THE EFFECTS OF FISCAL POLICY IN ITALY: ESTIMATES WITH A SVAR MODEL

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1. Introduction and conclusions

This paper studies the effects of government spending, distinguishing between wage and non-wage expenditure, and of net revenues on key macroeconomic variables in Italy. We study these effects in the context of a Vector Autoregression approach, using a methodology to identify the fiscal shocks recently proposed by Blanchard and Perotti (2002).

The VAR approach heavily relies on the existence of reliable and non-interpolated quarterly data over a sufficiently long period of time. In Italy, quarterly national accounts data on general government budget are available only for a few years, hence cannot be used in this approach. For our analysis we construct a database of quarterly cash data for selected fiscal variables for the period 1982:1-2003:4, largely on the basis of the information contained in the Italian Treasury Quarterly Reports.

In the method proposed by Blanchard and Perotti (2002) the identification of fiscal shocks is essentially obtained by exploiting decision lags in fiscal policymaking, which allow to assume that discretionary government purchases and revenues are predetermined with respect to the macroeconomic variables, and information about the elasticity of fiscal variables to economic activity, which enable to identify the automatic response of fiscal policy. A similar approach is used by Fatás and Mihov (2001), who rely on Cholesky ordering to identify fiscal shocks.

The method proposed by Blanchard and Perotti (2002) has been applied in a number of studies based on US data. Among these, Blanchard and Perotti (2002) employ a three-variable VAR which includes GDP, government direct expenditure and net revenue. They find that expansionary fiscal shocks increase output. Following a direct expenditure shock, private consumption reacts positively and private investment reacts negatively.[1] The response of GDP to a one dollar shock to

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[1] The responses of the components of GDP are assessed on the basis of a 4-variable VAR, which also includes the component of GDP whose response they are studying.

direct expenditure is around 50 cents at the 4th and 8th quarter and gradually increases to a peak of 1.29 cents at the 15th quarter.[2] Their results imply a cumulative multiplier (*i.e.* the ratio of the cumulative change in GDP to the cumulative change in government expenditure) close to 0.5 at the 4th, 8th and 12th quarters, reflecting leakages through the trade channel.[3]

The same identification method has been used in Perotti (2002), which examines 5 OECD countries including the US, and in the study by Galí *et al.* (2003) on the US. Perotti (2002) uses a five-variable VAR, which includes GDP, the GDP deflator, government direct expenditure, net revenue and the interest rate. As for the US economy, when using the full historical sample he finds that the cumulative multiplier of an expenditure shock is also positive and below 1 at the 4th, 8th and 12th quarters. Galí *et al.* (2003) use a four-variable VAR, which includes GDP, government direct expenditure, employment and the real interest rate. Their results imply a larger cumulative multiplier of government spending: its value increases from around unity at the 4th quarter to approximately 2 at the 12th quarter. The authors find a relatively large positive reaction of private consumption; the response of investment is not significant.[4] Also in Fatás and Mihov (2001) a government direct expenditure shock in the US induces a positive response of private consumption, while the response of investment is not significant. The reported results imply values of the cumulative multiplier similar to those of Galí *et al.* (2003). The authors also examine separately the effects of non-wage and wage spending, reaching the conclusion that a fiscal expansion based on the latter is more effective in boosting economic activity. However, the shock to wages is far more persistent and this could explain the greater effects it has on GDP.

Studies applying the method proposed by Blanchard and Perotti (2002) in countries different from the US are relatively scarce, largely owing to the limited availability of quarterly public finance data. Perotti (2002) investigates the effects of fiscal policy for Australia, Canada, Germany and the UK. He finds that responses to fiscal shocks estimated on US data are often not representative of the average OECD country included in the sample. In general, the estimated effects of fiscal policy turns out to be small: in the pre-1980 sample, positive government spending multipliers larger than one are rare; in the post-1980 period, significantly negative multipliers are the norm; the tax multipliers are even smaller. To assess the effects of fiscal policy in France, Biau and Girard (2005) use a five-variable VAR, which includes government direct expenditure, net revenue, GDP, the price level and the interest rate. Their results imply values of the cumulative multiplier of government

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[2] For the sake of comparability with our findings, we report the results obtained by Blanchard and Perotti (2002) using the specification with deterministic trend.

[3] We computed the cumulative multipliers, on the basis of the data reported in Blanchard and Perotti (2002), to allow a meaningful comparison with our own results. The cumulative multiplier gauges the effects on economic activity per unit of expenditure, thus automatically correcting for the persistence of the shock. This feature is particularly important as the fiscal shocks that we identify for Italy exhibit a significantly lower persistence than those estimated in the studies using US data.

[4] The responses of the components of GDP are assessed on the basis of a 5-variable VAR, which also includes the component of GDP whose response they are studying.

spending at the 4th, 8th and 12th quarters equal to, respectively, 1.9, 1.4 and 1.5. The authors find a positive reaction of private consumption. The effects on private investment are also positive but only in the first year.

Summing up, the reviewed studies, which adopt a relatively homogeneous methodology to the one used in our study on Italy, indicate that in the US a shock to government direct expenditure has positive and relatively long-lasting effects on private consumption and output. These results are a straightforward implication of all Keynesian models but they have been shown to be also compatible with a dynamic general equilibrium model characterized by sticky prices and the presence of non-Ricardian consumers (Galí *et al.*, 2003).[5] There is no consensus on the effects on investment. The evidence concerning the other countries is mixed and very limited.

Alternative approaches to the identification of fiscal shocks in the context of VAR studies have been proposed by Edelberg, Eichenbaum and Fisher (1999) and by Mountford and Uhlig (2002). Edelberg, Eichenbaum and Fisher (1999) study the response of the US economy to specific episodes of military build-ups, identified in Ramey and Shapiro (1997). They conclude that there is a significant and positive short-run effect on output, which fades away after some years. Mountford and Uhlig (2002) use sign restrictions on the impulse responses in order to identify fiscal shocks. In particular, an expenditure shock is identified by a positive response of expenditure for up to four quarters after the shock.[6] In their results, a deficit spending shock stimulates output only in the first four quarters, although only weakly.

Turning to our analysis, the main results can be summarized as follows.

As in all comparable VAR studies, we examine the effects of a shock to total direct government spending.[7] We do so on the basis of a six-variable VAR, which includes private GDP, the private GDP deflator, employment, the real interest rate, direct expenditure and net revenue.[8] As in previous studies, direct expenditure has a positive impact on output. The spending shocks we identify are far less persistent than those estimated in the US context. As a consequence, the response of output after impact is relatively small and fades away quickly. In terms of cumulative

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[5] The model proposed by the authors allows for rule-of-thumb consumers (who do not borrow or save) in coexistence with infinite-horizon Ricardian consumers. An implication of the model is that the impact of government spending on consumption and output is greater when the persistence of the shock is low; this may explain why the results for the cumulative multiplier in our study are on the high side of the range of available estimates.

[6] This identification strategy excludes temporary fiscal shocks.

[7] We include only current direct expenditures, almost ninety per cent of total direct expenditure in the Italian context, as we are not fully confident of reliability of our cash data for investment.

[8] In national accounts, government direct expenditure exactly matches the public component of aggregate demand in total GDP. As our data are not from national accounts, we do not observe this correspondence: *i.e.* a shock to cash government spending does not reflects into a corresponding change in public demand. Therefore, we prefer to include in the VAR private GDP (and its deflator) instead of total GDP (and the corresponding deflator).

multiplier, an indicator which gauges the effects on economic activity per unit of expenditure, our results are on the high side of the evidence from comparable studies, being broadly similar to those reported, for US, in Galí *et al.* (2003) and Fatás and Mihov (2001) and, for France, in Biau and Girard (2005). The values of the multiplier at the 4th, 8th and 12th quarters are equal to, respectively, 1.5, 1.7 and 1.2. The responses of private consumption and investment are positive, but generally not significant.

However, these results (briefly commented in Appendix 1) are not very precise, partly because of the fact that the two main components of direct spending (lumped together in the model) appear to have significantly different effects on the macroeconomic variables.

In our benchmark seven-variable model we therefore distinguish between wage expenditure and purchases of goods and services. We find that a shock to government purchases of goods and services has a relatively sizeable effect on economic activity: an exogenous one per cent (in terms of private GDP) shock raises private real GDP by 0.6 per cent after 3 quarters. The response of private GDP goes to zero after two years, reflecting with a lag the relatively low persistence of the spending shock, which fades away completely in the 4th quarter. The values of the cumulative multiplier (computed for total GDP) at the 4th, 8th and 12th quarters are respectively 2.4, 2.4 and 1.7. These values would suggest that purchases have a larger impact on economic activity than that generally indicated by econometric models with "keynesian" short-term features (e.g., see Henry, 2004, and the specific comparison with the Bank of Italy quarterly econometric model carried out in section 4.2).The increase in economic activity is determined by positive responses of private consumption and investment. The effect on inflation is positive and short-lived.

In contrast, public wages have no significant effect on GDP and employment in the short-run; a negative and significant effect emerges after two years. The reactions of inflation and interest rates are positive and larger than in the case of a shock to purchases. Finally, shocks to net revenue have negligible effects on all the macroeconomic variables.

The results of our analysis are quite robust to the use of alternative models or different specifications of the benchmark model. We broadly confirm the results of other authors using comparable methods, but we are also able to distinguish between the two largest components of direct spending. Contrary to Fatás and Mihov (2001), we find that purchases on goods and services have a greater impact on economic activity than wage spending. As the former is a direct demand of private goods while the latter represents a monetary transfer, having only an indirect impact on private consumption, our result can be considered relatively standard.[9]

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[9] Furthermore, as already mentioned, the results in Fatás and Mihov (2001) may be partly due to differences in the persistency of the shocks.

Finally, at least two important caveats concerning our analysis need to be reminded. First, as in all studies using VARs to analyze the effects of fiscal policy, policy surprises may not coincide with the estimated shocks. Fiscal actions are sometimes preceded by announcements and economic agents may react to the latter rather than to the former. We regard this issue as especially relevant for our estimated shocks to wages: they include large sums for arrears, paid to public employees with significant lags with respect to both the definition of the amounts and the signing of the contracts. Second, we use cash data from an administrative source, whose accounting practices may not be fully consistent over the whole sample period. As documented in section 2, we corrected the original series to increase homogeneity over time. Moreover, we find that the largest fiscal shocks match historical accounts of government actions (section 3.3).[10] Nevertheless, our data may still present some inconsistency. We thus believe that our results need be taken with caution.

2. Government accounts quarterly data

2.1 Sources and construction of the data

The availability of quarterly fiscal variables represents the main constraint for the analysis of fiscal policy with Vector Autoregressions. In Italy, quarterly national accounts data on general government budget (based on ESA95) have been released for the first time at the beginning of 2004 and are available only from 1999 onwards, hence cannot be used in our analysis. Only for government consumption (an aggregate approximately equal to the sum of public wages and purchases of goods and services) a national account quarterly series starting in 1980 is available.[11]

In contrast to national accounts data, which are partly elaborated on an accrual basis, our data focus on government actual payments and receipts. It is controversial whether cash-basis or accrual-basis data are the most appropriate when studying the impact of government operations on the behavior of the rest of the economy.[12] In fact, our analysis shows that the effects on GDP of government consumption, if measured per unit of expenditure, does not change significantly when cash data are replaced by national account data. Furthermore, the precision of the estimates in the first quarters is generally higher when using cash data (see Section 4.2.1).

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[10] Also, when we compare the effects of a shock to direct spending using alternatively our cash data and a corresponding national accounts time series, we obtain similar values of the cumulative multiplier (section 4.2.1).

[11] The use of national account data would have implied two important limitations. First it does not allow us to assess the impact on activity of different spending items. Secondly, as a quarterly series of net revenue is not available, we cannot use national accounts data in a VAR model which presents the desirable feature of taking into account developments in the whole general government budget.

[12] For a discussion on the issue see, among others, Levin (1993).

The sources of our government budget data are the Italian Ministry of Treasury and the Bank of Italy. Since the early Eighties, the Treasury publishes quarterly cash figures, covering actual payments and receipts of central and local governments, as well as those of health and social security institutions.[13] Starting in 1994 we take public sector data directly from this source. For the previous years (1982-93) we sum the figures for each subsector, consolidating intergovernmental flows when possible.[14] A comparison between our cash data and national account data is reported in Appendix 2.

In our analysis we consider a 3-way disaggregation of the government budget. On the expenditure side we consider current spending on goods and services and compensation of employees. The other expenditure items, mainly monetary transfers to households and firms, are subtracted from total revenues to obtain our third fiscal aggregate, net taxes. Revenues are computed as a residual item starting from the Bank of Italy cash deficit figure, which excludes debt settlements and privatization receipts.[15] Measuring net revenue as a residual from the cash deficit probably ensures a better coverage, because data on the individual revenue items are not statistically homogeneous over the sample period for a number of reasons, including the numerous tax reforms enacted during the sample.[16] As a check, we also constructed net taxes from the sum of individual tax revenues, less transfers to households. The results do not qualitatively differ from those presented in this paper.

In the end, the only budget components which do not appear in our model are interest payments and capital purchases of goods by the government, or government investment. We exclude the former because it is largely outside the scope of government control; we exclude the latter because it has a very erratic behavior, and we are less confident of the quality of the data.[17] We plan to explore this issue, including the construction of government investment data, in further work.

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[13] Cash data with a more limited coverage are available for the years 1980 and 1981 and the late Seventies. See Ministry of Treasury, Relazione trimestrale di cassa, various issues.

[14] For the years for which information at both aggregate and sub-sector levels are available, the sum of state sector, local governments, health sector and social security institutions represents a rather constant percentage of total public sector figures (ranging on average between 94 and 100 per cent, depending on the budget item). We apply to each budget item, for the years before 1994, the corresponding scale factor.

[15] Statistics on the general government borrowing requirement (the deficit in cash terms) are published by the Bank of Italy on a monthly basis since the early Eighties. These data refer to the financing of the borrowing requirement (*i.e.*, it is computed by looking at changes in debt instruments), on which precise and almost complete information are available. The main reason why we exclude debt settlements and privatization receipts is that they are not considered in national accounts data. Moreover, outlays for debt settlements refer to expenditures undertaken in past periods, whereas privatization receipts cannot be thought of as resources compulsorily subtracted from the private sector. For these reasons, their impact on the economic activity should be negligible.

[16] Among other factors, in 1998 a new tax (IRAP) is introduced, replacing health contributions and other few taxes. This reform significantly altered the composition of both revenue and expenditure sides. The revenue from this new tax was included in indirect taxes, whose weight in total revenue consequently increased; social security contributions decreased because of the elimination of health contributions.

[17] Note also that the ratio between cash and national account data on investment is very volatile over the sample period, ranging from about 80 per cent to almost 100 per cent.

Current spending on goods and services includes intermediate consumption and social transfers in kind (both included in government consumption). Raw data have been corrected to take into account that some of the expenditures included in this item refer to operations that are either not classifiable as government consumption or are not treated consistently over the sample period. In particular, we excluded compensations of banks for their revenue collection service, as this item is recorded, for accounting purposes and not on a regular basis, both on the expenditure and revenue side. Also, payments by the Municipality of Rome to local transport enterprises, which were recorded as transfers before 1998, have been subtracted from the series starting in that year.

We also corrected the original series of compensation of employees to increase homogeneity over the sample period. First, since contributions for retirement for its employees were not paid by the State to social security institutions until January 1996, we have subtracted from the original series these contributions for the following years (in national accounts this problems is treated by including, until 1996, an imputed value of notional contributions equal to State payments to retirees). Second, from 1994 salaries of University personnel were recorded as transfers to public entities rather than as compensation of employees. Hence, we have augmented the post-1994 figures by an amount equal to the fraction of such payments in total wage expenditure observed in 1993.

Finally, before applying a statistical procedure to adjust for seasonality, we distributed evenly across quarters the corporate income taxes (IRPEG and ILOR) installments, although this additional smoothing did not turn out to significantly affect our results.

2.2 The seasonally-adjusted data in real terms

Seasonally-adjusted cash figures in real terms (using the private GDP deflator) for current spending on goods and services and compensation of employees are plotted in Figure 1.

Government spending on goods and services has almost steadily increased over the sample period. A significant reduction in the growth rate occurred in the period 1992-97, when it averaged less than 1 per cent (it was about 6 per cent, on average, in both the previous and the following subperiods), reflecting the consolidation effort in the run-up to the monetary union.[18] As a ratio to GDP, current spending on goods and services decreased from 6.3 per cent in 1991 to 6.1 per cent in 1997. After 1997 fiscal policy loosened, taking advantage of the substantial

[18] The amount of corrections introduced by the budget laws for 1992 and 1993 was sizeable: overall, the estimated impact on the borrowing requirement (against estimates based on the assumption of constant policies) amounted to almost 100 billion euros (about 12 per cent of GDP), of which more than a third coming from expenditure cuts. A significant part of these cuts were made on spending on goods and services and compensation of employees. The adjustments implemented in the following three years were also considerable.

decrease in interest payments, and by 2003 government spending on goods and services was at 7.8 percentage points of GDP.

Compensation of employees shows a slightly different pattern. After a substantial increase in the Eighties, it started falling in real terms. A substantial drop occurred over the period 1991-99, when it moved from 11.4 per cent of GDP to 8.8 per cent. This decline reflects both wage restraints (stricter than those occurred for private employees) and a fall in the number of employees (by close to 5 per cent between 1991 and 1999). In the last years the number of employees and the related expenditure have again increased significantly. As a ratio to GDP, compensation of employees in 2003 reached 9.3 per cent.

Finally, Figure 2 plots seasonally-adjusted cash figures in real terms of our measure of net revenues. Net revenues have steadily been increasing over the sample period, with the significant exceptions of the years 1994, 1998 and 2002. The first two reductions mainly reflected the drop in gross revenue, which owed to the expiration of temporary tax increases in the previous year (e.g. the extraordinary tax in 1997 which aimed at reducing the deficit below 3 per cent of GDP and therefore allowing Italy's participation to the monetary union). The reduction in 1998 (from 48.0 to 46.5 per cent of GDP, in national accounts) was also due to the introduction of a new tax (IRAP), replacing health contributions and other taxes, which, contrarily to the expectations, did not turn out to be revenue neutral.

3. The VAR model

3.1 Specification

The benchmark specification of the VAR model includes the following seven variables: the real private GDP y_t (*i.e.*, real GDP minus real government consumption), the private GDP deflator p_t, private employment e_t, the ten-year nominal interest rate i_t, real government spending on goods and services g_t, real government wages w_t and real net taxes t_t. All variables, with the only exception of the interest rate, are log-transformed. The sample period runs from 1982:1 to 2003:4. All fiscal variables are seasonally-adjusted using the TRAMO-SEATS procedure and expressed in real terms using the private GDP deflator. We use the long-term interest rate, instead of the short-term rate, since the former is arguably a more important determinant of components of GDP such as private investment.

The reduced form VAR model is:

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

in which X_t is the vector of variables, $B(L)$ is an autoregressive lag polynomial and U_t is the vector of reduced form innovations. Our benchmark specification also

includes a constant and a quadratic time trend, which we omit from the notation for convenience. The choice of the number of lags is made by looking at the autocorrelation function of the reduced form VAR residuals and by computing likelihood ratio tests. The number of lags is set to 3 since it provides serially uncorrelated residuals. The likelihood ratio test of 4 lags against the null hypothesis of 3 lags confirms our choice.

In the paper we refer to a number of other specifications. A 6-variable model, where the two components of government spending are lumped together, is mainly used for the purpose of establishing an homogeneous comparison with other VAR studies (the results using this model are referred to in the introduction and briefly discussed in Appendix 1). A 5-variable model, which includes the four macroeconomic variables of the benchmark model and only the fiscal variable we want to analyse, is used to check for robustness in section 4.2.1. Another 6-variable model is used to analyse the effects of fiscal shocks on the main GDP components; it includes the variables of the previous 5-variable model, except GDP, substituted by the two main components of aggregate private demand (consumption and investment). Finally, a few alternative 7-variable models are again used to check for robustness. The changes with respect to the benchmark model include the use of alternative macroeconomic variables (private wages instead of employment and the short-term interest rate instead of the long-term one), different orderings of the budgetary components in the identification scheme and different ways the variables are expressed (in levels as in the benchmark specification but without trend, or in differences).

3.2 Identification and estimation

Our identification strategy builds on Blanchard and Perotti (2002) and Perotti (2002). We identify the fiscal shocks by imposing contemporaneous restrictions on the vector U_t, so to derive a vector of "structural" fiscal shocks, orthogonal to each other and to the variables of the model. The following relationship holds between the reduced form residuals U_t and the structural shocks V_t:

$$AU_t = BV_t$$

where the shocks V_t are independent and identically distributed with covariance matrix equal to the identity one. The matrix A links contemporaneously the reduced form innovations while the matrix B defines how the structural shocks affects the variables of the VAR. Given the reduced form representation and the relationship between residuals and shocks, the structural form of the VAR can be obtained by pre-multiplying (1) by the matrix *A*:

$$AX_t = AB(L)X_{t-1} + AU_t = AB(L)X_{t-1} + BV_t = D(L)X_{t-1} + BV_t \qquad (2)$$

where $D(L)$ is the structural autoregressive lag polynomial.

In the next section we describe the approach we use to identify the shocks. Only fiscal shocks have a clear economic interpretation in our analysis.

We start by expressing the reduced form innovations of the government spending, government wages and net taxes equations as linear combinations of the structural fiscal shocks v_t^g, v_t^w, v_t^T to these variables, and of the innovations of the other reduced form equations of the VAR:

$$\begin{aligned} u_t^g &= \alpha_y^g u_t^y + \alpha_p^g u_t^p + \alpha_i^g u_t^i + \alpha_e^g u_t^e + \beta_T^g v_t^T + \beta_w^g v_t^w + v_t^g \\ u_t^T &= \alpha_y^T u_t^y + \alpha_p^T u_t^p + \alpha_i^T u_t^i + \alpha_e^T u_t^e + \beta_g^T v_t^g + \beta_w^T v_t^w + v_t^T \\ u_t^w &= \alpha_y^w u_t^y + \alpha_p^w u_t^p + \alpha_i^w u_t^i + \alpha_e^w u_t^e + \beta_g^w v_t^g + \beta_T^w v_t^T + v_t^w \end{aligned} \tag{3}$$

The coefficients α_j^i capture both the automatic elasticity of fiscal variable *i* to the "macroeconomic" variables *j* (*y, p, i* , and *e*) and the discretionary change in variable *i* enacted by the policymaker in response to an innovation in these macro variables. The coefficients β_j^i measure instead how the structural shock to the fiscal variables affect contemporaneously the fiscal variable *i*.

We are interested in estimating the structural shocks v_t^g, v_t^T and v_t^w, and in studying the responses of the other variables of the system, in particular real GDP, to these shocks. However, without further restrictions the system above clearly does not allow us to identify these structural shocks. As in Blanchard and Perotti (2002) and Perotti (2002), we achieve identification by exploiting the existence of decision lags in fiscal policy and institutional information about the automatic elasticity of fiscal variables to real GDP, employment and the price level.

Specifically, we start with the observation that policymakers typically take more than a quarter to enact discretionary measures in responses to shocks to, say, real GDP: by the time the policymakers learn about the unexpected change in output, decide on the fiscal response, get it approved by the legislative branch, and implement it, certainly more than a quarter elapses. As a consequence, with quarterly data the coefficients α_j^i capture only the automatic elasticity of the fiscal variable *i* to the macro variable *j:* due to decision and implementation lags, the contemporaneous, discretionary change in variable *i* in response to an innovation in variable *j* is zero.

Still, without further restrictions one would not be able to identify the coefficients α_j^i: for instance, in the first equation an OLS regression of u_t^g on u_t^y, u_t^p, u_t^i and u_t^w would not provide a consistent estimate of α_y^g, because all the u_t^j are correlated with the structural shocks v_t^i. In order to identify the system, we need an *external* estimate of the automatic contemporaneous elasticities α_j^i.

We compute these elasticities on the basis of institutional information, like statutory tax rates, as described in Appendix 3. Using these values for the contemporaneous elasticities α_j^i we can estimate the structural shocks.

Using the elasticities described above we construct the *cyclically adjusted* (CA) residuals for the fiscal variables:

$$\begin{aligned} u_t^{w,CA} &\equiv u_t^w - \alpha_y^w u_t^y - \alpha_p^w u_t^p - \alpha_i^w u_t^i - \alpha_e^w u_t^e = \beta_g^w v_t^g + \beta_T^w v_t^T + v_t^w \\ u_t^{g,CA} &\equiv u_t^g - \alpha_y^g u_t^y - \alpha_p^g u_t^p - \alpha_i^g u_t^i - \alpha_e^g u_t^e = \beta_T^g v_t^T + \beta_w^g v_t^w + v_t^g \\ u_t^{T,CA} &\equiv u_t^T - \alpha_y^T u_t^y - \alpha_p^T u_t^p - u_i^T u_t^i - \alpha_e^T u_t^e = \beta_g^T v_t^g + \beta_w^T v_t^w + v_t^T \end{aligned} \tag{4}$$

Since not all the coefficients β_j^i can be identified, we need to take a stance on the ordering among the fiscal shocks, that is on which fiscal variable can contemporaneously react to the others. In our benchmark case, we assume that public wages "come first": this assumption is equivalent to setting β_T^w and β_g^w to zero. We then assume that government purchases is decided before net taxes, *i.e.* that $\beta_T^g = 0$. Therefore the coefficients β_w^g, β_g^T and β_w^T need to be estimated.

Thus, (4) becomes:

$$\begin{aligned} u_t^{w,CA} &= v_t^w \\ u_t^{g,CA} &= \beta_w^g v_t^w + v_t^g \\ u_t^{T,CA} &= \beta_g^T v_t^g + \beta_w^T v_t^w + v_t^T \end{aligned} \tag{5}$$

Under these assumptions, the government wages shock is equal to the cyclically adjusted residuals of the corresponding equation: $u_t^{w,CA} = v_t^w$. Since we assume that government spending on goods and services can be adjusted taking into account the decision on public wages, then the coefficient β_w^g can be estimated by a simple OLS regression of $u_t^{g,CA}$ on the estimate of the government wages shock. Finally the coefficients β_g^T and β_w^T can be estimated by an OLS regression of $u_t^{T,CA}$ on the government spending and government wages structural shocks. The coefficients of the equations for real private GDP, the GDP deflator, employment and the ten-year interest rate can be estimated recursively by means of instrumental variables regressions. With respect to real private GDP the following equation is employed:

$$u_t^y = \alpha_g^y u_t^g + \alpha_w^y u_t^w + \alpha_T^y u_t^T + v_t^y$$

using the estimated series for the fiscal shocks, $\hat{v}_t^g$, $\hat{v}_t^w$ and $\hat{v}_t^T$ as instruments for, respectively, u_t^g, u_t^w and u_t^T. We then proceed in a recursive way for the price level, employment and the ten-year interest rate equations.

Having estimated all the coefficients (the alphas and the betas), we can construct the A and B matrices which are used to compute the impulse responses to fiscal shocks. The A matrix is:

$$A = \begin{bmatrix} 1 & 0 & 0 & 0 & -\alpha_g^y & -\alpha_w^y & -\alpha_T^y \\ -\alpha_y^p & 1 & 0 & 0 & -\alpha_g^p & -\alpha_w^p & -\alpha_T^p \\ -\alpha_y^e & -\alpha_p^e & 1 & 0 & -\alpha_g^e & -\alpha_w^e & -\alpha_T^e \\ -\alpha_y^i & -\alpha_p^i & -\alpha_e^i & 1 & -\alpha_g^i & -\alpha_w^i & -\alpha_T^i \\ 0 & -\alpha_p^g & 0 & 0 & 1 & 0 & 0 \\ 0 & -\alpha_p^w & 0 & 0 & 0 & 1 & 0 \\ -\alpha_y^T & -\alpha_p^T & 0 & 0 & 0 & 0 & 1 \end{bmatrix}$$

while the *B* matrix is:

$$B = \begin{bmatrix} \sigma^y & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & \sigma^p & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & \sigma^e & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & \sigma^i & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & \sigma^g & \beta_w^g & 0 \\ 0 & 0 & 0 & 0 & 0 & \sigma^w & 0 \\ 0 & 0 & 0 & 0 & \beta_w^T & \beta_g^T & \sigma^T \end{bmatrix}$$

where the elements on the main diagonal are the standard deviation of the structural shocks.

Once the VAR is estimated and identified we compute impulse responses to evaluate the dynamic effects of a structural shock. Impulse responses are computed using the structural moving average representation of the VAR defined in equation (1):

$$X_t = \left[I - B(L)\right]^{-1} A^{-1} B V_t = C(L) A^{-1} B V_t \tag{6}$$

in which the polynomial $B(L)$ comes from the OLS estimation of the reduced form VAR and the matrices A and B are defined above. The reduced form moving average representation of the VAR is described by the polynomial $C(L)$. Error

bands are computed by Monte Carlo simulations based on 1000 replications, as in Stock and Watson (2001).

3.3 Interpreting the structural shocks

Overall, the largest estimated fiscal shocks tend to match well known episodes of government actions. In the case of purchases, the most conspicuous negative shocks are estimated in the third quarter of 1992 and in the last quarter of 1997. In the third quarter of 1992 fiscal policy reacted to the devaluation which occurred in the summer of 1992; at the end of 1997 fiscal policy made its last effort to obtain Italy's participation to EMU, as decisions were taken on the basis of the deficit for 1997. Both episodes are part of a longer period of expenditure containment. As for the first episode, we estimate almost uninterruptedly negative shocks from 1992:2 to 1993:2; as for the second episode negative shocks are observed throughout 1996:4 to 1997:4. More recently, data show the effects of the cash constraints imposed at the end of 2002 and at the end of 2003. Wage shocks are also consistent with the timing of contracts renewals. For example, wage increases for the period 2002-03 started to be paid only at the end of 2003. As a result, real wage shocks are negative in 2002 and in the first half of 2003, then they turn positive. A similar pattern can be observed in the period 2000-01 (Figure 3). In the case of net revenue, the original quarterly series exhibits a large variability, with a relatively unstable seasonal pattern. These features, that are reflected on frequently large estimated shocks, make the matching between the latter and historical episodes of government action less precise (Figure 4). Nevertheless, for example, we estimate uninterruptedly positive shocks to net revenue from 1996:4 to 1997:4, indicating that the restrictive fiscal policy aiming at the participation to the monetary union concerned almost the entire budget and not only purchases.

4. The effects of government spending

In this section we comment on the effects on the fiscal and the macroeconomic variables of exogenous shocks to the two largest components of government direct spending. The impulse responses are constructed assuming a shock equal to a one percent of real private GDP. In Figures 5 and 6 the whole set of impulse responses for the benchmark specification for each of the two shocks are plotted. In each figure we also present two lower and two upper bounds, corresponding to, respectively, the fifth, sixteenth, eighty-fourth and ninety-fifth percentiles of the distribution of the responses at each horizon. Throughout the paper, in line with most previous studies, we define as "statistically significant" those estimates for which the narrow error bound (identified by the sixteenth and the

eighty-fourth percentiles) does not include the value 0.[19] All impulse responses can be interpreted as deviations from the baseline and are expressed as shares of GDP, by multiplying them by their average share in GDP.

4.1 The response of fiscal variables

We start by studying the responses of the three fiscal policy variables to shocks to government purchases and government wages.

A striking feature of the Italian data is that shocks to government purchases and to government wages display almost no persistence: in both cases, by the fourth quarter, the response of each variable to itself is virtually 0. In contrast, a considerable persistence of government spending to its own shocks is found in VAR studies based on both U.S. data (Blanchard and Perotti, 2002, Mountford and Uhlig, 2002, Fatás and Mihov, 2001, and Edelberg, Eichenbaum and Fisher, 2003) and other OECD countries data (Perotti, 2002).

In all these studies, the government spending variables are from the national income accounts; government spending is measured by total government consumption (essentially the sum of purchases and compensation of employees), and, in some cases, it includes also capital expenditure.[20] However, this different aggregation is not a reason for the difference in the estimated persistence of government spending: when we estimate a 5-variable VAR with our 4 benchmark macroeconomic variables and our proxy for government consumption (computed by summing up cash government purchases and wages), we still find no persistence in the shocks.

In the case of government wage shocks, their lack of persistence may reflect the presence of large transitory sums for arrears. In Italy there were long delays in public wage settlements in the last two decades. As a result, the initial payments after a wage settlement have often included large sums for arrears.[21] Note, however, that this explanation is not without problems: it implies that, at the time of wage settlements, what we call shocks could have been largely anticipated. Similarly, the lack of persistence in cash purchases might reflect irregularities in the timing of payments by public entities.

Of course, an alternative explanation is measurement error in fiscal variables. If the measurement error is white noise, and it is a large component of fiscal

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[19] As pointed out by Sims and Zha (1999), error bands corresponding to 0.50 or 0.68 probability (the latter approximately coincides with our narrow error bound) are often more useful than 0.95 bands since they provide a more precise estimate of the true coverage probability.

[20] Only Fatás and Mihov (2001) consider also wage and non-wage public spending separately. In their study, a shock to non-wage spending is also quite persistent, though much less than that to wage spending.

[21] Wage agreements in the public sector concerned a time span of three years in the Eighties and of two years since mid-Nineties. Settlements for different sub-sectors (teachers, doctors, local authorities, ministries and others) usually started in the second year of the period they referred to and were not reached at the same time; they were instead irregularly distributed over two years.

variables, then the lack of persistence of fiscal shocks is precisely what we should expect our impulse responses to display.

Interestingly, when we use real government consumption (deflated using its own deflator) from the national income accounts in the 5-variable VAR, together with our 4 benchmark macroeconomic variables, we find a considerable persistence of the government spending shock, in line with the other VAR studies. The persistence is lower but still significant (the shock disappears only after 16 quarters) if we apply the deflator of private GDP to the national account series in nominal terms.

The responses of public wages to purchases, and of purchases to public wages, are minimal. We find instead a surprisingly large[22] positive impact effect of public wages on net taxes – about 1.2 percentage points of GDP – which is, again, very short-lived. This effect does depend, however, entirely on the most recent data: it halves, becoming fully consistent with the working of the tax system, when we end the sample in the mid-Nineties. Purchases, instead, have a large negative effect on net taxes in the second quarter; which, again, disappears afterwards. The effect is surprising, as GDP expands and this should automatically lead to a positive response of net taxes. The negative response may reflect the fact that in Italy fiscal policies aimed at modifying the balance have been generally pursued with actions on both revenue and expenditure.

Inverting the order of the first two fiscal variables (government purchases and government wages) in our identification scheme has virtually no effects on the results displayed so far. These results are also robust to several alternative specifications of the VAR: in particular, when only one fiscal variable (public wages, purchases, or net taxes) is included in turn in the VAR, or when the short-term interest rate replaces the long-term one. The results are also robust when all variables are expressed in levels without any time trend, with the small exception that in this case the response of public wages to its own shocks appears to be more persistent, stabilising between 0.4 and 0.2 percentage points of GDP in the first 2 years. As it is often the case, the responses are more persistent when the variables are expressed in first differences: typically, after the first quarter the response of a fiscal policy variable to its own shock stabilises between 0.4 and 0.6 percentage points of GDP over the whole five years horizon.

4.2 The response of output

GDP responds to a purchase shock in a hump-shaped fashion: it increases on impact by about 0.2 percentage points, then it increases further to reach a peak of 0.6

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[22] The mechanical impact on revenue of an increase in public wages, taking into account social security contribution rates and the personal income tax, is currently slightly above 50 per cent. Net revenue would also react to the impact on government purchases and private GDP, both approximately 0.2 per cent of GDP. Overall, the impact on revenue consistent with the automatic working of the tax system is inside the bounds (16^{th} and 84^{th} percentiles) of our confidence interval.

percentage points after 3 quarters, and then slowly returns to trend by the end of the second year. The response to a wage shock hovers at about 0.2 percentage points for the first year and a half; however, this response is estimated rather imprecisely, and it is never statistically significant. At the end of the second year the response of private GDP becomes slightly negative and, for a few quarters, statistically significant.

These GDP responses are quite small if compared to standard textbook presentations of the impact of fiscal expansions. However, one should keep in mind at least three points. First, standard analyses focus on total GDP, which includes government consumption. Second, the impact on private GDP depends on the persistence over time of the shock, and, as already mentioned, the fiscal shocks we identify are very short-lived. Third, it is not entirely appropriate to compare the GDP responses to the two spending shocks, since when one fiscal variable is shocked the other moves too.

One way to address these issues is to compute the cumulative multipliers, *i.e.* the ratio of the cumulative change in *total* GDP to the cumulative change in total government consumption (the sum of the cumulative change in purchases and the cumulative change in public wages), in response to each of the two shocks. This ratio provides a measure of the cumulative impact on GDP of a unit cumulative change in government consumption due to a spending shock.[23] Figures 8 and 9 display the median cumulative multipliers of the shocks to government purchases and to government wages, respectively. The cumulative multiplier of a purchase shock is quite large relative to the rest of the literature: it starts at about 1.2, it reaches a value slightly above 2.5 after 6 quarters, and then declines slowly to about 1.5 after 4 years; it is also estimated quite precisely, so that it is always significant. In contrast, the cumulative multiplier of a public wage shock is smaller and goes below 1 (indicating that the increase in aggregate demand coming from the its public sector component is partly compensated by other factors) in the fourth year; moreover, it is very imprecisely estimated, so that it is always statistically insignificant.

An issue not addressed by the cumulative multiplier presented above is that the impact on GDP depends also on the response of net revenue. If the latter is approximately proportional to the response of total GDP, this factor may be disregarded, as it merely represents the automatic working of the tax system. This is approximately the case when we analyse the shock to wages.[24] In the case of

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[23] It can be shown, in a two-variable model, that the cumulative multiplier provides a measure of the effects on GDP independent of the persistence of the shock. This feature allows to compare the results of a VAR study with simulations of econometric models, where the shocked variable can be kept constant afterwards. Unfortunately the result does not hold exactly when more than two variables are involved. We are indebted for this analysis with Daniele Terlizzese.

[24] The response of net revenue to a shock to wages is slightly too large in the first quarter (given the size of the shock and the impact on private GDP) and unexpectedly negative in the third (taking into account that the responses of wages and private GDP are, respectively, slightly positive and nil). Overall, these two deviations from what it could be expected from the working of automatic stabilizers offset each other.

purchases, instead, notwithstanding the GDP expansion, there is a large decline in net revenue in the second quarter. A way to partially take into account this factor, which may have facilitated the GDP expansion (though, as shown in section 5, changes in revenue alone do not seem to have significant effects on GDP), is to modify the cumulative multiplier described above, netting its denominator by the cumulative change in net revenue.[25] As shown in Figure 10, the resulting value of this modified cumulative multiplier still exceeds 2 at peak but is lower than that of the more standard indicator.

An alternative way to compare our results with those of other approaches is to try to replicate the fiscal shock we observe, and also the responses of the other fiscal variables, in a model simulation. The results of this comparison, using the Bank of Italy quarterly econometric model (BIQEM) are presented in Figure 11 (see Banca d'Italia, 1986 and Terlizzese, 1993).[26] In the simulation with the Bank of Italy model the effects on GDP of a shock to purchases are smaller but more persistent; in the first 2 years they are well inside our error bounds.

Finally, a few caveats concerning the substantial difference in our results between the effects on GDP of a shock to purchases and one to wages should be mentioned. First, as just mentioned, the shock to purchases is accompanied by a transitory but sizeable drop in revenue, which may have facilitated the rise in economic activity. Second, as mentioned in section 4.1, the wage shocks may be anticipated, as significant delays in the payments typically occur. Third, the variability that we observe in the total amount paid for public wages seems largely due to its unit wage component and to a much smaller degree to the changes in public employment. In a different institutional context the relative role of these two factors may be different and this may modify the effects on GDP.

4.2.1 Robustness

The above results are qualitatively quite robust to alternative specifications of the model. In Figure 12 we present the median response of GDP to a purchase shock in alternative models that differ with respect to the variables included and the way shocks are identified. In particular, we present the results of the following five alternatives: the first, labelled "short-term rate", includes the short-term interest rate instead of the long-term one; the second, "private wage", includes the latter instead of private employment; the third, "5VAR", excludes the two other fiscal variables; the fourth, "purchases first", uses a different ordering of the expenditure variables when identifying the shocks (in the benchmark model wages are ordered first, whereas in this alternative specification purchases are first); the fifth, "Cholesky" or

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[25] In standard textbook analyses of the keynesian model, to a large extent the effect of fiscal policy on GDP depends on the deficit, which is very close to the resulting variable at the denominator. Thus, this ratio provides a measure of the cumulative impact on GDP of a unit cumulative change in the aggregate deficit due to a fiscal policy shock.

[26] In the simulation, nominal interest rates are kept as in the baseline and the responses of fiscal variables to the shock to purchases are treated as shocks.

recursive ordering, identifies the shocks following the approach used by Fatás and Mihov (2001). Under this identification scheme, it is assumed that fiscal variables respond in the same quarter to the macroeconomic variables in the VAR while it takes at least one quarter for fiscal policy to affect the economy. The ordering among the fiscal variables is the same as in the benchmark specification: revenues are allowed to adjust to changes in the two spending components of the budget. The results obtained with this identification scheme are very close to those of the benchmark model and well within the upper (95 per cent) and lower (5 per cent) bounds of the GDP response in that model, also reported in the figure. Figure 14 does the same, but with respect to a public wage shock. Again, there are no noticeable differences from the results obtained by the benchmark specification.

A second set of specifications makes different assumptions regarding the statistical properties of the variables included in the VAR. Figure 13 displays the median responses of private GDP to purchase shocks when all variables are entered in levels, but a trend is not included, and when all variables enter in first differences. The Figure also reports the median response of GDP in the benchmark specification. As in the benchmark specification, in the specification in levels with no trend private GDP has a hump-shaped response, but it is stronger: the peak is at about 1, instead of 0.6, and the entire response is statistically significant over the whole horizon. In the first-difference specification, the response of GDP is initially similar to that of the benchmark model. Afterwards, the response remains almost constant at 0.4 per cent of GDP, reflecting the higher persistence of the shock to purchases in this specification. The response of private GDP is no longer statistically significant.

Figure 15 does the same as Figure 13, but it refers to the public wage shock. Here the GDP response was insignificant to start with. Alternative specifications of the trend do not alter the results substantially: in all specifications the GDP responses are statistically insignificant.

We also assess whether our cash data and national account data provide different results. This comparison is necessarily restricted to the aggregate of government consumption, for which national accounts data are available, and for which the sum of wages and purchases is a relatively good approximation (in both cases, we compute variables in real terms by using the private GDP deflator). Moreover, it has to be carried out with a 5-variable VAR model, as we have not a quarterly series for net revenue in national accounts. As already mentioned, the national accounts variable is smoother. Its shocks exhibit a greater degree of persistence, fading away in about four years. The effects on GDP are positive in the first two years and negative afterwards, as when using cash data, but their size is significantly larger (Figure 16). However, there is no significant difference between the cumulative multiplier obtained by the two sets of data (Figure 17). As for the precision of these estimates, using the cash data the error band is significantly narrower in the first four quarters; afterwards, national accounts estimates are slightly more precise.

4.3 The responses of GDP components and the other variables in the VAR

When studying the GDP response to a given spending shock, the results are virtually identical when the other spending variable and net taxes are excluded (see Figures 12 and 14). Thus, we study the effects of spending shocks on private consumption and private investment by having both these two variables in a VAR that only includes the government spending variable whose shock we are studying.

Figure 18 displays the responses of private investment and private consumption to a shock to purchases as shares of GDP, by multiplying them by the average share of private investment and private consumption in GDP, respectively. Both components are positively affected by the shock, and exhibit roughly similar patterns: both responses are hump-shaped, starting at about zero on impact and reaching a peak in the fourth quarter, at about 0.2 percentage points of GDP in the case of investment, 0.3 percentage points in the case of consumption. When the two components are added together, they explain relatively well the effects of purchases on GDP in the benchmark 7-variable VAR model.

The response of private investment to a public wage shock is positive but very limited, 0.1 percentage points of GDP at most; private consumption instead declines, by as much as 0.3 percentage points after about 3 years (Figure 19). Once again, the sum of the two responses is sufficiently close to the response of GDP in the benchmark model.

Figures 20 and 21 display the median responses of private employment to the two spending shocks, together with the usual lower and upper bounds. The results closely tailor those of private GDP. In the case of a shock to purchases, the effects on employment are slightly more sluggish and persistent, in line with what one could expect: employment increases on impact by almost 0.2 percentage points, then it increases further to reach a peak of 0.5 percentage points after 4 quarters, and then slowly returns to trend by year 4, two years after the effects on GDP have vanished. In the case of a shock to public wages, the responses of employment are very small and estimated rather imprecisely, similarly to those of GDP.

The median effects on inflation of the two spending shocks are positive but transitory (Figures 22 and 23). The shock to purchases causes an increase in inflation (measured by the change in the private GDP deflator) by 0.5 percentage points on impact, partly offset by a fall in the third quarter. The effects are negligible in all other quarters. The cumulated effect on the price level stabilises at 0.3 percentage points by the end of the first year; this result is slightly higher than those reported in Henry *et al.* (2004), which refer to a set of harmonized simulations conducted using various econometric models of countries of the euro area.[27] In the case of a wage shock, inflation does not react on impact but increases by 0.5 percentage points in the second quarter; this reaction is, again, partially offset in the third quarter; inflation is positive in each of the following 3 quarters, before

[27] We take into account that the shock in the model simulations is persistent.

returning to trend. The response of the price level stabilises at 0.6 percentage points by the end of the second year. The limited response of inflation to government spending shocks is in line with results obtained by other studies (see Perotti, 2002, and Henry *et al.,* 2004 and the studies cited therein). In fact, the response we find, though relatively small, is larger than what is found in many other studies (see, e.g., Mountford and Uhlig, 2002).

Figures 24 and 25 display the median responses of long-term nominal interest rates to the two spending shocks. In the case of a shock to purchases, the interest rate falls on impact by 0.3 percentage points; afterwards it is constantly above trend, by around 0.2 percentage points, but this effect is not statistically significant. The initial negative change in the interest rate has been found already in other studies (see Perotti, 2002, and studies cited therein); at this stage, we do not have a convincing explanation for this negative impact effect. A shock to public wages leads instead to a positive effect on interest rates already in the first quarter. The profile of the response is hump-shaped, with a peak in the fifth quarter at 0.6 percentage points. The effect, statistically significant between the fourth and the seventh quarter, dies out at the beginning of the third year. The larger response of interest rates in the case of a wage shock might be related to its stronger effects on inflation.

5. The effects of net revenue

We now discuss the response of the various macro variable in our VAR to a shocks to net revenues equal to 1 percentage point of GDP. In Figure 7 the whole set of impulse responses for the benchmark specification are plotted. Like in the case of the other fiscal shocks, the response of net revenue to its own shock is very short-lived, returning to zero immediately after the shock. Overall, we were not able to estimate any significant – statistically or economically – effect of net revenue shocks on the other variables. The effect on government wages and purchases is extremely small, and entirely insignificant. Rather counter-intuitively, we find a positive effect on GDP; however, this effect is extremely small, and again statistically insignificant. Similarly, the effects on private employment and inflation are very small and insignificant. Overall, these results are robust to all the alternative specifications that have been considered for assessing the robustness of the effects of government purchases and wages (level VAR without time trends, variables in first differences and other specifications).

APPENDIX 1
RESULTS OF THE MODEL INCLUDING TOTAL DIRECT SPENDING (6-VARIABLE MODEL)

To establish a setup comparable with those used in most of the VAR studies on the topic, we consider a specification in which the two main components of government expenditure, namely wages and purchases of goods and services, are lumped together.[28] The other variables are the same as in the benchmark model. Figure 26 displays the impulse responses, to a 1-percentage-point-of-GDP shock to government expenditure, of the six variables included in the VAR. The median and lower and upper bounds (corresponding to the fifth, sixteenth, eighty-four and ninety-fifth percentiles of the distribution) are also presented. Figure 27 reports the impulse responses to a shock to net revenue. An analogous overview of the results obtained for the benchmark model is provided in Figures 5, 6 and 7.

As in the benchmark model, the shock to government expenditure exhibits a very low persistence: by the second quarter, government expenditure response to itself drops significantly and by the forth quarter it is virtually 0. The response of net taxes in the second quarter is counter-intuitive, as in the benchmark specification as for a shock to purchases.

As in previous studies, direct expenditure has a positive impact on output. The response of private GDP after impact is relatively small and fades away quickly: private output increases on impact by about 0.1 percentage points, then it increases further to reach a peak of about 0.3 percentage points in the forth quarter (except for a blip after 3 quarters); it becomes slightly negative starting in the seventh quarter. Furthermore, this response is estimated rather imprecisely, and it is statistically significant only in the 4^{th}, 5^{th} and 6^{th} quarters. The responses of private consumption and investment are positive, but generally not significant.

Finally, Figure 28 shows the cumulative multiplier of a shock to total direct government expenditure. The value of the multiplier reaches a peak in the 6^{th} quarter, at 1.8, and gradually declines to around unity in the fourth year.

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[28] In this way we limit our analysis to the impact of current direct expenditures, which however in Italy accounts for almost ninety per cent of total direct expenditure.

APPENDIX 2
COMPARISON WITH NATIONAL ACCOUNT DATA

A comparison of yearly national accounts data and our cash data, adjusted in the way described in Section 2 above, shows reasonably similar patterns. National accounts series are generally smoother than cash series, mainly due to the accrual criterion adopted in the computation of the former.

Until 1994 national accounts data on current spending on goods and services are significantly higher than cash data, indicating that items recorded under these items in national accounts appear elsewhere in cash data; afterwards the difference shrinks, getting almost negligible in the last five years. Also for net revenue, national account data are higher than cash data; the difference remains more or less constant over the sample period. Instead, the series of compensation of employees in cash and national account data almost coincide.

Turning to quarterly data, we can only compare government consumption from the national accounts with the sum of current spending on goods and services and compensation of employees in our cash data.[29] The raw data from the two sources are very similar; this is not true for the seasonally-adjusted data, where the national account series is significantly smoother than our cash series.

Finally, a comparison between cash and national account quarterly data for each of the three fiscal aggregates we use can be done for the period 1999-2003.

For both spending items the cash and national accounts series exhibit very similar patterns. The series of net revenue in national accounts looks more volatile than our cash series, but this is due to the mechanical smoothing we have performed on it.

A detailed analysis of the data and graphs is available from the authors upon request.

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[29] To have an homogeneous comparison, we subtracted from government consumption the sum of a number of very small items, also included in this aggregate. As for these items we only have annual data, we split evenly the total on the different quarters.

APPENDIX 3
COMPUTATION OF THE ELASTICITIES OF FISCAL VARIABLES

In the approach used by Blanchard and Perotti (2002) to identify fiscal shocks it is necessary to employ estimates (obtained outside the VAR model) of the contemporaneous elasticities of the fiscal variables with respect to the macroeconomic variables.

As for expenditure items, we assume that only purchases of goods and services are affected, though marginally, by changes in the price level in the same quarter. Our benchmark elasticity is 0.1, implying a –0.9 elasticity of the variable in real terms (to deflate, we apply the GDP deflator for all variables). Using lower or higher values (–1.0 and –0.5, as in Perotti, 2002) has almost no impact on the results.

We assume that other influences of macro variables on direct expenditures are either extremely small or non-existent. The length of the procedures governing most payments simply exclude the possibility that a change in real GDP affects direct expenditure in the same quarter, either via automatic rules or via discretionary actions.[30] As for prices, a change in the GDP deflator does not influence wages in the same quarter as generalized pay increases are awarded only on the basis of contracts renewed every two years and there are lags between the signing of the contract and the actual payments.[31]

As for the elasticity of net revenue with respect to the macroeconomic variables (ε_{nr}^{varj}):

$$\varepsilon_{nr}^{varj} = \varepsilon_{r}^{varj} * r/nr$$

we compute it as the product of the elasticity of revenue to the macroeconomic variables and the average ratio of revenue over net revenue in the period we examine. As for the elasticity of revenue, we take into account that the bulk of the contemporaneous effects on revenue of private employment, GDP and GDP deflator come from the withholding tax on employment income (IRPEF) and, in the case of the two latter variables, also from excises and VAT.

Overall, we obtain an elasticity of total real net revenue to employment, GDP, and GDP deflator of, respectively, 0.3, 0.3 and –0.4. Clearly, the elasticity with respect to GDP crucially depends on the inclusion in the VAR of the employment variable (or, in some alternative specifications, private wages). In the specifications without employment, the revenue elasticity with respect to GDP rises to 0.5.

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[30] Real GDP may have indeed a slight contemporaneous influence on social transfers, but this budget items enters with a negative sign our net revenue variable (see below).

[31] Over the period we examine, only in the years 1982-86 both private and public wages were indexed to prices and the linkage included some lags.

FIGURES

Figure 1

Seasonally-adjusted Government Expenditure Items
(millions of euros at 1995 prices)

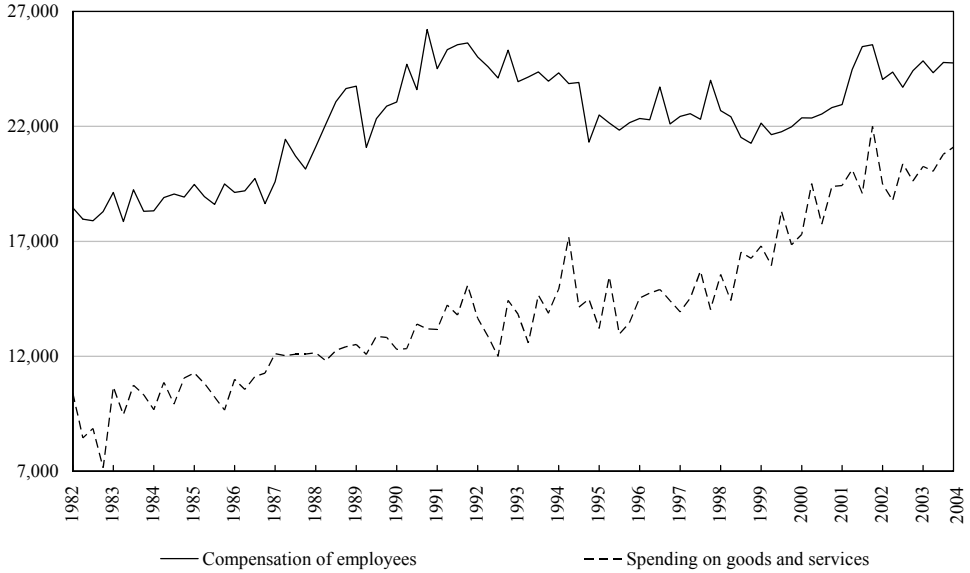


Figure 2

Seasonally-adjusted Government Net Revenue
(millions of euros at 1995 prices)

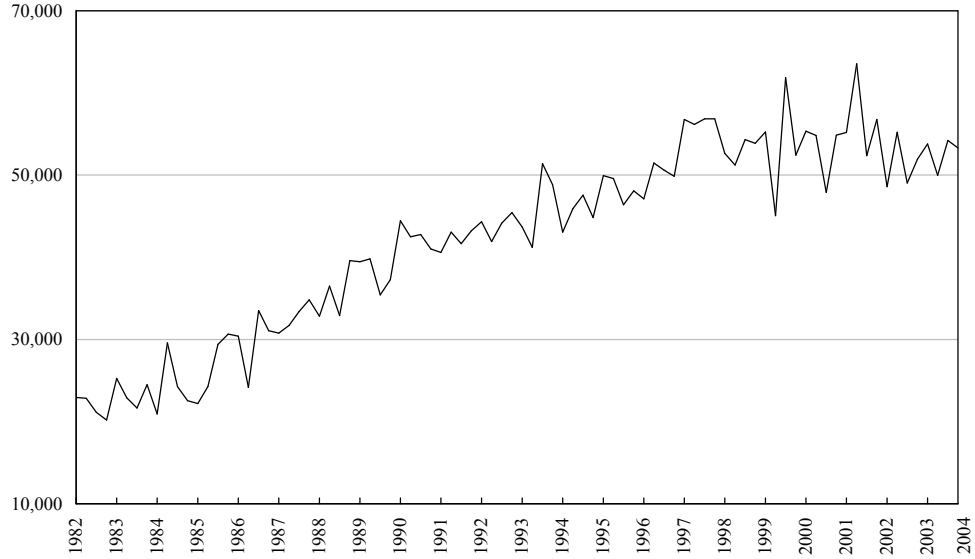


Figure 3

Shocks to Government Expenditure
(percentage values)

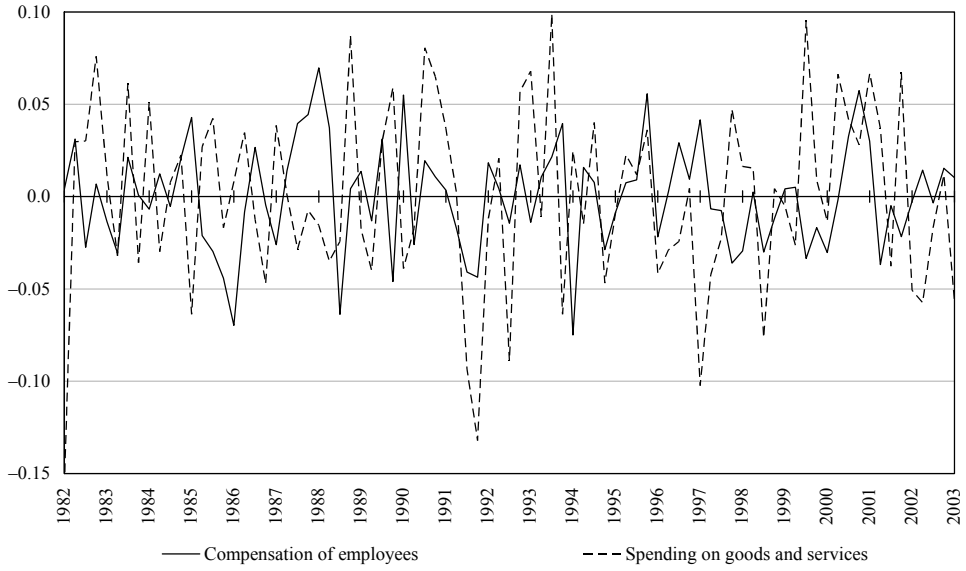


Figure 4

Shocks to Net Revenue
(percentage values)

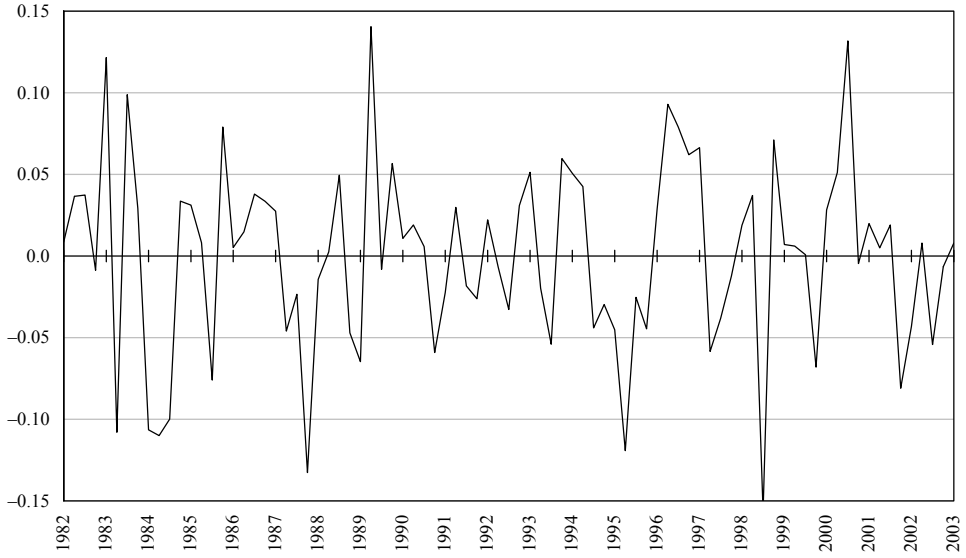
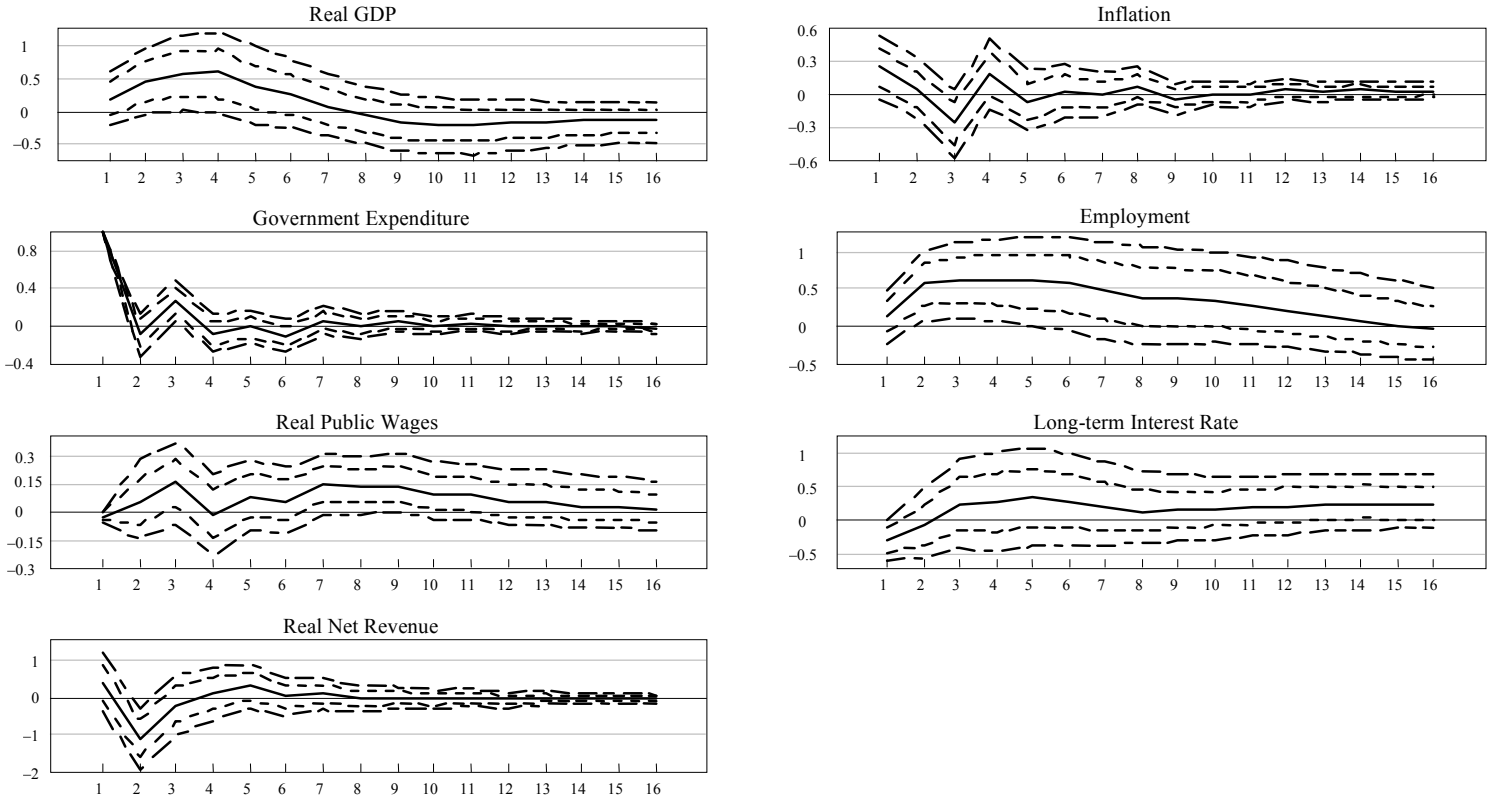


Figure 5

Impulse Responses to a Positive Government Purchases Shock[(1)]

(benchmark model)

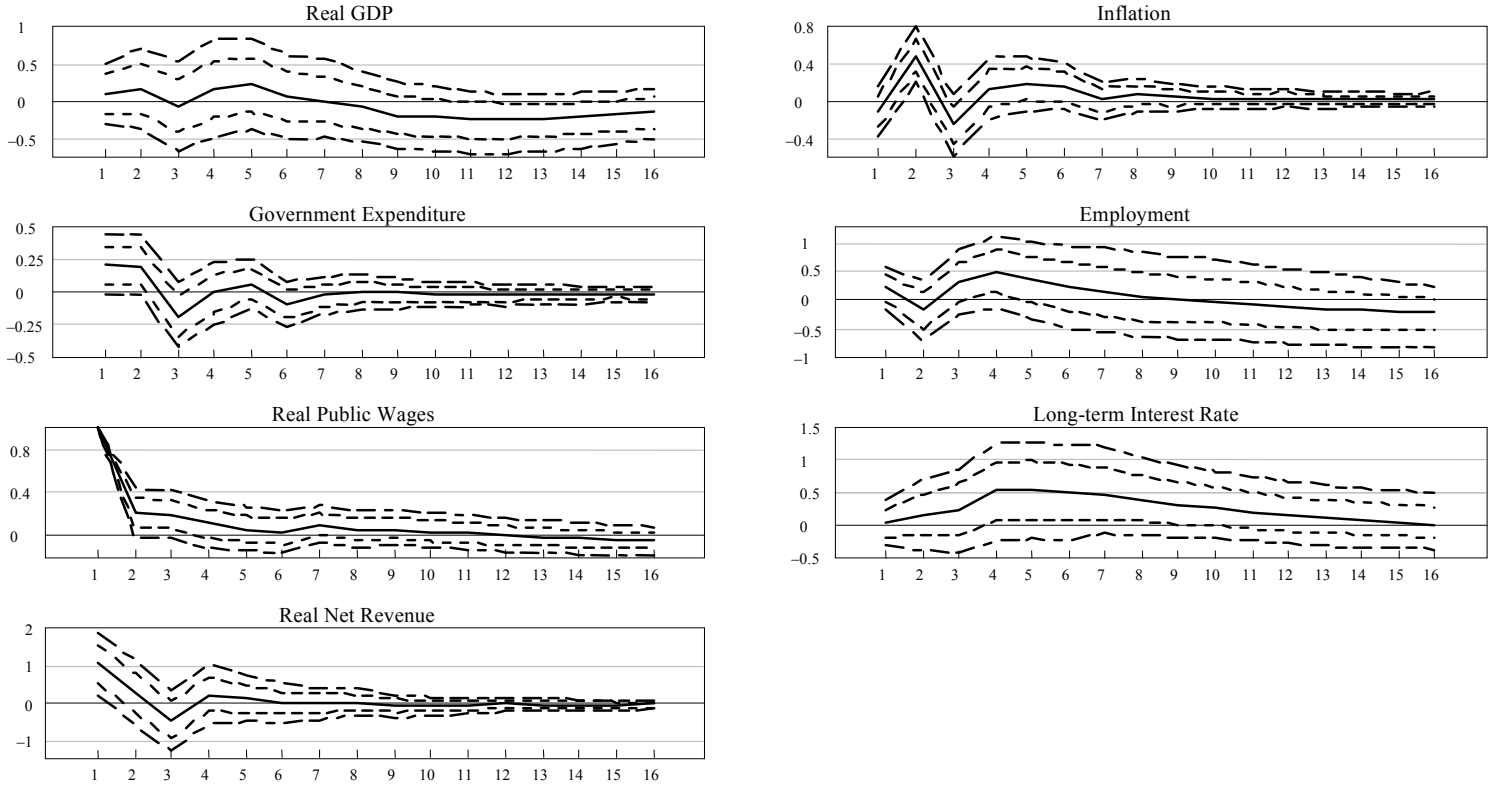


[(1)] The curves represent the median and two sets of lower and upper bands, corresponding to the 5th, 16th, 84th and 95th percentiles of the distribution.

Figure 6

Impulse Responses to a Positive Government Wage Shock[(1)]

(benchmark model)

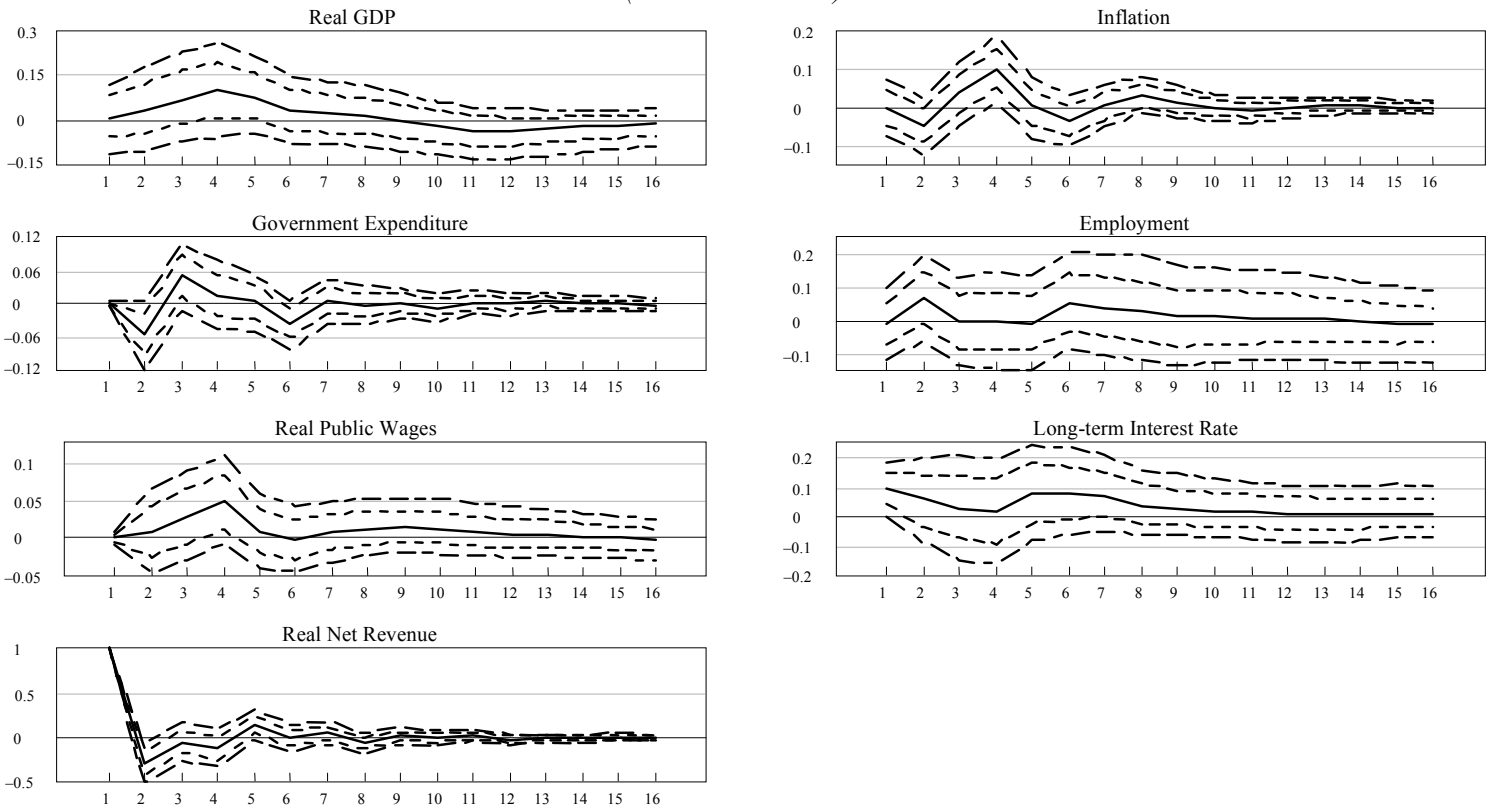


(1) The curves represent the median and two sets of lower and upper bands, corresponding to the 5th, 16th, 84th and 95th percentiles of the distribution.

Figure 7

Impulse Responses to a Positive Net Revenue Shock[1]

(benchmark model)



[1] The curves represent the median and two sets of lower and upper bands, corresponding to the 5th, 16th, 84th and 95th percentiles of the distribution.

Figure 8

Effects of Government Purchases on GDP:
Cumulative Multiplier – Median and Upper and Lower Bounds
(benchmark specification)

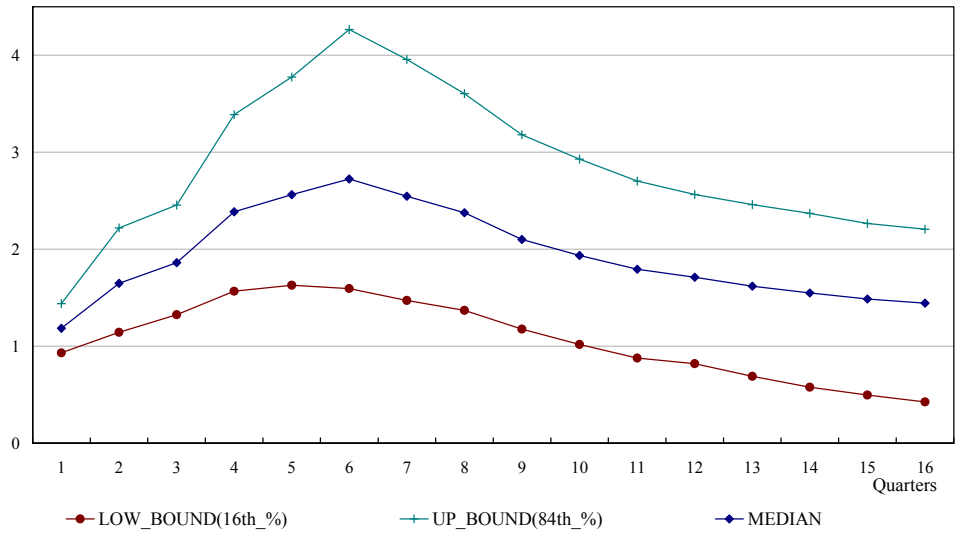


Figure 9

Effects of Government Wages on GDP:
Cumulative Multiplier – Median and Upper and Lower Bounds
(benchmark specification)

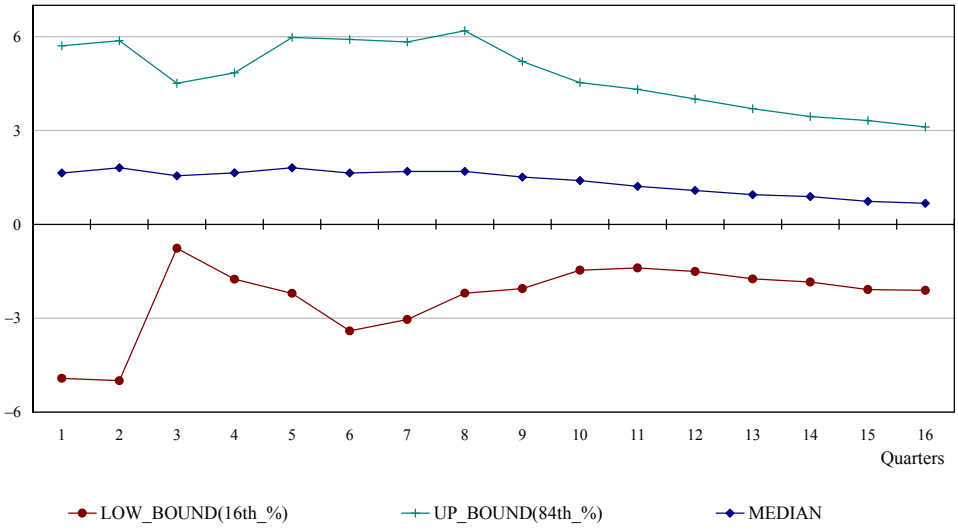


Figure 10

Effects of Government Purchases on GDP: Cumulative Multiplier and Cumulative Multiplier Corrected for Revenue – Median
(benchmark specification)

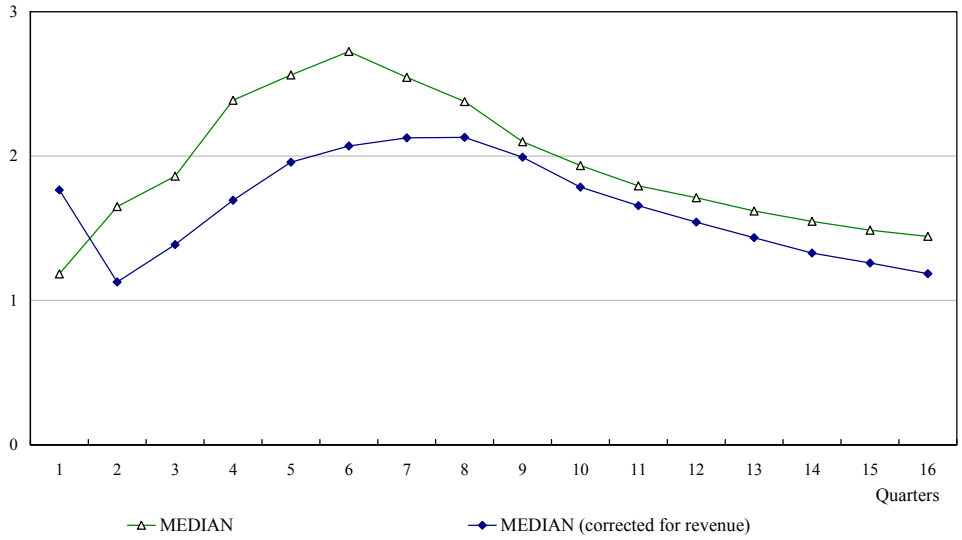


Figure 11

Effects of Government Purchases on GDP: Benchmark Specification and BIQEM
(median values – percent of GDP)

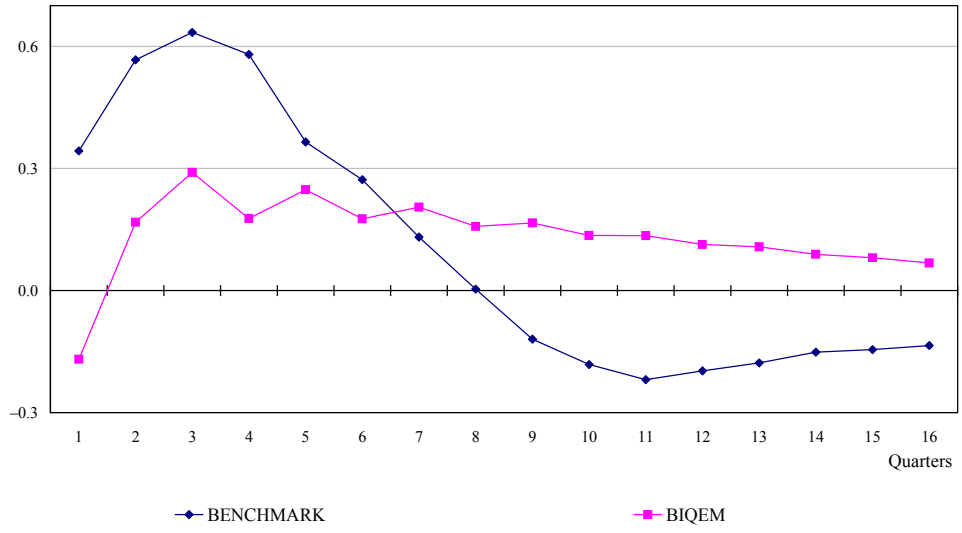


Figure 12

Effects of Government Purchases on GDP:
Benchmark Specification and Alternative Models
(median values – percent of GDP)

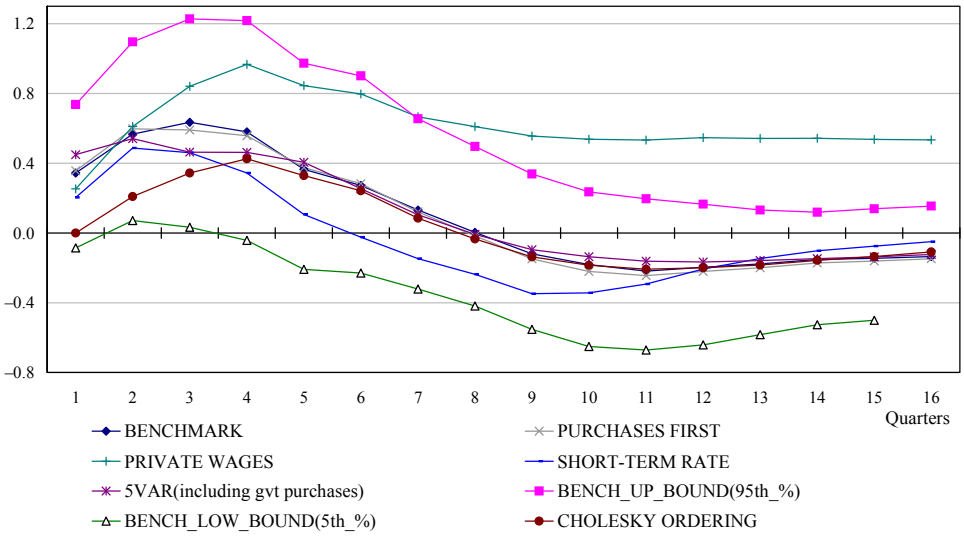


Figure 13

Effects of Government Purchases on GDP: Benchmark Specification and Models in Levels without Trend and in Differences
(median values – percent of GDP)

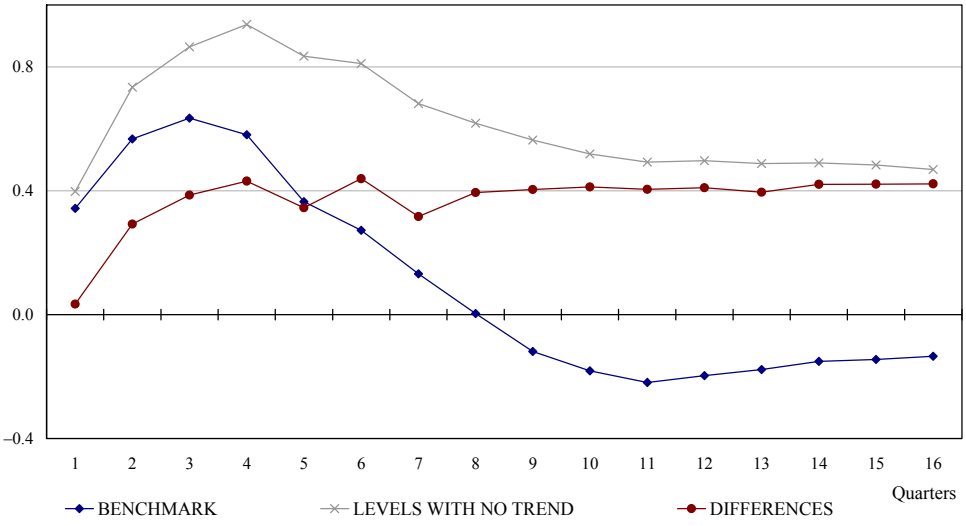


Figure 14

Effects of Government Wages on GDP:
Benchmark Specification and Alternative Models
(median values – percent of GDP)

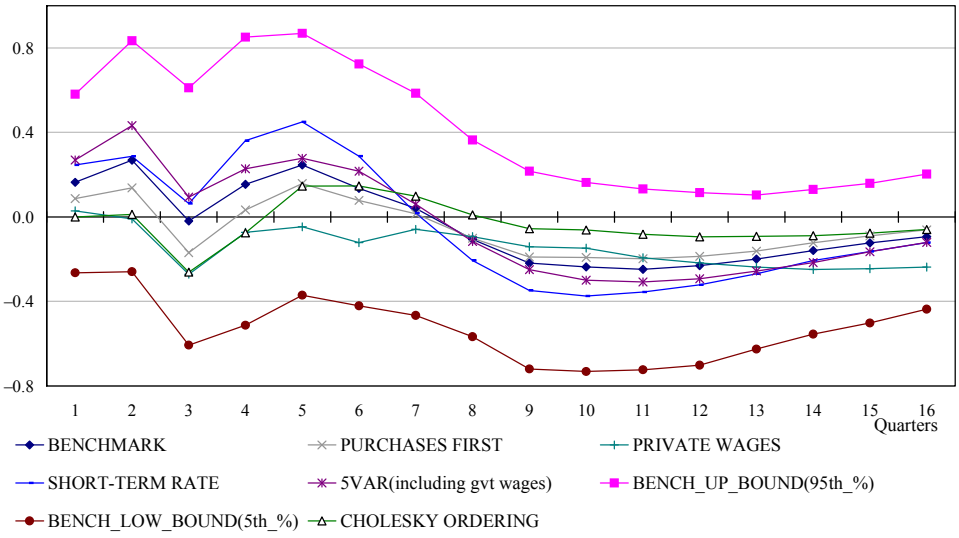


Figure 15

Effects of Government Wages on GDP: Benchmark Specification and Models in Levels without Trend and in Differences
(median values – percent of GDP)

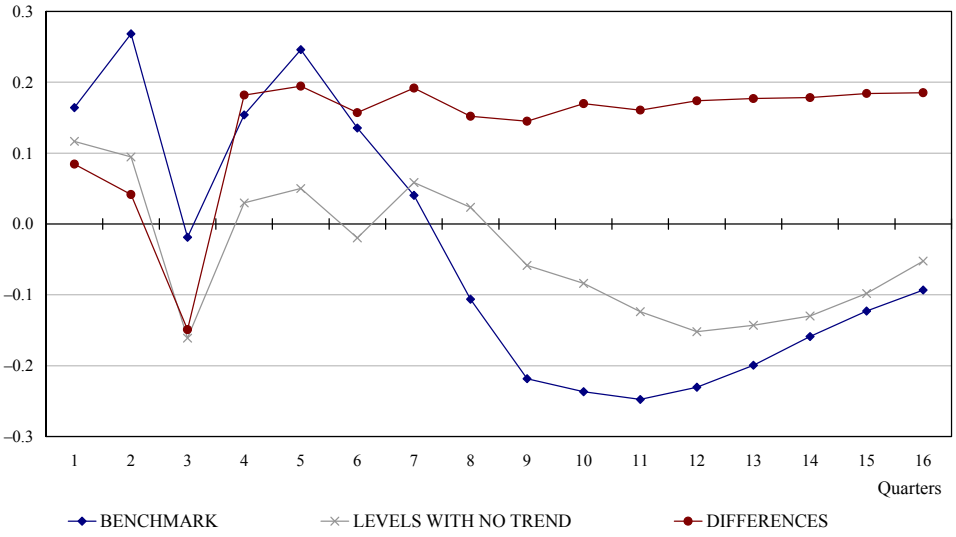


Figure 16

Effects of Government Consumption and Government Purchases+Wages on Themselves and on GDP: Median Values

(5-variable model – percent of GDP)

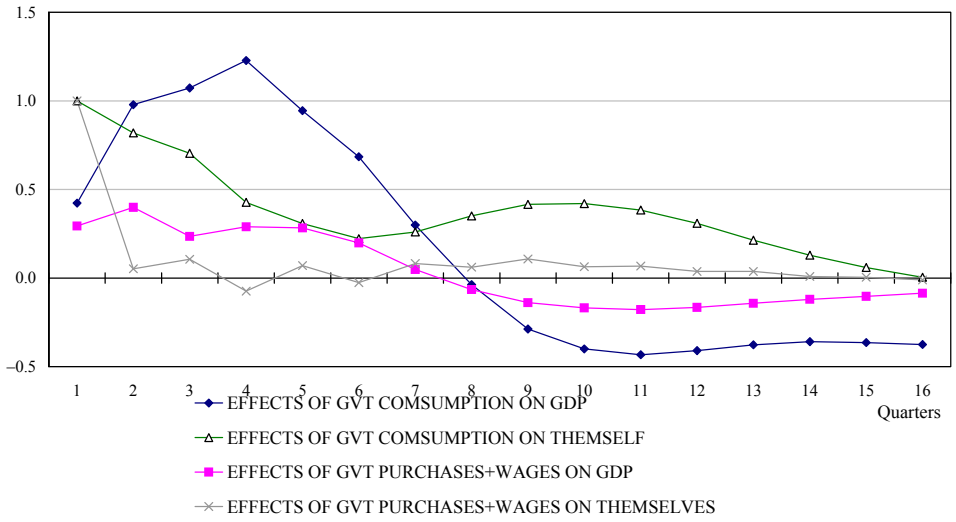


Figure 17

Effects of Government Consumption and Government Purchases+Wages on GDP: Cumulative Multipliers

(5-variable model)

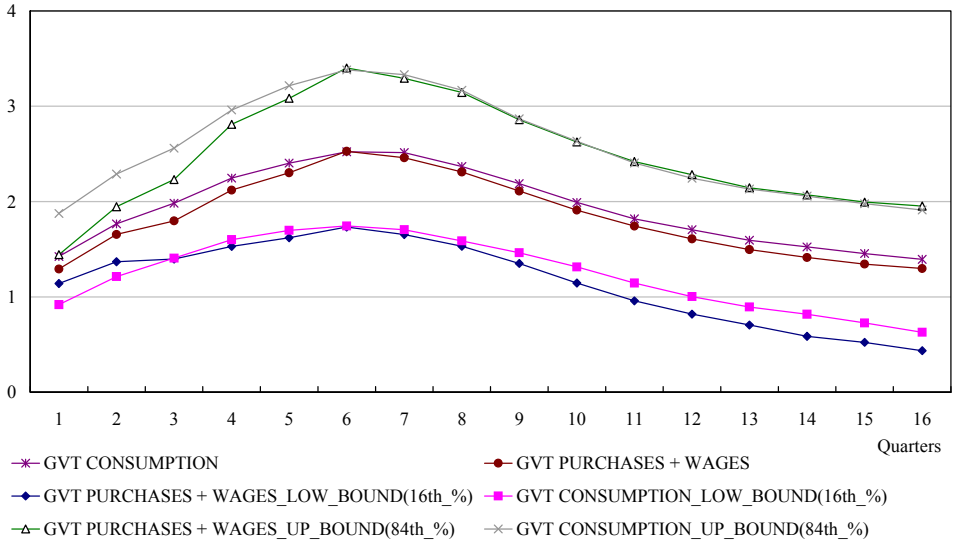


Figure 18

Effects of Government Purchases on: GDP (Benchmark Specification), Private Consumption, Private Investment and Total Private Demand
(6-variable model – percent of GDP)

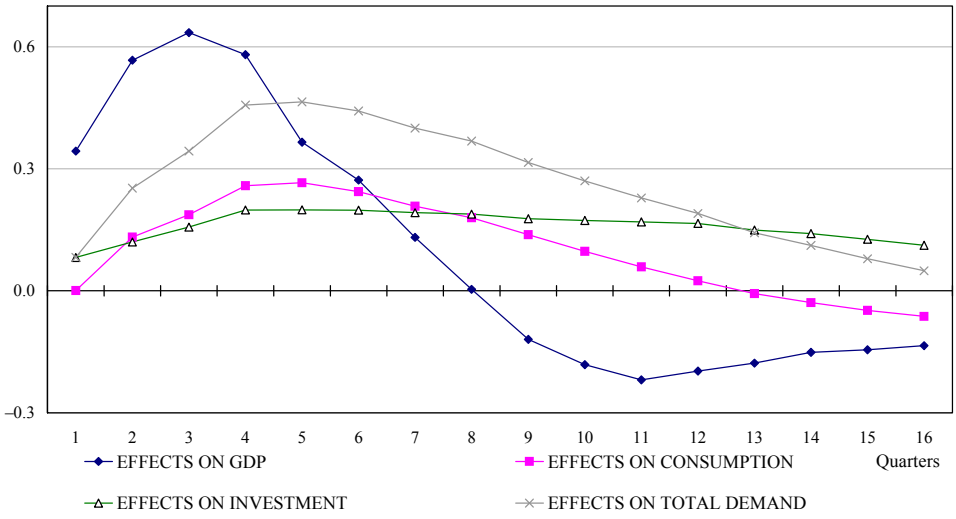


Figure 19

Effects of Government Wages on: GDP (Benchmark Specification), Private Consumption, Private Investment and Total Private Demand
(6-variable model – percent of GDP)

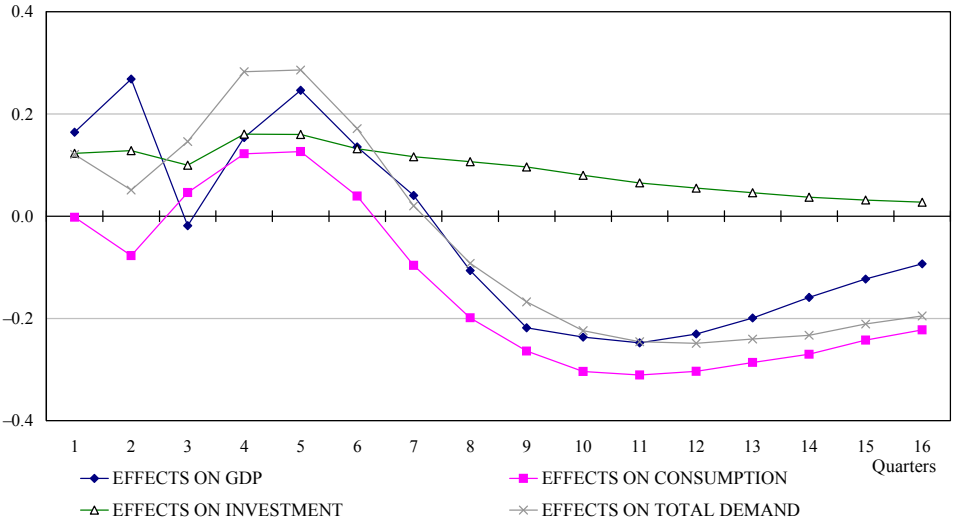


Figure 20

Effects of Government Purchases on Private Employment: Median and Upper and Lower Bounds
(benchmark specification – percent change)

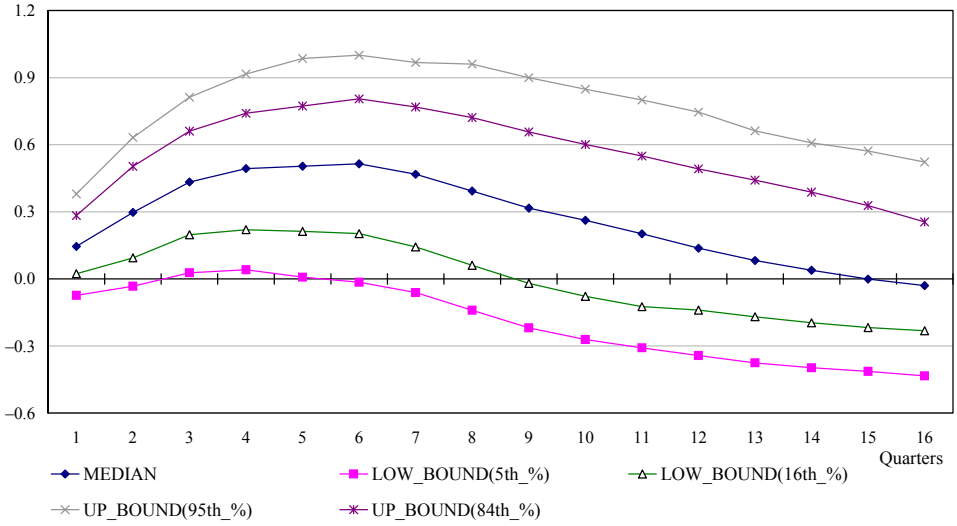


Figure 21

Effects of Government Wages on Private Employment: Median and Upper and Lower Bounds
(benchmark specification – percent change)

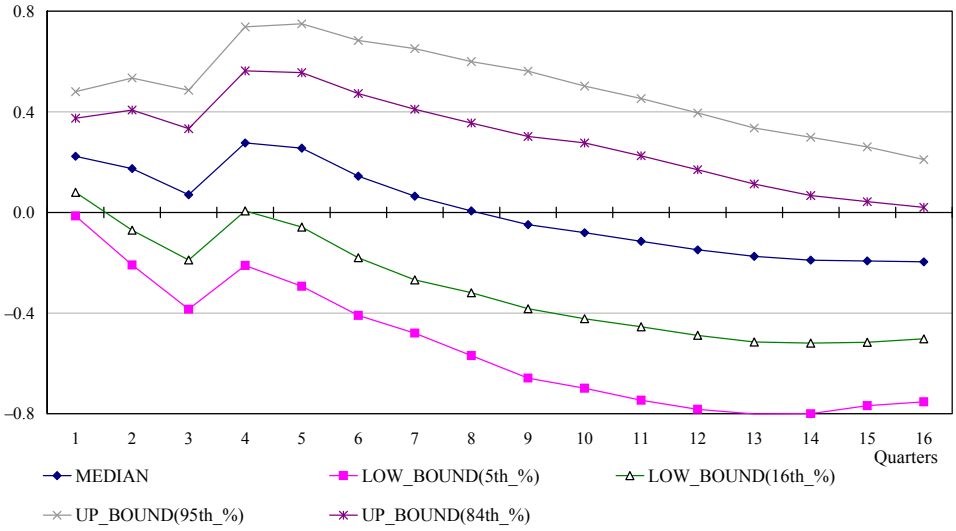


Figure 22

Effects of Government Purchases on Inflation:
Median and Upper and Lower Bounds
(benchmark specification – percent change)

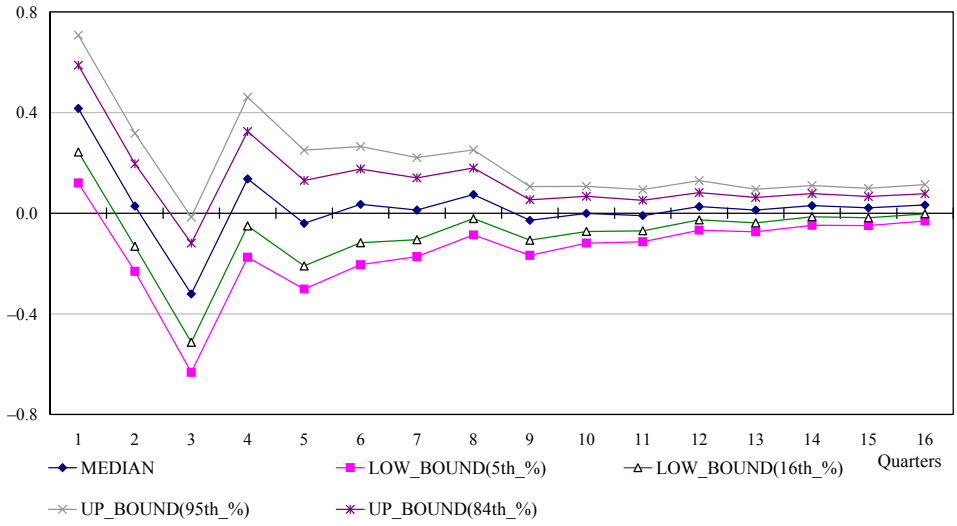


Figure 23

Effects of Government Wages on Inflation:
Median and Upper and Lower Bounds
(benchmark specification – percent change)

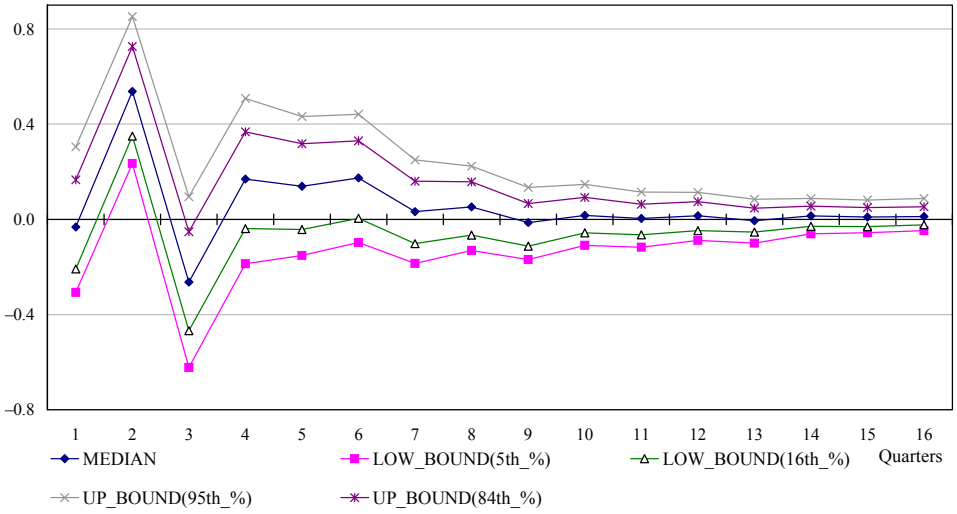


Figure 24

Effects of Government Purchases on Long-term Interest Rates: Median and Upper and Lower Bounds
(benchmark specification – percent values)

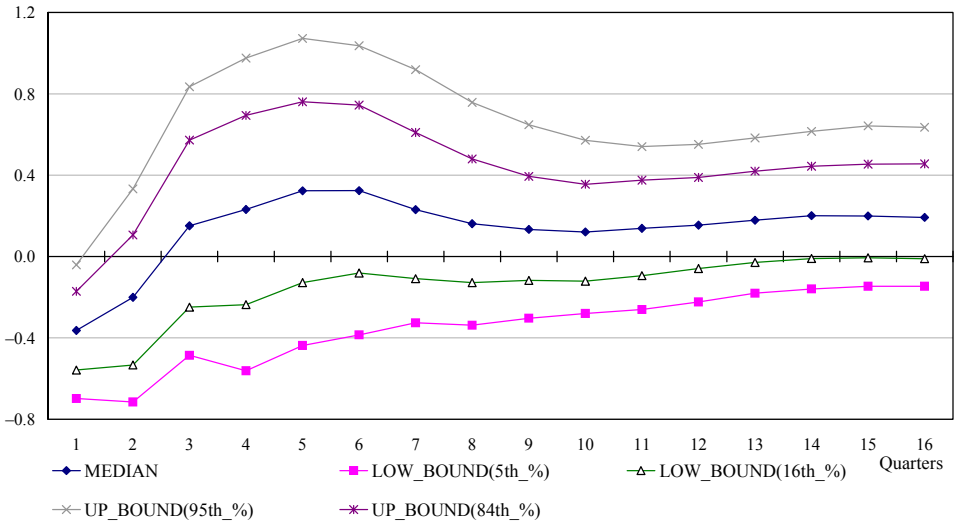


Figure 25

Effects of Government Wages on Long-term Interest Rates: Median and Upper and Lower Bounds
(benchmark specification – percent values)

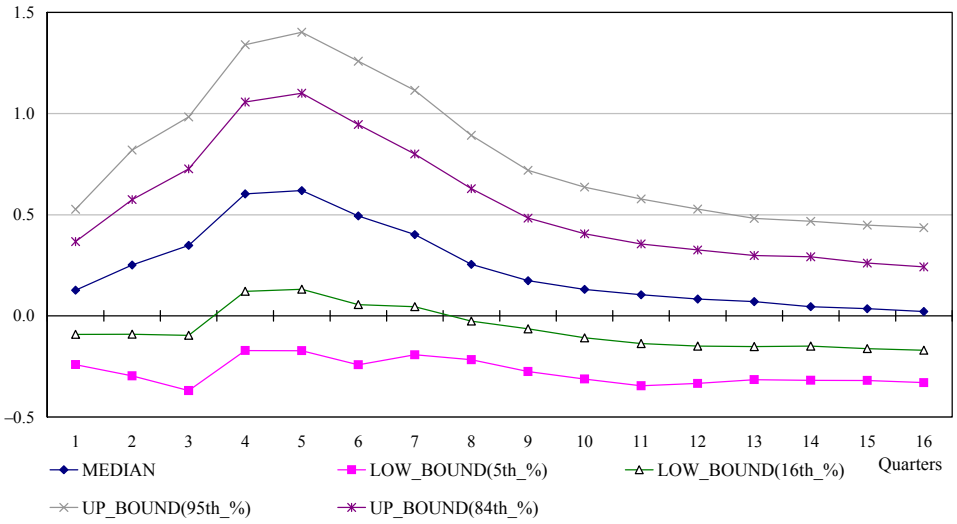
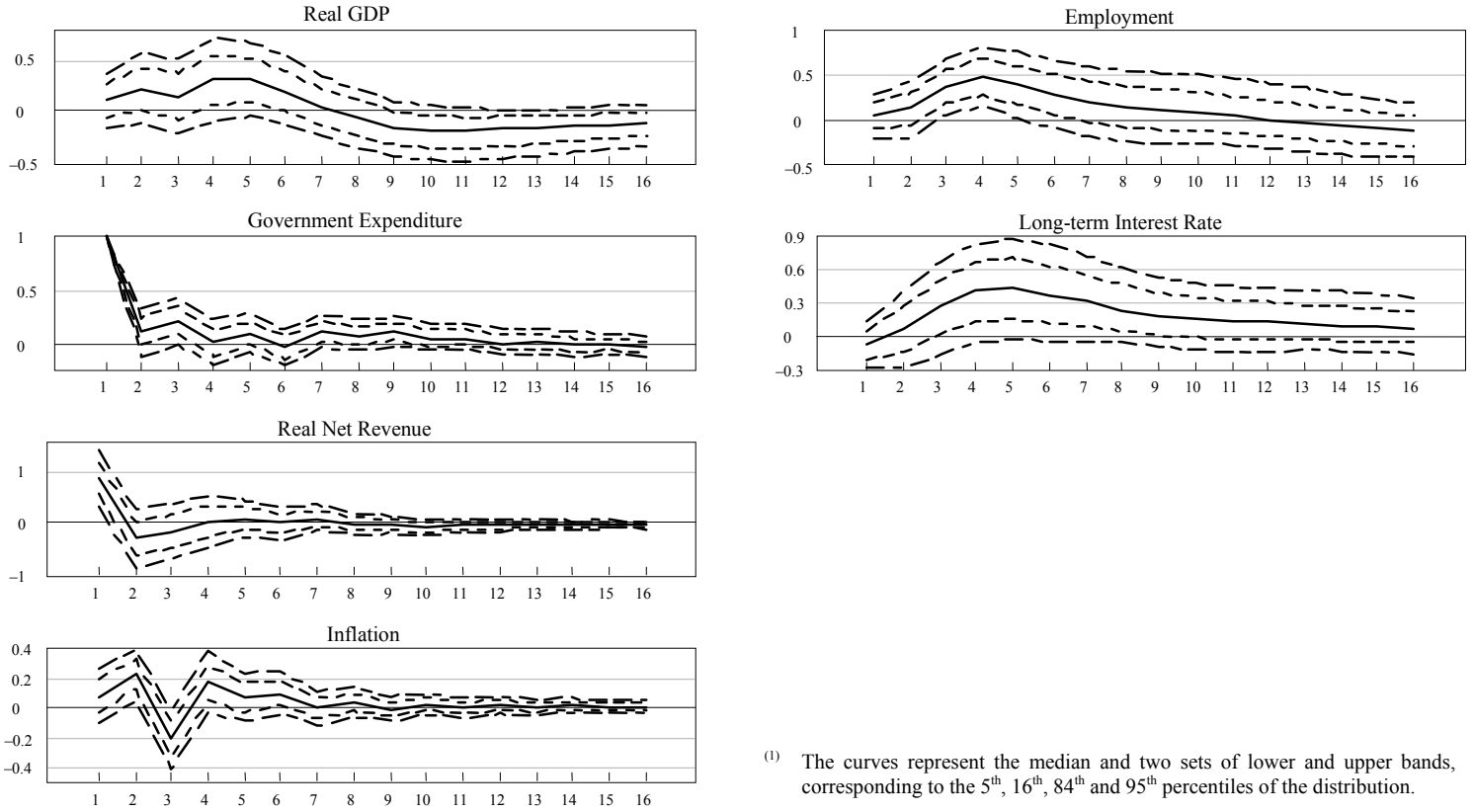


Figure 26

Impulse Responses to a Positive Government Expenditure Shock[(1)]

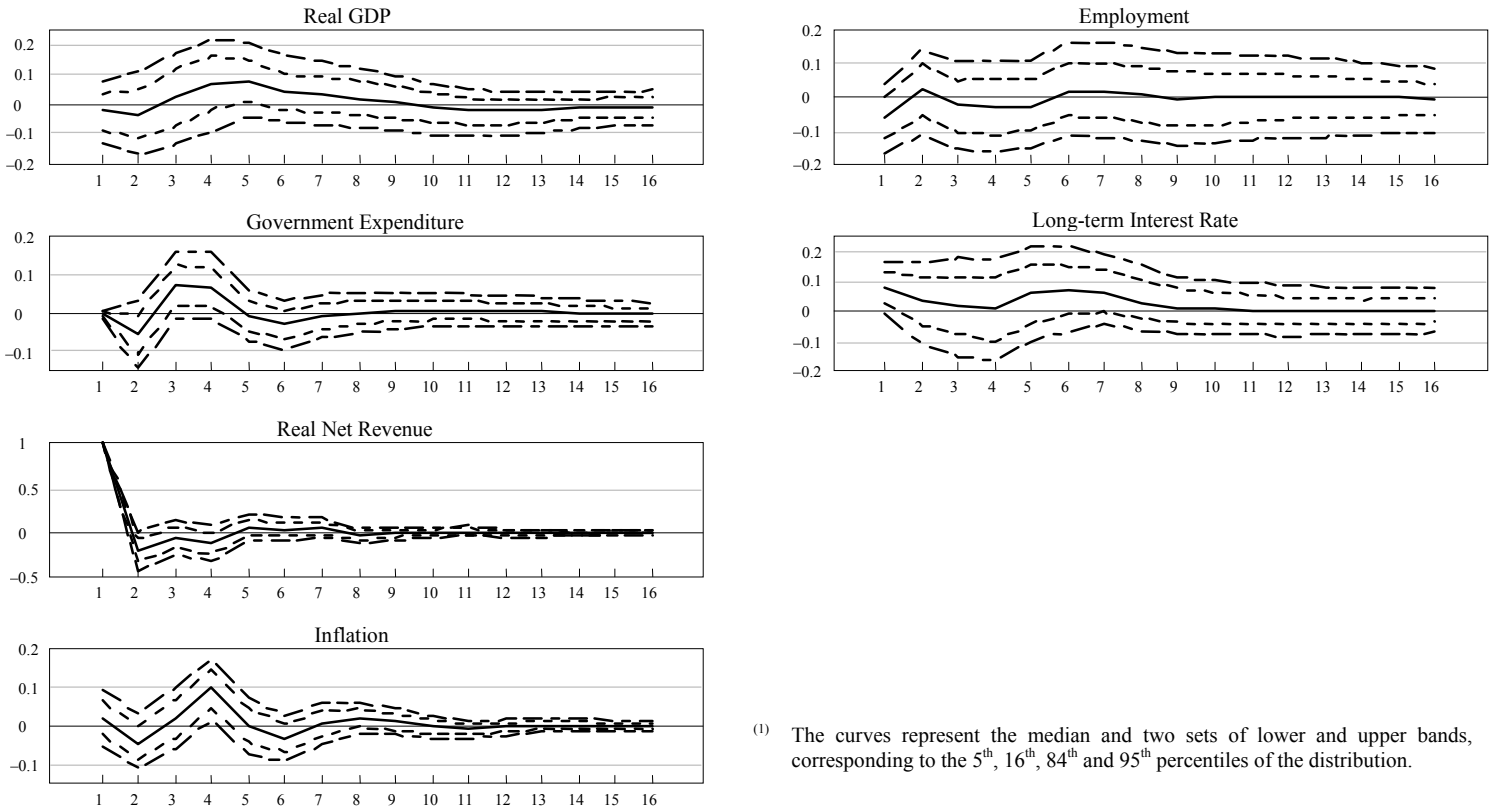
(6-variable model)



(1) The curves represent the median and two sets of lower and upper bands, corresponding to the 5th, 16th, 84th and 95th percentiles of the distribution.

Figure 27

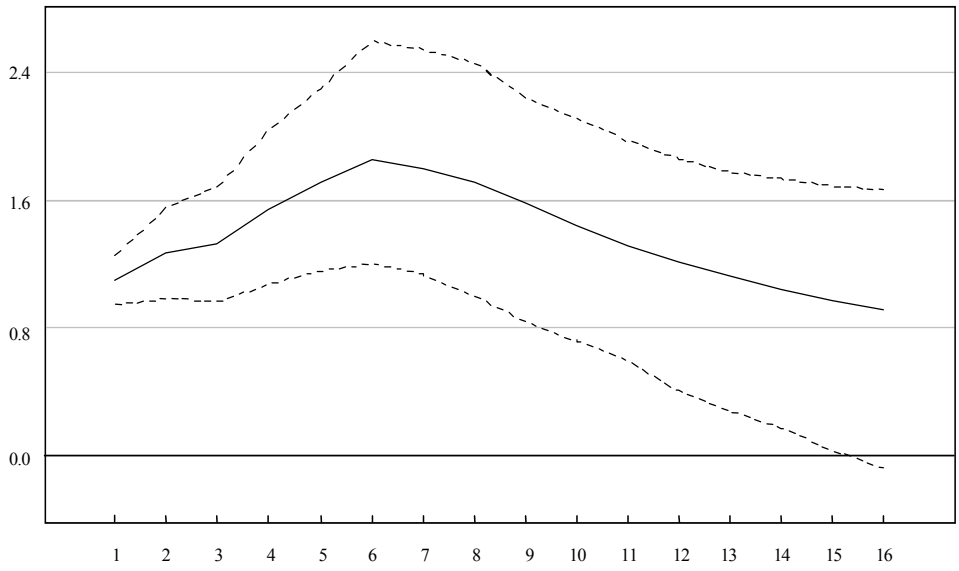
Impulse Responses to a Positive Net Revenue Shock[(1)]
(6-variable model)



(1) The curves represent the median and two sets of lower and upper bands, corresponding to the 5th, 16th, 84th and 95th percentiles of the distribution.

Figure 28

Cumulative Multiplier
(6-variable model)



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