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Abstract

This paper estimates the effects of exogenous fiscal policy shocks in Spain in a VAR framework. Government expenditure expansionary shocks are found to have a positive impact on output in the short-term at the cost of higher inflation and public deficits and lower output in the medium and long term. Tax increases are found to have a negative impact on economic activity in the medium term while having only a temporary effect on the improvement of the public deficit. The application of these results to the analysis of fiscal policy in Spain since the mid-nineties point to the conclusion that the consolidation process does not seem to have involved costs in terms of output growth and the stance of fiscal policy has become more counter-cyclical.

1 Introduction

The role of fiscal policy in influencing economic activity has been one of the most extensively discussed issues by both academics and policy-makers. A renewed emphasis on this issue has recently been observed in the European and Monetary Union (EMU), where fiscal policy emerges as the only instrument on the demand side in the hands of Member States to offset idiosyncratic shocks.

Despite this relevance, we know surprisingly very little about the effects of fiscal policy on economic activity [Perotti (2001)]. From a theoretical point of view, the sign and magnitude of the impact of discretionary fiscal policy on aggregate demand depends on a number of key assumptions[1], with different models offering often opposite conclusions.

The empirical evidence does not provide either a common picture. In particular, although most of the recent literature, based either on structural macro models or on VAR analysis, shows positive short-term output multipliers stemming from expansionary fiscal policy shocks, the estimated magnitude and duration of these effects is very disperse (see Table 1 for a brief summary of the effects of fiscal policy shocks on GDP and prices in selected VAR studies). There is even some evidence of negative fiscal multipliers for some OECD countries in the post-1980 period [Perotti (2004)]. In addition, a recent stream of the literature that aims at explaining the economic effects of fiscal consolidations has found, under certain circumstances, positive output responses following fiscal retrenchments, the so-called non-Keynesian effects of fiscal policy [Giavazzi and Pagano (1990), European Commission (2003) and Perotti (1999)][2].

Against this background, this paper aims at providing evidence for the case of Spain on the effects of exogenous fiscal policy shocks on a set of key macroeconomic variables within a VAR framework. Most of the recent existing evidence on the responses of fiscal policy shocks relies indeed on SVAR models, with the main differences among papers coming from the alternative approaches followed to identify the fiscal policy shocks. These approaches can be summarised in four [Perotti (2004)]: 1) some authors [Burnside et al. (2003), Ramey and Shapiro (1997), and Edelberg et al. (1999)] identify fiscal policy shocks by using dummy variables that capture specific episodes such as the military build-ups corresponding to the Korean and the Vietnam war or the Reagan fiscal expansion in the case of the US; 2) other authors identify fiscal shocks by imposing sign restrictions on the impulse-response functions [Mountford and Uhlig (2002)]; 3) Favero (2002) and Fatas and Mihov (2002) identify fiscal shocks by using a Choleski ordering; 4) and finally, Blanchard and Perotti (2002) and Perotti (2004) identify fiscal policy shocks by exploiting decision lags in policy making and information about the elasticity of fiscal variables to economic activity. This latter approach is the one we follow in this paper. In this respect, our results should be considered as a complement to the previous evidence on the same topic already available for Spain using alternative identification schemes [De Castro (2005) and Marcellino (2002)].

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1. Including, inter alia, the existence of nominal rigidities in the economy, the elasticity of the labour supply, the interest-rate elasticity of investment, the interest-rate and income elasticities of money demand, the degree of openness of the economy, the exchange-rate regime, the magnitude of the wealth effects, the presence of forward-looking agents and, more generally, the role played by rational expectations.

2. See also Giudice et al. (2003) for an interesting synthesis of the theoretical arguments behind the non-Keynesian effects along with a useful compilation of the empirical evidence.

Table 1: Effects of fiscal policy shocks in selected VAR studies (1)

	GDP				Prices			
Quarters	**1st**	**4th**	**12th**	**20th**	**1st**	**4th**	**12th**	**20th**
Expenditure shock – US								
Blanchard and Perotti (2002) 1947-1997	+*	+	+*	+*				
Perotti (2004) 1961-2000	+*	+	+*	+*	+*	−	−*	−*
Perotti (2004) 1980-2000	+	+	−	−*	+	−	+	+
Neri (2001) 1965-1996	+*	+*	−	−	+	+	+	+
Fatás and Mihov (2001) 1960-1996	+*	+*	+*	+*	−*	−*	−*	−*
Edelberg, Eichenbaum and Fisher (1998) 1948-1996	+*	+*	+*		+*	+*	−	
Burnside, Eichenbaum and Fisher (1999) 1947-1994	+*	+*	+					
Mountford and Uhlig (2002) 1955-2000	+	+	−	−	−	−*	−*	−
Canzoneri, Cumby and Diba (2002)	+*	+*	+		−	+	+	
Expenditure shock – Germany								
Perotti (2004) 1961-2000	+*	+*	−	+*	+*	+*	+*	+*
Perotti (2004) 1980-2000	+	−*	−	−	+	+*	+*	+
Marcellino (2002) 1981-2001	+*	+*			−	−		
Revenue shock – US								
Blanchard and Perotti (2002) 1947-1997	−*	−*	−*	−				
Perotti (2004) 1961-2000	−*	−*	−*	−*	+	−	−*	−*
Perotti (2004) 1980-2000	−*	−	*	−	−	−*	−*	−
Neri (2001) 1965-1996	−*	−*	−*	−*	−*	−*	−*	−*
Mountford and Uhlig (2002) 1955-2000	−*	−*	−*	−	+	+	−	−
Canzoneri, Cumby and Diba (2002)	−*	−*	−*		+	−	−	
Revenue shock – Germany								
Perotti (2004) 1961-2000	−*	−*	−*	−	−	+*	+	−
Perotti (2004) 1980-2000	+	−*	−	−*	−*	−	−*	−
Marcellino (2002) 1981-2001	−	−			+	+		

* The value 0 is outside the region between the two one-standard error bands.

(1) Source: Henry, J., P. Hernández de Cos and S. Momigliano (2004).

The rest of the paper is organised as follows: section 2 describes the data and addresses the methodological issues related to the specification and identification of the VAR; section 3 presents the results stemming from expenditure shocks, whereas section 4 focuses on the effects of shocks to net taxes; section 5 analyses the robustness of the results, section 6 includes an application of our results to the analysis of the contribution of fiscal policy to GDP growth in Spain since the mid-nineties, and, finally, section 7 concludes.

2 Methodological issues

2.1 The VAR specification

Our benchmark specification of the VAR includes quarterly data on public expenditure (g_t), net taxes (t_t) and GDP (y_t) in real terms[3], the GDP deflator (p_t) and the three-year interest rate of government bonds (r_t)[4]. g_t is defined as the sum of public consumption[5] and public investment, whereas t_t includes public revenues net of transfers[6], excluding interest payments on government debt. Thus the general government primary budget balance is obtained as the difference between t_t and g_t. All variables are seasonally adjusted and enter in logs except the interest rate, which enters in levels. The sample covers the period 1980:1-2004:4[7].

The reduced form VAR can be written as

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

where $X_t \equiv (g_t, t_t, y_t, p_t, r_t)$ is the vector of endogenous variables. The only deterministic component is a constant term and D(L) is an autoregressive lag polynomial. The vector $U_t \equiv (u_t^g, u_t^t, u_t^y, u_t^p, u_t^r)$ contains the reduced form residuals, which in general will have non-zero correlations. Model (1) is estimated by OLS and the number of lags was set to five according to the information provided by LR tests and the Akaike information criterion.

In order to account for the effects on private consumption and investment, two alternative 6-variable VAR models were used. They included the original five variables of the baseline specification plus one of both private sector variables.

2.2 Identification of fiscal policy shocks

The reduced-form residuals have little economic significance in that they are linear combinations of structural shocks. In particular, following Blanchard and Perotti (2002) and Perotti (2004), 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 GDP, price and interest rate innovations, b) systematic discretionary responses of fiscal policy to the macro variables in the system, and c) random discretionary fiscal policy shocks, taken as the truly uncorrelated structural fiscal policy shocks. Thus, the reduced-form residuals in the first two equations can be decomposed as:

$$u_t^g = \alpha_{g,y}u_t^y + \alpha_{g,p}u_t^p + \alpha_{g,r}u_t^r + \beta_{g,t}e_t^t + e_t^g \tag{2a}$$

3. In all cases the GDP deflator is employed so as to obtain the corresponding real values.

4. The inclusion of the long-term interest rate instead of the short-term one is justified for its closer relationship with consumption and investment decisions.

5. Compensation of civil servants plus other consumption expenditure items such as purchases of goods and services.

6. It includes both current and capital transfers. More concretely, transfers include all expenditure items except public consumption, public investment and interest payments.

7. GDP volumes and deflator 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 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.

$$u_t^t = \alpha_{t,y} u_t^y + \alpha_{t,p} u_t^p + \alpha_{t,r} u_t^r + \beta_{t,g} e_t^g + e_t^t \quad \text{(2b)}$$

where (e_t^g , e_t^t) are the structural orthogonal shocks of government expenditure and net taxes[8], respectively.

In particular, we are interested in analysing the effects of the discretionary fiscal shocks, e_t^g and e_t^t, on the rest of the variables of the system, for which estimations for the $\alpha_{i,j}$'s and $\beta_{i,j}$'s in (2) are needed. The use of quarterly variables allows for setting the discretionary contemporaneous response of government expenditure or net taxes to GDP, prices or interest rate innovations to zero in that it typically takes longer than three months to approve and implement new measures. Therefore, the coefficients $\alpha_{i,j}$'s in (2a) and (2b) only reflect the automatic responses of fiscal variables to innovations in the rest of the variables of the system, the first component mentioned above.

Given that interest payments on government debt are excluded from the definitions of expenditure and net taxes, the semi-elasticities of these two fiscal variables to interest rate innovations, i. e. $\alpha_{g,r}$ and $\alpha_{t,r}$, have been set to zero. While this assumption appears justified for government expenditure and plays no role when analysing its effects, it is slightly more controversial for net taxes[9].

Consider now equation (2a). Our choice of the items included in the definition of government expenditure, notably public consumption and investment, makes it hard to think about any automatic response of public expenditure to economic activity. Accordingly, we can set $\alpha_{g,y} = 0$. The case of price elasticity is different, though. Some share of purchases of goods and services are likely to respond to the price level. In addition, the wage component is typically indexed to the CPI, even though indexation takes place with some delay. Thus, an eclectic approach has been adopted and, following Perotti (2004) the price elasticity of government expenditure has been set to -0.5. The relevance of this choice, however, seems very limited in that, as it will be explained ahead, setting this price elasticity to zero does not seem to affect the results significantly.

As for (2b), the output and price elasticities $\alpha_{i,j}$ are 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 response of the different tax-bases and, in the case of transfers, the relevant macroeconomic aggregate to GDP and price changes. In general, the contemporaneous output elasticity of net taxes can be calculated as:

$$\alpha_{t,y} = \sum_i \varepsilon_{T_i,B_i} \varepsilon_{B_i,y} \frac{T_i}{T} \quad \text{(3)}$$

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8. Similarly, e_t^y , e_t^p , e_t^r would be the structural orthogonal shocks derived from the reduced-form residuals in the other three equations related to activity, prices and interest rate, respectively.

9. The income tax-base includes interest income as well as dividends, which covary negatively with interest rates. Recalling the argument in Perotti (2004), 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.

with $T=\sum T_i$ being the level of net taxes[10], 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 for some components of net taxes were, however, obtained directly through econometric estimation, whereas others were calibrated. Appendix A explains in detail the procedure followed to obtain such elasticities.

Once the output and price elasticities have been estimated, the so-called "adjusted" fiscal shocks (u^{CA}) can be derived as follows:

$$u_t^{g,CA}=u_t^g-(\alpha_{g,y}u_t^y+\alpha_{g,p}u_t^p+\alpha_{g,r}u_t^r)=\beta_{g,t}e_t^t+e_t^g \tag{3a}$$

$$u_t^{t,CA}=u_t^t-(\alpha_{t,y}u_t^y+\alpha_{t,p}u_t^p+\alpha_{t,r}u_t^r)=\beta_{t,g}e_t^g+e_t^t \tag{3b}$$

Some further assumptions are needed here and they depend on our view of the functioning of fiscal policy. If one believes that expenditure decisions are prior to tax ones, $\beta_{g,t}$ would be zero. Hence, e_t^g could be recovered directly from (3a) and use it in (3b) so as to estimate $\beta_{t,g}$ by OLS. Conversely, if tax decisions are deemed to come first, we would have to proceed symmetrically so as to get an estimate of $\beta_{g,t}$. It could be quite difficult to find arguments that fully justify any of both orderings. Therefore, we have decided to present our results on the basis that expenditure comes first, i. e. $\beta_{g,t}$ = 0. Nevertheless, this choice does not seem to affect the main results in a substantial way[11], as it will be shown later on.

Since we are interested in studying the effects of fiscal policy shocks, the ordering of the remaining variables is immaterial to the results. Accordingly, the reduced form output residuals are assumed to be a linear combination of the fiscal shocks.

$$u_t^y=\gamma_{y,g}u_t^g+\gamma_{y,t}u_t^t+e_t^y \tag{4}$$

By definition, some contemporaneous correlation between the reduced form residuals of the fiscal equations and e_t^y is expected. Hence (4) is estimated by instrumental variables, using the structural uncorrelated fiscal shocks, e_t^g and e_t^t as instruments for u_t^g and u_t^t. Likewise, the price equation

$$u_t^p=\gamma_{p,g}u_t^g+\gamma_{p,t}u_t^t+\gamma_{p,y}u_t^y+e_t^p \tag{5}$$

can be estimated by using e_t^g, e_t^t and e_t^y as instruments. And finally, the interest rate equation

$$u_t^r=\gamma_{r,g}u_t^g+\gamma_{r,t}u_t^t+\gamma_{r,y}u_t^y+\gamma_{r,p}u_t^p+e_t^r \tag{6}$$

can be estimated accordingly once e_t^p has been obtained.

10. The T_i's are positive in the case of taxes and negative in the case of transfers.

11. In fact, this is mainly due to the low and non-significant correlation between expenditure and net-tax shocks.

As a result, the innovation model can be written as

$$\Gamma U_t = \mathrm{B} V_t \tag{7}$$

where V_t is the vector containing the orthogonal structural shocks and

$$\Gamma = \begin{pmatrix} 1 & 0 & -\alpha_{g,y} & -\alpha_{g,p} & -\alpha_{g,r} \\ 0 & 1 & -\alpha_{t,y} & -\alpha_{t,p} & -\alpha_{t,r} \\ -\gamma_{y,g} & -\gamma_{y,t} & 1 & 0 & 0 \\ -\gamma_{p,g} & -\gamma_{p,t} & -\gamma_{p,y} & 1 & 0 \\ -\gamma_{r,g} & -\gamma_{r,t} & -\gamma_{r,y} & -\gamma_{r,p} & 1 \end{pmatrix} \tag{8}$$

and

$$\mathrm{B} = \begin{pmatrix} 1 & \beta_{g,t} & 0 & 0 & 0 \\ \beta_{t,g} & 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \end{pmatrix} \tag{9}$$

Accordingly, the reduced form residuals are linear combinations of the orthogonal structural shocks of the form:

$$U_t = \Gamma^{-1} \mathrm{B} V_t \tag{10}$$

Table 2 shows the estimated coefficients for the baseline model. All of them have the expected sign except $\gamma_{r,y}$ that yielded a negative value. Given that it turned out to be non-significant, it was decided to fix it to zero.

Finally, we are also interested in characterising the responses of some GDP components such as private consumption and private investment, for which these variables are added in turn to the VAR. The identification of the resulting 6-variable VARs was achieved by departing from (8) and (9) and estimating the contemporaneous bi-directional interaction between GDP and its respective component[12].

12. Another possibility would be to replace GDP by one of both components and re-estimate Γ accordingly. However, both approaches yield very similar results.

Table 2: Estimates of B and Γ in the benchmark specification

	Regressors				
Equation	e^g	u^g	u^t	u^y	u^p
u^t	$\beta_{t,g} = 0.554$ (1.83)			$\alpha_{t,y} = 0.62$	$\alpha_{t,p} = 0.78$
u^y		$\gamma_{y,g} = 0.103$ (3.07)	$\gamma_{y,t} = -0.008$ (-0.69)		
u^p		$\gamma_{p,g} = 0.065$ (2.83)	$\gamma_{p,t} = -0.014$ (-1.94)	$\gamma_{p,y} = 0.055$ (0.80)	
u^r		$\gamma_{r,g} = 0.064$ (1.66)	$\gamma_{r,t} = 0.023$ (1.97)	$\gamma_{r,y} = -0.044$ (-0.39)	$\gamma_{r,p} = 0.212$ (1.21)

Notes: t-ratios in brackets. The negative sign of $\gamma_{r,y}$ is quite unexpected and lacks economic justification. Therefore, given that it was non-significant, it was decided to set $\gamma_{r,y} = 0.0$.

3 The effects of government expenditure shocks

3.1 The baseline specification

Figure 1 displays the responses of the endogenous variables to a positive expenditure shock[13]. It should be first highlighted that the expenditure shock turns out to be very persistent and only becomes insignificant after almost five years. The high persistence of public expenditure shocks is in line with the evidence existing for other OECD countries [Perotti (2004) and Galí et al. (2003)].

The increase of government expenditure raises GDP, which peaks in the 3rd quarter after the shock. The cumulative output multipliers[14] are slightly above one in the first two years: 1.31 and 1.33 in the fourth and eight quarters after the shock, respectively (see Table 3). These multipliers are broadly in line with previous studies for the case of Spain [De Castro (2005)] and are at the higher-ranks of the values obtained for other OECD countries [(Fatás and Mihov (2000), Mountford and Uhlig (2002), Perotti (2004) and Galí et al. (2003)]. The sign and magnitude of these VAR short-term responses are also consistent with the short-term multipliers obtained with macroeconometric models. In particular, Estrada et al. (2004) report output multipliers of government spending in Spain of 1.2 at the end of the first year and 1.4 after eight quarters.

In the longer term, however, our results show that the GDP response dwindles steadily and becomes significantly negative after four years. This evidence is also in line with the negative medium-term output responses that have been obtained for some other OECD countries [Perotti (2004), Neri (2001) and Mountford and Uhlig (2002)].

As regards the impact on other fiscal variables, net-tax revenues rise and remain positive and significant for approximately twelve quarters, turning negative in the medium term, following the decline in economic activity. The initial increase of net-tax collections improves slightly the primary balance during some quarters following the shock. In the medium term, however, as expected, a persistent deterioration in the primary balance shows up.

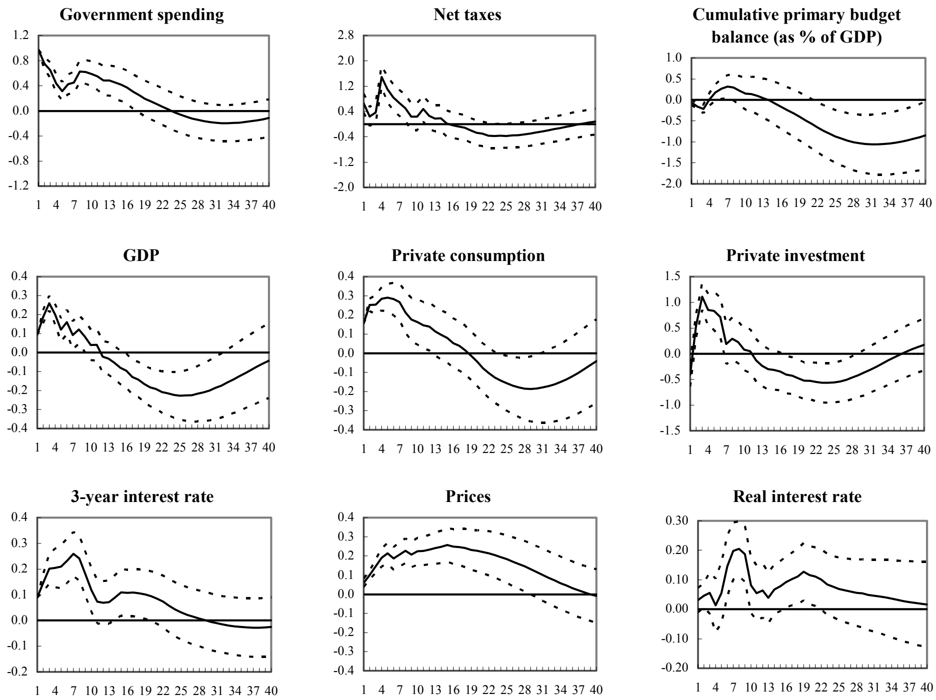
Table 3: Cumulative output multipliers to government expenditure shocks

	Quarters				
Shock to:	**4^{th} q**	**8^{th} q**	**12^{th} q**	**16^{th} q**	**20^{th} q**
Expenditure (Baseline VAR)	1.31	1.33	1.00	0.65	0.26
Expenditure (Net taxes first)	1.31	1.37	1.06	0.74	0.40
Expenditure ($\alpha_{g,p}$ = 0)	1.30	1.32	0.97	0.61	0.21
Public consumption	0.67	-0.33	-1.75	-4.02	-8.69
Public investment	1.12	1.86	1.72	1.16	0.69

13. The responses of private consumption and private investment obtained from a 6-variable VAR are also depicted. In all cases, impulse responses are reported for ten years and the one-standard deviation confidence bands have been obtained by Monte Carlo integration methods with 500 replications.

14. The cumulative dynamic multiplier at a given quarter is obtained as the ratio of the cumulative response of GDP and the cumulative response of government expenditure.

Figure 1: Responses to an increase in government expenditure



Higher government expenditure also brings about a persistent positive response of the GDP deflator, which implies higher inflation in the quarters following the shock. This is a potentially important result since, although De Castro (2005) already obtains evidence of this kind for Spain, this is far from being a general finding in VAR analysis. In fact, the evidence from this literature on the effects of government spending shocks on prices or inflation is rather mixed[15]. Our results are, in any case, consistent with those derived from macromodels for Spain, which find relatively large positive effects on inflation stemming from government expenditure shocks [Estrada et al. (2004) and Henry et al. (2004)].

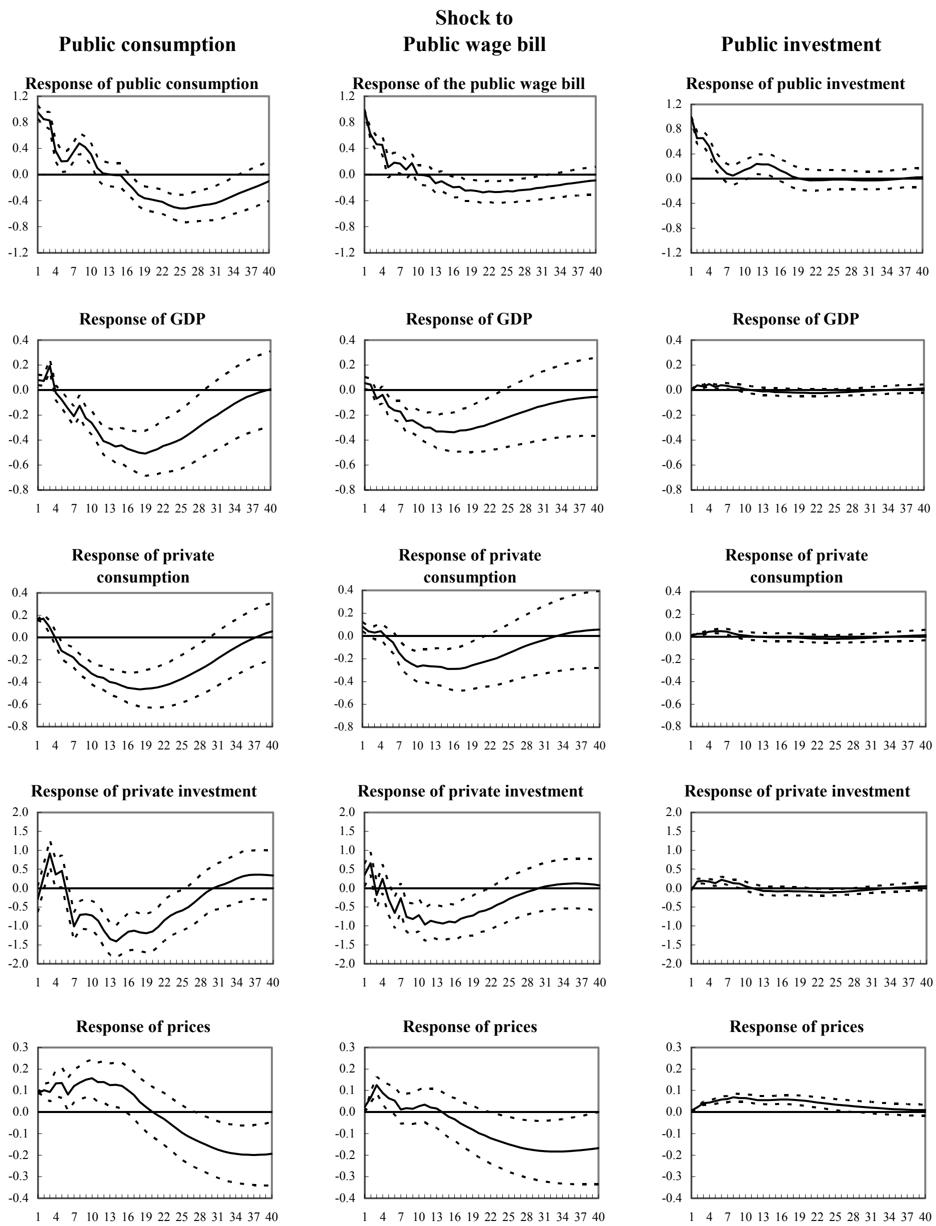
Likewise, interest rates increase persistently following a positive shock to government expenditure[16]. While the positive response of the interest rate in the short term might be due to higher demand and inflationary pressures, the persistent deterioration of the primary balance could contribute to sustain the interest rate above its baseline values. Moreover, the real interest rate[17] rises, being such increase significant on average over the first three years after the shock, thereby helping to drag economic activity.

15. For the US, Fatás and Mihov (2001), and Mountford and Uhlig (2002) show negative effects on prices after a positive government spending shock, while Perotti (2004) finds an initial positive impact and negative effects thereafter on the CPI over the period 1961-2000; for the sub-period starting in 1980, the effects (albeit not significant) are instead positive after one, twelve and twenty quarters and negative after four quarters. Edelberg et al. (1999) find a negative effect after an initial positive effect, Neri (2001) reports no significant effects and Canzoneri et al. (2002) find a temporary rise in inflation after a brief decline. For other OECD countries, Perotti (2002) finds positive effects of government spending on prices in Germany, the UK and Australia, and negative, albeit small, in Canada. Marcellino (2002) reports minor and not statistically significant effects on inflation in Germany, Italy and Spain and a positive and significant effect in France in the short term. For a summary of all these results see Henry et al. (2004).

16. In contrast, Perotti (2004) finds no clear-cut evidence in either direction on this issue.

17. The real interest rate is obtained as the difference between the nominal interest rate and the observed annual inflation rate in the same period. We are aware that this definition may be controversial from a theoretical point of view in

Figure 2: Responses to shocks to government expenditure components



As for the GDP components, the augmented VAR yields patterns of response for private consumption and investment quite similar to that of GDP, going up in the quarters following the shock and declining in the longer term. Thus private consumption reaches its peak in the 5th quarter, whereas private investment peaks somewhat earlier. These short-run effects are again consistent with those derived from macro models for Spain and, as regards consumption, with most of the VAR evidence for other countries [Fatás and Mihov (2001), Blanchard and Perotti (2002), and Gali et al. (2003)]. The evidence for private investment is

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that it implicitly assumes that expected inflation equals observed inflation. Nevertheless, we consider that it can represent an acceptable approximation.

however more mixed, with some papers showing negative responses of this variable to an exogenous increase in government spending.

3.2 The effects of different public expenditure components

In order to account for the different effects on economic activity stemming from public consumption expenditure and public investment, aggregate expenditure is replaced in the VAR by either component in turn in both the baseline and augmented VARs. Figure 2 shows the corresponding impulse response functions.

Neither public consumption nor investment shocks appear too persistent. In both cases, GDP increases and peaks in the third quarter. The GDP response to a public consumption shock becomes significantly negative from the fourth quarter onwards. This fall is also observed in the responses of private consumption and investment, which reproduce output movements quite closely. Moreover, the main culprit for these results is the wage bill component of public consumption, as can be shown in the second column of Figure 2[18].

In contrast, the positive response of GDP to public investment shocks is of significantly lower magnitude[19], although takes more time to fade away, around eight quarters. Thereafter, the GDP response becomes non-significant. In the same vein, private consumption and investment show positive responses in the first two years after the shock.

Finally, all expenditure items involve positive short-term price responses. However, in the case of increases in the wage bill, this positive response quickly fades away as a result of the negative effects on economic activity.

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18. These results are consistent with the hypothesis that public wage increases may exert upward pressure on the equilibrium wage, leading to lower profits and investment [Alesina et al. (2002)].

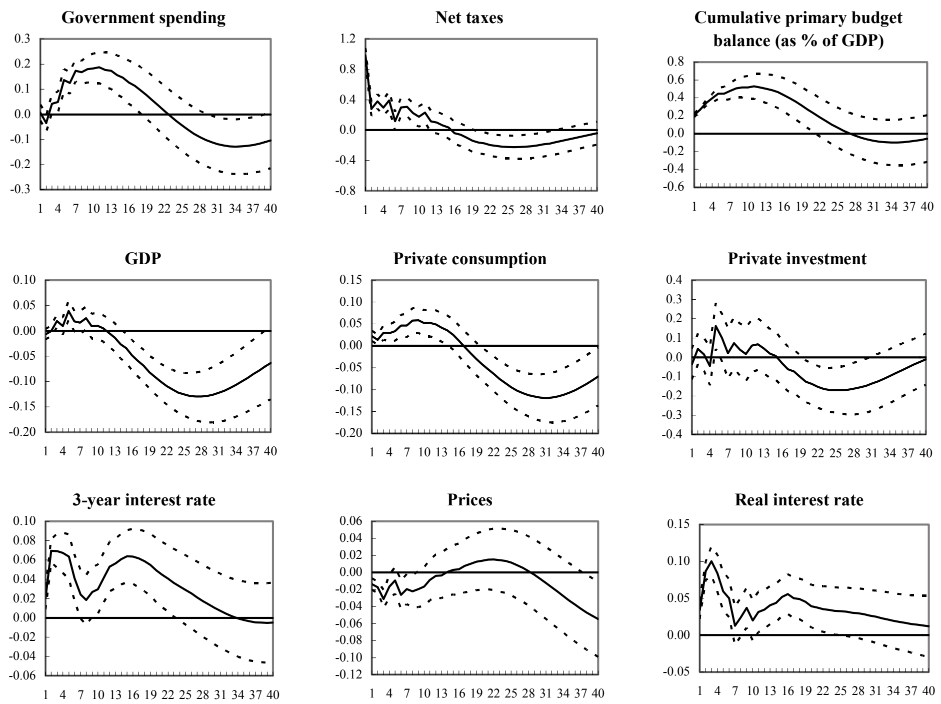
19. Nevertheless, the correct way to address the ability of stimulating economic activity is by means of output, consumption and investment multipliers, since the size of the response by itself is little informative.

4 The effects of net taxes

4.1 The baseline specification

Figure 3 shows the responses following an increase of net taxes. Around 70% of the initial shock disappears after four quarters, although the response remains significant until the end of the third year. Higher revenues encourage government spending, which increases significantly after 2 quarters and remains significant for four years. Such an increase in government expenditure is high enough to offset the rise in net taxes, for which the initial improvement of the primary budget balance phases out over three years and deteriorates thereafter. Thus, on a cumulated basis, the primary balance rises until the 12th quarter or so and fades thereafter. This result of a deterioration of the public deficit following an increase in taxes, together with that presented in the previous sections, is in accordance with previous evidence on the existence of a bias towards deficit in public sector's size in Spain. In addition, it is also compatible with the existing empirical evidence of bi-directional causality between public revenues and expenditure [De Castro et al. (2004)].

Figure 3: Responses to an increase in net taxes



The GDP response to the tax shock, although positive due to the parallel increase of government expenditure, is largely non-significant in the first years after the shock. Expectedly, however, the response becomes negative in the medium term[20]. As in the case of

20. The international evidence is here mixed. Mountford and Uhlig (2002), Marcellino (2002) and Canzoneri et al. (2002) find no significant results, while Neri (2001) shows negative effects on output following a positive tax shock. Furthermore, the sign and size of output responses in Perotti (2004) varies widely depending on the country and period considered. For instance, in the post-1980 period he obtains positive short-term output responses to net-tax shocks too.

expenditure shocks, net-tax shocks yield positive and persistent effects on nominal and real interest rates. In this respect, the persistently higher interest rates might be helping to amplify the negative effects on activity derived from higher taxes.

As far as GDP components are concerned, private consumption and investment responses, in general, mimic the GDP's one. Some slight differences can be observed, though, especially in the short-term behaviour. Specifically, while private consumption rises in the short term, the response of private investment is non significant. Despite this initial difference, clear negative responses in the medium term arise in both cases.

Finally, prices fall in the first 8 quarters after the tax shock and become non-significant until the 10th year, when this variable registers a significant fall consistent with the long-lasting negative effects on economic activity[21].

4.2 The effects of different net-tax components

As in the case of government expenditure items, net-tax components are found to have different effects on economic variables. In sum, shocks to indirect taxation seem to involve no clear effects on economic activity, whereas shocks to direct taxation are clearly contractionary in the medium term[22]. Moreover, shocks to social security contributions also drag economic activity in the short term but, contrary to what could be expected, have positive effects in the medium-term (see Figure 4).

As for the effects on prices, increases of indirect taxes involve, as expected, positive price responses, whereas shocks to direct taxes do not appear to have significant effects. These two results seem to fit well with the existing evidence provided by simulations with macromodels [Henry et al. (2004)]. Prices fall, however, in response to a shock to social security contributions, which seems to be explained by the subdued economic activity in the first quarters following the shock.

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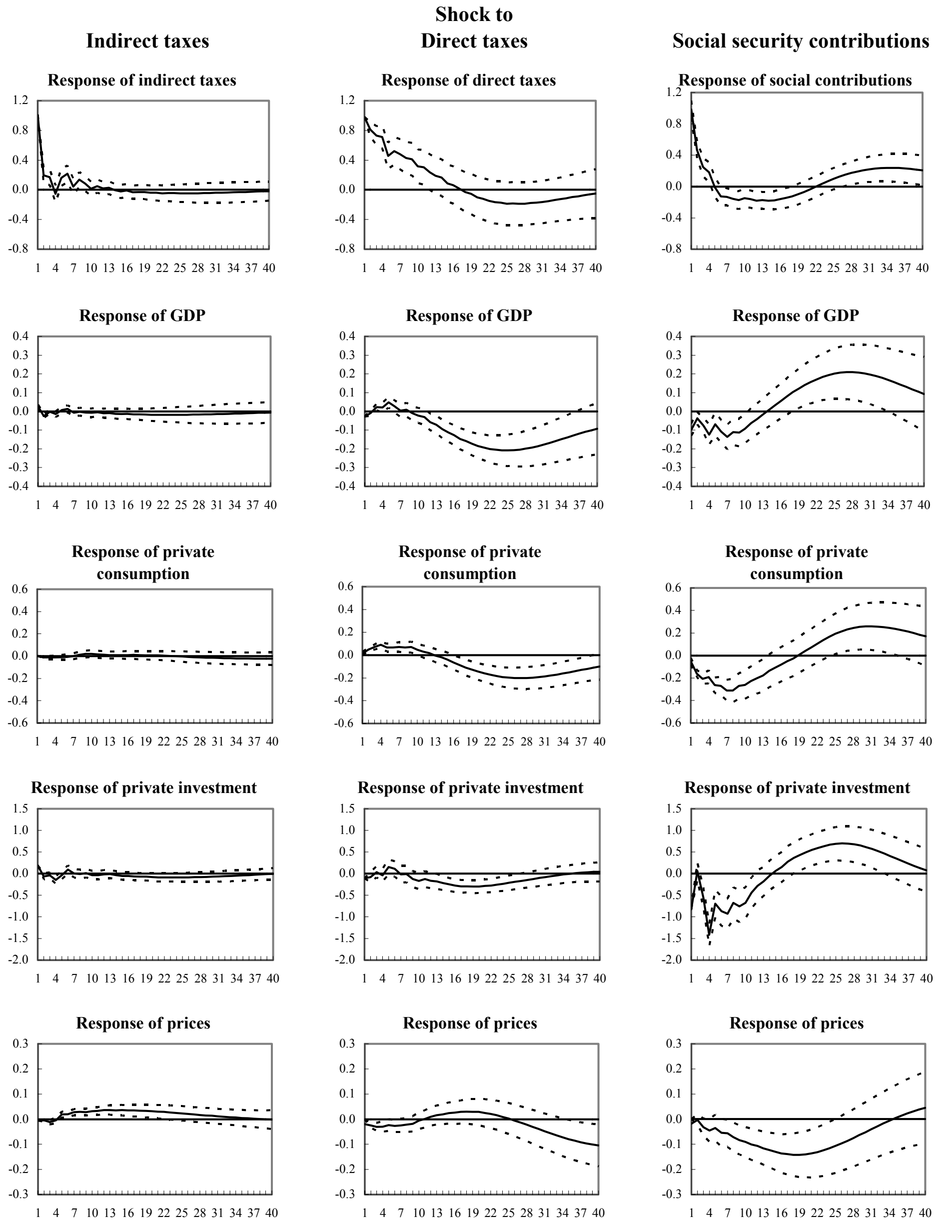
21. The international evidence on this effect is again rather mixed, Mountford and Uhlig (2002) find that a net-revenue shock has a negligible effect on prices in the US when controlling for the business cycle and for monetary policy shocks, while in Canzoneri et al. (2002) the inflation response to a net-tax increase is negative, although very small, after an initial minor positive effect. Marcellino (2002) reports non-significant effects on inflation of positive tax shocks in France, Germany and Spain, while inflation significantly increases in Italy in the short run. Perotti (2004) finds that, especially in the post-1980 period, the impact of a tax shock on prices is very small, typically negative or zero, while after three years there is evidence of a positive effect in UK and Australia, although only in the latter is the effect sizeable.

22. This result is rather intuitive and differs from De Castro (2005). In this respect, the identification scheme used here appears more accurate in order to account for the effects of net taxes and, in particular, their breakdown.

Figure 4: Responses to shocks to components of net taxes



5 Robustness checks

In order to test to what extent the results presented above are conditioned by the assumptions made on some coefficients in matrixes Γ and Β defined in section 2 some alternative specifications are tried. The first one has to do with possibly the most controversial assumption in the identification process: the ordering of fiscal variables. As pointed out before, it is difficult to justify that expenditure decisions are prior to tax ones or the opposite. In this regard, De Castro et al. (2004) show that, depending on the period under scrutiny, the causality between revenues and expenditure in Spain varies. Accordingly, it is decided to re-estimate under the alternative assumption that taxes come first, which implies imposing $\beta_{t,g} = 0$ and estimate $\beta_{g,t}$ in (3.a) by OLS.

Since the reduced form residuals in the expenditure and net-tax equations show low and non-significant correlation, the differences with the baseline VAR results, if any, are minimal. As a matter of fact, none of the variables under analysis show different response profiles and the output multipliers are almost identical.

Setting the price elasticity of government expenditure exogenously, in our case $\alpha_{g,p} = -0.5$, may appear controversial too. In order to have an idea of the sensitivity of our results to this assumption, an alternative specification setting $\alpha_{g,p} = 0.0$ is run. As in the former case, our results appear quite robust to different parameterisations in that no significant differences are perceived with respect to the benchmark specification.

Furthermore, we are interested in checking the sensitivity of our results to different output and price elasticities of net taxes. Firstly, we run the model setting $\varepsilon_{t,y} = 0.4$ exogenously. Secondly, a similar exercise is carried out with $\varepsilon_{t,y} = 0.4$ jointly with $\varepsilon_{t,p} = 0.5$, instead of the estimated 0.78 in the baseline VAR. In both cases the results are almost identical to the baseline specification and the output multipliers of government expenditure are exactly the same as those reported in the first row of Table 3.

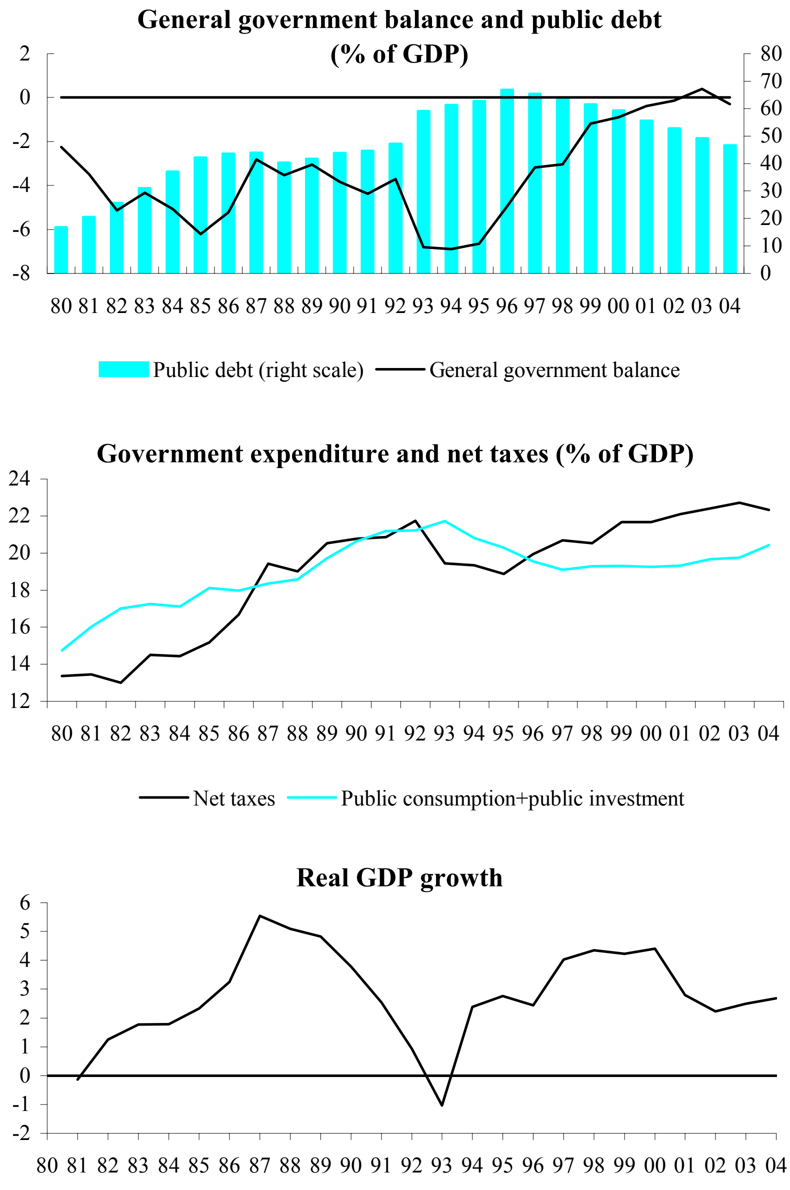
The baseline specification has also been estimated with detrended variables, for which Hodrick-Prescott trends are used (with $\lambda = 1600$). Although in this case the numbers change, the main conclusions remain valid. In particular, expenditure shocks lead to higher prices, interest rates and net taxes. Moreover, GDP always increases in the short term and tends to decline after some quarters. Furthermore, following a net-tax shock, prices fall, expenditure rises and output increases in the short-term and declines in the medium term.

Finally, in order to check the stability of our results by sub-samples, we re-estimated the model for the period starting in 1992:1 up to 2004:4. With this sub-sample the estimated discretionary fiscal shocks seem to have been less persistent, with real effects of significantly lower magnitude and largely non-significant. Moreover, the deficit bias of the public sector’s size does not show up, which could be due to the consolidation process that spread along most of the period covered by this sub-sample. Nevertheless, the small number of observations leads to very imprecise estimates, for which the latter results have to be taken with the greatest care.

6 An application to the analysis of the contribution of discretionary fiscal policy to GDP growth since the mid-nineties checks

Since the beginning of the 80s fiscal policy in Spain can be characterised by broadly two distinct periods. On the one hand, during the 80s and until the mid-90s the public sector size increased dramatically, a process that was closely associated to the building up of the Welfare State and the modernisation of the tax system. This period was also characterised for the presence of persistent public deficits and growing public debt levels. On the other hand, since mid-nineties, and in particular during the second half of the nineties, a steady expenditure-based consolidation process was followed, according to which the public deficit was cut from 6.6% of GDP in 1995 to a balanced budget in 2003 (Figure 5).

Figure 5: Overview of public finances in Spain



In relation to this second period, as it was mentioned in the introduction, a recent strand of the literature has concentrated on analysing the impact of fiscal consolidations on economic activity, providing some evidence of short run positive growth effects under certain circumstances. In this context, the results presented in the previous sections of this paper can be used to estimate the contribution of fiscal policy, or more precisely of discretionary fiscal shocks, to economic activity during the consolidation process.

Figure 6: Contribution of discretionary fiscal shocks to GDP growth since 1996 (annual averages)

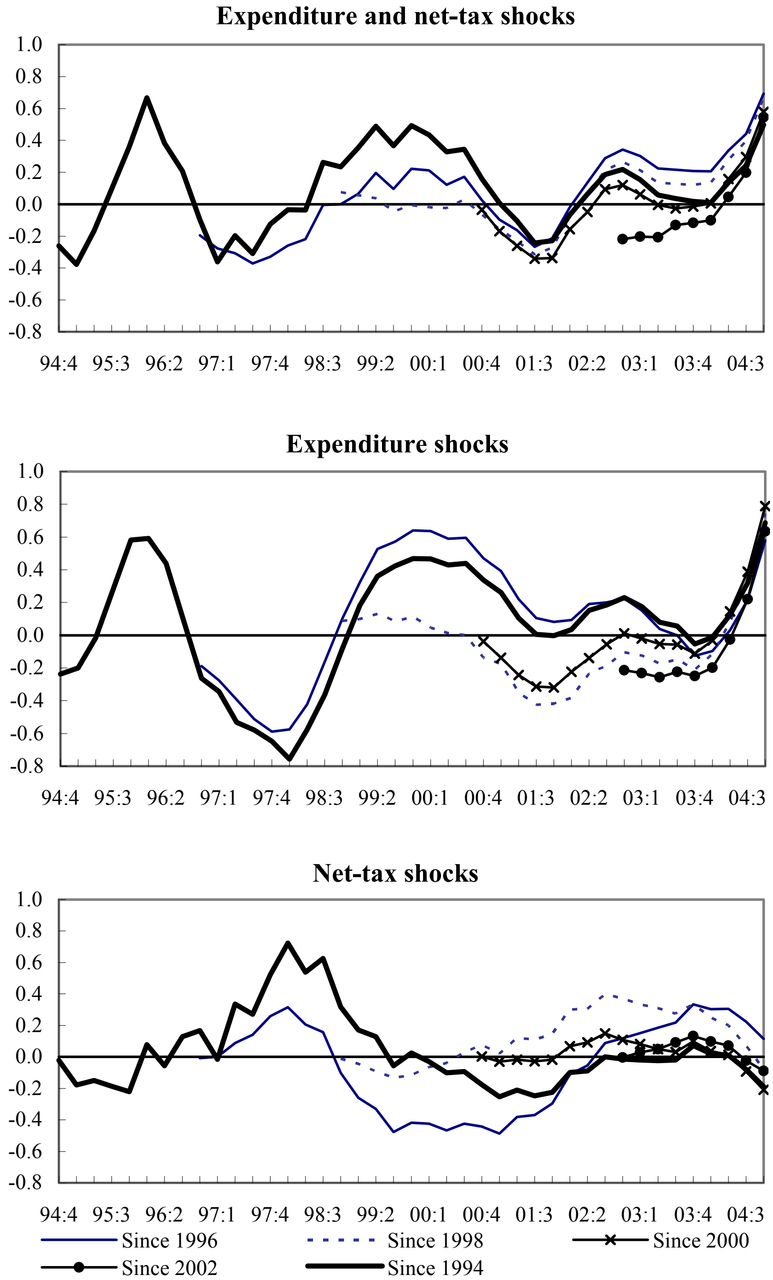


Figure 6 shows the annual average contributions of fiscal shocks to GDP growth since 1994. Specifically, we have simulated the contribution of the fiscal shocks starting in 1994, 1996, 1998, 2000 and 2002, respectively, up to the end of the sample period[23]. Hence, the vertical distance between the line that incorporates, for example, the effects of the shocks since 1996 and the line with the shocks since 1998 measures the growth contribution due to the shocks that take place in 1996 and 1997. In other words, the vertical distance between both lines is attributed to the lagged effect of the non-common shocks of these two periods. The same applies for the rest of the curves.

According to these simulations, during the first years of the consolidation process, namely between 1996 and 1998, the fiscal contraction dragged GDP growth slightly, mainly as a result of the contractionary effects of expenditure shocks partially offset by the expansionary impact of net-tax shocks. As regards 1998-2000, fiscal shocks taking place in this period had broadly neutral effects on GDP growth, while the observed positive contribution of fiscal policy stems from the lagged effects of the fiscal shocks in the former period. Indeed, the fiscal shocks between 1996 and 1998, mainly on the expenditure side (see figure 6), at the outset of the expenditure-based fiscal consolidation, are estimated to have contributed positively to GDP growth in the period 1998-2000 as compared with the shocks from 1998 onwards. Finally, the lagged effect of net-tax shocks from 1998 to 2000 have posted a positive contribution in 2002 and 2003 that, added to the lagged effects of spending shocks, yielded a positive effect on output growth of around 0.2 percentage points per year. Finally, the growing contribution to growth in 2004 can be attributed to the expenditure shocks, which were mainly associated to the robust growth of public consumption.

In sum, our simulations confirm the view that the consolidation process, defined as the cumulated exogenous fiscal policy shocks, did not involved large negative costs in terms of output in the Spanish case. In fact, the estimated contribution to GDP growth of the fiscal policy shocks implemented since 1996 has been, on average, close to zero[24].

Finally, our results can also be used to define the tone of the fiscal policy in relation with the position of the economic cycle. For this purpose, figure 7 compares the estimated shocks to the primary fiscal balance, taken as a measure of the discretionary fiscal policy stance, with the output gap of the Spanish economy, calculated with the H-P filter (with $\lambda = 1600$). A positive correlation between both should be interpreted as a counter-cyclical fiscal policy. According to this figure, the fiscal policy stance appears to have been counter-cyclical on average until the mid-eighties, but it became pro-cyclical in the early nineties. Between 1998 and 2004 the fiscal policy stance recovered its counter-cyclical nature, with the exception of the year 2003, when the consolidation process continued despite the economic slowdown[25].

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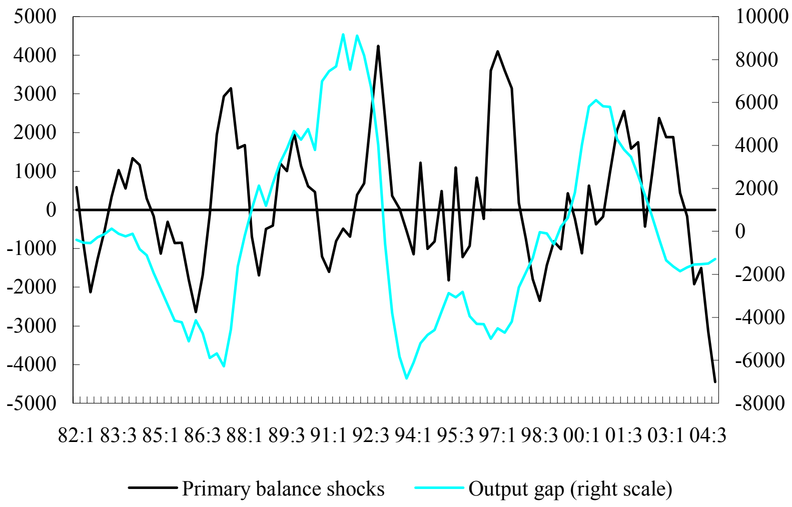
23. To carry out the simulations, we departed from the estimated parameters of the VAR, the estimated innovation model described in (10) and the observed lagged values of the system variables. Thus, when the structural shocks are set to zero, the VAR parameters and the lagged values of the variables yield a given path for the different variables of the system, whereas applying a set of estimated structural shocks starting in a given year will yield different values for the system variables from that year onwards. Accordingly, the differences obtained for the variables are attributed to the differential element between both simulations, notably the non-zero structural shocks in the second case. The similar reasoning applies when comparing two sets of structural shocks starting in different points in time.

24. Exactly 0.08 percentage points on average.

25. Galí and Perotti (2003) conclude that fiscal policy in Spain has become more countercyclical in the post-Maastricht period. While this is in accordance with our results for the period between 1998 and 2002, it contrasts with our findings for the period between the Maastricht Treaty and 1997.

Figure 7: The fiscal policy stance (annual values)



7 Conclusions

This paper aims at deepening on the knowledge of the economic effects of fiscal policy shocks in Spain by using a VAR methodology. Our results can be summarized as follows: 1) Output multipliers of government expenditure are found to be slightly above one in the short term, while negative in the longer term; 2) net-tax increases often produce positive although small short-term output responses, while negative in the medium term; 3) government expenditure shocks yield significant effects on prices of the same sign; 4) net-tax increases yield negative short-term price responses; 5) shocks to fiscal variables produce significant responses of nominal interest rates; 6) both government expenditure and net-tax increases generate public deficits in the medium term, and 7) responses of GDP or prices may differ significantly depending on the spending or tax component considered.

Two main policy conclusions could be drawn from these results. Firstly, fiscal policy is able to stimulate economic activity through expenditure expansions at the cost of higher inflation and public deficits and lower output in the medium term. Secondly, attempts to achieve fiscal consolidation by increasing the tax burden might fail to succeed and are likely to involve even higher deficits. Last, but not least, such a policy might slow economic activity down in the medium term.

The application of the previous results to the analysis of fiscal policy in Spain since the mid-nineties shows that the consolidation process, from a medium-term perspective, does not seem to have involved costs in terms of output growth, and the stance of fiscal policy has become more counter-cyclical.

Two final caveats are in order. Firstly, it should be taken into account that VARs are a useful forecasting tool in the short term. In this respect, our results, mainly those stemming from public spending shocks, are broadly consistent with a standard Keynesian view of the functioning of the economy. However, their accuracy declines at longer horizons. Therefore, the conclusions obtained regarding the long-term responses to fiscal policy shocks have to be interpreted with caution. Secondly, the econometric model employed in this paper ensures the symmetry of the responses to shocks of equal absolute value with opposite signs. However, there are good reasons to believe that the real economy may not be symmetric and, accordingly, reactions to fiscal expansions might be of very different magnitude to fiscal retrenchments, with the size of the difference depending on a complex set of variables, including the initial state of public finances. This potential asymmetries cannot, however, be captured by our estimates.

Appendix A: Construction of output and price elasticities

In order to calculate the output and price elasticities needed for the identification of the VAR model 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:

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

where $\varepsilon_{tdirh,w}$ is the elasticity of personal income tax revenues to the real wage, 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:

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

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

The output elasticity of corporate income tax revenues stems from:

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

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:

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

with $\varepsilon_{tind,c}$ and $\varepsilon_{c,y}$ the elasticity of indirect taxes to private consumption 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:

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

where B^i is the relevant tax base for the i[th] 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:

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

where λ measures the long-term relationship between both variables and εi the short-term contemporaneous elasticity we are interested in.

It is worth mentioning that the estimated employment elasticity of the real wage, $\varepsilon_{w,emp}$, turned out to be negative although non-significant. Then, it was decided to set $\varepsilon_{w,emp}$ =0.

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.

The procedure followed to obtain the price elasticities was slightly different to output elasticities. Those for total direct taxes and social security contributions were directly estimated, yielding values of 0.4 and -0.2, respectively. Indirect taxes are typically proportional. Hence, following Perotti (2002), a price elasticity of 0 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. Table A.1 shows the output and price elasticities obtained.

Table A.1: Output and price elasticities of net taxes

			Output elasticities	**Price elasticities**
$\varepsilon_{tdirh,w}$ = 1.8	$\varepsilon_{w,emp}$ = 0.0	$\varepsilon_{emp,y}$ = 0.17	$\varepsilon_{tdirh,y}$ = 0.17	$\varepsilon_{tdir,p}$ = 0.40
$\varepsilon_{ss,w}$ = 0.80			$\varepsilon_{ss,y}$ = 0.17	$\varepsilon_{ss,p}$ = -0.20
$\varepsilon_{tdirc,gos}$ = 1.0		$\varepsilon_{gos,y}$ = 1.04	$\varepsilon_{tdirc,y}$ = 1.04	
$\varepsilon_{tind,c}$ = 1.0		$\varepsilon_{c,y}$ = 0.30	$\varepsilon_{tind,y}$ = 0.30	$\varepsilon_{tind,p}$ = 0.0
			$\varepsilon_{transf,y}$ = -0.20	$\varepsilon_{transf,p}$ = -1.0
			$\varepsilon_{t,y}$ = 0.62	**$\varepsilon_{t,p}$ = 0.78**

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