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Monetary and Budgetary Policy Interaction: An SVAR Analysis of Stabilization Policies in Monetary Union

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Abstract

This paper examines the interaction between monetary and budgetary policy. A comparison of the dynamic responses in different exchange rate regimes offers an assessment of the monetary union case. The analysis proceeds on an SVAR-common trends model. In its current specification, we can only infer responses to the budgetary policy shock. Its identification is obtained by imposing a (long term) solvency condition on government accounts, exploiting automatic stabilisation responses of government revenues, and the imposition of the Fisher relationship. Two main conclusions emerge. Budgetary policy shocks indirectly lead to monetary tightening. Such effects are significant in countries with flexible exchange rate regimes only. Second, policy regime shifts are important.

1 INTRODUCTION

With the creation of EMU, a new macroeconomic regime has been installed. The prime aim of the ECB is to maintain price stability and - only in a second line - to support general economic objectives. A multitude of national budgetary authorities is bound by the Stability and Growth Pact (SGP). The rules of the Pact comprise the use of automatic stabilisers around structurally sound fiscal positions, close to balance or in surplus in the medium term. EMU affects many structural aspects of the European economies. In addition, the transmission channels and effectiveness of both monetary and budgetary policy are bound to change in the EMU environment. Moreover, responses

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to macroeconomic conditions will depend on the interaction between both demand side policies. The reciprocal effects between multiple budgetary authorities further complicate this picture. Such a complex interplay of factors will determine stabilisation outcomes.

The policy tasks assigned to monetary and budgetary authorities in the EMU are based on long term considerations, reflecting the stability culture in which the Maastricht Treaty was signed (Wyplosz, 2002). The prophecy that the new regime would be a "fair weather" arrangement, seems to become true (Alesina et al., 2001) however. The demise of the SGP and the recurrent concern on (national) inflation outcomes, reveals concerns by policy makers about short term stabilisation, willing to use the budgetary tool. This raises the question of what the interaction between monetary and budgetary authorities will look like in a monetary union.

We therefore examine the interactive behaviour of monetary and budgetary policy and its dependency on the monetary regime explicitly. The basic idea is to explore the conduct of budgetary policy in countries that were part of a quasi-monetary union through a fixed exchange rate regime. It thereby contributes to the literature in two major ways: (1) methodologically, a common trends structural VAR in output, inflation and the policy instruments let us impose as few a priori restrictions as possible to identify monetary and budgetary policy shocks; (2) by testing for the importance of monetary regimes in budgetary policy behaviour. The current version of the paper only examines the effects of non-systematic budgetary policy on monetary policy. The main result is the positive effect on interest rates of budgetary policy shocks. The impact is not direct however, but passes via the positive output and inflation responses. Another major finding is the importance of policy regimes shifts.These results provide another angle to assess the behaviour of fiscal policy in the first years of EMU. Obviously, any such extrapolation runs foul of the Lucas critique, and we point at some differences with EMU when suggesting empirical and theoretical extensions to present research.

The paper is structured as follows. Section 2 presents a succinct overview of the theoretical literature on interaction (and policy coordination), based on the holistic approach of the Fiscal Theory of the Price Level. It then appraises existing empirical evidence on interaction and its dependence on the monetary regime. This and a brief event study on the second moments of stabilisation policies justify the subsequent analysis. The econometric set up of the common trends model and the application to our analysis is discussed in Section 3. The argument focuses in particular on the identification and the interpretation of the structural shocks. Section 4 analyses the results on interaction. Robustness of the empirical approach is checked along different lines. Finally, Section 5 concludes.

2 LITERATURE REVIEW: STABILISATION, BUDGETARY POLICY AND THE MONETARY REGIME

2.1 THEORETICAL LITERATURE

Probably the most comprehensive approach towards the interaction of monetary and budgetary policy is found in the fiscal theory of the price level (henceforth FTPL). It suggests that if the fiscal authorities fail to take actions to ensure their intertemporal budget constraint is satisfied, equilibria are possible where fiscal - rather than monetary - policy determines the price level (Wren-Lewis, 2002). The possibility of a non-Ricardian regime arises as government solvency eventually has to be ensured in real terms. This leads to an active fiscal policy to which monetary policy can only passively adjust. Such a scenario may not be realistic, both for theoretical[1] and practical reasons. A Ricardian regime was guaranteed by the monetary dominance of the Bundesbank in the EMS. Likewise, the SGP now safeguards the ECB (Ballabriga and Martinez-Mongay, 2002). EMU adds a distinct flavour though, as the concern has shifted from long term stability to the conduct of **stabilisation policies** in a **monetary union** (Fatas and Mihov, 2002).

Let us consider the issue of stabilisation first. Departures of the basic FTPL models which introduce nominal inertia and Blanchard-Yaari consumers, justify a role for short term stabilisation policy which may still be consistent with an active monetary policy (Leith and Wren-Lewis, 2001). The nature of fiscal policy - active or passive - is thereby irrelevant. However, while stabilisation policy and solvency may be compatible, the combination is not necessarily credible. In particular, with budgetary policy now having effects on both inflation and output, a time inconsistency problem arises which is very much alike the one encountered in monetary policy (Kydland and Prescott, 1977). This gives rise to a conflict with long term solvency of government debt[2]. The SGP may then be considered as an incomplete answer to this trade-off. Putting a ceiling on positive deficit deviations may ensure budgetary policy is locally Ricardian. However, this does not rule out debt implosions and - more importantly - unduly restrains the use of budgetary policy. In other words, more short term budgetary flexibility is possible without endangering solvency (Leith and Wren-Lewis, 2000).

A more common framework to consider policy interaction is established in the growing literature on micro-founded general equilibrium models of sticky prices, which may be considered as a subset of the FTPL models. Optimal monetary and budgetary policy is derived under alternative assumptions of the settings of the interaction process (Schmitt-Grohe and Uribe, 2001). That is, the exact timing and the discretionary or commitment character of policy need to be determined.

Both approaches thus stress the importance of the institutional set up. Such policy games can be analysed in much simpler models however. A series of papers have examined the game theoretic

[1] The FTPL is not without controversy however and its relevance is still being questioned. In particular, the existence of equilibria that may never be attained in reality is contentious (Buiter, 1999).

[2] The proposal of an independent fiscal stabilisation agency (Wyplosz, 2002) has to be seen in this light.

interaction of monetary and budgetary policy. In these small models, optimal policy instrument setting is found by minimising loss functions in the policymakers' targets, subject to the economy's aggregate demand and supply constraints where price stickiness is generally assumed (Dixit and Lambertini, 2001b). The essential message of these models is that the Nash equilibrium entails non-cooperative races ("leadership battles") between both policymakers whenever there are conflicts on the policy objectives. This results in an unbalanced policy mix. The solution to this coordination failure is to instil one of both authorities with leadership[3]. Such models justify constraints on fiscal policy as monetary commitment to low inflation can be destroyed by budgetary discretion (Dixit and Lambertini, 2000). The standard argument thereby is that the spending and inflation bias result from a lack of commitment not to use inflation to alleviate tax distortions. This does not seem to create a rationale for "positive" policy coordination then[4].

Nevertheless, the analysis so far focuses on the interaction of a single monetary and a single budgetary actor. Key to understand the EMU framework is the interaction between a single monetary authority and multiple budgetary authorities in open economies. This inevitably involves a discussion on the interaction of budgetary authorities. Some papers have analysed the relevance of the FTPL in the context of a monetary union. For a two-country model, the basic result conveys that it is sufficient to have one insolvent government in the union to determine the price level for the union as a whole (Canzoneri et al., 2001). Thereby, fiscal solvency can not be guaranteed for any other government in the monetary union[5]. In the presence of rigidities, it is the relative strength of the fiscal feedback parameters that determine whether the regime is Ricardian or not. The justification for the SGP is now somewhat different: by ensuring solvency of each government in the union, the possibility that one country sets the price level is ruled out. Beetsma and Jensen (2002) construct a multiple country version of a micro-founded model with sticky prices, to which fiscal policy is added. The specification allows tracking the reaction of all variables to shocks in both policies. The crucial point of the model is that differences in price rigidities across member states of the monetary union cause the single monetary policy to have diverse effects on the output gap and inflation in distinct countries. This induces a different degree of budgetary policy variability across countries. In particular, in the presence of an asymmetric supply shock in one country, budgetary policies in the other countries expand to offset the desinflationary impact of the central bank's interest rate rise. The net effect of these countries' unilateral spending boost, is the central bank now having to fight inflationary pressures (Uhlig, 2002). The underlying reason is free riding between the budgetary authorities.

Can the free riding problem be overcome by a closer coordination? Coordination of monetary and

[3]In this respect, the implications of the game theoretic models are very similar to those of the FTPL. Leadership may be considered as the enforcement of behaviour on the other policymaker.

[4]However, with the same basic model ingredients, Buti et al. (2001) show that coordination may be beneficial in the presence of supply shocks.

[5]Except in the particular case where this price level would be exactly right for the other countries in the union.

budgetary policy receives little theoretical support. As Obstfeld and Rogoff (2002) show, the first best may as well be achieved by optimal domestic policy setting. In addition, there are arguments based on political economy and on game-theoretic interactions between policy makers which render coordination suboptimal (Persson and Tabellini, 1995). As cooperation necessarily entails a further degree of cooperation between budgetary authorities, leadership may shift to budgetary policy. Inflationary policies may then be the result. Non-cooperation actually suffices to discipline budgetary policy in a monetary union and is therefore welfare-improving (Beetsma and Bovenberg, 2001). An even stronger result holds: the indirect effects of free riding budgetary authorities on the common monetary policy may give incentives to each government to push for budgetary constraints (Beetsma and Uhlig, 1999). From a practical point of view, the different nature of monetary and fiscal policy makes fine-tuned cooperation probably unfeasible. Such operational problems apply both to joint monetary - fiscal policy setting, as to closer budgetary cooperation. To summarize the arguments, theoretical evidence on the welfare losses of (non-)coordination is not clear cut. Probably, the conclusion of this literature is that properly designed institutions - rather than "ad hoc" coordination - go a long way towards a first best outcome in monetary union.

2.2 EMPIRICAL LITERATURE and EVENT STUDY

The literature on interaction of monetary and budgetary policy has largely remained theoretical. Assessing whether the macroeconomic regime of EMU is making a difference in terms of stabilisation policies is hard with little more than three years of evidence (Fatas and Mihov, 2002). One may thus want to look for a lever to examine the dependency of joint monetary and budgetary policy setting. We propose to contrast macroeconomic stabilisation and budgetary policy conduct in countries that maintained a flexible respectively a fixed exchange rate over a prolonged period of time. This is as close as we can get to a (quasi-)monetary union.

To that end, we perform a small event study of budgetary policy behaviour and stabilisation outcomes before and after fixing the exchange rate. Attaching a particular period to this choice is a contentious issue. The former official IMF classification - based on country reporting - is unable to distinguish between official and factual exchange rate policies. In particular, should one regard frequent devaluations to an anchor currency as managed floating e.g. the "soft" ERM period 1979-1989? Conversely, a period of exchange rate stability may be more accurately described as a fixed exchange rate regime, even if it officially moved within very wide bands or was only informally pegged e.g. the post-EMS crisis period. We therefore disregard the official "Annual Report" of the IMF, and adopt the historical de facto classification of Reinhart and Rogoff (2002) instead. It is based on a variety of descriptive statistics on official and parallel exchange rates, and the use of multiple exchange rates. As it is not so clear how to categorise the "soft" ERM period, we also base our decision on the study of Levy-Yeyati and Sturzenegger (2002). They perform a cluster analysis on various volatility measures of official exchange rate and international reserves, to sort regimes.

Erratic switches between regimes indicate to us a non-fixed period. Our classification can be found in Table 1 of Appendix B.

With this categorisation, we first compute standard deviations of the output gap, inflation and the net government lending ratio for the different countries/regimes. Figure 1 (Appendix C) displays the cross-sectional standard deviation for the three series at leads and lags relative to the indexed period 0. If anything, fixing the exchange rate seems to favour macroeconomic stability, without requiring more budgetary intervention. A closer examination of the results on a country basis does not change the picture. Table 2 shows that the reduction in inflation and output gap volatility is substantial, even for countries that fixed their exchange rate early. Setting this off against the experience of floating countries, the fall is even more pronounced. The budget deficit is largely unaffected and has even become more volatile for two large countries (Germany and Spain), but also two small countries (Belgium and the Netherlands).

These results do not properly reflect what we would like to examine however. First, they are strongly influenced by the convergence efforts in the transition to EMU (Fatas and Mihov, 2002). We would like to abstract from any exogenous (or endogenous) macroeconomic disciplinary effect of fixed exchange rates[6]. Exchange rate pegging not only serves as a nominal anchor, but may also be a commitment mechanism for budgetary discipline. Second, the stabilisation response to asymmetric shocks is of more importance, so we need to remove aggregate cyclical effects. Third, the cross-country standard deviations are based on different sample sizes. Consequently, we compute procentual deviations from EU averages for the three series under study[7], and set country standard deviations relative to this average before and after fixing. The values in Table 3 tell a slightly different story now. Output gap volatility still decreases, but in those countries inflation with the longest history of fixing the exchange rate (Austria, France and Netherlands) volatility has increased now. On the other hand, inflation volatility has gone up, but not in the Mediterranean countries, as one would expect. Rather, Denmark, Ireland, Finland and again the Netherlands are responsible for this increase. Finally, the budget deficit has become more volatile in Finland, Portugal, Germany and Spain. Still, in the latter two countries, it has converged to the European average from a low initial value.

The interpretation of this descriptive exercise is too simplistic, even if it gives some interesting insights. First, the interpretation is necessarily imprecise. The breakpoint classification may not be relevant. Also, we only partially try to isolate asymmetric shocks. But we cannot unambiguously distinguish between the types of shocks that hit these countries. I.e. we do not assess the (a)symmetry and the relative importance of demand versus supply shocks. In addition, permanent and transitory fluctuations in output and inflation are not distinguished. Second, we can assess the correlation of stabilisation outcomes and policies only. We cannot infer whether economic shocks

[6] The present event study is inspired on the analysis of Gavin and Perotti (1997) . These authors consider first moments of several budgetary indicators at exchange rate regime switches in Latin-American countries.

[7] Where the EU average is a real GDP weighted average (with weights based on a moving average of 4 years).

have become more pronounced, or whether (non-)systematic budgetary policy has become more erratic. Or a combination of both at the same time. The logical consequence is to move to more advanced econometric techniques.

Few empirical papers tackle the issue of interaction explicitly. In particular, only recently has the joint modelling of monetary and fiscal policy reaction functions been highlighted as both a methodological improvement and as an empirical test of the largely theoretical policy coordination literature (Favero, 2002). Simultaneous estimation of a system of monetary and - less common - budgetary Taylor rules has extended traditions in the policy rule literature[8]. A consistent result for panels of OECD and EU countries is the evidence of systematic policy substitutability (Wyplosz, 1999; Mélitz, 2000). While this is not so alarming for any individual country, it does question the reaction of multiple budgetary authorities to a single monetary policy (Buti et al., 2002)[9]. Interestingly, for the country with a flexible exchange rate regime in these panels (Germany), all papers point at complementarity between authorities. Other results (Claeys, 2001) demonstrate that monetary policy is not systematically reactive to budgetary policy in Germany, Japan and the United States but is offsetting in the European countries under study. The budgetary reaction function displays noteworthy cross-country differences too. In the European countries with monetary dependence on Germany, budgetary policy acts as a substitute and is significantly reactive to inflation. Conversely, in the anchor country of the EMS, the government budget is tightened in response to monetary contraction, but not to inflationary bursts[10]. Nevertheless, even the reaction function approach is only able to examine the mutual systematic policy responses. The "ad hoc" nature of the reaction functions may blur the results, as the mechanisms that link inflation, interest rates and debt are not made explicit. In addition, one may want to introduce the way interaction between monetary and budgetary authorities occurs: are reactions truly systematic, or do policymakers react to non-systematic policy shocks?

These criticisms suggest the use of the complementary approach to policy reaction functions, viz. structural VARs (henceforth SVAR). While the literature on the effects of monetary policy in the SVAR framework has abounded over the last decade, attention to the effects of budgetary policy has only recently received attention (Blanchard and Perotti, 1999). While the inclusion of budgetary policy in a monetary SVAR has basically been neglected, empirical research on budgetary policy has gradually started to include price variables based on Sims' (1988) conjecture that the presence of these jump variables may embody expectations of changes in budgetary policy. By absorbing some

[8] Policy interaction is introduced by mutual inclusion of the other policy instrument.

[9] Von Hagen et al. (2001) detect a complementary reaction of systematic monetary to budgetary policy however, while Wyplosz (1999) finds no significant response at all.

[10] A related approach can be found in Favero (2002) who constructs a small-scale model for the four large EMU-countries. Dynamic simulations show that deviations by fiscal authorities from systematic behaviour do not change the behaviour of monetary policy. Ballabriga and Martinez-Mongay (2002) take a complementary approach by assessing the correlation of the non-systematic monetary and budgetary shocks from their separately estimated reaction functions for all EU-countries. Convergence of monetary policy shocks is apparent, but coordination of fiscal and monetary shocks, both within and across countries, is absent.

of the future effects of fiscal policy, larger scale VARs may reveal muted responses of macroeconomic variables to non-systematic budgetary shocks[11]. Also, exclusion of interest rates may lead to aggregation of monetary and budgetary shocks if there are important systematic contemporaneous relationships between both policies[12].

On quarterly data for the USA, SVAR studies including output, inflation and monetary and budgetary policy instruments provide inconclusive answers on the pattern of interaction. Weise (1996) finds one way influence of Federal Funds rate shocks: deficits decrease at first but are loosened afterwards. The specification and identification is questionable though. In contrast, decomposition of the budget items in the semi-structural VAR and the identification of different type of budgetary shocks in the agnostic SVAR approach, lead both Perotti (2002) and Mountford and Uhlig (2002) to the same inference: revenue shocks lead to higher interest rates. While consistent with policy complementarity, reverse causation may underlie this stylised fact. The larger tax base of non-labour income automatically translates into higher revenues. This is further endorsed by the positive revenue response to a monetary tightening. Nevertheless, a small but significant effect remains after controlling for monetary shocks in Mountford and Uhlig (2002). Puzzling interest rate behaviour follows after spending shocks (Perotti, 2002). Mountford and Uhlig (2002) find no responses to deficit and balanced budget shocks. Another hint at the possible influence of the monetary regime follows from Perotti's (2002) general conclusion that the effects of budgetary policy have become weaker after 1980. The author puts forward the Volcker shift in USA monetary policy, as illustrated in Clarida et al. (2000).

What does evidence on European countries teach us? Comparable studies are few – due to data availability on government accounts – but all emphasise the distinct pattern of policy interaction in Germany. Again Perotti (2002) finds significant interest rate falls after spending shocks in Germany. With a methodology close to Perotti's (2002), both Marcellino (2002) and Bruneau and De Bandt (2003) find more marked (and persistent) effects in monetary policy reactions to budgetary expenditure and revenue shocks in the large EMU-countries and EMU as a whole than in Germany itself. As the former author correctly stresses, this response may be either direct or via the impact on inflation and the output gap. No budgetary reaction seems to follow from monetary policy shocks in Marcellino (2002), but budgetary loosening follows in all countries - except Germany - in Bruneau and De Bandt (2003)[13].Both papers restrict attention to the 1980-2001 sample period. The European countries under study have been characterised by different monetary regimes over this period however.

The simple longer term policy assignment that charges monetary policy with inflation stabilisa-

[11] Conversely, exclusion of fiscal variables might bias the evaluation of the effects of monetary policy shocks.

[12] As Mountford and Uhlig (2002) and Perotti (2002) stress however, this control for monetary policy does not seem to be important for assessing the effects of budgetary policy on output.

[13] Note also that Marcellino (2002) is the only author to assess coordination explicitly by adding German budgetary policy to the VAR specification of the other countries. While the Bundesbank's monetary dominance is obvious, this is questionable for German budgetary policy though.

tion and budgetary policy with output stabilisation[14] might indeed break down in a macroeconomic framework with a single monetary policy and decentralised budgetary authorities. In particular, either of uncorrelated economic shocks, a non-zero weight attributed to inflation volatility by the budgetary authority or diverging stabilisation preferences between monetary and budgetary policy, is a sufficient condition to change budgetary policy behaviour. Ceteris paribus, we might therefore anticipate that in comparison to flexible exchange rate regimes: (1) budgetary policy shocks should have no impact on monetary policy; (2) monetary policy shocks result in more pronounced budgetary responses. No paper has explicitly discussed the stylised facts on interaction in different monetary regimes[15]. The present paper is an attempt to fill this gap by extending evidence on the effects of budgetary policy to small open economies with fixed exchange rate regimes, augmenting the specification with monetary policy. A consistent empirical methodology needs to account for the ceteris paribus conditions. First, we need to condition upon the types of shocks that hit countries. Assessing policy shocks in an SVAR is therefore a natural way to proceed. Subsequently, an extensive analysis of the policy shocks should give insights in the policy interaction patterns. Second, the dynamic analysis in an SVAR only holds under the condition that sytematic policy behaviour was unaffected by changes in monetary regime. We test the stability of the parameters in the policy reaction functions, inherent in the SVAR specification. Some caveats have to be kept in mind in the following analysis however. The Lucas critique not only holds on the reaction coefficients in the reaction function. Studies of small open economies with fixed exchange rate regimes may indeed shed light on policy interaction in EMU, where each country is small relative to the Union. Interaction between budgetary policymakers (e.g. in the Euro group) may add an extra game theoretical dimension to national budgetary reactions.

3 AN SVAR-COMMON TRENDS ANALYSIS

This Section first discusses some equivalent representations for cointegrated data series and then shows which restrictions are necessary to identify permanent and transitory shocks. Next, the specification of our SVAR is set out. A discussion of the identification of the shocks through the long term restrictions in the common trends model, relates our methodology to – and puts into a critical perspective – the existing literature.

3.1 THE COMMON TRENDS METHODOLOGY

A common trends model decomposes time series into trends and stationary variables. Denoting by X_t the time series under study, it is composed of permanent trends X_t^P, and a transitory stationary

[14] Either via the automatic stabilisers or some well considered discretionary intervention (Taylor, 2000; Wren-Lewis, 2002).

[15] The study that comes closest to this is the SVAR analysis of Dalsgaard and De Serres (1999). Specification and identification are somehow peculiar and inconsistent across countries, which makes a comparison difficult.

residual X_t^T as in Eq.(1), where neither component is observable as such.

$$X_t = X_t^P + X_t^T \tag{1}$$

Basically, the existence of r cointegrating relationships between the n variables, allows us to extract the $k \equiv n - r$ permanent components, as driven by the k common stochastic trends. An equivalent way to write X_t then is Eq.(2)

$$X_t = X_0 + F\tau_t + \Phi(L)\nu_t \qquad \nu_t \sim WN(0, I_n) \tag{2}$$

where it has been assumed that $\Phi(\lambda)$ is finite for all λ in and on the unit circle, and X_0 is stationary. The trend component is then described by $F\tau_t$, where F is the loading matrix on the permanent components and of dimension $n * k$ and rank k, and τ_t is a random walk with drift μ and innovation φ_t as in Eq.(3).

$$\tau_t = \mu + \tau_{t-1} + \varphi_t \qquad \varphi_t \sim WN(0, I_k) \tag{3}$$

Hence, the common trends model gives us the decomposition of the time series (1) in Eq.(4).

$$\begin{cases} X_t^T = X_0 + \Phi(L)\nu_t \\ X_t^P = F[\tau_0 + \mu t + \sum_{i=1}^{t} \varphi_i] \end{cases} \tag{4}$$

When the number of k common trends is less than the number n of variables, there are exactly $r = n - k$ linearly independent cointegrating vectors (let them be collected in β as in the usual notation). As these are orthogonal to the loading matrix F, the process $\beta' X_t$ is jointly stationary. In particular, when X_t is generated by a VAR with lag length l as in Eq.(5)

$$A(L)X_t = \rho + \varepsilon_t \qquad \varepsilon_t \sim WN(0, \Sigma) \tag{5}$$

and assuming that X_t is cointegrated of order (1,1) with r cointegrating vectors, then we know from the Representation Theorem that $rank[A(1)] = r$ and $A(1) = \alpha\beta'$ with α the loading matrix of adjustment coefficients on the r cointegrating vectors. Equation (5) can be rewritten then as a VECM (Eq. (6))

$$A^*(L)\Delta X_t = \rho - \alpha\beta' X_{t-1} + \varepsilon_t \qquad \text{with } A^*(\lambda) = I_n - \sum_{i=1}^{p-1} A_i^* \lambda_i \ , \ A_i^* = - \sum_{j=i+1}^{p} Aj \tag{6}$$

Under the assumption that expression (7) is nonsingular, and thereby ruling out orders of integration larger than 1,

$$\alpha'_\perp (\sum_{j=1}^{p} jA_j)\beta_\perp \tag{7}$$

there exists a Wold VMA representation of Eq.(6) as in (8)

$$\Delta X_t = \delta + C(L)\varepsilon_t \tag{8}$$

which can be rewritten as a common trends model similar to Eq.(4), if we let $C(\lambda) = C(1) + (1 - \lambda)C^*(\lambda)$ and $C^*(\lambda) = \sum_{i=0}^{\infty} C_i^* \lambda_i$ is absolutely summable and $C_i^* = \sum_{j=i+1}^{\infty} C_j \;\; (i \geq 0)$. In that case we obtain the following common trends representation of the VAR(p) process Eq.(9)

$$\begin{cases} X_t^T = X_0 + C^*(L)\varepsilon_t \\ X_t^P = C(1)[\xi_0 + \rho t + \sum_{i=1}^{t} \varepsilon_i] \end{cases} \tag{9}$$

where $C(1)$ has reduced rank k under the assumption of r cointegrating vectors, or in other words, only k elements of $C(1)\varepsilon_t$ result in independent permanent effects on X_t. Warne (1993) derives a general estimation strategy based on (6) and the Wold VMA representation as in Eq.(8). Hereupon, the asymptotic properties of the impulse response functions (IRF) – and the forecast error variance decomposition (FEVD) – of the n variables to permanent and transitory innovations are deduced under the dual hypothesis of a known finite upper bound on the lag order and no misspecification of the VAR.

The general identification strategy in the common trends model can be described as follows. Call Γ any regular matrix of dimension $n*n$ such that $\Gamma\Sigma\Gamma'$ is diagonal. Then $R(1) \equiv C(1)\Gamma^{-1}$ is the total impact matrix. Let $\eta_{i,t}$ be the i-th component of the vector $\Gamma\varepsilon_t$. The matrix Γ is said to identify the common trends model (Eq.(9)) when: (a) Γ is uniquely determined from the parameters in Eq.(6); (b) the covariance matrix of $\Gamma\varepsilon_t$ is diagonal with non-zero diagonal elements; and (c) the total impact matrix $R(1) = [\digamma \vdots \mathbf{0}]$. The innovation is categorised as transitory (permanent) if column i ($i \in \{1, ..., n\}$) of $R(1)$ is (non-)zero or in other words, permanent innovations are associated to the k common trends. Hence, the reduced form VMA representation in expression (8) is equivalent to the structural model (Eq.(10))

$$\Delta X_t = \delta + R(L)\eta_t \tag{10}$$

where η_t contains the serially uncorrelated structural disturbances with mean zero and with covariance matrix I_n.

In practice, after having established the cointegrating rank r, we need to determine the cointegrating vectors β. These may either be obtained via the usual estimation techniques or can be directly imposed from the steady state properties of some economic theory. This associates the cointegrating vectors to the r transitory innovations and thus imposes $n * r$ identifying restrictions. In a second step, we calculate the matrix of common trend parameters using the orthogonality of the cointegrating vectors to the permanent components to . Following King et al. (1991), we may write $\digamma = \digamma_0 \pi$. Then, having $\beta' \digamma_0 = 0$ results in a further $r * k$ restrictions. However, these restrictions do not attribute any particular economic meaning to the k trends. We therefore need $k * k$ additional assumptions to isolate k unique (and economically interpretable) trends. Assuming that the permanent shocks are uncorrelated and satisfy a (Choleski) ordering on their reciprocal influence[16], gives us $\frac{k(k+1)}{2}$ further restrictions. Finally, at least $\frac{k(k-1)}{2}$ additional constraints on the

[16] That is, π is lower triangular.

effect of permanent shocks on the variables included in the model need be motivated by economic theory. Estimation then proceeds on the VECM (Eq.(6)).

3.2 SPECIFICATION

We specify a VAR in (log) levels of real GDP (y), inflation (p), a short term nominal interest rate (i) and (log) levels of real government expenditure (G) and revenues (T). Real output y and inflation p can be considered as the policy objectives of both monetary and budgetary authorities[17], whereas the interest rate and the budget items are the sole respectively dual policy instruments to achieve these. A priori, three lags are included in the VAR[18]. Hence, our model for the DGP can be written in the VECM form as follows:

$$\begin{array}{c} \Delta X_t = \alpha\beta' X_{t-1} + A_1^* \Delta X_{t-1} + A_2^* \Delta X_{t-2} + \varepsilon_t \\ \text{where} \quad X_t = [\, y \;\; p \;\; i \;\; G \;\; T \,]'. \end{array} \quad . \tag{11}$$

DATA (see Appendix A) All data are on a semi-annual frequency, as in Dalsgaard and De Serres (1999), Favero (2002) and Marcellino (2002). This rather unusual choice reflects two trade-offs. First, the joint modelling of monetary and budgetary policy leads to an intermediate choice of data frequency. Monetary decisions are taken at a much higher frequency. Given the rather high degree of interest rate smoothing found in the literature on Taylor rules (Clarida et al., 1998), this measure is probably not too coarse. In contrast, budgetary policy is legislatively set at an annual frequency. Yet, discretionary semestral revisions are not unusual and stabilisation responses are automatic. Whereas the latter effect mainly influences government revenues, the former mainly involves expenditure adjustments (Van den Noord, 2002). Secondly, this frequency enables us to include a relatively large set of countries with fixed exchange rate regimes, which have not been included in previous research [19]. The sampling periods for the different countries has not been fixed: the inital period varies between the mid 1960s to mid 1970s and the sample ends in 2001:2 (Table 4).

Essential to the identification procedure is the construction of the budgetary instruments. Cyclically sensitive budget items have been assembled in government revenues (T). I.e. as in Blanchard and Perotti (1999), they include tax revenues net of transfers. On the other hand, net capital expenditure – which is mainly related to interest payments on outstanding debt – is added to government consumption[20]. The main reason for its inclusion is theoretical: governments need to satisfy the

[17] Strictly speaking, a loss function would specify this in terms of deviations from target output (y^*) and target inflation (p^*). This is implicit in the empirical model.

[18] This was subsequently confirmed by lag order criteria tests on most specifications.

[19] These countries are: Austria, Canada, France, Germany, Italy, Japan, the Netherlands, Spain and the United States.

[20] This expenditure category may be cyclically sensitive however, but this effect seems sizeable in high debt countries only.

intertemporal government budget constraint. Also, government investment has not been included for it may have long term productive effects that may obscure the identification of shocks.

IDENTIFICATION We suppose three cointegration relations may be present in the DGP of $X_t = [\, y \;\; p \;\; i \;\; G \;\; T \,]'$, to which we associate the three temporary shocks:

1. $G_t - T_t$ (*"Solvency condition"*) The intertemporal government budget constraint (IGBC) requires that any shock to government expenditure must be offset by opposing revenue measures in order to satisfy solvency i.e. future real primary surpluses can be foreseen to be sufficient to repay all existent and future real debt. Under some weak economic assumptions, the first difference of the IGBC shows that the cointegration relation between the I(1) variables government expenditures G_t and revenues T_t, with respective coefficients $[1,1]'$ is a necessary condition for the IGBC to hold. This concept of strong sustainability implies that the undiscounted public debt is finite in the long run; or equivalently that the primary deficit series is stationary[21]. This leads us to interpret the underlying structural innovation as the budgetary shock. Three remarks are necessary at this point. First, we only test for weak sustainability in the empirical strategy, thereby leaving the cointegration vector unspecified[22]. Second, budgetary shocks are supposed to have no long term effect on other variables. Having taken out government investment of the budget, this seems not too controversial. Third, this specification does not allow to assess the effects of balanced budget shocks as they are neutral by definition.

2. $y_t + \theta T_t$ (*"Automatic stabilisation"*) In the countries that we consider, government absorbs a relatively constant share of output[23]. The cointegration relation between government revenues and real output must then be due to business cycle shocks, the nature of which we leave unspecified. It thus allows us to take out the automatic stabilisation properties of the government budget and simultaneously isolates temporary economic shocks. One further remark on the identifcation of the budgetary shocks should be made at this point. We are not only unable to distinguish between shocks to expenditures and revenues. By tying down T to y, it is implicitly assumed that budget shocks are driven by expenditure shocks G whereas there is no immediate response of revenues. This assumption is not unreasonable if one considers the political economy of budget processing though: G is determined first and taxes set accordingly (Beetsma and Bovenberg, 1998)[24].

3. $i - p$ (*"Fisher condition"*) The real interest rate is constante, or nominal interest rates and inflation are cointegrated. Through this relation, we derive short term shocks to the

[21] For empirical tests of government solvency using this criterion, see Ahmed and Rogers (1995).

[22] Even if we implicitly impose some structure by including interest payments in government expenditures.

[23] The clear exception is Spain.

[24] It is also consistent with the evidence in SVAR specifications that allow for endogenous responses of both expenditure and revenues.

real interest rate. This is an admittedly contentious identification of monetary policy shocks[25]. More extensive identification schemes are currently being investigated[26]. It nevertheless allows us to isolate any short term inflationary effects of budgetary shocks. Hence, responses in the interest rate to budgetary shocks may be attributed to monetary policy.

With $n = 5$ variables and $k = 3$ cointegration relations, we have already specified 15 parameters in the cointegration vectors. A further 6 restrictions come from the orthogonality of the three cointegration vectors to the $r = 2$ common trends. Uncorrelatedness and a causal ordering of the permanent shocks gives us 3 more restrictions, which leaves 1 restriction to be imposed. In accordance with the existing literature (King et al., 1991), we interpret the permanent components as a real and a nominal common trend respectively. We distinguish both by assuming the nominal trend has no long term effect on real output.

VALIDITY OF AND CRITICISM ON THE COMMON TRENDS MODEL Any SVAR analysis needs to impose at least $n * n$ identifying restrictions. Limiting the discussion to the budgetary policy literature[27], all of the methods that have been adopted towards identification, have tried to overcome two major difficulties: (a) how to handle anticipation effects, which may be particularly relevant for budgetary policy; (b) how to avoid being too "dogmatic", bringing to bear on the data extensive external information or strong theoretical priors[28].

The narrative approach requires historical information on distinct periods of budgetary shocks. These may not be entirely unanticipated however. Besides, the approach is not really useful for the analysis of interaction. Choleski ordering assumes some prior beliefs on the exogeneity and the mutual influence of the variables in the system. Semi-structural VARs use decision lags and require institutional information on the elasticity of fiscal variables to output. The latter aspect is not unsolvable, but requires a substantial amount of external information and the estimation – and consequent imposition of – a number of parameters[29] (Blanchard and Perotti, 1999). In quarterly data sets, lag restrictions avoid to some extent anticipation effects but would not capture these completely if implementation lags are important. The agnostic identification approach of Mountford and Uhlig (2002) imposes sign restrictions on the impulse responses only, and infers thereupon different types of budgetary shocks. It can thereby fully account for anticipation effects, but can

[25] We also considered introducing a Taylor type relation between nominal interest rates, inflation and output as in Hendry and Doornik (1994). The stationary residuals could then be considered as monetary policy shocks. However, the inclusion of a trend is then necessary. Also, the long term relation may be compatible with other interpretations, such as a basic IS-curve. In both cases, this may obscure the identifcation of the other shocks.

[26] The inclusion of real balances is considered so as to obtain a long term money demand relation.

[27] But similar approaches and problems arise in the monetary policy literature. For a comprehensive overview, see Christiano et al. (2000).

[28] This paragraph is based on the discussion in Perotti (2002).

[29] In small samples, this may create numerical accuracy problems. Marcellino (2002) checks and confirms convergence to a global optimum and robustness of the IRFs, for different starting values of the initial parameters.

not avoid being dogmatic: assumptions are needed precisely on the effects of the shocks on those variables we are interested in.

There are basically two reasons for us adopting long term restrictions. First, imposing long term restrictions is novel in the literature on budgetary policy effects and policy interaction. To our knowledge, only two papers have adopted a similar approach before, both allowing for policy interaction in an SVAR in output growth, inflation, a monetary variable and the budget deficit[30]. This approach has some potential benefits. It does not restrict contemporaneous links and should therefore be able to completely catch anticipation effects[31]. In addition, short run responses are completely left unspecified. To a certain degree, the method entails less dogmatic assumptions, as these are mostly consistent with the steady state properties of a wide range of theories. A second reason to justify this approach is more practical. As in Dalsgaard and De Serres (1999), the semi-annual frequency of the data does not even permit us to base identification on contemporaneous relations.

Nevertheless, *"identification in macroeconomics is a dirty business"* (Faust and Leeper, 1997, p. 352). While both short and long term restrictions may be very sensitive to the exact parameter value imposed (King and Watson, 1997; Sarte, 1999), long term restrictions suffer from two additional problems (Faust and Leeper, 1997). First, even in large samples, substantial uncertainty surrounds the estimates of the long term inverted MA representation in expression (8). Second, we extract a limited number of shocks from the possibly large set of underlying shocks. This necessarily involves a debatable linear aggregation over shocks and the problem of high frequency feedbacks. While the former problem can be tackled by setting a priori the lag length, the latter is only partly solved by an extension of the specification. With semi-annual frequency data, this may be a problem indeed.

We do not test the robustness of the long term restriction of the nominal trend on output[32]. However, by imposing a single restriction and letting the other long term restrictions be implicitly determined by the properties of the DGP, inferential problems may have been reduced to a minimum. This is another advantage of the common trends model. By specifying the models in levels and not in growth rates, the cointegration properties based on a theoretical structure, let a large number of identifying restrictions be self-imposed and thus let fully speak the data. All available information is used, whereas a specification in growth rates throws this information away. Finally, the minimal set of specific restrictions should incorporate anticipatory effects of budgetary policy.

We also anticipate other points of criticism that can be stated on the common trends model in general and our specification in particular.

- The economic interpretation of the permanent and the transitory innovations is not evident.

[30] Both also focus on European countries: Dalsgaard and De Serres (1999) impose 6 long term restrictions whereas Bruneau and De Bandt (2003) achieve identification by a combination of long and short term restrictions.

[31] And in particular so if price variables are added to the system (cfr. the Sims conjecture).

[32] This seems a very robust restriction anyway, as King and Watson (1997) demonstrate.

- The VAR can suffer from misspecification. We consider a set of open economies, but include domestic variables only. Also, some European countries experienced important periods of budgetary consolidation. Such non-linear effects of budgetary policy may be hard to capture in a linear framework as a VAR.
- We define very general shocks to budgetary policy, but the identification procedure can not be extended to distinguish different types of budgetary shocks.

4 EMPIRICAL RESULTS

Prior to the estimation and the dynamic analysis of the model, we first need the establish the following results[33]:

1. *Unit root properties of the data series*
   based on ADF and KPSS tests, we conclude that all series in $X_t = [\ y \quad p \quad i \quad G \quad T\ ]'$ can be regarded as non-stationary for all countries[34]. Inconclusive border cases are assumed to be I(1) series. In some cases, unit root tests assuming a structural break were necessary. The corresponding dummy variabels are retained in the analysis[35].

2. *Cointegrating rank of VAR (*Eq.*(11))*
   Under the assumption of a trend orthogonal to the cointegrating relationships, both the Johansen trace and the Saikkonen and Lütkepohl test favour a cointegrating rank of 3 for most countries (at a 5% significance level). For Germany however, even with the inclusion of a shift dummy as from 1990:2, the Saikkonen and Lütkepohl test detects a cointegrating rank of 2. Surprisingly, in the full system for the United States, there is evidence of a single cointegrating relationship only. Nevertheless, we continue with 3 cointegrating relations for all countries in the further analysis. Two of these relations do stand in firm theoretical ground, the other has a natural economic interpretation. This choice is broadly supported by evidence on each of the presupposed long term relations separately.
   The "solvency" relation is not rejected under the assumption of a constant in the cointegrating relation. Evidence is much weaker in Italy and the Netherlands however. Debt derailment in these countries must be the underlying cause.
   Our second equilibrium relation between real output and governement net revenues performs relatively well. We allowed for a linear trend in the cointegration relation as the theoretical underpinnings for why government absorption would be a constant fraction of output in steady

[33] Initial steps are performed in the time series programme JMulti. Estimation of the SVAR is done in RATS.

[34] The only exception to this are German, Austrian and Dutch interest rates.

[35] For Italy, a break in the nominal interest rate series related to the 1992 EMS-crisis was evident. German Reunification led to a break in real output and government expenditure in 1990:2. For unclear reasons, an impulse dummy was also necessary for Spain in 1978:1. The inclusion of impulse, respectively shift, dummies did not alter the conclusions on the unit root properties.

state are weak[36]. The existence of a long term relation then between government revenues and real output, is only rejected for Canada[37]. Relatedly, we also tested whether government spending is related to real output. With the exception of Austria, Italy and the Netherlands, this was not the case[38]. Thus, we seem to have isolated automatic stabilisers.
Finally, the Fisher relation is not rejected in any country, with the exception of France.

3. *Estimation of the cointegrating vectors* β
the three cointegrating relations were estimated in the VECM (Eq. (6)) via maximum likelihood, and the results used as input for the common trends model[39].

4. *Imposition of the long term restrictions*
Identification of the permanent innovations requires the imposition of parameter values on F_0. In order to identify the real trend in (Eq.(12)), a permanent supply shock on real output, results in a corresponding $\hat{\theta}$ long term increase in net revenues, where $\hat{\theta}$ refers to the estimated long run equilibrium coefficient between y and T. The coefficient $\hat{\phi}_G$ is then derived from a simple OLS of $y + \hat{\theta}T$ on G. Similarly, the coefficients $\hat{\omega}_G$ and $\hat{\omega}_T$ are obtained from a regression of G and T on p respectively.

$$F_0^{'} = \begin{bmatrix} 1 & 0 & 0 & \hat{\phi}_G & \hat{\theta} \\ 0 & 1 & 1 & \hat{\omega}_G & \hat{\omega}_T \end{bmatrix} \tag{12}$$

After these initial steps, the common trends model was estimated, the Wold VMA representation computed and the IRFs and FEVD – and their respective asymptotic standard errors – calculated.

4.1 BASIC RESULTS: INTERACTION

Results of the dynamic analysis are presented in Figs. 2a-i. The main result can be stated immediately: budgetary shocks lead to increases in nominal interest rates. As there is no initial impact on inflation, this must imply monetary policy contraction. However, this effect is not significant for the European countries in the sample but Germany. The evidence thus largely confirms Perotti's (2002) supposed absence of monetary policy reaction in fixed exchange rate regimes. However, the results must be qualified on two fronts[40]. First, the output response is not consistent across countries. While positive budget shocks do lead to output expansion in Japan, Spain, Italy and the

[36] Indeed, Wagner's law would predict that governments absorb an increasingly larger share of output as output increases.
[37] The unrelatedness of output and revenue fluctuations may be due to the importance of raw materials exports.
[38] The cyclicality of government spending probably owes to large interest payments in high debt countries, or to incentives to "spend the filled coffers of the Treasury".
[39] We also experimented with the imposition of theoretical relationships on the data. The robustness of these results was questionable though.
[40] The structural budgetary shocks display a variety of persistence. In most European countries the shocks dies out after two to five years. In the United States, Japan and Italy however, the dampening of the shock lasts much longer.

Netherlands, a similar and significant response is found to negative budgetary shocks in Austria, Canada, France and the United States, whereas the reponse is not significant in Germany. This result stands in sharp contrast with the evidence of small Keynesian output effects in the existing literature on the effects of budgetary policy. It is due to the enforcement of the long term solvency condition in our identification scheme. It is puzzling that the Ricardian effects of budgetary policy are not related to the debt structure of the respective countries. Keynesian responses are found in Italy for example. Also, the different responses can not be due to government investment, for this expenditure category has been excluded. Second, a significant interest rate response is detected in Austria. As this country is certainly characterised by a very stable exchange rate regime over the entire sample, it points at one flaw in our approach. The present identification does not account for possible coordination of budgetary policy shocks, and hence similar responses across countries may still occur.

With such different output responses, this still raises the question as to why we observe interest rate increases. One may attribute the rise to crowding out and market discipline effects of budget shocks when revenues do not react in a commensurate way to expenditure shocks, be they positive or negative. No initial impact on revenues is allowed for in the identification scheme, as revenues are bound to real output. After the initial shock, revenue responses do increase considerably – albeit not always significantly. This is due to automatic stabilisation[41] and – partially – the interest rate increases themselves. In the latter case, government revenues flow in as the tax base of non-labour income is enlarged. We can not disentangle shocks in tax rates later on however, but such discretionary responses to correct deviations from the solvency condition seem to be responsible for more pronounced revenue responses in some countries. Most notably, restoration of solvency in Austria and France seems to have been achieved by a combination of reductions in government size and tax increases. On the other hand, results for Japan and the Netherlands indicate the creation of a debt burden as revenues are not increased in proportion with budget shocks. The explanation for the interest rate increase is probably more straightforward however, albeit somewhat counterintuitive. In both cases, budgetary shocks lead to increases in real output and consequently in higher inflation. Central banks thus react indirectly to non-systematic budgetary policy via its effects on output and inflation. It may then be questioned whether there is any informational content then in the behaviour of budgetary policy as such. It also raises the question as to the approporiate theoretical framework in order to capture such effects. Nevertheless, the basic result remains that there is no significant response in the countries with a fixed exchange rate regime.

Our results are hard to compare with previous results in the literature for two reasons. First, most authors have a much richer specification in both expenditures and revenues. This allows a variety of endogenous responses from expenditure to revenues and vice versa. Interest rate effects are generally detected in response to revenue shocks. Second, in the present specification, deviations

[41] A notable exception is Germany, which confirms evidence on the weak automatic stabilisation responses of the German Federal Budget.

from solvency may have a stronger impact on output, and therefore on interest rates. Note that our significant interest rate responses for the countries with a flexible exchange rate are in line with the predictions of a standard RBC model with distortionary taxation. The insignificant results in countries with a fixed exchange rate regime are more in line with expectations. Using long term restrictions, similar insignificant results for France and EMU are found by Bruneau and De Bandt (2003). Marcellino (2002) finds more erratic interest rate responses in the large EMU countries.

What is the effect then of monetary policy shocks on budgetary policy? In the current version of the paper, the identification scheme does not correctly attribute to the real interest rate shocks the status of monetary policy shocks[42]. Deviations of the real interest rate are mainly due to the inflation shock being larger than the nominal interest rate shock, which would suggest accomodative monetary policy. It is thus more appropriately characterised as a short term inflation shock, which dies out relatively quickly (2 years). Its effect is in general weak: it does not significantly affect output. Only in Germany and France do positive output responses result. Even combining output effects with the nominal interest rate increase, inflation does not affect government revenues significantly. Surprisingly, revenues decrease in Japan. On the other hand, inflation leads to a pronounced fall in government expenditure in high debt countries as Italy.

As a final point, we present some results on the effects of business cycle shocks. While not of prime interest, it shows three interesting results. First, the identification scheme makes sense. The shocks dampen over a frequency of 2 to 5 years. In this period, inflation increases in proportion[43], to which monetary policy reacts in a contractionary (and non-accomodative) way. Second, they confirm the results on the strong automatic stabilisation responses of government revenues[44]. Finally, the responses of government expenditures are more diverse. Explicitly countercyclical budgetary policy is indicated by significant expenditure cuts in Germany and Japan[45]. On the other hand, significant increases follow in the other major European countries. This could be consistent with two effects that are not discernible in the current specification: (a) the real interest rate increases – steered by non-accomodative monetary policy – raise the real debt burden; (b) because of political economy incentives, government proceeds of the Treasury tend to be spent as they flow in.

4.2 ROBUSTNESS CHECKS

There are several ways to assess the robustness of the results. The series decomposition and the structural shocks out of the common trends model are examined[46].

[42] Inference on the monetary policy shocks would be based on the usual IRF and the (conditional) correlation of monetary and budgetary policy shocks at leads, but most probably lags. A strong comovement of both shocks would indicate policy complementarity (or substitutability) in countries with sovereign monetary policy. In (quasi-)monetary unions, it indicates fine tuning responses of budgetary authorities to exogenous monetary policy shocks.

[43] Hence, short term demand shocks may be more important than supply shocks.

[44] Again, they underscore the weak and insignificant budgetary response in Germany.

[45] And to a lesser extent in the United States and the Netherlands.

[46] Explicit stability tests on the parameters of the model (Hansen and Johansen, 1999) are deferred to later analyses.

4.2.1 MODEL FIT

The common trends model provides us with a decomposition of the series into permanent and transitory components (Eq.(9)). The former can be directly compared to measures of potential output, cyclically adjusted government balances, core inflation and base real interest rates as calculated by international organisations or obtained by some mechanical data filters. At this stage, we base our assessment on the fluctuations of the series around the permanent components only. The real and the nominal common stochastic trend that we extract from the data series do make sense in a large number of cases. The transitory output gaps generally correspond to periods of economic fluctuations. Nevertheless, this result holds only if the sample is of "adequate" size. This means the sample size is large enough either to encompass the inflationary burst of the seventies or to validate the imposition of the solvency condition. Also, countries should not have experienced periods of unstable budgetary policy to generate reasonable permanent components. This brings us to the wider issue of stability. Estimation over wider samples (such as in Canada, Germany or the United States) or restricted samples (Austria and France) produced more stable and significant responses. This is clearly associated to changes in the policy regime. Major movements in the permanent components are not properly captured by estimation over different regimes. Pegging the exchange rate to a low inflation anchor seems especially relevant for the monetary part of the model[47], while the transition to EMU makes an important difference for budgetary policy in many countries.

4.2.2 FURTHER POLICY SHOCK ANALYSIS

Do the policy shocks make sense (a)? The FEVDs (not reported) shows that the identification of the shocks is relatively robust. The results generally confirm economic priors. At short horizons, most of the variability in the various series is accounted for by the transitory components. In particular, variability in expenditure is largely explained by its own past behaviour. This is consistent with government expenditure being a largely independent process, driven by factors exogenous to the model. Output variability is accounted for by transitory business cycle shocks, but an important fraction is determined by the real trend already. Government revenues are mostly related to the business cycle shocks and this obviously owes to automatic stabilisation. Both price variables are mainly influenced by the temporary inflation shock. At longer forecast horizons, the variability in all variables is primarily due to the common trends. However, some puzzling results emerge. Output variability is never fully accounted for by shocks to the real trend. Inflation variability is to some extent still determined by the short term transitory shocks. The nominal trend is sizeable in explaining government accounts' variability. Finally, large uncertainty surrounds the estimates of all FEVDs.

Do the policy shocks make sense (b)? Since the criticism of Rudebusch (1998), we know that inference on structural shocks is a dubious exercise as the disturbance series we obtain may depend

[47] Consider the permanent shift after 1984-1986 in France for example (Fig. 2c).

on the particular specification of the empirical model. It may be too much to require an exact timing or an appropriate size of policy shocks. Nevertheless, periods of strong deviations away from or towards solvency should be easily discernible. The following figures (Fig. 3a-b) display our structural budgetary policy shocks. Large outliers are exceptional but some periods do come out clearly. In the United States, the tax cut of 1975 and the Carter-Reagan expansion of the early eighties is visible. The large Japanese budgetary expansion is also suggested. Strong expansions in Italy may be associated to the large debt buildup at the end of the eighties. Two classic examples in the budgetary policy literature do not come to light however. Neither the German Reunification, nor the "Mitterand" expansion early eighties are evident. On the other hand, the strong budgetary cuts in 1997 under the Juppé government can be observed. This budgetary retrenchment seems to be a recurrent phenomenon in all current EMU members under study. Major negative shocks occur around 1992-1993 and again in the period just before EMU-entry (1996-1998)[48]. Marcelllino (2002) concludes from the stability of the budgetary policy shocks that the transition to EMU has mainly influenced systematic policy. A preliminary comparison of the volatility of the non-systematic part of budgetary policy did not indicate any significant differences across exchange rate regimes. However, the independent disciplining effect of an exchange rate peg and a possible increase in instrument variability to economic shocks can not be sorted out in this way.

5 CONCLUSION

The macroeconomic framework of EMU has been designed for long term stability. The provision of short term stabilisation may be less adequate however. That this question is not of purely academic interest is show by the current political and economic reality. This paper empirically analyses the interaction of stabilisation policies in a monetary union. The SVAR approach is rationalised on both theoretical grounds as well as the incompleteness of current approaches to analyse policy interaction. The comparison of dynamic responses to policy shocks across different exchange rate regimes shows that budgetary policy shocks – away from solvency – lead to contractionary monetary policy. The impact is indirect however as monetary authorities react to the expansionary effects on output. Moreover, such effects are insignificant in countries with a fixed exchange rate. In its current version, the specification does not allow us to infer the budgetary response to monetary policy shocks.

Some caveats have to be kept in mind when assessing these results. Any discussion on the differences in budgetary policy in countries – even after controlling for the type of shocks – will run in the same inferential problems as in the OCA literature. Countries that were "good" candidates for fixing exchange rates may not have needed the budgetary instrument anyway. In addition, there

[48] Fatas and Mihov (2002) study European budgetary policy in the last decade before EMU and do indeed find that the largest budgetary consolidation efforts took place in these two periods. That the latter effect is especially pronounced in Italy corroborates our evidence.

is the issue whether OCA criteria are endogenous or not. In that case, the results on the quasi-monetary union countries may be considered as a lower bound for the effect of monetary policy shocks on the dynamic response of budgetary policy. Obviously, the Lucas critique will always apply if we extrapolate evidence to other policy regimes. The fixed exchange rate regime is the closest approximation to a monetary union as possible. Theoretical models of interaction – as in Beetsma and Jensen (2002) – therefore need to be extended in the two following ways. First, the qualitative difference of EMU is the game theoretic interaction between the single monetary and the several budgetary authorities. Second, as the present evidence suggests, debt plays an important role in interaction.

Empirical problems remain however. An immediate issue therefore is to extend the current specification to identify monetary policy shocks. The inclusion of real money balances may be first step. Moreover, we study small open economies and are interested in the policy behaviour relative to other countries. SVARs and common trends models on open economies have been successfully applied to monetary policy[49]. A serious problem is the exact choice of the specification: with limited data availability on budgetary data, too large VARs may result in insignificant results[50]. The structural policy shocks obtained may be fully exploited to examine the behaviour of budgetary policy in a monetary union. Simulations to assess the actual contribution of budgetary policy to macroeconomic stability would be the logical end of the exercise.

[49] We have to keep in mind however that a specification in relative ratios isolates asymmetries across countries (Artis and Ehrmann, 2000).

[50] An alternative would be to restrict attention to a smaller SVAR in the output gap, inflation, a short term interest rate and the primary deficit to potential output ratio. Identification of supply, demand and policy shocks comes from imposing long term identification restrictions.

REFERENCES:

ALESINA A., BLANCHARD O., GALI J., GIAVAZZI F. and UHLIG H., 2001, *Defining a macroeconomic framework for the Euro Area*, Monitoring the ECB, Report no. 3, CEPR.

ARTIS M. and EHRMANN M., 2000, *The exchange rate, a shock-absorber or source of shocks? A study of four open economies*, EUI working paper no. 38.

BALLABRIGA F. and MARTINEZ-MONGAY C., 2002, *Has EMU shifted policy?*, European Commission, DG II, Economic Papers no. 166.

BEETSMA R. and UHLIG H., 1999, *An analysis of the SGP*, Economic Journal, vol. 109, p. 546-571.

BEETSMA R. and BOVENBERG L., 1998, *Monetary union without fiscal coordination may discipline policymakers*, Journal of international economics, vol. 45, p.239-258.

BEETSMA R. and BOVENBERG L., 2001, *The optimality of a monetary union without a fiscal union*, Journal of Money, Credit and Banking, vol. 33, p. 179-204.

BEETSMA R. and JENSEN H., 2002, *Monetary and fiscal policy interactions in a micro-founded model of a monetary union*, ECB working paper no. 166.

BLANCHARD O. and PEROTTI R., 1999, *An empirical characterisation of the dynamic effects of changes in government spending and taxes on output*, NBER working paper no. 7269.

BRUNEAU C. and DE BANDT O., 2003, *Monetary and fiscal policy in the transition to EMU: what do SVAR models tell us?*, Banque de France, mimeo, forthcoming in: Economic Modelling.

BUITER W., 1999, *The fallacy of the fiscal theory of the price level,* NBER working paper no. 7302.

BUTI M., ROEGER H. and IN'T VELD J., 2001, *Monetary and fiscal policy interactions under a Stability Pact*, EUI Working paper no. 8.

CANZONERI M., CUMBY R. and DIBA B., 2001, *Is the price level determined by the needs of fiscal solvency*, American Economic Review, vol. 91(5), p. 1221-1238.

CHRISTIANO L., EICHENBAUM M. and EVANS C., 2000, *Monetary policy shocks: what have we learned and to what end?*, in: TAYLOR J. and WOODFORD M. (eds.), *Handbook of Macroeconomics*, Volume A. Handbooks in Economics, vol. 5, Amsterdam, New York and Oxford, Elsevier Science, North Holland, p. 65-148.

CLAEYS P., 2001, *Stabilisation policies: fiscal policy rules and the interaction with monetary policy*, mimeo, European University Institute.

CLARIDA R., GALI J. and GERTLER M., 1998, *Monetary policy rules in practice: some international evidence*, European Economic Review, Papers and proceedings, vol. 42, p. 1033-1067.

CLARIDA R., GALI J. and GERTLER M., 2000, *Monetary policy rules*, Quarterly journal of Economics, vol. 115(1), p. 147-180.

DALSGAARD T. and DE SERRES A., 1999, *Estimating prudent budgetary margins for 11 EU countries: a simulated SVAR model approach*, OECD Economics Department Working paper no. 216.

DIXIT A. and LAMBERTINI L., 2000, *Symbiosis of monetary and fiscal policies in a monetary union*, mimeo.

DIXIT A. and LAMBERTINI L., 2001, *Monetary - Fiscal policy interactions and commitment versus discretion in a monetary union*, European Economic Review, vol. 45(4-6), p. 977-997.

FATAS A. and MIHOV I., 2002, *On constraining fiscal policy discretion in EMU*, mimeo, Paper presented at the IUE – Robert Schuman Centre – Oxford Review of Economic Policy Conference on "EMU, four years on", September 2002.

FAUST J. and LEEPER E., 1997, *When do long-run identifying restrictions give reliable results?*, Journal of Business and Economic Statistics, vol. 15(3), p. 334-353.

FAVERO C., 2002, *How do European monetary and fiscal authorities behave?*, CEPR discussion paper no. 3426.

GAVIN M. and PEROTTI R., 1997, *Fiscal policy in Latin America*, NBER Macroeconomics Annual, p. 11-61.

HANSEN H. and JOHANSEN S., 1999, *Some tests for parameter constancy in cointegrated VAR models*, Econometrics Journal, vol. 2(2), p. 306-333.

HENDRY D.and DOORNIK J., 1994. *Modelling linear dynamic econometric systems*, Scottish Journal of Political Economy, vol. 41, p. 1-33.

KING R., PLOSSER C., STOCK J. and WATSON M., 1991, *Stochastic trends and economic fluctuations*, American Economic Review, vol. 2, p. 819-840.

KING R. and WATSON M., 1997, *Testing long run neutrality*, Federal Reserve Bank Richmond, Quarterly Review, vol. 83(3), p. 69-101.

KYDLAND F. and PRESCOTT E., 1977, *Rules rather than discretion: the inconsistency of optimal plans*, Journal of Political Economy, vol. 85, p. 473-491.

LEITH C. and WREN-LEWIS S., 2000, *Interactions between monetary and fiscal policy rules*, Economic Journal, vol. 110, no. 462, p. 93-108.

LEITH C. and WREN-LEWIS S., 2001, *Compatibility between monetary and fiscal policy under EMU*, University of Glasgow working paper no. 15.

LEITH C. and WREN-LEWIS S., 2002, *Interactions between monetary and fiscal policy under flexible exchange rates*, University of Glasgow working paper no. 11.

LEVY-YEYATI E. and STURZENEGGER F., 2002, *Classifying exchange rate regimes: deeds versus words*, mimeo.

MARCELLINO M., 2002, *Some stylised facts on non-systematic fiscal policy in the Euro-area*, IGIER working paper no. 225.

MELITZ J., 2000, *Some cross-country evidence about fiscal policy behaviour and consequences for EMU*, European Economy, no. 2, p. 3-21.

MOUNTFORD A. and UHLIG H., 2002, *What are the effects of fiscal policy shocks?*, CEPR discussion paper no. 3338.

OBSTFELD M. and ROGOFF K., 2002, *Global implications of self-oriented national monetary rules*, Quarterly Journal of Economics, vol. 117, p. 503-535.

PEROTTI R., 2002, *Estimating the effects of fiscal policy in OECD countries*, ECB working paper no.

168.

PERSSON T. and TABELLINI G., 1995, *Double edged incentives: institutions and policy coordination*, in: GROSSMAN G. and ROGOFF K. (eds.), *Handbook of international macroeconomics*, vol. 3, Amsterdam, North-Holland.

REINHART C. and ROGOFF K., 2002, *The modern history of exchange rate arrangements: a reinterpretation*, NBER working paper no. 8963.

RUDEBUSCH G., 1998, *Do measures of monetary policy in a VAR make sense?*, International economic review, vol.39(4), p. 207-231.

SARTE P., 1997, *On the identification of structural vector autoregressions*, FRB Richmond - Economic Review, vol. 83(3), p. 45-67.

SCHMITT-GROHE S. and URIBE M., 2001, *Optimal fiscal and monetary policy under sticky prices*, CEPR discussion paper no. 2942.

SIMS C., 1988, *Identifying policy effects*, in: BRYANT R., HENDERSON D., HOLTMAN G., HOOPER P. and SYMANSKY S. (eds.), *Empirical Macroeconomics for Independent Economies*, The Brookings Institutions, Washington D.C., p. 305-321.

TAYLOR J., 2000, *Reassessing discretionary fiscal policy*, Journal of economic perspectives, vol. 14(3), p. 21-36.

UHLIG H., 2002, *One money, but many fiscal policies in Europe: what are the consequences?*, mimeo, paper presented at the EC workshop on Monetary and fiscal policy interactions in EMU (March 2002).

VAN DEN NOORD P., 2002, *Automatic stabilisers in the 1990s and beyond*, in: BUTI M., VON HAGEN J. and MARTINEZ-MONGAY C. (eds.), *The behaviour of fiscal authorities, stabilisation, growth and institutions*, Palgrave.

VON HAGEN J., HUGHES-HALLETT A., STRAUCH R., 2001, *Budgetary consolidation in EMU*, European Commission, DGII Economics Working paper no. 148.

WARNE A., 1993, *A common trends model: identification, estimation and inference*, Stockholm university, Institute for International Economic Studies, seminar paper no. 555.

WEISE C., 1996, *Severity of economic fluctuations under a balanced budget amendment*, Contemporary Economic Policy, no. 14, p. 26-41.

WREN-LEWIS S., 2002, *Fiscal policy, inflation and stabilisation in EMU*, mimeo, paper presented at the EC workshop on Monetary and fiscal policy interactions in EMU (March 2002).

WYPLOSZ C., 1999, *Economic policy coordination in EMU: strategies and institutions*, CEPII Working paper no. 4.

WYPLOSZ C., 2002, *Fiscal policy: institutions versus rules*, Graduate Institute for International Studies Geneva, HEI Working paper no. 3.

APPENDIX A: DATA

Series	Frequency	Source
gross domestic product output gap (in %) GDP deflator public consumption deflators CPI short term interest rate government net lending$^{(a)}$	semi-annual	OECD
EXPENDITURE	semi-annual	OECD
= government consumption (non wage)$^{(b)}$+ government consumption (wage) + (capital transfers received by government + other capital transfers		
+ net interest payments on government debt - income property paid by government		
+ income property received by government+ consumption of government fixed capital)		
(NET) REVENUE	semi-annual	OECD
= social security transfers received by government+ direct taxes + indirect taxes+ transfers received by government - TRANSFERS		
TRANSFERS	semi-annual	OECD
= subsidies + social security transfers+ other transfers paid by government		

Note: OECD, Economic Outlook, no.71; (a) UK data come from the Treasury; (b) real expenditure is derived by deflating public consumption with the corresponding deflator, other components are deflated with the GDP deflator.

APPENDIX B: TABLES

TABLE1.Regimeclassification$^{(a)}$andpeggingperiod.

Country	Regime switch (float to peg)	*Country*	Regime switch (float to peg)
Austria	1980:2	*Netherlands*	1983:1
Belgium	1990:1	*Portugal*	1996:1
Germany	1999:1		Regime
Denmark	1996:1	*Norway*	float
Spain	1994:1	*Sweden*	float
Finland	1995:1	*Great Britain*	float
France	1986:1	*Australia*	float
Ireland	1996:1	*Canada*	float
Italy	1996:1	*United States*	float

Note: (a) classification of exchange rate regimes derives from Reinhart and Rogoff (2002).

TABLE 2. Standard deviation of output gap, inflation and the net government lending ratio[(a)] under different exchange rate regimes.

Country	Output gap (s.d.)		Inflation (s.d.)		Budget deficit (s.d.)	
	Before[(b)]	After[(b)]	Before	After	Before	After
Austria	1,39	0,83	2.03	1.61	2.10	1.30
Belgium	1.44	1.22	2.71	0.91	3.80	3.90
Germany	1.75	0.78	1.78	0.80	1.40	1.90
Denmark	1.57	0.42	3.95	0.96	–	–
Spain	1.24	0.73	4.94	0.86	2.28	2.51
Finland	2.16	1.30	4.35	1.65	3.82	3.80
France	1.02	0.91	3.31	1.18	1.70	1.51
Ireland	1.57	1.97	5.70	1.80	4.01	1.59
Italy	1.43	0.41	5.98	1.28	2.24	2.16
Netherlands	1.31	0.94	2.32	1.44	2.35	2.60
Portugal	2.18	0.66	7.98	0.67	3.82	0.68
average[(c)]	1.55	0.93	4.01	1.13	2.75	2.12
Norway	1.27		4.23		3.53	
Sweden	1.35		3.97		4.67	
Great Britain	1.43		5.44		2.63	
Australia	1.33		4.30		2.01	
Canada	1.12		3.51		3.44	
United States	1.51		2.47		2.00	
average[(c)]	1.34		3.99		3.05	

Notes: (a) all data are from OECD (see Appendix A): the gap is derived from a mechanical HP-filter on real GDP (smoothing parameter $\lambda = 100$), inflation is based on the GDP-deflator. The net government lending for Great Britain is from the Treasury; (b) classification of exchange rate regimes derives from Reinhart and Rogoff (2002); (c) simple average.

TABLE 3. Standard deviation of relative[(a)] output gap, inflation and the net government lending ratio[(b)] before and after entry into a fixed exchange rate regime.

Country	Output gap (s.d.)		Inflation (s.d.)		Budget deficit (s.d.)	
	Before[(c)]	After[(c)]	Before	After	Before	After
Austria	77	243	61	47	81	60
Belgium	92	26	53	42	102	34
Germany	167	10	64	82	15	59
Denmark	53	15	99	160	–	– [(e)]
Spain	131	66	94	82	32	40
Finland	64	13	153	182	207	379
France	70	405	47	34	86	60
Ireland	121	16	117	176	–	– [(e)]
Italy	129	44	92	79	168	68
Netherlands	106	223	91	144	93	62
Portugal	89	39	229	73	115	138
average[(c)]	100 (=1104)	100 (=781)	100 (=42)	100 (=49)	100 (=346)	100 (=187)

Notes: (a) relative to a real GDP weighted EU average (b) all data are from OECD (see Appendix A): the gap is derived from a mechanical HP-filter on real GDP (smoothing parameter $\lambda = 100$), inflation is based on the GDP-deflator; (c) classification of exchange rate regimes derives from Reinhart and Rogoff (2002); (d) simple average; (e) Ireland and Denmark have not been included in these EU averages.

TABLE 4. Sample period in estimation of (Eq.(11)).

Country	SAMPLE	*Country*	SAMPLE
Austria	1980:1 - 2001:1	*Italy*	1970:2 - 2001:1
Germany	1961:2 - 2001:1	*Netherlands*	1970:2 - 2001:1
Spain	1980:1 - 2001:1	*Canada*	1967:2 - 2001:1
France	1970:2 - 2001:1	*United States*	1960:2 - 2001:1
		Japan	1971:2 - 2001:1

APPENDIX C: FIGURES

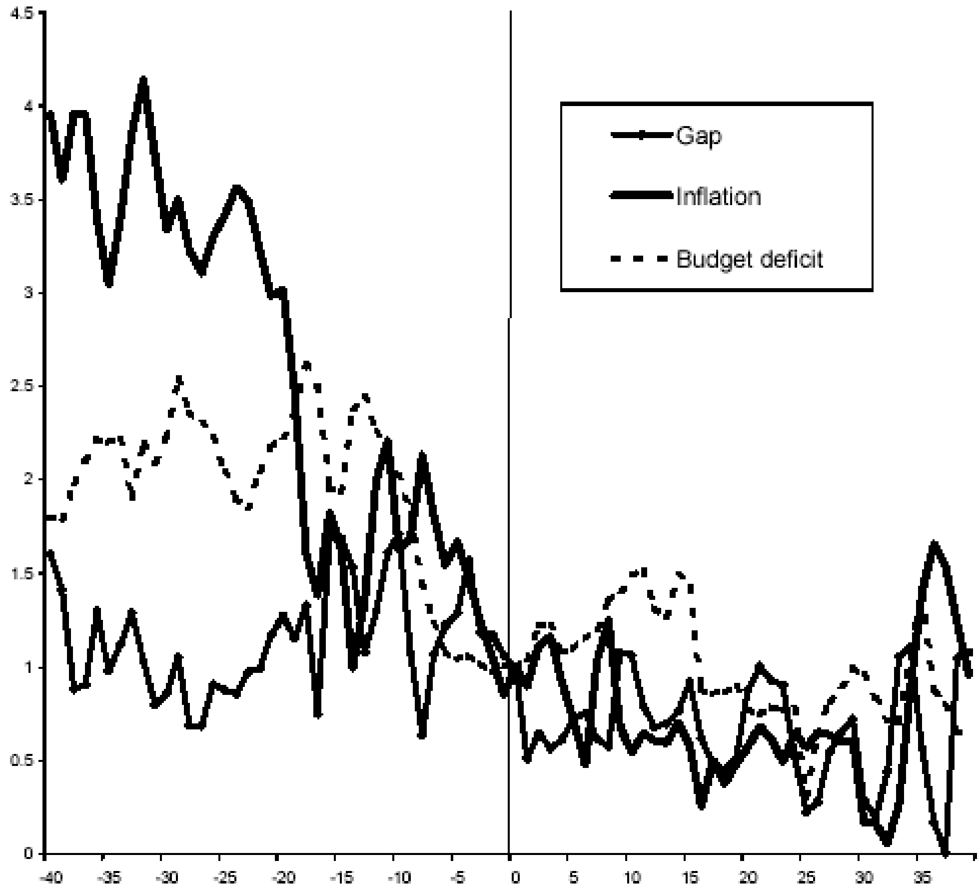
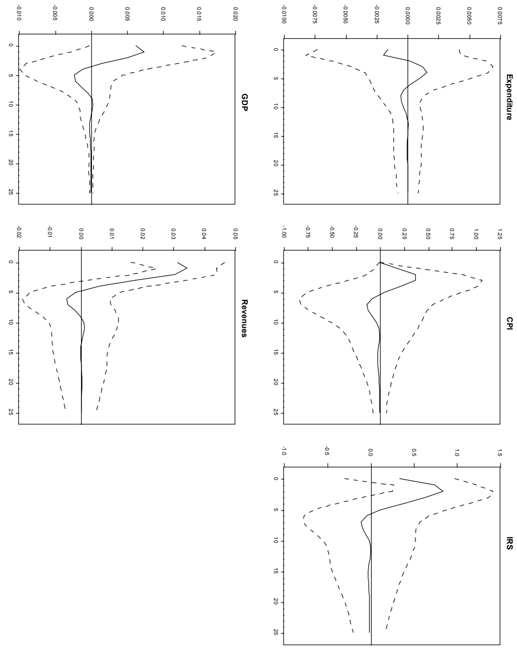
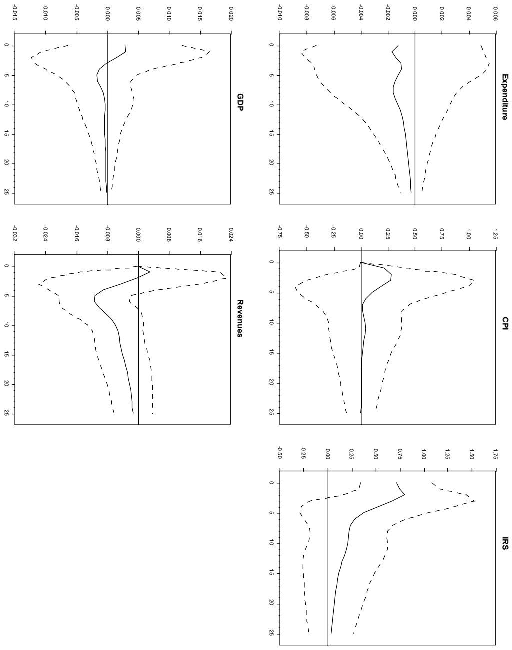


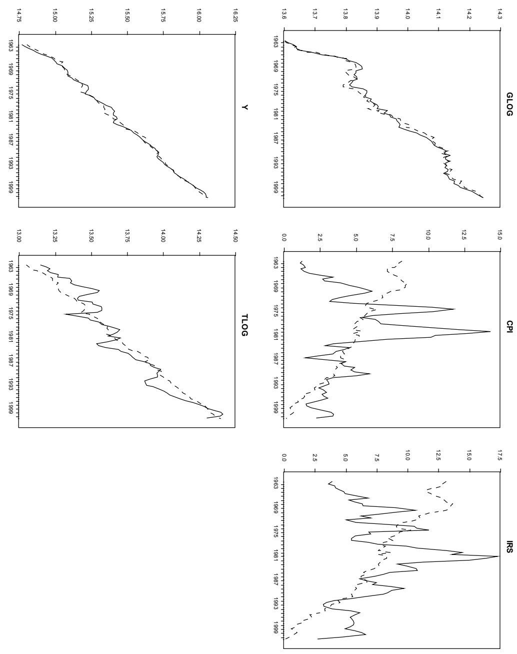
Fig. 1. Event study: volatility of output gap, inflation and budget deficit before and after the switch to a fixed exchange rate regime (in semesters).



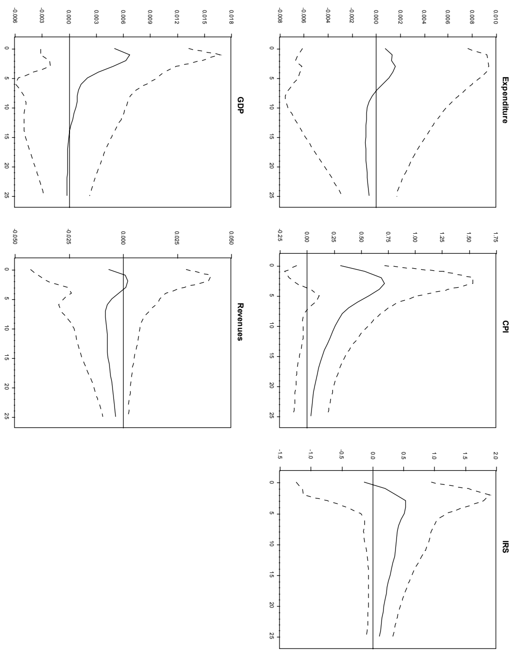
Impulse response to business cycle shock.



Impulse response to budgetary shock.

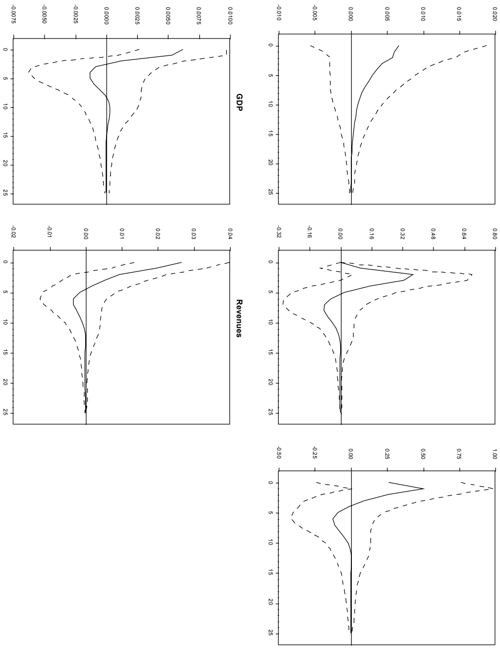


Series (——) and permanent components (- - -).



Impulse response to inflationary shock.

Fig. 2a. United States (Figures report dynamic impulse responses and the 95% asymptotic error bounds).



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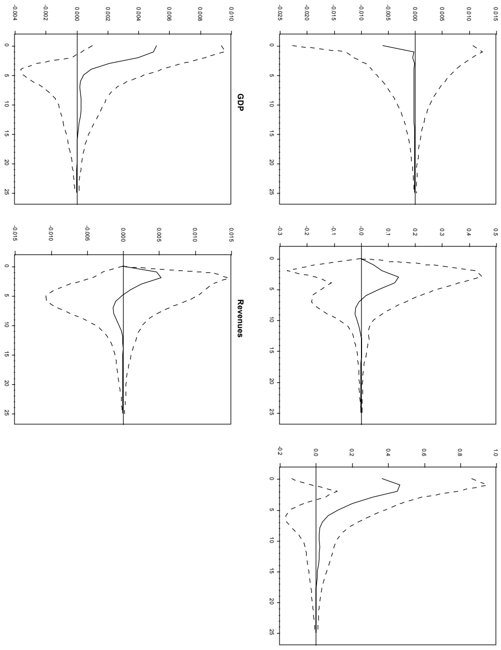

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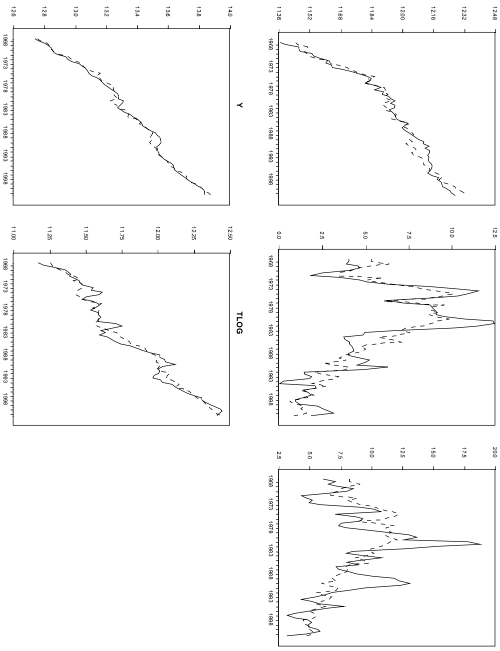
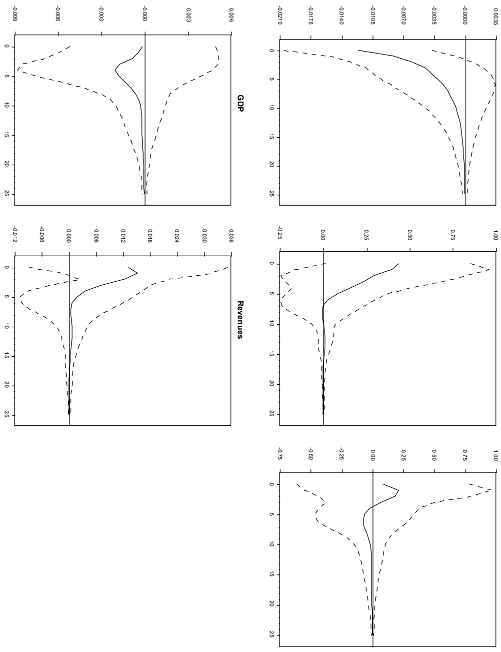
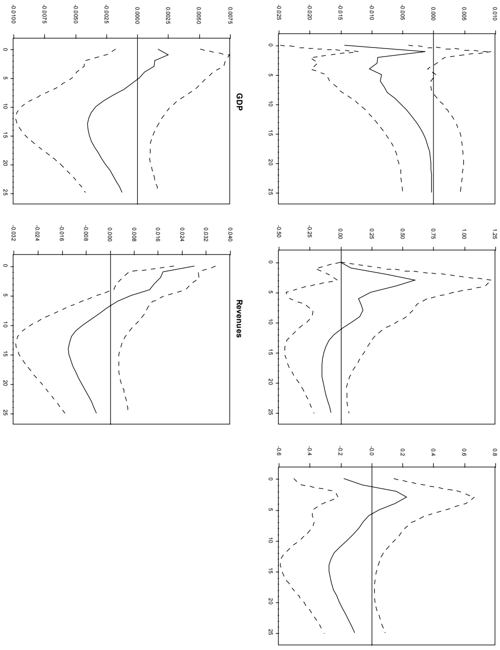


Series (——) and permanent components (- - -).

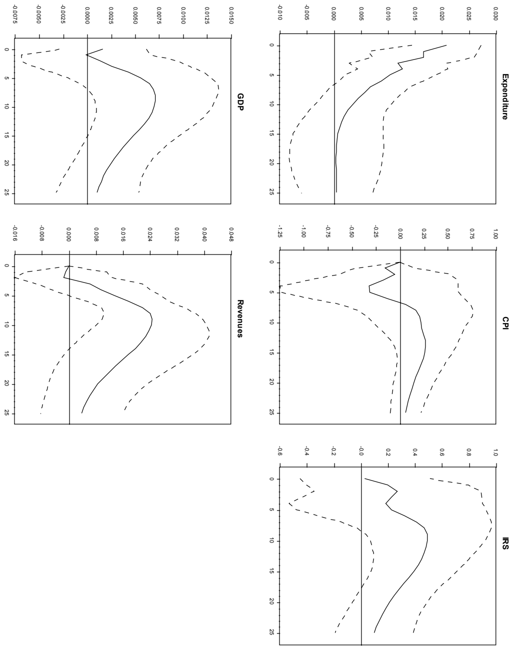


Impulse response to inflationary shock.

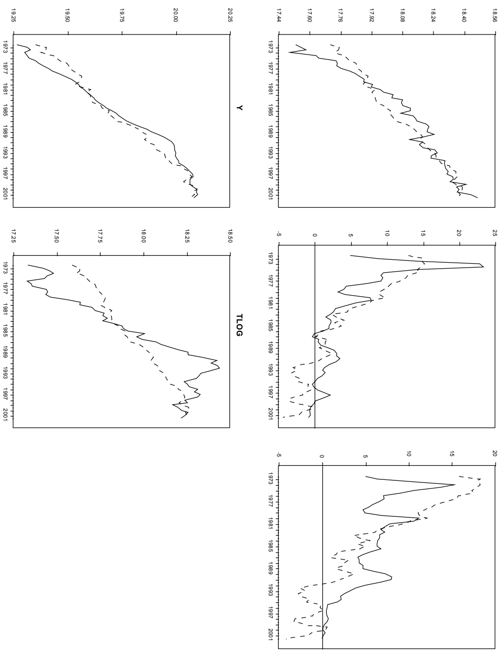
Fig. 2b. Canada (Figures report dynamic impulse responses and the 95% asymptotic error bounds).



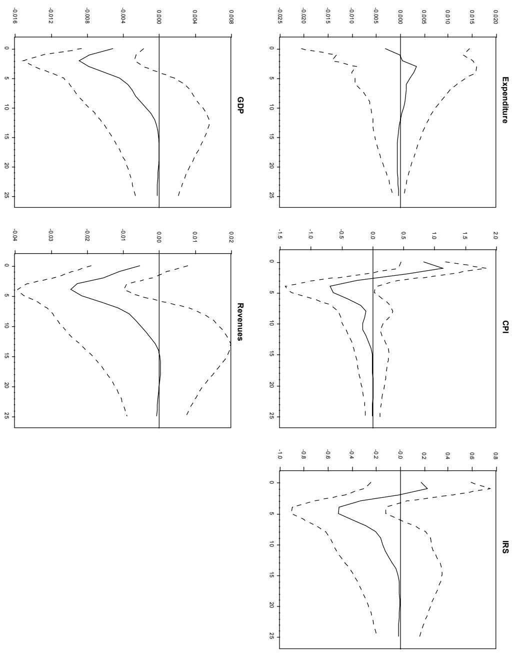
Impulse response to business cycle shock.



Impulse response to budgetary shock.

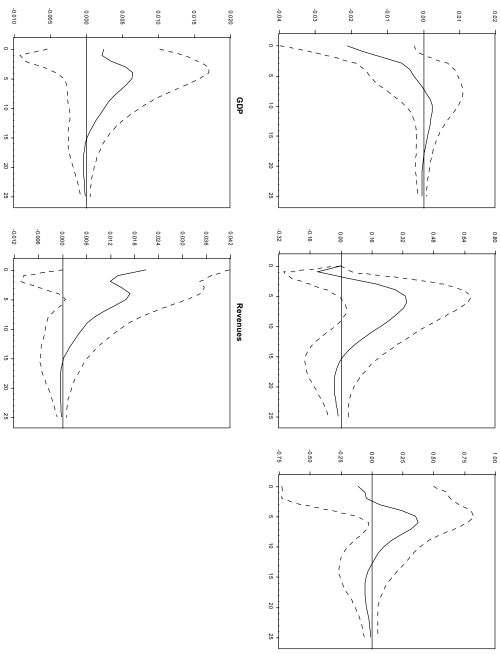


Series (——) and permanent components (- - -).

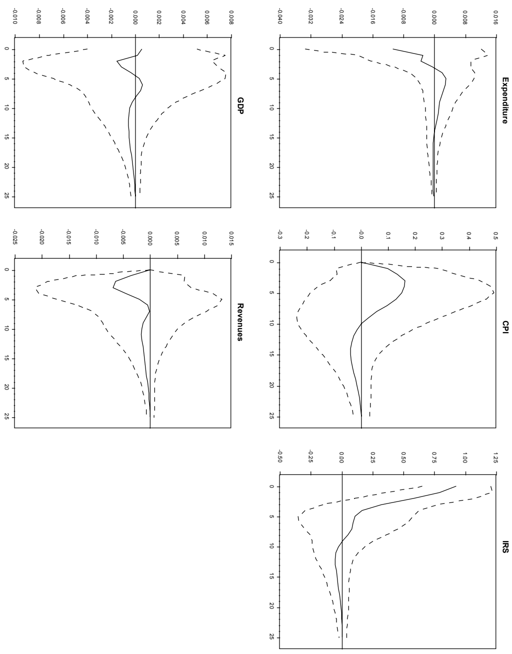


Impulse response to inflationary shock.

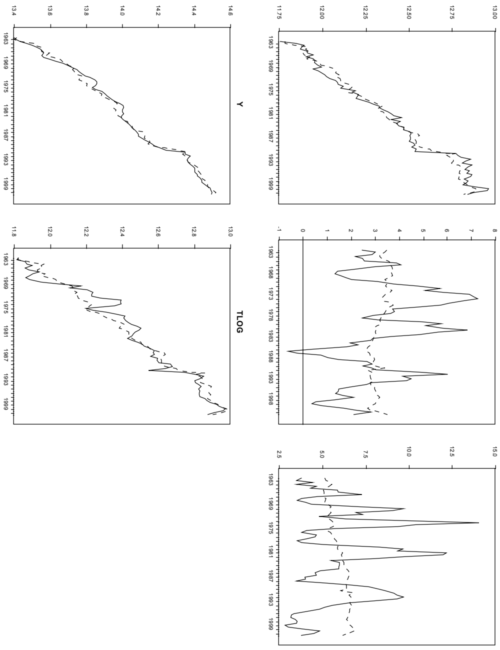
Fig. 2c. Japan (Figures report dynamic impulse responses and the 95% asymptotic error bounds).



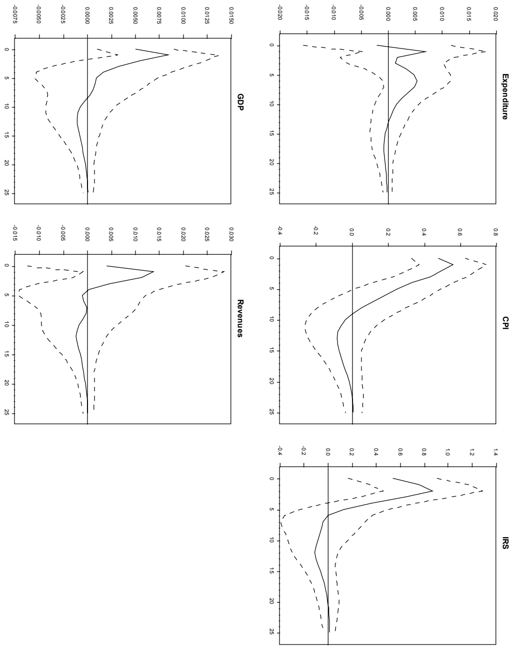
Impulse response to business cycle shock.



Impulse response to budgetary shock.

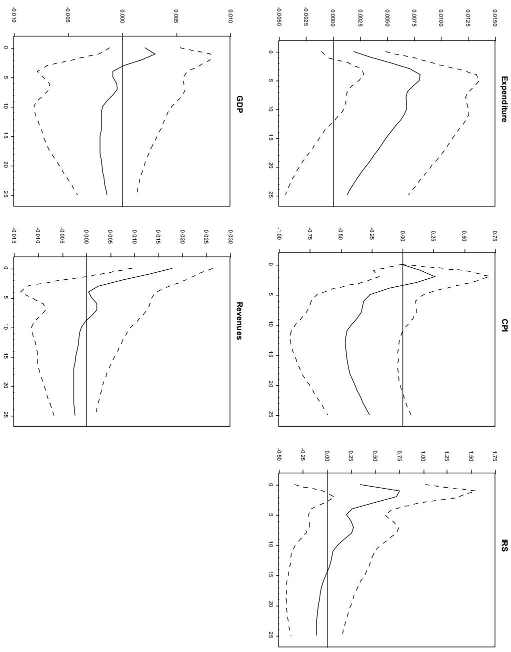


Series (——) and permanent components (- - -).



Impulse response to inflationary shock.

Fig. 2d. Germany (Figures report dynamic impulse responses and the 95% asymptotic error bounds).



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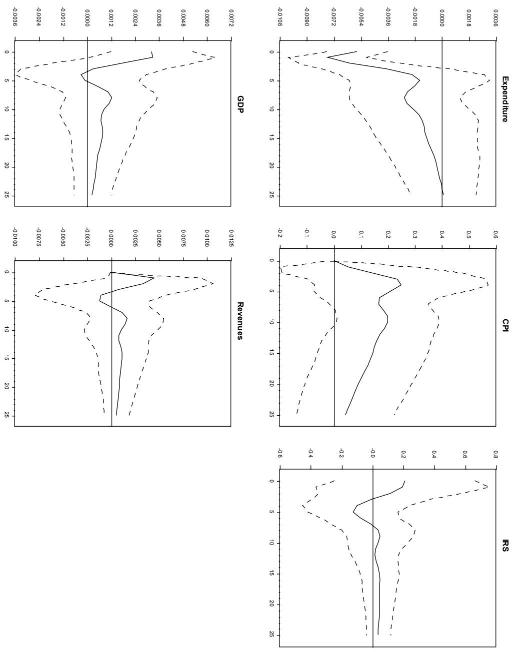
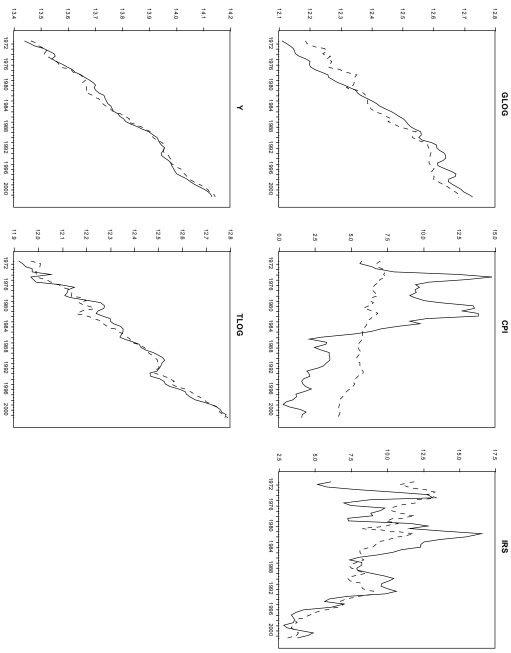
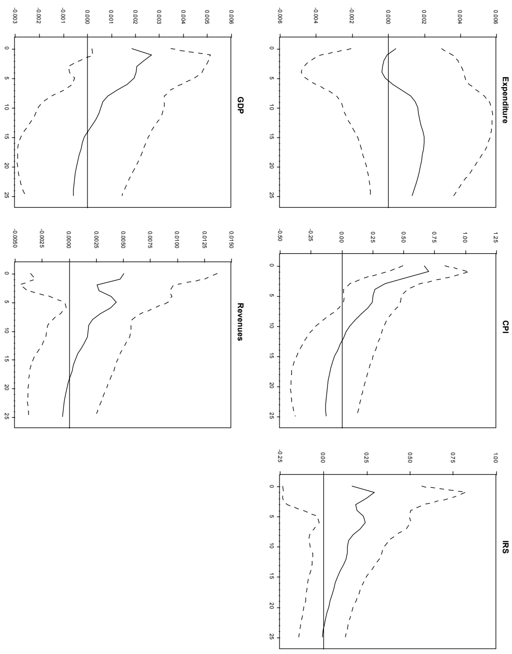


Impulse response to budgetary shock.

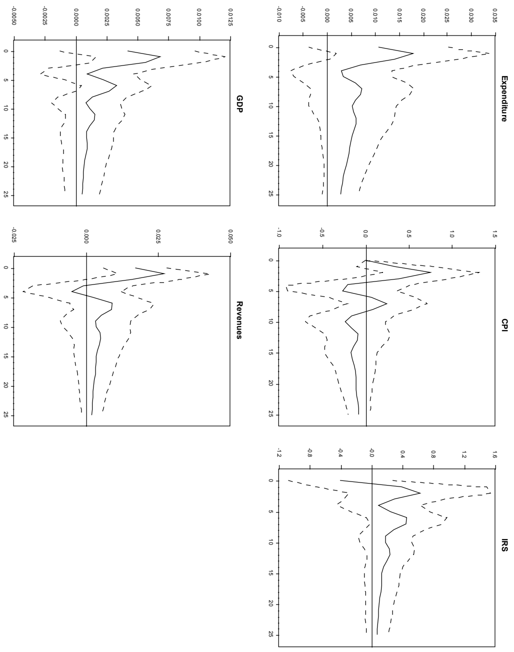


Series (——) and permanent components (- - -).



Impulse response to inflationary shock.

Fig. 2e. France (Figures report dynamic impulse responses and the 95% asymptotic error bounds).



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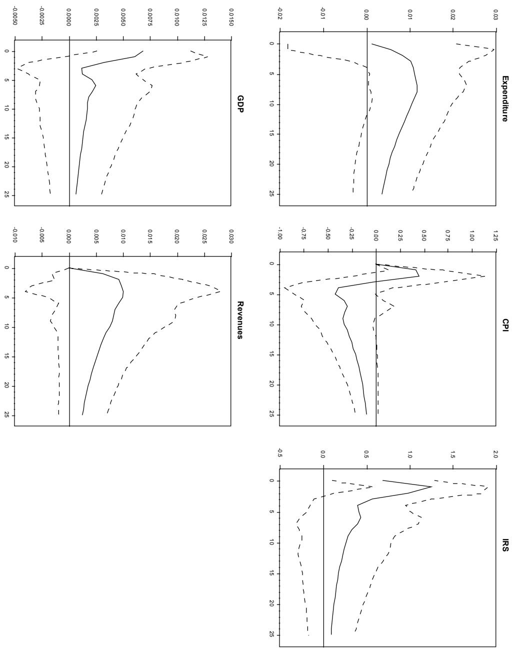

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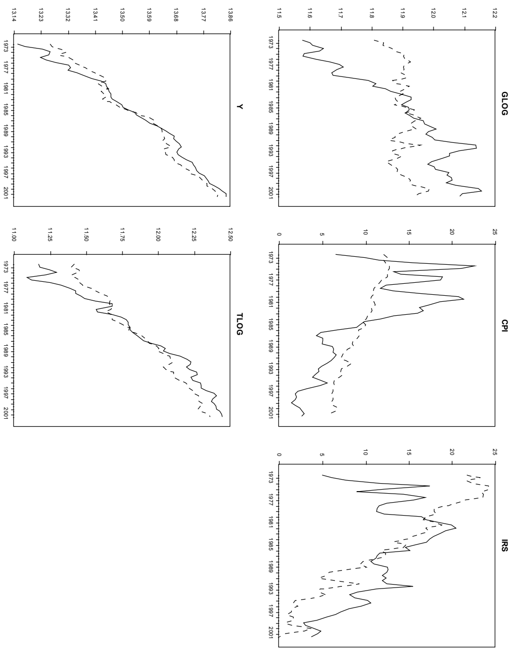
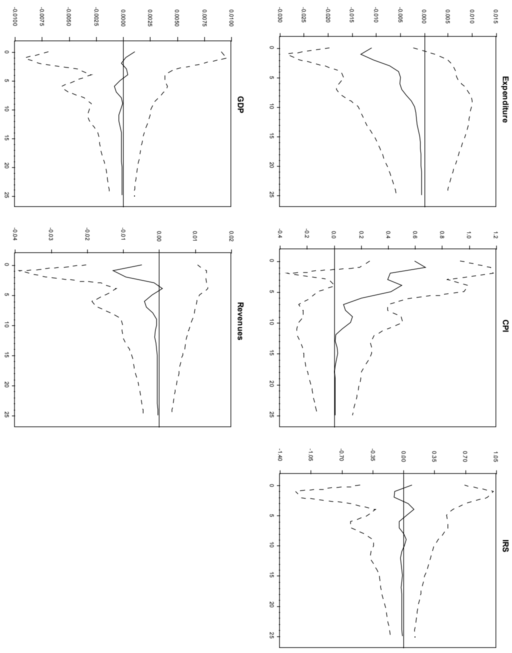
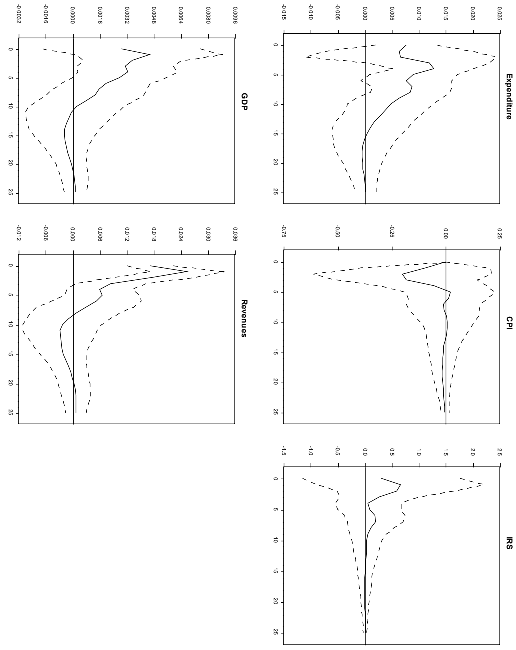


Series (——) and permanent components (- - -).



Impulse response to inflationary shock.

Fig. 2f. Italy (Figures report dynamic impulse responses and the 95% asymptotic error bounds).



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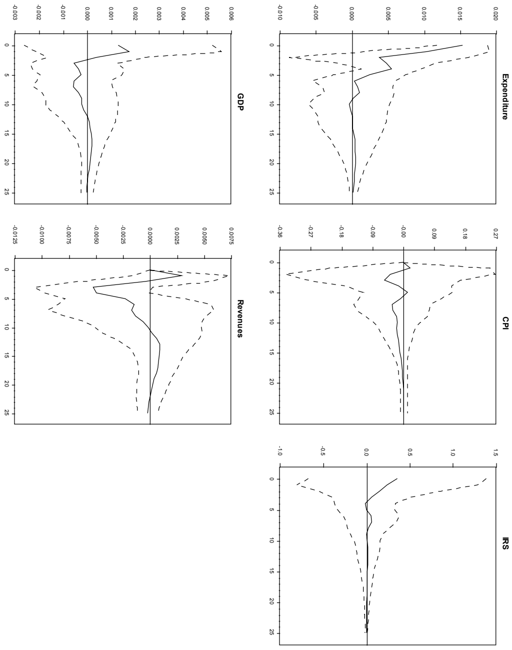

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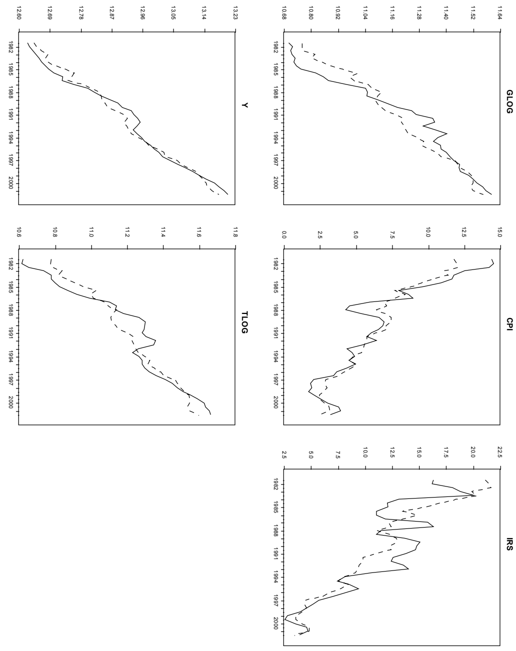
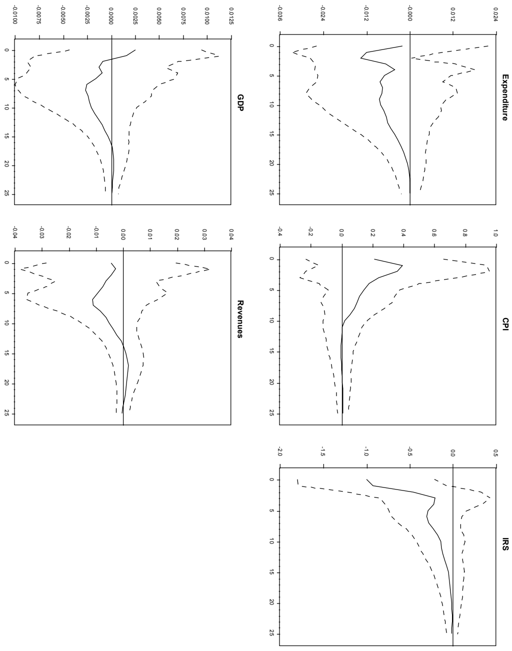
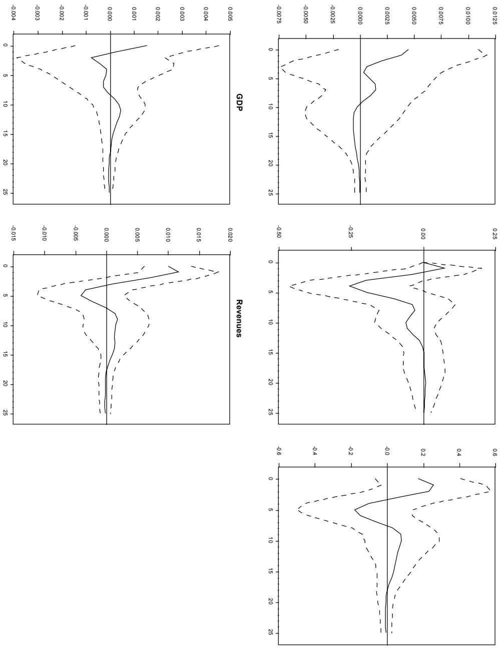


Series (——) and permanent components (- - -).



Impulse response to inflationary shock.

Fig. 2g. Spain (Figures report dynamic impulse responses and the 95% asymptotic error bounds).



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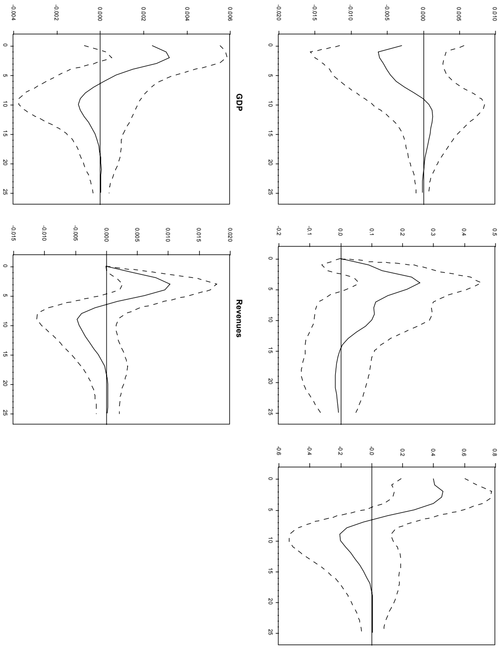

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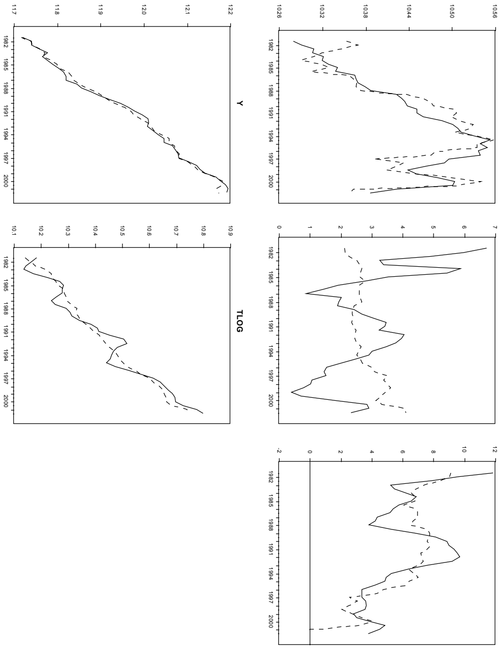
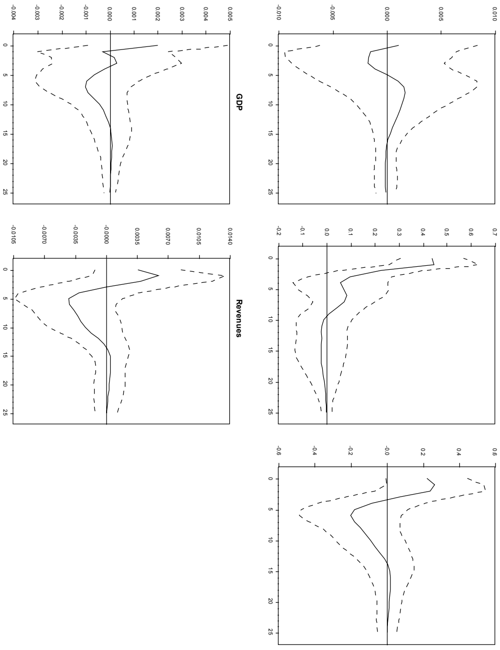
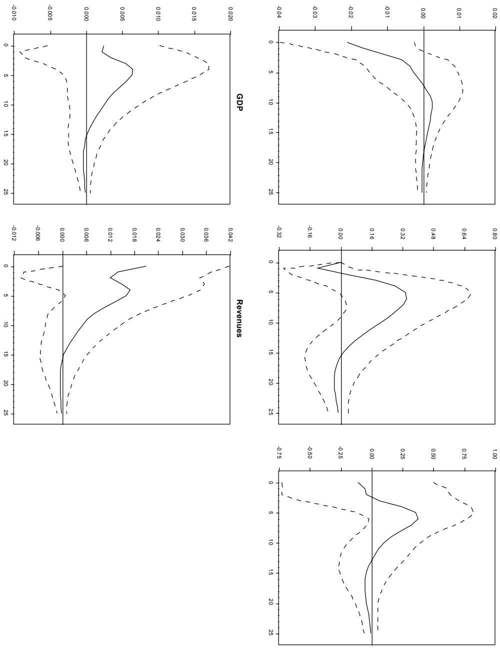


Series (——) and permanent components (- - -).

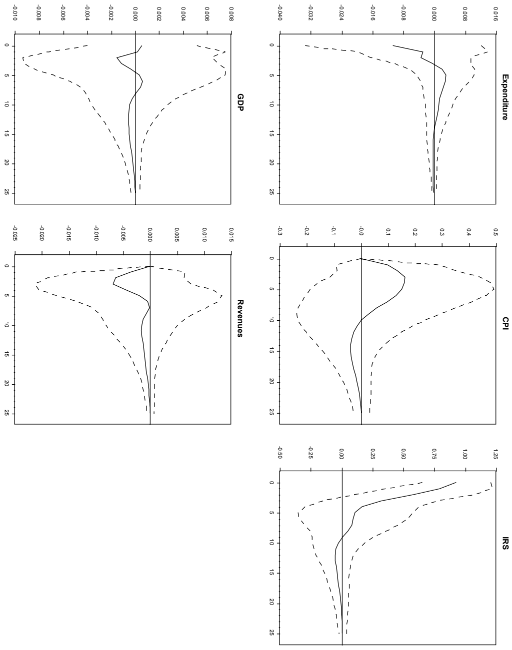


Impulse response to inflationary shock.

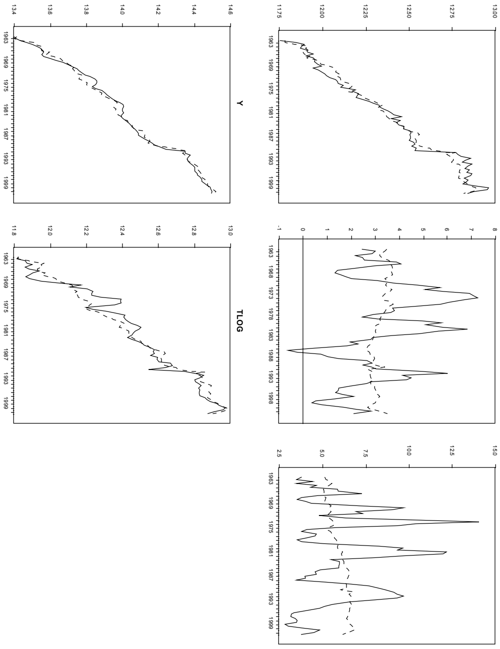
Fig. 2h. Austria (Figures report dynamic impulse responses and the 95% asymptotic error bounds).



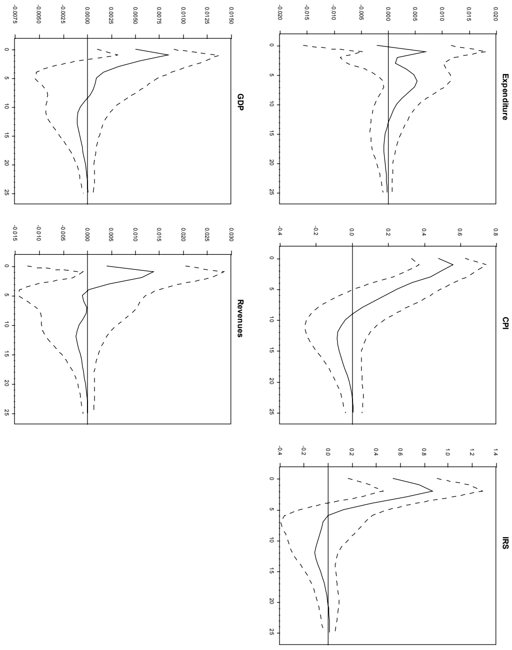
Impulse response to business cycle shock.



Impulse response to budgetary shock.



Series (——) and permanent components (- - -).



Impulse response to inflationary shock.

Fig. 2i. Netherlands (Figures report dynamic impulse responses and the 95% asymptotic error bounds).

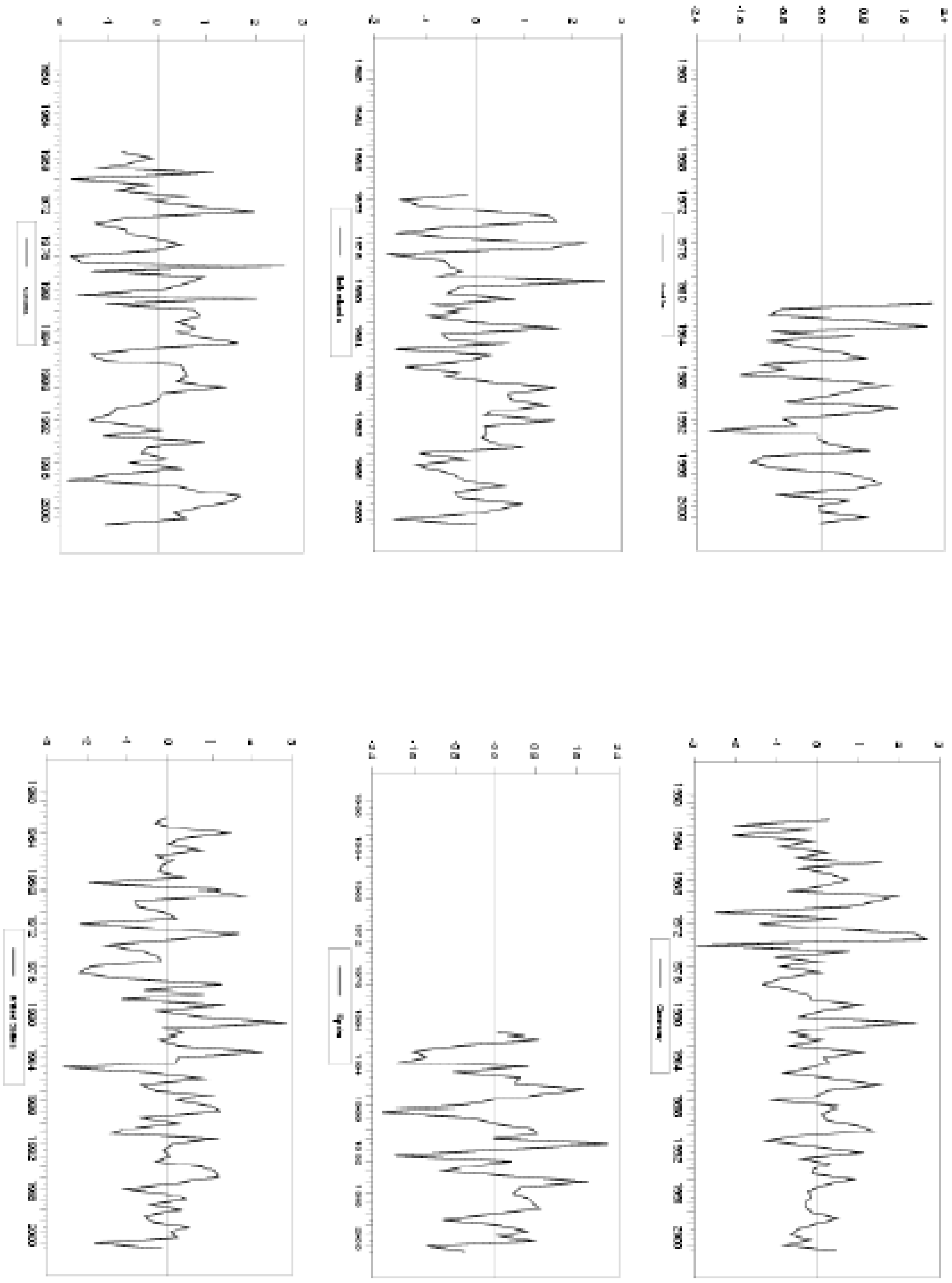


Fig. 3a. Structural budgetary policy shocks.

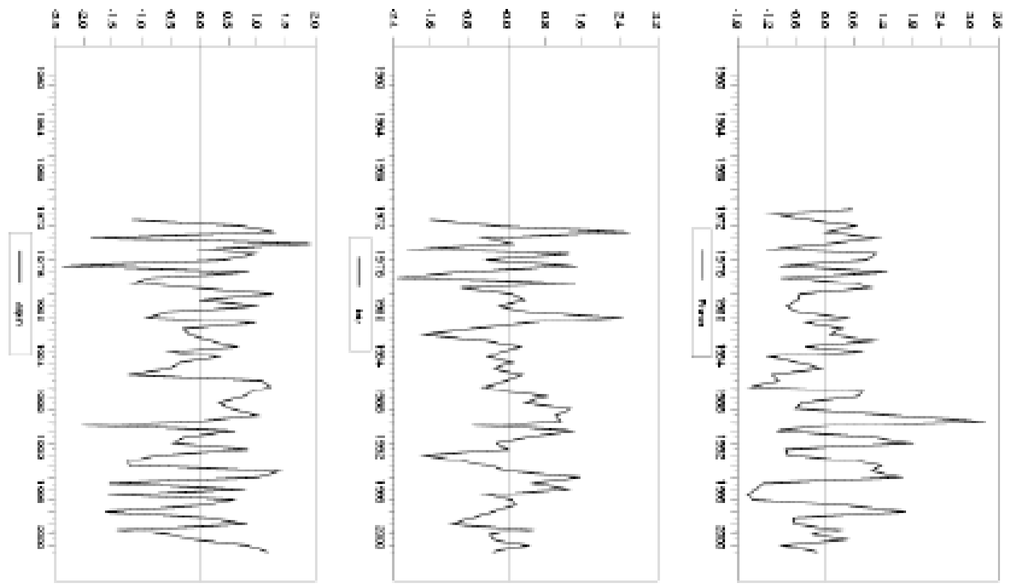


Fig. 3b. Structural budgetary policy shocks.