Fiscal Shocks and The Real Exchange Rate*

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Abstract

We estimate the impact of shocks to government spending on the real exchange rate for a panel of EMU member countries. Our key finding is that the impact differs across different types of government spending, with shocks to public investment generating a larger and more persistent impact on the real exchange rate than shocks to government consumption. Within the latter category, we also show that the impact of shocks to the wage component of government consumption is larger than for shocks to the non-wage component.

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1 Introduction

The aim of this paper is to study the effects of government spending shocks on the real exchange rate in member countries of the euro area. Although this question seems simple, the literature finds difficult to reconcile these effects in theoretical and empirical grounds.

From the theoretical point of view, contrasting implications of a positive shock to government spending are found. On the one side, neoclassical models predict an increase in output and a negative wealth effect. The latter is produced because agents foresee that they will be taxed in order to finance the increase in public spending. This generates an increase in the current labour supply, a decrease in real wages, a decrease in private consumption and a depreciation of the real exchange rate. On the other side, the implications of Neo-Keynesian models with nominal rigidities are different. Government spending shocks increase labour demand, real wages, private consumption and output. That is, these shocks produce demand side effects and are associated with real appreciation.

Accordingly, an important branch of the recent empirical literature on fiscal policy has focused on whether fiscal shocks generate real depreciation or real appreciation. The evidence is mixed: Monacelli and Perotti (2006) and Ravn et al. (2007) find that a shock to government consumption produces real depreciation, while Beetsma et al. (2008) show that a shock to government absorption is associated with real appreciation. We seek to contribute to this literature by inspecting whether the impact of fiscal shocks differs across different types of government spending. We

This paper estimates a panel VAR for eleven EMU countries in order to analyse the relation between government spending and real exchange rate. The closest study to ours is Beetsma et al. (2008), which estimates a six-variable panel VAR using fourteen EU countries. However, we innovate along two dimensions. First, we estimate a more parsimonious three-variable system (government spending, output and the real exchange rate). Second, we highlight that the impact of government spending may differ across its components. Accordingly, we allow public investment to operate differently to government consumption. Furthermore, within the latter category, we permit differences between its wage and non-wage components.

We find that a shock to total government absorption appreciates the real exchange rate. Moreover, we identify differences across the components of government spending, with shocks to public investment generating a larger and more persistent impact on the real exchange rate than shocks to government consumption. Within the latter category, we also show that the impact of shocks to the wage component of government consumption is larger than for shocks to the non-wage component. These results carry over to different measures of the real exchange rate and to the relative price of nontradables.

However, when we estimate the model on a different set of countries (the four-country panel of Australia, Canada, United Kingdom and United States that has been studied by Monacelli and Perotti 2006 and Ravn et al. 2007), we find that fiscal shocks are associated with real depreciation. We view this difference in results as emanating from the different types of exchange rate regime across the two panels: real appreciation tends to occur in a panel of countries characterised by fixed nominal exchange rates, while real depreciation tends to occur in a panel of countries that are characterised by floating nominal exchange rates.

The reminder of the paper is organized as follows: In Section 2 we make an extensive description of the dataset and the method to construct variables as deviations from the other EMU members. Section 3 presents the strategy to identify exogenous spending shocks. In Section 4, we present the baseline estimations and study the responses to shocks in different types of government spending. Section 5 presents different robustness checks of the baseline results. In Section 6, we study the responses of alternative real exchange rates and the relative price of nontradables. Section 7, compares our results to those produced by a different set of countries. Finally, in Section 8, we conclude.

2 Data

The literature dealing with fiscal shocks has considered a range of different measures of government spending.[1] Most papers have focused on government consumption, whether in the aggregate (Blanchard and Perotti 2002, Monacelli and Perotti 2006) or subcomponents (Monacelli and Perotti 2008 focus on non-wage government consumption, while Cavallo 2005, 2007 studies wage government consumption and Giordano et al 2007 compare the effects of wage and non-wage government consumption). Beetsma et al (2006, 2008) provide an important exception, by analysing total government absorption and also the individual public investment and public consumption subcomponents.

We adopt a general approach and consider five measures of government spending: total government absorption (the sum of total government consumption and government fixed investment); government fixed investment; government consumption; wage government consumption; and non-wage government consumption. The time span of our data is 1970 to 2006 and the frequency is annual.

Since we are interested in the effect of government spending shocks on the real exchange rate of advanced countries with a common exchange rate regime, we study eleven EMU countries. We exclude Luxembourg for two reasons: limited availability of fiscal variables and no data for real effective exchange rate vis-à-vis the rest of the EMU. The European Commission publishes, however, this variable for Belgium and Luxembourg together. We take this combined measure as a proxy for the real effective exchange rate of Belgium.

[1]Government spending has three components: government consumption, government investment and transfers (welfare payments, pensions). Since transfers just redistribute spending across private citizens, it should not have a first-order short run impact on macroeconomic variables and we exclude that component from the analysis that follows.

The source for almost all of these variables is the OECD Economic Outlook No 82. The only exception is government fixed investment for Greece, where we use national sources.[2] Since we are interested in the effect of real government spending, we use government deflators instead of GDP deflators.[3] Each fiscal variable is deflated with its own deflator, which the exception of non-wage government consumption for which we use the deflator of total government consumption.

Although data coverage is good, we do not include government wage consumption for Belgium between 1970 and 1975, Germany in 1970 and Portugal between 1970 and 1977. The latter country also lacks data for total government consumption and government fixed investment for the same period. Germany also lacks total government consumption for 1970.[4]

The second variable used in our baseline model is gross domestic product in constant local currency units. The source of this variable is also the OECD Economic Outlook. The last variable in our baseline estimations is the CPI-based real effective exchange rate vis-à-vis the rest of the EMU, published by the European Commission. Alternative real effective exchange rate measures from the same source (GDP- and NULC-based real effective exchange rates), are used in Section 6. We take these to assess how different real exchange rates, which are based on price deflators with dissimilar shares of domestic prices, respond to government spending shocks.

2.1 Database in relative terms

Since we are interested in evaluating how fiscal policy deviations affect real exchange rates among the EMU countries, we construct a set of indices which measure the deviations of our variables of interest from the rest-of-EMU countries.[5] To this end, we define I as an index that measures the deviations of the variable of interest from the rest-of-EMU countries. This index evolves as follows:

$$I_{i,t} = I_{i,t-1} * \frac{Z_{i,t}}{Z_{i,t-1}}, \tag{1}$$

where

$$\frac{Z_{i,t}}{Z_{i,t-1}} = \frac{X_{i,t}}{X_{i,t-1}} - \frac{X_{i,t}^{EMU}}{X_{i,t-1}^{EMU}}. \tag{2}$$

[2]The author would like to thank George Tavlas for providing these data.

[3]It is worth mentioning that fiscal variables deflated with GDP deflator can generate positive effects on output and employment (Monacelli and Perotti 2006).

[4]Data from West Germany and Germany are combined by splicing growth rates in 1991.

[5]This step is not carried out by Beetsma et al (2006), which examined the impact of country-level variables on the real exchange rate. However, these authors do include time dummies, such that the country-level variables can be intepreted as deviations from the global mean. In contrast, we construct a different "rest of the world" for each country in the panel, in line with variation in trade weights.

The subindex i stands for home country and subindex j for EMU countries different than i. $X_{i,t}$ is the real value of the considered spending variable or real GDP of country i at time t and $X_{i,t}^{EMU}$ is the same variable for the other EMU countries. The last term of (2) is defined as

$$\frac{X_{i,t}^{EMU}}{X_{i,t-1}^{EMU}} \equiv \prod_{j \neq i} \left(\frac{X_{j,t}}{X_{j,t-1}} \right)^{\omega_{ij}}. \tag{3}$$

From here onwards, we will refer to the expression in (3) as the *benchmark*. ω_{ij} is the time invariant trade weight of country j in country i and it is given by

$$\omega_{ij} = \frac{\Sigma_{t=t_0}^{T}(EXP_{ij,t} + IMP_{ij,t})}{\Sigma_{t=t_0}^{T}(EXP_{i,t} + IMP_{i,t})}.^{6} \tag{4}$$

$EXP_{ij,t}$ are nominal exports from country i to country j in period t and $IMP_{ij,t}$ are nominal imports of country i from country j in period t.[7] Both are measured in current U.S. dollars. $EXP_{i,t}$ represents total exports of country i to the EMU in period t while $IMP_{i,t}$ stands for total imports of country i from the EMU in period t. We set t_0=1971 and T=2006. For years where X_t is not available, like for example fiscal variables in Portugal between 1970 and 1977, we set ω_{ij} to zero and re-normalize.

The reason for using trade weights instead of GDP weights lies in the fact that trade spillovers from discretionary fiscal policy are found to be important in EU countries.[8] Moreover, trade weights are more consistent with the third variable of our model; the real effective exchange rate.[9] Trade weights together with the alternative GDP weights are reported in Table 1.

3 Shock identification

As is highlighted in Beetsma (2008), the literature has followed two strategies to identify exogenous and unexpected fiscal shocks. The first one is to take events for which it is reasonable to assume that they are exogenous and unexpected. This is the 'narrative' or 'Dummy Variable' approach (Ramey and Shapiro 1998; Edelberg et al. 1999; Burnside et al. 2004 and Romer and Romer 2007).

The second strategy is to identify shocks imposing structural restrictions. Identification strategies within this set vary with the frequency of the data. Most studies using non-interpolated

[6] Since these trade weights are very stable in the 1970 to 2006 period, there is no significant change in the results by considering either $\omega_{ij,t}$ or ω_{ij}.

[7] The source of these data is the Direction of Trade Statistics (DOTS) of the International Monetary Fund.

[8] See Beetsma et al. (2006).

[9] Trade weights used in the real effective exchange rate published by the European Commission are not exactly the same as those used in the benchmark variable. The former retrospectively includes Slovenia as an EMU country, while we exclude Slovenia from the output and fiscal measures, since its inclusion would be problematic in terms of data availability prior to the mid 1990s.

quarterly data identify fiscal shocks using the procedure developed by Blanchard and Perotti (2002) and Perotti (2004). This method decouples the cyclical and the discretionary component of fiscal policy assuming that systematic discretionary responses of fiscal variables are absent in quarterly data. To do this, they make use of country-by-country elasticities available from the OECD (2005) of the various components of net taxes with respect to output.

However, high-quality quarterly data are not available for many countries and restricting attention to only those countries that report quarterly data may skew empirical analysis, since those countries may also be distinctive along other dimensions. Accordingly, we opt to employ annual data and a different identification strategy. Moreover, the use of annual data has some advantages, as highlighted by Beetsma et al. (2008). First, shocks are closer to what a real fiscal shock is, since fiscal policy is not substantially revised within a year. Second, the use of annual data reduces the role of anticipation effects.[10]

In terms of identification strategies with annual data, the available options (besides the structural approach based on short- or long-run restrictions or a combination of these two) are sign restrictions or Choleski decomposition. In the first case, the identification is pursued by constraining the cross-correlation function in response to shocks to assign structural interpretation to orthogonal innovations. This method is used by Mountford and Uhlig (2008) and Canova and Pappa (2007) to identify fiscal shocks.

As in Beetsma et al. (2006, 2008), we use the Choleski decomposition. The reason for this choice is the fact that using sign constraints in the context of our model would imply to impose a sign for a certain number of periods to the correlation between government spending deviations and the real growth differential, leaving the response of the real effective exchange rate unconstrained. Here, rather than relying on this data-driven approach to identify spending shocks, we assume that some variables are not allowed to react contemporaneously to shocks in others.

Our three-variables structural model in companion form can be written as follows

[10]Blanchard and Perotti (2002) test the existence of anticipated fiscal policy with future values of estimated fiscal shocks using quarterly frequency. To this end, they include future values of a dummy variable that measures fiscal shocks in their empirical model. They show that anticipation effects are not important in the United States. Studies suggesting the existence of anticipation effects find that fiscal policy may be anticipated one or two quarters in advance. Using a new variable based on narrative evidence that improves the Ramey-Shapiro military dates, Ramey (2008) shows the existence of anticipation effects that produce qualitative changes in the responses of consumption and real wages. To show this, she performs different Granger causality tests between the war dates and the VAR shocks. The latter were defined as the residual of a dynamic empirical model in which up to four lags of the dependent variable are included.In our dataset, the presence of anticipation effects could be tested by checking whether output differentials or the real exchange rate Granger causes future values of the government spending VAR shocks. Another strategy would be the implementation of tests similar to those used by Ramey (2008). However, this is not possible in our dataset because series of government spending shocks identified with the narrative approach are only available for the United States. Since we use annual frequency any anticipation of policy changes that are further than two quarters into the future becomes less likely. Finally, the use of annual data makes seasonal effects to be less important than in quarterly data. The reason for this is that seasonal changes in fiscal variables are less likely to have cycles that last more than one year.

$$A_0 Z_{i,t} = A(L)Z_{i,t-1} + CX_{i,t} + \varepsilon_{i,t}. \tag{5}$$

$Z_{i,t}$ is a vector of endogenous variables containing: the government spending differential from the rest-of-EMU countries ($\mathrm{g}_{i,t}$), the real GDP differential ($\mathrm{y}_{i,t}$) and the real effective exchange rate ($\mathrm{e}_{i,t}$). All these variables are in log levels. $X_{i,t}$ is a vector with the country-specific intercepts (c_i), country-specific linear trends ($\mathrm{t}_{i,t}$) and year dummies (d_t). Subscripts i and t denote the country and the year. Matrix A_0 captures the contemporaneous relations between the endogenous variables. Matrix $A(L)$, is the matrix polynomial in the lag operator L that captures the relation between the endogenous variables and their lags. Matrix C contains the coefficients of the country fixed effects, the country-specific linear trends and the time fixed effects. The vector $\varepsilon_{i,t}$, contains the orthogonal structural shocks to each equation of the VAR and $\mathrm{var}(\varepsilon_{i,t}) = \Omega$. Thus,

$$Z_{i,t} = \begin{bmatrix} \mathrm{g}_{i,t} \\ \mathrm{y}_{i,t} \\ \mathrm{e}_{i,t} \end{bmatrix} \quad A_0 = \begin{pmatrix} 1 & -\alpha_{\mathrm{yg}} & -\alpha_{\mathrm{eg}} \\ -\alpha_{\mathrm{gy}} & 1 & -\alpha_{\mathrm{ey}} \\ -\alpha_{\mathrm{ge}} & -\alpha_{\mathrm{ye}} & 1 \end{pmatrix} \quad X_{i,t} = \begin{bmatrix} \mathrm{c}_i \\ \mathrm{t}_{i,t} \\ \mathrm{d}_t \end{bmatrix} \quad \varepsilon_{i,t} = \begin{bmatrix} \varepsilon^{\mathrm{g}}_{i,t} \\ \varepsilon^{\mathrm{y}}_{i,t} \\ \varepsilon^{\mathrm{e}}_{i,t} \end{bmatrix}.$$

Premultiplying (5) by A_0^{-1} we obtain our model in reduced-form,

$$Z_{i,t} = B(L)Z_{i,t-1} + DX_{i,t} + u_{i,t}; \tag{6}$$

where $B(L) = A_0^{-1}A(L)$, $D = A_0^{-1}C$, $u_{i,t} = A_0^{-1}\varepsilon_{i,t}$, $u_{i,t} = \begin{bmatrix} u^{\mathrm{g}}_{i,t} & u^{\mathrm{y}}_{i,t} & u^{\mathrm{e}}_{i,t} \end{bmatrix}'$ and $\mathrm{var}(u_{i,t}) = \Sigma$.

In order to recover $\varepsilon_{i,t}$ and Ω from the reduced-form, we impose $\alpha_{\mathrm{yg}} = \alpha_{\mathrm{eg}} = \alpha_{\mathrm{ey}} = 0$ to matrix A_0. Therefore, the structural shocks are given by

$$\begin{bmatrix} \varepsilon^{\mathrm{g}}_{i,t} \\ \varepsilon^{\mathrm{y}}_{i,t} \\ \varepsilon^{\mathrm{e}}_{i,t} \end{bmatrix} = \begin{pmatrix} 1 & 0 & 0 \\ \alpha_{\mathrm{gy}} & 1 & 0 \\ \alpha_{\mathrm{ge}} + \alpha_{\mathrm{ye}}\alpha_{\mathrm{gy}} & \alpha_{\mathrm{ye}} & 1 \end{pmatrix} \begin{bmatrix} u^{\mathrm{g}}_{i,t} \\ u^{\mathrm{y}}_{i,t} \\ u^{\mathrm{e}}_{i,t} \end{bmatrix}.$$

Imposing these restrictions is equivalent to assume that fiscal spending deviation from the rest of the EMU countries does not react contemporaneously to shocks in the real GDP differentials or the real exchange rate and; that the real GDP differential does not react contemporaneously to shocks in real exchange rate. Therefore, the Choleski ordering to identify shocks is: government spending deviations, GDP differential and real effective exchange rate.

These identification assumptions are in line with papers dealing with the effects of discretionary fiscal shocks in the sense that we order g before y. This ordering is motivated by the fact that government spending is planned before the period starts. Moreover, Beetsma et al. (2006)

estimate a panel VAR in public spending (g) and output (y) for seven EU countries with non-interpolated quarterly fiscal data assuming that g does not react to y within a quarter. From these results they construct an estimate of the response of public spending to output at annual frequency finding that it is not significantly different from zero.

4 Baseline empirical model

4.1 Estimation approach

We estimate the three equations of our system independently using least squares in RATS. To deal with country-specific heterogeneity we include country fixed effects (c_i) and country-specific linear trends ($t_{i,t}$). The latter is used because many variables, even if they are defined as deviations from the other EMU members, show trending behaviour at the individual country level. Although all variables are defined as deviations from the rest of the EMU, the use of fixed trade weights may produce common fluctuations across countries. To control for this and to eliminate cross-country contemporaneous residual correlation, we include time fixed effects (d_t).

Nickell (1981) and Arellano (2003) show that the introduction of lagged regressors in panels with fixed effects induce serial correlation between the residuals and future values of the regressors. When the time dimension of the panel is fixed and the cross-section dimension tends to infinity, this correlation produces a bias in the coefficient of the lagged dependent variable. Our panel has eleven EMU countries and annual data for the period 1970 to 2006. This means that if present, biases in the coefficients may be small. We set the lag length of each model to two according to the Akaike Information Criterion, Schwarz Bayesian Information Criterion and the absence of first-order autocorrelation, tested with the Durbin-Watson statistic. However, it is important to mention that the latter statistic may not be the appropriate test for first order serial autocorrelation in panels with fixed effects. This is because these country-specific intercepts induce serial correlation between the residuals and the future values of the regressors.[11]

As previously mentioned, we estimate panel VARs for five types of government spending. Following Beetsma et al. (2001, 2008), we define GEXP (government absorption) as the sum of total government consumption (GC) and government fixed investment (GINV). Perotti (2007b) shows that government investment and government consumption have dissimilar effects on GDP. Taking this into account and since the distribution of the GDP increase determines the response of the real exchange rate, we also study the dynamic effects of positive shocks in these two variables. Furthermore, in the same way as Cavallo (2005, 2007) and Giordano et al. (2007), we break down total government consumption into wage (WGC) and non-wage

[11] For possible alternatives see Baltagi et al. (2007).

(NWGC) consumption.

In Table 2 and Figure 1, we present the real exchange rate and GDP differential responses to a shock to government spending deviation equivalent in magnitude to 1 percent of GDP. To scale the responses we take the cross-country average of the government expenditure to GDP ratio for the period 1970 to 2006. For these EMU countries, this ratio is equal to 22 percent. The shares of government investment, total government consumption, wage and non-wage government consumption in GDP are 3.2, 18.8, 11.2 and 7.6 percent, respectively.

In order to derive the 16th and 84th percentiles of the impulse-response distribution in the figures, we perform Monte Carlo simulations and assume that the parameter distribution is normal. Hence, the mean of the impulse response minus/plus one standard deviation corresponds to the 16th and 84th percentiles of its distribution, respectively. Taking this into account, we use this information to construct several t-tests and show whether the point estimates of the mean impulse-responses are statistically different from zero in Tables 2 and 4.

4.2 Impulse-response analysis

4.2.1 government absorption

A 1 percent of GDP shock to government absorption produces a 0.95 percent increase in the GDP differential on impact. This effect is statistically significant at 1 percent. The peak is found one year after the shock when the GDP differential reaches 1.36 percent. From year one onwards, this effect starts vanishing and becomes statistically insignificant in year seven. This spending shock appreciates the real effective exchange rate on impact by 1.04 percent and also in the subsequent six years. The peak appreciation is in year two with a value of 1.47 percent. This response is statistically significant up to year six.

These qualitative results are in line with the findings of Beetsma et al. (2008). The main difference is that the real exchange rate does not show an impact appreciation in their empirical model. As in our case, the maximum appreciation is between year one and three. Since we define all variables as deviations from the rest-of-EMU trend and we use eleven EMU countries, instead of fourteen EU, it is not possible to directly compare their quantitative results to ours.

4.2.2 Government investments vs. government consumption

Shocks of 1 percent of GDP in government investment or government consumption increase the GDP differential. For the first case, the response is larger and significant for a longer period. Both appreciate the exchange rate on impact: a shock to government investment produces a real appreciation of 1.23 percent while a shock to government consumption appreciates the exchange rate by 1.48 percent.

Shocks in government investment produce larger and more persistent exchange rate responses than shocks in government consumption. In the latter, the real appreciation vanishes from year five onwards. Government investment generates the largest real appreciation across all definitions of government spending. The peak appreciation produced by this shock is 3.49 percent in year three. Furthermore, the point estimate of the mean response is statistically significant along the whole impulse-response horizon.

4.2.3 Government consumption: wage vs. non-wage elements

When government consumption is broken down into the wage and non-wage components, a shock to the latter increases the GDP differential by 0.5 percent to 0.93 percent while a shock to the former does not have a statistically significant effect on this variable.

The real exchange rate response is positive and statistically significant for both shocks. In the non-wage case, it is significant at 10 percent and equivalent to 0.8 and 1.01 percent appreciation in year zero and year one. A shock to government wages produces a larger and more persistent exchange rate response. The impact is equal to a 1.07 appreciation while the peak, in year two, equals to 1.92 percent.

4.3 Variance decomposition

Next, we study the contribution of structural innovations to the h-step ahead forecast error variance. This exercise gives information on the relative power of each shock to explaining the forecast error variance of the equations in the VARs at different forecast horizons. Therefore, it is complementary to the impulse-response analysis presented previously. Since we are interested only in the proportion of forecast error variance attributable to each shock, we do not report the size of these standard errors.

In what follows, we examine the contribution of structural innovations in government spending to the forecast error variance of the exchange rate equation. Accordingly, Figure 2 shows that the forecast error variance attributable to a shock to government absorption ranges between 3.0 and 5.8 percent.[12] Between h=1 and h=6 this proportion grows and from h=7 onwards it stabilizes around 5.8 percent.

Consistently with the impulse-response analysis, government investment explains the largest proportion of the forecast error variance in the real exchange rate equation. For the first two steps, the variance attributable to this shock is less that 5 percent. However, from h=3 onwards, this share grows and stabilizes at 34.7 percent after h=8.

The forecast error variance attributable to government consumption is the second largest. Between h=4 and h=10, it accounts for 14 percent of the total variance. After government investment and consumption, a shock to government wages explains the largest proportion in later years. From h=3 onwards, 13.7 percent of the forecast errors variance in the real exchange

[12]Figure 2 shows the proportion of the forecast error variance attributable to a shock in two of the three endogenous variables, for all the equations and VARs. That is, if the equation is GDP, we show the share of variance attributable to a shock in government spending and real exchange rate.

rate equation is attributable to this shock. In line with our previous results, non-wage government consumption explains the smallest proportion of forecast error. The shares of forecast error variance attributable to this shock are between 0.8 and 1.06 percent.

For the case of the GDP equation, the largest proportion of forecast error variance is attributable to shock to government investment. This is on average 12 percent of the forecast error variance of this equation. In the second place, we find a government absorption explaining between 4 and 9 percent of the forecast error variance. On the other extreme, the least proportion is attributable to a shock to wage government consumption. This is close to zero along the whole forecast horizon.

4.4 Summary

A 1 percent of GDP shock to each definition of government spending, measured as deviation from the rest-of-EMU trend, appreciates the real effective exchange rate. The magnitude and persistence differs from case to case. The largest impact response is produced by a shock to total government consumption, followed by a shock to government investment and then by a shock to government absorption. An investment shock produces the largest and the most persistent effect on the real exchange rate. When government consumption is broken down into the wage and non-wage component, the former produces real appreciation while the latter does not.

5 Robustness checks

In order to check the robustness of our results, we follow five different strategies. First, we estimate each panel VAR excluding one country member at a time and constructing variables relative to a different benchmark, to see if there are single countries driving the results of the whole panel. In this exercise, the rest-of-EMU benchmark is made of the other nine rather than ten EMU countries.

Figure 3 shows the mean real exchange rate responses to a 1 percent of GDP shock to each government spending. Thick black lines are the responses of the baseline model while thin gray lines are the responses excluding one country member at a time. This figure shows that baseline exchange rate responses are robust to this change in the dataset. However, the exclusion of some countries in some types of government spending produce quantitative differences.

When the shock is in government absorption, the exclusion of Ireland produces larger real appreciations for the first years. For a shock to government investment, we find that the exclusion of Belgium leads to larger responses from year four onwards. For a shock to government consumption, the exclusion of Ireland generates again a larger response in the first years and the exclusion of Greece, leads to more persistent real appreciation. Finally, when the shock is in government wages, the exclusion of Portugal or the Netherlands leads to greater real appreciations.

The second robustness check is to estimate a panel VAR including an additional endogenous variable which is defined as the difference between the total government absorption and one of the other four definitions of government spending analyzed in this paper. That is, when the variable is government investment, this additional variable is given by total government absorption minus government investment. For this case, this is equal to government consumption. We name this variable the 'complement government spending'.

Figure 4, 5 and Table 4 show the responses to shocks in government fixed investment, government consumption, wage and non-wage government consumption. The Choleski ordering to identify these shocks in Figure 4 is: government spending, the complement government spending, the GDP and finally the real exchange rate. Alternatively, Figure 5 presents the responses for the case in which the complement government spending variable is ordered first. This change in the specification does not change the responses the real exchange rate.[13]

Another strategy to check the robustness of our results is to estimate the baseline for a different period. Precisely, we take the pre-EMU years (i.e. from 1970 to 1998). We do this to check if this change in the exchange rate regime has affected the way in which the real exchange rate responds to shocks in government spending. Table 3 shows the statistically significant differences in the responses of the exchange rate and GDP for these two periods and Table 4 shows the exchange rate responses for the whole impulse-response horizon. We check whether the differences between the responses in these two periods are significant with t-tests that are based on the 1000 different responses generated by the Monte Carlo simulations for each year of the impulse-response horizon.

For all cases where impact GDP responses are statistically significant, the pre-EMU sample delivers larger responses. This difference changes sign from year two onwards. The exchange rate impact response for the pre-EMU period is also larger for all government spending. This negative difference last at least four periods in government absorption, five in investment and the whole impulse-response horizon in government wages. Although the responses are qualitatively similar, there is evidence that government spending shocks produced larger real appreciation in the period preceding the creation of the European Monetary Union; at least in government absorption, investment and wage consumption.

Since Perotti (2004) and Romer and Romer (2007) provide evidence showing that variance of fiscal policy shocks and their effects on GDP and consumption have declined after 1980, we also estimate each panel VAR for the period 1980 to 2006. Figure 7 shows the impulse-response functions of each endogenous variable to shocks in each definition of government spending. The point estimates of the mean exchange rate response, together with their significance, are also reported in Table 4.

[13]For a shock in government fixed investment, government total consumption and non-wage government consumption, the response of the complement government spending is positively correlated with the shock. In contrast, a shock in government wages is negatively correlated with this additional variable. This strong negative correlation explains why output does not increase as a result of a shock in wage government consumption.

This robustness check shows that the baseline responses are qualitatively robust to this change in the sample period, although real exchange rate responses become less persistent. Table 4 shows that the impact and peak response of the exchange rate to shocks in government absorption, government consumption, wage and non-wage government consumption are grater than in the baseline. Government investment produces a larger impact but smaller peak and less persistent response. In line with the evidence of the decline in the variance of fiscal shocks, point estimates of the mean response in this period are less significant.

Finally, we check if our baseline results are robust to the inclusion of the general consolidated gross debt as a ratio of GDP. Following Beetsma et al. (2008) we include the logarithm of the first two lags of this variable.[14] Figure 8 shows that our baseline responses are robust to this specification. As highlighted by Beetsma el al. (2008), this may be the result of the country-specific trends picking up the effects of movements in the debt-GDP ratios.

Although exchange rate responses are qualitatively similar, Table 4 shows that the inclusion of the debt feedback leads to a larger delayed appreciations to government absorption and government wages shocks. The real exchange response to a shock to government consumption is larger for the whole impulse-response horizon, when the debt feedback is included. For the case of a government investment shock, exchange rate impact and year one to four responses are smaller than in the baseline model.

6 Alternative relative price indices

6.1 Real exchange rates based on different price deflators

This section studies how exchange rate responses are affected by the use of deflators with different shares of domestic prices. To this end, we replace the CPI-based real effective exchange rate in each panel VAR by the GDP- and the NULC-based (nominal unit labor cost) real effective exchange rates, taken from the European Commission.

The use of these alternative exchange rate measures complements the study previously presented for the CPI-based real exchange rate. This is because the GDP-based real exchange rate measures the relative competitiveness between countries as a whole, since it depends on output prices. By contrast, the exchange rate based on nominal unit labour cost gives information on the relative competitiveness only in the labour markets. Moreover, by studying these we can show the role of price indices with different proportions of domestic prices in the exchange rate responses. The exchange rate based on the CPI deflator is the one with the least proportion of domestic prices, since it includes import prices. On the contrary, the nominal unit labor cost deflator has the largest share of domestic prices.

Figure 9 shows the responses of these exchange rates to a shock to each type of govern-

[14] The source for general government consolidated gross debt is AMECO.

ment spending of a magnitude equivalent to 1 percent of GDP. For a shock to government absorption, the exchange rates based on CPI or GDP deflators respond similarly. However, the NULC-based exchange rate response is different since it has the largest impact and it is the most persistent. As shown in Table 4, all responses to a shock to government absorption are statistically significant at least for the first five years. This result suggest that, in EMU countries, this shock appreciates more the exchange rate based on the largest share of domestic prices.

A shock to government investment produces close impact responses in the CPI- and GDP-based exchange rates. However, the latter gives the smallest real appreciation from year two onwards. After year one, the NULC- and CPI-based exchange rates appreciate similarly. When this exercise is done for government consumption, we find that the largest and the most persistent appreciation is in the NULC-based exchange rate. This result, together with the one of government investment, suggest that the largest and most persistent response in the NULC-based exchange rate as a result of a shock to government absorption, is produced by the government consumption subcomponent. In order of magnitude and persistence, the second largest response to a shock to government consumption is in the GDP-based exchange rate.

Finally, a shock to government wages produces the largest impact appreciation in the UNLC-based exchange rate. This is because this shock is associated with a labor demand shock. However, this response becomes the smallest after two years. Table 4, shows that these responses are significant for the first periods only, implying that the observed differences of the point estimates in latter years are not meaningful. Although presented for completeness in Figure 9, we omit the assessment of the shock to non-wage government consumption because these responses are not statistically significant.

6.2 Relative price of nontradables

We have shown that exchange rates based on deflators with different shares of domestic prices respond differently to shocks in government absorption, government investment and government consumption. In this line, since the relative price of nontradables plays an important role in the real exchange rate fluctuations, we study the response of the relative price of nontradables to these shocks. To this end, we replace the real effective exchange rate with the ratio of nontradable to tradable price indices, expressed in relative terms vis-à-vis trading partners.

As in the baseline model, the relative price of nontradables evolves following equation (1). That is, it moves according to the difference between the rates of change in relative price of nontradables in the considered countries and the rate of change in the benchmark. The latter is formed by the trade weighted average of the relative price of nontradables in the other EMU members. However, $\frac{Z_{i,t}}{Z_{i,t-1}}$ is now

$$\frac{Z_{i,t}}{Z_{i,t-1}} = \frac{\frac{P^{NT}_{i,t}}{P^{NT}_{i,t-1}}}{\frac{P^{T}_{i,t}}{P^{T}_{i,t-1}}} - \prod_{j \neq i} \left(\frac{\frac{P^{NT}_{j,t}}{P^{NT}_{j,t-1}}}{\frac{P^{T}_{j,t}}{P^{T}_{j,t-1}}} \right)^{\omega_{ij}} . \tag{7}$$

Similarly to equation (2), i stands for home country, j for the other EMU countries and ω_{ij} is a time invariant trade weight given by equation (4). P^{NT} and P^{T} are prices of nontradable and tradable goods, respectively. Following Lane and Milesi-Ferretti (2002), we construct proxies for P^{NT} and P^{T} using price indices of different sectors. We take these indices from the EU KLEMS dataset.

For P^{NT}, we take a value added weighted average of three different price indices: 'construction', 'hotels and restaurants' and 'community social and personal services'; while for P^{T}, we take the 'manufacturing' price index.

Figure 10 shows the responses to a spending shock equivalent to 1 percent of GDP for all government spending. As in the case where the real exchange rate is used, the relative price of nontradables increases after a spending shock to government absorption, government fixed investment and total government consumption. Shocks in non-wage and wage consumption do not produce statistically significant responses.

Although the impact effect is not significant, a shock to government investment produces the largest and the most persistent response in the relative price of nontradables. The peak is in year five with a value equivalent to 3.8 percent. In the second place, the largest response is produced by a shock to total government consumption with insignificant impact effects and a peak in year one equal to 1.24 percent. As shown in Figure 11 and 12, responses of the relative price of nontradables are robust to the introduction of the 'complement government spending', as additional endogenous variable. However, for a shock to total government consumption, the response of the relative price of nontradables is of smaller magnitude.

Taking the United States as a case study and defining government consumption as government consumption of intermediate goods and services plus compensation of government employees and defense spending on equipment and software, Monacelli and Perotti (2008) find similar results. A 1 percent of GDP shock to this variable produces an increase in relative price of nontradables with a maximum close to 1 percent in year one.

For the EMU, the sum of government fixed investment and total consumption (government absorption) produces also an increase in the relative price of nontradables. Although the impact effect is not significant, the peak response is in year three and equal to 1.05 percent. This result is in line with the findings of Monacelli and Perotti (2008). In contrast, shocks in wage and non-wage government consumption do not generate statistically significant responses.

Responses of the relative price of nontradables are qualitatively similar to those of the real exchange rate as a result of a shock to government investment and consumption. A positive deviation from the rest-of-EMU trend in government absorption, government investment or total government consumption produces an increase in the relative price of nontradables as well as a real exchange rate appreciation.

7 The Perotti sample

In contrast to our results, several papers find that shocks in government absorption or government consumption produce real depreciation.[15] These studies, use countries for which non-interpolated quarterly fiscal data are available and identify shocks with the approach of Blanchard and Perotti (2002).

Here, we take this set of countries, formed by Australia, Canada, United Kingdom and United States, and estimate different panel VARs using variables in relative terms at annual frequency. To construct relative measures we follow the procedure outlined in Section 2 but using instead the G7 countries as the benchmark. The chosen real effective exchange rate index is taken from the European Commission, based on the CPI deflator and computed vis-à-vis twenty four trading partners. To identify fiscal shocks we use the same Choleski ordering of Section 3.

Figure 13 shows the responses to a spending shock equivalent to 1 percent of GDP in government absorption, government fixed investment and total government consumption.[16] As in the literature dealing with these countries, we find that a shock to government absorption produces a real depreciation. The peak is found in year two, where it is equivalent to 2.54 percent. From this year onwards, the real exchange rate appreciates but does not reach the original levels; at least before ten years after the shock. For this fiscal variable as well as total government consumption, the results are the opposite to those of the EMU countries. Government consumption produces a statistically insignificant impact response but produces a real depreciation equivalent to 3.85 percent in year four. In line with Perotti (2007) findings, government investment is not more effective than government consumption shocks in boosting the GDP. Moreover, shocks in the former do not affect the real exchange rate.

This section shows that using the same estimation approach and methodology to identify fiscal shocks, the real exchange rate responses differ between the EMU and the Perotti sample. A potential explanation for this lies in the exchange rate regime. On the one hand, the Perotti sample is formed by countries adopting flexible exchange rate regimes after the collapse of the Bretton Woods system. While on the other, we have the EMU countries with different exchange rate arrangements going from flexible exchange rate regimes with bands to currency union.

It is well known that the monetary policy can not target the exchange rate and the business cycle at the same time if capital flows are free. Therefore, if the country has a flexible exchange rate regime, the monetary policy can accommodate a fiscal expansion. Then, if the depreciation

[15]See for example Monacelli and Perotti (2006) and Ravn et al. (2007).

[16]Since wage and non-wage government consumption for Australia are not available at the OECD Economic Outlook, shocks in these variables are not studied.

of the local currency produced by the monetary expansion is large enough, the increase in prices produced by the fiscal shock may be counterbalanced by the nominal exchange rate effect leading to a real exchange rate depreciation. In contrast, an expansionary fiscal shock is more likely to generate real exchange rate appreciation if the exchange rate regime is fixed.

To test this conjecture, a potential strategy would be to follow Beetsma et al. (2008). That is, to include monetary instrument such as the short run interest rate in the baseline estimation and place it after the government spending variable in the Choleski ordering. Doing this, it will be possible to account for changes in monetary policy and confront the results between these two sets of countries.

The discrepancy between the exchange rate responses may be related to the structural differences between the 'Anglo-Saxon' countries of the Perotti sample and the countries of the EMU used in our baseline model. This is somehow suggested by the first robustness test showing that the exclusion of Ireland produces important quantitative differences in the exchange rate responses. These differences affecting the exchange rate responses may be in the structure of the labour markets or in the governmental institutions. To test the former a strategy would be the inclusion of the rate of unemployment in the baseline specification, since this would capture the difference in the flexibility of the labour markets. To test the latter, a potential approach would be to account for the tradable and nontradable goods composition of the government absorption. Furthermore, these two differences could also be tested by excluding group of countries with structural similarities in these dimensions and compare the exchange rate responses as in the first robustness check.

8 Conclusions

This paper makes a contribution to the literature of fiscal shocks in open economies by estimating the effects of different government spending shocks on the real effective exchange rate of eleven EMU countries. To this end, we use a dataset with different types of government spending and GDP constructed as deviations from the other EMU members to then estimate a three-variables panel VAR.

When we use the most aggregate measure of government spending, our results are in line with papers using similar set of countries and annual data. That is, an unexpected government absorption shock appreciates the real exchange rate. The study of the different government spending subcomponents shows that the largest appreciation is produced by shocks in government fixed investment and that this appreciation is maximized between three or four years after the realization of the shock. To the best of our knowledge, this result has not been shown before. Most papers studying the response of the real exchange rate to spending shocks use either total government consumption or total government absorption, without allowing for differences across the components of government spending.

Moreover, government consumption produces the largest impact and the least persistent real exchange rate response. Within this category, government wages are the part of spending generating the exchange rate appreciation since non-wage government consumption does not affect the exchange rate. Furthermore, statistically significant exchange rate responses are found to be of larger magnitude for the period preceding the EMU.

We also analyze the effects of these shocks on the relative price of nontradables finding that they respond similarly to the real exchange rate. Relative price of nontradables increase as a result shocks in government absorption, government investment and government consumption. As in the case of the exchange rate, the response of the relative price of nontradables is maximized in relation to a public investment shock.

The result of real appreciation produced by a spending shock is in sharp contrast to the findings of papers using the Perotti sample. Using the same method as for the EMU, we also find that government spending shocks depreciate the real exchange rate of these countries. A possible explanation for this may be the role of different exchange rate regimes in both country samples.

References

Arellano, M. (2003). *Panel Data Econometrics*, Oxford University Press.

Baltagi, B. H., Heun Song, S., Cheol Jung, B. and Koh, W. (2007). Testing for serial correlation, spatial autocorrelation and random effects using panel data, *Journal of Econometrics* **140**(1): 5–51.

Beetsma, R. (2008). A survey of the effects of discretionary policy, *Working paper*, University of Amsterdam, Amsterdam School of Economics.

Beetsma, R., Giuliodori, M. and Klaassen, F. (2006). Trade spill-overs of fiscal policy in the European Union: a panel analysis, *Economic Policy* **21**(48): 639–687.

Blanchard, O. and Perotti, R. (2002). An empirical characterization of the dynamic effects of changes in government spending and taxes on output, *The Quarterly Journal of Economics* **117**(4): 1329–1368.

Burnside, C., Eichenbaum, M. and Fisher, J. D. M. (2004). Fiscal shocks and their consequences, *Journal of Economic Theory* **115**(1): 89–117.

Canova, F. and Nicoló, G. D. (2002). Monetary disturbances matter for business fluctuations in the G-7, *Journal of Monetary Economics* **49**(6): 1131–1159.

Canova, F. and Pappa, E. (2007). Price differentials in monetary unions: The role of fiscal shocks, *Economic Journal* **117**: 713–737.

Cavallo, M. (2005). Government employment expenditure and the effects of fiscal policy shocks, *Working Paper 16*, Federal Reserve Bank of San Francisco.

Cavallo, M. (2007). Goverment consumption expenditure and the current account, *Public Finance and Management* **7**: 73–115.

Edelberg, W., Eichenbaum, M. and Fisher, J. D. (1999). Understanding the effects of a shock to government purchases, *Review of Economic Dynamics* **2**(1): 166–206.

Galí, J., López-Salido, J. D. and Vallés, J. (2007). Understanding the effects of government spending on consumption, *Journal of the European Economic Association* **5**(1): 227 – 270.

Giordano, R., Momigliano, S., Neri, S. and Perotti, R. (2007). The effects of fiscal policy in Italy: Evidence from a VAR model, *European Journal of Political Economy* **23**(3): 707–733.

Lane, P. R. and Milesi-Ferretti, G. M. (2002). External wealth, the trade balance, and the real exchange rate, *European Economic Review* **46**(6): 1049–1071.

Lane, P. R. and Perotti, R. (2003). The importance of composition of fiscal policy: evidence from different exchange rate regimes, *Journal of Public Economics* **87**(9-10): 2253–2279.

Monacelli, T. and Perotti, R. (2006). Fiscal policy, the trade balance and the real exchange rate: Implications for international risk sharing, *Working paper*, Universitá Bocconi.

Monacelli, T. and Perotti, R. (2008). Openness and the sectoral effects of fiscal policy, *Journal of the European Economic Association* **6**(2-3): 395–403.

Mountford, A. and Uhlig, H. (2005). What are the effects of fiscal policy shocks?, *SFB 649 Discussion Papers SFB649DP2005-039*, Sonderforschungsbereich 649, Humboldt University, Berlin, Germany.

Nickell, S. J. (1981). Biases in dynamic models with fixed effects, *Econometrica* **49**(6): 1417–26.

OECD (2005). *Economic Outlook*, Paris.

Pappa, E. (2005). New-keynesian or RBC transmission? the effects of fiscal policy in labor markets, *Working Papers 5313*, CEPR Discussion Paper.

Perotti, R. (2004). Estimating the effects of fiscal policy in OECD countries, *Discussion paper*, CEPR.

Perotti, R. (2007). Public investment and the golden rule: Another (different) look, *Working paper*, NBER. International Seminar on Macroeconomics.

Ramey, V. A. and Shapiro, M. D. (1998). Costly capital reallocation and the effects of government spending, *Carnegie-Rochester Conference Series on Public Policy* **48**: 145–194.

Ravn, M., Schmitt-Grohe, S. and Uribe, M. (2007). Explaining the effects of government spending shocks on consumption and real exchange rate, *NBER Working Papers 13328*, National Bureau of Economic Research, Inc.

Romer, C. and Romer, D. (2007). The macroeconomic effects of tax changes: estimates based on a new measure of fiscal shocks, *Working paper*, University of California, Berkeley.

Uhlig, H. (2005). What are the effects of monetary policy on output? results from an agnostic identification procedure, *Journal of Monetary Economics* **52**(2): 381–419.

Table 1: Trade weights (ω_{ij}) and GDP weights.

Country	Partner	Trade	GDP	Country	Partner	Trade	GDP
Austria	Belgium	3.3	3.9	Ireland	Austria	1.3	3.1
	Finland	1.2	2.1		Belgium	13.5	3.9
	France	6.8	23.0		Finland	2.4	2.0
	Germany	64.5	31.6		France	20.3	22.6
	Greece	0.8	2.1		Germany	30.2	31.0
	Ireland	0.5	1.3		Greece	0.8	2.1
	Italy	14.9	18.6		Italy	9.7	18.2
	Netherlands	5.1	6.2		Netherlands	15.4	6.1
	Portugal	0.7	1.6		Portugal	1.2	1.6
	Spain	2.2	9.6		Spain	5.2	9.4
Belgium	Austria	1.2	3.2	Italy	Austria	4.7	3.8
	Finland	0.8	2.1		Belgium	7.2	4.6
	France	26.7	23.2		Finland	1.0	2.4
	Germany	32.4	31.8		France	28.3	27.2
	Greece	0.6	2.1		Germany	37.8	37.3
	Ireland	1.7	1.3		Greece	2.5	2.5
	Italy	7.3	18.7		Ireland	1.1	1.5
	Netherlands	25.6	6.3		Netherlands	9.0	7.4
	Portugal	0.8	1.7		Portugal	1.4	1.9
	Spain	2.9	9.7		Spain	7.0	11.3
Finland	Austria	3.7	3.1	Netherlands	Austria	1.7	3.3
	Belgium	7.1	3.9		Belgium	22.5	4.0
	France	13.5	22.8		Finland	1.4	2.1
	Germany	43.6	31.2		France	15.1	23.7
	Greece	1.4	2.1		Germany	44.8	32.6
	Ireland	1.8	1.3		Greece	0.9	2.2
	Italy	9.5	18.4		Ireland	1.4	1.4
	Netherlands	12.9	6.2		Italy	7.9	19.1
	Portugal	1.8	1.6		Portugal	0.9	1.7
	Spain	4.7	9.5		Spain	3.4	9.9
France	Austria	1.6	4.0	Portugal	Austria	1.9	3.1
	Belgium	16.9	4.9		Belgium	6.0	3.9
	Finland	1.0	2.6		Finland	1.6	2.0
	Germany	35.2	39.4		France	19.9	22.7
	Greece	1.1	2.6		Germany	27.3	31.1
	Ireland	1.4	1.6		Greece	0.5	2.1
	Italy	20.0	23.1		Ireland	0.8	1.3
	Netherlands	10.8	7.8		Italy	11.0	18.3
	Portugal	1.9	2.0		Netherlands	8.3	6.1
	Spain	10.1	12.0		Spain	22.7	9.5
Germany	Austria	9.8	4.4	Spain	Austria	1.5	3.4
	Belgium	14.1	5.5		Belgium	5.9	4.2
	Finland	2.2	2.9		Finland	1.2	2.2
	France	25.2	32.1		France	31.0	24.6
	Greece	1.7	2.9		Germany	27.6	33.7
	Ireland	1.6	1.8		Greece	1.1	2.2
	Italy	17.5	25.9		Ireland	1.3	1.4
	Netherlands	20.5	8.7		Italy	15.8	19.8
	Portugal	1.6	2.3		Netherlands	8.3	6.7
	Spain	5.9	13.4		Portugal	6.5	1.8
Greece	Austria	2.4	3.1				
	Belgium	5.7	3.9				
	Finland	1.6	2.0				
	France	14.2	22.8				
	Germany	35.6	31.2				
	Ireland	0.9	1.3				
	Italy	24.3	18.4				
	Netherlands	10.2	6.2				
	Portugal	0.6	1.6				
	Spain	4.5	9.5				

Table 2: Responses to a fiscal spending shock equivalent to 1% of GDP.

REER responses

shock in →	GEXP		GINV		GC		WGC		NWGC	
0	1.04	***	1.23	**	1.48	***	1.07	*	0.80	*
1	1.41	***	2.22	***	1.69	***	1.84	**	1.01	*
2	1.47	***	3.14	***	1.37	**	1.92	**	0.43	
3	1.31	***	3.49	***	0.84	*	1.69	**	-0.16	
4	1.04	**	3.29	***	0.37		1.36	**	-0.49	
5	0.78	**	2.81	***	0.03		1.04	*	-0.57	
6	0.55	*	2.25	***	-0.16		0.76		-0.51	
7	0.39		1.74	***	-0.25		0.54		-0.39	
8	0.27		1.33	**	-0.27		0.36		-0.25	
9	0.19		1.01	**	-0.26		0.23		-0.13	
10	0.14		0.77	*	-0.23		0.12		-0.04	

GDP responses

shock in →	GEXP		GINV		GC		WGC		NWGC	
0	0.95	***	1.70	***	0.81	***	-0.1		0.50	**
1	1.36	***	2.32	***	1.24	***	-0.4		0.88	**
2	1.35	***	2.40	***	1.11	***	-0.6		0.93	**
3	1.17	***	2.24	***	0.83	**	-0.7		0.85	**
4	0.94	***	1.99	***	0.55		-0.8		0.76	*
5	0.73	**	1.71	**	0.33		-0.9		0.69	
6	0.55	*	1.44	**	0.17		-1.0		0.63	
7	0.41		1.20	*	0.06		-1.0		0.59	
8	0.31		1.01	*	-0.01		-1.0	*	0.56	
9	0.23		0.85		-0.06		-1.0	*	0.52	
10	0.18		0.72		-0.08		-1.0	*	0.48	

Note: *, ** and ***, denote statistical significance at 10, 5 and 1 percent, respectively.

Table 3: Difference between Baseline and pre-EMU responses to a spending shock equivalent to 1% of GDP.

REER responses

shock in →	GEXP		GINV		GC		WGC		NWGC	
0	-0.25	***	-0.45	***	-0.09	***	-0.19	***	-0.02	*
1	-0.22	***	-0.55	***	0.08	**	-0.13	***	0.00	*
2	-0.16	***	-0.59	***	0.19	***	-0.45	***	0.08	**
3	-0.07	***	-0.56	***	0.19	***	-0.63	***	0.06	*
4	0.04	**	-0.39	***	0.17	***	-0.63	***		
5	0.15	***			0.15	***	-0.51	***		
6	0.23	***	0.23	***	0.13	***	-0.35	***		
7	0.28	***	0.50	***	0.10	***	-0.22	***		
8	0.28	***	0.69	***	0.06	***	-0.13	***		
9	0.26	***	0.77	***			-0.08	***		
10	0.23	***	0.77	***	-0.02	***	-0.07	***	0.04	*

GDP responses

shock in →	GEXP		GINV		GC		WGC		NWGC	
0	-0.12	***	-0.18	***	-0.16	***			-0.17	***
1			-0.09	*	-0.09	**	-0.24	***	-0.10	***
2	0.15	***	0.15	***	0.05	***	-0.18	***	0.01	**
3	0.33	***	0.44	***	0.15	***			0.14	***
4	0.46	***	0.72	***	0.19	***	0.02	***	0.23	***
5	0.52	***	0.95	***	0.19	***	0.08	***	0.29	***
6	0.52	***	1.10	***	0.14	***	0.10	***	0.31	***
7	0.48	***	1.15	***	0.08	***	0.07	***	0.31	***
8	0.41	***	1.12	***			0.02	***	0.31	***
9	0.33	***	1.04	***	-0.04	**			0.30	***
10	0.25	***	0.92	***	-0.09	***			0.29	***

Note: Only statistically significant differences reported. *, ** and ***, denote statistical significance at 10, 5 and 1 percent, respectively.

Table 4: Real effective exchange rate responses to fiscal spending shock equivalent to 1 % of GDP.

shock	t	Baseline		4-vbles VAR		pre-EMU		post-1980		incl. DEBT		GDP-defl		NULC-defl	
	0	1.04	***			1.29	***	1.21	***	1.01	***	1.00	***	1.18	***
	1	1.41	***			1.63	***	1.61	***	1.29	***	1.39	***	1.29	**
	2	1.47	***			1.63	***	1.32	***	1.43	***	1.51	***	1.45	**
	3	1.31	***			1.38	***	0.87	**	1.40	***	1.37	***	1.51	**
	4	1.04	**			1.00	**	0.49		1.25	***	1.08	**	1.40	**
GEXP	5	0.78	**			0.63		0.24		1.06	***	0.77	*	1.19	**
	6	0.55	*			0.32		0.10		0.85	**	0.52		0.95	*
	7	0.39				0.11		0.02		0.67	**	0.34		0.71	*
	8	0.27				-0.01		-0.02		0.52	*	0.22		0.51	
	9	0.19				-0.07		-0.03		0.39	*	0.14		0.36	
	10	0.14				-0.08		-0.04		0.29		0.10		0.26	
	0	1.23	**	1.12	**	1.69	**	1.42	**	0.96	*	1.14	**	0.89	
	1	2.22	***	2.08	***	2.77	***	2.27	***	1.65	**	2.24	***	2.07	**
	2	3.14	***	3.08	***	3.73	***	2.63	***	2.68	***	2.97	***	3.08	***
	3	3.49	***	3.51	***	4.05	***	2.46	***	3.21	***	3.09	***	3.48	***
	4	3.29	***	3.34	***	3.68	***	1.96	***	3.17	***	2.79	***	3.33	***
GINV	5	2.81	***	2.84	***	2.90	***	1.37	**	2.80	***	2.31	***	2.86	***
	6	2.25	***	2.25	***	2.02	**	0.86	*	2.31	***	1.81	**	2.28	***
	7	1.74	***	1.69	***	1.24	*	0.48		1.84	***	1.39	**	1.73	**
	8	1.33	**	1.22	**	0.64		0.23		1.43	**	1.06	*	1.29	**
	9	1.01	**	0.86	*	0.24		0.07		1.10	**	0.82	*	0.95	*
	10	0.77	*	0.60		0.00		-0.02		0.85	**	0.65	*	0.72	
	0	1.48	***	1.47	***	1.57	***	1.56	***	1.54	***	1.49	***	2.01	***
	1	1.69	***	1.60	***	1.60	**	1.79	***	1.78	***	1.90	***	1.96	**
	2	1.37	**	1.22	**	1.18	*	0.96	*	1.61	***	1.75	**	1.90	**
	3	0.84	*	0.74		0.65		0.26		1.25	**	1.23	**	1.61	**
	4	0.37		0.33		0.20		-0.09		0.88	*	0.64		1.20	*
GC	5	0.03		0.04		-0.11		-0.18		0.57		0.18		0.79	
	6	-0.16		-0.14		-0.28		-0.14		0.33		-0.11		0.46	
	7	-0.25		-0.24		-0.35		-0.05		0.15		-0.26		0.22	
	8	-0.27		-0.28		-0.33		0.02		0.03		-0.31		0.07	
	9	-0.26		-0.29		-0.28		0.08		-0.06		-0.30		-0.01	
	10	-0.23		-0.27		-0.21		0.11		-0.11		-0.26		-0.05	
	0	1.07	*	1.20	*	1.26	*	1.64	**	1.03	*	1.34	*	1.49	*
	1	1.84	**	1.86	**	1.97	*	2.71	***	1.84	**	1.86	**	1.93	*
	2	1.92	**	1.82	**	2.36	**	2.25	***	2.03	**	1.95	**	1.77	*
	3	1.69	**	1.48	*	2.32	**	1.31	*	1.92	***	1.81	**	1.44	
	4	1.36	**	1.18	*	1.99	**	0.53		1.67	**	1.57	*	1.08	
WGC	5	1.04	*	0.98		1.54	*	0.07		1.37	**	1.28	*	0.77	
	6	0.76		0.81		1.11		-0.11		1.07	*	1.01		0.52	
	7	0.54		0.64		0.76		-0.13		0.80		0.76		0.33	
	8	0.36		0.47	***	0.49		-0.08		0.57		0.56		0.19	
	9	0.23		0.29	***	0.31		-0.03		0.37		0.40		0.09	
	10	0.12		0.13		0.20		0.01		0.21		0.27		0.02	
	0	0.80	*	0.87	*	0.82		0.74	*	0.82	**	0.49		0.26	
	1	1.01	*	1.10	*	1.02		1.59	***	1.02	*	1.06	*	0.54	
	2	0.43		0.51		0.35		0.82	*	0.48		0.45		0.31	
	3	-0.16		-0.03		-0.22		-0.02		-0.02		-0.34		-0.08	
	4	-0.49		-0.33		-0.49		-0.39		-0.30		-0.83		-0.37	
NWGC	5	-0.57		-0.43		-0.55		-0.37		-0.39		-0.98	*	-0.50	
	6	-0.51		-0.42		-0.49		-0.18		-0.37		-0.89	*	-0.49	
	7	-0.39		-0.35		-0.38		0.03		-0.30		-0.70	*	-0.40	
	8	-0.25		-0.27		-0.25		0.19		-0.21		-0.48		-0.28	
	9	-0.13		-0.18		-0.15		0.27		-0.12		-0.28		-0.16	
	10	-0.04		-0.11		-0.07		0.30		-0.05		-0.12		-0.07	

Note: Point estimates of the Impulse-Response mean. *, ** and ***, denote statistical significance at 10, 5 and 1 percent, respectively.

Table 5: PVAR estimates for: government expenditure (GEXP).

	GEXP	GDP	REER
$GEXP_{t-1}$	1.03***	0.06	-0.01
	[.0594]	[.0405]	[.0790]
$GEXP_{t-2}$	-0.25***	-0.06	0.02
	[.0560]	[.0381]	[.0744]
GDP_{t-1}	0.32***	1.17***	0.52***
	[.0844]	[.0575]	[.1122]
GDP_{t-2}	-0.13	-0.24***	-0.37***
	[.0890]	[.0605]	[.1182]
$REER_{t-1}$	0.09**	-0.01	0.94***
	[.0412]	[.0281]	[.0548]
$REER_{t-2}$	-0.05	-0.02	-0.24***
	[.0379]	[.0258]	[.0504]
...			
DW	2.01	2.07	2.04

Note: EMU sample. *, ** and *** denote statistical significance at 10, 5 and 1 percent, respectively. Standard deviation in square brackets. Country specific intercepts and trends, and time dummies are omitted. DW is Durbin-Watson statistic.

Table 6: PVAR estimates for: government fixed investment (GINV).

	GINV	GDP	REER
$GINV_{t-1}$	0.93*** [.0563]	0.01 [.0098]	0.01 [.0189]
$GINV_{t-2}$	-0.16*** [.0535]	-0.01 [.0093]	0.02 [.0179]
GDP_{t-1}	0.69** [.3243]	1.16*** [.0569]	0.47*** [.1088]
GDP_{t-2}	-0.48 [.3350]	-0.24*** [.0588]	-0.36*** [.1124]
$REER_{t-1}$	0.55*** [.1584]	-0.01 [.0278]	0.92*** [.0531]
$REER_{t-2}$	-0.38** [.1460]	-0.03 [.0256]	-0.26*** [.0490]
...			
DW	2.00	2.06	2.03

Note: EMU sample. *, ** and *** denote statistical significance at 10, 5 and 1 percent, respectively. Standard deviation in square brackets. Country specific intercepts and trends, and time dummies are omitted. DW is Durbin-Watson statistic.

Table 7: PVAR estimates for: government consumption (GC).

	GC	GDP	REER
GC_{t-1}	0.91*** [.0580]	0.06 [.0480]	-0.02 [.0929]
GC_{t-2}	-0.14*** [.0538]	-0.08* [.0445]	-0.03 [.0862]
GDP_{t-1}	0.32*** [.0667]	1.16*** [.0552]	0.51*** [.1068]
GDP_{t-2}	-0.11 [.0732]	-0.22*** [.0606]	-0.31*** [.1173]
$REER_{t-1}$	0.04 [.0342]	-0.02 [.0283]	0.93*** [.0549]
$REER_{t-2}$	-0.02 [.0313]	-0.02 [.0259]	-0.23*** [.0501]
...			
DW	2.06	2.08	2.01

Note: EMU sample. *, ** and *** denote statistical significance at 10, 5 and 1 percent, respectively. Standard deviation in square brackets. Country specific intercepts and trends, and time dummies are omitted. DW is Durbin-Watson statistic.

Table 8: PVAR estimates for: wage government consumption (WGC).

	WGC	GDP	REER
WGC_{t-1}	1.04***	-0.02	0.10
	[.0561]	[.0425]	[.0822]
WGC_{t-2}	-0.14**	0.01	-0.04
	[.0537]	[.0407]	[.0788]
GDP_{t-1}	0.22***	1.19***	0.52***
	[.0710]	[.0539]	[.1041]
GDP_{t-2}	-0.07	-0.26***	-0.38***
	[.0754]	[.0572]	[.1106]
$REER_{t-1}$	0.01	0.00	0.91***
	[.0366]	[.0277]	[.0536]
$REER_{t-2}$	-0.06*	-0.03	-0.23***
	[.0339]	[.0257]	[.0497]
...			
DW	2.01	2.06	2.03

Note: EMU sample. *, ** and *** denote statistical significance at 10, 5 and 1 percent, respectively. Standard deviation in square brackets. Country specific intercepts and trends, and time dummies are omitted. DW is Durbin-Watson statistic.

Table 9: PVAR estimates for: non-wage government consumption (NWGC).

	NWGC	GDP	REER
$NWGC_{t-1}$	0.87*** [.0560]	0.02 [.0196]	0.00 [.0379]
$NWGC_{t-2}$	-0.11** [.0497]	-0.02 [.0174]	-0.05 [.0336]
GDP_{t-1}	0.22 [.1537]	1.19*** [.0539]	0.52*** [.1041]
GDP_{t-2}	-0.03 [.1637]	-0.26*** [.0574]	-0.30*** [.1109]
$REER_{t-1}$	-0.02 [.0797]	-0.01 [.0279]	0.91*** [.0539]
$REER_{t-2}$	0.07 [.0728]	-0.02 [.0255]	-0.22*** [.0493]
...			
DW	2.03	2.07	2.01

Note: EMU sample. *, ** and *** denote statistical significance at 10, 5 and 1 percent, respectively. Standard deviation in square brackets. Country specific intercepts and trends, and time dummies are omitted. DW is Durbin-Watson statistic.

9 Appendix: PVAR estimates for 4-variables system.

Table 10: PVAR estimates for: government investment.

	GINV	GC	GDP	REER
$GINV_{t-1}$	0.92***	0.03**	0.01	0.01
	[.0571]	[.0119]	[.0100]	[.0191]
$GINV_{t-2}$	-0.15***	-0.03**	0.00	0.02
	[.0542]	[.0113]	[.0095]	[.0182]
GC_{t-1}	0.24	0.89***	0.05	-0.03
	[.2773]	[.0582]	[.0485]	[.0930]
GC_{t-2}	-0.26	-0.12**	-0.08*	-0.05
	[.2575]	[.0540]	[.0451]	[.0864]
GDP_{t-1}	0.60*	0.27***	1.14***	0.46***
	[.3330]	[.0699]	[.0583]	[.1117]
GDP_{t-2}	-0.38	-0.06	-0.20***	-0.28**
	[.3604]	[.0756]	[.0631]	[.1209]
$REER_{t-1}$	0.51***	0.03	-0.02	0.90***
	[.1648]	[.0346]	[.0288]	[.0553]
$REER_{t-2}$	-0.35**	-0.02	-0.02	-0.25***
	[.1493]	[.0313]	[.0261]	[.0501]
...				
DW	2.01	2.10	2.08	2.02

Note: EMU sample. *, ** and *** denote statistical significance at 10, 5 and 1 percent, respectively. Standard deviation in square brackets. Country specific intercepts and trends, and time dummies are omitted. DW is Durbin-Watson statistic.

Table 11: PVAR estimates for: government consumption.

	GC	GINV	GDP	REER
GC_{t-1}	0.89***	0.24	0.05	-0.03
	[.0582]	[.2773]	[.0485]	[.0930]
GC_{t-2}	-0.12**	-0.26	-0.08*	-0.05
	[.0540]	[.2575]	[.0451]	[.0864]
$GINV_{t-1}$	0.03**	0.92***	0.01	0.01
	[.0119]	[.0571]	[.0100]	[.0191]
$GINV_{t-2}$	-0.03**	-0.15***	0.00	0.02
	[.0113]	[.0542]	[.0095]	[.0182]
GDP_{t-1}	0.27***	0.60*	1.14***	0.46***
	[.0699]	[.3330]	[.0583]	[.1117]
GDP_{t-2}	-0.06	-0.38	-0.20***	-0.28**
	[.0756]	[.3604]	[.0631]	[.1209]
$REER_{t-1}$	0.03	0.51***	-0.02	0.90***
	[.0346]	[.1648]	[.0288]	[.0553]
$REER_{t-2}$	-0.02	-0.35**	-0.02	-0.25***
	[.0313]	[.1493]	[.0261]	[.0501]
...				
DW	2.10	2.01	2.08	2.02

Note: EMU sample. *, ** and *** denote statistical significance at 10, 5 and 1 percent, respectively. Standard deviation in square brackets. Country specific intercepts and trends, and time dummies are omitted. DW is Durbin-Watson statistic.

Table 12: PVAR estimates for: wage government consumption.

	WGC	GEXP-WGC	GDP	REER
WGC_{t-1}	1.13*** [.0616]	-0.57* [.3397]	0.03 [.0473]	0.09 [.0924]
WGC_{t-2}	-0.24*** [.0588]	0.51 [.3245]	-0.04 [.0452]	-0.02 [.0883]
$GEXP - WGC_{t-1}$	0.04*** [.0117]	0.84*** [.0648]	0.02** [.0090]	-0.01 [.0176]
$GEXP - WGC_{t-2}$	-0.04*** [.0110]	-0.18*** [.0611]	-0.02** [.0085]	0.01 [.0166]
GDP_{t-1}	0.13* [.0739]	0.79* [.4076]	1.15*** [.0568]	0.54*** [.1109]
GDP_{t-2}	0.01 [.0770]	-0.30 [.4249]	-0.21*** [.0592]	-0.40*** [.1156]
$REER_{t-1}$	-0.02 [.0364]	0.32 [.2009]	-0.01 [.0280]	0.92*** [.0547]
$REER_{t-2}$	-0.04 [.0338]	-0.15 [.1867]	-0.02 [.0260]	-0.24*** [.0508]
...				
DW	2.02	1.98	2.08	2.03

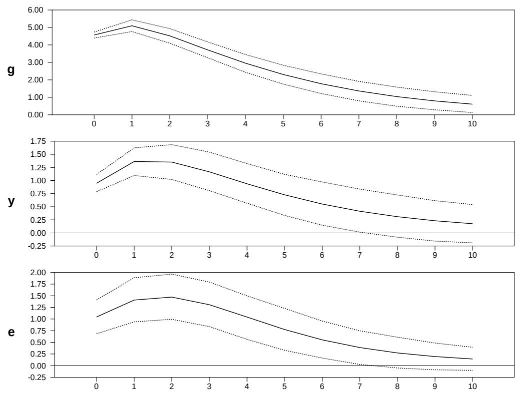
Note: EMU sample. *, ** and *** denote statistical significance at 10, 5 and 1 percent, respectively. Standard deviation in square brackets. Country specific intercepts and trends, and time dummies are omitted. DW is Durbin-Watson statistic.

Table 13: PVAR estimates for: non-wage government consumption.

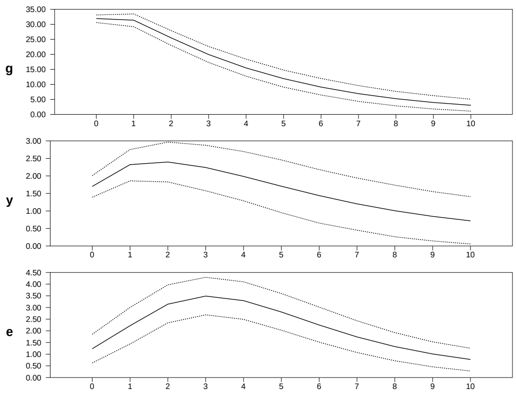
	NWGC	GEXP-NWGC	GDP	REER
$NWGC_{t-1}$	0.86*** [.0562]	0.07** [.0328]	0.02 [.0197]	0.004 [.0379]
$NWGC_{t-2}$	-0.11** [.0499]	-0.08*** [.0291]	-0.02 [.0174]	-0.05 [.0336]
$GEXP-NWGC_{t-1}$	-0.03 [.0985]	1.07*** [.0575]	0.04 [.0345]	-0.002 [.0664]
$GEXP-NWGC_{t-2}$	-0.02 [.0935]	-0.26*** [.0546]	-0.05 [.0327]	0.06 [.0630]
GDP_{t-1}	0.23 [.1650]	0.36*** [.0963]	1.16*** [.0578]	0.53*** [.1113]
GDP_{t-2}	0.004 [.1741]	-0.15 [.1016]	-0.23*** [.0610]	-0.36*** [.1174]
$REER_{t-1}$	-0.01 [.0821]	0.11** [.0479]	-0.01 [.0287]	0.90*** [.0553]
$REER_{t-2}$	0.08 [.0746]	-0.10** [.0436]	-0.02 [.0261]	-0.24*** [.0503]
...				
DW	2.03	1.98	2.07	2.03

Note: EMU sample. *, ** and *** denote statistical significance at 10, 5 and 1 percent, respectively. Standard deviation in square brackets. Country specific intercepts and trends, and time dummies are omitted. DW is Durbin-Watson statistic.

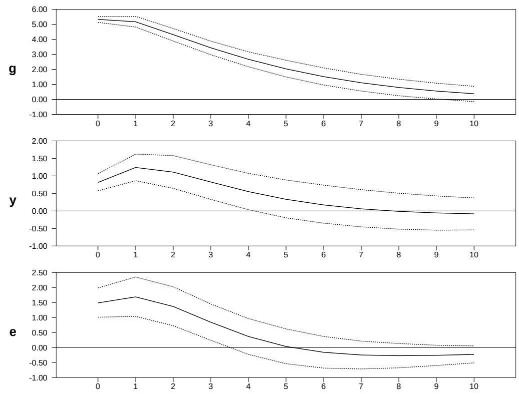
Figure 1: Baseline. Responses to a spending shock equivalent to 1% of GDP.



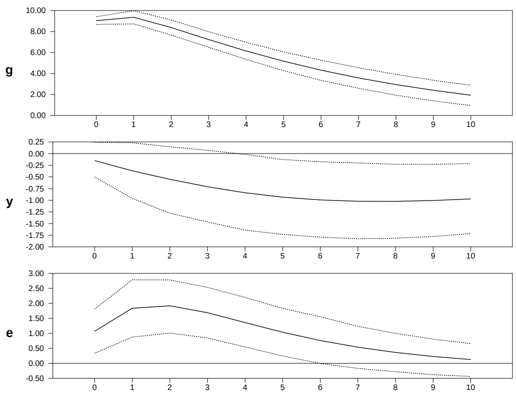
shock in GEXP



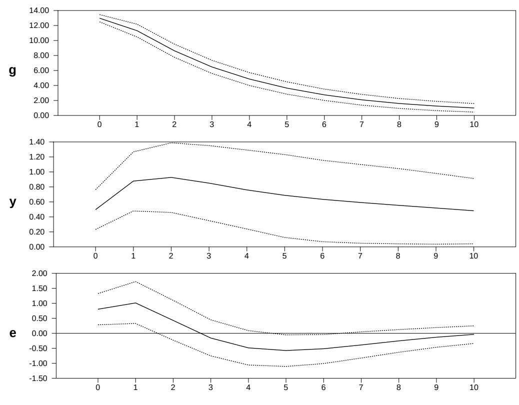
shock in GINV



shock in GC



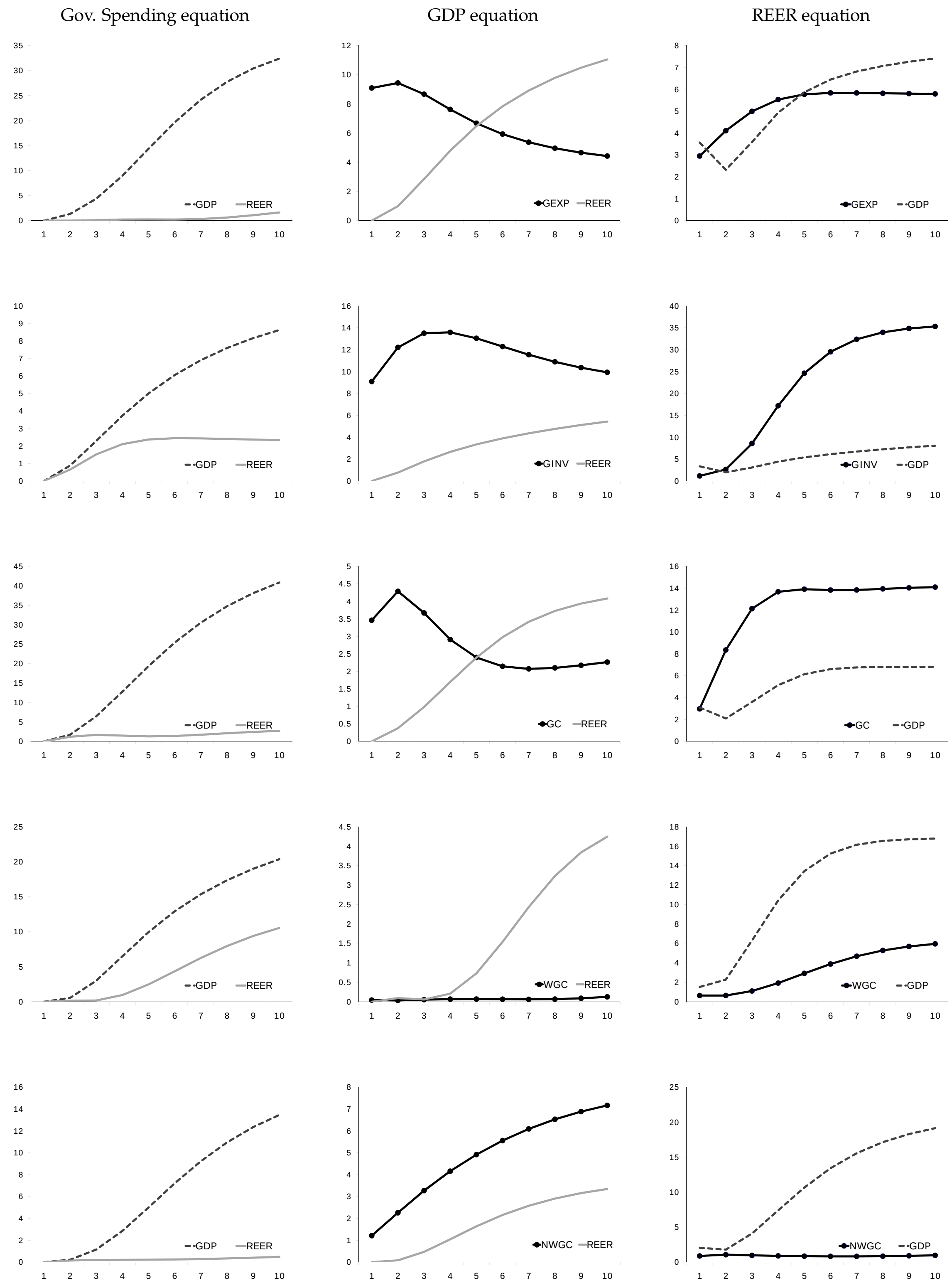
shock in WGC



shock in NWGC

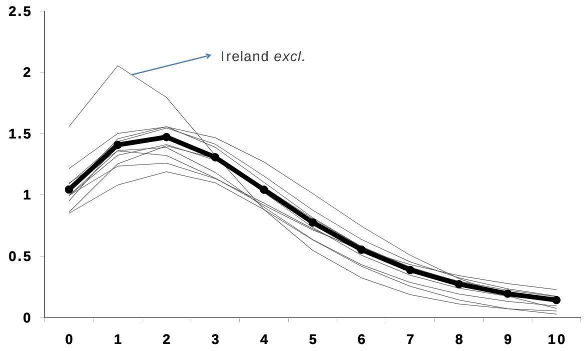
Note: Solid lines are the point estimates of the Impulse-Response mean. Dotted lines are the 16th and 84th percentiles from Monte Carlo simulations based on 1000 replications. Vertical axis indicates the percentage deviation from the rest-of-EMU for government spending (g), GDP differentials (y) and the percentage appreciation of the real effective exchange rate (e).

Figure 2: Variance decomposition.

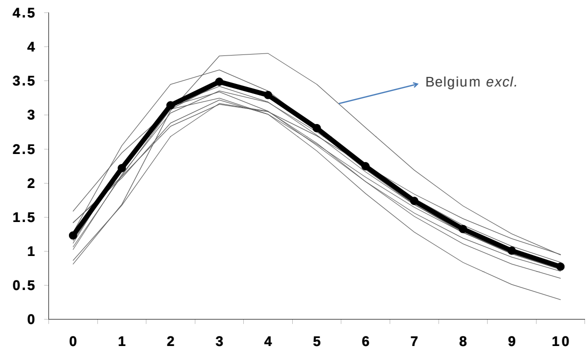


Note: Each row represents a VAR model for each definition of government spending. Vertical axis measures the percentage of forecast error variance attributable to a shock in the plotted endogenous variable.

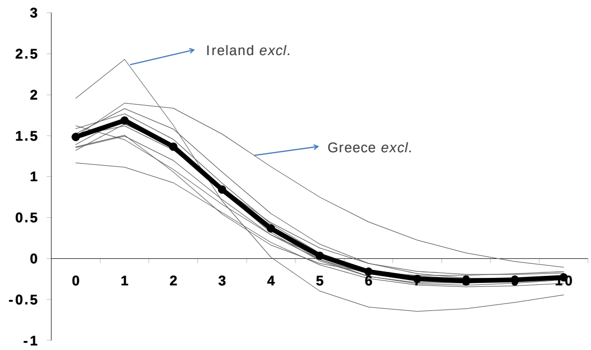
Figure 3: Robustness check. Real exchange rate responses for different spending shocks: one country member excluded.



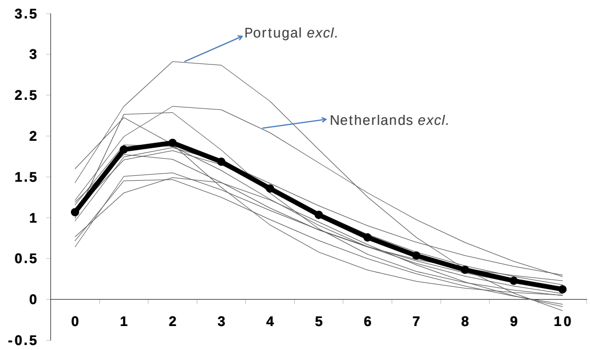
shock in GEXP



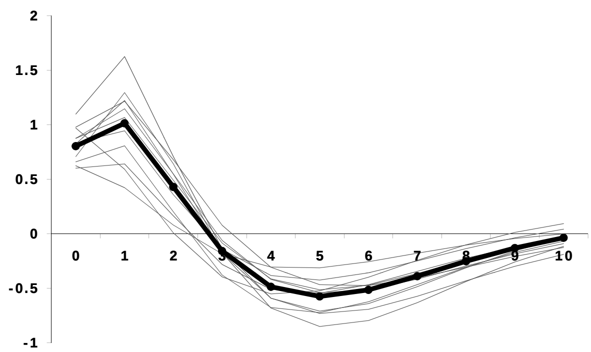
shock in GINV



shock in GC



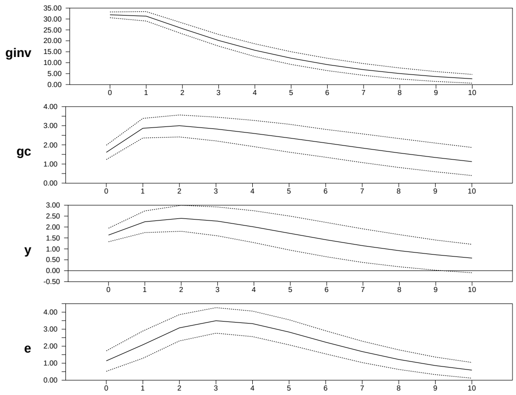
shock in WGC



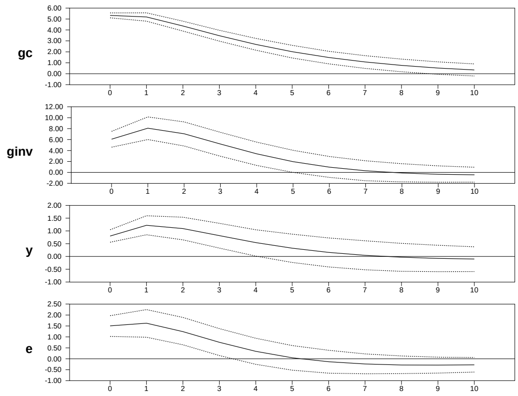
shock in NWGC

Note: Thick line denotes the response of the baseline EMU model. Thin lines, denote the responses for PVAR estimated excluding one country member at a time.

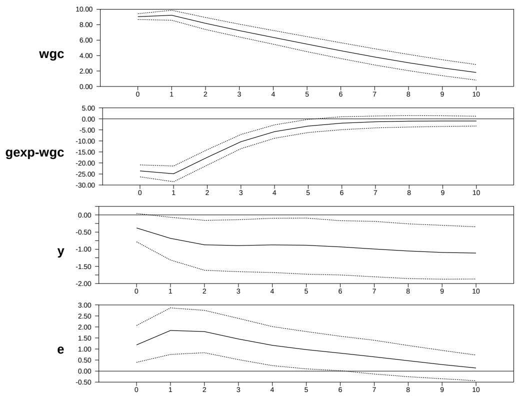
Figure 4: Robustness check. VAR including the 'complement government spending'. Shocked variable in 1st position.



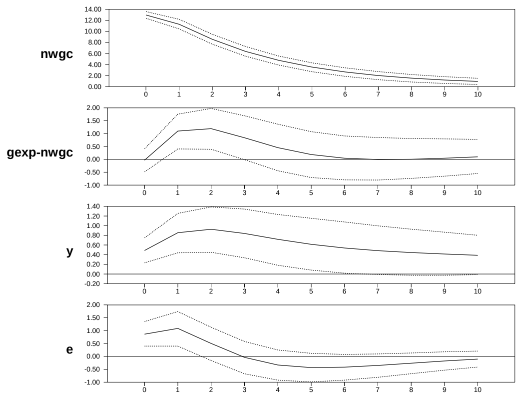
shock in GINV



shock in GC



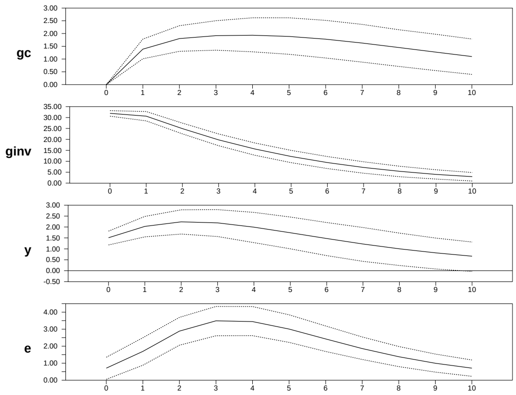
shock in WGC



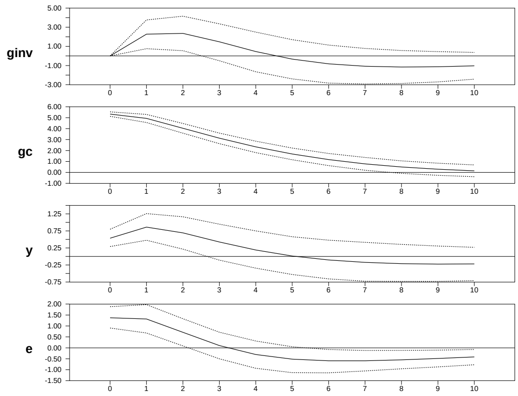
shock NWGC

Note: Solid lines are the point estimates of the Impulse-Response mean. Dotted lines are the 16th and 84th percentiles from Monte Carlo simulations based on 1000 replications. Vertical axis indicates the percentage deviation from the rest-of-EMU for government spending and GDP differentials (y), and the percentage appreciation of the real effective exchange rate (e).

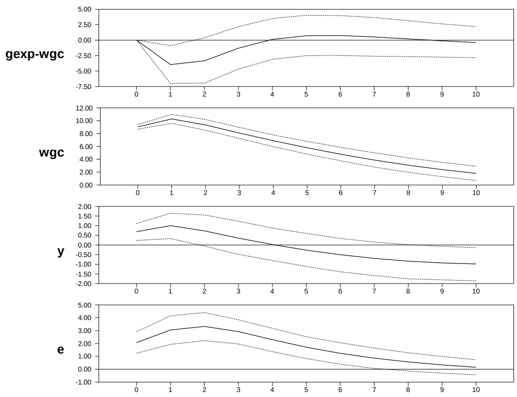
Figure 5: Robustness check. VAR including the 'complement government spending'. Shocked variable in 2nd position.



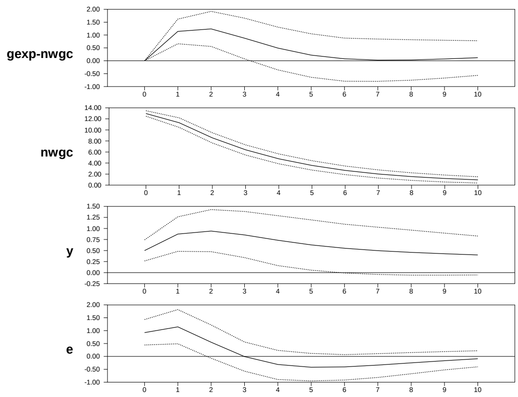
shock in GINV



shock in GC



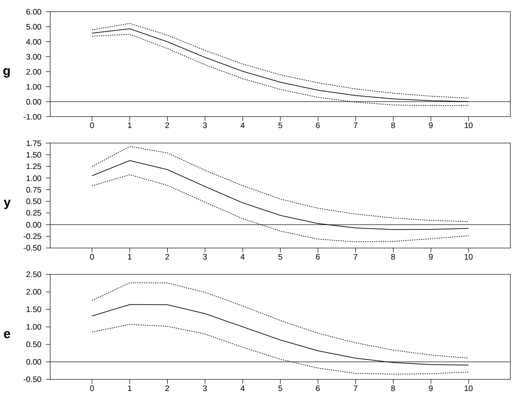
shock in WGC



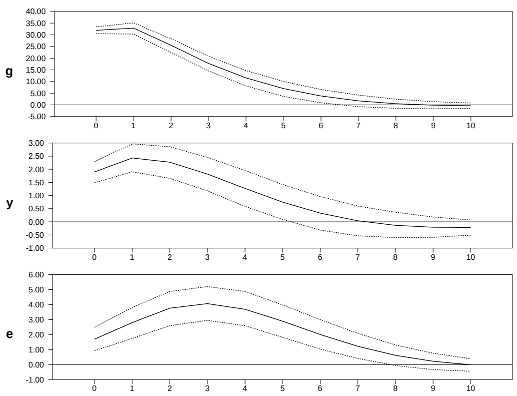
shock NWGC

Note: Solid lines are the point estimates of the Impulse-Response mean. Dotted lines are the 16th and 84th percentiles from Monte Carlo simulations based on 1000 replications. Vertical axis indicates the percentage deviation from the rest-of-EMU for government spending and GDP differentials (y), and the percentage appreciation of the real effective exchange rate (e).

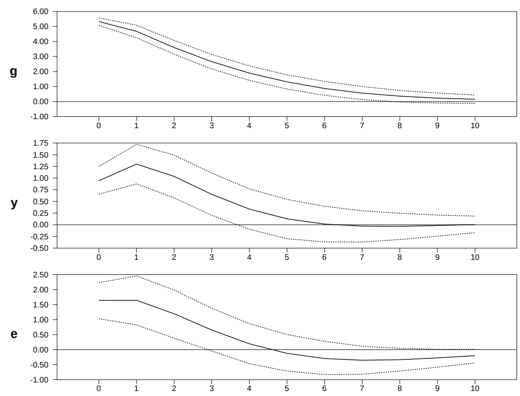
Figure 6: Robustness check. Baseline model estimated for the period 1970-1998. Responses to spending shock equivalent to 1% of GDP.



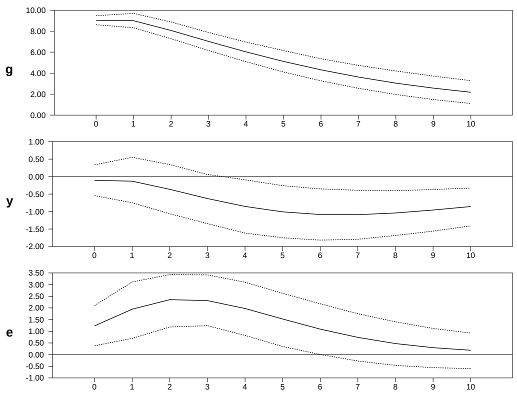
shock in GEXP



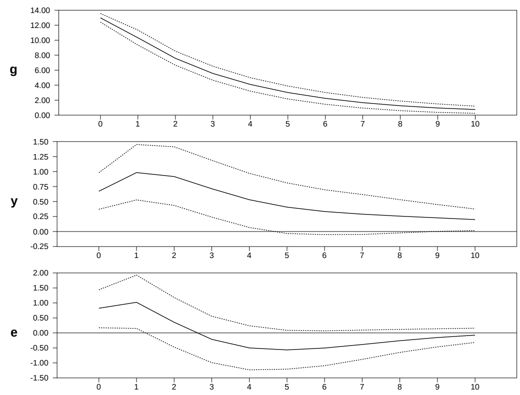
shock in GINV



shock in GC



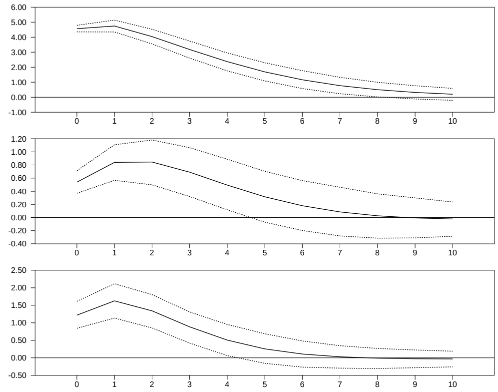
shock in WGC



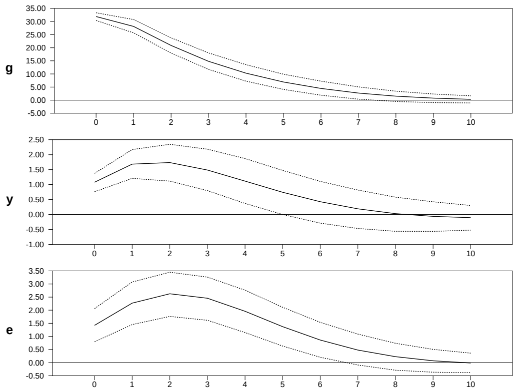
shock in NWGC

Note: Solid lines are the point estimates of the Impulse-Response mean. Dotted lines are the 16th and 84th percentiles from Monte Carlo simulations based on 1000 replications. Vertical axis indicates the percentage deviation from the rest-of-EMU for government spending (g), GDP differentials (y) and the percentage appreciation of the real effective exchange rate (e).

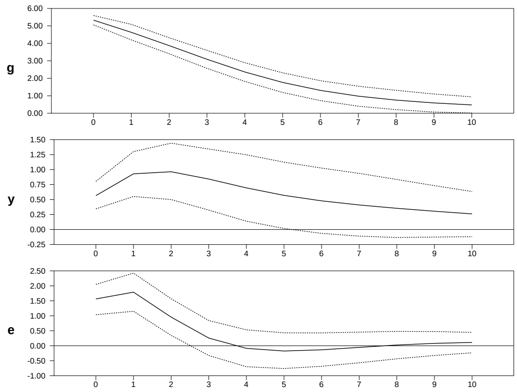
Figure 7: Robustness check. Baseline model estimated for the period 1980-2006. Responses to spending shock equivalent to 1% of GDP.



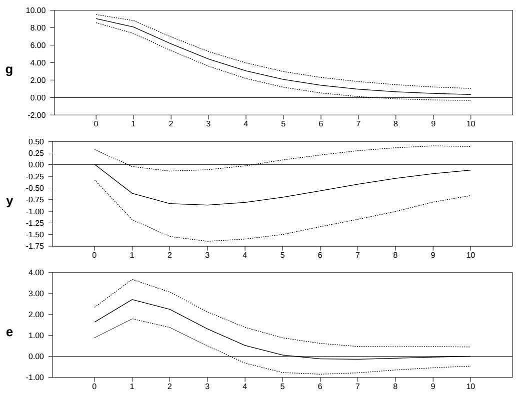
shock in GEXP



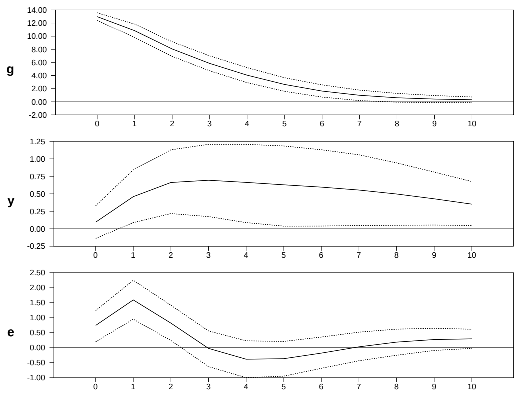
shock in GINV



shock in GC



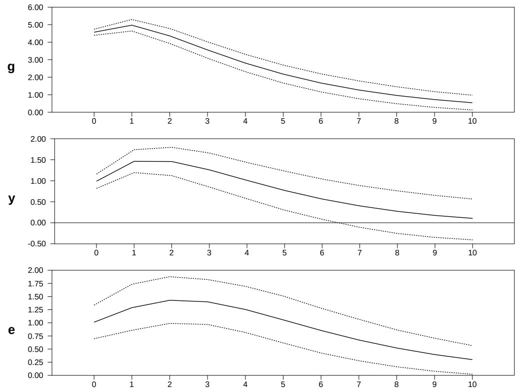
shock in WGC



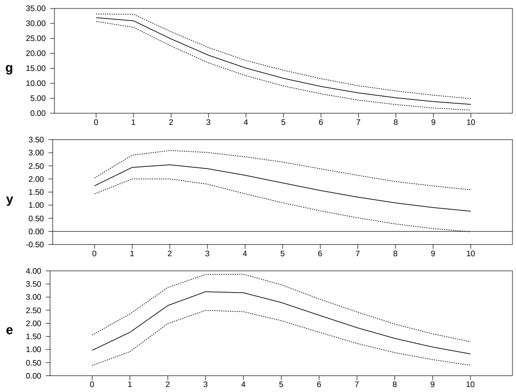
shock in NWGC

Note: Solid lines are the point estimates of the Impulse-Response mean. Dotted lines are the 16th and 84th percentiles from Monte Carlo simulations based on 1000 replications. Vertical axis indicates the percentage deviation from the rest-of-EMU for government spending (g), GDP differentials (y) and the percentage appreciation of the real effective exchange rate (e).

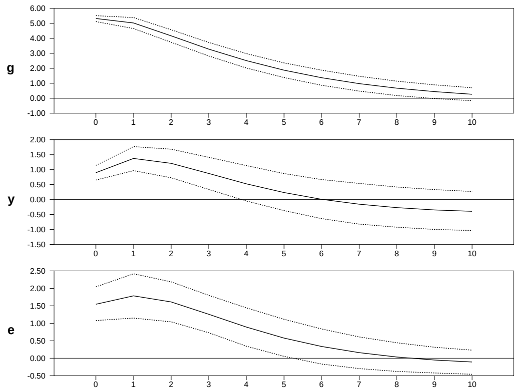
Figure 8: Robustness check. Baseline model including two lags of public debt over GDP. Responses to spending shock equivalent to 1% of GDP.



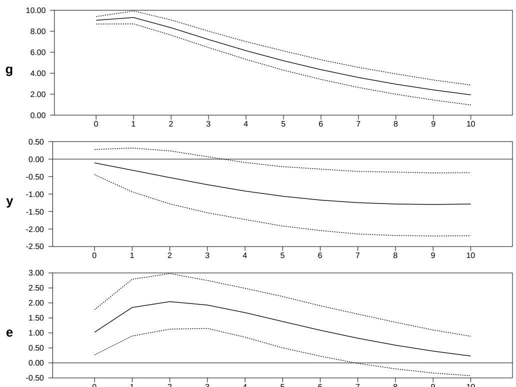
shock in GEXP



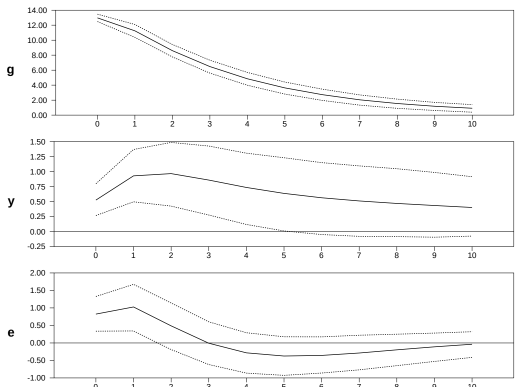
shock in GINV



shock in GC



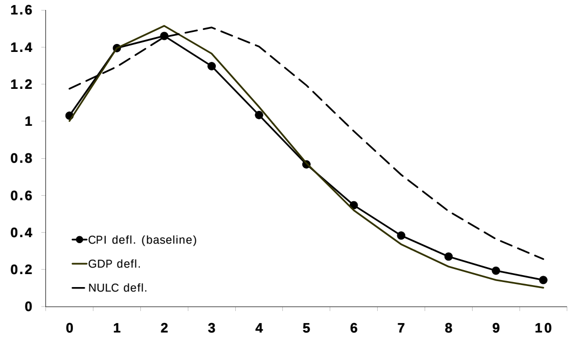
shock in WGC



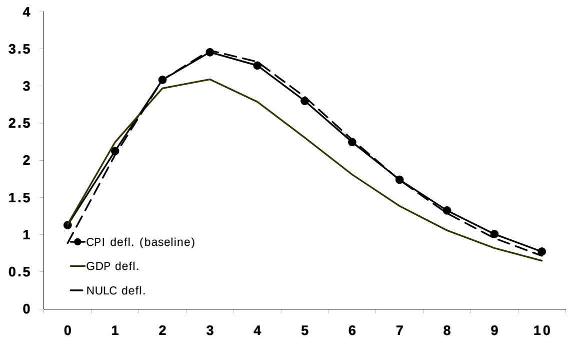
shock in NWGC

Note: Solid lines are the point estimates of the Impulse-Response mean. Dotted lines are the 16th and 84th percentiles from Monte Carlo simulations based on 1000 replications. Vertical axis indicates the percentage deviation from the rest-of-EMU for government spending (g), GDP differentials (y) and the percentage appreciation of the real effective exchange rate (e).

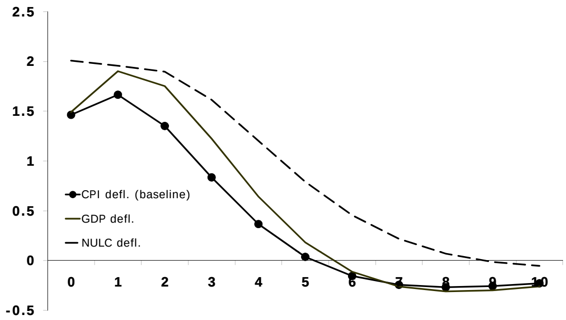
Figure 9: Responses of real effective exchange rates using different deflators to a spending shock equivalent to 1% of GDP.



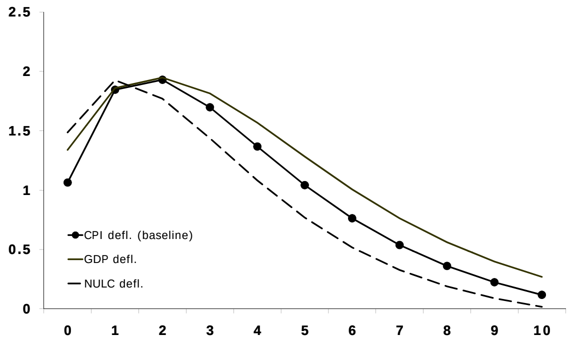
shock in GEXP



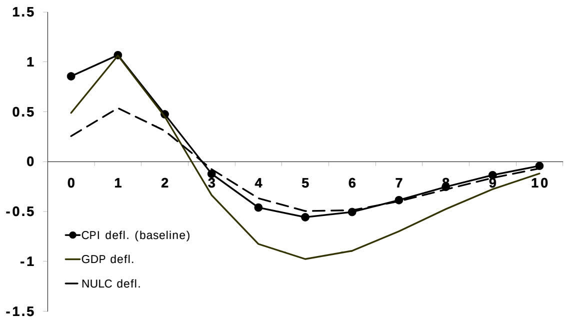
shock in GINV



shock in GC



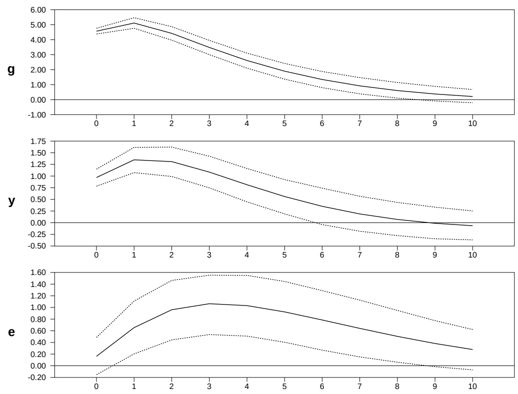
shock in WGC



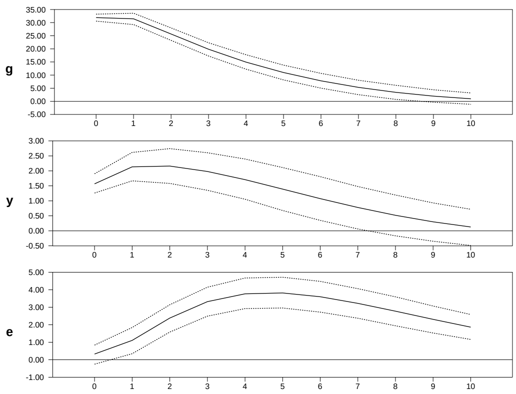
shock in NWGC

Note: Point estimates of the Impulse-Response mean. CPI defl. (baseline) is the real effective exchange rate deflated with CPI and used in the baseline estimations. GDP defl. is the exchange rate deflated with the GDP deflator and NULC defl. is the exchange rate deflated using nominal unit labour cost for total economy.

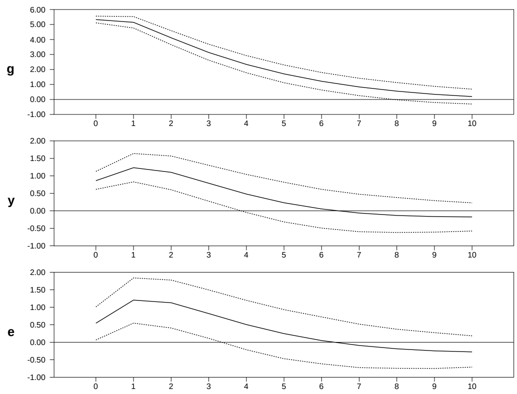
Figure 10: Responses to a spending shock equivalent to 1% of GDP. Relative price of nontradables (e).



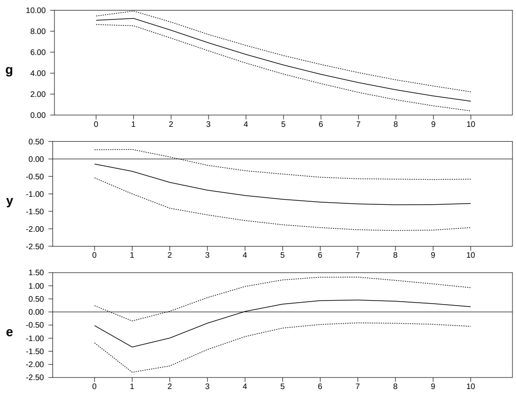
shock in GEXP



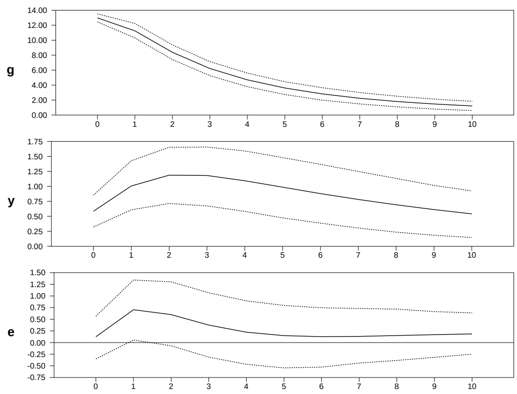
shock in GINV



shock in GC



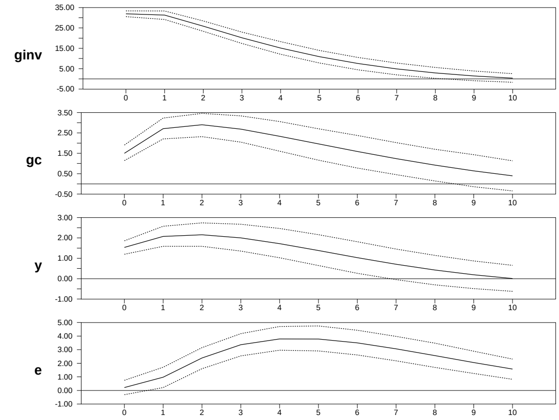
shock in WGC



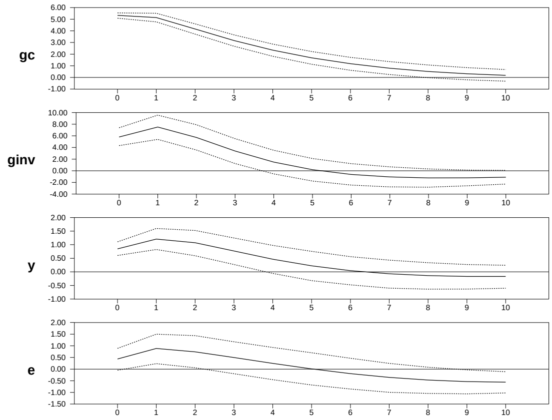
shock in NWGC

Note: Solid lines are the point estimates of the Impulse-Response mean. Dotted lines are the 16th and 84th percentiles from Monte Carlo simulations based on 1000 replications. Vertical axis indicates the percentage deviation from the rest-of-EMU for government spending (g), GDP differentials (y) and the percentage change on the relative price of nontradables (e).

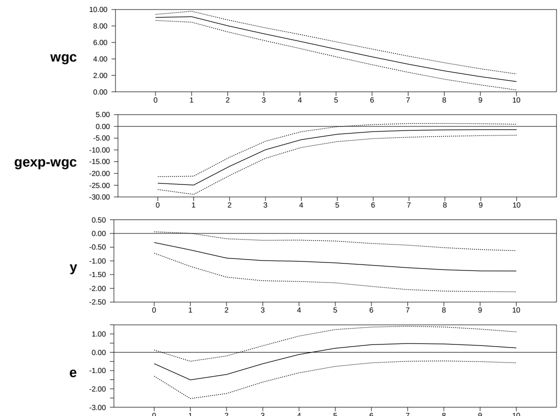
Figure 11: Robustness Check. Responses to a spending shock equivalent to 1% of GDP. Relative price of nontradables (e). VAR including the 'complement government spending'. Shocked variable in 1st position.



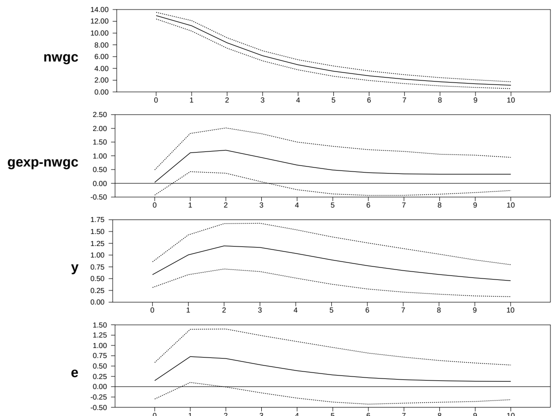
shock in GINV



shock in GC



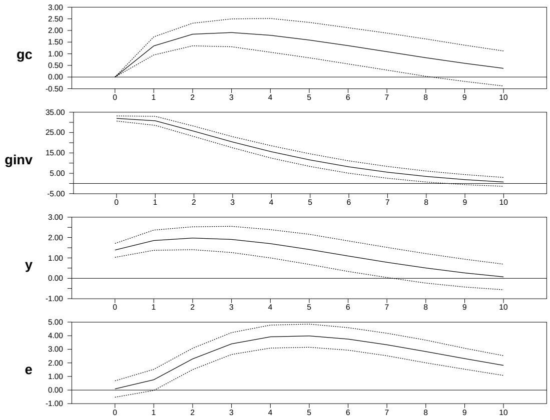
shock in WGC



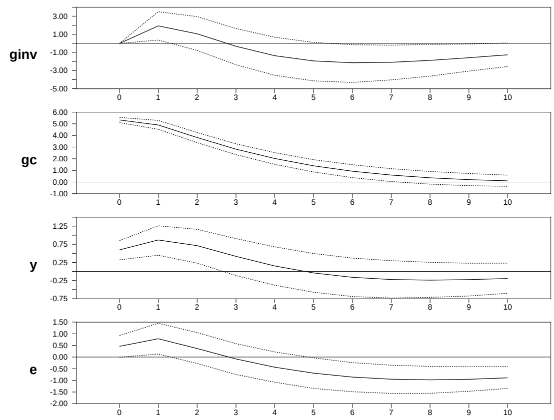
shock NWGC

Note: Solid lines are the point estimates of the Impulse-Response mean. Dotted lines are the 16th and 84th percentiles from Monte Carlo simulations based on 1000 replications. Vertical axis indicates the percentage deviation from the rest-of-EMU for government spending and GDP differentials (y), and the percentage change on the relative price of nontradables (e).

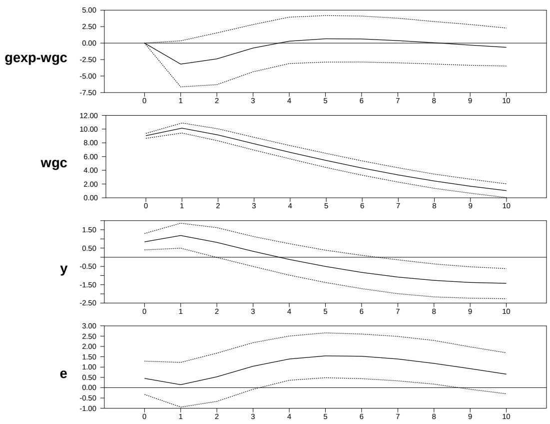
Figure 12: Robustness Check. Responses to a spending shock equivalent to 1% of GDP. Relative price of nontradables (e). VAR including the 'complement government spending'. Shocked variable in 2nd position.



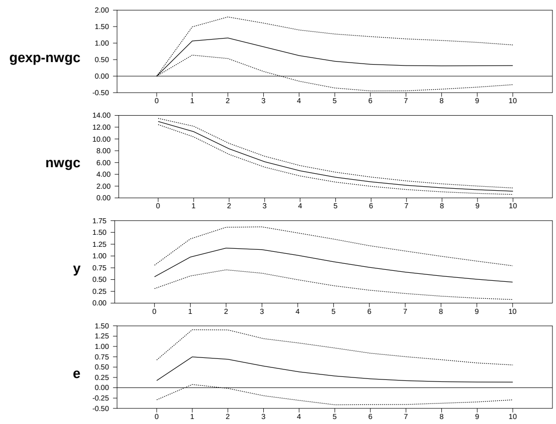
shock in GINV



shock in GC



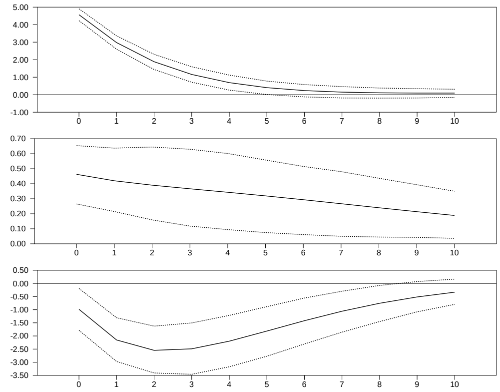
shock in WGC



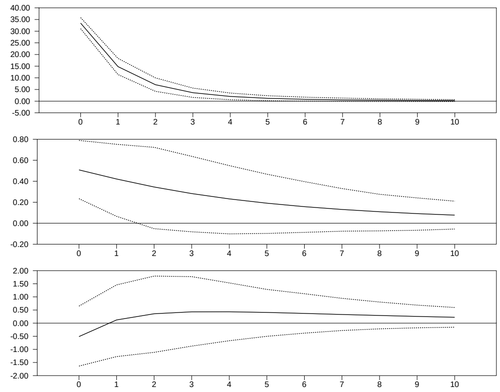
shock NWGC

Note: Solid lines are the point estimates of the Impulse-Response mean. Dotted lines are the 16th and 84th percentiles from Monte Carlo simulations based on 1000 replications. Vertical axis indicates the percentage deviation from the rest-of-EMU for government spending and GDP differentials (y), and the percentage change on the relative price of nontradables (e).

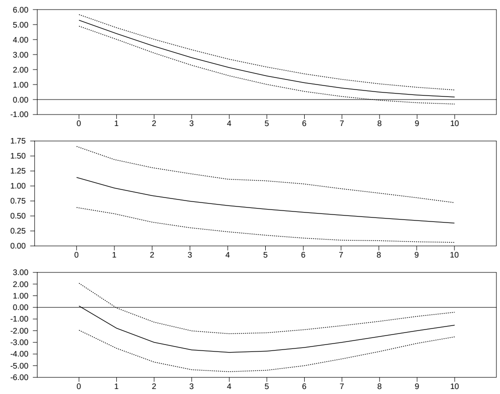
Figure 13: Responses to a spending shock equivalent to 1% of GDP using the Perotti sample: Australia, Canada, United Kingdom and United States.



shock in GEXP



shock in GINV



shock in GC

Note: Solid lines are the point estimates of the Impulse-Response mean. Dotted lines are the 16th and 84th percentiles from Monte Carlo simulations based on 1000 replications. Vertical axis indicates the percentage deviation from the G7 countries for government spending (g), GDP differentials (y) and the percentage appreciation of the real effective exchange rate (e).