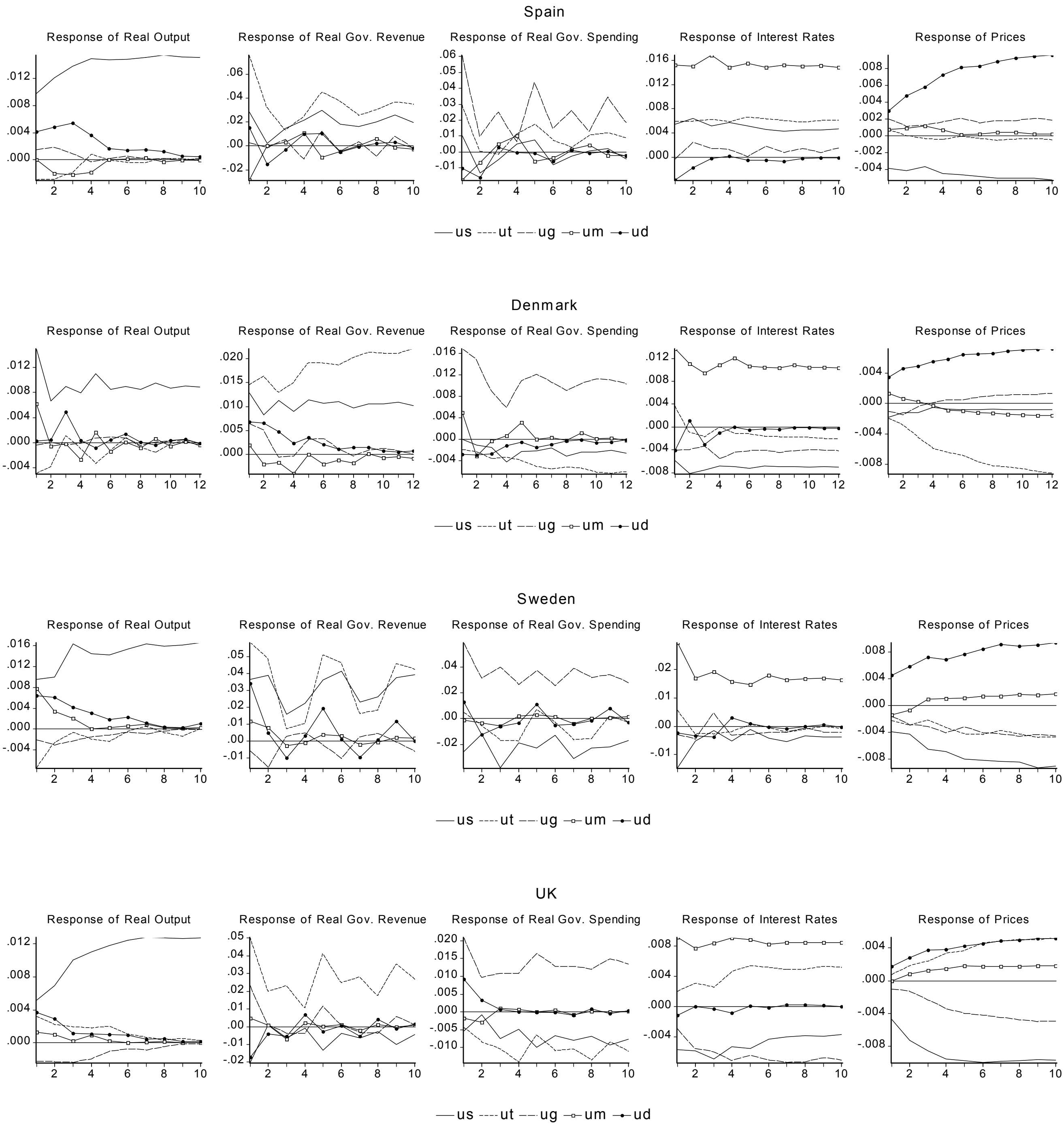

Figure 6
IRFs SVAR model: EMU Countries, Denmark, Sweden and the UK.(cont.)

Endnotes

[1] The use of VAR models to measure the impact of monetary policy, however, is not completely uncontroversial as e.g. Rudebusch (1998) argues. In particular, the interpretation of the monetary residuals as true monetary policy innovations has been questioned. In a fiscal policy context the interpretation of the fiscal errors as policy innovations is possibly even more doubtful given that there are typically lags between policy announcement and implementation. Concerning the SVAR, in addition, the identifying restrictions that are imposed sometimes meet criticism; the SVAR results are typically sensitive to some extent to the set of identifying restrictions that is imposed. These criticisms necessarily also apply to our analysis but we have no way to circumvent them.

[2] Insightful studies are e.g. Sims (1992), Bernanke and Blinder (1992), Gerlach and Smets (1995), Rudebusch (1998). Gordon and Leeper (1994) and Leeper et al. (1996) analyze in detail the difficulties with identification in VAR models of monetary policy.

[3] Note that this requirement that $CC^T = \Sigma$, in principle allows an infinite number of different identification schemes.

[4] In macroeconomic SVAR models e.g., long run restrictions are often based upon small scale IS-LM-Phillips curve type models.

[5] They note: "While there is a widely used, correct algorithm for generating error bands for impulse responses in reduced form models, it is not easy to see how to extend it to over-identified structural VARs, and some mistaken attempts at extension have appeared in the literature." Because of such methodological problems and to keep the graphical presentation tractable, we decided to refrain from calculating and presenting standard error bands in this paper.

[6] All growth rates are quarter-to-quarter. We have also experimented with alternative definitions of some variables and which are sometimes also used in the literature: instead of real output growth, we included the output gap and instead of growth rates of real government revenues and real government spending we included the level of both variables, viz. ratios of GDP or per capita. Outcomes under these modifications did not seem to produce better results or other insights so it was decided to stick to the original framework.

[7] As noted earlier this interpretation of the fiscal and monetary and fiscal innovations in the SVAR approach as representing deliberate policy actions remains subject to some criticism.

[8] Alternative orderings of the variables imply (even) less attractive identifying restrictions. We experimented with alternative identifying restrictions and generally found that the results in the short-run are not overly sensitive to small changes in the identifying restrictions. In particular we note that with the alternative assumption that (v) revenue shocks do not have a permanent effect on government spending growth, outcomes appear not to be very different.

[9] Stock market prices are proxied by the Dow Jones EURO STOXX all shares price index in case of the EMU-12, the TSE Topix all shares index in case of Japan and the NYSE Common Stocks Index in case of the US.

[10] Hoppner (2002) provides arguments why such a decomposition based on an (S)VAR model may not in all cases be appropriate to distinguish cyclical and structural deficits.

[11] While this is an important result, of course it does not tell us anything on an equally important aspect: the degree of symmetry of macroeconomic shocks in the EMU. The existence of asymmetric shocks constitutes a principal factor that could make EMU less than an optimal currency area, as a large literature initiated by Bayoumi and Eichengreen (1992) on EMU and optimal currency areas has demonstrated.