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The Macroeconomic Effects of Fiscal Policy

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Abstract

We investigate the macroeconomic effects of fiscal policy using a Bayesian Structural Vector Autoregression approach. We identify fiscal policy shocks via a partial identification scheme, but also: (i) include the feedback from government debt (ii); look at the impact on the composition of output; (iii) assess the effects on asset markets (iv) use quarterly data; and (v) analyze empirical evidence from the U.S., the U.K., Germany, and Italy. The results show that government spending shocks, in general, have a small effect on GDP; lead to important "crowding-out" effects; have a varied impact on housing prices and generate a quick fall in stock prices. Government revenue shocks generate a mixed effect on housing prices and a small and positive effect on stock prices. The empirical evidence also suggests that it is important to explicitly consider the government debt dynamics in the model.

Keywords: fiscal policy, Bayesian Structural VAR, debt dynamics.
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1. Introduction

Compared to the large empirical literature on the effects of monetary policy on economic activity, fiscal policy has received less attention, a feature that contrasts with the public debates on its role. The government deficit and debt limits of the Stability and Growth Pact in the context of the Economic and Monetary Union (EMU), the possibility of independent institutions running fiscal policy, the creation of fiscal policy committees, the influence of regulation in the structure of market incentives, and the Balanced Budget Amendment in the U.S., are based on the assumption that fiscal policy can be an effective tool for stabilizing business cycles.

First, we consider the effects of fiscal policy on the composition of GDP, namely, by estimating the impact of government spending and government revenue shocks on private consumption and private investment as in Galí et al. (2007). Consequently, we are able to identify the potential "crowding-out" effects of fiscal policy on the private sector.

Second, we also ask how asset markets (via not only stock prices but also housing prices) are affected by fiscal policy shocks. Sounder fiscal positions, in particular when associated with a permanent fall in government debt, can have a strong impact on both stock market prices and long-term government bond rates (Ardagna, 2009). In addition, fiscal policy can have a major influence on housing markets, namely, via specific subsidies, other tax measures and its effects on household's disposable income. Therefore, we look at the persistence of the effects of fiscal shocks and assess whether the reaction of stock and housing prices is quantitatively similar or exhibits asymmetry instead.

We identify fiscal policy shocks using a recursive partial identification based on the work of Christiano et al. (2005), and estimate a Bayesian Structural Vector Autoregression (B-SVAR) model, therefore, accounting for the posterior uncertainty of the impulse-response functions.

Another novelty of the paper is that we explicitly include the feedback from government debt in our estimations. In fact, while equilibrium structural models are normally solved by imposing the government's intertemporal budget constraint, this does not happen with VAR-based fiscal policy models. We deal with this limitation by following Favero and Giavazzi (2008), and, as a result, we consider the response of fiscal variables to the level of the government debt.

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In addition, an important contribution of the paper is the use of quarterly fiscal data, which allows us to identify more precisely the effects of fiscal policies. We analyze empirical evidence from the U.S., the U.K., Germany, and Italy, respectively, for the periods 1970:3-2007:4, 1964:2-2007:4, 1980:3-2006:4, and 1986:2-2004:4. The set of quarterly fiscal data, is taken from national accounts (in the case of the U.S. and the U.K.) or computed by drawing on the higher frequency (monthly) availability of fiscal cash data (for Germany and Italy). To the best of our knowledge, such fiscal data set, apart from not having been compiled before, has not yet been used in this strand of economic modelling.

Broadly speaking, the results point to an expansionary effect of fiscal policy in the case of the U.S. and the U.K. in line with the traditional "Keynesian" model and corroborated by Blanchard and Perotti (2002). As for Italy and Germany, there is some evidence of a "Non-Keynesian" multiplier in accordance with the results of Giavazzi and Pagano (1990, 1996), Giudice et al. (2004), and Afonso (2010).

Interestingly, when one looks at the response of asset prices, the findings suggest that markets tend to interpret expansionary fiscal policies as leading to a deterioration of public finances. Therefore, stock prices react negatively to a rise of government spending and positively when there is fiscal consolidation. Nevertheless, while the reaction of stock prices is relatively quick, the effect on housing prices is, in general, persistent.

When we explicitly take into account the feedback from government debt in our framework, the effects of fiscal policy on (long-term) interest rates and GDP become more persistent and these variables are also more responsive to the shock.

The rest of the paper is organized as follows. Section two reviews the related literature. Section three explains the empirical strategy used to identify the effects of fiscal policy shocks, and to take into account the uncertainty regarding the posterior distribution impulse-response functions. Section four provides the empirical analysis and discusses the results. Section five concludes with the main findings and policy implications.

2. Literature

For the U.S., different approaches have been used in the identification of the fiscal policy shock. Ramey and Shapiro (1998) use a "narrative approach" to isolate political events, and find that, after a brief rise in government spending, nondurable

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consumption displays a small decline while durables consumption falls. Following the same approach, Edelberg et al. (1999) show that episodes of military build-ups have a significant and positive short-run effect on U.S. output and consumption, and that the sign of the response does not change when anticipation effects are taken into account. Fatás and Mihov (2001) and Favero (2002) use a Cholesky ordering to identify fiscal shocks and show that increases in government expenditures are expansionary, but lead to an increase in private investment that more than compensates for the fall in private consumption. Blanchard and Perotti (2002) use information about the elasticity of fiscal variables to identify the automatic response of fiscal policy, and find that expansionary fiscal shocks increase output, have a positive effect on private consumption, and a negative impact on private investment. More recently, using sign restrictions on the impulse-response functions and identifying the unexpected variation in government spending by a positive response of expenditure for up to four quarters after the shock, Mountford and Uhlig (2005) find a negative effect in residential and non-residential investment.[1]

Regarding other countries, Perotti (2004) investigates the effects of fiscal policy in Australia, Canada, West Germany, U.S. and the U.K., and finds a relatively large positive effect on private consumption and no response of private investment. Biau and Girard (2005) find a cumulative multiplier of government spending larger than one, and positive reactions of private consumption and private investment in France. For Spain, Castro and Cos (2008) report that, while there is a positive relationship between government expenditure and output in the short-term, in the medium and long-term expansionary spending shocks only lead to higher inflation and lower output. Heppke-Falk et al. (2006) use cash data for Germany, and find that a positive shock in government spending increases output and private consumption, although the effect is relatively small. Giordano et al. (2007) show that, in Italy, government expenditure has positive and persistent effects on output and on private consumption.

As for the empirical importance of housing over the business cycle, there are only a small number of papers that discuss the empirical link between economic policy and housing prices, the focus has mainly been on the effects of monetary policy. Some

[1] Giavazzi and Pagano (1990) and Alesina and Ardagna (1998) have uncovered the presence of "non-Keynesian effects" (i.e., negative spending multipliers) during large fiscal consolidations, with output rising significantly despite large cuts in government spending. Perotti (1999) also obtains such findings, but only in circumstances of "fiscal stress" (unusually high debt-to-GDP ratios). In addition, Afonso (2008b) finds some evidence of expansionary fiscal consolidations, for a few budgetary items (general government final consumption, social transfers, and taxes).

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examples are McCarthy and Peach (2002) and Chirinko et al. (2004). Iacoviello and Minetti (2003) emphasize the housing market as creating a credit channel for monetary policy. Iacoviello (2005) looks at the monetary policy-house price to consumption channel and finds a significant effect on house prices. Julliard et al. (2007) suggest that monetary policy contractions have a large and significantly negative impact on real housing prices, but the reaction is extremely slow. On the other hand, monetary policy shocks do not seem to cause a significant impact on stock markets.

In what concerns fiscal policy, it can impinge on housing market developments notably via subsidies and tax measures: taxation of the imputed rental value of the house, tax deductibility of interest payments, capital taxes on housing gains, and VAT on new houses. Given short-run inelastic housing supply, fiscal subsidies for buying houses may end up pushing up its demand and prices. On the other hand, and as mentioned for Italy by Jappelli and Pistaferri (2007), tax deductibility of interest rates may not have affected much the demand for mortgage debt. In addition, sounder fiscal positions and lower sovereign financing needs allow for lower interest and better financing conditions for mortgage-loans, while higher government indebtedness can crowd-out resources available to would be home-owners (Maclennan et al., 1999).

In the case of stock prices the attention has been normally targeted towards the role played by monetary policy. Rigobon and Sack (2002, 2003) and Craine and Martin (2003) use a heteroskedasticity-based estimator and find a significant response of the stock market to shocks in the interest. Bernanke and Kuttner (2005) show that a hypothetical unanticipated 25-basis-point cut in the Federal funds rate target is associated with about a 1% increase in broad stock indexes. More recently, Ardagna (2009) reports that fiscal adjustments based on expenditure reduction and signalling sounder fiscal behaviour are related with increases in stock market prices. Using a panel of OECD countries, the author also shows that fiscal consolidation that lead to a permanent and substantial fall in government debt are linked to a stronger increase in stock market prices.

In terms of interest rates, according to Gale and Orszag (2003) there are two important reasons for why budget deficits may raise nominal interest rates: (i) they reduce aggregate savings when private savings do not increase by the same amount (no Ricardian equivalence) and if there are no compensating foreign capital inflows, which leads to a decrease in the supply of capital; and (ii) they increase the stock of government debt and, consequently, the outstanding amount of government bonds

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(relative to other financial assets). In this case, there is a "portfolio effect", as a higher interest rate on government bonds would be required in order to incentive investors to hold the additional bonds.

While some studies find that interest rates tend to increase after a rise in the deficit, others do not (Engen and Hubbard, 2004). The empirical findings seem to depend on whether expected or current budget deficits are used as explanatory variables (Upper and Worms, 2003; Brook, 2003; Laubach, 2009), and also on whether yield differentials in Europe with respect to Germany (Codogno et al., 2003) or interest rate swap spreads are used as the dependent variable (Goodhart and Lemmen, 1999; Afonso and Strauch, 2007).

For Europe, the existing evidence points either to a significant (although small) effect (Bernoth et al., 2003; Codogno et al., 2003; Afonso and Strauch, 2007; Faini, 2006), or to the absence of impact (Heppke-Falk and Hüfner, 2004). For the U.S., the effect seems to be substantially larger (Gale and Orszag, 2002). For OECD countries, Ardagna (2009) shows that long-term government bond rates fall in periods of budget consolidation and rise when the fiscal position deteriorates.

3. Modelling strategy

The modelling strategy adopted consists in the estimation of the following Structural VAR (SVAR)

$$\underbrace{\Gamma(L)}_{n\times n}\underbrace{X_t}_{n\times 1} + \gamma_i d_{t-1} = \Gamma_0 X_t + \Gamma_1 X_{t-1} + \ldots + \gamma_i d_{t-1} = c + \varepsilon_t \qquad (1)$$

$$d_t = \frac{(1+i_t)}{(1+\pi_t)(1+\mu_t)} d_{t-1} + (g_t - t_t) \qquad (2)$$

$$v_t = \Gamma_0^{-1}\varepsilon_t \ , \qquad (3)$$

where $\varepsilon_t \mid X_s, s < t \sim \mathrm{N}(\underline{0}, \Lambda)$, *Γ(L)* is a matrix valued polynomial in positive powers of the lag operator *L*, *n* is the number of variables in the system, ε_t are the fundamental economic shocks that span the space of innovations to X_t, and v_t is the VAR innovation, $d_t := B_t/(P_t Y_t)$, $d_{t-1} := B_{t-1}/(P_{t-1}Y_{t-1})$, $g_t := G_t/(P_t Y_t)$, and $t_t := T_t/(P_t Y_t)$.

Equation (2) refers to the government's intertemporal budget constraint, and i_t, G_t, T_t, π_t, Y_t, P_t, μ_t and d_t represent, respectively, the interest rate (or the average cost of debt refinancing), government primary expenditures and government revenues,

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inflation, GDP, price level, real growth rate of GDP, and the debt-to-GDP ratio at the beginning of the period *t*.

Following Favero and Giavazzi (2008), this specification includes the feedback from government debt, an assumption that is potentially important in the determination of the effects of fiscal policy shocks for a number of reasons. First, when fiscal authorities care about the stabilization of debt, government revenue and government spending need to adjust accordingly. Second, the debt dynamics may influence interest rates as they depend on future expected monetary policy and the risk premium. Third, debt may not be neutral and have an impact on inflation and output (Barro, 1974; Kormendi, 1983; Canzoneri et al., 2001, Afonso, 2008). Therefore, it is important to allow for the fact that government revenues, government spending, real GDP growth, inflation and the interest rate are linked by the government intertemporal budget constraint.

Fiscal policy is characterized as follows:

$$G_t = f(\Omega_t) + \varepsilon_t^G \tag{4}$$

$$T_t = g(\Omega_t) + \varepsilon_t^T \tag{5}$$

where, G_t is the government spending, T_t is the government revenue, f and g are linear functions, Ω_t is the information set, and ε_t^G and ε_t^T are, respectively, the government spending shock and the government revenue shock. The shocks ε_t^G and ε_t^T are orthogonal to the elements in Ω_t.

We follow a recursive identification scheme and assume that the variables in X_t can be separated into 3 groups: (i) a subset of n_1 variables, X_{1t}, whose contemporaneous values appear in the policy function and do not respond contemporaneously to the fiscal policy shocks; (ii) a subset of n_2 variables, X_{2t}, that respond contemporaneously to the fiscal policy shocks and whose values appear in the policy function only with a lag; and (iii) the policy variables in the form of government expenditure, G_t, and/or government revenue, T_t.

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The recursive assumptions can be summarized by $X_t = [X_{1t}, G_t, T_t, X_{2t}]'$ and

$$\Gamma_0 = \begin{bmatrix} \underbrace{\gamma_{11}}_{n_1 \times n_1} & \underbrace{0}_{n_1 \times 2} & \underbrace{0}_{n_1 \times n_2} \\ \underbrace{\gamma_{21}}_{2 \times n_1} & \underbrace{\gamma_{22}}_{2 \times 2} & \underbrace{0}_{2 \times n_2} \\ \underbrace{\gamma_{31}}_{n_2 \times n_1} & \underbrace{\gamma_{32}}_{n_2 \times 2} & \underbrace{\gamma_{33}}_{n_2 \times n_2} \end{bmatrix}. \tag{6}$$

The two upper blocks of zeros correspond, respectively, to the assumptions that the variables in X_{1t} do not respond to the fiscal policy shock either directly or indirectly. This approach delivers a correct identification of the fiscal policy shock but not of the other shocks in the system.[2] In practice, we include in our system the same variables as in Christiano et al. (2005), but also add housing price among the X_{1t} variables, that is, we allow the policy authority to react contemporaneously to changes in the housing market. We also include the stock market index and the exchange rate in X_{2t}.

The identification procedure adopted in this paper is closer in spirit to Fatás and Mihov (2001), who use a Cholesky ordering to capture the unexpected variation in fiscal policy. In contrast, Afonso and Sousa (2009) identify the potential impact of fiscal policy on asset prices, by using a Fully Simultaneous System approach in a Bayesian framework. Nevertheless, the empirical findings deliver qualitatively similar results, which allows one to be confident on their robustness. Finally, we assess the posterior uncertainty about the impulse-response functions by using a Monte Carlo Markov-Chain (MCMC) algorithm.

4. Empirical analysis

4.1 Building the data set

We use quarterly data for four countries: U.S., U.K., Germany and Italy. All the variables are in natural logarithms unless stated otherwise.[3]

For the identification of the fiscal policy shocks, the variables in X_{1t} - the ones predetermined with respect to fiscal policy innovations - are GDP, private consumption, GDP deflator, and private investment. To these variables, we add for the housing price

[2] Since the fiscal policy shock is identified regardless of the ordering restrictions among the non-policy variables, we can put arbitrary *0s* in the non-policy blocks of Γ_0 in order to obtain *(n-1)n/2* linearly independent restrictions and to get consistent impulse-responses (Christiano et al, 1999). As a result, the Choleski decomposition emerges as a particular case, where the restrictions are imposed such that Γ_0 becomes a lower triangular matrix.

[3] A detailed description is provided in Afonso and Sousa (2009).

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index (or the median sales price of new houses sold, in the case of the U.S.), the housing starts (only for the U.S.), and the average cost of government debt financing (or the yield to maturity of long-term government bonds). The variables in X_{2t} – the ones allowed to react contemporaneously to fiscal policy shocks – are the S&P500 Index (for the U.S.), the FTSE-All Shares Index (for the U.K.), and the MSCI index (for Germany and Italy). As measure of the fiscal policy instruments we use either the government expenditures (in which case, the government revenues are included in X_{1t}) or the government revenues (in which case, the government expenditures are included in X_{1t}). We include a constant (or quarterly seasonal dummies), and the government debt-to-GDP ratio in the set of exogenous variables. For Germany, we also consider two dummies: (i) one dummy for 1991:1, corresponding to the German reunification; and (ii) another dummy for 2000:3, to capture the spike in government revenue due to the sale of UMTS (Universal Mobile Telecommunications System) licenses.

Due to limitations of the data, housing starts are included only in the U.S., and among the set of variables included in the SVAR, the average government debt cost servicing deserves a special attention. Therefore, we obtain the average implicit interest rate by dividing the net interest payments by the government debt at time $t-1$.

The quarterly fiscal data refers to the Federal Government spending and revenue in the case of the U.S.A., and the Public Sector spending and revenue in the case of the U.K. In both cases, quarterly fiscal data is available directly from national accounts. As for Germany and Italy, we compute the quarterly series of government spending and revenue using budgetary cash data, which is monthly published by the fiscal authorities of both countries. In this case, data for government spending and revenue refer to the Central Government and are available in a cash basis.

The data cover the following samples: 1970:3-2007:4, in the case of the U.S.A.; 1971:2-2007:4, in the case of the U.K.; 1979:2-2006:4, in the case of Germany; and 1986:2-2004:4, in the case of Italy.

Figures 1, 2, 3, and 4 provide a comparison of the annual values of such quarterly fiscal data with the annual national accounts data provided by the European Commission (Ameco database). It is interesting to observe that the patterns of both

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series are rather similar.[4] Moreover, in most of the cases, the levels themselves are also close.

Finally, Figure 5 plots the observed government debt-to-GDP ratio and the implicit debt-to-GDP ratio, that is, the one that would emerge by including the feedback from government debt. It shows that, despite some small discrepancies in the case of Italy, the implicit series for the debt-to-GDP ratio tracks pretty well the actual series.

4.2 Results

The starting point is the estimation of a Bayesian Structural VAR (B-SVAR) that does not include the feedback from government debt, that is, where equation (2) is not considered. Then, we compare the results with the ones that emerge from estimating specifications (1), (2), and (3).

Figures 6, 7, 8, and 9 show the impulse-response functions to a fiscal policy shock. The solid line refers to the median response when the VAR is estimated without including the debt feedback, and the dashed lines are, respectively, the median response and the 68 percent posterior probability intervals from the VAR estimated by imposing the government budget constraint. The confidence bands are constructed using a Monte Carlo Markov-Chain (MCMC) algorithm based on 50000 draws.

U.S.

Figure 6a displays the impulse-response functions of all variables in X_t to a shock in government spending in the U.S.

In the case we do not include the debt feedback, it can be seen that the effects on GDP are positive, sizeable, and reach a peak at after 8 quarters. The impact on private consumption and private investment is also positive, therefore, supporting the idea that government spending has an expansionary "Keynesian" effect in the economy and that there is no "crowding-out".[5] In addition, there is a positive effect on the average cost of debt and the price level. In what concerns the reaction of asset markets, the empirical

4 In this context, Pérez (2007) argues that, for some EU countries', intra-annual cash fiscal information can be used to improve the forecasting and monitoring of the annual General Government deficit in terms of ESA95.

5 Fatás and Mihov (2001), when looking at the response to changes in different components of government expenditures, find that increases in government consumption are always expansionary, while increases in public investment do not have a significant impact on output. Here, we can not analyse some of these policy experiments because we have not made explicit the role of different components of government spending.

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evidence suggests that while there is a positive effect on housing prices that persists for almost 20 quarters, the reaction of stock prices is rather small and negative.

When we include the debt dynamics in the model, the effects of a government spending shock on GDP become somewhat smaller. The effects on private consumption and private investment also remain positive although smaller. In addition, the effect on the average cost of refinancing the debt is negligible. The reaction of asset markets is similar to the model without the government constraint: there is a positive (although smaller) and persistent effect on housing prices, while the reaction of stock prices is still small due to the debt dynamics and the portfolio reallocation.

Figure 6b shows the impulse-response functions to a shock in government revenue. The results suggest that government revenue declines steadily following the shock which erodes after 8 quarters. Contrary to a shock in government spending, the effects on GDP are negative, very persistent, and the trough is reached at after at after 12 quarters. They also reveal a change in the composition of GDP's major components: while private consumption is negatively impacted by a positive shock in government revenues, the effect on private investment is positive but quickly erodes after 8 quarters. That is, in this case, the "crowding-out" effect works mainly through the consumption channel. In what concerns the reaction of asset markets, the empirical evidence suggests that the effects of revenue shocks tend to be negative for housing prices and slightly positive for stock prices.

U.K.

The impulse-response functions to a shock in government spending in the U.K are shown in Figure 7a.

The results show that an increase in government spending has a positive effect on GDP in accordance with the predictions of the standard IS-LM model. As for the US, there is evidence of a change in its composition: private consumption increases but the effects on private investment are negative, suggesting the idea of a "crowding-out" effect via investment (see, for example, Blanchard and Perotti (2002)). In what concerns the reaction of asset markets, the empirical evidence suggests that both housing and stock prices fall after the spending shock but the effect on housing markets is much more persistent. That is, markets seem to interpret the expansion of government spending as signalling a deterioration of public finances (Ardagna, 2009). In contrast, the effects on the price level and on the average cost of financing the debt are positive.

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When the debt dynamics is included in the model, the impulse-response functions do not change significantly.

Figure 7b shows the impulse-response functions to a shock in government revenue. They support the idea of a "crowding-in" effect: private investment reacts positively to the shock; private consumption falls in the first 8 quarters after the shock but then recovers and the effect becomes positive. The effects on housing prices are also positive, but the reaction takes place with a lag of around 8 quarters. By their turn, stock prices react positively to the shock but the effect reaches a peak at around after 8 quarters. Finally, the effects on the price level and the interest rate are negative and the impact is maximum at after 8 to 12 quarters.

When we include the feedback from the government debt in the model, the effects on the majority of the variables included in the model become smaller.

Germany

We now look at the impulse-response functions a shock in government spending for Germany (Figure 8a). The effects on GDP are negative, reflecting the fall in both private consumption and private investment, and providing evidence of a "Non-Keynesian" effect (see, for instance, Giavazzi and Pagano (1990, 1996), Giudice et al. (2004), and Afonso (2008b)). There is, therefore, evidence of a "crowding-out" effect. Nevertheless, the magnitude of the impact is small and, in this respect, it corroborates the findings of Heppke-Falk et al. (2006). Government spending shocks also have a negative and persistent effect on the price level and the average cost of financing debt. Finally, housing prices seem to increase after the shock while stock prices fall immediately after the shock, possibly, reflecting the deterioration of fiscal policy.

These findings do not change significantly when the debt dynamics is included in the model.

Figure 8b plots the impulse-response functions to a shock in government revenue. Similarly to the U.S., the results show that government revenue declines quickly after the shock, eroding after 2 quarters.[6] The effects on GDP are positive and support the idea of a "crowding-in" effect as both private consumption and private

[6] Afonso and Claeys (2008) mention that large revenue reductions unmatched by expenditure cuts have pushed the deficit beyond the 3% threshold in Germany in 2002, putting the country in an excessive deficit situation within the EU fiscal framework.

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investment react positively to the shock. Revenue shocks tend to be significant and positive only for housing prices.

Italy

We look at the effects of a fiscal policy shock in Italy. Figure 9a displays the impulse-response functions to a shock in government spending. Despite a very small positive effect in the first quarters, GDP, private consumption, and private investment fall, suggesting a "crowding-out" effect and a "Non-Keynesian" pattern. Government spending shocks have a positive and persistent effect on both the price level and the average cost of financing the debt, in accordance with the findings of Giordano et al. (2007). Housing prices seem to be positively affected by the shock, while stock prices fall immediately after the shock but later start recovering.

When we take into account the feedback from government debt, the results suggest that the effects on GDP, private consumption, private investment, the price level and the interest rate become smaller. This gives rise to the importance of considering the debt dynamics in the model.

Figure 9b shows the impulse-response functions to a shock in government revenue. The effects on GDP, private consumption, and private investment are negative in the first quarters, but the impacts are not persistent as they vanish after 4 to 6 quarters and even become positive after that. Looking at the reaction of asset markets, one can see that the effects of government revenue shocks tend to be positive for stock prices and negative for housing prices. This suggests that while the credit-channel (that is, the fall in interest rates) impacts positively in stock markets, for housing markets that channel is annihilated by the "crowding-out" effects. Moreover, it is in accordance with the argument that the effects of fiscal consolidation on stock prices are particularly strong in countries which typically runner high levels of government deficit (Ardagna, 2009).

4.3 Fiscal shocks and government debt feedback

We now consider the potential debt feedback and estimate the following structural VAR:

$$\Gamma_0 X_t + \Gamma_1 X_{t-1} + \ldots + \gamma_i (d_{t-1} - d^*) = c + \varepsilon_t, \tag{7}$$

$$d_t = \frac{(1+i_t)}{(1+\pi_t)(1+\mu_t)} d_{t-1} + (g_t - t_t). \tag{8}$$

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The specification of (7) is suggested by the empirical findings in Bohn (1998), who estimates a fiscal reaction function in which d^* is the unconditional mean of the debt ratio and allow us to take into account the debt feedback. Following Bohn (1998) and Favero and Giavazzi (2008), we model the target level of the debt as a constant on the basis of the evidence of stationarity of d. In addition, we impose the government's intertemporal budget constraint as described by (8).

Table 1 reports the estimated coefficients on $(d_{t-1} - d^*)$ in the structural equations of the SVAR (government spending and government revenue). We report the coefficients (and the standard errors in brackets) taken from the estimation for the full sample and for sub-samples. In the case of the U.S., we consider two sub-samples: 1970:3 – 1987:4, corresponding to the pre-Greenspan era; and 1988:1 – 2007:4, after Greenspan. In the case of the Germany, we also split the sample in two periods: 1980:3 – 1990:4, that is before the reunification; and 1991:1 – 2006:4, that is after the reunification. For the U.K. and Italy, each sub-sample is built by splitting the entire sample in roughly two sub-samples of similar size.

Table 1 – The effect of $(d_{t-1}-d^*)$ in a VAR.

U.S.		T_t	G_t	Germany		T_t	G_t
$(d_{t-1}-d^*)$	1970:3 – 2007:4 (N=150)	0.187*** (0.068)	-0.180*** (0.050)	$(d_{t-1}-d^*)$	1980:3 – 2006:4 (N=106)	0.211*** (0.112)	-0.021 (0.064)
	1970:3 – 1987:4 (N=70)	-0.352 (0.261)	-0.176 (0.156)		1980:3 – 1990:4 (N=42)	-0.122 (0.410)	-1.087*** (0.271)
	1988:1 – 2007:4 (N=80)	0.203 (0.158)	-0.228 (0.154)		1991:1 – 2006:4 (N=64)	0.017 (0.192)	-0.075 (0.060)
U.K.		T_t	G_t	Italy		T_t	G_t
$(d_{t-1}-d^*)$	1964:2 – 2007:4 (N=175)	0.120*** (0.037)	-0.065** (0.030)	$(d_{t-1}-d^*)$	1986:2 – 2004:4 (N=75)	0.081 (0.476)	-4.125** (1.741)
	1964:2 – 1984:4 (N=83)	0.013 (0.109)	-0.102 (0.089)		1986:2 – 1994:4 (N=35)	1.344 (1.529)	-3.963 (8.288)
	1985:1 – 2007:4 (N=92)	0.143** (0.127)	-0.043 (0.104)		1995:1 – 2004:4 (N=40)	4.353** (1.838)	-6.642 (6.518)

Note: standard errors in brackets. *, **, *** - statistically significant respectively at the 10%, 5%, and 1% levels.

For the U.S., the results show a significant response of revenue and primary spending to deviations of the debt-to-GDP ratio from its sample average only for the full sample. Indeed, one sees that when the debt-to-GDP ratio is above its historical mean, government primary spending decreases (the coefficient associated to $(d_{t-1} - d^*)$

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in the government spending equation is negative and significant (-0.180), while in the government revenue equation is positive and significant (0.187)).

For the U.K., the results are similar. They show a stabilizing effect of the debt level on the primary budget balance that works through the response of both government revenue and government spending to deviations of the debt from the target level. This is, particularly, the case of the full sample. It is also the case of the second sub-sample (1985:1 – 2007:4) but only for government revenue. Therefore, when the debt ratio is above its sample mean, it is possible to observe an increase in government revenue (0.120, in the full sample; 0.143, for the second sub-sample).

In the case of Germany, there is evidence of a small stabilizing effect of the debt level on the primary surplus that works through the government revenue (0.211). In addition, the results of the estimation of the model in the first sub-sample (1980:3-1990:4) suggest that government spending tends to decrease (-1.087) when the debt-to-GDP ratio is above its sample mean.

Finally, for Italy, one can see that when the debt ratio is above average, government spending strongly falls (-4.125). Additionally, in the period 1995:1-2004:4, there is evidence supporting a stabilizing effect of government debt on the primary surplus that works through the government revenue: the coefficient associated to ($d_{t-1} - d^*$) is positive and large in magnitude (4.353). This is in line with the increase of fiscal policy discipline imposed by the Maastricht Treaty.

5. Conclusion

This paper provides a detailed evaluation of the macroeconomic effects of fiscal policy. It, therefore, also deals with a relevant policy question, in particular, given the expansionary fiscal policies adopted by governments in industrialized countries in the attempt to stabilize the economies after the burst of the financial crisis in 2008.

We identify fiscal policy shocks using a recursive partial identification, and estimate a Bayesian Structural Vector Autoregression, therefore, accounting for the posterior uncertainty of the impulse-response functions. In addition, we explicitly include the feedback from government debt in our framework.

The empirical evidence suggests that government spending shocks: (i) have, in general, a small but positive effect on GDP; (ii) have a varied effect on private consumption and on private investment; (iii) have a positive effect on housing prices; (iv) lead to a quick fall in stock prices; and (v) in general, impact positively on the price

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level and the average cost of refinancing the debt. In addition, government revenue shocks: (i) have a positive effect on GDP and private investment; (ii) have a varied effect on private consumption; (iii) a varied impact on housing prices and a positive effect on stock prices; and (iii) in general, do not impact on the price level, but have a mixed effect on the interest rate.

When the debt dynamics is explicitly taken into account, (long-term) interest rates and GDP become more responsive and the effects of fiscal policy on these variables also become more persistent.

Finally, the results support the existence of a stabilizing effect of the debt level on the primary budget balance that works through both government spending and revenue in the case of the U.S. and the U.K., through government revenue in the case of Germany, and through government spending in the case of Italy. This signals that governments tend to adjust their fiscal imbalances in response to government debt developments.

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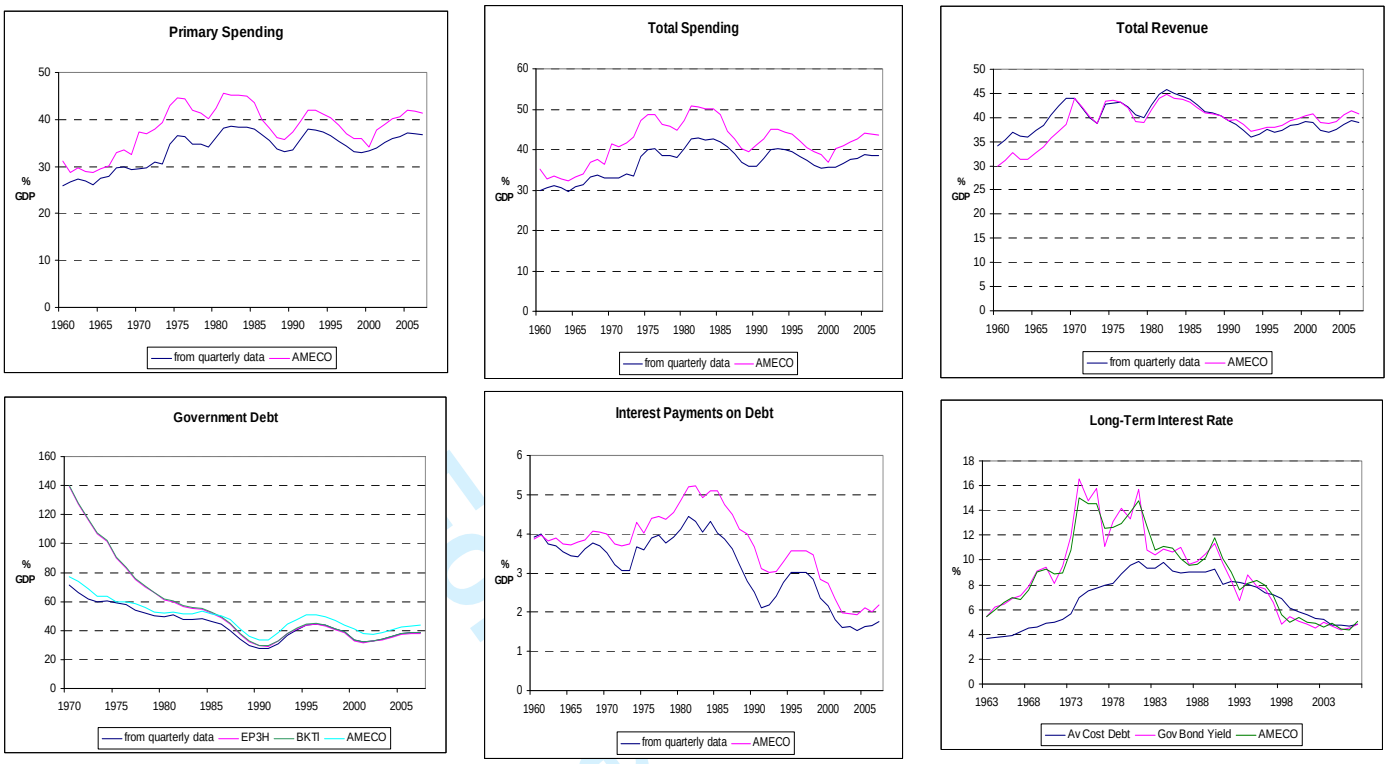
Figure 1 – Quarterly *versus* annual fiscal data, U.S..

Figure 2 – Quarterly *versus* annual fiscal data, U.K..



Notes: EP3H – 'Financial Intermediation Services Indirectly Measured (FISIM) adjusted GDP; BKTL – GDP at current prices.

Figure 3 – Quarterly *versus* annual fiscal data, Germany.

Figure 4 – Quarterly *versus* annual fiscal data, Italy.

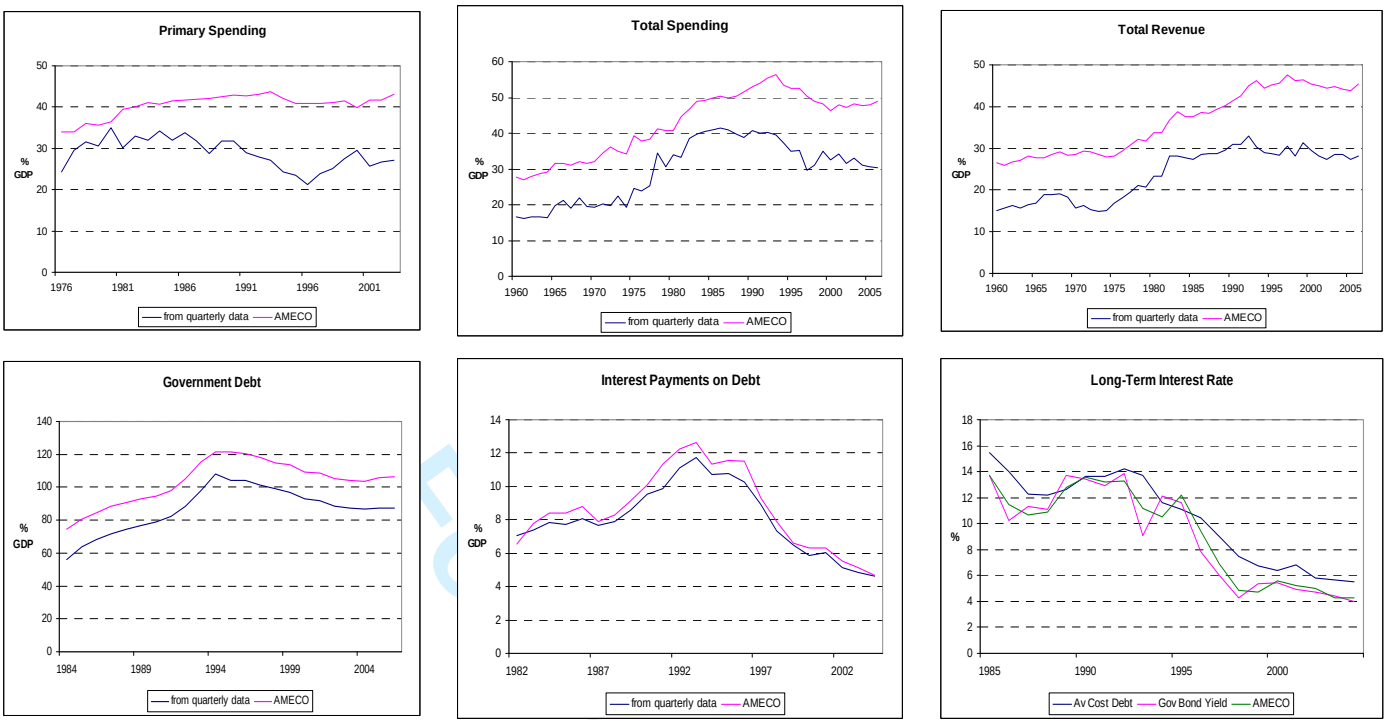
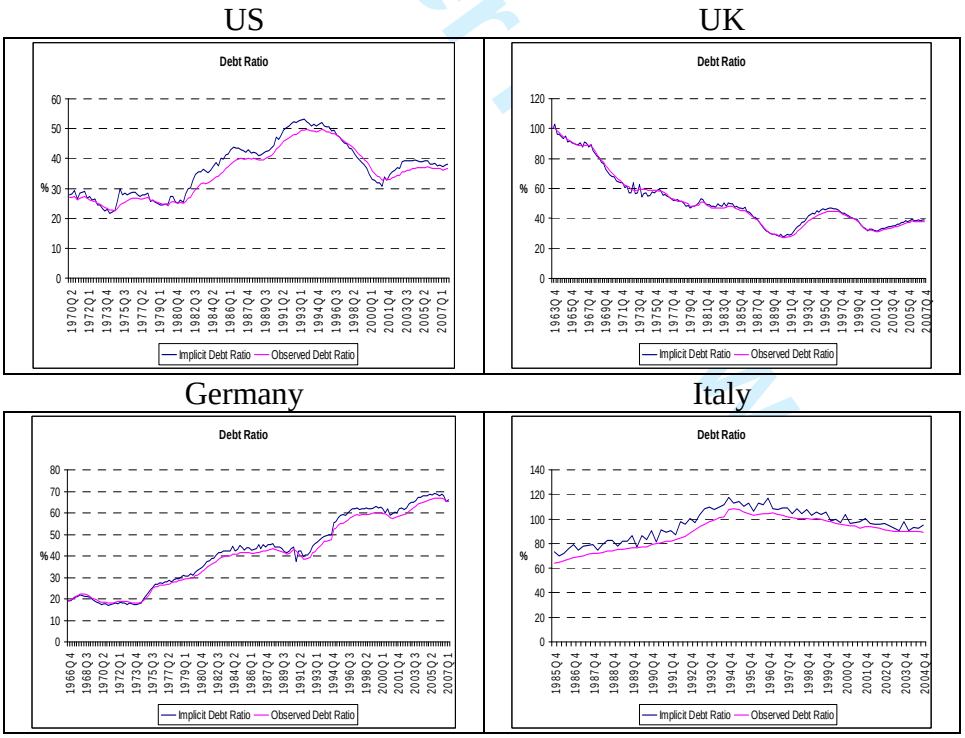


Figure 5 - Implicit debt ratio and observed debt ratio, percentage of GDP.



Note: Implicit debt ratio computed via equation (2).

Figure 6 – Impulse-response functions, US.

6a – spending shock 6b – revenue shock

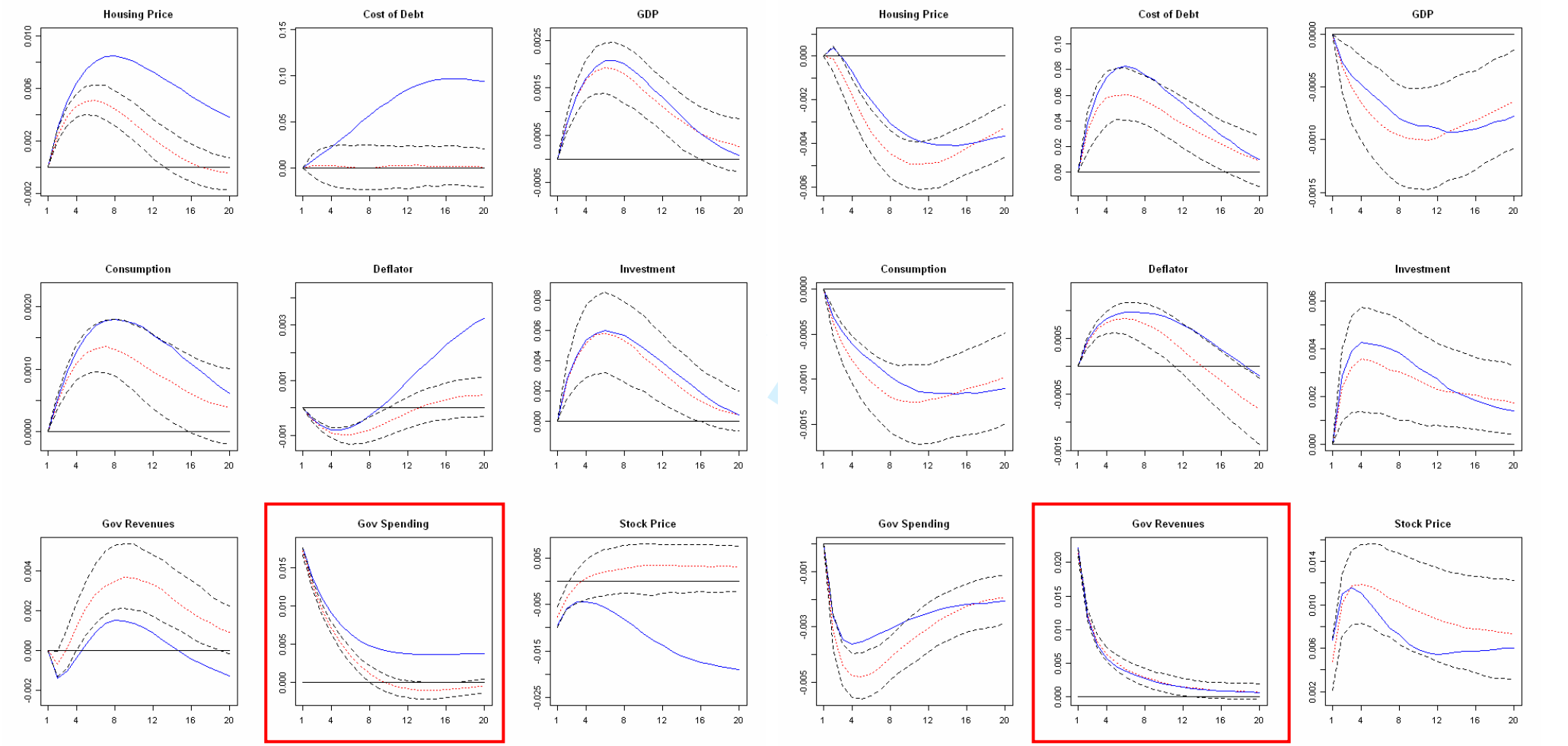


Figure 7 – Impulse-response functions, UK.

7a – spending shock

7b – revenue shock

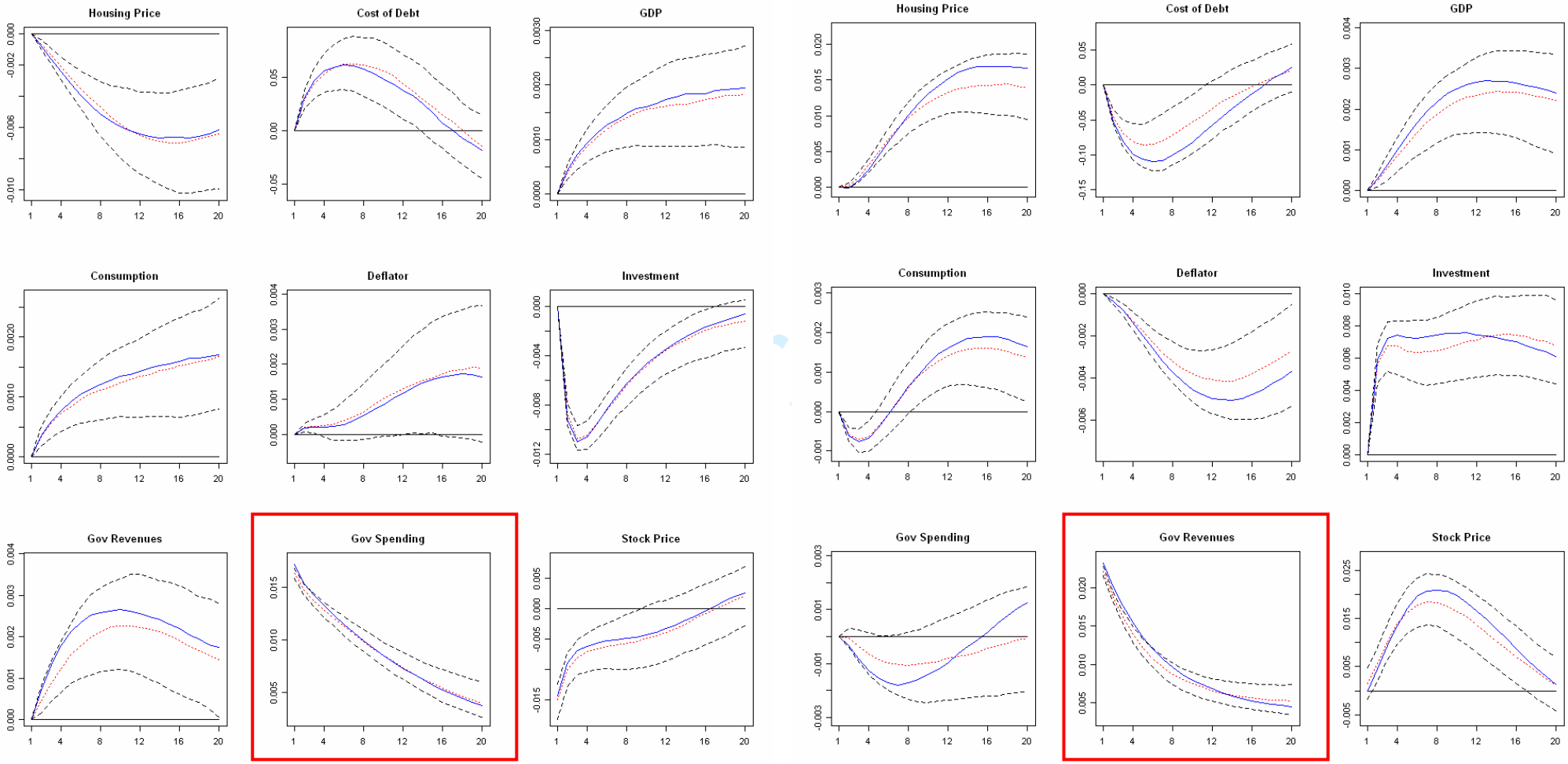


Figure 8 – Impulse-response functions, Germany.

8a – spending shock 8b – revenue shock

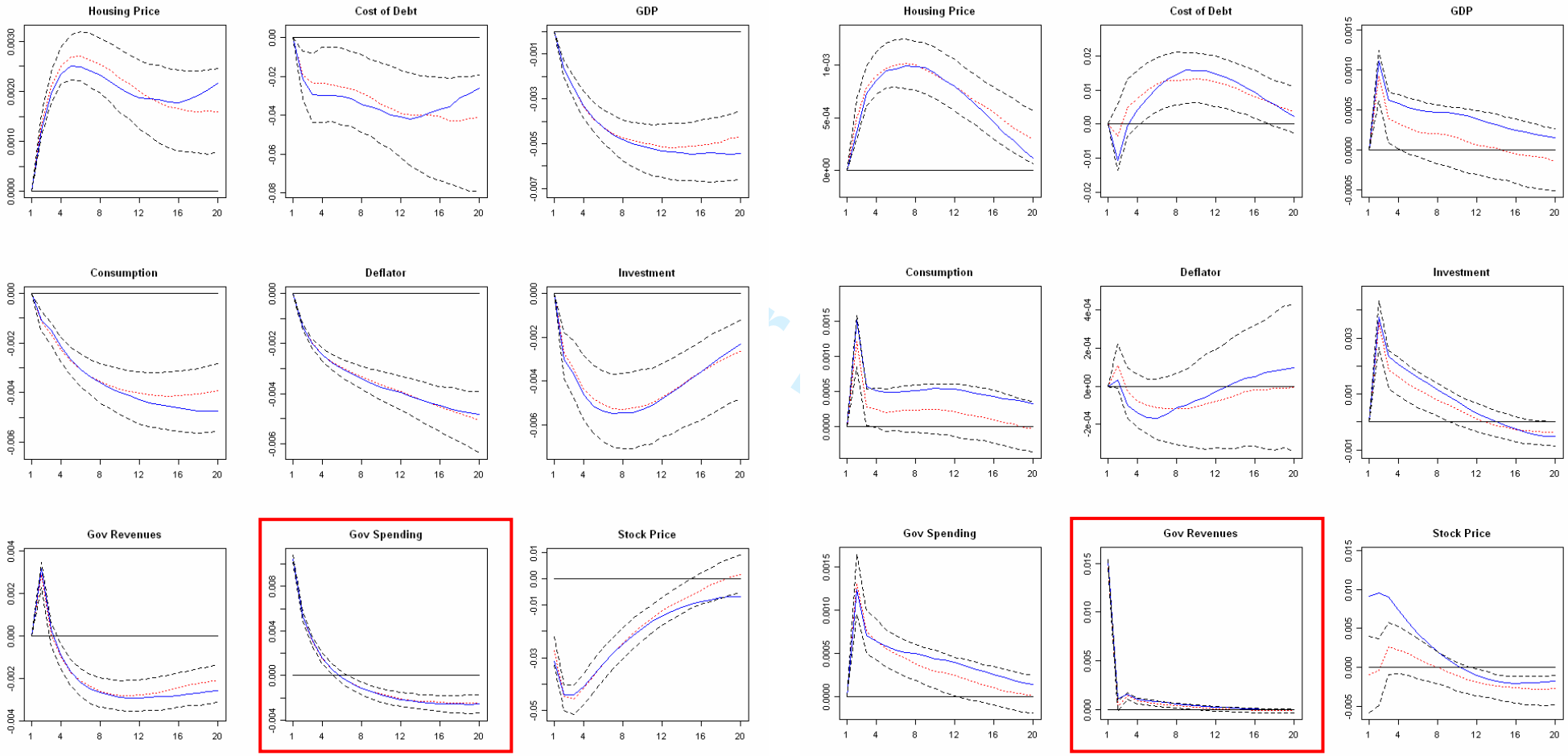
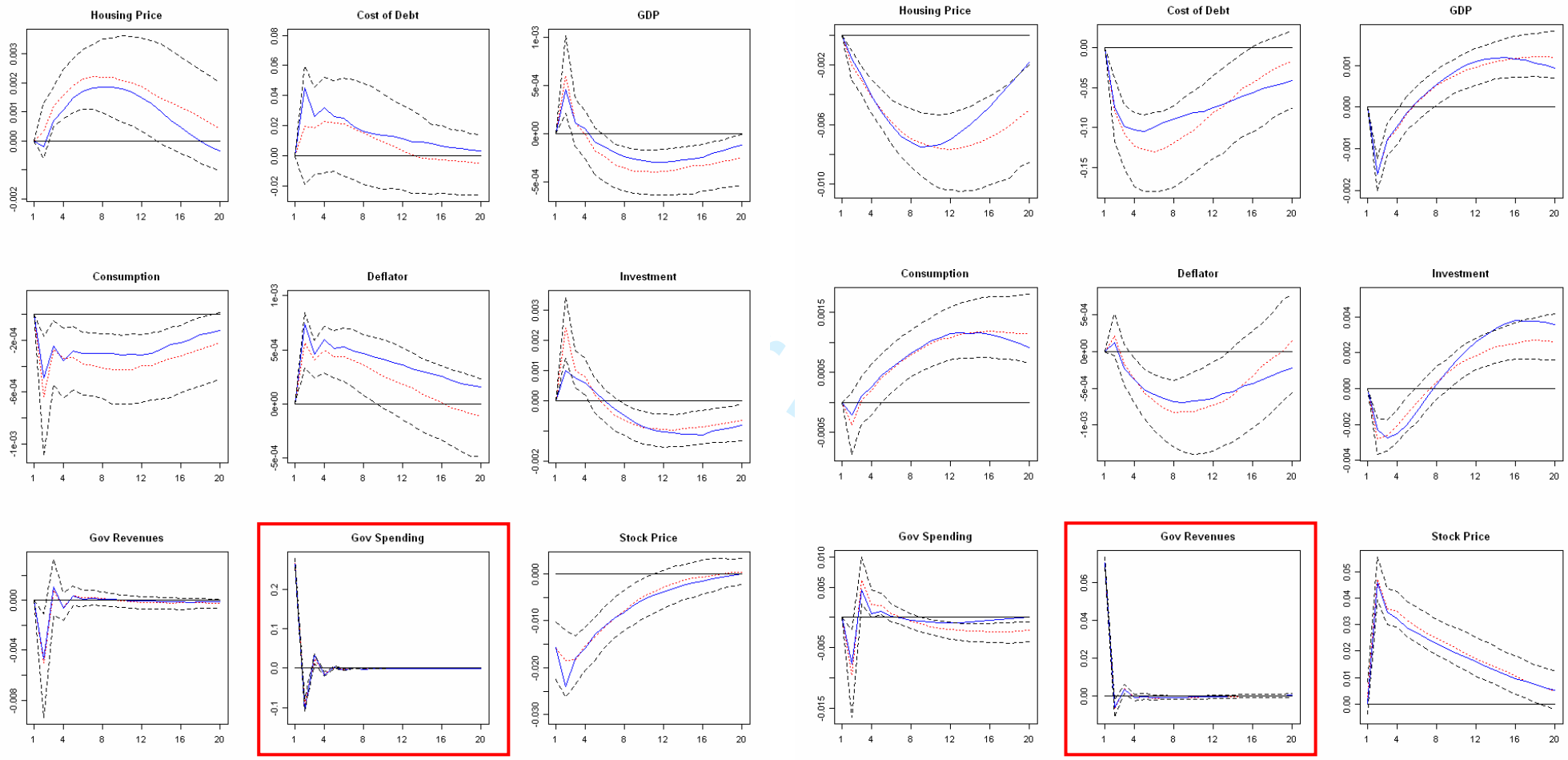


Figure 9 – Impulse-response functions, Italy.

9a – spending shock

9b – revenue shock