The Effects of Fiscal Shocks on the Exchange Rate in the Spain [§]

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Abstract

We analyse the impact of fiscal shocks on the Spanish effective exchange rate over the period 1981-2008 using a standard structural VAR framework. We show that government spending brings about positive output responses, jointly with real appreciation. Such real appreciation is explained by persistent nominal appreciation and higher relative prices in the short term, although the latter fall below baseline values in the medium term. In turn, the current account deteriorates when government spending rises mainly due to the fall of exports caused by the real appreciation. Accordingly, our results in this regard are largely consistent not only with the conventional Mundell-Fleming model and, in general a traditional Keynesian view, but also with a wide set of RBC or New Keynesian models under standard calibrations. Moreover, our estimations are fully in line with the "twin deficits" hypothesis. Furthermore, we show that shocks to purchases of goods and services and public investment lead to real appreciation, whereas the opposite happens with higher personnel expenditure. We obtain output multipliers around 0.5 on impact and slightly above unity one year after the shock, which are in line with previous empirical evidence regarding some individual European countries.

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[§] The views expressed in this paper are those of the authors and do not necessarily reflect those of the Bank of Spain.

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1 Introduction

Last years have witnessed an increasing literature on the macroeconomic effects of discretionary fiscal policy in a wide set of countries. This strand of the literature gained momentum with Blanchard and Perotti (2002), who proposed a new and interesting methodology to identify fiscal policy shocks in VARs with quarterly data by exploiting decision lags in policy making and information about elasticities of fiscal variables to economic activity.[1] Notwithstanding, other studies such as Mountford and Uhlig (2009) assess the effects of fiscal shocks under a different methodology that consists in imposing some sign restrictions to impulse response functions. While most papers have focused on the U.S. (Edelberg et al, 1999; Fatás and Mihov, 2001; Blanchard and Perotti, 2002; Perotti, 2004; Mountford and Uhlig, 2009, among others), growing evidence on other countries has arisen. Some examples in this regard are Heppke-Falk et al. (2006) for Germany, De Castro (2006) and De Castro and Hernández de Cos (2008) for Spain, Giordano et al. (2007) for Italy, Marcellino (2006) for the four largest countries of the euro area or Afonso and Sousa (2009a, 2009b) for Germany, Italy and Portugal, and Bénassy-Quéré and Cimadomo (2006) for Germany, the U.K. and the U.S., among others.

However, most of these papers fail to analyse in depth the implications of fiscal shocks on external competitiveness, a crucial element especially for small open economies such as Spain. Still, there are some recent studies assessing the effects of fiscal, mainly spending, shocks on the nominal or real exchange rate, relative prices or the terms of trade. Nevertheless, as it is commonplace in the analysis of discretionary fiscal shocks, broad agreement on their effects is lacking. Thus, Kim and Roubini (2008) and Enders et al. (2011) for the U.S., Monacelli and Perotti (2010) for Australia, the U.S. and the U.K. and Ravn et al. (2007) for a pool of Australia, Canada, the U.S. and the U.K., find that higher government expenditure yields real depreciations. By contrast, Beetsma et al. (2008) for a panel of EU counties, Corsetti et al. (2009) for the U.S. or Bénétrix and Lane (2009) or Galstyan and Lane (2009) for Ireland argue that

[1] Perotti (2004) developed this methodology further and has constituted the basis of later studies focused on different countries.

government spending shocks lead to real appreciations. In addition, Froot and Rogoff (1991) and De Gregorio et al., (1994) observe long-run real appreciation in response to increases in government consumption.

In the related literature real depreciation caused by government expenditure shocks is justified on the basis of the following argument: in a large economy, a fiscal expansion increases the real interest rate, which depresses private consumption. Since the demand for money is assumed to depend on private consumption, insofar as prices are sticky, a fall in consumption leads to a depreciation of the nominal and real exchange rate (see Obstfeld and Rogoff, 1995). Moreover, it is also argued that in the short run international price movements tend to amplify instead of mitigate country-specific consumption risk (Enders et al, 2010).

Conversely, a usual argument behind spending shocks-led real appreciations is that insofar as government spending mostly concentrates on home-produced goods, fiscal expansions should make these goods relatively scarcer, thereby increasing their relative price with respect to imported goods and leading to real appreciation (see Frenkel and Razin, 1996).

We aim to provide further evidence in this area by assessing the effects of government spending shocks on external competitiveness and the current account balance in Spain. We base our conclusions on impulse response functions drawn from structural VARs, wherein discretionary fiscal shocks have been identified following the methodology proposed by Blanchard and Perotti (2002) and Perotti (2004). To our understanding, this is the first paper that tackles these issues for Spain under this framework.

We find that government spending shocks lead to real appreciation and deterioration of the external balance. Hence, our results are in line with the "twin deficits" hypothesis. The real depreciation is explained by both an appreciation of the nominal effective exchange rate and by an increase in relative prices. This pattern is consistent with not only the conventional Mundell-Fleming model and Keynesian analysis, but also with a wide set of RBC models under standard calibrations or with some New Keynesian formulations (see, Corsetti et al., 2009).

By spending component, we show that shocks to purchases of goods and services and public investment lead to real appreciation, whereas the opposite happens with higher personnel expenditure. Finally, we obtain output multipliers around 0.5 on impact and slightly above unity one year after the shock, which are in line with previous empirical evidence regarding some individual European countries. However, we offer interesting evidence of output multipliers being higher if we constraint our estimations to a period characterised by a quasi-fixed exchange rate regime.

The rest of the paper is organised as follows: section 2 describes the data, section 3 methodological issues and section 4 the results. Finally, we present our conclusions in section 5.

2 The data

The baseline VAR includes quarterly data on public expenditure (g_t), net taxes (t_t) and GDP (y_t), all in real terms,[2] the GDP deflator (p_t), the three-year interest rate of government bonds (r_t)[3] and the real effective exchange rate (REER henceforth) vis à vis the rest of the world. All variables are seasonally adjusted and enter in logs except the interest rate and the REER, which enter in levels. The definition of fiscal variables follows Blanchard and Perotti (2002) and Perotti (2004). In particular, government spending (g_t) is defined as the sum of government consumption and investment, whereas net taxes (t_t) are defined as total government current receipts, less current transfers and interest payments on government debt.[4] In turn, the REER is defined as usual, namely an increase reflects a real appreciation of the relevant currency.

We try other VAR specifications aiming to better understand the responses of certain variables to fiscal shocks. For this purpose, we also assessed the reactions of nominal effective exchange rates, net exports or the role of relative prices. On the other hand, as we are also interested in the analysis of exchange rate responses to different

[2] The nominal variables have been deflated by the GDP deflator in order to obtain the corresponding real values.
[3] The long-term interest rate is preferred to the short-term one because of its closer relationship with private consumption and investment decisions. However, this choice turned out to be immaterial to the results in that the inclusion of short-term rates in the VAR led to similar conclusions.
[4] More concretely, transfers include all expenditure items except public consumption, public investment and interest payments.

types of fiscal shocks, we included non-wage government consumption, government spending on wages and salaries and public investment in turn as endogenous variables. As before, the GDP deflator was used to get their corresponding real values.

We use data covering the period 1981:Q1 to 2008:Q4. GDP volumes and deflator, exports, imports and net exports have been taken from the Quarterly National Accounts (National Institute of Statistics, INE) while the three-year bond rate has been obtained from the Banco de España database. The quarterly fiscal variables until 2000 were taken from Estrada et al. (2004), which were estimated applying monthly and quarterly official fiscal indicators on a cash basis to the official ESA-95 annual account data. These fiscal variables are the same as those used in De Castro (2006) and De Castro and Hernández de Cos (2008). However, from 2000 on, those variables are not interpolated; they are official figures published by the IGAE (Ministry of Economy and Finance). Finally, real and nominal effective exchange rates have been obtained from the IFS (IMF) database and are defined in such a way that an increase reflects an appreciation. Relative prices are computed from the real and the nominal effective exchange rates.

3 Specification and identification of the baseline (S)VAR model

The reduced-form baseline VAR is specified in levels and can be written as

$$X_t = D(L)X_{t-1} + U_t \tag{1}$$

where $X_t \equiv (g_t, t_t, y_t, p_t, r_t, reer_t)$ is the vector of endogenous variables and *D(L)* is an autoregressive lag-polynomial. The benchmark specification includes a constant and a deterministic time trend. The vector $U_t \equiv (u_t^g, u_t^t, u_t^y, u_t^p, u_t^r, u_t^{reer})$ contains the reduced-form residuals, which in general will present non-zero cross-correlations. The baseline VAR includes four lags of each endogenous variable according to the information provided by LR tests, the Akaike information criterion and the final prediction error.[5]

[5] Schwarz and Hannan-Quinn information criteria suggested more parsimonious specifications. In order to assess the robustness of our results to different specifications and transformations, we tried several alternatives, including estimating with two lags, removing the time trend or substituting the long-term interest rate by a short-term one. These different alternatives showed the same qualitative results.

We apply the identification strategy proposed by Blanchard and Perotti (2002) and Perotti (2004), which exploits decision lags in policy making and information about the elasticity of fiscal variables to economic activity. Their strategy relies on the assumption that the reduced-form residuals of the g_t and t_t equations, u_t^g and u_t^t, can be thought of as linear combinations of three types of shocks: a) the automatic responses of spending and net taxes to the rest of macroeconomic variables in the system, b) systematic discretionary responses of fiscal policy to the same set of macro variables and c) random discretionary fiscal policy shocks, which are the truly uncorrelated structural fiscal policy shocks whose effects are the purpose of our analysis.

The innovations model can be written as $\Gamma U_t = \mathrm{B} V_t$, where $V_t \equiv (e_t^g, e_t^t, e_t^y, e_t^p, e_t^r, e_t^{reer})$ is the vector containing the orthogonal structural shocks. Accordingly, the reduced-form residuals are linear combinations of the orthogonal structural shocks of the form $U_t = \Gamma^{-1}\mathrm{B}V_t$. The respective matrices Γ and B can be written as:

$$\Gamma = \begin{pmatrix} 1 & 0 & -\alpha_{g,y} & -\alpha_{g,p} & -\alpha_{g,r} & -\alpha_{g,reer} \\ 0 & 1 & -\alpha_{t,y} & -\alpha_{t,p} & -\alpha_{t,r} & -\alpha_{t,reer} \\ -\gamma_{y,g} & -\gamma_{y,t} & 1 & 0 & 0 & 0 \\ -\gamma_{p,g} & -\gamma_{p,t} & -\gamma_{p,y} & 1 & 0 & 0 \\ -\gamma_{r,g} & -\gamma_{r,t} & -\gamma_{r,y} & -\gamma_{r,p} & 1 & 0 \\ -\gamma_{reer,g} & -\gamma_{reer,t} & -\gamma_{reer,y} & -\gamma_{reer,p} & -\gamma_{reer,r} & 1 \end{pmatrix} \tag{2}$$

$$\mathrm{B} = \begin{pmatrix} 1 & \beta_{g,t} & 0 & 0 & 0 & 0 \\ \beta_{t,g} & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 \end{pmatrix}$$

As we are interested in analysing the effects of "structural" discretionary fiscal shocks e_t^g and e_t^t on the rest of the variables of the system, estimations for the $\alpha_{i,j}$'s and

$\beta_{i,j}$'s in (2) are needed. In general, approving and implementing new measures in response to specific economic circumstances typically takes longer than three months. Hence, one key assumption in this approach is that quarterly variables allow setting discretionary contemporaneous responses of fiscal variables to changes in underlying macroeconomic conditions to zero. Therefore, the coefficients $\alpha_{i,j}$'s in (2) only reflect the automatic responses of fiscal variables to the rest of the variables of the system, the first source of innovations aforementioned.

The way fiscal variables are defined allows making further assumptions concerning the values of the $\alpha_{i,j}$'s. Specifically, the semi-elasticities of fiscal variables to interest rate innovations are set to zero given that interest payments on government debt are excluded from both definitions.[6] Moreover, the automatic responses of public expenditure to economic activity and the real exchange rate are also set to zero.[7] The case of the price elasticity is different because some share of purchases of goods and services is likely to respond to the price level. Thus, we set the price elasticity of government expenditure to -0.5.[8]

Output and price elasticities of net taxes, $\alpha_{t,y}$ and $\alpha_{t,y}$, are estimated at 0.64 and 0.87, respectively, fully in line with those in De Castro and Hernández de Cos (2008). These are obtained as weighted averages of the elasticities of the different net-tax components, including transfers, computed on the basis of information like statutory tax rates and estimations of the contemporaneous responses of the different tax-bases and, in the case of transfers, the relevant macroeconomic aggregate to GDP and price changes. [9]

Furthermore, given that our main interest lies on expenditure shocks we assume that spending decisions are prior to tax ones, which implies a zero value for $\beta_{g,t}$. This allows us to retrieve e_t^g directly and use it to estimate $\beta_{t,g}$ by OLS, which completes the identification of the first two equations. For the remaining shocks the sequential

[6] In many cases, the income tax base includes interest income as well as dividends, which in general co-vary negatively with interest rates. Nevertheless, the full set of effects of interest rate innovations on the different tax categories are very complex to analyse and, on the other hand, their contemporaneous effects are deemed to be very small.

[7] The absence of contemporaneous response to real exchange rate innovations can be justified on the grounds of the popular home bias of public expenditure items, especially public consumption.

[8] We took this assumption from Perotti (2004). De Castro and Hernández de Cos (2008) and Burriel et al. (2010) show that this assumption affects neither Spanish nor EMU results.

[9] Further details are provided in the appendix.

ordering u_t^y, u_t^p, u_t^r and u_t^{reer} is imposed. The corresponding structural shocks are estimated by instrumental variables in turn, using e_t^g and e_t^t as instruments for u_t^g and u_t^t, respectively. In any case, since we are interested in studying the effects of fiscal policy shocks, the ordering for the remaining variables is immaterial to the results.

In what follows we present our results in terms of impulse response functions. As usual, these are reported jointly with 68% confidence bands[10] obtained by Monte Carlo integration methods with 1000 replications.

4 The effects of government spending shocks

4.1 The baseline VAR

Figure 1 displays the responses of the endogenous variables to a rise in public expenditure.[11] The shock is remarkably persistent and only phases out after three years. An increase in government expenditure entails a positive reaction of output for the first two years following the shock, which is largely in line with previous evidence for different countries. In general, government spending shocks are found to yield positive output responses in the short-term as shown by Blanchard and Perotti (2002), Perotti (2004), Fatás and Mihov (2001) or Mountford and Uhlig (2009) for the US, Heppke-Falk et al. (2006) for Germany, De Castro (2006) and De Castro and Hernández de Cos (2008) for Spain or Giordano et al. (2007) for Italy, although the size and persistence of output multipliers varies significantly across studies.[12] However, in the long term output falls due to the increase in interest rates. In turn, interest rates rise owing to higher inflation[13] and higher financing needs of the government. Net taxes also go up, partly

[10] Edelberg et al. (1999), Fatás and Mihov (2001), Blanchard and Perotti (2002) or Perotti (2004) among others, also choose this bandwidth to present their results.
[11] Impulse responses show deviations with respect to the baseline to a one-percent shock of the relevant fiscal variable. Hence, GDP responses cannot be directly interpreted as output multipliers.
[12] Caldara and Kamps (2008) show that, after controlling for differences in the specification of the reduced form model, all identification approaches used in the literature yield qualitatively and quantitatively very similar results for government spending shocks. Differences are, however, more marked in the case of tax shocks.
[13] We also estimated our baseline VAR until 2009. In this case prices did not react to spending shocks, although the responses of the other variables were broadly the same. This is due to the special

aimed at providing funds for increased expenditure but mainly due to more buoyant economic activity stemming from the innovation.

The real effective exchange rate appreciates in real terms in response to higher government spending.[14] This pattern is consistent with not only the conventional Mundell-Fleming model and Keynesian analysis, but also with a wide set of RBC models under standard calibrations or with some New Keynesian formulations (see, for instance, Corsetti et al., 2009). Accordingly, higher public spending would entail an increase in nominal and real interest rates that would trigger capital inflows and the subsequent appreciation. Moreover, insofar as government spending mostly concentrates on home-produced goods, fiscal expansions should make these goods relatively scarcer, thereby increasing their relative price with respect to imported goods and leading to real appreciation.

However, our results in this regard oppose to Kim and Roubini (2008) for the US for the period 1973–2002, Monacelli and Perotti (2010) for Australia, the U.S. and the U.K. or Ravn et al. (2007) for a pool of Australia, Canada, the U.S. and the U.K., where higher government expenditure yields real depreciations.

4.2 The effects on relative prices and the nominal effective exchange rate

Real appreciation driven by spending shocks can be due to nominal appreciation, increase in relative home prices or both. In our case, since Spain is a small economy, it seems highly unlikely that domestic spending shocks lead to significant effects on the level of foreign prices. In order to deepen the understanding of responses of the real effective exchange rate we substituted in our VAR the REER by the nominal effective exchange rate (NEER) and the relative prices. Both were identified in a similar way to REER in the baseline VAR.

Figure 2 shows that higher public spending leads to nominal appreciation as indicated by the upward and persistent response of NEER. Such nominal appreciation is consistent with the increase in nominal interest rates following the shock. On the other

circumstances that affected the Spanish economy that year. Specifically, a sizeable fiscal stimulus package was implemented in 2009 concomitant with the negative inflation due to the fall of bank credit.

[14] Bénétrix and Lane (2009) obtain similar results for Ireland.

hand, relative home prices also rise in the short term owing to higher domestic inflation. However, this reaction is less persistent than in the case of the NEER; the upward response of relative prices vanishes in the second year after the shock and eventually becomes negative, although such decline is very short-lived.

4.3 Effects on net exports

To assess the effect of spending innovations on the external sector of the economy we enlarged our baseline model in two different ways: firstly, we specified a 7-variable VAR model including net exports; secondly, we estimated an 8-variable VAR where in addition to the variables in the baseline model, we included exports and imports of goods and services. Both specifications are formally equivalent, although the latter allows us to better understand the driving forces behind the reaction of net foreign demand. The corresponding impulse responses are presented in Figure 3.

Higher government spending deteriorates the balance of goods and services for around two and a half years due to the real appreciation. On the one hand, the home-bias of government expenditure explains the initial lack of response of imports. On the other hand, real appreciation discourages the external demand of domestic production and consequently exports decline for around 10 quarters, becoming their response non-significant thereafter. Given the relatively high import content of Spanish exports, their decline contributes to reducing the demand of foreign-produced goods as of the second year after the shock. Nevertheless, such decline offsets only partially the negative response of exports.

Therefore, our results are fully consistent with the “twin deficit” hypothesis. Moreover, our conclusions so far are also in accordance with Corsetti and Müller (2006), notably small and more open countries are more likely to register twin deficits, especially when fiscal shocks are very persistent, which is also the case here.

4.4 The effects of different expenditure components

In general, the different government expenditure items are expected to entail non-homogeneous effects on other economic variables. In particular, Baxter and King (1993) argue that an increase in government investment has a stronger impact on output

than an increase in government consumption, while Alesina et al. (2002) argue that public wage increases may exert upward pressure on the equilibrium wage of the economy that would lead to lower profits and investment. However, evidence on the impact on external competitiveness is scarcer: Ricci et al. (2008) and Lee et al. (2008) highlight the empirical role of government consumption as an important driver of medium-term real exchange rate movements for a large panel of countries; moreover, Froot and Rogoff (1991) and De Gregorio et al., (1994) found that increases in government consumption lead to long-run real appreciation.[15]

On the other hand, government consumption and government investment may be expected to have different effects on relative prices. It is usually assumed that an increase in government consumption triggers the relative demand for non-tradables and thereby causes real appreciation. By contrast, a long-run increase in public investment is deemed to have an ambiguous impact on the real exchange rate because an expansion in the stock of public capital may be expected to enhance productivity. In this connection, an increase in public investment that enhances productivity in the tradables sector may generate real appreciation through the Balassa-Samuelson mechanism, whereas if such productivity gains take place fundamentally in non-tradables sector, it may actually lead to real depreciation.

To assess their effects, we replaced government expenditure by purchases of goods and services, personnel expenditure and public investment in turn in our baseline VAR. Figure 4 shows the responses of REER to shocks to these different government components. As expected, an increase in purchases of goods and services entails a real appreciation as a result of higher relative demand for non-tradables. However, a rise in personnel expenditure provokes a positive, though non-significant response of the REER in the very short term that after some quarters becomes negative and significant. Such real depreciation may be linked to the fall in private investment profitability (Alesina et al., 2002), and the subsequent productivity losses, led by the upward pressure on private wages exerted by public wages. Finally, a shock to public investment generates a real appreciation, which seems to suggest that productivity gains

[15] Lane and Milesi-Ferretti (2002), Galstyan and Lane (2009) and Bénétrix and Lane (2009) provide some evidence for Ireland.

derived from higher public investment materialise more intensively in the tradables sector, in line the Balassa-Samuelson argument.

4.5 Output multipliers

While cumulative output multipliers[16] on impact are estimated at slightly below 0.5, they rise to around one or even higher one year after the shock (see Table 1) in the different models we estimate. In fact, in view of their standard errors, output multipliers are not statistically different across the different specifications. These values are broadly in line with multipliers gauged in De Castro (2006) or De Castro and Hernández de Cos (2008) in the case of Spain, Giordano et al. (2007) for Italy and Heppke-Falk et al. (2006) for Germany. By contrast, these turn out to be somewhat higher than VAR-based output multipliers for the US. (Fatás and Mihov, 2001; Perotti, 2004; Mountford and Uhlig, 2009; Burriel et al., 2010) or for the EMU as a whole (Burriel et al., 2010).

However, the effects of fiscal policy depend, inter alia, on the exchange rate regime, the degree of economic openness and the monetary policy regime. In particular, the effects of fiscal policy shocks on output are deemed to be larger under fixed exchange rates and with accommodative monetary policy. Conversely, fiscal multipliers are expected to decrease with the degree of openness. In this connection, Spain has undergone significant changes in these areas over the period covered by our sample. Firstly, Spain joined the EU in 1986, which meant an unprecedented opening to international trading flows. Secondly, both floating and fixed exchange rates have prevailed since 1980. Specifically, Spain joined the European Monetary System (EMS) mechanism in 1989, which set a quasi-fixed exchange rate regime with respect to the Deutsche Mark, and later on joined the EMU.[17] Therefore, a (quasi) fixed exchange rate regime has prevailed in Spain since 1989. Finally, the Law of Autonomy of the Bank of Spain was approved in 1993, according to which monetisation of public deficits were forbidden thereafter.

[16] The cumulative multiplier at a given quarter is obtained as the ratio of the cumulative response of GDP and the cumulative response of government expenditure at that quarter.

[17] Despite the quasi-fixed exchange rate regime, constant depreciations within the bands set by EMS along with four devaluations took place between 1992 and 1995 as a consequence of the turmoil in the EMS after the rejection of the Maastricht Treaty by Denmark.

These factors, especially the exchange rate regime, may presumably have affected fiscal multipliers. In order to assess its importance we re-estimated our baseline VAR for the period 1989-2009 characterised by a (quasi) fixed exchange rate regime. While in this case our output multiplier on impact stood at 0.5, it rose to 1.4 four quarters after the shock, which turned out to be statistically higher than with the whole sample. Therefore, our estimates for Spain are consistent with the hypothesis of fiscal policy being more effective under fixed than under flexible exchange rates.

By spending component, all items bring about positive output multipliers on impact around 0.4. However, differences show up in medium term responses. Specifically, public investment involves a stronger impact on output than government consumption and total government spending as a whole in the medium term. This evidence is consistent with Baxter and King (1993) and suggests the presence of spillovers between public investment and private sector productivity. Moreover, public spending on goods and services yields similar or even higher output multipliers than public investment. Conversely, personnel expenditure, despite yielding positive and significant output multipliers on impact, they quickly become negative and significant during the second year after the shock. Therefore, these negative output effects derived from the government's wage bill explain the also negative multipliers of total public consumption in the medium term in that personnel expenditure is the largest item of public consumption.[18]

5 Conclusions

The empirical literature on the effects of public spending on the exchange rate and the current account is especially inconclusive. Most of this strand of the literature focuses on the US economy, while evidence about other countries is scanter. This paper contributes a new piece of evidence for the Spanish case. In order to assess the effects of public expenditure on variables characterising the external side of the economy we estimate a SVAR following the methodology sketched in Blanchard and Perotti (2002).

[18] Regarding the effects stemming from different spending items, De Castro and Hernández de Cos (2008) obtain similar results.

Our analysis shows that government spending brings about positive output responses, jointly with real appreciation. Such real appreciation is explained by persistent nominal appreciation and higher relative prices in the short term. In turn, the current account deteriorates when government spending rises mainly due to the fall of exports caused by the real appreciation. Accordingly, our results in this regard are largely consistent not only with the conventional Mundell-Fleming model and, in general a traditional Keynesian view, but also with a wide set of RBC or New Keynesian models under standard calibrations. Moreover, our estimations are fully consistent with the "twin deficits" hypothesis.

As for expenditure components, we observe that while spending on goods and services and public investment increase output and lead to real appreciation, higher personnel expenditure weights on economic activity and brings about real depreciation already in the second year after the shock. Such real depreciation might be linked to lower potential growth as a result of lower investment profitability stemming from higher labour costs.

On the other hand, we obtain output multipliers around 0.5 on impact and slightly above unity one year after the shock. These multipliers are in line with previous empirical evidence regarding some individual European countries, such as Germany, Italy or even Spain, although they seem to be on the high side when compared with multipliers estimated for other OECD countries, including the US. Finally, we find some evidence in favour of the hypothesis of output multipliers being higher under fixed exchange rates in the case of Spain.

Appendix. Construction of output and price elasticities

In order to calculate the output and price elasticities we basically follow the OECD methodology proposed in Giorno et al. (1995), which focuses on four tax categories, i.e. personal income tax, corporate income tax, indirect taxes and social security contributions. In addition, they consider the elasticity of transfer programmes, notably unemployment benefits. According to this methodology, the output elasticity of the personal income tax can be obtained as:

$$\varepsilon_{tdirh,y} = (\varepsilon_{tdirh,w}\varepsilon_{w,emp} + 1)\varepsilon_{emp,y} \qquad \text{(A.1)}$$

where $\varepsilon_{tdirh,w}$ is the elasticity of personal income tax revenues to earnings, measured by the compensation per employee, $\varepsilon_{w,emp}$ is the employment elasticity of the real wage and $\varepsilon_{emp,y}$ the GDP elasticity of employment. Analogously, the output elasticity of social security contributions is:

$$\varepsilon_{ss,y} = (\varepsilon_{ss,w}\varepsilon_{w,emp} + 1)\varepsilon_{emp,y} \qquad \text{(A.2)}$$

with $\varepsilon_{ss,w}$ being the elasticity of social contributions to earnings.

The output elasticity of corporate income tax revenues stems from:

$$\varepsilon_{tdirc,y} = \varepsilon_{tdirc,gos}\varepsilon_{gos,y} \qquad \text{(A.3)}$$

where $\varepsilon_{tdirc,gos}$ is the elasticity of tax revenues to the gross operating surplus and $\varepsilon_{gos,y}$ the output elasticity of the gross operating surplus. In the same fashion, given that the main tax base for indirect tax collections is private consumption, the output elasticity of indirect taxes is obtained as:

$$\varepsilon_{tind,y} = \varepsilon_{tind,c}\varepsilon_{c,y} \qquad \text{(A.4)}$$

where $\varepsilon_{tind,c}$ and $\varepsilon_{c,y}$ are the private consumption elasticity of indirect taxes and the output elasticity of private consumption, respectively.

Since we employ data on a national accounts basis, collection lags should not affect the elasticities to the respective tax-bases significantly. Hence, these have been taken from van den Noord (2000) and Bouthevillain et al. (2001). The output elasticities of the relevant tax bases were, however, obtained from econometric estimation on a quarterly basis. In general, the general equation used for estimating these elasticities was:

$$\Delta Ln(B_t^i) = \gamma + \varepsilon_i \Delta Ln(Y_t) + \eta_t \qquad \text{(A.5)}$$

where B^i is the relevant tax base for the ith tax category and ε_i is the output elasticity of such tax base. These equations, given the likely contemporaneous correlation between the independent variable and the error term, were estimated by instrumental variables.

However, if the variables B^i and Y are cointegrated, (A.5) contains a specification error. In this case, the following ECM specification would be preferable:

$$\Delta Ln(B_t^i) = \gamma + \mu(Ln(B_{t-1}^i) - \lambda Ln(Y_{t-1}) - \phi) + \varepsilon_i \Delta Ln(Y_t) + \sum_{j=1}^{k} \varphi_j \Delta Ln(Y_{t-j}) + \sum_{j=1}^{k} \nu_j \Delta Ln(B_{t-j}^i) + \eta_t \quad \text{(A.6)}$$

where λ measures the long-term contemporaneous elasticity we are interested in.

Information on the output elasticity of net transfers is more limited than in the former cases. Although unemployment benefits respond to the underlying economic conditions, many expenditure programmes do not have built-in conditions that make them respond contemporaneously to employment or output. Therefore, recalling Perotti's argument, an output elasticity of net transfers of -0.2 has been assumed.

As for price elasticities, following van der Noord (2000) those of direct taxes paid by households, corporate income taxes and social contributions were obtained as $\varepsilon_{tdirh,p} = \varepsilon_{tdirh,w} - 1$, $\varepsilon_{tdirc,p} = \varepsilon_{tdirc,gos} - 1$ and $\varepsilon_{ss,p} = \varepsilon_{ss,w} - 1$, respectively. Indirect taxes are typically proportional. Hence, following Perotti (2004), a zero price elasticity was assumed. Finally, although transfer programmes are indexed to the CPI, indexation occurs with a considerable lag. Thus, the price elasticity of transfers was set to -1.

Accordingly, contemporaneous output elasticities of net taxes can be calculated as:

$$\alpha_{t,y} = \sum_i \varepsilon_{T_i,B_i} \varepsilon_{B_i,y} \frac{T_i}{T} \quad \text{(A.7)}$$

with $T = \sum T_i$ being the level of net taxes[19], ε_{T_i,B_i} the elasticity of the ith category of net taxes to its own tax base and $\varepsilon_{B_i,y}$ the GDP elasticity of the tax base of the ith category of net taxes. Price elasticities are obtained in a similar fashion. Table 2 shows the resulting output and price elasticities.

[19] The T_i's are positive in the case of taxes and negative in the case of transfers.

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Table 1: Cumulative output multipliers in different specifications

	Quartes after the shock			
	q=1	q=4	q=8	q=12
Baseline VAR	0.41*	0.94*	0.95*	0.55
VAR with $neer_t$ and $prel_t$	0.43*	1.12*	1.21*	0.73
VAR with net exports	0.43*	1.003*	1.04*	0.73*
Baseline VAR since 1989	0.49*	1.36*	1.98*	1.78
Expenditure on goods and services	0.39*	1.56*	2.36*	2.21*
Personnel expenditure	0.42*	-0.64	-4.59*	-14.09
Total public consumption	0.28*	0.23	-1.03*	-3.08*
Public investment	0.4*	1.03*	1.89*	1.75

Notes: Cumulative output multipliers at a given quarter are defined as the cumulative output response relative to the cumulative increase in the relevant expenditure item. An asterisk indicates that the estimated value is significant within a 68% confidence interval.

Table 2: Output and price elasticities of net taxes

		Output elasticities		**Price elasticities**	
$\varepsilon_{tdirh,w}$	1.8	$\varepsilon_{tdirh,y}$	0.17	$\varepsilon_{tdir,p}$	0.8
$\varepsilon_{w,emp}$	0.0	$\varepsilon_{ss,y}$	0.17	$\varepsilon_{ss,p}$	-0.2
$\varepsilon_{emp,y}$	0.17	$\varepsilon_{tdirc,y}$	1.04	$\varepsilon_{tind,p}$	0.0
$\varepsilon_{ss,w}$	0.8	$\varepsilon_{tind,y}$	0.3	$\varepsilon_{transf,p}$	-1.0
$\varepsilon_{tdirc,gos}$	1.0	$\varepsilon_{transf,y}$	-0.2	$\boldsymbol{\varepsilon_{t,p}}$	**0.87**
$\varepsilon_{gos,y}$	1.04	$\boldsymbol{\varepsilon_{t,y}}$	**0.62**		
$\varepsilon_{c,y}$	0.3				
$\varepsilon_{tind,c}$	1.0				

Figure 1: Responses to an increase in government spending: Baseline VAR

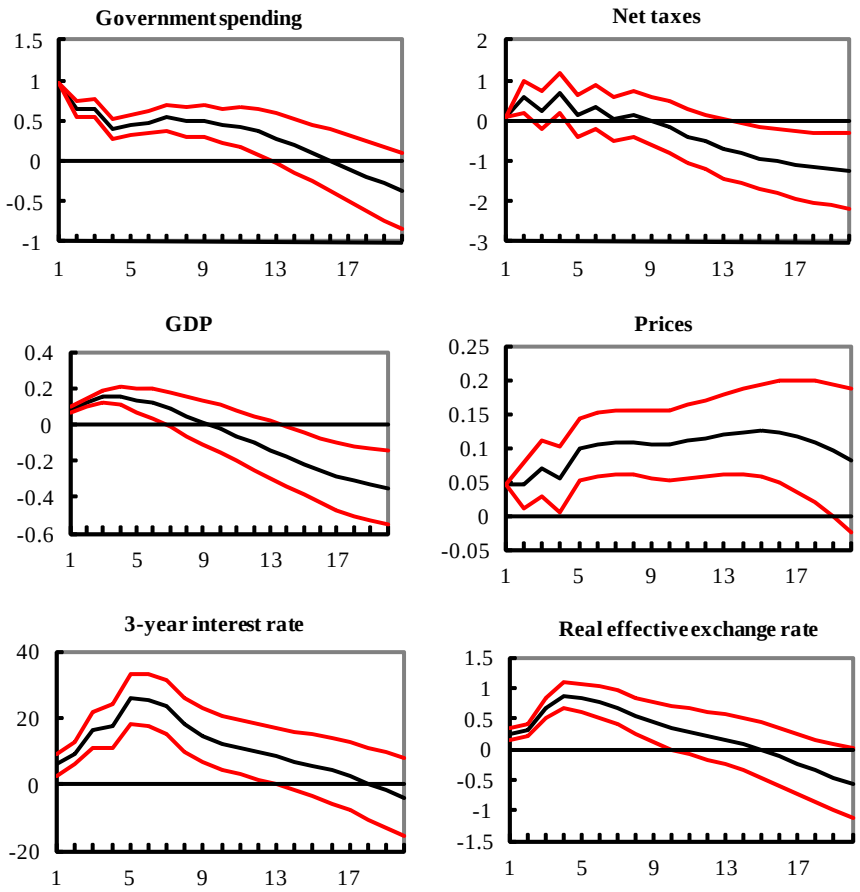

Figure 2: Responses of nominal effective exchange rate and relative prices to an increase in government spending

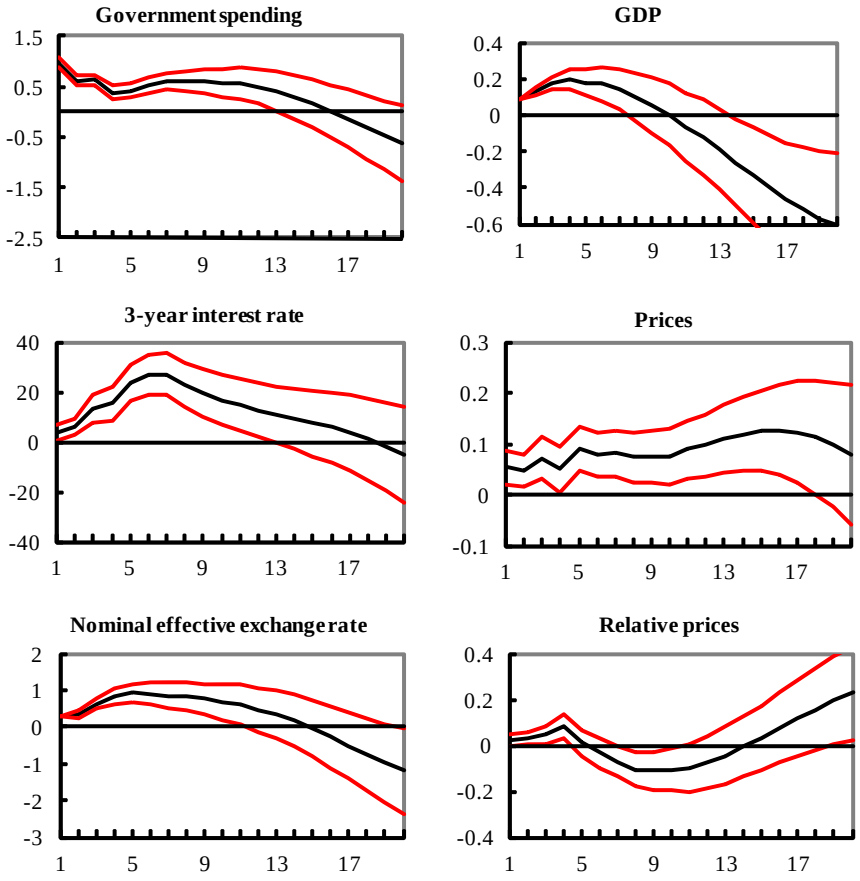

Figure 3: Effects of government spending on net exports

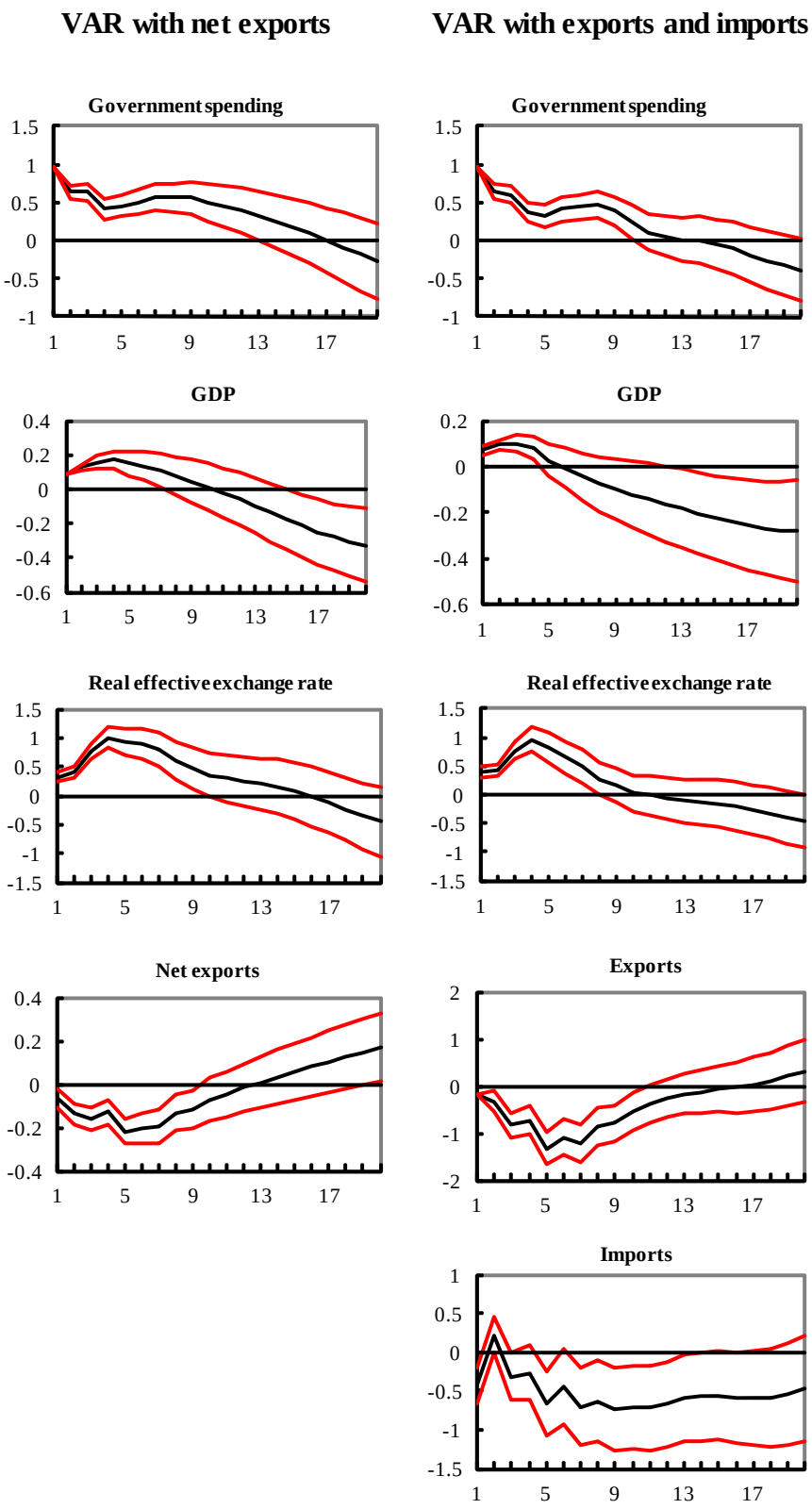

Figure 4: Effects of expenditure components on the exchange rate