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THE EFFECTS OF FISCAL POLICY IN ITALY: EVIDENCE FROM A VAR MODEL

by Raffaela Giordano[*], Sandro Momigliano[*], Stefano Neri[*] and Roberto Perotti[**]

Abstract

This paper studies the effects of fiscal policy on private GDP, inflation and the long-term interest rate in Italy using a structural vector autoregression model. To this end, a database of quarterly cash data for selected fiscal variables for the period 1982:1-2004:4 is constructed, largely relying on the information contained in the Italian Treasury Quarterly Reports. The main results of the study can be summarized as follows. A shock to government purchases of goods and services has a sizeable and robust effect on economic activity: an exogenous one per cent (in terms of private GDP) shock increases private real GDP by 0.6 per cent after 3 quarters. The response goes to zero after two years, reflecting with a lag the low persistence of the shock. The effects on employment, private consumption and investment are also positive. The response of inflation is positive but small and short-lived. In contrast, public wages, which in many studies are lumped together with purchases, have no significant effect on output, while the effects on employment turn negative after two quarters. Shocks to net revenue have negligible effects on all the variables.

JEL classification: E62, H30.

Keywords: fiscal policy, government spending, fiscal multipliers, VAR.

Contents

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1. Introduction[1]

The lack of consensus in the economic literature on the effects of fiscal policy suggests that empirical investigation in this area has still a very important role to play. The issue is particularly important for EMU countries, which rely only on fiscal policy to counteract adverse macroeconomic idiosyncratic shocks. As theory and empirical evidence indicate that the size of multipliers may vary across fiscal instruments (Hemming *et al.*, 2002), it seems also important to distinguish between different components of the government budget.

This paper seeks to contribute to the analysis of the effects of fiscal policy by applying a Vector Autoregression approach to Italian data. In particular, the paper studies the effects of government spending, distinguishing between wage and non-wage expenditure, and of net revenues. To this end we use, as a benchmark, a 7-variable VAR model, which also includes private GDP, a measure of inflation, employment and the interest rate. Other specifications are also considered for the purposes of establishing a homogeneous comparison with other VAR studies, checking for robustness or analysing the effects of fiscal shocks on the main components of GDP.

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 for this approach. For our analysis we construct a database of quarterly cash data for selected fiscal variables for the period 1982-2004, largely on the basis of the information contained in the Italian Treasury Quarterly Reports.

To identify the fiscal shocks we use a methodology proposed by Blanchard and Perotti (2002). In their approach the identification of fiscal shocks is obtained by exploiting decision

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lags in fiscal policymaking, which allow assuming 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 enables to identify the automatic response of fiscal policy. Blanchard and Perotti (2002) employ a three-variable VAR, which includes GDP, government direct expenditure and net revenue. Using U. S. data, they find that expansionary fiscal shocks increase output. Following a direct expenditure shock, private consumption reacts positively and private investment reacts negatively.[2] The response of GDP to a one dollar shock to direct expenditure is around 50 cents at the 4th quarter and gradually increases to a peak of $1.29 at the 15th quarter. 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 and 12th quarters, reflecting leakages through the trade channel.[3]

The identification method proposed by Blanchard and Perotti (2002) has also been applied to U.S. data in Perotti (2002), who also examines other 4 OECD countries, and in Galí *et al.* (2006). Perotti (2002) uses a five-variable VAR, which includes GDP, the GDP deflator, government direct expenditure, net revenue and the interest rate. When using the full sample, he finds that the cumulative multiplier of an expenditure shock is positive and lower than 1 at the 4th and 12th quarters. Galí *et al.* (2006) 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 They find that a government direct expenditure shock in the U.S. induces a positive response of private consumption, while the response of investment is not significant. The reported results positive reaction of private consumption and no response of investment. A similar approach is used by Fatás and Mihov (2001), who rely on Cholesky ordering to identify fiscal shocks.

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[2] 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. 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 and those of other studies. 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 U.S. data.

imply values of the cumulative multiplier close to those obtained by Galí *et al.* (2006). The authors also examine separately the effects of wage and non-wage spending, reaching the conclusion that a fiscal expansion based on the former is more effective in boosting economic activity. However, shocks to wages are far more persistent and this explains, at least for the first 3 years, its greater effect on GDP.

Studies applying the method proposed by Blanchard and Perotti (2002) in countries different from the U. S. are relatively scarce, largely owing to the limited availability of quarterly public finance data. Perotti (2002) investigates the effects of fiscal policy in Australia, Canada, Germany and the UK. He finds that responses to fiscal shocks estimated on U. S. data are often not representative of the average OECD country included in the sample. In general, the estimated effects of fiscal policy turn 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 spending at the 4^{th} and 12^{th} quarters equal to 1.9 and 1.5, respectively. The authors find a positive reaction of private consumption. The effects on private investment are also positive but only in the first year. Using data for the Spanish economy, de Castro and Hernández de Cos (2006) find a positive relationship between government expenditure and output in the short-term; in the medium and long term public spending expansionary shocks are instead associated with higher inflation and lower output.

Summing up, the reviewed studies, which adopt a methodology quite similar to the one used in our study on Italy, indicate that in the U.S. 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 Ricardian and non-Ricardian consumers (Galí *et al.*, 2006). There is no consensus on the effects on investment. The evidence concerning the other countries is mixed and very limited.

A general point about all these results, including the ones reached in this paper, should be made. The cyclical position of the economy is often seen as an important element when assessing the impact of fiscal policy on economic activity (e.g. Hemming *et al.*, 2002). In this respect, the estimates in these studies should be considered as "average effects", depending on the economic situations which prevailed in each sample period. Therefore, the results may generally not offer a good guidance for the effects of fiscal shocks under extreme economic circumstances, like a deep recession or a boom.

Alternative approaches to the identification of fiscal shocks in the context of VAR studies have been proposed by Edelberg *et al.* (1999) and by Mountford and Uhlig (2002). Edelberg *et al.* (1999) study the response of the U. S. economy to specific episodes of military build-ups, identified in Ramey and Shapiro (1998). They conclude that there is a significant and positive short-run effect on output. 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. In their results, a spending shock stimulates output only in the first four quarters, although only weakly.

The rest of the paper is structured as follows. Section 2 and Appendix A describe the data. In Section 3 we outline the specification of the VAR model and the identification method. In Section 4 we present the results concerning the effects of government spending and some robustness exercises. In Section 5 we briefly discuss the effects of a shock to net revenue. In Section 6 the results of the model including total direct spending (6-variable model) are illustrated. Section 7 presents the conclusions.

2. Government accounts quarterly

2.1 Sources and construction of the fiscal data

The availability of quarterly fiscal variables represents the main constraint for the analysis of fiscal policy with VAR models. 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. 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. Thus, the use of national account data would have implied two important limitations. It would have not been possible to take into account developments in the whole general government budget, including revenue, and, also, to distinguish, within government consumption, between wages and purchases.[4]

The sources of our government budget data are the Italian Ministry of Treasury, which publishes quarterly cash figures since the early eighties, and the Bank of Italy. In contrast to national accounts data, which are partly elaborated on an accrual basis, Treasury data refer to general 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 behaviour of the rest of the economy (for a discussion of this issue see, among others, Levin, 1993). In fact, our analysis shows that the effects on GDP of government consumption, if measured per unit of expenditure, do not change significantly when cash data are replaced by national account data (see Section 4.3).

We consider a 3-way disaggregation of the government budget. On the expenditure side, we focus on current spending on goods and services and public wages. 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 cash deficit published by the Bank of Italy on a monthly basis since the early eighties. Measuring net revenue as a residual from the cash deficit ensures a better coverage, as data on the individual revenue items are not statistically homogeneous over the sample period, also owing to the numerous tax reforms enacted during the sample.

However, as a check, we also constructed net taxes as the sum of individual tax revenues minus transfers to households. The results do not qualitatively differ from those presented in this paper.

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[4] In fact, we found that excluding net revenue from the VAR model did not significantly modify our estimates (see Section 4.3).

In the end, the only budget components which do not appear in our model are interest payments and government investment. We exclude the former because they are largely outside the scope of government control and the latter because we are not confident enough about the quality of the data (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). We plan to explore this issue, including the construction of government investment data, in a future work.

Additional information on the construction of the series and a comparison between our cash data and national account data are reported in Appendix A.

2.2 The seasonally-adjusted fiscal data

Seasonally-adjusted cash figures in real terms (using the private GDP deflator) for current spending on goods and services, public wages and our measure of net revenues 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 sub-periods), reflecting the consolidation effort in the run-up to the monetary union.[5] 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 fall in interest payments and by 2003 government spending on goods and services was at 7.4 percentage points of GDP. In 2004 this ratio fell slightly, to 7.2, reflecting the cash constraints introduced with the budget and reinforced at the end of the year.

Public wages show 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 and a fall in the number of employees (by about 5% between 1991 and 1999). Over

[5] The corrections introduced by the budget laws for 1992 and 1993 were 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 public wages. The adjustments implemented in the following three years were also considerable.

the last years, the number of employees and the related expenditure has again increased significantly. As a ratio to GDP, public wages in 2004 reached 10.1 per cent.

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, 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, allowing Italy's participation in 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, contrary to expectations, did not turn out to be revenue-neutral.

3. The VAR model

3.1 Specification and estimation

The benchmark specification of the VAR model includes the following seven variables: the real private GDP (*i.e.*, real GDP minus real government consumption), the inflation rate based on the private GDP deflator, private employment, the ten-year nominal interest rate, real government spending on goods and services, real government wages and real net taxes. All the variables, with the only exception of the interest rate, are log-transformed. The sample period runs from 1982:1 to 2004:4. All fiscal variables are seasonally adjusted using the TRAMO-SEATS procedure and expressed in real terms using the private GDP deflator.[6]

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. 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 reflect into a

[6] Our results do not change if seasonal patterns are accounted for by dummy variables. The results are available upon request.

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).

The reduced-form VAR is defined by the following dynamic equation:

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

where X_t is the vector of variables, $B(L)$ is an autoregressive lag polynomial in the operator L and U_t is the vector of reduced-form innovations. Our benchmark specification includes a constant and a linear time trend, which we omit from the notation for convenience. The choice of the number of lags is made on the basis of the autocorrelation function of the reduced form VAR residuals and the likelihood ratio tests. The number of lags is set to 3 since it provides serially uncorrelated residuals.[7] The residuals did not show any sign of ARCH effects and the Kolmogorov-Smirnov statistic suggested the correctness of the assumption of normality for the reduced-form innovations. The augmented Dickey-Fuller test for the presence of unit roots indicated that all the variables are integrated of order one. We also tested for the presence of cointegrating relationships among the variables and found mixed evidence according to the rank and the maximum eigenvalue tests.[8] In this situation and given that our a priori did not include a meaningful long-run relationship among the variables, we decided not to impose any cointegrating restriction and, thus, estimate the VAR with the variables entering in levels, relying on the results of Sims *et al.* (1990). The stability of the parameters of the model could not be tested by recursive estimation of the model because of the limitation imposed by the availability of data on the fiscal variables. Similarly, due to data limitation it was not possible to estimate the benchmark model for the pre- and post-Maastricht period in order to take fully into account the possibility of structural changes in fiscal policy (the results of some experiments using dummy variables are reported in Section 4.3).

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

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[7] The likelihood ratio test of 4 lags against the null hypothesis of 3 lags confirms our choice (the likelihood ratio statistic is equal to 58.67, which implies a *p*-value of 0.49 when the degrees of freedom correction for short-sample is taken into account, see Sims, 1980). Nevertheless, the results are robust to using 4 lags.

[8] See Lütkepohl, Saikkonen and Trenkler (2001) for a comparison of the two tests. The authors found evidence that these two tests may deliver different results when using short samples.

of establishing a homogeneous comparison with other VAR studies (Section 4.5). 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 (the short-term interest rate instead of the long-term one), different orderings of the budgetary components in the identification scheme, different ways in which the variables are expressed (in levels as in the benchmark specification but without trend) and the use of the identification approach proposed in Fatás and Mihov (2001).

3.2 The identification of fiscal shocks

Our identification strategy builds on Blanchard and Perotti (2002) and Perotti (2002). As it is standard in the literature on structural VARs, we assume the following relationship between the reduced form residuals U_t and the structural shocks V_t:

$$AU_t = BV_t$$

in which the shocks are assumed to be independently and identically distributed with covariance matrix equal to the identity one. Only fiscal shocks have a clear economic interpretation in our analysis. In the next paragraph we describe the approach we use to identify the shocks.

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 and v_t^T to these variables, and of the innovations of the other reduced-form equations of the VAR (all the *u*'s):

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

$$u_t^w = \alpha_y^w u_t^y + \alpha_p^w u_t^p + \alpha_i^w u_t^i + \alpha_e^w u_t^e + \beta_g^w v_t^g + \beta_T^w v_t^T + v_t^w$$

The coefficients α_j^i capture both the automatic elasticity of fiscal variable *i* to the "macroeconomic" variables *j* (*y, p, r* 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*.

In this paper we are interested in estimating the structural shocks v_t^g, v_t^w and v_t^T, and in studying the responses of the macroeconomic variables, 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 of the model 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^π, u_t^i and u_t^e 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 B. 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 to decide which fiscal variable reacts to the others contemporaneously. 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 are 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, 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 interest rate equations.

Once the reduced form of the VAR and all the coefficients (the alphas and the betas) are estimated, we compute the impulse responses using the structural moving average representation of the VAR. Error bands are computed by Monte Carlo simulations based on 1000 replications, as in Stock and Watson (2001).

3.3 Interpreting the fiscal shocks

The largest fiscal shocks that we estimate tend to match well known episodes of government actions (Figure 2). In the case of purchases, the most conspicuous negative shock is found in the third quarter of 1992, when fiscal policy reacted to the devaluation occurred in the summer. The cumulative sum of shocks over the fiscal consolidation period 1992-97 amounts to approximately 30% of purchases. Negative shocks are observed throughout the period 1996:4-1997:4, with the only exception of 1997:3, when fiscal policy made its last effort to obtain Italy's participation in EMU, as decisions were taken on the basis of the deficit for 1997. Afterwards, data generally show the loosening of fiscal policy. More recently, large negative shocks reflect the cash restraints imposed at the end of 2002, 2003 and 2004, to compensate large slippages with respect to the planned annual deficit.

Government wage shocks generally reflect the timing of contracts renewals. For example, wage increases for the period 2002-03 were paid only in the second half of 2003, when about a third of employees received increases and arrears, and in the first half of 2004, when contracts for the other two thirds of the employees were signed. As a result, real wage shocks are negative in 2002 and in the first half of 2003, and then turn positive. A similar pattern can be observed in the period 2000-01.

In the case of net revenue, the original quarterly series exhibits a large variability, with a relatively unstable seasonal pattern. These features, which are reflected on frequently large estimated shocks, make the matching between the latter and historical episodes of government action less precise. Nevertheless, we estimate uninterrupted positive shocks to net revenue

from 1996:4 to 1997:4, indicating that the restrictive fiscal policy aiming at the participation in 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 responses of the fiscal and the macroeconomic variables to exogenous shocks to the two largest components of government direct spending. The impulse responses are constructed assuming a shock equal to one per cent of real private GDP. For the benchmark specification, in Figures 3 and 4 the whole sets of impulse responses to each of the two shocks are plotted. In each graph we present the median response and two sets of lower and upper bands, corresponding to the fifth, sixteenth, eighty-fourth and ninety-fifth percentiles of the distribution of the responses at each horizon. Throughout the paper, like in most previous studies, we define as "statistically significant" those estimates for which the narrow error band (identified by the sixteenth and the eighty-fourth percentiles) does not include zero.[9]

All impulse responses can be interpreted as deviations from the baseline and are expressed, except for inflation and interest rates for which percentages points are used, as ratios to GDP.

4.1 The response of fiscal variables

We start by studying the responses of the 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 a lesser extent, those to government wages display little persistence. In contrast, a considerable persistence in the response of government spending to its own shocks is found in VAR studies based on both U.S. (Blanchard and Perotti, 2002, Mountford and Uhlig, 2002, Fatás and Mihov, 2001 and Edelberg *et al.*, 1999) and other OECD countries data (Perotti, 2002).

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[9] 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 band) are often more useful than 0.95 bands since they provide a more precise estimate of the true coverage probability.

In all these studies, government spending is obtained from the national income accounts and is measured by total government consumption (essentially the sum of purchases and public wages).[10] However, this different aggregation does not explain the difference in the estimated persistence of government spending. Indeed, we still find no persistence in the shocks when a five-variable VAR that includes the four macroeconomic variables and our proxy for government consumption (the sum of cash government purchases and wages) is estimated. Interestingly, when we use real government consumption (deflated using its own deflator) from the national income accounts in the 5-variable VAR, we find a considerable persistence of the government consumption 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.

In the case of government wage shocks, their lack of persistence may reflect the presence of large transitory sums for arrears. In Italy long delays in public wage settlements occurred in the last two decades. As a result, the initial payments after a wage settlement have often included large sums for arrears. However, this explanation would imply that our shocks estimated at the time of wage settlements could indeed have been largely anticipated. The lack of persistence in cash purchases might reflect irregularities in the timing of payments by public entities.

An alternative explanation may be the presence of measurement errors in the fiscal variables. To the extent that these errors are white noise and large, then the lack of persistence of fiscal shocks is precisely what the impulse responses should display. However, if the lower persistence in cash data reflected errors, they would plausibly have lead to distorted or at least less precise results, compared to those based on national accounts data. On the contrary, with the 5-variable VAR not only we obtain expenditure multipliers that are very similar using government consumption or the sum of cash wages and purchases, but in the latter case the error bands are significantly narrower for the first quarters (Section 4.3).

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[10] In some studies, the aggregate also includes capital expenditure. Only Fatás and Mihov (2001) consider 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.

The responses of public wages to purchases and of purchases to public wages are quite small. We find instead persistent positive effects of public wages on net taxes, which are larger than those consistent with the automatic working of the tax system.[11] However, the latter are always inside the bands (16^{th} and 84^{th} percentiles) of our confidence interval, except in the fourth quarter. Moreover, most of the effects on revenue depend on the most recent data: they halve, becoming fully consistent with the working of the tax system, when we end the sample in the mid-nineties. Government purchases, instead, have a large negative effect on net taxes in the second quarter, which again disappears soon 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 mini budgets, decided in the course of the year to redress slippages with respect to original targets, have often included cash restraints, largely concentrated on purchases, and revenue increases.

These results are robust to a series of alternative identification schemes and specification of the VAR. Inverting the order of the first two fiscal variables (government purchases and wages) in our identification scheme or substituting the long-term with the short-term interest rate has virtually no effects on all the results. The limited persistency of then shocks also present when considering only one fiscal variable (public wages, purchases, or net taxes) at a time.

4.2 The response of output

After a shock to government purchases private GDP responds with a hump-shaped pattern. It increases on impact by around 0.2 percentage points and then it increases further to reach a peak of 0.6 percentage points in the 4^{th} quarter. It slowly returns to trend by the end of the second year. The response to a wage shock is initially similar, with an impact of 0.2 percentage points, but already in the third quarter GDP returns to trend; afterwards the effect is constantly positive, hovering at about 0.1 percentage points. However, these responses are estimated rather imprecisely and are never statistically significant.

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[11] 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.

In our results the different response of GDP to shocks to purchases and shocks to wages may be due to a number of factors. At least part of the difference could be due to the effects on net revenue of the two shocks. As mentioned in Section 4.1, the shock to purchases is accompanied by a transitory but sizeable drop in revenue, which may facilitate the rise in economic activity, while the shock to wages determines an increase in net revenue, which is higher than expected. Further, as also mentioned in Section 4.1, wage shocks may be largely anticipated, as significant delays in payments typically occur. Finally, the variability that we observe in the total amount paid for public wages seems to largely reflect changes in unit wages rather than 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.

The GDP responses to shocks to purchases appear quite small, if compared to standard textbook presentations of the impact of fiscal expansions. However, three points should be made on this regard. First, standard analyses focus on total GDP, which includes government consumption. Second, the impact depends on the persistence over time of the shock and, as already mentioned, the fiscal shocks that we identify are very short-lived. Third, in principle we need to take into account that when one component of government consumption is shocked, the other moves too, though these effects are quite small.

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 expenditure shocks. This ratio provides an approximate measure of the impact on GDP of a unit change in government consumption due to a spending shock.[12] As the response of GDP to wages is never significant, we only discuss the cumulative multipliers of the shocks to government purchases. The median values that we estimate (Figure 5) are quite large relative to the rest of the literature: the multiplier starts at about 1.2, it reaches a value slightly below 3 after 6 quarters, and then declines slowly to about 1.7 after 4 years; it is also estimated quite precisely, so that it is always significant. The fact

[12] It can be shown, in a two-variable model, that the cumulative multiplier provides a measure of the effects on GDP entirely independent of the persistence of the shock. This feature allows comparing 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 to Daniele Terlizzese.

that our results are on the high side of the range of available estimates may partly owe to the low persistence of the shocks; in models which allow for the presence of Ricardian agents, as in Galí *et al.* (2006), the impact of government spending on consumption and output is usually inversely related to the persistence of the shock.

An issue not addressed by the cumulative multiplier is that the impact on GDP also depends 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. In the case of 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.[13] This modified cumulative multiplier still exceeds 2 at peak, but it is lower than the standard indicator.

An alternative way to assess our results is to compare them with those obtained by replicating the estimated fiscal shocks and 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, see Banca d'Italia, 1986 and Terlizzese, 1993), are presented in Figure 6.[14] 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 two years they are well inside our error bands.

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[13] In standard textbook analyses of the Keynesian model, the effect of fiscal policy on GDP depends to a large extent 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.

[14] 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.

4.3 Robustness analyses

The above results are quite robust across alternative specifications of the model. In Figure 7 we present the median response of GDP to a purchase shock in alternative models that differ because of the variables included and the way shocks are identified. In particular, we present the results of the following five alternative exercises: the first, labelled "short-term rate", includes the short-term interest rate instead of the long-term one; in the second, "levels with no trend", the specification of the VAR, contrary to the benchmark, does not include a trend; 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); the fifth, "Cholesky" or 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 of 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 these alternative specifications are generally very close to those of the benchmark model and well within the upper (84^{th} percentile) and lower (16^{th} percentile) bands of the GDP response in that model, also reported in the figure. There are only two exceptions. First, in the first quarter there is a sizeable difference between the assumption of no impact, underlying the "Cholesky" ordering approach, and all the other estimates. This assumption seems however questionable, as usually payments are contemporaneous to, or even follow, the actual provision of the goods or services. Secondly, excluding the trend among the exogenous variables amplifies the effects on GDP, nonetheless leaving broadly the same hump-shaped pattern.

Figure 8 presents the same robustness exercises, considering a public wage shock. Overall, there are no noticeable differences with respect to the results obtained using the benchmark specification.

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 within a 5-variable VAR model, as we have not a quarterly series for net revenue in national accounts.

The national accounts variable is smoother; its shocks exhibit a greater degree of persistence, fading away in about four years. The response of GDP is positive in the first two years and negative afterwards, as when using cash data, but significantly larger (Figure 9). However, there is no significant difference between the cumulative multiplier obtained by using the two sets of data (Figure 10). As for the precision of these estimates, in the first five quarters the error band is significantly narrower when the cash data are used; afterwards, the precision of the estimates based on the two sets of data is the same.

As a further robustness check we studied the effects of political cycles on the behaviour of fiscal policy variables (see Franzese, 2000 and Mink and de Haan, 2005, and the studies cited therein) To this end, we added to the benchmark model 5 dummy variables, one for the quarters in which general elections were held and the previous four. As a robustness check we also considered the elections that were not planned. The dummies in the equations of government wages and net revenue are not statistically significant. For government purchases, the dummy anticipating by 4 quarters the date of the elections is instead significant, although only when expected elections are considered. Lags beyond the fourth one were not significant. The OLS estimates indicate that government spending on goods and services are 12 (in the case of expected elections) and 5 (in the case of all the elections) per cent higher in that quarter. However, the likelihood ratio test for the null hypothesis of no political cycle effects provides ambiguous results, depending whether "surprise elections" are excluded or not.[15] With all elections included, the test gives a strong support for the existence of a political cycle in purchases (the *p*-value of the likelihood ratio statistic is 0.007) while in the other case, it suggests the opposite conclusion (the *p*-value is 0.34). In any case, the estimated effects of

[15] The test was performed including all dummies up to the fourth in all the equations of the VAR.

fiscal policy shocks on the macroeconomic variables did not show any significant change with respect to the benchmark model when political cycle effects were taken into account.

Finally, to assess the possibility of a level shift in the relationships between variables as a consequence of the Maastricht Treaty, we run a number of experiments adding dummy variables to the benchmark model. In particular, we included in our benchmark specification five dummy variables set to 1 from, respectively, 1991:4 (when the signing of the Maastricht Treaty could have been anticipated), 1992:1 (when the Treaty was signed), 1992:2, 1992:3 and 1992:4 onward (in order to take into account the possibility of lags in the implementation of the Treaty). These dummies were jointly statistically significant but their inclusion did not qualitatively modify the impulse responses. In the case of a shock to government purchases, the inclusion of the dummies led, in the first two years, to an upward shift of the response of interest rates (with a maximum difference of 0.4 percentage points in the 3rd and 4th quarters) and to a downward shift (by approximately 0.2 percentage points) of the GDP and the employment responses. The impulse responses of these variables in the following years, as well as those of the other variables, were essentially unaffected.

4.4 The responses of the other macroeconomic variables and of GDP components

As Figures 3 and 4 show, the responses of private employment to the two spending shocks strongly differ. In the case of a shock to purchases, the effects on private employment are close to those of private GDP, though they 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, while the effect on GDP is very small but constantly positive, that of employment turns negative in the third quarter and gets progressively larger; after one and a half year the effect becomes significant and at the end of the third year tends to stabilize at -0.5 percentage points. The negative impact on private sector employment of a positive shock to the public sector wage bill is consistent with a number of theoretical models and it has some empirical support. For example, in the model presented by Holmund (1997) an increase in the average public wage or employment, by increasing the reservation utility of private sector workers and their bargaining power, leads to an increase in the average private

sector wage and a reduction in private sector employment. Algan *et al.* (2002) find evidence of public employment crowding out private employment.

The median effects on inflation of the two spending shocks are positive but transitory. A shock to purchases increases inflation (measured by the change in the private GDP deflator) by 0.3 percentage points on impact. The effects are negligible in all other quarters. The cumulated effect on the price level stabilises at slightly less than 0.4 percentage points by the end of the first year. In the case of a wage shock, inflation does not react on impact but increases by 0.4 percentage points in the second quarter; this increase is, however, almost entirely offset in the third quarter; afterwards the effects are negligible and not significant. The response of the price level is close to zero at the end of the first year. The limited response of inflation to government spending shocks is in line with results obtained by other studies (see Perotti, 2002, Henry *et al.*, 2004 and the studies cited therein). In fact, the response that we find, though relatively small, is larger than the results of many other studies (e.g., Mountford and Uhlig, 2002).

As for the median response of the long-term nominal interest rate, in the case of a shock to purchases it is hump-shaped. Initially, the interest rate falls by 0.3 percentage points; afterwards it increases and remains constantly positive. It reaches a peak in the fifth quarter, at 0.4 percentage points and then slowly declines. The effects are not statistically significant, except in the first and the fifth quarters. The initial negative change in the interest rate has been already found 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 to a similar hump-shaped response on the interest rate, but there is a positive effect already in the first quarter. The peak is, at the fourth quarter, also at 0.4 percentage points and significant. The other effects are not statistically significant.

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 (Figures 7 and 8). Thus, we study the effects of spending shocks on private consumption and private investment by having both these two variables in a 6-variable VAR that only includes the government spending variable whose shock we are studying.

The responses of private investment and private consumption to a shock to purchases are both positive; for investment the effects are significant between the 2nd and the 6th quarter, while for consumption this holds only for the 2nd quarter. Figure 11 displays these responses expressed as shares of GDP, by multiplying them by the average share of private investment and private consumption in GDP, respectively. The two components 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 model. The responses of private investment and consumptions to a shock to public wages are both positive but never significant.

5. The effects of shocks to net revenue

In Figure 12 the whole set of impulse responses to a shock to net revenues equal to 1 percentage point of GDP for the benchmark specification is plotted. Like in the case of the other fiscal shocks, the response of net revenue to its own shock is short-lived: after the first quarter it hovers around 0.1 per cent of GDP. Overall, we find that the effects of net revenue shocks on the other variables are very small and somewhat contradictory. In particular, rather counter-intuitively, we estimate a positive and statistically significant effect on GDP; however, this effect is transitory and extremely small, reaching a peak at 0.16 per cent of GDP in the 5th quarter. In contrast, we find a permanent negative effect on employment, significant in some quarters but always very small (0.1 per cent of GDP). We obtain similar results in the alternative specifications that have been considered for assessing the robustness of the effects of government purchases and wages.

6. Results of the model including total direct spending (6-variable model)

To establish a comparable setup 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. In this

way we focus on the impact of current direct expenditures, which in Italy account for almost ninety per cent of total direct expenditure.

The other variables are the same as in the benchmark model. Figure 13 displays the impulse responses to a one-percentage point of GDP shock to government expenditure of the six variables included in the VAR. The median and the two sets of lower and upper bands (corresponding to the fifth, sixteenth, eighty-four and ninety-fifth percentiles of the distribution) are presented. Figure 14 reports the impulse responses to a shock to net revenue (the analogous overview of the results obtained for the benchmark model is provided in Figures 3, 4 and 12).

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

Similarly to 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 0.2 percentage points, remains broadly stable in the following three quarters and then declines slowly; it becomes slightly negative starting in the 8^{th} quarter. The response is estimated rather imprecisely: it is statistically significant only in the first two quarters. The responses of private consumption and investment are positive, but not significant. Overall, the results are in-between those of the shocks to purchases and wages in the benchmark model. Figure 15 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 just above unity in the fourth year.

7. Conclusions

This paper has studied the effects of fiscal policy on private GDP, inflation and interest rates in Italy using a structural Vector Autoregression model and relying on a new database of quarterly cash data for fiscal variables.

As in all comparable VAR studies, we examine the effects of a shock to total direct government spending using a 6-variable VAR, which includes private GDP, the private GDP

deflator, employment, the interest rate, direct expenditure and net revenue. We find, in line with previous studies, that direct expenditures have a positive effect on output. The effects of expenditure on itself, however, are far less persistent than those estimated for the U.S. economy, implying a response for output which is relatively small and fades away quickly. In terms of cumulative 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 the U.S., in Galí *et al.* (2006) and in Fatás and Mihov (2001) and, for France, in Biau and Girard (2005).

In the benchmark 7-variable model we distinguish between wage expenditure and purchases of goods and services. We find that shocks to government purchases of goods and services have a relatively large 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. The values of the cumulative multiplier (computed for overall GDP) at the 4^{th}, 8^{th} and 12^{th} quarters are 2.4, 2.4 and 1.7, respectively. 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. The increase in economic activity is determined by the positive responses of both private consumption and investment. The effect on inflation is positive and short-lived. In contrast, public wages have no significant effect on output; a negative and significant effect on employment emerges after 6 quarters. The reactions of inflation are negligible; those of interest rates are positive but not significant. Finally, shocks to net revenue have small and somewhat contradictory 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 the results obtained by Fatás and Mihov (2001) using U.S. data, we find that purchases on goods and services have a greater impact on economic activity in Italy than spending on wages.

Appendix A – Construction of the data and comparison with national account data

The sources of our general government 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. Since 1994, the Treasury computes also the consolidated data for the general government sector. For the previous years (1982-1993) we sum the figures for each sub-sector, consolidating intergovernmental flows when possible.

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.

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 public wages. All the remaining items, excluding interest payments, investment, debt settlements and privatization receipts, are included in net revenue. Net revenues are computed as a residual item starting from the Bank of Italy general government borrowing requirement.

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. The borrowing requirement is computed on the basis of changes in debt instruments, on which precise and almost complete information is 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. We exclude interest payments because they are largely outside the scope of government control and investment because we are not confident

enough about the quality of the data (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).

Measuring net revenue as a residual from the cash deficit 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. However, 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.

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 expenditure included in this item refers 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 public wages 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 problem 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 public wages. Hence, we have added to the post-1994 figures an amount equal to the fraction of such payments in total wage expenditure observed in 1993.

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

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A comparison of yearly national accounts data with our cash data, adjusted in the way described above, shows reasonably similar patterns (a detailed analysis and graphs are available from the authors upon request). 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 yearly 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. The series of public wages in cash and national account data almost coincide.

As for quarterly data, we can only compare government consumption from the national accounts with the sum of current spending on goods and services and public wages in our cash data. While 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 can be made for the period 1999-2004. For both spending items, the cash and national accounts series show 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 performed on it.

Appendix B – 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, and even then 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 (we apply the private GDP deflator to 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.[16] 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.[17]

We compute the elasticity of net revenue with respect to the macroeconomic variable *j* (ε_{nr}^{varj}) as the product of the elasticity of revenue to the macroeconomic variable *j* and the average ratio of revenue over net revenue in the period we examine:

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

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 comes

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

[17] Over the sample period, only in the years 1982-1986 both private and public wages were indexed with a lag to prices.

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 elasticities 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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Figure 1

Seasonally-adjusted Government Expenditure Items

(millions of euros at 1995 prices)

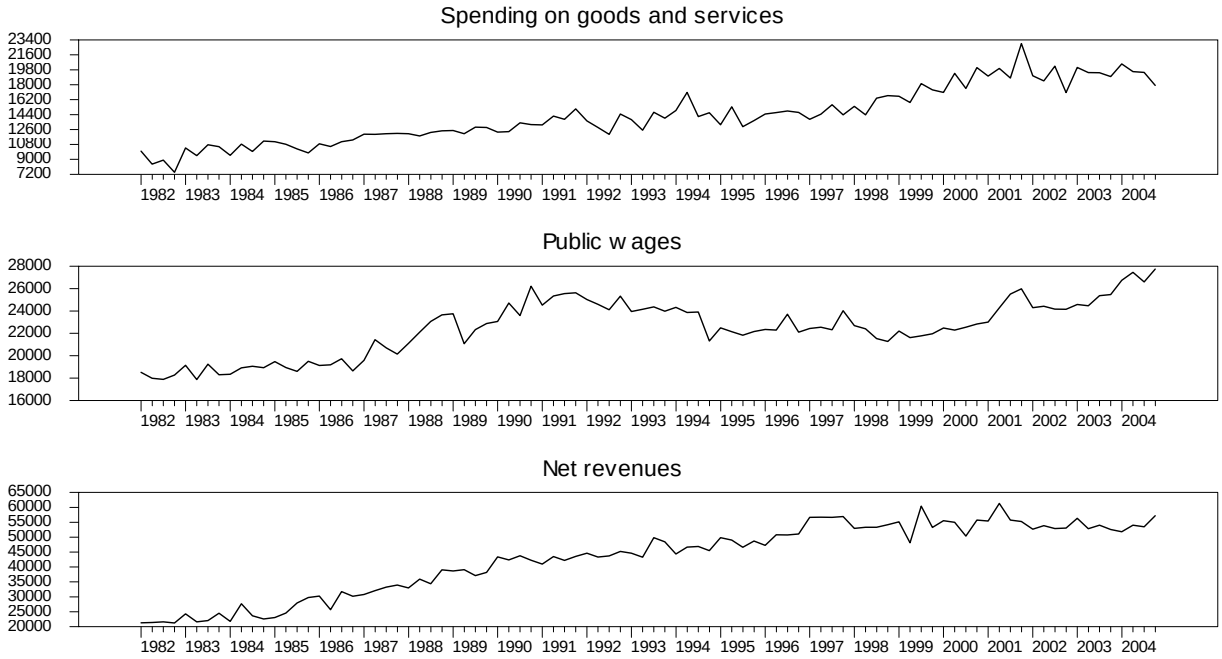


Figure 2

Shocks to Fiscal Variables

(percentage values)

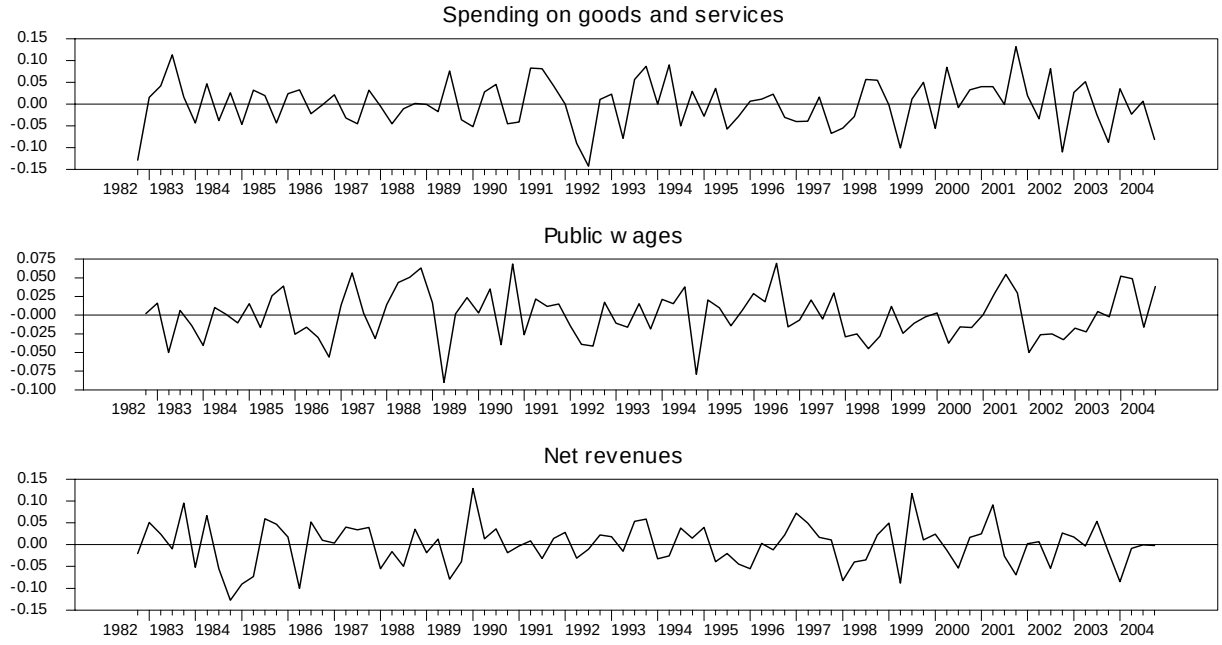
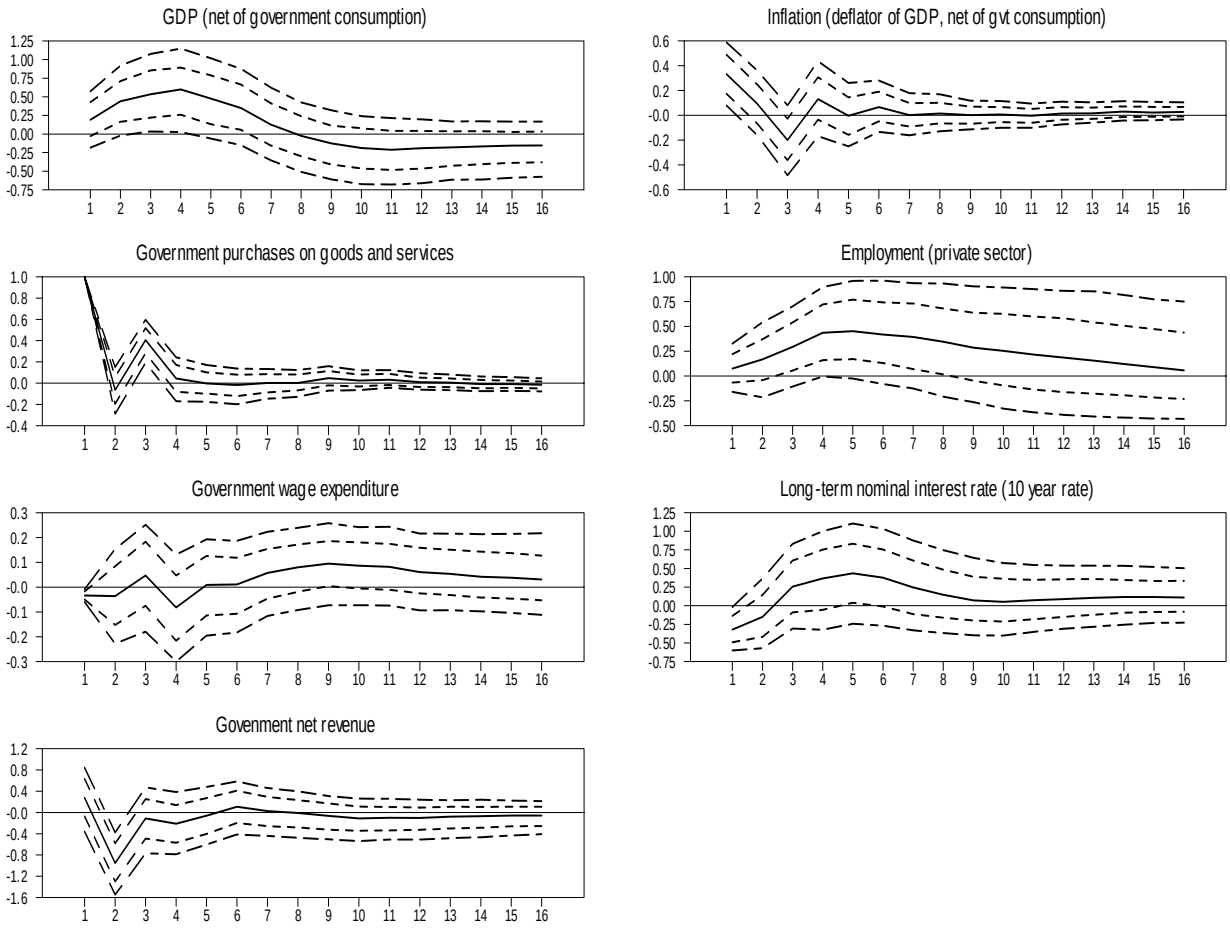


Figure 3

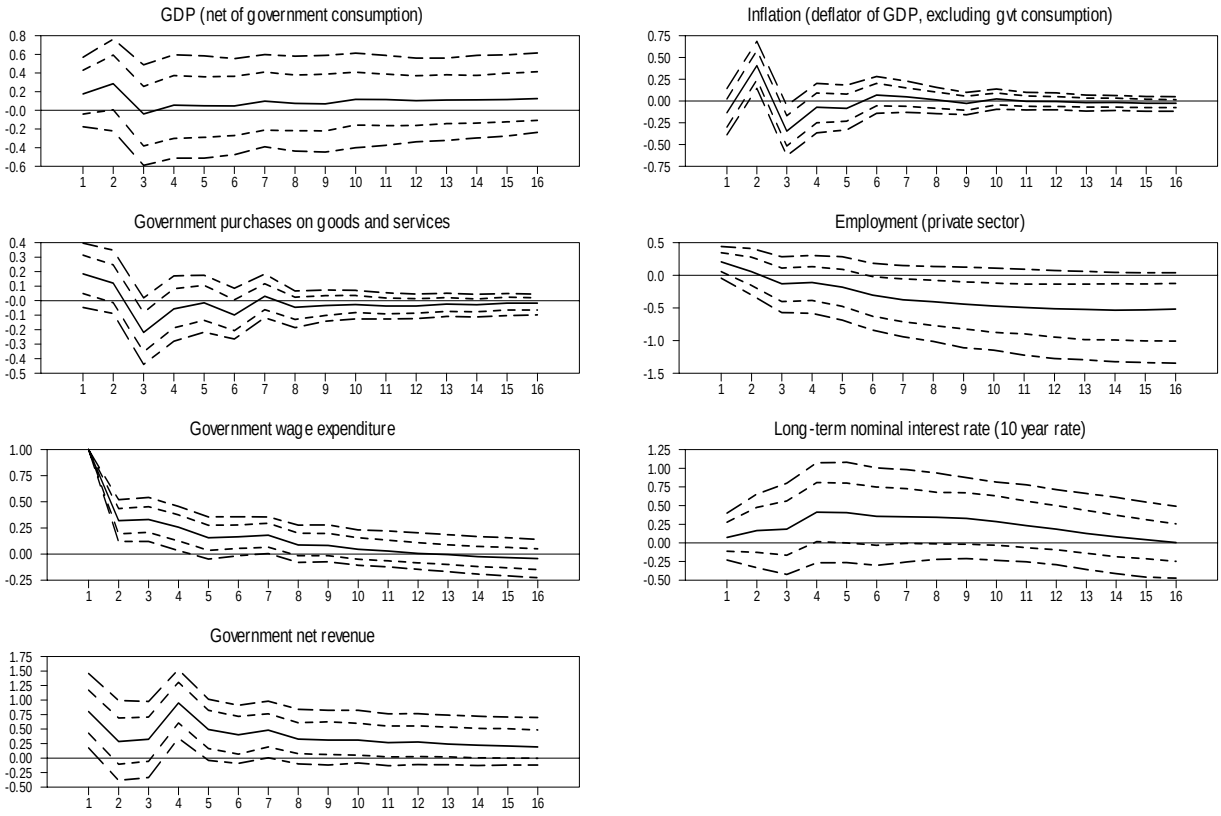
Impulse Responses to a Positive Government Purchases Shock: Benchmark Model [1]



[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 4

Impulse Responses to a Positive Government Wage Shock: Benchmark Model [1]



[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 5

Effects of Government Purchases on GDP: Cumulative Multiplier
(median and upper and lower bands - benchmark specification)

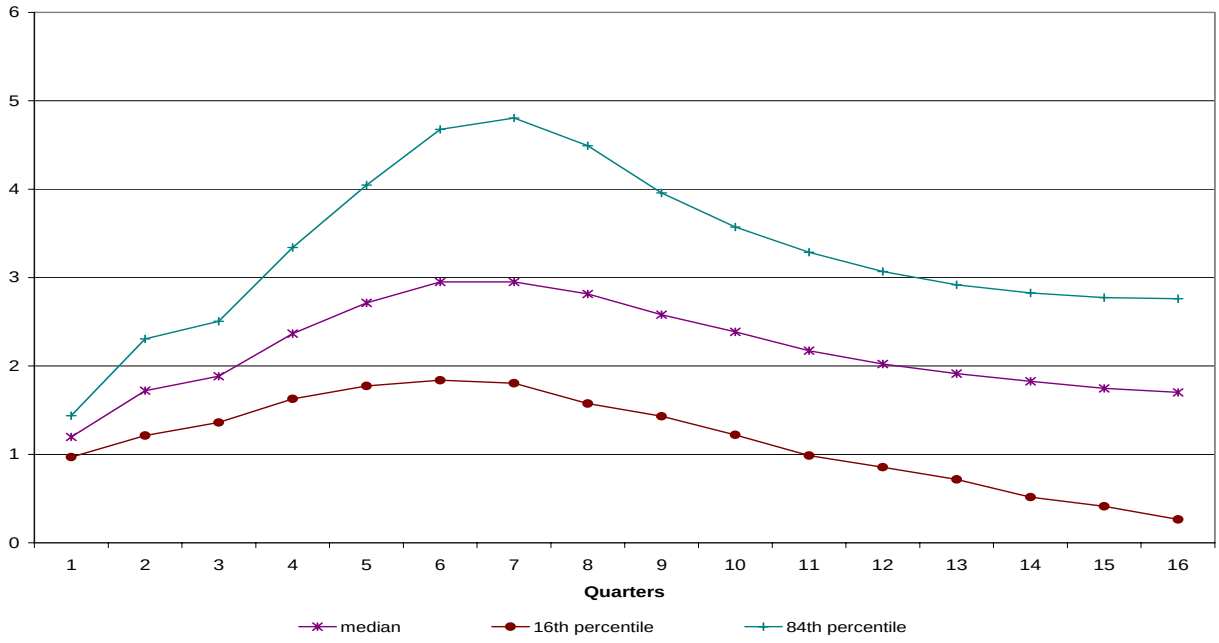


Figure 6

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

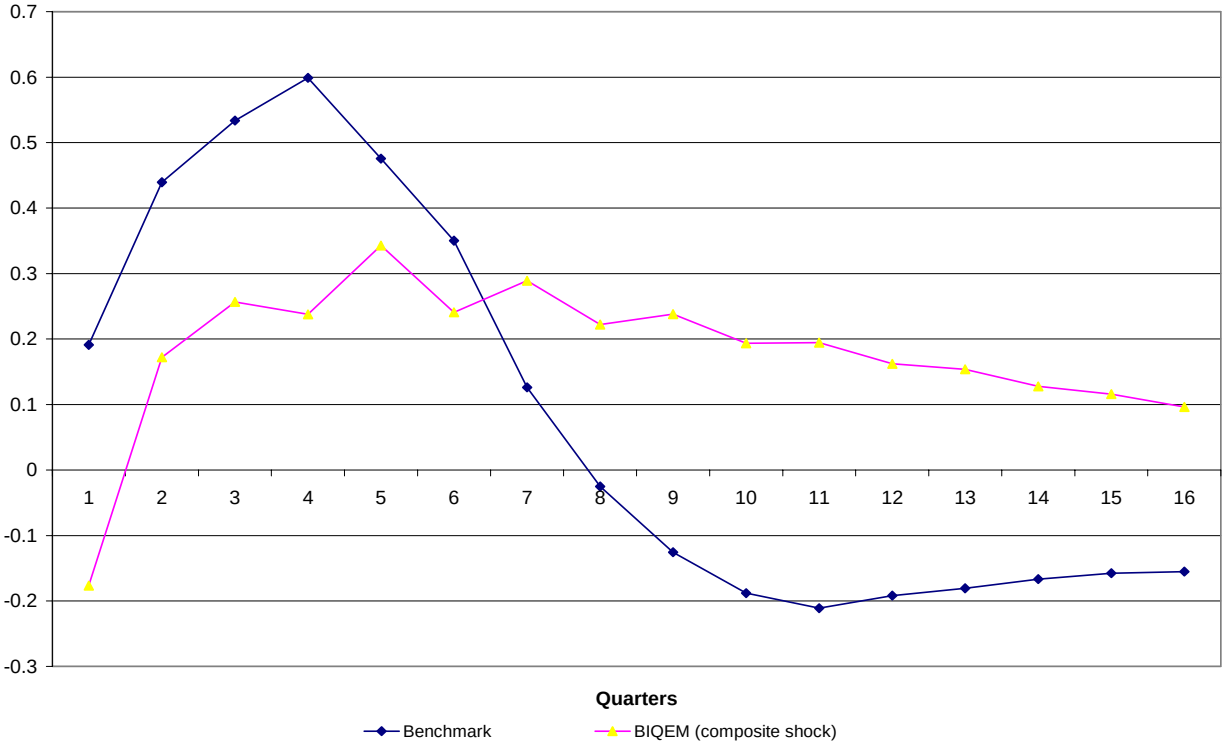


Figure 7

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

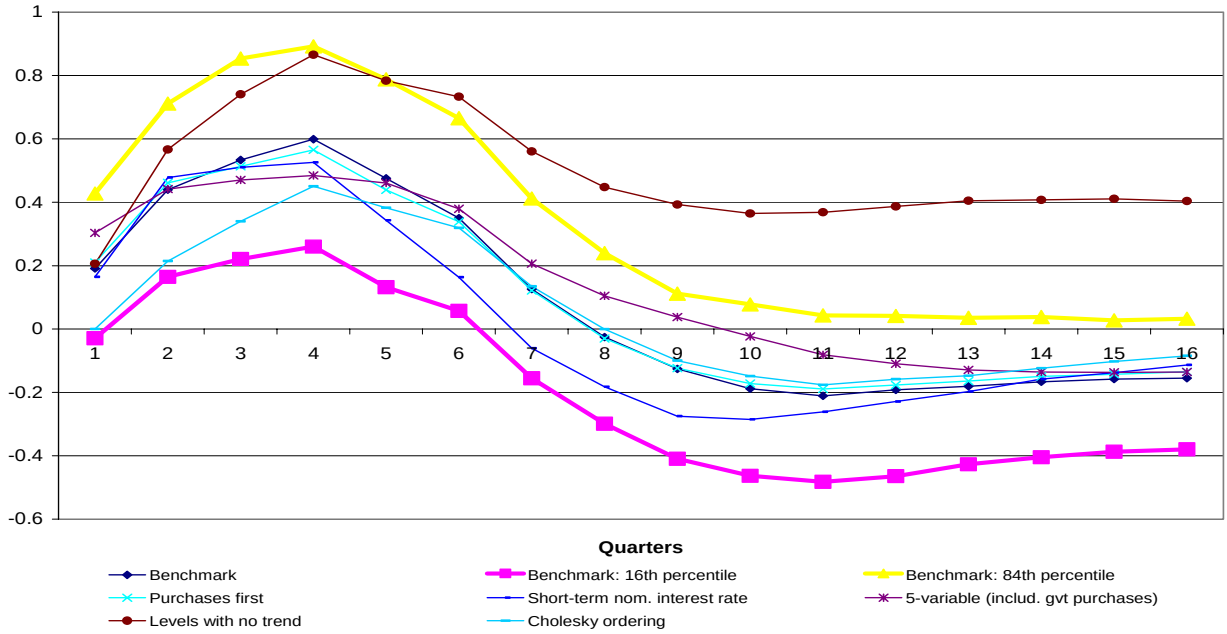


Figure 8

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

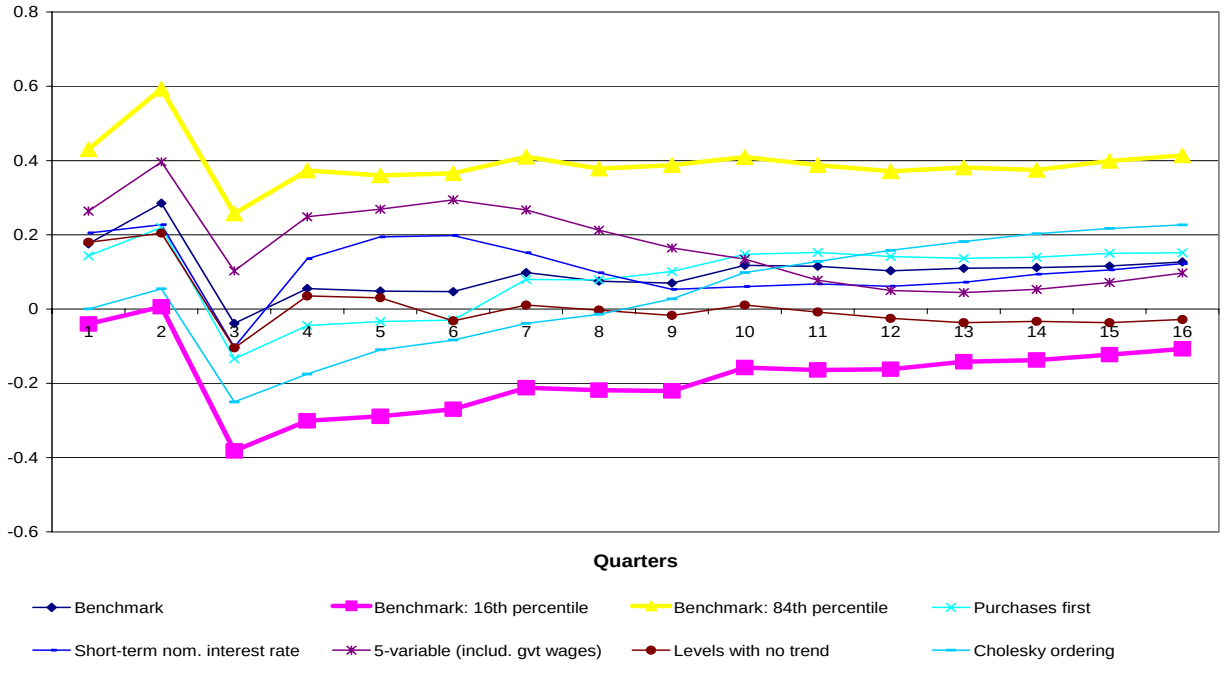


Figure 9

Effects of Government Consumption and Government Purchases+Wages on Themselves and on GDP: 5-Variable Model

(median values - percent of GDP)

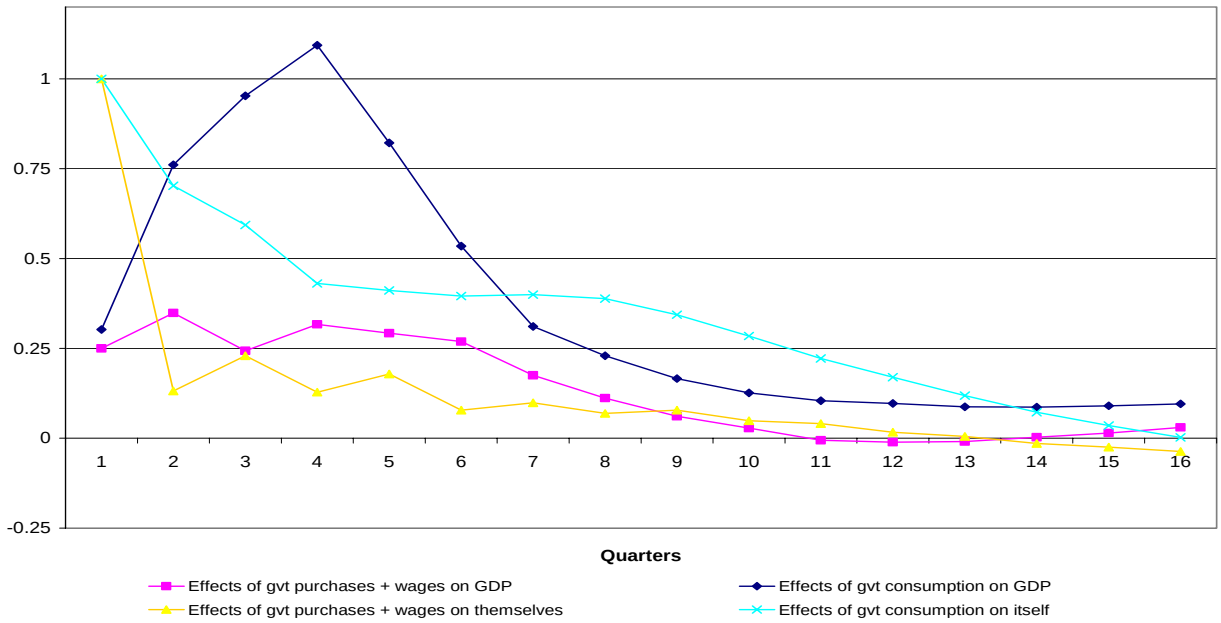


Figure 10

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

(5-variable model)

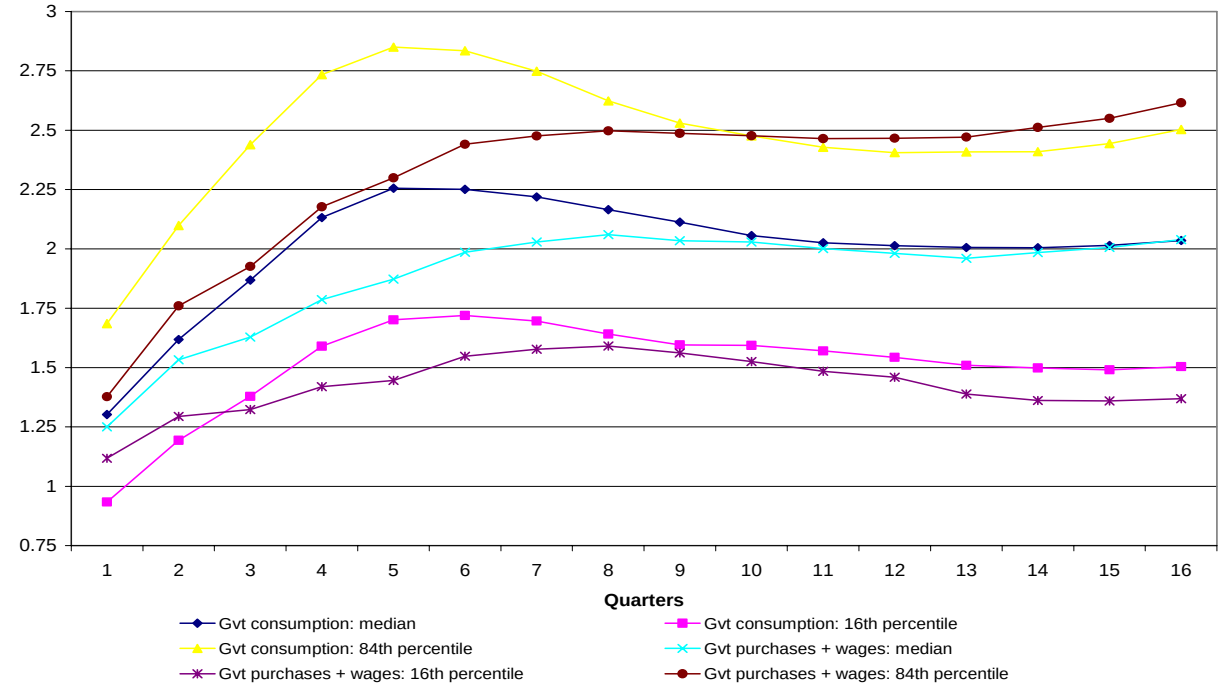


Figure 11

Effects of Governmentt Purchases on: GDP (Benchmark Specification), Private Consumption, Private Investment and Total Private Demand

(6-variable model – percent of GDP)

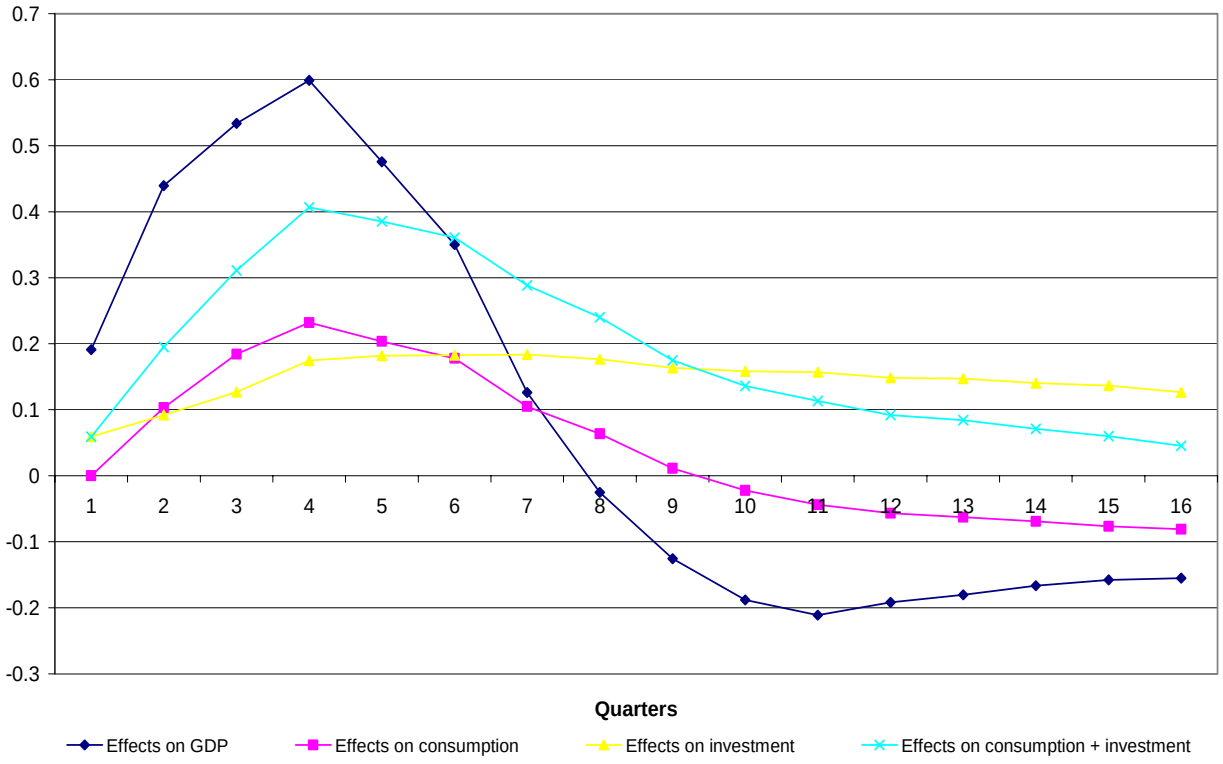
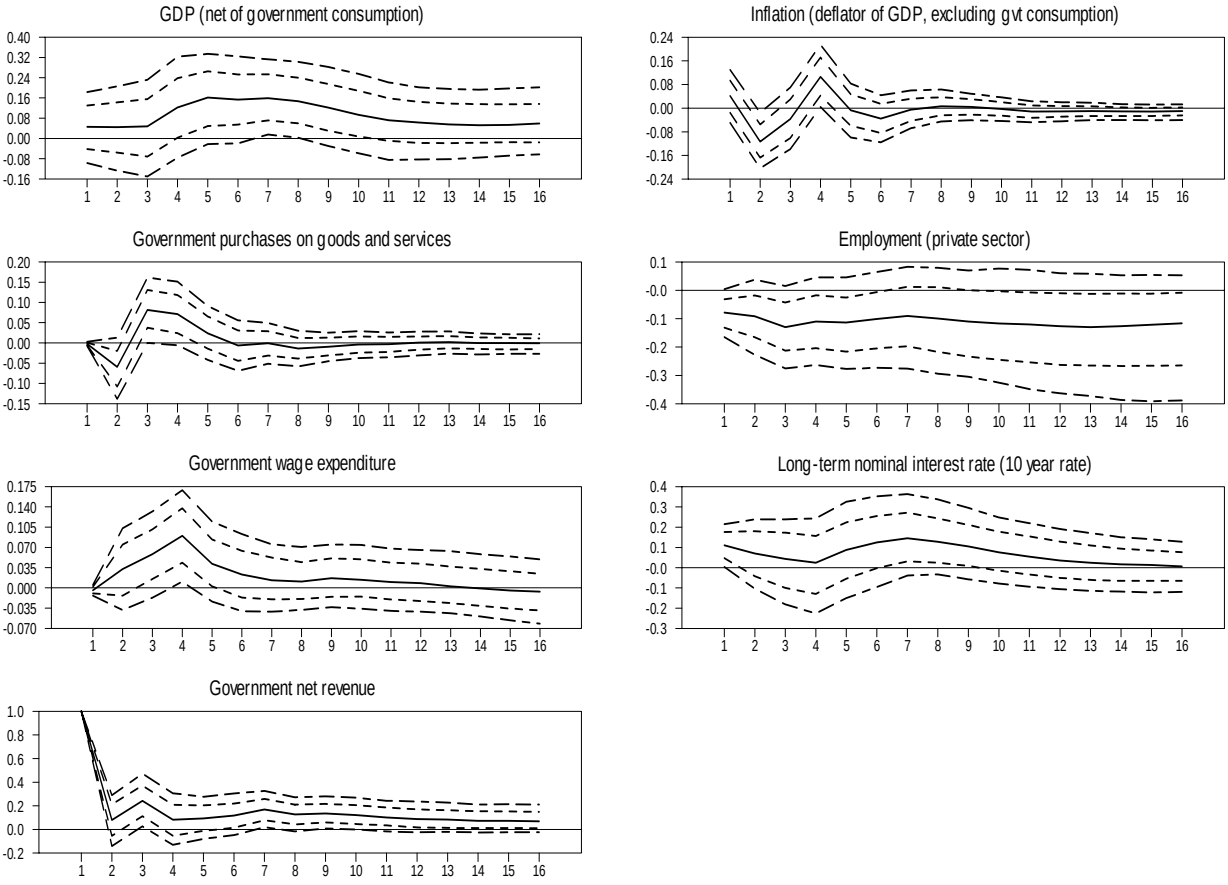


Figure 12

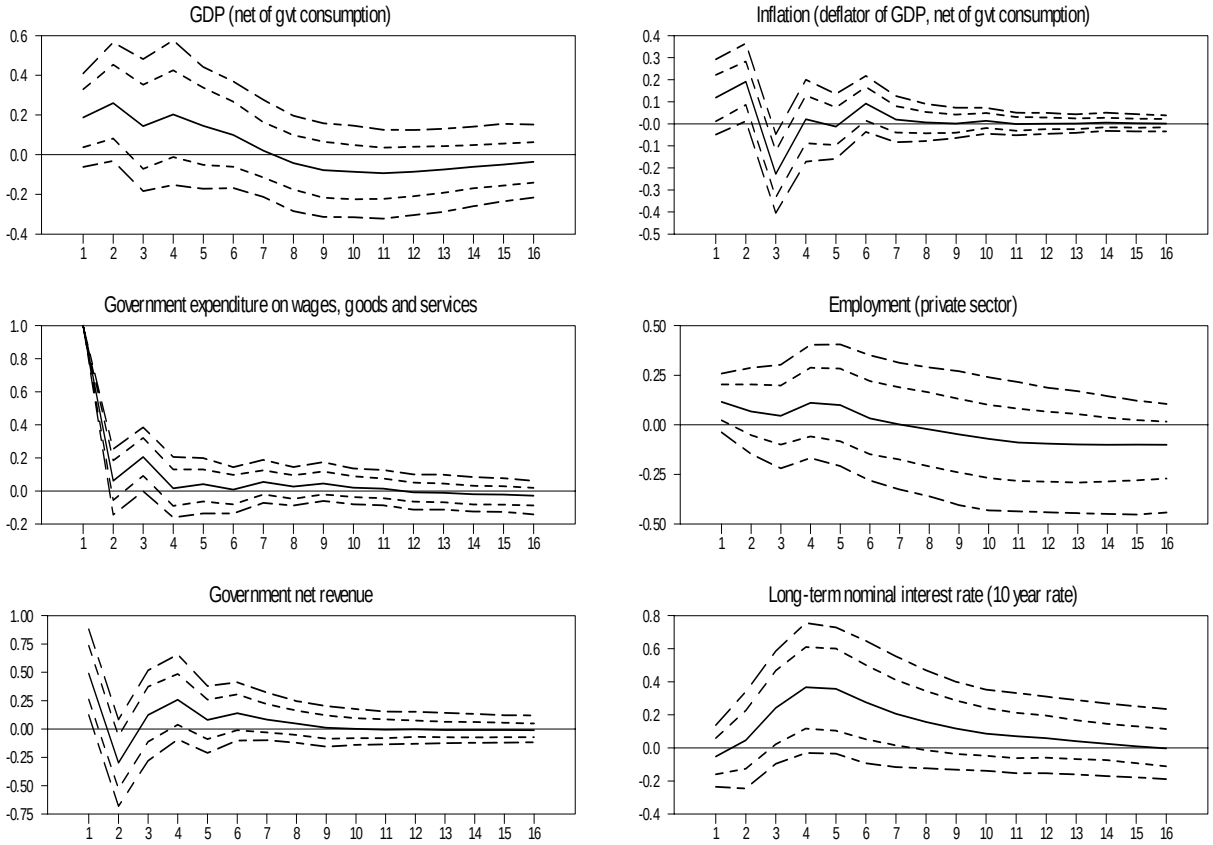
Impulse Responses to a Positive Government Revenue Shock: Benchmark Model [1]



[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 13

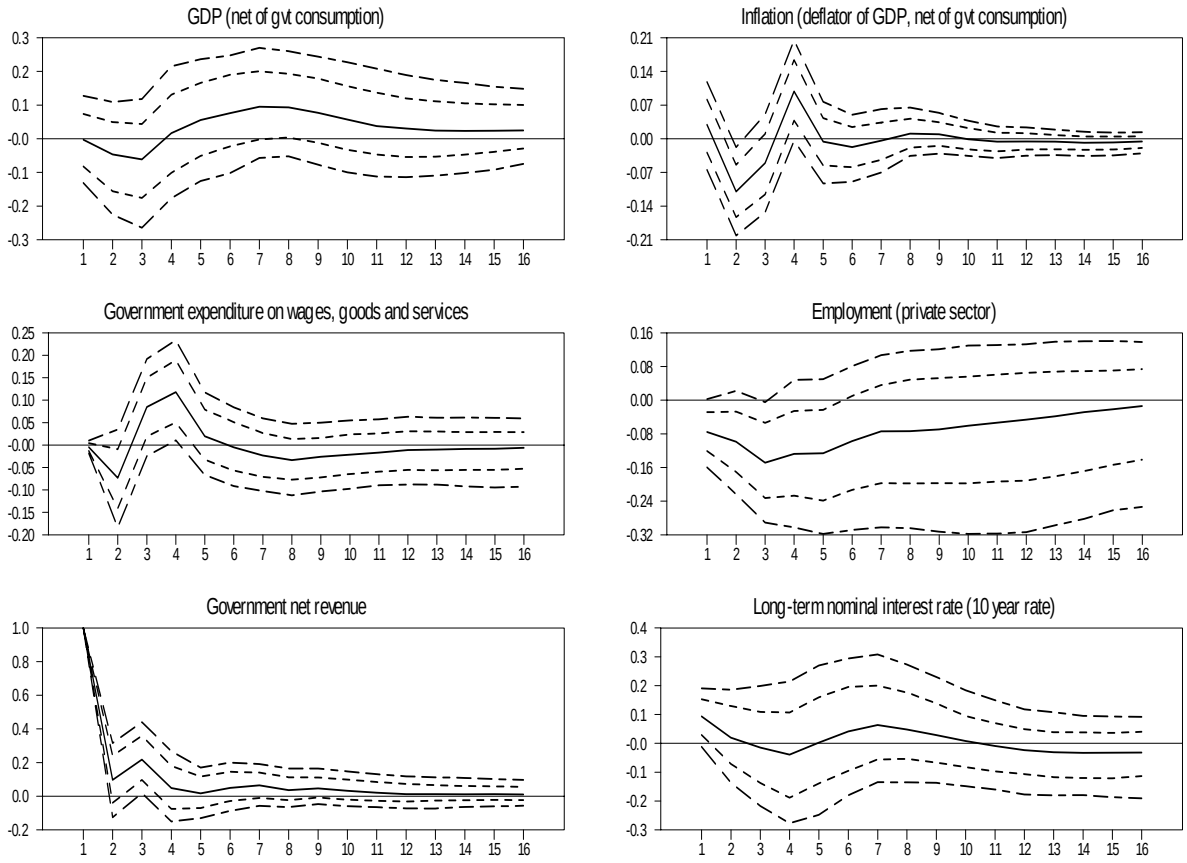
Impulse Responses to a Positive Government Expenditure Shock: 6-Variable Model (1)



(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 14

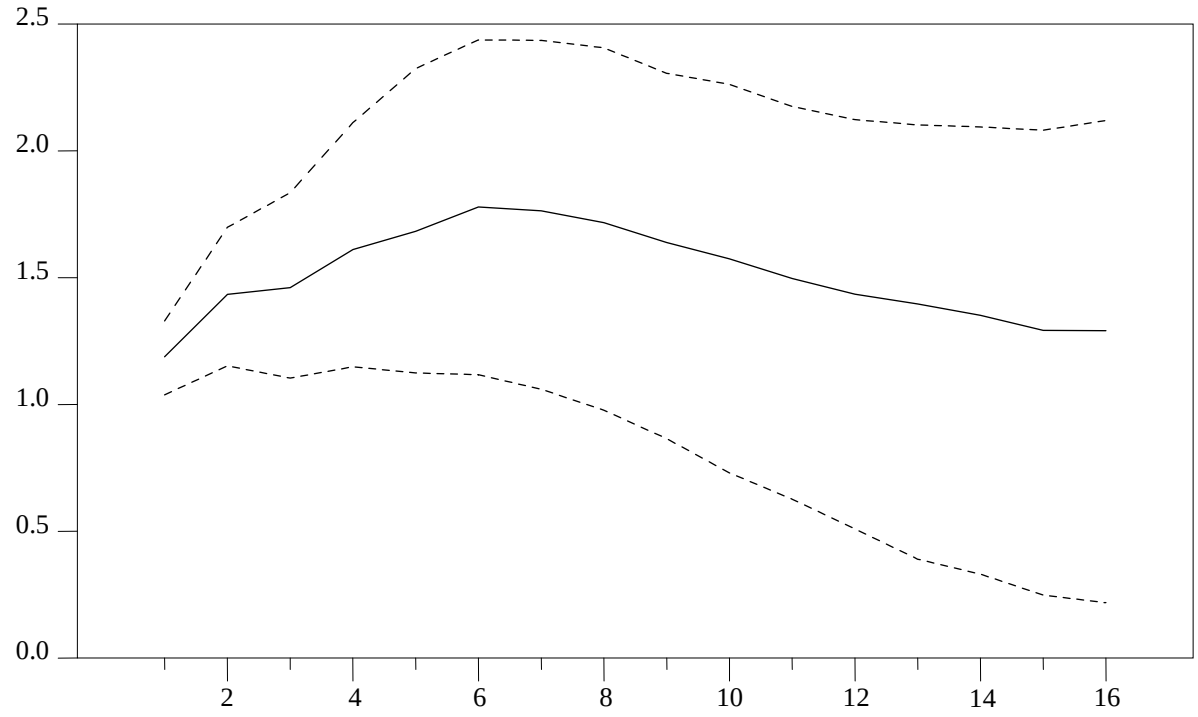
Impulse Responses to a Positive Government Net Revenue Shock: 6-Variable Model [1]



[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 15

Effects of Government Expenditure on GDP:
Cumulative Multiplier (6-Variable Model)[(1)]



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

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