The Economic Effects of Fiscal Policy: the Case of Spain

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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 positive effects 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 drag economic activity in the medium term while entailing an only temporary improvement of the public budget balance. The application of these results to the analysis of fiscal policy in Spain since the mid-nineties points to the conclusion that the consolidation process does not seem to have involved costs in terms of output growth. Moreover, the stance of fiscal policy has become more counter-cyclical in that period.

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Keywords: VAR; Fiscal Shocks; Fiscal multipliers.

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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 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 depend on a number of key assumptions, with different models offering often opposite conclusions.

The empirical evidence does not provide a common picture either. 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 public expenditure increases and tax cuts, 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

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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
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; Perotti, 1999)\(^2\).

More recently, Giuliodori and Beetsma (2005) and Beetsma et al. (2006) have explored the effects that domestic fiscal shocks exert on foreign exports in the EU countries\(^3\). They find that such trade spillovers are non-negligible, which advocates for closer fiscal policy coordination at the EU level. Interestingly, Corsetti and Müller (2006) identify fiscal shocks for the US, Canada, the United Kingdom and Australia so as to analyse the external impact of shocks to government spending and public deficits. Their main conclusion is that Twin Deficits phenomena are more limited in relatively closed economies and with less persistent fiscal shocks.

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2 See also Giudice et al. (2003) for a synthesis of the theoretical arguments behind the non-Keynesian effects along with a useful compilation of the relevant empirical evidence.
3 Beetsma et al. (2006) proceed in two steps: first, they estimate a panel VAR for the EU countries to recover the fiscal shocks (the fiscal block); second, they estimate a different panel VAR to estimate the response of foreign exports (domestic imports) to shocks in domestic activity. By combining both estimates, they retrieve the response of foreign exports to domestic fiscal shocks. Their estimations are based on annual data.
Table 1: Effects of fiscal policy shocks in selected VAR studies (1)

<table>
<thead>
<tr>
<th>Quarters</th>
<th>GDP</th>
<th>Prices</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1st</td>
<td>4th</td>
</tr>
<tr>
<td><strong>Expenditure shock – US</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blanchard and Perotti (2002) 1947-1997</td>
<td>+*</td>
<td>+*</td>
</tr>
<tr>
<td>Perotti (2004) 1961-2000</td>
<td>+*</td>
<td>+*</td>
</tr>
<tr>
<td>Neri (2001) 1965-1996</td>
<td>+*</td>
<td>+*</td>
</tr>
<tr>
<td>Fatás and Mihov (2001) 1960-1996</td>
<td>+*</td>
<td>+*</td>
</tr>
<tr>
<td>Edelberg, Eichenbaum and Fisher (1998)</td>
<td>+*</td>
<td>+*</td>
</tr>
<tr>
<td>Burnside, Eichenbaum and Fisher (1999)</td>
<td>+*</td>
<td>+*</td>
</tr>
<tr>
<td>1947-1994</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Canzoneri, Cumby and Diba (2002)</td>
<td>+*</td>
<td>+*</td>
</tr>
<tr>
<td><strong>Expenditure shock – Germany</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perotti (2004) 1961-2000</td>
<td>+*</td>
<td>+*</td>
</tr>
<tr>
<td>Canzoneri, Cumby and Diba (2002)</td>
<td>+*</td>
<td>+*</td>
</tr>
<tr>
<td><strong>Revenue shock – US</strong></td>
<td></td>
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<tr>
<td>Blanchard and Perotti (2002) 1947-1997</td>
<td>+*</td>
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<tr>
<td>Perotti (2004) 1961-2000</td>
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<tr>
<td>Neri (2001) 1965-1996</td>
<td>+*</td>
<td>+*</td>
</tr>
<tr>
<td>Mountford and Uhlig (2002) 1955-2000</td>
<td>+*</td>
<td>+*</td>
</tr>
<tr>
<td>Canzoneri, Cumby and Diba (2002)</td>
<td>+*</td>
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<tr>
<td><strong>Revenue shock – Germany</strong></td>
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<tr>
<td>Perotti (2004) 1961-2000</td>
<td>+*</td>
<td>+*</td>
</tr>
<tr>
<td>Canzoneri, Cumby and Diba (2002)</td>
<td>+*</td>
<td>+*</td>
</tr>
</tbody>
</table>

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

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 to 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) identification of fiscal policy shocks by using dummy variables that capture specific episodes such as the military build-ups corresponding to the Korean and the Vietnam wars or the Reagan fiscal expansion in the case of the US (Burnside et al., 1999; Ramey and Shapiro, 1998; Edelberg et al., 1998); (2) imposition of sign restrictions on the impulse-response functions (Mountford and Uhlig, 2002); (3) identification of fiscal shocks based on a Choleski ordering (Favero, 2002; Fatás and Mihov, 2001); (4) and finally, identification of fiscal policy shocks by exploiting decision lags in policy making and information about the elasticity of fiscal variables to economic activity (Blanchard and Perotti, 2002; Perotti, 2004). This latter approach is the one we follow in this paper for two reasons: first because, in our view, it provides a useful benchmark for taking into account institutional information about the tax and transfer system as well as the timing of tax collections; second, because it allows to distinguish the nature of the different fiscal policy shocks and, accordingly, better estimate their effects. In this respect, our results add to the previous evidence on the same topic.
already available for Spain obtained with alternative identification schemes (De Castro, 2006; Marcellino, 2002).

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\(^4\), the GDP deflator \( (p_t) \) and the three-year interest rate of government bonds \( (r_t) \).\(^5\) \( g_t \) is defined as the sum of public consumption\(^6\) and public investment, whereas \( t_t \)

\(^4\) In all cases the GDP deflator is employed so as to obtain the corresponding real values.
\(^5\) 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. The model was also estimated with the 3-month rate of government bonds and the results were almost identical to those reported here.
\(^6\) Compensation of civil servants plus other consumption expenditure items such as purchases of goods and services.
includes public revenues net of transfers\textsuperscript{7}, excluding interest payments on government debt. Thus the general government primary budget balance is obtained as the difference between the levels of $t_t$ 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\textsuperscript{8}.

The reduced-form VAR can be written as

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

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 $U_t \equiv (u_t^g, u_t^r, u_t^y, u_t^p, u_t^r)$ 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.

\textsuperscript{7} It includes both current and capital transfers. More concretely, transfers include all expenditure items except public consumption, public investment and interest payments.

\textsuperscript{8} 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. Appendix A explains in detail the procedure followed to obtain the quarterly 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:

\[
\begin{align*}
    u_t^g &= \alpha_{g,y} u_t^y + \alpha_{g,p} u_t^p + \alpha_{g,t} u_t^t + \beta_{g,t} e_t^t + e_t^g \\
    u_t^t &= \alpha_{t,y} u_t^y + \alpha_{t,p} u_t^p + \alpha_{t,t} u_t^t + \beta_{t,t} e_t^t + e_t^t
\end{align*}
\]  

(2a)  

(2b)

where \((e_t^g, e_t^t)\) are the structural orthogonal shocks of government expenditure and net taxes\(^9\), respectively.

In particular, we are interested in analysing the effects of the structural discretionary fiscal shocks, \( e_t^g \) and \( e_t^t \), on the rest of the variables of the system, for which estimations for the \( \alpha_{ij} \)'s and \( \beta_{ij} \)'s in (2) are needed. The

\(^9\) Similarly, \( e_t^y, e_t^p, e_t^t \) 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.
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 $\alpha_{ij}$'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 $\alpha_{t,r}$, were 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\(^\text{10}\).

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 the 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

\(^{10}\) The income tax-base includes interest income as well as dividends, which covary 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.
component is typically indexed to the CPI, even though indexation takes place with some delay. Thus, an eclectic approach was adopted and, following Perotti (2004) the price elasticity of government expenditure was 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:

$$\alpha_{i,y} = \sum_i \varepsilon_{T_i,B_i} \varepsilon_{B_i,y} \frac{T_i}{T} \tag{3}$$

with $T = \sum T_i$ being the level of net taxes\textsuperscript{11}, $\varepsilon_{T_i,B_i}$ the elasticity of the $i^{th}$ category of net taxes to its own tax base and $\varepsilon_{B_i,y}$ the GDP elasticity of the tax base of the $i^{th}$ category of net taxes. The price elasticities for some components of net taxes were, however, obtained directly through

\textsuperscript{11} The $T_i$'s are positive in the case of taxes and negative in the case of transfers.
econometric estimation, whereas others were calibrated. Appendix B 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 \( u_{t}^{CA} \) can be derived as follows:

\[
\begin{align*}
  u_{t}^{g,CA} &= u_{t}^{g} - (\alpha_{g,t}^{y} u_{t}^{y} + \alpha_{g,t}^{p} u_{t}^{p} + \alpha_{g,t}^{e} e_{t}^{e}) = \beta_{g,t}^{e} e_{t}^{e} + e_{t}^{g} \quad \text{(3a)} \\
  u_{t}^{t,CA} &= u_{t}^{t} - (\alpha_{t,g}^{y} u_{t}^{y} + \alpha_{t,g}^{p} u_{t}^{p} + \alpha_{t,g}^{e} e_{t}^{e}) = \beta_{t,g}^{e} e_{t}^{e} + e_{t}^{t} \quad \text{(3b)}
\end{align*}
\]

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 \( \beta_{t,g} \). It could be quite difficult to find arguments that fully justify any of both orderings. Therefore, we 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\(^{12}\), 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.

\(^{12}\) In fact, this is mainly due to the low and non-significant correlation between expenditure and net-tax shocks.
Accordingly, the reduced-form output residuals are assumed to be a linear combination of the fiscal shocks.

\[ u_i^t = \gamma_{y,g} u_i^g + \gamma_{y,t} u_i^t + e_i^y \]  

(4)

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

\[ u_i^p = \gamma_{p,g} u_i^g + \gamma_{p,t} u_i^t + \gamma_{p,p} u_i^p + e_i^p \]  

(5)

can be estimated by using \( e_i^g \), \( e_i^t \) and \( e_i^p \) as instruments. And finally, the interest rate equation

\[ u_i^r = \gamma_{r,g} u_i^g + \gamma_{r,t} u_i^t + \gamma_{r,p} u_i^p + e_i^r \]  

(6)

can be estimated accordingly once \( e_i^p \) has been recovered.

As a result, the innovation model can be written as

\[ \Gamma U_t = BV_t \]  

(7)

where \( V_t \) is the vector containing the orthogonal structural shocks,

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

(8)
and

\[
B = \begin{pmatrix}
1 & \beta_{g,t} & 0 & 0 & 0 \\
\beta_{t,g} & 1 & 0 & 0 & 0 \\
0 & 0 & 1 & 0 & 0 \\
0 & 0 & 0 & 1 & 0 \\
0 & 0 & 0 & 0 & 1
\end{pmatrix}
\]  

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

\[
U_t = \Gamma^{-1}BV_t
\]  

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. Since the model is overidentified, these overidentifying restrictions are formally tested and accepted at the 0.23 significance level\(^{13}\).

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

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\(^{13}\) The LR test yielded a value of 12.8. Moreover, the resulting impulse responses were very similar to those stemming from an exactly identified model with a Choleski decomposition with the ordering \((p,g,y,t,r)\).
estimating the contemporaneous bi-directional interaction between GDP and its respective component\textsuperscript{14}.

\textbf{Table 2: Estimates of $B$ and $\Gamma$ in the benchmark specification}

<table>
<thead>
<tr>
<th>Regressors</th>
<th>$\beta_{t,g}$</th>
<th>$\alpha_{t,y}$</th>
<th>$\alpha_{t,p}$</th>
<th>$\gamma_{y,g}$</th>
<th>$\gamma_{y,t}$</th>
<th>$\gamma_{p,t}$</th>
<th>$\gamma_{p,g}$</th>
<th>$\gamma_{r,g}$</th>
<th>$\gamma_{r,t}$</th>
<th>$\gamma_{r,y}$</th>
<th>$\gamma_{r,p}$</th>
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</thead>
<tbody>
<tr>
<td>$u^t$</td>
<td>$0.554$</td>
<td>$0.62$</td>
<td>$0.78$</td>
<td>$0.103$</td>
<td>$-0.008$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$u^y$</td>
<td>$0.62$</td>
<td>$0.78$</td>
<td></td>
<td>$0.065$</td>
<td>$-0.014$</td>
<td>$0.055$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$u^p$</td>
<td>$0.78$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$0.055$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$u^t$</td>
<td>$0.023$</td>
<td>$-0.044$</td>
<td>$0.212$</td>
<td></td>
<td></td>
<td></td>
<td>$0.064$</td>
<td>$0.0023$</td>
<td>$-0.044$</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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 $\gamma_{r,y} = 0.0$.

One frequent criticism to the identification of quarterly fiscal policy shocks is that fiscal decisions are mainly taken on a year-by-year basis and embedded in the budget. However, while acknowledging that the yearly budget incorporates important policy measures, supplements to it and other decisions affecting fiscal policy during the year are always possible and, indeed, have been commonplace in most of the sample period under

\textsuperscript{14} Another possibility would be to replace GDP by one of both components and re-estimate $\Gamma$ accordingly. However, both approaches yield very similar results.
consideration. Accordingly, the identification of such post-budget shocks, whose effects are non-negligible, is of major importance. Moreover, given that the yearly budget is a highly political document the expenditure plans or any tax changes envisaged in it can be altered if considered necessary, which is presumably discounted by the economic agents. Therefore, the identification of quarterly fiscal shocks may offer a more precise view of their effects.

A word of caution though: to the extent that policy measures contained in the annual budget help configure agents’ expectations, the estimated effects on the basis of quarterly data might be biased, although, as Perotti (2004) argues, the sign of the bias is unclear.

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. It should be first highlighted that the expenditure shock turns out to be very persistent and only becomes insignificant after almost

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15 As a matter of fact, the expenditure ceiling for the central government sub-sector’s set out in the budget is only binding since the Budgetary Stability Law came into force in 2003.

16 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. In this respect, the choice of the confidence interval width is very standard in this kind of studies and indeed follows Edelberg et al. (1998), Burnside et
five years. The high persistence of public expenditure shocks is in line with the existing evidence for other OECD countries (Perotti, 2004; Galí et al., 2003).

**Figure 1: Responses to an increase in government expenditure**

The increase of government expenditure raises GDP, which peaks in the 3rd quarter after the shock. The cumulative output multipliers\(^\text{17}\) are slightly above one in the first two years: 1.31 and 1.33 in the fourth and eight

\(^{17}\) 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.
quarters after the shock, respectively (see Table 3). These multipliers are broadly in line with previous studies for the case of Spain (De Castro, 2006), although they are on the high side compared with the values obtained for other OECD countries (Fatás and Mihov, 2001; Mountford and Uhlig, 2002; Perotti, 2004; Gali 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.

Table 3: Cumulative output multipliers to government expenditure shocks

<table>
<thead>
<tr>
<th>Shock to:</th>
<th>4th q</th>
<th>8th q</th>
<th>12th q</th>
<th>16th q</th>
<th>20th q</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expenditure (Baseline VAR)</td>
<td>1.31</td>
<td>1.33</td>
<td>1.00</td>
<td>0.65</td>
<td>0.26</td>
</tr>
<tr>
<td>Expenditure (Net taxes first)</td>
<td>1.31</td>
<td>1.37</td>
<td>1.06</td>
<td>0.74</td>
<td>0.40</td>
</tr>
<tr>
<td>Expenditure ($a_{p,p} = 0$)</td>
<td>1.30</td>
<td>1.32</td>
<td>0.97</td>
<td>0.61</td>
<td>0.21</td>
</tr>
<tr>
<td>Expenditure (with 3-month interest rate of gov. bonds)</td>
<td>1.28</td>
<td>1.31</td>
<td>1.07</td>
<td>0.74</td>
<td>0.37</td>
</tr>
<tr>
<td>Public consumption</td>
<td>0.67</td>
<td>-0.33</td>
<td>-1.75</td>
<td>-4.02</td>
<td>-8.69</td>
</tr>
<tr>
<td>Public investment</td>
<td>1.12</td>
<td>1.86</td>
<td>1.72</td>
<td>1.16</td>
<td>0.69</td>
</tr>
</tbody>
</table>

In the longer term, however, our results show that the GDP response dwindles steadily and becomes significantly negative after four years, which
might be due to the higher real interest rates that contribute to reduce permanent income and expected investment profitability. This evidence is also in line with the negative medium-term output responses obtained for some other OECD countries (Perotti, 2004; Neri, 2001; 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 initially positive response of net-tax collections offsets the increase of public expenditure in the quarters following the shock. In the medium term, however, a persistent deterioration in the primary balance shows up as expected.

Higher government expenditure also brings about a significantly positive response of the GDP deflator for 28 quarters. Such increase in the price level implies higher inflation in the quarters following the shock. This is a potentially important result since, although De Castro (2006) 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\textsuperscript{18}. 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; Henry et al., 2004).

Likewise, interest rates increase persistently following a positive shock to government expenditure\textsuperscript{19}. 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\textsuperscript{20} rises. Such increase is significant on average over the first three years after the shock, thereby helping to drag economic activity.

\textsuperscript{18} 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. (1998) 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 (2004) 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. By contrast, Giuliodori and Beetsma (2005) get non-significant inflation responses in Germany and France and positive in the two quarters after the shock in Italy. For a summary of some of these results see Henry et al. (2004).

\textsuperscript{19} In contrast, Perotti (2004) finds no clear-cut evidence in either direction on this issue.

\textsuperscript{20} 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 that it implicitly assumes that expected inflation equals observed inflation. Nevertheless, we consider that it can represent an acceptable approximation.
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; Gali et al., 2003). The evidence for private investment is however more mixed, with some papers showing negative responses of this variable to an exogenous increase in government spending. The short-run upswings of private consumption and investment arise as a consequence of the demand multiplier effect of public expenditure. In particular, the investment rise in spite of the higher real interest rate is largely in accordance with the accelerator hypothesis that fits well the investment behaviour in Spain (Estrada et al., 1997).

3.2. The effects of different public expenditure components

Public consumption and public investment are expected to entail different effects on economic activity. While public consumption, mainly through compensation of employees, quantitatively the most important item, might be expected to have some impact on private wages that might drag
investment profitability, public investment is deemed to bring about non-negligible spillover effects on productivity of the private sector. Accordingly, in order to account for such different effects, 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. Interestingly, Figure 2 shows that main culprit for the GDP decline is the wage bill component of public consumption in real terms, which is 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).
Figure 2: Responses to shocks to government expenditure components

- **Public consumption**
  - Response of public consumption

- **Public wage bill**
  - Response of the public wage bill

- **Public investment**
  - Response of public investment

- **Response of GDP**

- **Response of private consumption**

- **Response of private investment**

- **Response of prices**

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**Legend:**
- 1 4 7 10 13 16 19 22 25 28 31 34 37 40
In contrast, the positive response of GDP to public investment shocks is of significantly lower magnitude\textsuperscript{21}, although it takes more time, around eight quarters, to fade away. 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. This result appears consistent with the aforementioned hypothesis that public investment brings about non-negligible spillover effects on the private sector’s productivity.

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

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 eventually offset the rise in net taxes, for which the initial improvement of the primary budget balance

\textsuperscript{21} Nevertheless, the correct way to address the ability of stimulating economic activity is by
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.

Figure 3: Responses to an increase in net taxes

This deterioration of the public deficit until the fifth year after the increase in taxes is in accordance with previous evidence on the existence of a bias towards deficit in public sector’s size in Spain. In addition, the significant responses of either fiscal variable after shocks to the other one means of output, consumption and investment multipliers, since the size of the response by itself is little informative.
are also compatible with the existing empirical evidence of bi-directional causality between public revenues and expenditure (De Castro et al., 2004).

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\textsuperscript{22}. As in the case of expenditure shocks, net-tax shocks yield positive and persistent effects on nominal and real interest rates\textsuperscript{23}. 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. Admittedly

\textsuperscript{22} The international evidence on this issue is 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. Giuliodori and Beetsma (2005) report negative output responses to a positive tax shock only in Germany, while broadly non-significant in France and Italy. Finally, Beetsma et al. (2006) get negative output responses in the EU.

\textsuperscript{23} In principle, it could be expected that a positive shock to net taxes increased government saving in the short term, thereby putting downward pressure on interest rates. However, the empirical evidence is unclear in this respect (see, for instance, Perotti, 2004). The positive response of interest rates shown in this paper might be linked to the upward reaction of government spending.
however, the short-term consumption rise turns out to be rather counter-intuitive. This nonetheless appears to be due to the sizeable response of government spending and the multiplier effect thereof. In any case, this result should be taken with much care.

Finally, prices fall in the first 8 quarters after the tax shock and become non-significant thereafter.\(^{24}\)

### 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 (see Figure 4). 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, probably due to the dead-weight losses that distortionary taxes involve. Moreover, shocks to social security contributions also drag economic activity in the short term\(^ {25}\) by increasing labour costs.

\(^{24}\) 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. Conversely, Giuliodori and Beetsma, (2005) show largely non-significant inflation responses to net-tax shocks.

\(^{25}\) According to the responses in Figure 4, shocks to social security contributions yield positive output effects after five years, which turns out to be rather counter-intuitive.
Figure 4: Responses to shocks to components of net taxes

However, the forecasting limitations of this methodology for such long horizons advise against drawing conclusions from this result.
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.

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 $\Gamma$ and $\mathbf{B}$ defined in section 2 some alternative specifications were 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 direction of causality between revenues and expenditure in Spain varies. Accordingly, we 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 showed low and non-significant correlation, the differences with the baseline VAR results, if any, were minimal. As a matter of fact, none of the variables under analysis showed different response profiles and the output multipliers were 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 $\alpha_{g,p} = 0.0$ was run. As in the former case, our results appear quite robust to different parameterisations in that no significant differences were perceived with respect to the benchmark specification.

Furthermore, we were 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 was 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 were almost identical to the baseline specification and the output multipliers of government expenditure were exactly the same as those reported in the first row of Table 3.

In order to account for the monetary policy response to fiscal policy the long-term interest rate was replaced in the VAR by the 3-month interest rate of government bonds. The results were almost identical to those of the
baseline VAR, with output multipliers of public expenditure showing only marginal differences with the baseline specification, which might point to a fast transmission of short-term interest rate shifts to long-term rates.

The baseline specification was also estimated with detrended variables, for which Hodrick-Prescott trends were 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.

Some alternative modelling schemes were tried such as (i) including a linear trend in the VAR specification, (ii) including linear and quadratic trends, (iii) allowing for cointegration relationships among the variables and, (iv) replacing the price level by the inflation rate in the baseline specification. The results were qualitatively very similar in almost all cases to those shown in this paper.
6. An application to the analysis of the contribution of discretionary fiscal policy to GDP growth since the mid-nineties

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. That process was closely associated to the building up of the Welfare State and the modernisation of the tax system. This period was also characterised by the presence of persistent public deficits and growing public debt levels. On the other hand, 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).

In relation to this second period, as aforementioned 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 the structural discretionary fiscal shocks, to economic growth during the consolidation process.
Figure 5: Overview of public finances in Spain

General government balance and public debt (% of GDP)

Government expenditure and net taxes (% of GDP)

Real GDP growth
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. 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, the fiscal shocks 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

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26 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, simulating the model with and without the previously estimated structural shocks leads to different paths for the variables of the system. Such differences are attributed to the effects of the structural shocks. The advantage of this approach with respect to the standard variance
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 structural 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.27

Finally, our results can also be used to define the stance 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

 decomposition is that it allows to measure the specific contribution of the shocks taking

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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\textsuperscript{28}. Between 1998 and 2004 the fiscal policy stance recovered its counter-cyclical nature, with the exception of the year 2003, when the primary and headline budget balances kept improving despite the economic slowdown\textsuperscript{29}.

**Figure 7: The fiscal policy stance (annual values)**

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\textsuperscript{27} Exactly 0.08 percentage points per year on average.

\textsuperscript{28} Structural primary balance and output shocks were largely uncorrelated, with an estimated correlation coefficient of -0.013.

\textsuperscript{29} 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.
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 and hardly significant 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 due to their endogenous responses, 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 in the future. 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. Rather, its contribution to GDP growth appears to have been clearly positive in some periods. Furthermore, the stance of fiscal policy has become more counter-cyclical since the late nineties.

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, in general, 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.

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Appendix A. Construction of quarterly fiscal variables
The quarterly fiscal variables, except public consumption, are not directly available and it became necessary to interpolate the official annual national accounts data. In general, the interpolation method was achieved by using the Denton method in second relative differences with relevant indicators. The indicators were usually the quarterly concept corresponding to the annual one, on a national accounts basis, obtained by the Statistical Department of the Bank of Spain from official data of budgetary execution relevant for each item. It is worth noting that these quarterly concepts obtained directly from budgetary execution were used as indicators instead of being incorporated directly because the quarterly series were not always fully compatible with the annual official figures of the national accounts. Accordingly, the method employed corrects the levels of the official data of budgetary execution, but preserves the quarterly dynamics unaltered. The
remaining paragraphs describe the detailed procedure followed for the most important items.

In particular, the quarterly compensation of employees and the gross operating surplus (which by definition is consumption of fixed capital in the general government sector) were interpolated using as indicators the quarterly compensation of employees and the gross operating surplus, respectively, of non-market services (of which the general government sector is by far the most important one) of the quarterly national accounts. The correlation between the growth rates of the annual series and the annual growth rate of the indicator was perfect.

Indirect taxes net of subsidies received by the general government were obtained by subtracting those corresponding to the rest of the world from indirect taxes net of subsidies of the whole economy. The latter two are provided on a quarterly basis by the INE. However, the quarterly data for indirect taxes net of subsidies of the rest of the world is available only since 1995. Beforehand, the indicators used were transfers to the European Union plus the VAT resource for resources and current transfers from EAGGF-guarantee for subsidies. These indicators captured reasonably well the evolution of the national accounts data in that their correlations were 0.92 and 0.97, respectively.
As for direct taxes, the indicator used in the interpolation procedure was obtained from monthly data on budgetary execution on a national accounts basis since 1999. These data are extended with the quarter-on-quarter growth rates of a four-term non-centred moving average of direct taxes on a national accounts basis estimated by the Statistical Department of the Bank of Spain. Again, the correlation between the growth rates of the annual series and the annual growth rate of the indicator was 1.

As in the case of direct taxes, social contributions and social transfers were interpolated by using their corresponding quarterly indicators on a national accounts basis obtained by the Statistical Department of the Bank of Spain, with almost perfect correlation between the indicators and the official annual series.

The case of property income received was different in that interpolation was not necessary, given that this series coincides with the estimated one by the Statistical Department of the Bank of Spain.

Finally, public investment is interpolated since 1998 using the Index of Production of Construction Industry for public works released by the INE as indicator. Before 1998 the indicators used for the interpolation were central government plus social security investment and tenders of public works of the state and local governments. In this case, the correlation with the annual series was 0.88.
Appendix B. 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:

\[ \varepsilon_{\text{dirh}} = (\varepsilon_{\text{dirh,w}} \varepsilon_{\text{w,emp}} + 1) \varepsilon_{\text{emp,y}} \]  

(A.1)

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

\[ \varepsilon_{\text{ss}} = (\varepsilon_{\text{ss,w}} \varepsilon_{\text{w,emp}} + 1) \varepsilon_{\text{emp,y}} \]  

(A.2)

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

The output elasticity of corporate income tax revenues stems from:

\[ \varepsilon_{\text{dirc}} = \varepsilon_{\text{dirc,goa}} \varepsilon_{\text{goa,y}} \]  

(A.3)
where $\varepsilon_{\text{dir, gos}}$ is the elasticity of tax revenues to the gross operating surplus and $\varepsilon_{\text{gos, y}}$ 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:

$$\varepsilon_{\text{ind, y}} = \varepsilon_{\text{ind, c}} \varepsilon_{\text{c, y}}$$  \hspace{1cm} (A.4)

where $\varepsilon_{\text{ind, c}}$ and $\varepsilon_{\text{c, y}}$ are 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:

$$\Delta \ln(B_i^t) = \gamma + \delta t + \varepsilon_i \Delta \ln(Y_t) + \eta_i$$  \hspace{1cm} (A.5)

where $B_i^t$ is the relevant tax base for the $i$:th tax category and $\varepsilon_i$ 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 $B_i^t$ and $Y$ are cointegrated, (A.5) contains a specification error. In this case, the following ECM specification would be preferable:
\[ \Delta \ln(B_t^i) = \gamma + \mu(\ln(B_{t-1}^i) - \lambda \ln(Y_{t-1}) - \phi - \delta t) + \varepsilon_i \Delta \ln(Y_t) \]
\[ + \sum_{j=1}^{k} \phi_j \Delta \ln(Y_{t-j}) + \sum_{j=1}^{k} \psi_j \Delta \ln(B_{t-j}^i) + \eta_i \quad (A.6) \]

where \( \lambda \) measures the long-term relationship between both variables and \( \varepsilon_i \) 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 resulting output and price elasticities.
<table>
<thead>
<tr>
<th>Output elasticities</th>
<th>Price elasticities</th>
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<tr>
<td>$\varepsilon_{\text{tdrh},w} = 1.8$</td>
<td>$\varepsilon_{\text{tdrh},y} = 0.17$</td>
</tr>
<tr>
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<td>$\varepsilon_{\text{ss},y} = 0.17$</td>
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<td>$\varepsilon_{\text{tdrh},w} = 1.0$</td>
<td>$\varepsilon_{\text{gos},y} = 1.04$</td>
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<tr>
<td>$\varepsilon_{\text{tind},c} = 1.0$</td>
<td>$\varepsilon_{\text{tind},y} = 0.30$</td>
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<tr>
<td>$\varepsilon_{\text{transf},y} = -0.20$</td>
<td>$\varepsilon_{\text{transf},p} = -1.0$</td>
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<tr>
<td>$\varepsilon_{\text{t},y} = 0.62$</td>
<td>$\varepsilon_{\text{t},p} = 0.78$</td>
</tr>
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Table A.1: Output and price elasticities of net taxes
References


