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THE EFFECTS OF FISCAL SHOCKS WITH DEBT-STABILIZING BUDGETARY POLICIES IN ITALY

by Francesco Caprioli* and Sandro Momigliano*

Abstract

We study the effects of fiscal policy on macroeconomic developments in Italy over the period 1982-2010 with a Structural Vector Autoregression (SVAR) model. We include public debt and impose the government budget constraint in the estimation. In contrast with previous research we also include foreign demand, significantly improving estimation accuracy. We find that movements in debt induce stabilizing reactions in fiscal policy. In this context, expenditure and revenue shocks have significant effects on economic activity; these are stronger, as well as more precisely estimated and robust, for expenditure. Expenditure multipliers are higher when we exclude from our sample the initial years and, in particular, when we focus on the post-Maastricht period.

JEL Classification: E62, H30.
Keywords: policy, public debt, foreign demand, fiscal multipliers, VAR.

Contents

* Bank of Italy, Economics, Research and International Relations.

1 Introduction [1]

The large stimulus packages implemented by governments in most advanced countries to contrast the global recession that begun in mid-2008 have been at the center of a large debate (see, e.g., Corsetti et al. (2010), Romer and Romer (2010)). They brought renewed attention to the old question of the usefulness of fiscal policy to smooth cyclical fluctuations. Given the size of the downturn, a number of traditional arguments against counter-cyclical policies were relatively blunted, in particular those referring to the difficulties associated with the assessment of cyclical conditions and implementation lags (Blanchard et al. (2008)). Therefore, the debate focused on the size of the effects on the economy of higher government spending and/or lower taxes, with critics of the packages pointing out that these effects are relatively small, as private components of demand at least partially offset public stimulus.

The theoretical literature provides limited guidance on these issues, since the qualitative effects of fiscal policy are model-dependent (see, e.g., Cogan et al. (2009)); the empirical evidence is still not conclusive either, though it suggests that fiscal expansions generally boost private consumption and output.[2] In this paper we contribute to the debate on the effects on the economy of fiscal shocks by providing new results for the Italian economy based on the SVAR methodology. With respect to previous research (Giordano et al. (2008)), we extend the database up to 2010, introduce at least two important methodological innovations and also provide estimates for the post-Maastricht period.

We identify structural fiscal shocks using the methodology developed by Blanchard and Perotti (2002).[3] In our benchmark model we add two variables - government debt and for-

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[2] See Coenen et al. (2010). The two main empirical approaches that attempt to assess the effects of fiscal policy have specific limits. Reliable and non-interpolated quarterly fiscal data over a long enough period of time, a prerequisite for the VAR approach, exist only for a few countries. The "narrative" approach (i.e., Ramey and Shapiro (1997) and Edelberg et al. (1999)) is resource-intensive and intrinsically subjective, making its application across countries almost impossible.

[3] Other approaches most commonly used to identify structural shocks are the sign restrictions on impulse responses (see, e.g., Mountford and Uhlig (2002)), the dummy variable one (see e.g. Romer and Romer (2010)) and the Choleski ordering one, see, e.g., Fatas and Mihov (2001). The literature about the effects of fiscal policy using Vector Autoregression is large and offering a comprehensive survey goes beyond the scope of this paper. See Blanchard and Perotti (2002), Perotti (2004), Fatas and Mihov (2001), Mountford and Uhlig (2002), Giordano

eign demand - to the standard specification found in the literature (5 variables: private GDP, inflation, interest rates, net revenue and government consumption).

We believe that the inclusion of debt is important for at least three reasons. First, it allows us to analyze the reaction of fiscal variables - namely government spending and net revenue - to changes in public debt. Empirical evidence (see, e.g., Bohn (2007), Trehan and Walsh (1991), Hamilton and Flavin (1986) and Golinelli and Momigliano (2008)) suggests that this feedback effect is generally important. In the case of a high-debt country like Italy, the influence of debt on the fiscal authorities' decisions is likely to be particularly large. Second, it enables us to purge our fiscal shocks estimates from the systematic reactions of budgetary variables to debt level and to better understand the fiscal framework associated to the shock. In particular, recent research suggests that, depending on whether or not an expenditure shock is reabsorbed in the medium-long term, fiscal multipliers may have different values (see, e.g., Corsetti et al. (2009) and Ilzetzki et al. (2009)). Lastly, we can study the interaction between the level of public debt and its average cost.[4]

Other researchers have included public debt in a VAR exercise examining fiscal multipliers. We broadly follow the methodology by Favero and Giavazzi (2007), who add a deterministic equation linking debt dynamics to the government budget balance.[5]

We also include foreign demand, given its major influence on economic activity, Italy being a small open economy. As it can be safely assumed that foreign demand, measured by world demand, is not significantly influenced by Italian macro or fiscal variables, its inclusion in the VAR comes at a relatively small cost in terms of additional parameters to be estimated. At the same time, it improves considerably the accuracy of our estimates.

To better understand the channels through which fiscal shocks affect economic activity, we extend our benchmark specification in various respects. To assess the impact on a fundamental goal of the government, we add private employment to the model. We also replace private GDP with private consumption and investment. Furthermore, we distinguish between wages and purchases of goods and services, as previous research found that these two components of public spending have different effects on the economy.

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et al. (2008), Ramey and Shapiro (1997), Edelberg et al. (1999) and Burriel et al. (2010) among many others.

[4]In the aftermath of the recent crisis, and particularly in the euro-area countries, this issue has become more relevant as it has been observed that the relationship between sovereign bond spreads (relative to the German benchmark) and the state of public finances has strengthened (see ECB (April, 2010)).

[5]Chung and Leeper (2007) employ a conceptually similar approach. Creel et al. (2005) include public debt as an additional variable. This second approach allows for the analysis of the effects of direct shocks to government debt. This, however, comes at the cost of estimating a higher number of parameters than actually needed, as the government budget constraint is disregarded.

Finally, to study the stability across time of the results, we estimate our benchmark model over 8 rolling windows of 86 observations each, starting from the period 1982:1-2003:2. Moreover, as we find clear evidence of a structural break in 1993 for the fiscal reactions to debt level, we estimate our benchmark model over the period 1993-2010:2, i.e., in the post-Maastricht regime.

The main results can be summarized as follows. Shocks to both net revenue and government consumption are largely transitory, falling to a negligible or negative level after a few quarters. The initial impact of fiscal shocks on debt is gradually absorbed within three years in the full sample analysis, while the reabsorption is much faster in the post-Maastricht period. We obtain significant effects on private GDP for both revenue and expenditure shocks, that are stronger, as well as more accurate and robust for the latter. Expenditure multipliers are higher when we consider subperiods which exclude the initial years and, in particular, when we focus on the post-Maastricht period.

The paper proceeds as follows. Section 2 describes the data. In section 3 we outline the benchmark specification of the VAR model and our identification strategy. In section 4 we analyze the effects of government consumption shocks, first in the benchmark specification and then using the alternative models and periods discussed above. After discussing the effects of net revenue shocks in section 5, we conclude with section 6.

2 Data and variables

We extend up to 2010:2 the database of quarterly cash fiscal data constructed by Giordano et al. (2008) for the period 1982:1-2004:4, on the basis of the Italian Ministry of the Economy and Finance Quarterly Report and the general government borrowing requirement published by the Bank of Italy.[6,7] Our benchmark specification includes seven variables: private GDP (i.e., total GDP net of government consumption, (y_t)); the inflation rate (π_t) based on the private GDP deflator; the nominal interest rate on government debt (i_t); government consumption g_t; net taxes t_t; the debt-to-GDP ratio d_t and foreign demand f_t. We construct the interest rate on government debt as a weighted average of the yield on short-term and on long-term government debt, where the weight is given by the share of debt obligations with maturity shorter than one year. Government consumption is the sum of government spending on goods and services and government wages. Net taxes are computed subtracting government consumption, interest payments and investment from borrowing requirement; therefore this variable includes monetary

[6]Quarterly national account data for general government accounts are only available from 1999, with the exception of the government consumption item, which is available from 1980.

[7]We thank the authors for providing us with the original dataset. See Giordano et al. (2008) for a description of the sources and the construction details of the fiscal data.

transfers as well as revenue.[8]

Following Giordano et al. (2008), we include GDP net of government consumption instead of total GDP. This choice stems from the fact that cash government consumption has a different quarterly profile from the corresponding national accounts aggregate, which complicates somewhat the interpretation of the effects on total GDP of a shock to (cash) government consumption, as it cannot be assumed (contrary to the case of national accounts fiscal data) to have a 1-to-1 impact on aggregate demand. Moreover, excluding the government component of aggregate demand from total GDP allows to directly answer the most relevant policy question, that is how the private sector reacts to a fiscal shock.

All variables, apart from inflation, interest rate and the debt-to-GDP ratio, are log-transformed, converted in real terms using the private GDP deflator and seasonally adjusted using the TRAMO-SEATS procedure.

3 The benchmark specification

The reduced form VAR is specified in level[9] and can be written as follows:

$$X_t = \sum_{i=1}^{k_1} C_i X_{t-i} + \sum_{i=1}^{k_2} \gamma_i d_{t-i} + \sum_{i=0}^{k_3} \delta_i log(f_{t-i}) + U_t \tag{1}$$

where

$$X_t = \begin{bmatrix} log(y_t) \\ \pi_t \\ i_t \\ log(t_t) \\ log(g_t) \end{bmatrix} \tag{2}$$

k_1, k_2 and k_3 are the number of lags for the variables included in the VAR, for the debt-to-GDP ratio and for the foreign demand variable respectively.

U_t is the vector of reduced-form residuals. k_1, k_2 and k_3 are set to the minimum number of lags that delivers serially uncorrelated reduced-form residuals.[10] In particular, they are set equal to 3, 1 and 1 respectively. The benchmark specification includes a constant and a deterministic

[8] We exclude public investment from our benchmark specification (as in Giordano et al. (2008)) because we are not confident enough about the quality of the data. Results do not qualitatively change adding investment to either government consumption or net revenue, as shown in subsection 4.2.

[9] As shown by Sims et al. (1990), in large samples it is possible to ignore the cointegrating vector.

[10] Under the assumption that residuals are normally distributed, uncorrelation implies independence.

linear trend.[11] According to equation (1), past values of the debt-to-GDP ratio influence the current values of macroeconomic variables, which conversely influence the current value of the debt-to-GDP ratio according to the following law of motion:

$$d_t = \frac{1 + R_t}{(1 + \pi_t)(y_t/y_{t-1})} d_{t-1} + \frac{g_t - t_t}{y_t} \tag{3}$$

where:

$$R_t = \sum_{j=0}^{N} \frac{i_{t-j}}{N} \tag{4}$$

Equation (3) represents the period-by-period government budget constraint, expressed as a ratio to total GDP. Changes in the interest rate on government debt i_t only gradually affect its average cost R_t in equation (4); we set N = 20, as 5 years is approximately the financial duration of the debt at the end of our sample.[12]

We assume that the foreign demand dynamics can be approximated by an exogenous autoregressive process of the form:

$$log(f_t) = \alpha + \sum_{i=1}^{k_4} \beta_i log(f_{t-i}) + \xi t + \epsilon_t \tag{5}$$

where t is the time trend. According to equations (1) and (5), while current and past values of foreign demand affect the current values of macroeconomic and fiscal variables, the reverse is not true.[13] This assumption seems appropriate as Italy is a relatively small open economy.

As a measure of foreign demand, we follow Busetti et al. (2011), who compute the demand of Italian goods from abroad as:

$$f_t = \sum_{j=1}^{N} M_{j,t} \overline{q}_j \tag{6}$$

where $M_{j,t}$ corresponds to the total imports of goods by country j in volume at time t weighted by $\overline{q}_j$, the average ratio over the period 1999-2001 between Italian exports towards country j and total Italian exports. Busetti et al. (2011) construct this index both for commercial partners

[11] In a robustness check we also consider a quadratic specification for the trend.

[12] Compared to Favero and Giavazzi (2007), we add equation (4) and include in equation (1) the actual yield at issuance instead of the average cost of servicing public debt. We do so to identify more precisely the reaction of financial markets to public finances' conditions. Indeed, the yield at issuance responds immediately to investors' sentiments, while the average cost adjusts with a relatively long delay, depending on the maturity structure of government obligations. Moreover, the yield at issuance is more directly relevant for investment decisions in the private sector.

[13] In the benchmark specification we assume a systematic budgetary response to foreign demand. When we exclude such a systematic response, we find similar point estimates of fiscal multipliers.

belonging to the Euro area and outside EU. As a measure of global foreign demand we consider the sum of the two indexes.[14]

Given the specific way in which the debt-to-GDP ratio and the foreign demand are included in the specification, throughout the paper we refer to this benchmark as the (5+2 variables) model.

Compared to Giordano et al. (2008), while we add foreign demand and public debt for the reasons given above, we exclude private employment. We do so to have a parsimonious (in terms of the use of degrees of freedom) model as well as to align as much as possible our benchmark specification to the usual practise in the literature.[15]

3.1 Identification Strategy

The reduced-form residuals associated to the fiscal variables, u_t^g and u_t^t can be written as linear combinations of the structural fiscal shocks and of the reduced form residuals of the other variables in the VAR:

$$u_t^g = \alpha_y^g u_t^y + \alpha_\pi^g u_t^\pi + \alpha_i^g u_t^i + \beta_t^g \epsilon_t^t + \epsilon_t^g \tag{7}$$

$$u_t^t = \alpha_y^t u_t^y + \alpha_\pi^t u_t^\pi + \alpha_i^t u_t^i + \beta_g^t \epsilon_t^g + \epsilon_t^t \tag{8}$$

The α coefficients contain both the automatic elasticity and the discretionary change to the macro variables innovations, while the β coefficients measure the response of the fiscal variables to a structural shock. To estimate the α and β coefficients in equations (7)-(8) we follow the approach in Blanchard and Perotti (2002). First, we assume that, within a quarter, the discretionary change of fiscal variables to innovations in the macro variables is zero. Using quarterly data, this assumption can be justified on the ground of decision lags in fiscal policy-making which last longer than three months. Secondly, we estimate the α in equations (7)-(8) using external information on the elasticities of government consumption and taxes to output, inflation and interest rate. Following Giordano et al. (2008) (Appendix B therein) in this paper we set $\alpha_\pi^g = -0.9$, $\alpha_y^t = 0.3$, $\alpha_\pi^t = -0.4$ and all the other α equal to zero. In addition, we assume that government consumption does not contemporaneously adjust to revenues, i.e. we set β_t^g equal to zero. Consequently, we estimate β_g^t from equation (8) using OLS. We verify that even sizeable changes in these parameters do not significantly affect our results.

Finally, we estimate the coefficients relating the reduced-form macro variables residuals to the fiscal ones by instrumental variables, using as instruments for u_t^g and u_t^t their corresponding structural shocks, uncorrelated by definition.

[14] As a robustness check, we use also the world trade series, obtained from IMF International Financial Statistics, to measure foreign demand. The use of this series does not change the results of the paper.

[15] Nevertheless, in subsection 4.3 we discuss the effects of adding private employment to the model.

It is important to notice that the identification strategy for structural shocks does not depend on the presence of the debt-to-GDP ratio. The reason is simply that the law of motion of this ratio is deterministic. In other words, equation (3) holds as an identity and therefore it does not add any shock to the ones already included in the VAR model specified in equation (1).

A problem with the fiscal shocks identified using the SVAR approach is that they may be anticipated by economic agents, due to the delay between the announcement of fiscal measures and their actual implementation. In order to check for this possibility, we run Granger causality tests between the fiscal shocks estimated with the benchmark model and survey expectations about future policy actions and macro variables. The results do not support the hypothesis that fiscal shocks were anticipated.[16]

4 The effects of government consumption shocks

Figure 1 shows the response of the fiscal and macroeconomic variables to an exogenous shock (equal to 1% of private GDP) to government consumption.[17] In each panel the solid line represents the median response, while the dashed lines represent two sets of lower and upper bands, corresponding to the 5^{th}, 16^{th}, 84^{th} and 95^{th} percentiles of the distribution of the responses at each horizon, as commonly done in the literature.[18]

[16] As for survey expectations, we use the Consensus mean forecasts of ι) the annual growth rate of real GDP, private consumption, gross fixed investment, industrial production, consumer and producer prices, $\iota\iota$) unemployment rate (as percentage of labour force), current account and state sector budget balance, and $\iota\iota\iota$) 3 month Euro area interest rate and 10 year Italian government bond yield. Following Ramey (2008) and Kirchner et al. (2010), the fiscal shocks at time t are regressed on a constant, its own lag and the previous forecasts made in period $t-1$ for period t. The first and second panel of Table 4 summarize the results for the null hypothesis that the Consensus mean forecasts do not Granger cause the SVAR government consumption and net revenues shocks respectively; as the value for each possible predictor is below the 5% critical value (3.18), the null hypothesis cannot be rejected.

[17] We compute the Impulse Response Function (IRF) by: ι) simulating the system of equations (1) - (5) for as many periods as the desired horizon of the impulse responses excluding all structural shocks, $\iota\iota$) simulating the same system for the same number of periods but presuming a structural shock to the variable of interest. The difference between the simulation computed in ι) and $\iota\iota$) represents the response to the structural shock.

[18] We compute confidence bands for IRF by bootstrapping. After estimating equation (1) we obtain fitted residuals $\{\hat{u}_1, ..., \hat{u}_T\}$ normally distributed with zero mean and covariance matrix Ω. We draw errors from this distribution to simulate the system of equations (1) - (5) L times. For each draw we compute the IRF as described in the previous footnote. Finally, we collect the αth and $1-\alpha$th percentile across the L draws. In the simulation we set $L = 1000$.

4.1 The response of fiscal variables

Concerning the reaction of fiscal variables, two points are worth mentioning. The first is that the government consumption shock is largely short-lived, being equal to 0.1% of private GDP already after 5 quarters (thereafter, it further declines very slowly, reaching less than 0.05 after 8 quarters). The second is that the higher public consumption is fully financed by higher revenues; the latter increase in the fourth quarter by 0.31% of GDP and remain broadly constant for more than 1 year. This reaction emerges only when public debt is included in the specification: in this case net revenues increase by 0.21% of GDP on average in the first 3 years, while they decrease by 0.05% of GDP when debt is excluded.[19] The rise in net revenue is the main reason behind the absorbtion, within 3 years, of the initial surge in the debt.

4.2 The response of output

After a shock to public consumption, the response of private GDP is positive and highly significant for almost three years. The peak, reached at the fourth quarter, is equal to 0.45% of GDP. Positive and significant effects on economic activity of government consumption shocks represent a relatively common result of the VAR literature (e.g. Giordano et al. (2008), Perotti (2004), Mountford and Uhlig (2002) and Neri (2001)). The GDP response to government consumption is relatively small compared to standard textbook multipliers. This is due ι) to the fact that our analysis concerns only private GDP and $\iota\iota$) to the low persistence of the shock. To overcome these issues, we compute the cumulative multiplier (i.e., the ratio of the cumulative change in total GDP to the cumulative change in total government consumption)[20] charted in Figure 2. The median value is equal to 1.1 on impact, reaches its peak (2.7) after three years and declines gradually thereafter.

The response of private GDP is robust across alternative specifications of the model. Figure 3 shows the median response of private GDP to a government consumption shock in four alternative models. In the first, labeled "short-term interest rate", we consider the interest rate only on debt obligations with maturity shorter than one year. In the second, labeled "long-term interest rate", we use the gross yield on debt obligations with maturity longer than 3 years. In the third, "quadratic trend", the specification of the VAR includes a quadratic trend instead of a linear one; in the fourth, "government investment", we include government investment into

[19] For brevity's sake we do not report the simulations of the model when debt is excluded.

[20] Following Giordano et al. (2008), we compute total GDP in this context by adding the cash-based government consumption included in the model to private GDP.

our definition of government consumption.[21]

The results obtained with these alternative specifications confirm the hump-shaped pattern of private GDP and, apart from the "quadratic trend" specification for the quarters 6-10, they are well within the upper (95^{th} percentile) and lower (5^{th} percentile) bands of the GDP response in the benchmark specification.[22]

For a shock to government consumption, Figures 4 and 5 show the impact of including public debt and/or foreign demand in the model on, respectively, the medium value and accuracy of the response of private GDP. Compared to a 5-variable model which excludes both public debt and foreign demand, in our benchmark specification the response of private GDP is: ι) more persistent, as the effects are still positive after 4 years, instead of becoming negative already at the end of the third year; $\iota\iota$) estimated more accurately, as the confidence band of the response (i.e. the distance between the 95^{th} and the 5^{th} percentiles of the distribution) halves, on average; $\iota\iota\iota$) stronger, almost 3 times as large on average in the first 2 years. Adding the foreign demand to the model accounts for most of the improvement in the precision of estimates. This is not a surprise, given its major influence on Italian macroeconomic developments. The stronger response of private GDP largely reflects the inclusion of public debt. This result gives support to the argument by Favero and Giavazzi (2007) that omitting the reactions of budgetary variables to the level of debt can result in biased estimates of the effects of fiscal shocks. However, these reactions *per se* do not explain the larger effect on private GDP when debt is included. This is shown in Figure 6, which presents the median responses of the fiscal and macroeconomic variables in our benchmark specification (solid line) and in an alternative model without debt (dotted line): with the former specification the increase in net revenue shifts forward and it is more pronounced, while the expenditure shock drops to zero faster. A possible explanation for the higher multiplier is that the inclusion of debt leads to a more precise estimate of the exogenous fiscal shocks (as the endogenous reactions of fiscal variables to changes in debt are excluded).

The response of private GDP to a government consumption shock is also stronger and more precisely estimated than that reported in Giordano et al. (2008).[23]

[21] As additional robustness checks, we considered also model specifications in which ι) net revenues come first when identifying the shocks (in the benchmark model, government consumption is ordered first); $\iota\iota$) the reduced-form residuals of fiscal variables depend explicitly on the level of government debt and $\iota\iota\iota$) the average financial duration is set equal to 2 years instead of its end-of-sample value (5 years). We do not report these robustness checks, as estimates stay almost unchanged with respect to the benchmark specification.

[22] The lower impact on private GDP in the "quadratic trend" specification largely reflects the shorter persistence of the expenditure shock. The cumulative multiplier is very close to that for the benchmark specification.

[23] The greater precision can be ascribed to the inclusion of foreign demand in our model. The explanation of

We conclude this section splitting government consumption into its two main components, government spending on goods and services and public wages. In Figures 7 and 8 we report the IRF to government purchases on goods and services and to public wages respectively. In line with Giordano et al. (2008), we find that government purchases on goods and services have a larger impact on private GDP (0.49% on average in the first year) than government wages (0.25% private GDP on average in the first year).

4.3 The response of other macroeconomic variables and of GDP components

As Figure 1 shows, the reaction of inflation to a government consumption shock is not statistically significant. This is in line with the analyses by Marcellino (2006) and by King and Plosser (1985).[24] The response of interest rates is relatively small, hump-shaped and becomes statistically significant between the 4th and the 7th quarter. The existence of a positive relationship between interest rates and the level of government debt can be found in many empirical studies (see, e.g., Bernheim (1987, 1989), Gale and Orzag (2002), Miller and Russek (1996)).[25] The results for inflation and interest rates are robust across the alternative specifications described in section 4.2 with reference to Figure 3.[26]

To better understand the effects of fiscal shocks on the economic system we modify the benchmark specification along two directions. To assess the effects of fiscal shocks on a fundamental goal of budgetary policy, we include private employment as an additional variable in the VAR.[27] The response of employment is broadly consistent with that of private GDP; employment increases on impact and remains above its baseline level by 0.15 % during the first year; it drops gradually to zero in the following years.

In the second extension, we replace private GDP with private consumption and investment.

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the stronger effect on private GDP is less straightforward. Giordano et al. (2008) results (reported in page 727 of their paper) are based on a 6-variable model which, compared to our benchmark, includes private employment and excludes debt and foreign demand. If we examine a model which includes private employment, the larger effect on private GDP can be largely attributed to the extension of the sample from 2004:4 to 2010:2 and to the use of the new vintage of macroeconomic data; adding debt and foreign demand, the effects on private GDP do not sizeably change. If we exclude private employment from the model instead, sample and vintage effects are limited and the inclusion of debt in the model leads to a sizeable increase in the effect on private GDP.

[24] For a survey of the literature about the effect on prices of fiscal shocks, see Henry et al. (2004).

[25] For a survey of the literature about the effects of government debt on interest rates, see Engen and Hubbard (2004).

[26] Results not reported but available from authors.

[27] We do not report the IRF for this model; the results for the other variables are not significantly different from those of the benchmark specification.

As Figure 9 shows, the responses (expressed as a share of private GDP) of the two components of private GDP to a shock to government consumption are both positive and significant for almost two years. They are both hump-shaped, starting at about zero and reaching a peak after one year. The peak response is larger (0.35% of private GDP) for private consumption than for investment (0.19%), reflecting the relative size of the two variables.

4.4 Subsample stability and the Maastricht Treaty

To study the stability across time of the effects of government consumption shocks, we estimate our benchmark model over 8 rolling windows of 86 observations each,[28] starting from the period 1982:1-2003:2 and moving forward the sample by one year up to 1989:1-2010:2. Figure 10 shows that the median response of the fiscal and macroeconomic variables to a government consumption shock is relatively stable across subsamples, with the only limited exception of the reaction of interest rates, which is sizeably lower in the last two subsamples.

Although the response of private GDP shifts upward only slightly when we move forward our sample period, due to the lower persistence of the shock there is a sizeable upward shift in the cumulative multiplier starting from the 1987:1-2008:2 subsample, as shown in the left panel of Figure 11, which also includes three additional subsamples starting, respectively, in 90:1, 91:1 and 92:1, all ending in 2010:2. To provide a measure of the statistical significance of this shift, in the right panel of Figure 11 we report the averages of the cumulative multiplier and its lower confidence band (16^{th} percentile) for the first 5 subsamples and for the following 3 (we exclude the shorter subsamples). The greater effectiveness of fiscal policy may be related to a framework characterized by stronger fiscal discipline. Indeed, in the second half of the eighties policy-makers started to prioritize fiscal consolidation (Sartor (1998)) and this led to a steady improvement of the primary balance.

These indications are confirmed if we restrict our analysis to the post-Maastricht period, estimating the benchmark model using data from 1993:1 onwards.[29] The stability of public finances played a key role in shaping the institutional architecture of EMU and indeed we find a stronger debt-stabilizing reaction of expenditure and revenue after 1992 (see Appendix). Comparing the impulse response functions based on the post-Maastricht period (Figure 12) with those observed for the full sample (Figure 1) we find that: after 1992, government consumption shocks are much more short-lived than in the full sample period, as they drop to negative values

[28] We chose 86 observations, out of 114 in the full sample, as a compromise between two conflicting needs: obtaining precise estimates of the effects of fiscal shocks (especially those concerning the cumulative multipliers) and examining a sufficient number of subsamples to test the stability of estimates over time.

[29] Due to the limited amount of data before the 1993, we cannot estimate the benchmark specification before the structural break (as in, e.g. Boivin and Giannoni (2006)).

already in the second quarter; there is a much faster reabsorption of the debt and, consistently with the debt dynamics, interest rates do not increase; the positive effects on economic activity are slightly stronger than in the full sample analysis (the peak effect on private GDP equal to 0.51% of GDP, instead of 0.45%).

The greater effectiveness of fiscal policy for the period starting in 1993 is also shown in Figure 13, where the cumulative multiplier for the years following 1992 is reported. The high values of the multiplier have to be taken with caution, as their confidence bands are very large. The lack of accuracy in the estimates is due, in addition to the short time span, to the small value of the denominator of the multiplier (as already mentioned, the government consumption shock rapidly becomes negative).

5 The effects of net revenue shocks

Figure 14 shows the response of the fiscal and macroeconomic variables to an exogenous positive shock (equal to 1% of private GDP) to government net revenues, estimated over the full sample. This shock is even more short-lived than the government consumption shock examined in section 4.1, dropping to zero in the fourth quarter. The response of government consumption follows a hump-shaped pattern, reaching a peak of 0.17% of GDP after one year and also contributing to the reabsorption of the initial decrease of debt within three years.

The shock to net revenues has a negative effect on private GDP (the peak effect amounting to -0.21% of private GDP after one year), which is statistically significant between the fourth and the seventh quarter. The effect is smaller than in the case of an expenditure shock, in line with the findings of a large part of the empirical literature (see Table 3). This is also consistent with the idea that households decisions depend on permanent income, so that short-term changes in income (the revenue shocks we identify last only one quarter) have a limited effect on consumption.[30] Figure 15 illustrates the cumulative multiplier: its (negative) value plunges progressively, reaching its trough at -0.73 after three years and then it reverts slowly to zero.[31]

The response of private GDP is relatively robust to some alternative specifications (already described in section 4.2), as shown in Figure 16,[32] but not to the removal of debt from the model

[30]The relatively small effect has also to be assessed taking into account that the shock to net revenue is associated with an increase in government consumption, which partially offsets the impact on output of the revenue shock.

[31]We compute the cumulative multiplier for a net revenue shock as a ratio of the cumulative change in private GDP to the cumulative change in net revenue. We exclude from the latter the changes attributable to the dynamics of GDP, in order to make the results comparable to those of a shock to tax rates.

[32]The impact effect basically coincides in all those specification, and the trough effect ranges between -0.2%

(Figure 17);[33] in this case, we do not find a statistically significant effect on the economy, in line with Giordano et al. (2008), who did not consider this variable.

The response of interest rates is positive, but very small and statistically significant for a few quarters starting from the second year after the shock. This pattern seems to suggest that financial markets do not react to the initial decrease of debt, possibly because it is induced by higher taxes, but get concerned by its fast reabsorption induced by the response of government consumption.

As in the case of government consumption shocks, the rolling windows analysis for net revenue shock broadly indicates a subsample stability of the responses of budgetary and macroeconomic variables (Figure 18). However, restricting the analysis to the post-Maastricht period, both the negative effects on GDP and the positive ones on interest rates become not statistically significant.[34]

6 Conclusions and future research

In this paper we study the effects of fiscal policy on private GDP, inflation, private employment and interest rate using a Structural VAR approach and relying on quarterly cash-basis fiscal data for the Italian economy covering the period 1982:1-2010:2. Compared to Giordano et al. (2008), we introduce foreign demand and, modifying the methodology by Favero and Giavazzi (2007), public debt. Foreign demand is assumed to be exogenous and public debt is influenced by the other variables through a deterministic law of motion given by the government budget constraint.

The main results can be summarized as follows. The exogenous fiscal shocks which we estimate are largely transitory. Shocks to net revenue last one quarter, those to government consumption are more persistent, but after one year they wane to a tenth of their initial value. The initial debt surge (fall) following an expenditure (revenue) shock is fully absorbed over time: within 3 years in the full sample period, within less than 2 years in the post-Maastricht sample. A shock to government consumption induces, in our benchmark model, a positive effect on private GDP which is significant for two and a half years and robust to various alternative specifications. The peak effect, reached at the fourth quarter, is equal to 0.45% of private

and -0.24%.

[33] As in the case of expenditure shock (discussed in section 4.2) the change in the response of private GDP when debt is added to the model cannot be directly attributed to the dynamics of budgetary variables (government consumption is higher and revenue lower compared to the results based on a model which excludes debt); IRF not reported but available from authors.

[34] IRF not reported but available from authors.

GDP. Similar results are obtained when assessing separately shocks to wages and to purchases of goods and services; the effects on private GDP of the latter, however, are larger. Expenditure multipliers are higher when we examine subperiods starting after the middle of the eighties and, in particular, when we focus on the post-Maastricht period. These results are in line with the idea that the effects of fiscal stimulus on economic activity positively depend on the soundness of fiscal policy and, in particular, on expectations about future expenditure reversal (Corsetti et al. (2009)). Indeed, since the late eighties fiscal consolidation became the priority of Italian fiscal policy and we observe a more rapid reabsorption of the expenditure shock.

Interest rates increase significantly after an expenditure shock in the full sample, while they remain largely unaffected in the post-Maastricht period. These results may again reflect the different speed of debt reabsorption in the two periods, but also the lower volatility of the long-term yield on public debt in the post-Maastricht period[35] (which, again, may reflect the higher credibility of fiscal policies).

In the full sample analysis, net revenue shocks have a significant and negative effect on private GDP, although of small size. However, this result is not robust to some changes in the model specification and to restricting the sample to the post-Maastricht period. We are not surprised by this lack of robustness as a shock to net revenues (by construction) is the algebraic sum of all shocks to monetary transfers (positive and negative), each of them having specific effects on households' decisions. It seems therefore plausible that, depending on its composition, an increase in net revenues may have widely different effects on aggregate demand.[36,37] For the same reasons, results based on a VAR approach which lumps together different monetary transfers, should not be straightforwardly used to judge whether or not tax reliefs should be part of stimulus packages in a recession: the average effects of shocks to net revenues may be significantly different from those of, for example, tax reliefs (or transfers) targeted to credit-constrained households.

Our findings bring forth four methodological lessons. First, in the existing VAR literature

[35] We thank one anonymous referee for this comment.

[36] An extreme example of a net revenues surge that may have even boosted aggregate demand is the fiscal stimulus package adopted in Italy for 2009: it introduced two capital taxes, both on a voluntary basis - a feature which should have strongly limited their negative impact on private agents' consumption and investment decisions - using part of the revenue to boost monetary transfers targeted to unemployed workers - a measure likely to have a relatively strong impact on consumption (Hamburg et al. (2010)).

[37] Another possible reason for the lack of robustness has been pointed out by Perotti (2011). The author shows that in the approach by Blanchard and Perotti (2002) imposing that the discretionary and the endogenous components of changes in net revenues have the same effect on GDP generate impulse response functions biased towards zero if the constraint is not correct.

foreign demand is seldom included, possibly because the initial applications have been focusing on the U.S. economy, for which the assumption of its exogeneity to internal macro and fiscal variables does not hold. Our results, showing that the improvement in the accuracy of the estimates is very large, strongly speak in favor of the inclusion of foreign demand in the model, at least when data refer to a small open economy.

Second, our results for both expenditure and revenue shocks confirm for Italy the argument by Favero and Giavazzi (2007) that omitting the reactions of budgetary variables to the level of debt can result in incorrect estimates of the effects of fiscal shocks.

Third, we think that the very precise estimates that we obtain using cash-basis fiscal data may call into question the preference generally given by researchers to national accounts data when they assess the effects of fiscal shocks.

Fourth, as discussed above, the net revenue variable includes many components, each of them may have a different impact on aggregate demand. This suggests the need to analyze separately its main components. We leave this task to future research.[38]

Finally, we are aware that our empirical analysis falls short of addressing at least two further issues. The first concerns the possible asymmetry of the effects of fiscal shocks, depending on the cyclical conditions and/or the type of shock (positive or negative); the second is that fiscal multipliers may depend on the initial level of debt. We plan to apply a Markov-switching model in a future research to address these topics.

[38]Caldara (2011) shows that estimates of tax multipliers depend on the output elasticity of tax revenues. As its different components have specific output elasticity, this is another reason for analyzing separately net revenue components.

Appendix. The Maastricht Treaty as a fiscal structural break

In this section we test whether the Maastricht Treaty induced a structural break in the way government revenues and expenditures reacted to past levels of debt. Thus we estimate the following fiscal rules for government net revenues and consumption:

$$log(\frac{g}{y})_t = \sum_{i=1}^{k_1} \gamma_i^g log(\frac{g}{y})_{t-1} + \sum_{i=1}^{k_1} + \gamma_i^{g,y} log(y_{t-i}) + \sum_{i=1}^{k_2} \gamma_{g,d} d_{t-i} + \epsilon_t^g \tag{9}$$

$$log(\frac{t}{y})_t = \sum_{i=1}^{k_1} \gamma_i^t log(\frac{t}{y})_{t-i} + \sum_{i=1}^{k_1} \gamma_i^{t,y} log(y_{t-i}) + \sum_{i=1}^{k_2} \gamma_{t,d} d_{t-i} + \epsilon_t^t \tag{10}$$

Our benchmark specification includes a constant and a linear time trend, which we omit from (9)-(10) for notational convenience. According to this specification, each fiscal variable at time t is regressed on its own first k_1 lags, on the first k_1 lags of output and on the first k_2 lags of debt-to-GDP ratio. We test the null hypothesis that the parameters $\gamma_{g,d}$ and $\gamma_{t,d}$ are stable over time; in particular, given a structural date τ, equal to 1993:1, we estimate the system (9)-(10) before and after it. The likelihood ratio is equal to 4.8; as the chi-square cumulative distribution function at this value is equal to 0.97, we reject the null hypothesis of constant parameters.

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Table 1: Spending multipliers

	Sample period	Methodology	q1	q4	q8	q1 mult.	q4 mult.	q8 mult.	q1 cum. mult.	q4 cum. mult.	q8 cum. mult.	peak
USA												
Blanchard-Perotti (2002)	1947-1997	SVAR	$+^*$	$+$	$+^*$	$0.84-0.9$	$0.45-0.55$	$0.54-0.65$				0.9-1.3
Perotti (2004)	1960-1979	SVAR	$+^*$	$+$	$+^*$				1.13			1.6
Perotti (2004)	1980-2001	SVAR	$+$	$+$	-		$-^*$		0.31			0.5
Neri (2001)	1965-1996	SVAR	$+^*$	$+^*$	$-^*$	0.05	0.07	-0.01				0.075
Fatas and Mihov (2001)	1960-1996	SVAR	$+$	$+^*$	$+^*$	0.05	0.2	0.3				0.3
Gali et al. (2007)	1960-2003	SVAR	$+^*$	$+^*$	$+^*$	0.91	1.05	1.32				
Favero and Giavazzi (2007)	1960-1979	SVAR	$+^*$	$+$	$+^*$				0.06			
Favero and Giavazzi (2007)	1980-2006	SVAR	$+^*$	$+^*$	$+^*$				0.12			
Bruckner and Pappa (2010)	1975-2008	SVAR	$+^*$	$+$	$+^*$	0.7	0	0.15				
Burriel et al. (2010)	1981-2007	SVAR	$+^*$	$+^*$	$+^*$				0.76	0.91	0.67	
Ilzetzki et al. (2009)	1960-2007	SVAR	$+^*$	$+^*$	$+^*$				0.64			
Monacelli et al. (2010)	1954-2006	SVAR	$+^*$	$+^*$	$+^*$		1.21	1.54		1.16	1.50	1.6
Mountford and Uhlig (2002)	1955-2000	Sign restriction	$+$	$+$	$+$	0.65	0.27	-0.74				0.5
Edelberg et. al (1999)	1948-1996	Dummy variable	$+^*$	$+^*$	$+$	1.1	3.5	2				
Pappa (2009)	1970-1980	Sign restriction	$+^*$	$+^*$	$-$	0.22	0.37					
Pappa (2009)	1981-2007	Sign restriction	$+^*$	$+^*$	$-$	0.20	0.38					
Canova and Pappa (2007)	1969-1995	Sign restriction	$+^*$	$+$	$-$	0.3	0	-0.01				0.3
Ramey (2008)	1947-2003	Dummy variable	$+$	$-$	-	0.15	-0.25	-0.23			1.5	1.1
Germany												
Perotti (2004)	1960-1974	SVAR	$+^*$	$+^*$	-				0.41			1.7
Perotti (2004)	1975-1989	SVAR	$+$	$-^*$	-				0.40			0.8
Marcellino (2006)	1981-2001	SVAR	$+^*$	$-$	-							
Guntram et al. (2006)	1974-2004	SVAR	$+$	$+$	-				0.62	1.21	1.15	
France												
Marcellino (2006)	1981-2001	SVAR	$+$	$+$	-							
Italy												
Marcellino (2006)	1981-2001	SVAR	$-^*$	-	-							
Giordano et al. (2008)	1982-2004	SVAR	$+$	$+^*$	$+$	0.2^{**}	0.6^{**}	0^{**}	1.2	2.5	2.9	0.6
Spain												
Marcellino (2006)	1981-2001	SVAR	-	-	-							
de Castro and Hernandez de Cos (2006)	1981-2001	SVAR	$+^*$	$+^*$	$+^*$	0.1	0.25	0.1		1.31	1.33	
UK									$0.84-0.9$	$0.45-0.55$	$0.54-0.65$	
Perotti (2004)	1960-1979	SVAR	$+^*$	$-$	$+$				0.48			0.9
Perotti (2004)	1980-2001	SVAR	$+^*$	$-$	$+$				-0.22			-0.1
Pappa (2009)	1970-1980	Sign restriction	$+^*$	$+^*$	$-$	0.17	0.63					
Pappa (2009)	1981-2007	Sign restriction	$+^*$	$+^*$	$-$	0.09	0.76					
Bruckner and Pappa (2010)	1978-2008	SVAR	$+^*$	$-$	$-^*$	0.21	-0.05	-0.15				

Table 2: Spending multipliers [a] (concluded)

	Sample period	Methodology	q1	q4	q8	q1 mult.	q4 mult.	q8 mult.	q1 cum. mult.	q4 cum. mult.	q8 cum. mult.	peak
Japan												
Kuttner and Posen (2002)	1960-2000	SVAR	$+^*$	$+^*$	$+$				$0.84-0.9$	$0.45-0.55$	$0.54-0.65$	
Pappa (2009)	1970-1980	Sign restriction	$+^*$	$+^*$	$-$	0.20	0.30					
Pappa (2009)	1981-2007	Sign restriction	$+^*$	$+^*$	$-$	0.34	0.42					
Bruckner and Pappa (2010)	1978-2008	SVAR	$+^*$	-	-	0.4	0.0	-0.01				
EMU												
Canova and Pappa (2007)	1969-1995	Sign restriction	$+^*$	$+^*$		0.32	0	0.07				
Burriel et al. (2010)	1981-2007	SVAR	$+^*$	$+^*$	$+^*$				0.75	0.87	0.85	
Pool of countries												
High income countries: Ilzetzki et al. (2009)	1960-2007	SVAR	$+^*$	$+^*$	$+^*$	0.05	0.075	0.11	0.24	0.4	0.57	0.11
Developing countries: Ilzetzki et al. (2009)	1960-2007	SVAR	$+^*$	$+^*$	$+^*$	0.04	0.7	0.92	0.04	0.68	0.9	
debt/GDP $< 50\%$ *countries:* Ilzetzki et al. (2009)	1960-2007	SVAR	$-$	$+^*$	$+^*$	-0.015	0.05	0.04				
debt/GDP $> 50\%$ *countries:* Ilzetzki et al. (2009)	1960-2007	SVAR	$+^*$	$+^*$	$-$	0.06	0.0	0.03				
14 European Countries Beetsma et al. (2008)	1970-2004	SVAR	$+^*$	$+^*$	$+$	1.57	2					

Table 3: Net Revenue cut multipliers

	Sample period	Methodology	q1	q4	q8	q1 mult.	q4 mult.	q8 mult.	q1 cum. mult.	q4 cum. mult.	q8 cum. mult.	peak
USA												
Blanchard-Perotti (2002)	1947-1997	SVAR	$+^*$	$+^*$	$+^*$	$0.69 - 0.7$	$0.74 - 1.07$	$0.72 - 1.32$				0.8-1.3
Perotti (2004)	1960-1979	SVAR	$+^*$	$+^*$	$+^*$				0.69			1.1
Perotti (2004)	1980-2001	SVAR	$+^*$	$-^*$	$-^*$					-0.43**		0.2
Neri (2001)	1965-1996	SVAR	$+^*$	$+^*$	$+^*$	0.02	0.12	0.14				0.15
Favero and Giavazzi (2007)	1960-1979	SVAR		$-^*$	$-^*$	$-^*$				0.24		
Favero and Giavazzi (2007)	1980-2006	SVAR		$-$	$+$	$+$					0.007	
Burriel et al. (2010)	1981-2007	SVAR	$+^*$	$+^*$	$+^*$				0.02	0.06	0.35	
Mountford and Uhlig (2002)	1955-2000	Sign restriction	$+^*$	$+^*$	$+^*$				0	0	-0.33	0.4
Romer and Romer (2010)	1947-2005	Dummy variable	$+$	$+^*$	$+^*$		1.2	2.8			4.0	3.08
Canova and Pappa (2007)	1969-1995	Sign restriction	$+^*$	$-$	$-$	0.9	-0.05	-0.02				0.9
Germany												
Perotti (2004)	1960-1974	SVAR	$+^*$	$+^*$	$+^*$					-0.22		
Perotti (2004)	1975-1989	SVAR	$-$	$+^*$	$+$	$+^*$				0.02		
Marcellino (2006)	1981-2001	SVAR	$-$	$-$	-							
Guntram et al. (2006)	1974-2004	SVAR	$-$	-	-				0.08	0.38	0.85	
France												
Marcellino (2006)	1981-2001	SVAR	$+$	$+$	$+$							
Italy												
Marcellino (2006)	1981-2001	SVAR	-	$+$	$+$							
Giordano et al. (2008)	1982-2004	SVAR	$+$	$+$	$+$	0.05	0.12	0.12				
Spain												
Marcellino (2006)	1981-2001	SVAR	-	$+$	$+$							
de Castro and Hernandez de Cos (2006)	1981-2001	SVAR	$-$	$-$	-	-0.0	0.02	0.02				
UK												
Perotti (2004)	1960-1979	SVAR	$-^*$	$-$	$-^*$					0.10**		
Perotti (2004)	1980-2001	SVAR	$-^*$	$-$	$-^*$					-0.23**		
Japan												
Kuttner and Posen (2002)	1960-2000	SVAR	$+$	$+^*$	$+^*$							
Pool of countries												
EMU: Canova and Pappa (2007)	1969-1995	Sign restriction	$+^*$	$+^*$		0.4	0	0.04				
EMU: Burriel et al. (2010)	1981-2007	SVAR	$+^*$	$+^*$	$+$				0.79	0.63	0.49	

Table 4: Granger causality test

Government consumption shock	
Predictor	F-statistics
Annual growth rate of real GDP	0.0103
Annual growth rate of private consumption	0.0128
Annual growth rate of gross fixed investment	0.0005
Annual growth rate of industrial production	0.1175
Annual growth rate of consumer prices	0.0325
Annual growth rate of producer prices	0.0013
Unemployment rate	0.0031
Current account	0.0322
State sector budget balance	0.0016
3 month Euro area interest rate	0.0475
10 year Italian government bond yield	0.0033
Net Revenue shock	
Annual growth rate of real GDP	0.0545
Annual growth rate of private consumption	0.0442
Annual growth rate of gross fixed investment	0.0432
Annual growth rate of industrial production	0.0548
Annual growth rate of consumer prices	0.0534
Annual growth rate of producer prices	0.2189
Unemployment rate	0.0080
Current account	0.0269
State sector budget balance	0.1308
3 month Euro area interest rate	0.0103
10 year Italian government bond yield	0.0167

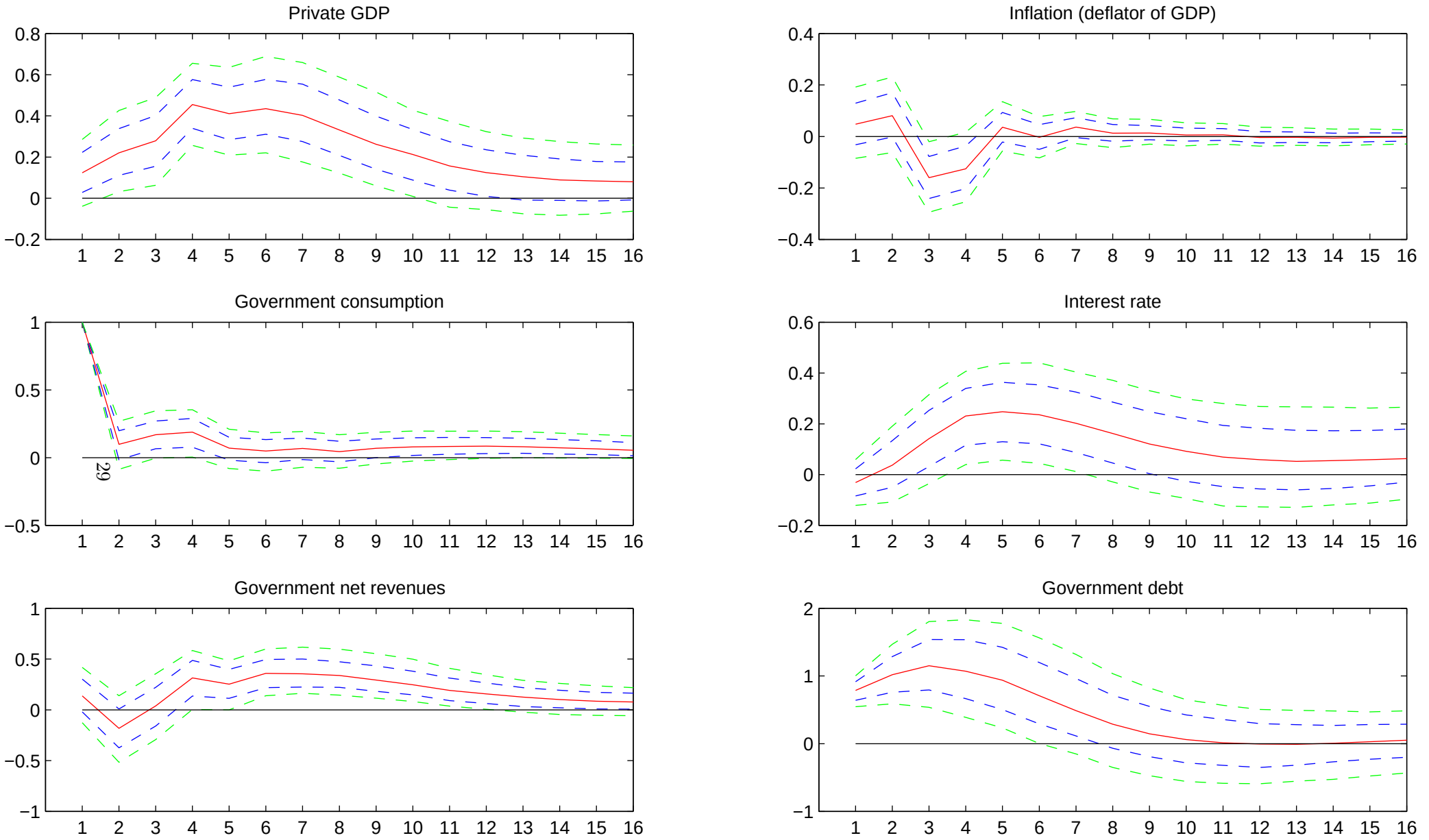


Figure 1: Impulse responses to a positive government consumption shock equal to 1% of private GDP: benchmark (5+2 variables) model. The curves represent the median and two sets of lower and upper bands, corresponding to the 5^{th}, 16^{th}, 84^{th} and 95^{th} percentiles of the distribution. Responses, except for inflation and interest rate, are deviations from the baseline and expressed in percentage points of GDP. Inflation and interest rate responses are deviations from the baseline and expressed in percentage points.

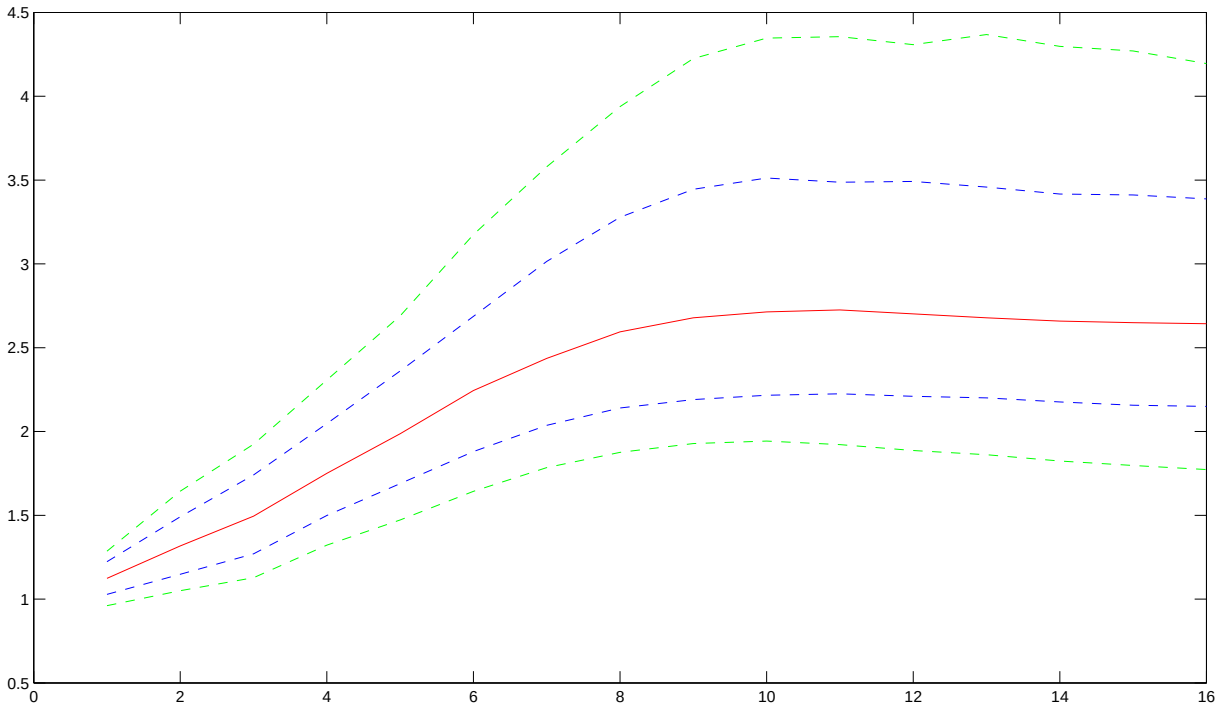


Figure 2: Cumulative multiplier of government consumption on GDP: benchmark (5+2 variables) model. The curves represent the median and two sets of lower and upper bands, corresponding to the 5^{th}, 16^{th}, 84^{th} and 95^{th} percentiles of the distribution.

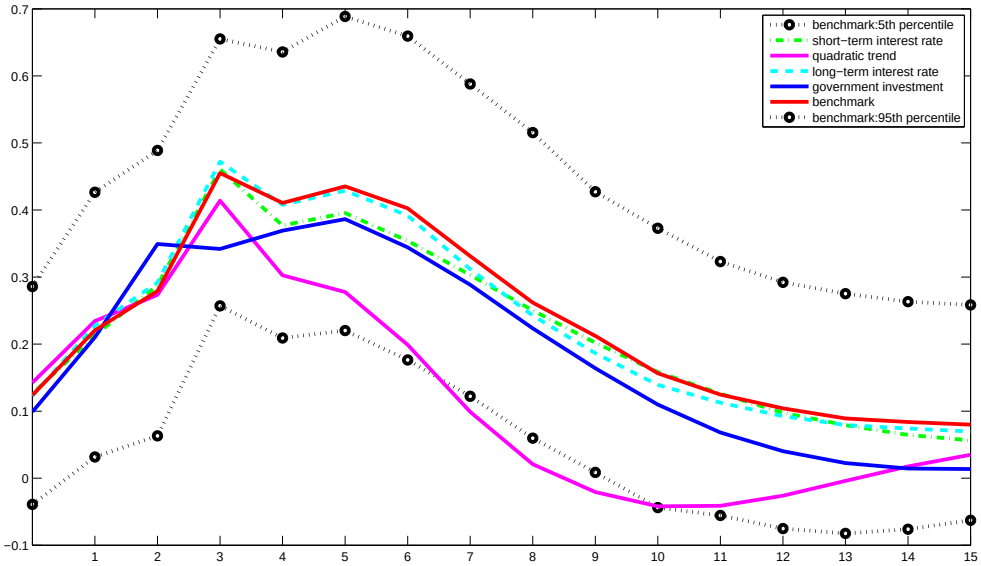


Figure 3: Effects on private GDP of a shock to government consumption (equal to 1% of private GDP): benchmark specification and alternative models (median values; % of GDP).

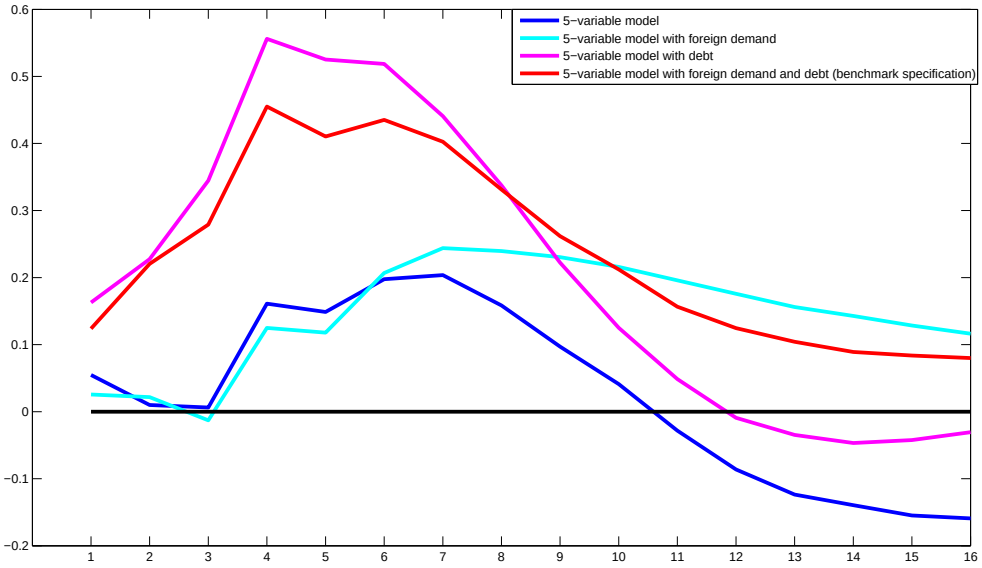


Figure 4: Effects on private GDP of a shock to government consumption (equal to 1% of private GDP): benchmark specification and alternative models which exclude debt and/or foreign demand (median values; % of GDP)

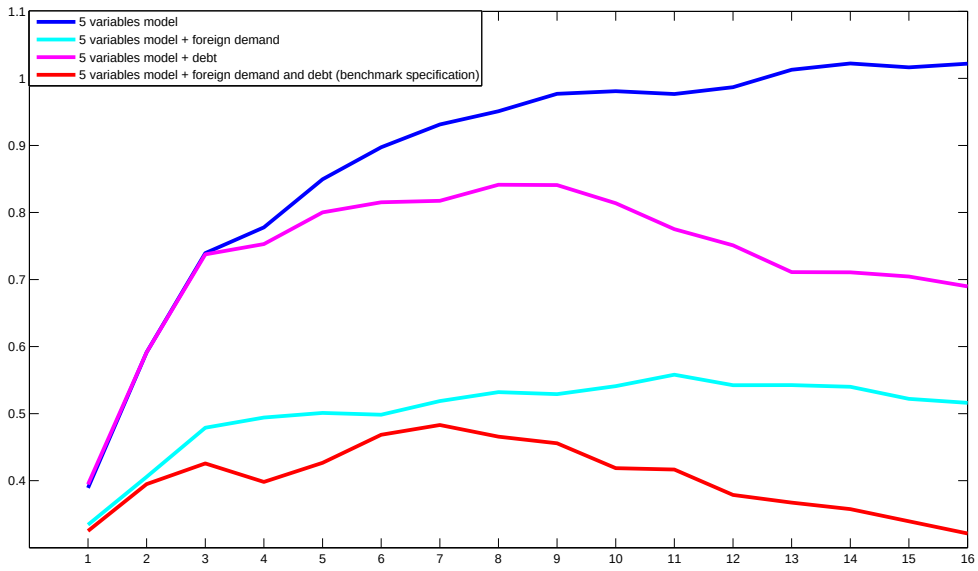


Figure 5: Size of confidence bands of the estimates of the effects on private GDP of a shock to government consumption equal to 1% of private GDP (difference between the 95^{th} and 5^{th} percentiles of the distribution of the private GDP responses; % of GDP): benchmark specification and alternative models which exclude debt and/or foreign demand.

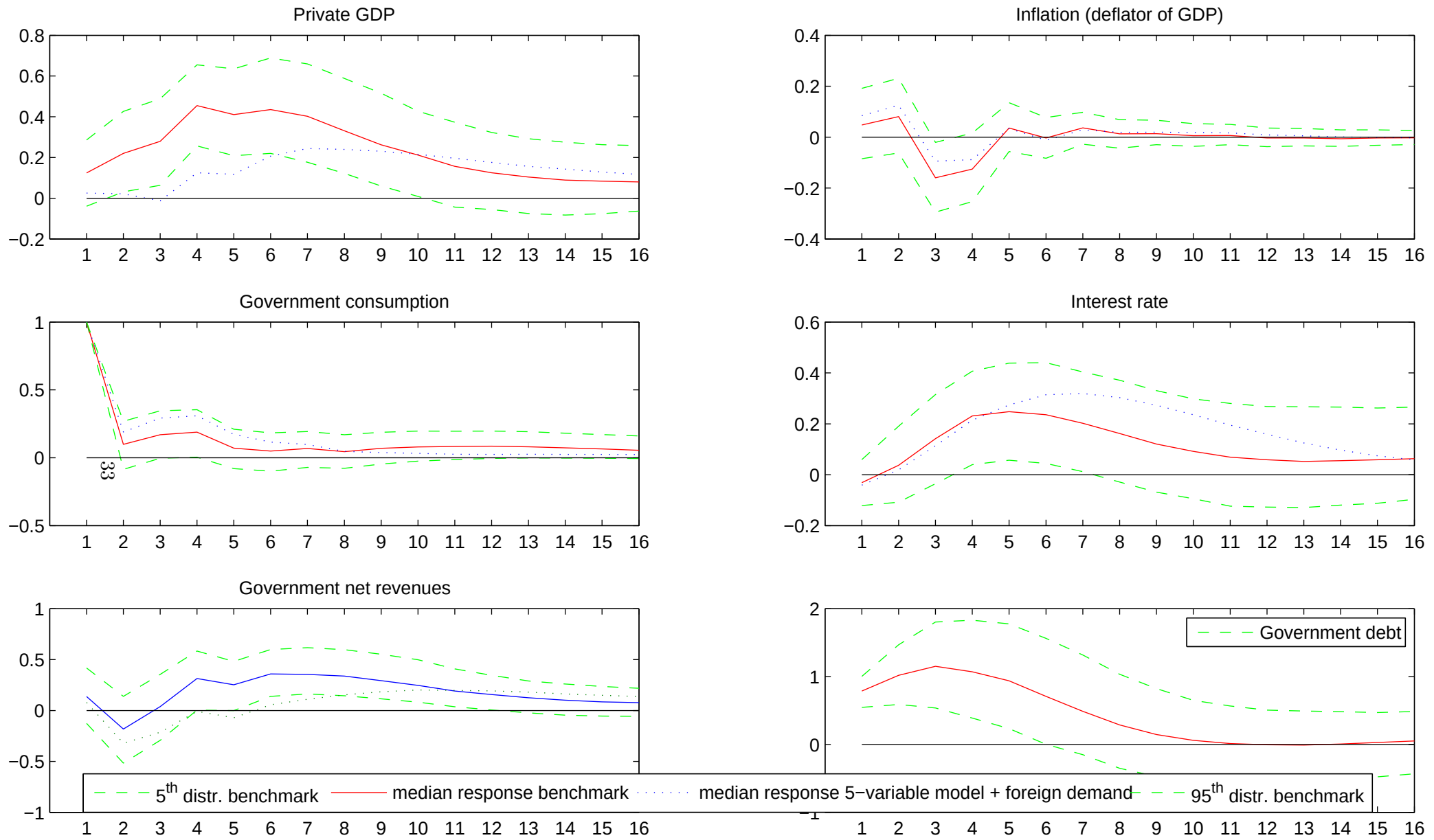


Figure 6: Impulse responses to a positive government consumption shock (equal to 1% of private GDP): median values of benchmark specification (solid line) and of (5+1 variables) model without debt (dotted line). The dashed curves represent the 5^{th} and 95^{th} percentiles of the distribution in the benchmark specification. Responses, except for inflation and interest rate, are deviations from the baseline and expressed in percentage points of GDP. Inflation and interest rate responses are deviations from the baseline and expressed in percentage points.

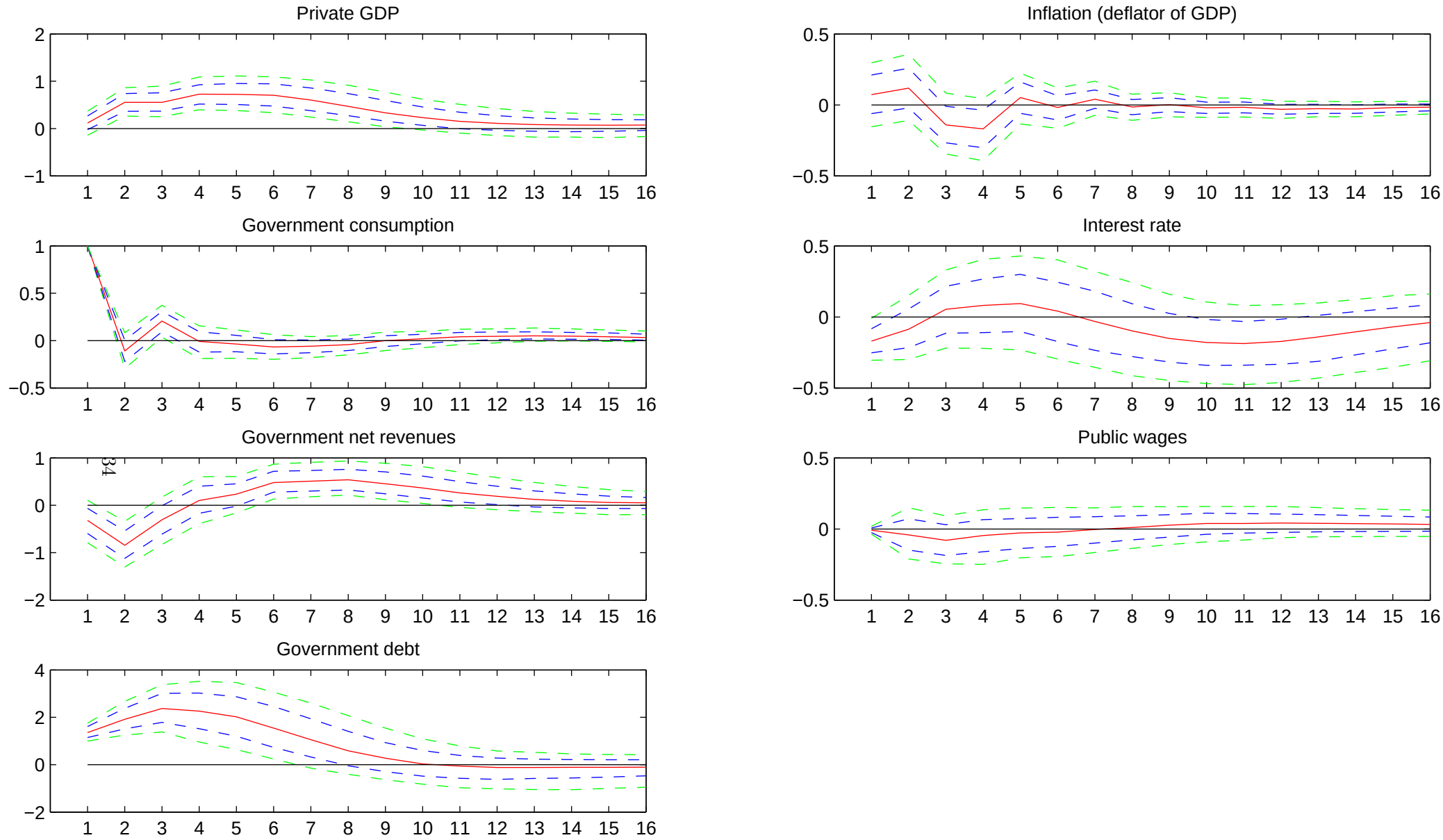


Figure 7: Impulse responses to a positive government purchases on goods and services shock equal to 1% of private GDP (Variant (6+2 variables) of the benchmark model with government purchases on goods and services and wages replacing government consumption). The curves represent the median and two sets of lower and upper bands, corresponding to the 5^{th}, 16^{th}, 84^{th} and 95^{th} percentiles of the distribution. Responses, except for inflation and interest rate, are deviations from the baseline and expressed in percentage points of GDP. Inflation and interest rate responses are deviations from the baseline and expressed in percentage points.

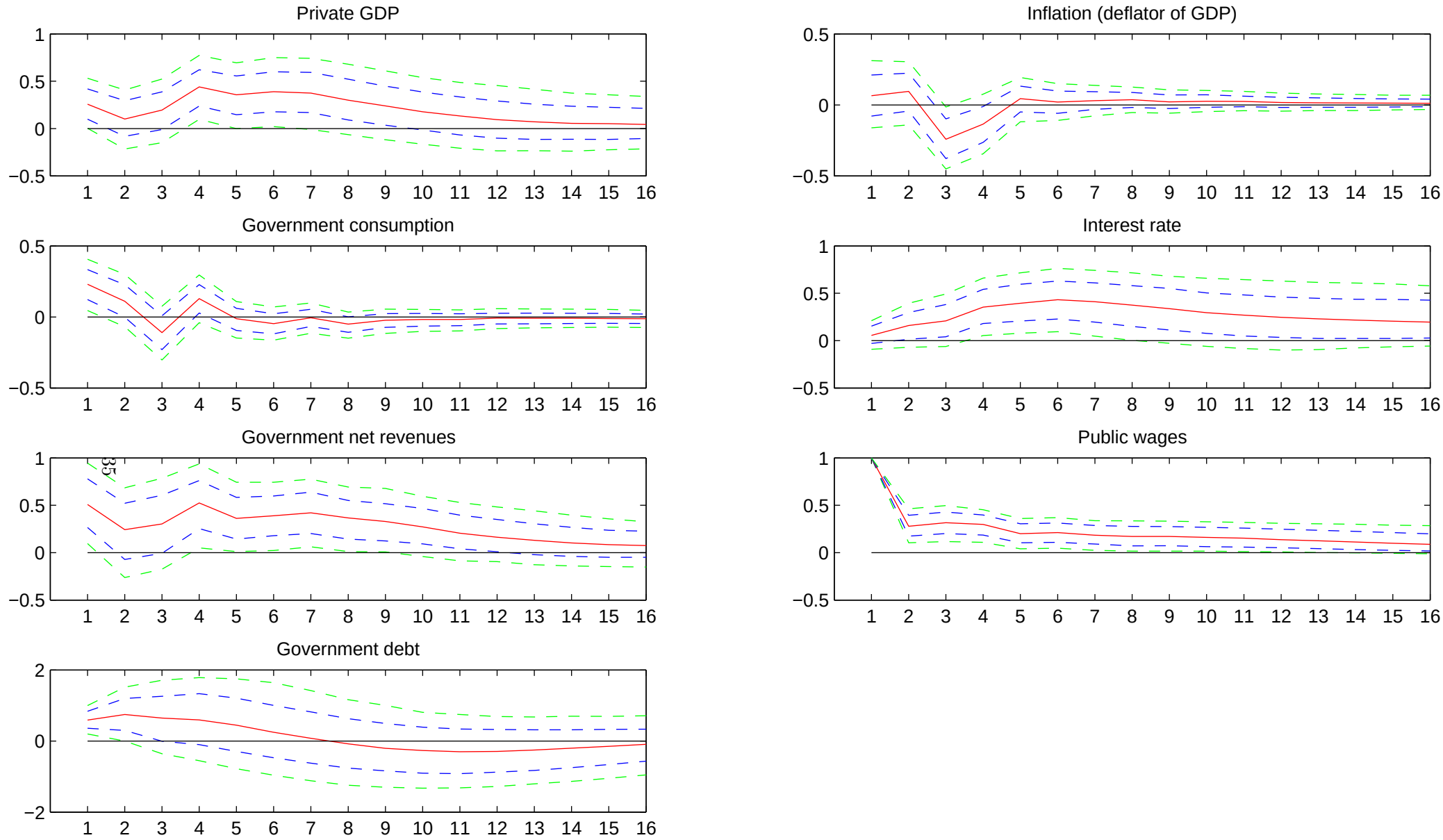
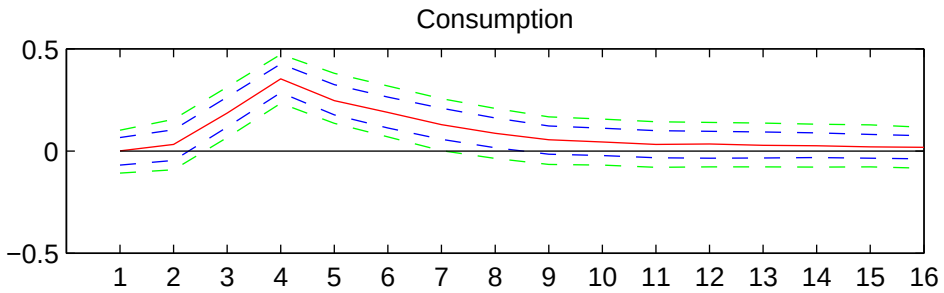
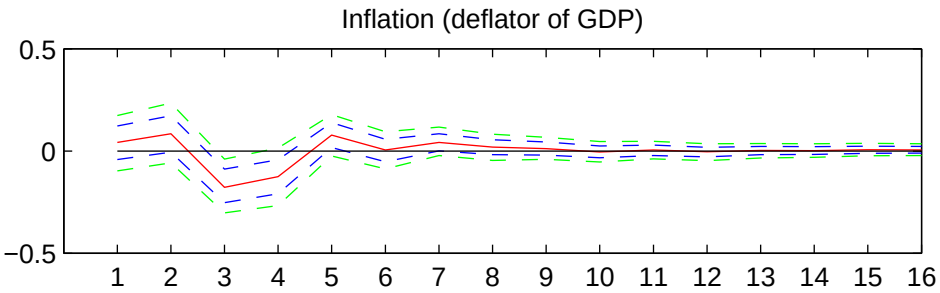
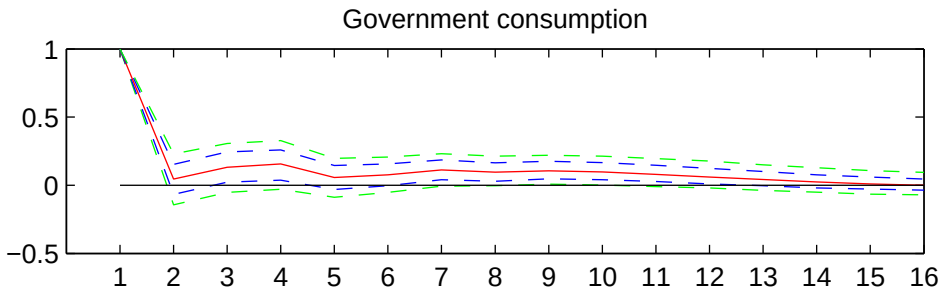
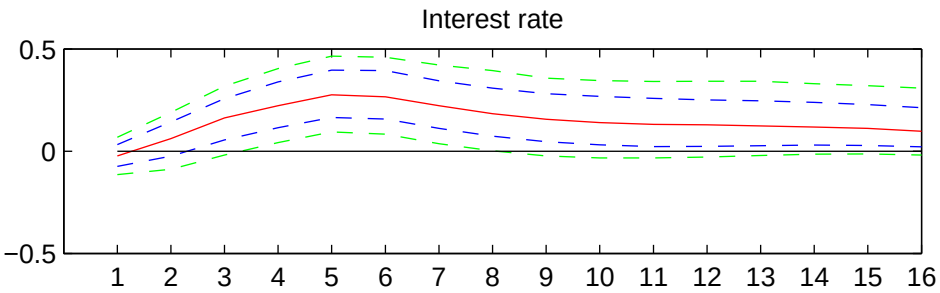


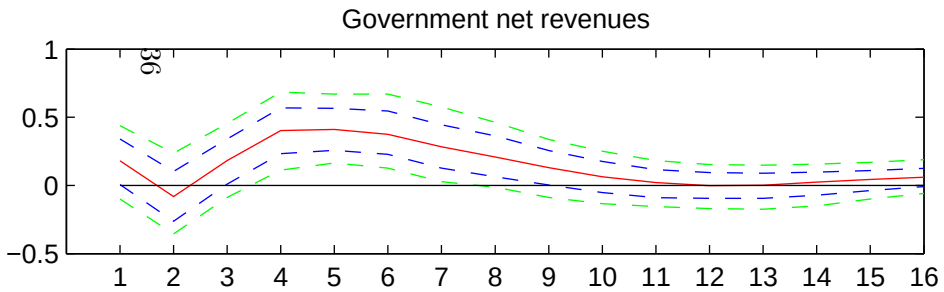
Figure 8: Impulse responses to a positive government wage shock equal to 1% of private GDP (Variant (6+2 variables) of the benchmark model with government purchases on goods and services and wages replacing government consumption). The curves represent the median and two sets of lower and upper bands, corresponding to the 5^{th}, 16^{th}, 84^{th} and 95^{th} percentiles of the distribution. Responses, except for inflation and interest rate, are deviations from the baseline and expressed in percentage points of GDP. Inflation and interest rate responses are deviations from the baseline and expressed in percentage points.

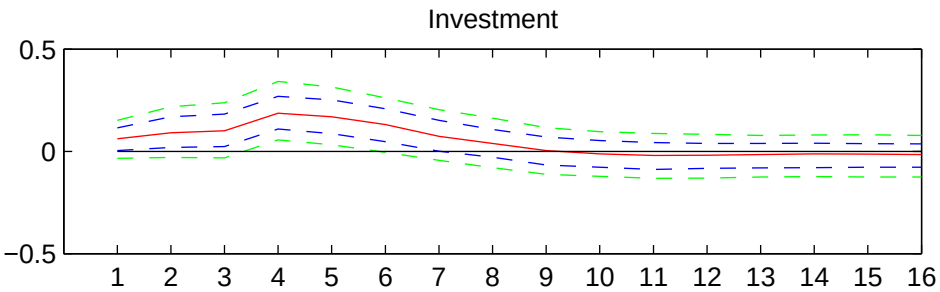












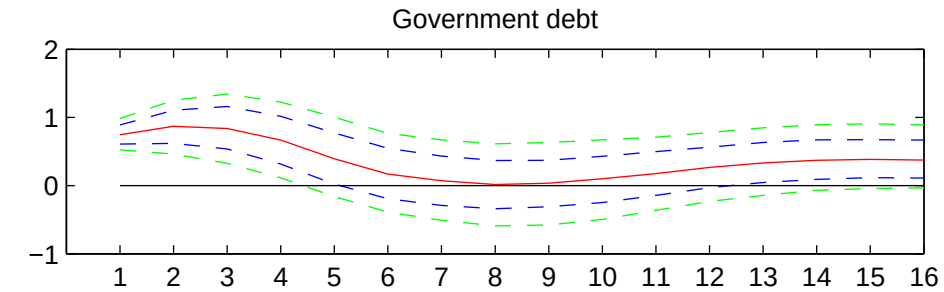


Figure 9: Impulse responses to a positive government consumption shock equal to 1% of private GDP (Variant of the benchmark model with private consumption and investment replacing private GDP). The curves represent the median and two sets of lower and upper bands, corresponding to the 5^{th}, 16^{th}, 84^{th} and 95^{th} percentiles of the distribution. Responses, except for inflation and interest rate, are deviations from the baseline and expressed in percentage points of GDP. Inflation and interest rate responses are deviations from the baseline and expressed in percentage points.

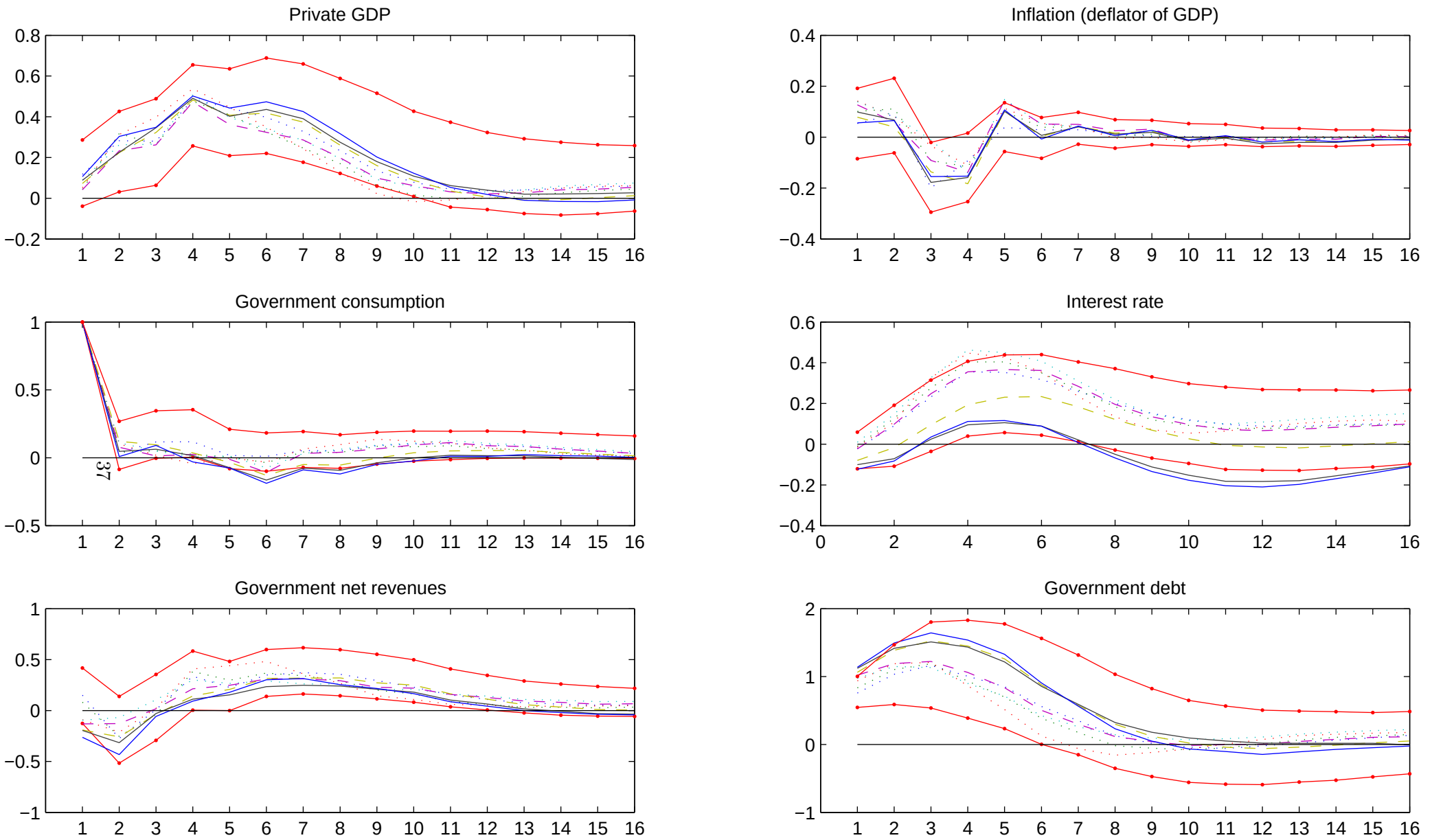


Figure 10: Median responses to a positive government consumption shock equal to 1% of private GDP: benchmark specification estimated over the subsamples 82-03, 83-04, 84-05, 85-06 (dotted lines), 86-07, 87-08 (dashed lines), 88-09, 89-10 (solid lines). Solid lines with bullets correspond to the 5^{th} and 95^{th} percentiles of the distribution of the benchmark specification estimated over the entire sample. Responses, except for inflation and interest rate, are deviations from the baseline and expressed in percentage points of GDP. Inflation and interest rate responses are deviations from the baseline and expressed in percentage points.

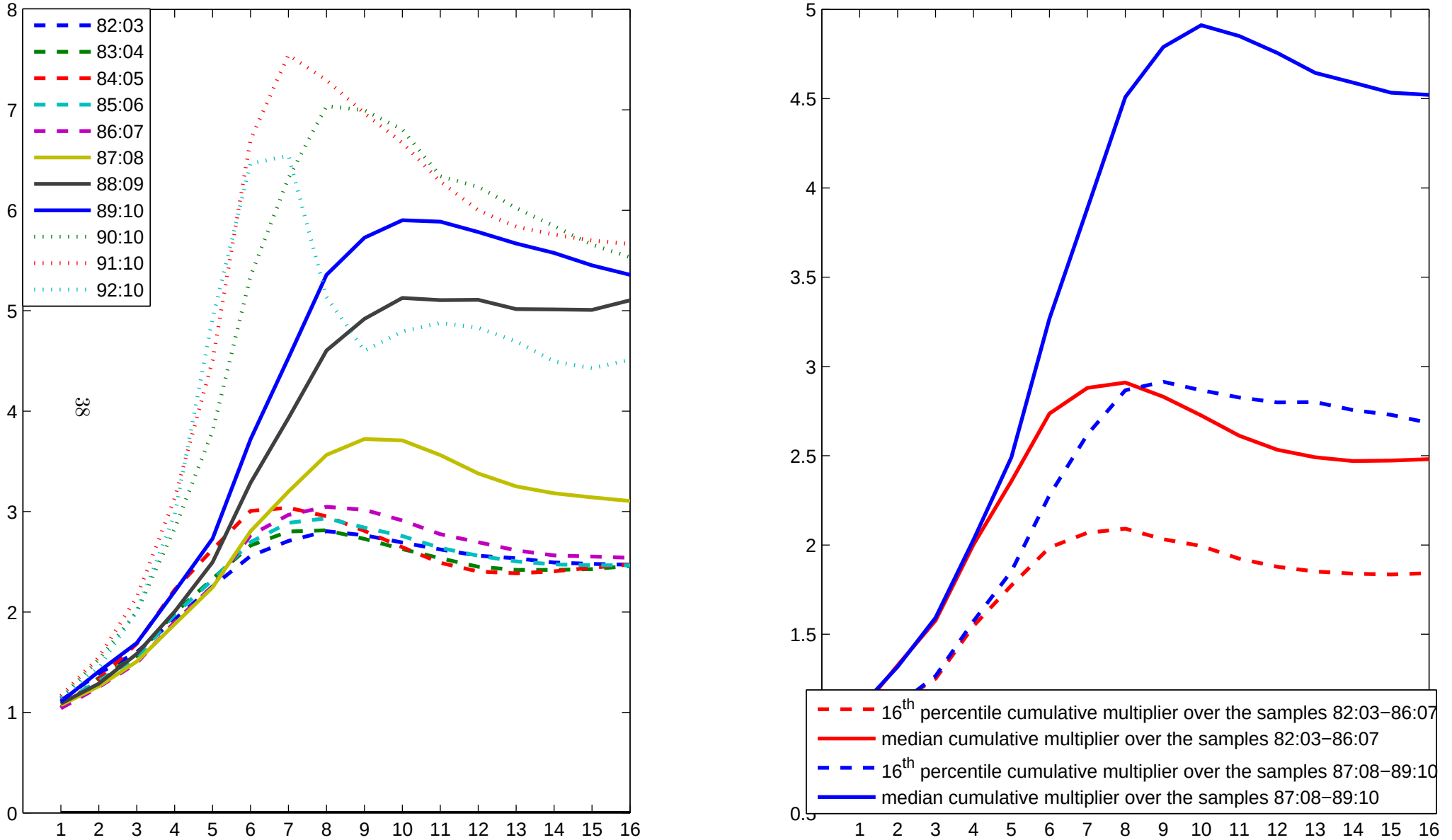


Figure 11: Cumulative multiplier of government consumption on GDP: benchmark specification estimated over the subsamples 82-03, 83-04, 84-05, 85-06, 86-07, 87-08, 88-09, 89-10, 90-10, 91-10, 92-10.

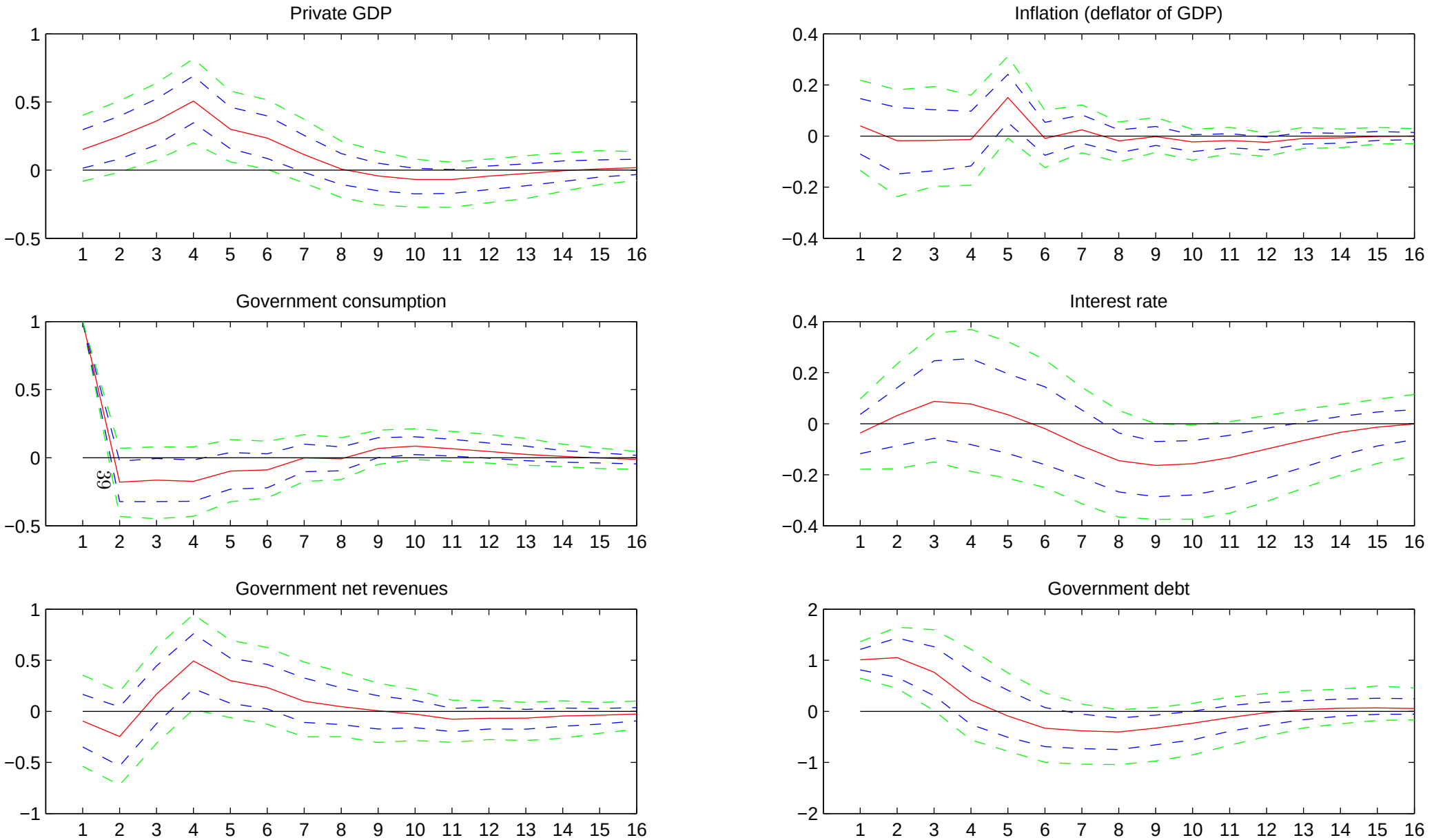


Figure 12: Impulse responses to a positive government consumption shock equal to 1% of private GDP: benchmark (5+2 variables) model estimated over the period 1993-2010. The curves represent the median and two sets of lower and upper bands, corresponding to the 5^{th}, 16^{th}, 84^{th} and 95^{th} percentiles of the distribution. Responses, except for inflation and interest rate, are deviations from the baseline and expressed in percentage points of GDP. Inflation and interest rate responses are deviations from the baseline and expressed in percentage points.

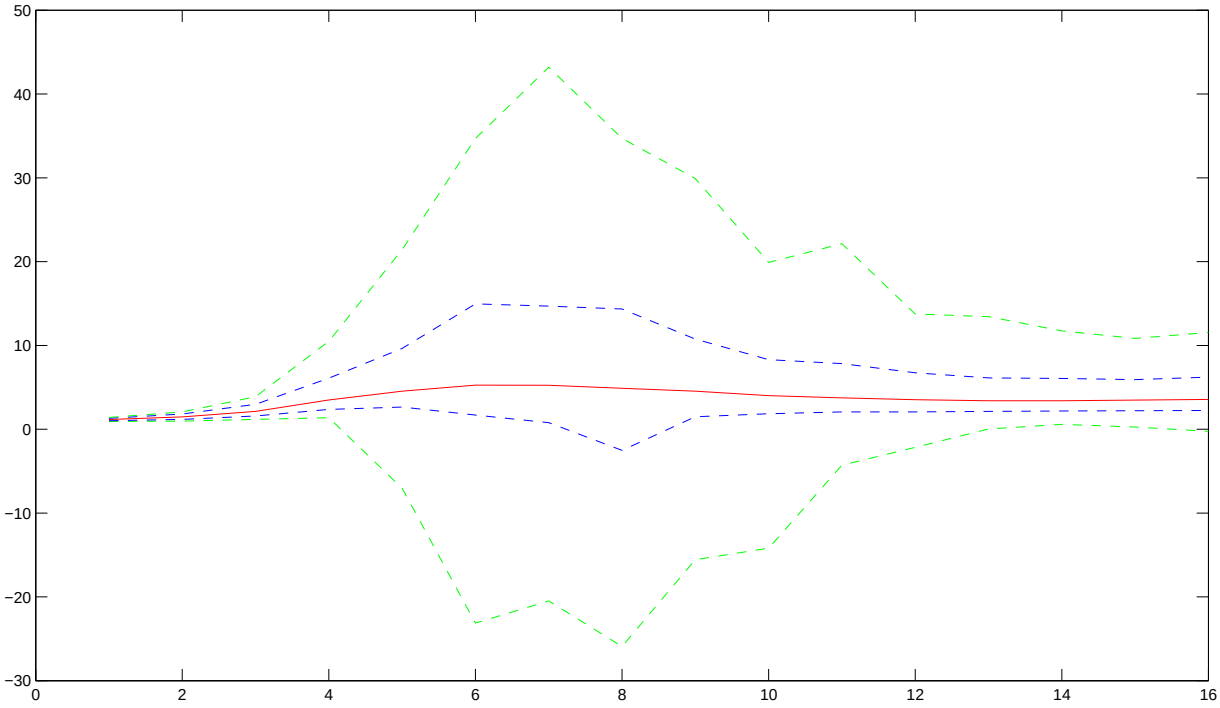


Figure 13: Cumulative multipliers of government consumption on GDP: benchmark (5+2 variables) model estimated over the period 1993-2010. The curves represent the median and two sets of lower and upper bands, corresponding to the 5^{th}, 16^{th}, 84^{th} and 95^{th} percentiles of the distribution line).

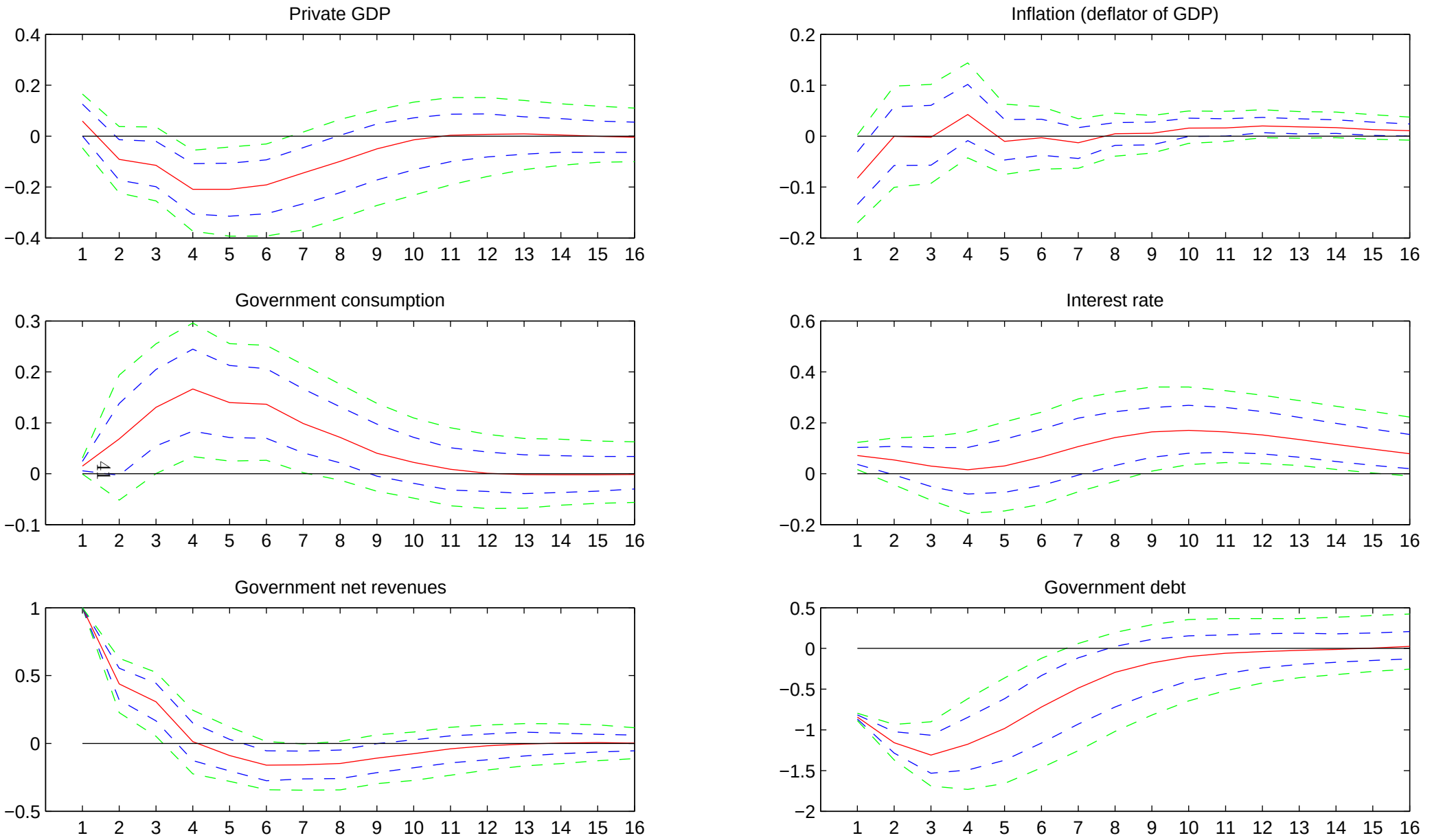


Figure 14: Impulse responses to a positive government net revenue shock equal to 1% of private GDP: benchmark (5+2 variables) model. The curves represent the median and two sets of lower and upper bands, corresponding to the 5^{th}, 16^{th}, 84^{th} and 95^{th} percentiles of the distribution. Responses, except for inflation and interest rate, are deviations from the baseline and expressed in percentage points of GDP. Inflation and interest rate responses are deviations from the baseline and expressed in percentage points.

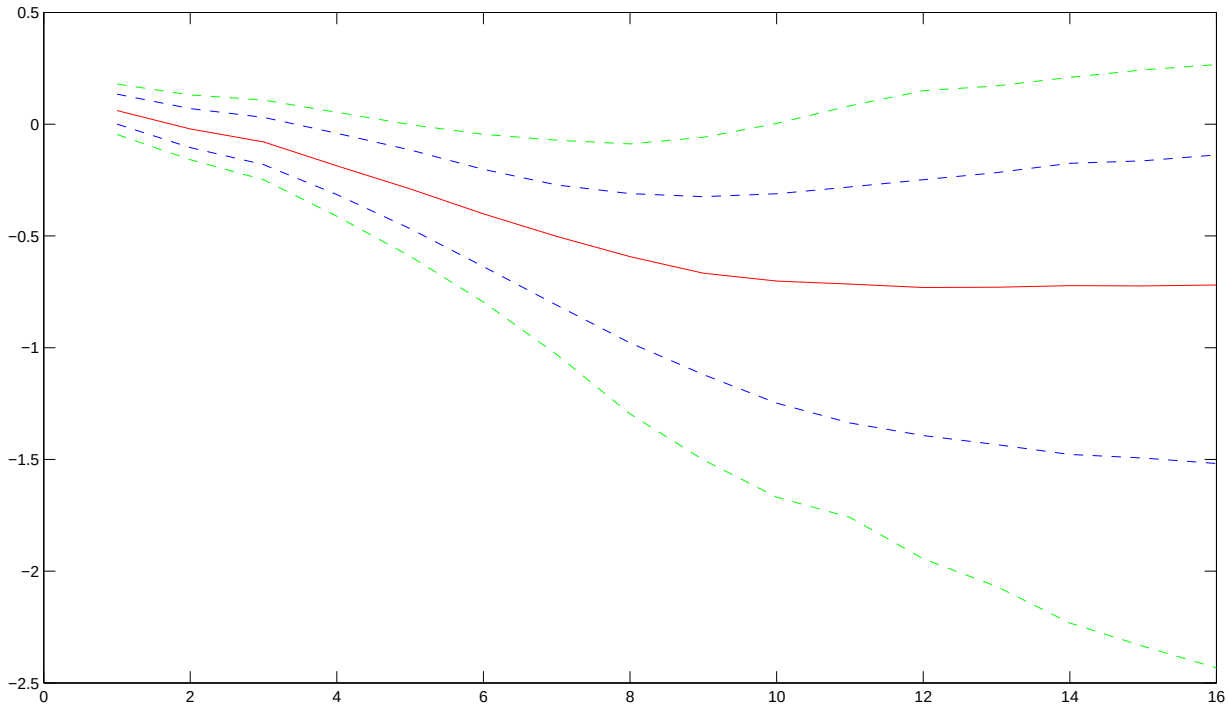


Figure 15: Cumulative multiplier of net revenue on GDP: benchmark (5+2 variables) model. The curves represent the median and two sets of lower and upper bands, corresponding to the 5^{th}, 16^{th}, 84^{th} and 95^{th} percentiles of the distribution.

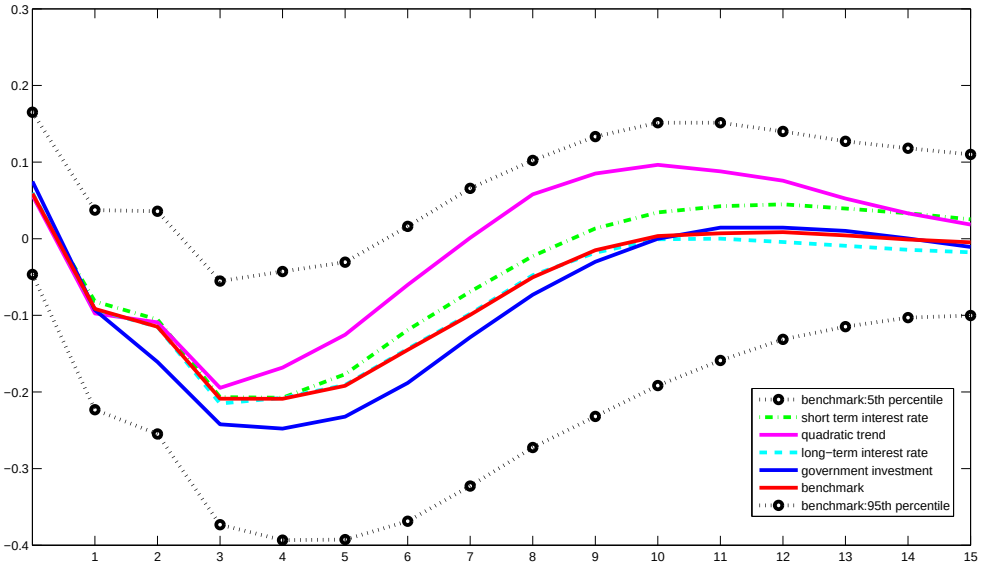


Figure 16: Effects on private GDP of a shock to net revenues (equal to 1% of private GDP): benchmark specification and alternative models (median values; % of GDP)

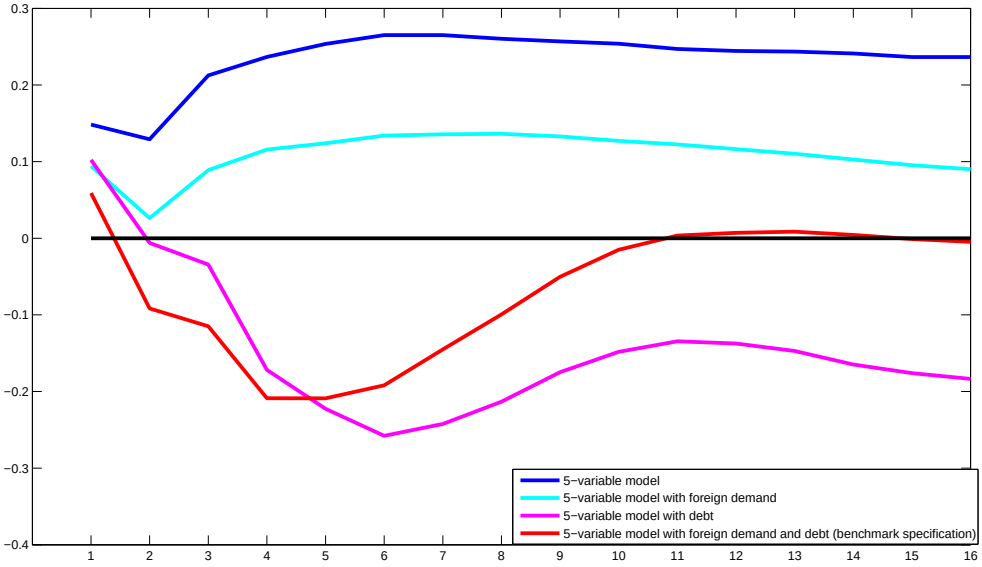


Figure 17: Effects on private GDP of a shock to net revenues (equal to 1% of private GDP): benchmark specification and alternative models which exclude debt and/or foreign demand (median values; % of GDP)

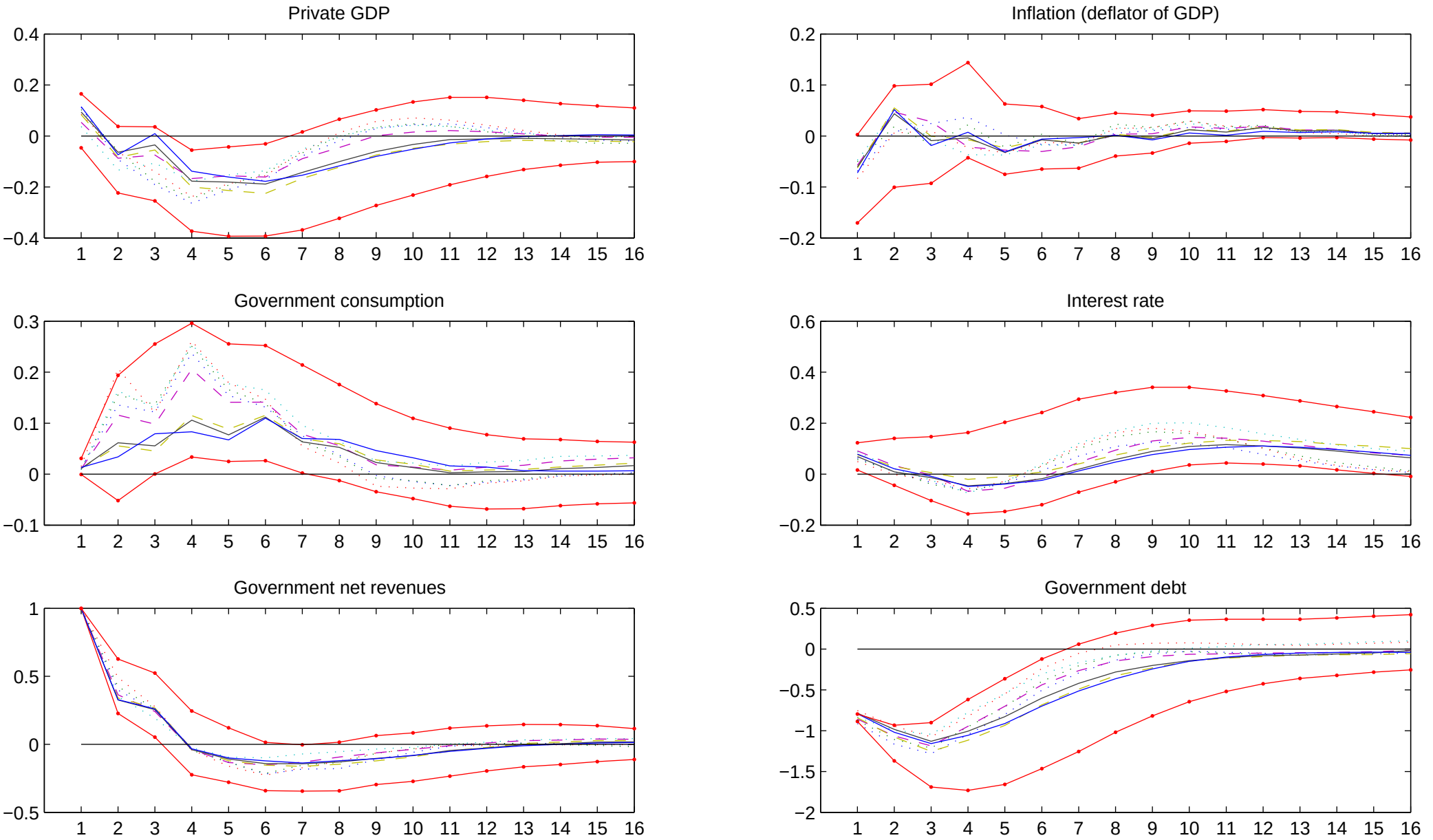


Figure 18: Median responses to a positive government net revenue shock equal to 1% of private GDP: benchmark specification estimated over the subsamples 82-03, 83-04, 84-05, 85-06 (dotted lines), 86-07, 87-08 (dashed lines), 88-09, 89-10 (solid lines). Solid lines with bullets correspond to the 5^{th} and 95^{th} percentiles of the distribution of the benchmark specification estimated over the entire sample. Responses, except for inflation and interest rate, are deviations from the baseline and expressed in percentage points of GDP. Inflation and interest rate responses are deviations from the baseline and expressed in percentage points.

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