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What are the effects of fiscal policy on asset markets?[☆,☆☆,★]

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ABSTRACT

We investigate the link between fiscal policy shocks and asset markets. Our results show that spending shocks have: a positive and persistent effect on GDP in the U.S. and in the U.K., while for Germany and Italy, such impact is temporary; a positive and persistent effect on housing prices; a negative effect on stock prices; and mixed effects on the price level. A VAR counter-factual exercise suggests that fiscal shocks play a minor role in the asset markets of the U.S. and Germany, and substantially increase the variability of housing and stock prices in the U.K., while government revenue shocks have increased volatility in Italy.

1. Introduction

Over the last decades, important economic events have captured the attention of academics, governments and policy makers towards fiscal policy. 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.

More recently, the sudden occurrence of the global financial turmoil became key for assessing the role that fiscal and external imbalances, oil prices, credit and stock markets or even duration dependence play on the likelihood of an expansion and contraction ending (Vinhas de Souza, 2006; Agnello and Schuknecht, 2009; Granville and Mallick, 2009a; Agnello and Nerlich, 2010; Castro, 2010). As a result, a large fiscal stimulus has become an important ingredient of the attempt to recover economic activity. Notably, these interventions pose major challenges because they represent a valuable test to the long-term sustainability of public finances as the evidence on current developments in government bond markets shows (Schuknecht et al., 2009). Moreover, they may lead to business cycle de-synchronization (Rafiq and Mallick, 2008; Mallick and Mohsin, 2007, 2010) or negatively affect the nexus between monetary and financial stability (Castro, forthcoming; Granville and Mallick, 2009b; Sousa, 2010a).

The behavior of asset markets is of major importance for financial institutions, homeowners, and policy makers. In addition, the linkages between the financial markets and the banking system, the housing sector, and the credit market have emerged very strongly and powerfully in the course of the financial turmoil. Not surprisingly, the relationship between macroeconomic variables, wealth, and asset returns has revived the interest on the topic by academics (Schuknecht et al., 2009; Sousa, 2010b, 2010c).

Yet, our understanding of the transmission of fiscal policy innovations to asset markets is far from complete. More importantly, despite the analysis of the macroeconomic effects of fiscal policy and the importance of asset markets over the business cycle, there is still

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an important gap in the literature, in particular, regarding the empirical relationship between fiscal policy actions and developments in asset prices.

Therefore, the current paper evaluates the effects of fiscal policy on economic activity and aims at contributing to our understanding of the linkages between fiscal policy and asset markets. We model them in a unified framework, using a parsimoniously restricted multivariate time-series model, where we analyze the effects of fiscal policy on *both* housing and stock prices. We ask how stock and housing prices are affected by fiscal policy shocks, and, to the extent that we find a link between them, we look at the magnitude and the persistence of the effects.

We identify fiscal policy shocks using information about the elasticity of fiscal policy variables to economic activity, therefore, taking into account the automatic response of government spending and revenue to output, inflation, and the interest rate. Moreover, we account for the posterior uncertainty of the impulse–response functions by estimating a Fully Simultaneous System of equations in a Bayesian framework.

Another contribution of the paper is that we explicitly consider the link between government debt and deficits in our framework, by including the government debt feedback dynamics in our estimations.

Therefore, we analyze empirical evidence from the U.S., the U.K., Germany, and Italy, using quarterly fiscal data that are taken from national accounts (in the case of the U.S. and the U.K.) or based on fiscal cash (for Germany and Italy). The use of quarterly fiscal data is another relevant contribution of the paper.

The main results of our work can be summarized as follows. Government spending shocks have: a positive and persistent effect on GDP in the case of the U.S. and the U.K., while for Germany and Italy, the (positive) impact is temporary and becomes negative after 4 to 8 qtr. Spending shocks have a positive and persistent effect on housing prices, although housing markets tend to respond with a lag of around 4 qtr; a negative effect on stock prices, with a faster time reaction than for housing prices; mixed effects on the price level, that is, the response is positive in the case of the U.K. and Italy, and negative for the U.S. and Germany; a reduction effect on unemployment only in the U.S.

On the other hand, government revenue shocks have: an initial negative effect on GDP that later becomes positive; a negative impact on housing prices for the U.S. and Italy, and a positive impact for the U.K. and Germany; a small and positive effect on stock prices; in general, a negative and persistent effect on the price level; a positive and persistent impact on the unemployment rate. When we include the feedback from government debt in the estimations long-term interest rates and GDP become more responsive, and the effects on these variables also become more persistent.

Finally, we perform a VAR counter-factual exercise, and show that fiscal policy shocks play a minor role in the observed patterns for stock and housing prices in the U.S. and Germany. Nevertheless, while both spending and revenue shocks seem to have an important effect on asset markets for the U.K., in the case of Italy only government revenue shocks have contributed to an increase of volatility in housing and stock prices, particularly in the nineties.

The paper is organized as follows. Section 2 briefly reviews the related literature. Section 3 explains the empirical strategy. Section 4 reports and discusses the empirical results. Section 5 concludes with the main findings and policy implications.

2. Related literature

While a large number of studies have been devoted to the analysis of the macroeconomic effects of monetary policy, the empirical evidence on the role of fiscal policy as a tool for economic stabilization is somewhat lagging and there is no consensus about the identification of fiscal policy shocks. Rotemberg and Woodford (1992) identify exogenous movements in U.S. government spending with innovations to defense purchases. In contrast, Ramey and Shapiro (1998) use the "narrative approach" to isolate political events that led to three large military build-ups unrelated to developments in the U.S. economy. They find that while nondurable consumption displays a small decline, durables consumption falls persistently after a brief rise. Fatás and Mihov (2001) consider a Cholesky ordering in the identification of fiscal shocks. They rely on the effects of changes in government spending, and base their decision on two arguments: alternative theories imply different economic dynamics following a change in government spending while having qualitatively similar predictions for the effects of changes in tax rates; and it does not require modeling the contemporaneous interaction between taxes and economic activity. They suggest 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, a feature that goes against the predictions of the Real Business Cycle model. Blanchard and Perotti (2002) exploit the decision lags in policymaking and use information about the elasticity of fiscal variables to economic activity, to identify the automatic response of fiscal policy. They find that expansionary fiscal shocks increase output, and have a positive effect on private consumption and a negative one on private investment. Mountford and Uhlig (2009) use sign restrictions on the impulse responses, and identify an expenditure shock by a positive response of expenditure for up to four qtr after the shock. The authors also report a negative effect in both residential and non-residential investments.

Despite the different identification schemes of fiscal policy shocks aimed at analyzing the macroeconomic effects of fiscal policy, less attention has been given to the potential role played by fiscal policy on asset markets. Indeed, such discussion has been centered on the effects of fiscal policy on long-term interest rates and on macroeconomic variables (GDP, consumption and its components, or investment and its components).[1] Moreover, only a few papers discuss the empirical link between economic policy and housing prices, the focus being mainly on the effects of monetary policy.[2]

Why should fiscal policy have linkages with housing markets? The developments in housing markets can be influenced by a variety of fiscal measures notably via subsidies and tax measures (Jappelli and Pistaferri, 2007). For instance, capital taxes on housing gains reduced VAT on home purchases, tax deductibility of interest payments, or taxation of the imputed rental value of the house are just a few examples of how fiscal policy can play an important role. Similarly, fiscal subsidies for buying new houses may push up its demand and prices, especially in the context of inelastic housing supply. In addition, when sovereign financing needs are lower and fiscal positions are sounder, a country's interest rates can be lower and mortgage-loans can have better financing conditions. In contrast, resources available to home-owners can be crowded-out in case of higher government indebtedness (MacLennan et al., 1999). More generally, the increase in housing prices and its potential wealth effect can contribute to reduce personal savings. If the corporate sector does not compensate accordingly the drop in savings, it is then left for the government to increase its own savings, reducing government imbalances, in order to prevent the occurrence of low levels of national saving (Barrell and Weale, 2010).

Can fiscal policy play a role in stock prices? As with housing prices, the linkages between economic policy and financial markets have been normally analyzed through the lenses of monetary policy.[3]

[1] For a revision of the effects of fiscal policy on long-term interest rates, see, for example, Gale and Orszag (2003), Brook (2003), and Laubach (2009). Afonso and Sousa (2009) tackled this question in a more generalist way, discussing the macroeconomic effects of fiscal policy.

[2] See, for instance, Aoki et al. (2004) and Iacoviello (2005).

[3] For a review of the topic, see Bernanke and Kuttner (2005).

Nevertheless, some recent studies consider that fiscal policy may also play an important role. Darrat (1988) and Arin et al. (2009) show that fiscal policy can indeed influence stock market returns. Tavares and Valkanov (2003) argue that fiscal policy can impact financial markets both directly (via bond markets and interest rates) and indirectly (via stock market returns). For emerging markets, Akitoby and Stratmann (2008) examine the effect of fiscal policy on sovereign risk spreads, and show that adjustments based on the revenue side lower spreads more than spending-based ones. In addition, while debt-financed spending increases sovereign risk, a change in government spending that is financed with taxes lowers spreads, which suggests that investors prefer the latter. Finally, Ardagna (2009) emphasize that, for OECD countries, fiscal adjustments that signal a sounder fiscal behavior (such as a reduction in government spending or a fiscal consolidation in the form of a permanent and substantial fall in government debt) are typically associated with increases in stock prices.

3. A fully simultaneous system approach

We identify fiscal policy shocks using a Fully Simultaneous system of equations approach in a Bayesian framework. Therefore, we take into consideration the automatic response of fiscal policy to economic activity. Moreover, we do not assume that the government reacts only to variables that are predetermined relative to policy shocks, and assume that there are no predetermined variables with respect to fiscal policy shock.

Consider the following structural VAR (SVAR)

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

$$d_t = \frac{1+i_t}{(1+\pi_t)(1+\mu_t)} d_{t-1} + \frac{G_t - T_t}{P_t Y_t} \tag{2}$$

$$v_t = \Gamma_0^{-1}\varepsilon_t, \tag{3}$$

where $\varepsilon_t | X_s, s<t \sim \mathrm{N}(\underline{0}, \Lambda)$, $\Gamma(L)$ 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.

We explicitly include the feedback from government debt as shown by specification (2), where $i_t, G_t, T_t, \pi_t, Y_t, P_t, \mu_t$ and d_t represent, respectively, the government debt implicit interest rate (or the average cost of debt refinancing), government primary expenditures and government revenues, inflation, GDP, price level, real growth rate of GDP, and the debt-to-GDP ratio at the beginning of the period t.[4]

The vector v_t contains the innovations of X_t, where $v_t \sim \mathrm{N}\left(\underline{0}, \Sigma\right)$ and $\Sigma := \Gamma_0^{-1}\Lambda(\Gamma_0^{-1})'$. Moreover, Γ_0 pins down the contemporaneous relations among the variables in the system.

In the structural VAR approach, we use Bayesian inference to assess the posterior uncertainty about the impulse–response functions in the Fully Simultaneous system of equations (Sims and Zha, 1999), and consider a Monte Carlo importance sampling weight algorithm. Appendix A provides a detailed description of the computation of the error bands.

We consider the following set of variables $X_t = [SP_t, G_t, T_t, Y_t, P_t, i_t, U_t, HP_t]'$, where SP_t represents the stock price index, G_t, the government expenditures, T_t, the government revenues, Y_t, the GDP, P_t, the GDP deflator, U_t, the unemployment rate, i_t, the long-term interest rate, and HP_t, the housing price index. In particular, we partition the data such that $X_t = [X_{1t}', G_t, T_t, X_{2t}']'$, where:

$$X_{1t} = [SP_t]; \quad X_{2t} = \begin{bmatrix} Y_t \\ P_t \\ i_t \\ U_t \\ HP_t \end{bmatrix}.$$

The economy is divided into three sectors: a financial, a public and a production sector. The financial sector — summarized by the stock prices index, SP_t — reacts contemporaneously to all new information, in recognition of the fact that stock prices are determined in markets characterized by a continuous auction structure. The public sector — that allows for simultaneous effects — comprises the equations for government spending and government revenue, and links them with the log real GDP, Y_t, the GDP deflator, P_t, and the average cost of financing debt, i_t. The production sector consists of log real GDP, Y_t, the GDP deflator, P_t, unemployment rate, U_t, and the housing price index, HP_t. The orthogonalization within this sector is irrelevant to identify fiscal policy shocks correctly. All these variables are not predetermined relative to the fiscal policy shocks but it is assumed that the policy shock can influence them contemporaneously.

Additionally, we adopt an identification of the fiscal policy shocks based on Blanchard and Perotti (2002) and Perotti (2004). This identification scheme consists of two steps: (i) institutional information about taxes and transfers and the timing of tax collections is used to identify the automatic response of taxes and government spending to economic activity, that is, to compute the elasticity of government revenue and spending to macroeconomic variables; and (ii) the fiscal policy shock is then estimated.

The identifying restrictions on the matrix of contemporaneous effects, Γ_0, can be defined as:

$$\Gamma_0 = \begin{bmatrix} \gamma_{11} & \gamma_{12} & \gamma_{13} & \gamma_{14} & \gamma_{15} & \gamma_{16} & \gamma_{17} & \gamma_{18} \\ 0 & \gamma_{22} & \gamma_{23} & -\xi_{G,Y}\cdot\gamma_{22} & -\xi_{G,\pi}\cdot\gamma_{22} & -\xi_{G,i}\cdot\gamma_{22} & 0 & 0 \\ 0 & \gamma_{32} & \gamma_{33} & -\xi_{T,Y}\cdot\gamma_{33} & -\xi_{T,\pi}\cdot\gamma_{33} & -\xi_{T,i}\cdot\gamma_{33} & 0 & 0 \\ 0 & 0 & 0 & \gamma_{44} & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & \gamma_{54} & \gamma_{55} & 0 & 0 & 0 \\ 0 & 0 & 0 & \gamma_{64} & \gamma_{65} & \gamma_{66} & 0 & 0 \\ 0 & 0 & 0 & \gamma_{74} & \gamma_{75} & \gamma_{76} & \gamma_{77} & 0 \\ 0 & 0 & 0 & \gamma_{84} & \gamma_{85} & \gamma_{86} & \gamma_{87} & \gamma_{88} \end{bmatrix} \begin{bmatrix} SP_t \\ G_t \\ T_t \\ Y_t \\ P_t \\ i_t \\ U_t \\ HP_t \end{bmatrix}, \tag{4}$$

where the parameters ξ_{ij} can be identified using external information. For instance, $\xi_{G,Y}$, $\xi_{G,\pi}$, and $\xi_{G,i}$ are the elasticities of government spending respectively to GDP, the GDP deflator, and the long-term interest rate. The description of the elasticities used in the identification procedure is reported in Table 1.

Table 1
Elasticities of government spending and revenue.

	Elasticities of government spending			Elasticities of government revenue		
	$\xi_{G,Y}$	$\xi_{G,\pi}$	$\xi_{G,i}$	$\xi_{T,Y}$	$\xi_{T,\pi}$	$\xi_{T,i}$
U.S.	0	−0.5	0	1.85	1.25	0
U.K.	0	−0.5	0	1.85	1.25	0
Germany	0	−1.0	0	0.95	−0.05	0
Italy	0	−0.9	0	0.30	−0.40	0

Note: The estimates of the elasticities for the U.S. are based on Blanchard and Perotti (2002), Perotti (2004), and Favero and Giavazzi (2007). The estimates of the elasticities for the U.K. are considered to be the same as in the U.S. The estimates for Germany and Italy are based respectively on Heppke-Falk et al. (2006) and Giordano et al. (2007).

[4] A feedback from the debt ratio to government revenue and government spending could be important in the fiscal reaction function whenever fiscal authorities attach some weight to debt stabilization and their behaviour is Ricardian (Favero and Giavazzi, 2007). Additionally, interest rates depend on future expected monetary policy and on the risk premium, and both may be affected by the debt dynamics. Finally, the impact of the level of debt on inflation and output fluctuations cannot be ruled out ex-ante (Barro, 1974; Kormendi, 1983).

4. Results and discussion

4.1. Data

We use quarterly data for four countries: U.S., U.K., Germany and Italy. All the variables are in natural logarithms unless stated otherwise. The data are available over the following samples: 1970:3–2007:4, in the case of the U.S.; 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. A detailed description of the data is provided in Appendix B.

For the identification of the fiscal policy shocks, we use the following variables; the production sector includes the log real GDP, Y_t, the GDP deflator, P_t, and the unemployment rate, U_t, the average cost of financing the debt, i_t, and the housing price index, HP_t. We use the stock price, SP_t, to summarize the financial sector, as the focus of our analysis is on the reaction of different asset markets (housing and financial markets) to fiscal policy shocks. Finally, as measure of the fiscal policy instruments we use either government expenditures or government revenues. In the set of exogenous variables, we include a constant (or quarterly seasonal dummies), and the government debt-to-GDP ratio as described in the previous section. For Germany, we also include two dummies: one for 1991:1, corresponding to the German reunification; and another one for 2000:3, to track the spike in government revenue associated with the sale of UMTS (Universal Mobile Telecommunications System) licenses.

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

4.2. Empirical results

We start by estimating a Fully Simultaneous System of Equations without including the debt feedback. That is, in practice, we look at specification (1) not considering, as is commonly done in the existing literature, the identity that links government revenues, government spending, government debt, GDP, real GDP growth, inflation and the interest rate, as defined in Eq. (2). We also provide the results of the estimation of the system including the feedback from government debt as described by specifications (1), (2), and (3).

Figs. 1, 3, 5, and 7 plot the impulse–response functions to a fiscal policy shock. The solid line corresponds to the median response when the VAR is estimated without the debt feedback, and the dashed lines are, respectively, the median response and the 68% posterior confidence intervals from the VAR estimated by including the feedback from government debt. The confidence bands are constructed by using a Monte-Carlo importance sampling normalized weights algorithm, and based on 50,000 draws.

We also plot in Figs. 2, 4, 6, and 8 the forecast-error variance decompositions to a fiscal policy shock, including the debt dynamics. The solid line corresponds to the median estimate, and the dashed lines indicate the 68% posterior confidence intervals estimated by using a Monte-Carlo importance sampling normalized weight algorithm, and based on 50,000 draws.

4.2.1. U.S.

Fig. 1a displays the impulse–response functions of all variables in X_t to a shock in government spending in the U.S. When the model is estimated without including the feedback from government debt, the results show that government spending declines steadily following the shock, and it roughly vanishes after 12 qtr. Moreover, the increase in government spending is followed by a short fall in government revenue that erodes after 6 qtr. The effects on GDP are positive and relatively large in magnitude, peaking at after 6 qtr. This is in line with the works of Fatás and Mihov (2001), Blanchard and Perotti (2002) and Perotti (2004) who also find a positive effect of government spending on GDP in the U.S., albeit with different time samples. The evidence also suggests that government spending shocks have a negative and persistent impact on the price level. On the other hand, there is a negative effect on long-term interest rates, depicted as the cost of debt. In what concerns the reaction of asset markets, the empirical evidence suggests that while there is a positive but almost negligible effect on stock markets, the reaction of housing prices is large and persistent, peaking at after 8 to 10 qtr. This feature can be linked with a fall in long-term interest rates, and reflecting notably the importance of the credit channel. The effects on unemployment are negative and also persistent.

After including the debt feedback, the effects of a government spending shock on GDP become somewhat smaller. On the other hand, and contrary to the previous findings, there is initially a positive impact on the average cost of refinancing the debt, which later becomes negative. Looking at the reaction of asset markets, the fiscal shock has a small and negative (although) persistent impact on stock prices, which is statistically significant only for a few quarters and then disappears, while the effect on housing prices remains positive. Unemployment is impacted negatively by the government spending shock, but the effects are much less pronounced, less persistent and statistically significant when we account for the dynamics of the debt feedback.

Fig. 1b shows the impulse–response functions of all variables to a shock in government revenue. When the debt feedback is not taken into account, the results suggest that government revenue declines steadily following the shock which erodes after 10 qtr. Additionally, the shock is initially followed by a fall in government spending which then recovers and becomes positive. Contrary to a shock in government spending, the effects on GDP are slightly negative in line with Perotti (2004). They are also very persistent, peaking at after 10 qtr. The evidence also suggests that government revenue shocks have a positive and persistent effect on the price level. On the other hand, there is a positive and persistent effect on long-term interest rates. In what concerns the reaction of asset markets, the empirical evidence suggests that the effects of revenue shocks tend to be rather small: despite a very small positive impact on housing and stock prices that persists for around 6 to 8 qtr, the effects then mean revert, erodes and become even slightly negative. The effects on the unemployment rate also point to a persistent increase that peaks at after around 12 qtr.

When one includes the debt feedback, the results suggest that government revenue also increases after the shock, reflecting the fall in the debt-to-GDP ratio. The effects on GDP are initially negative, but mean-revert after around 6 qtr and become positive. Moreover, the evidence suggests that government revenue shocks have a positive (but not persistent) effect on the price level, while the effect on long-term interest rates flips sign (vis-à-vis the absence of the government budget constraint) and becomes persistently negative in accordance to the debt stabilizing effects. In what concerns the reaction of asset markets, the empirical evidence suggests that the effects of revenue shocks tend to be amplified: stock prices are positively and persistently impacted by the revenue shock, whereas housing prices move in the opposite direction.

This response may reflect the impact of fiscal policy on GDP: when the debt feedback is not taken into account, the contractionary effect of fiscal policy pushes housing prices downwards; in contrast, when the dynamics from government debt is included, stock prices increase in reaction to the expectation of an economic recovery in the medium to long-term and in response to the fiscal consolidation process.

The effects on the unemployment rate point to an increase that peaks after around 4 qtr, reflecting the smaller (in magnitude) and less persistent response when the feedback mechanism is taken into account.

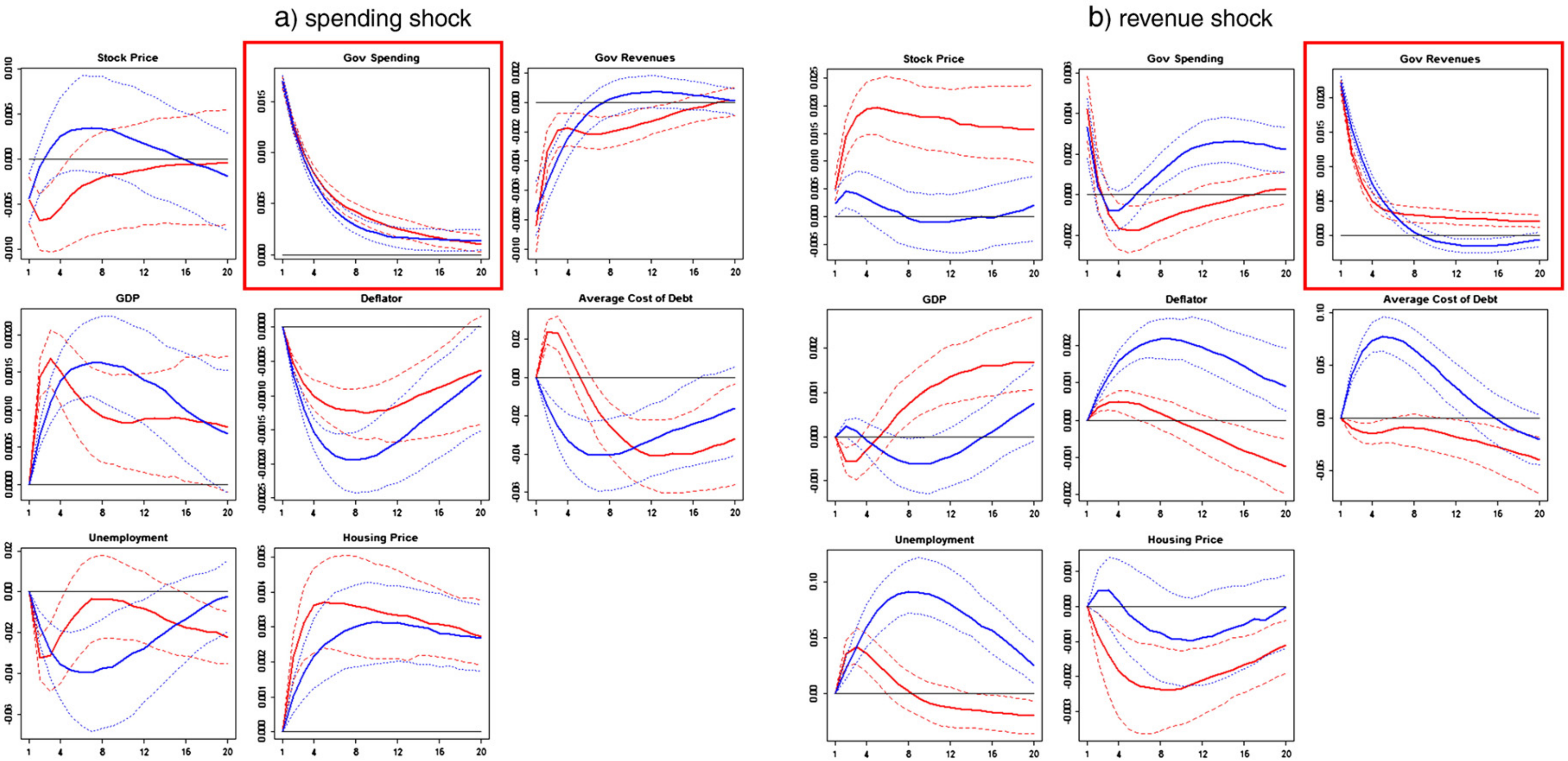

Fig. 1. Impulse–response functions, US. Note: Y-axis, percent deviations from the unshocked path; and X-axis, qtr. Blue solid and dotted lines — median response and 68% posterior probability intervals *without* the debt feedback, respectively; and red solid and dotted lines — median response and 68% posterior probability intervals *with* the debt feedback, respectively.

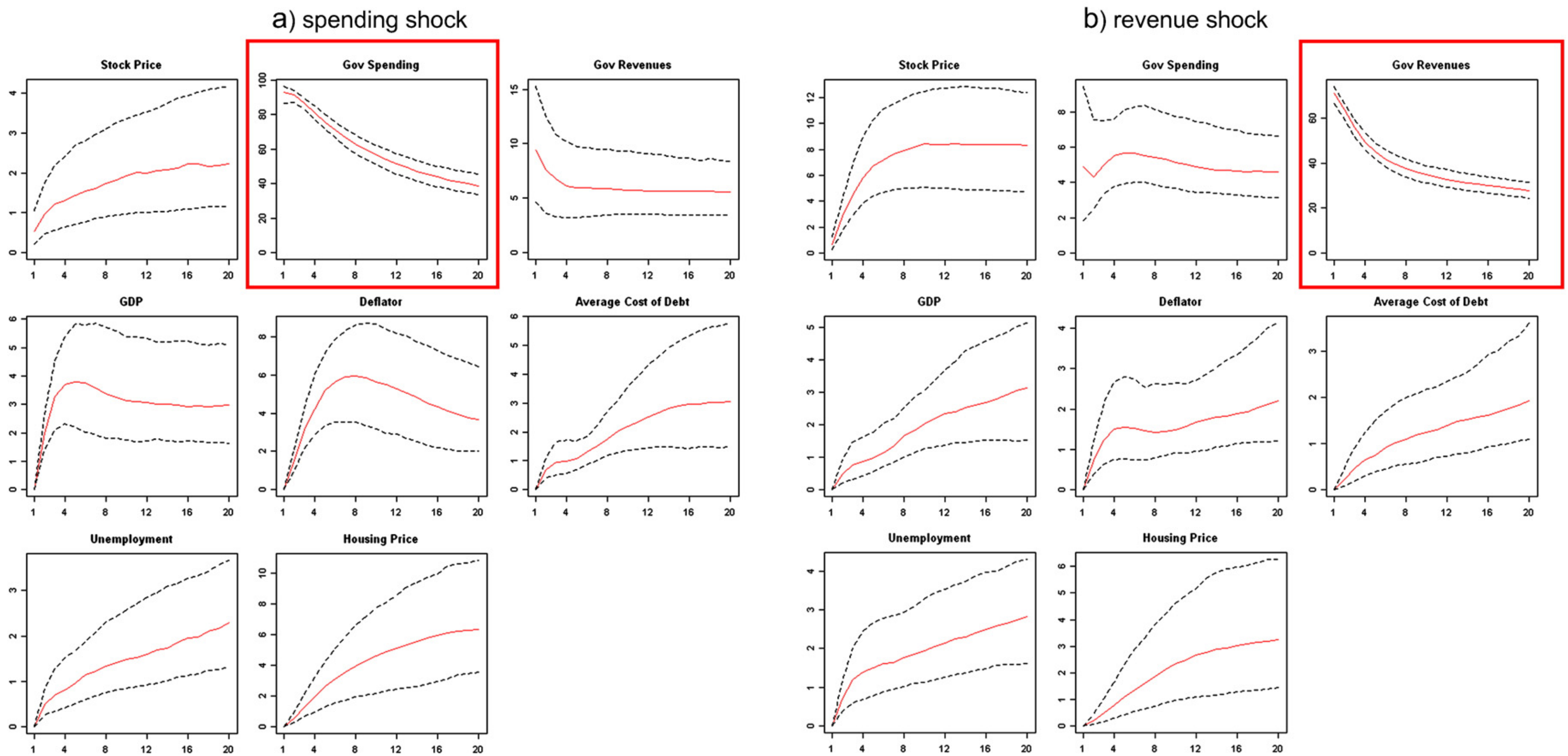

Fig. 2. Forecast-error variance decomposition, US. Solid line — the median estimate; and dashed lines — 68% posterior confidence intervals, with debt feedback.

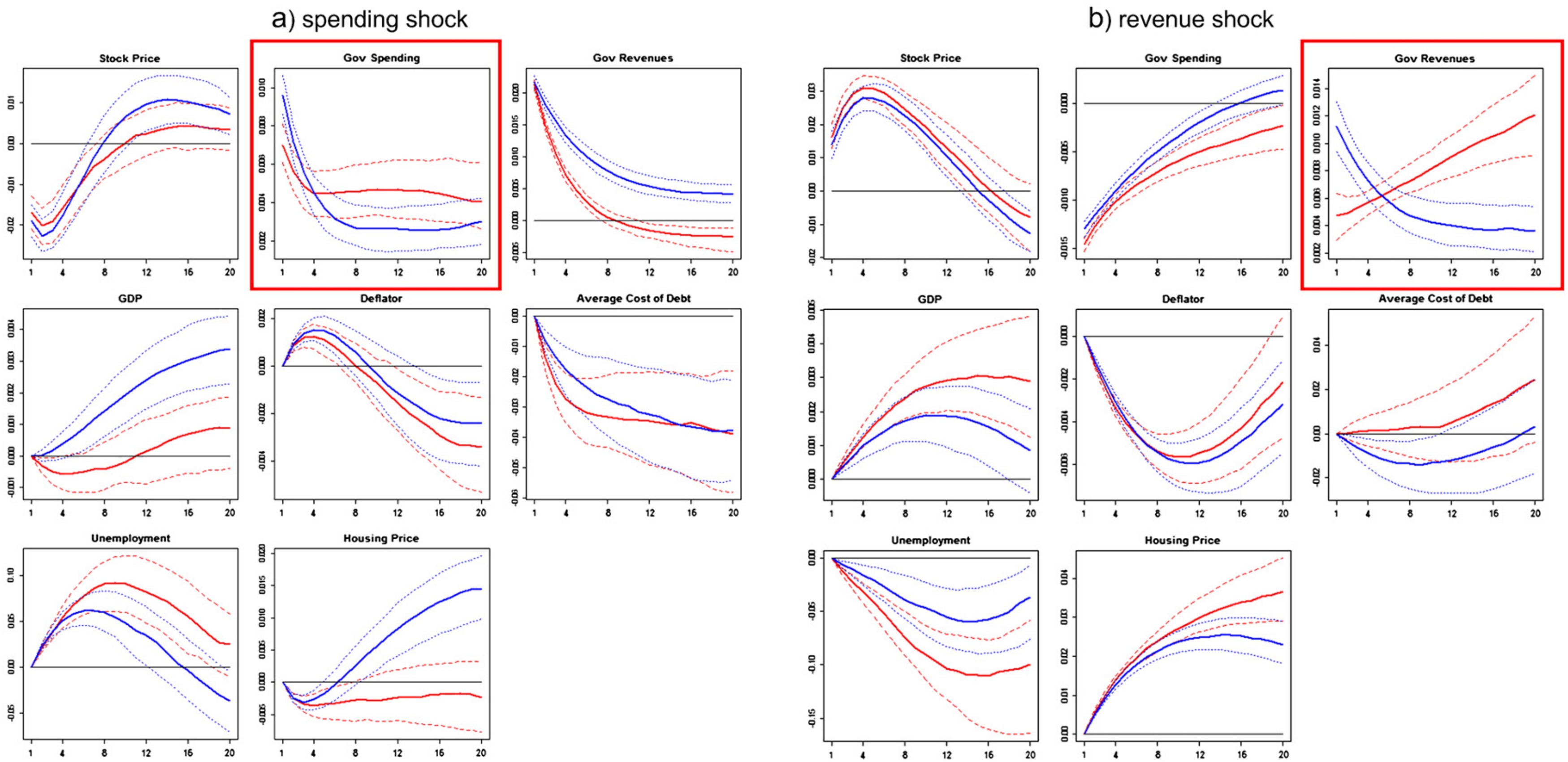

Fig. 3. Impulse–response functions, UK. Note: Y-axis, percent deviations from the unshocked path; and X-axis, qtr. Blue solid and dotted lines — median response and 68% posterior probability intervals *without* the debt feedback, respectively; and red solid and dotted lines — median response and 68% posterior probability intervals *with* the debt feedback, respectively.

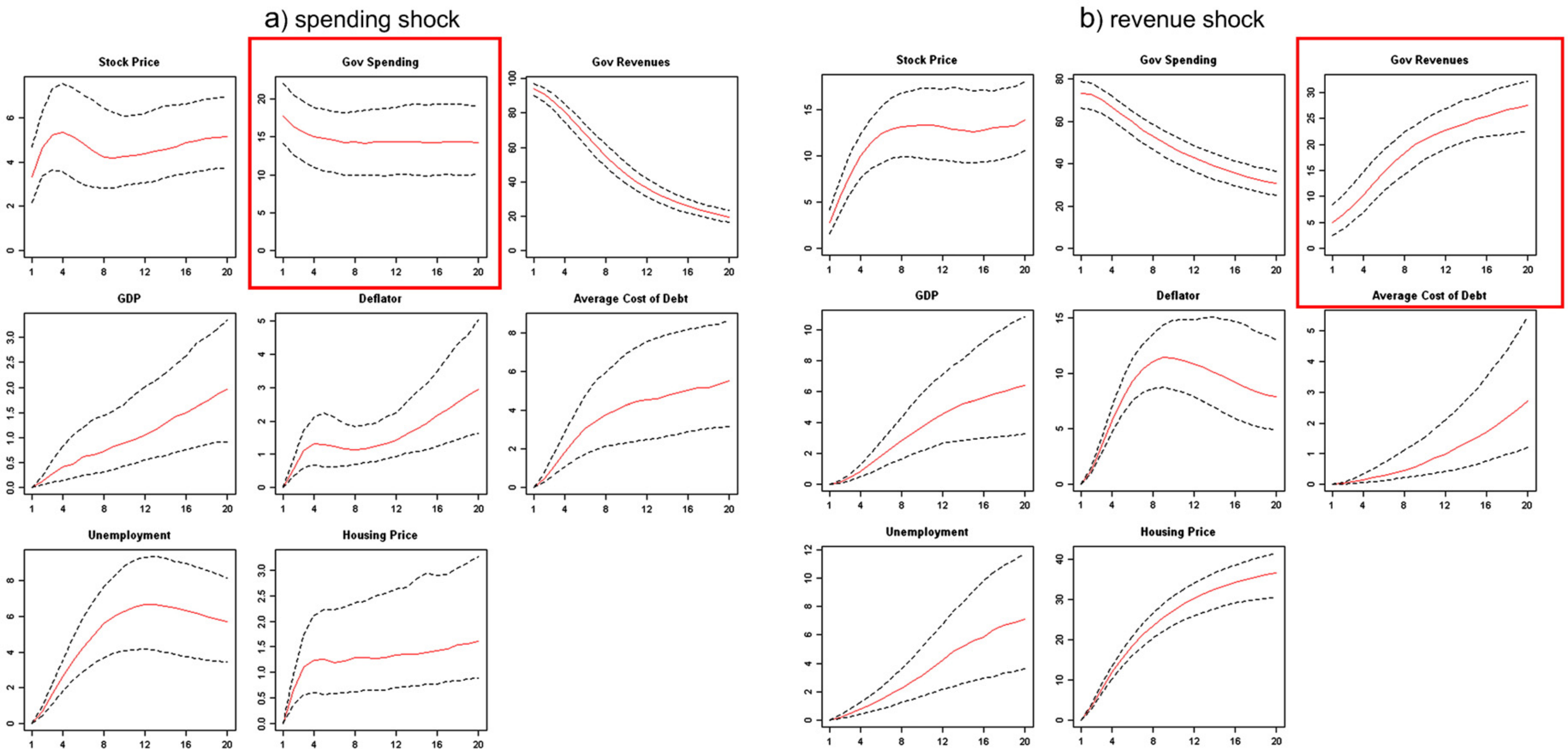

Fig. 4. Forecast-error variance decomposition, UK. Solid line — the median estimate; and dashed lines — 68% posterior confidence intervals, with debt feedback.

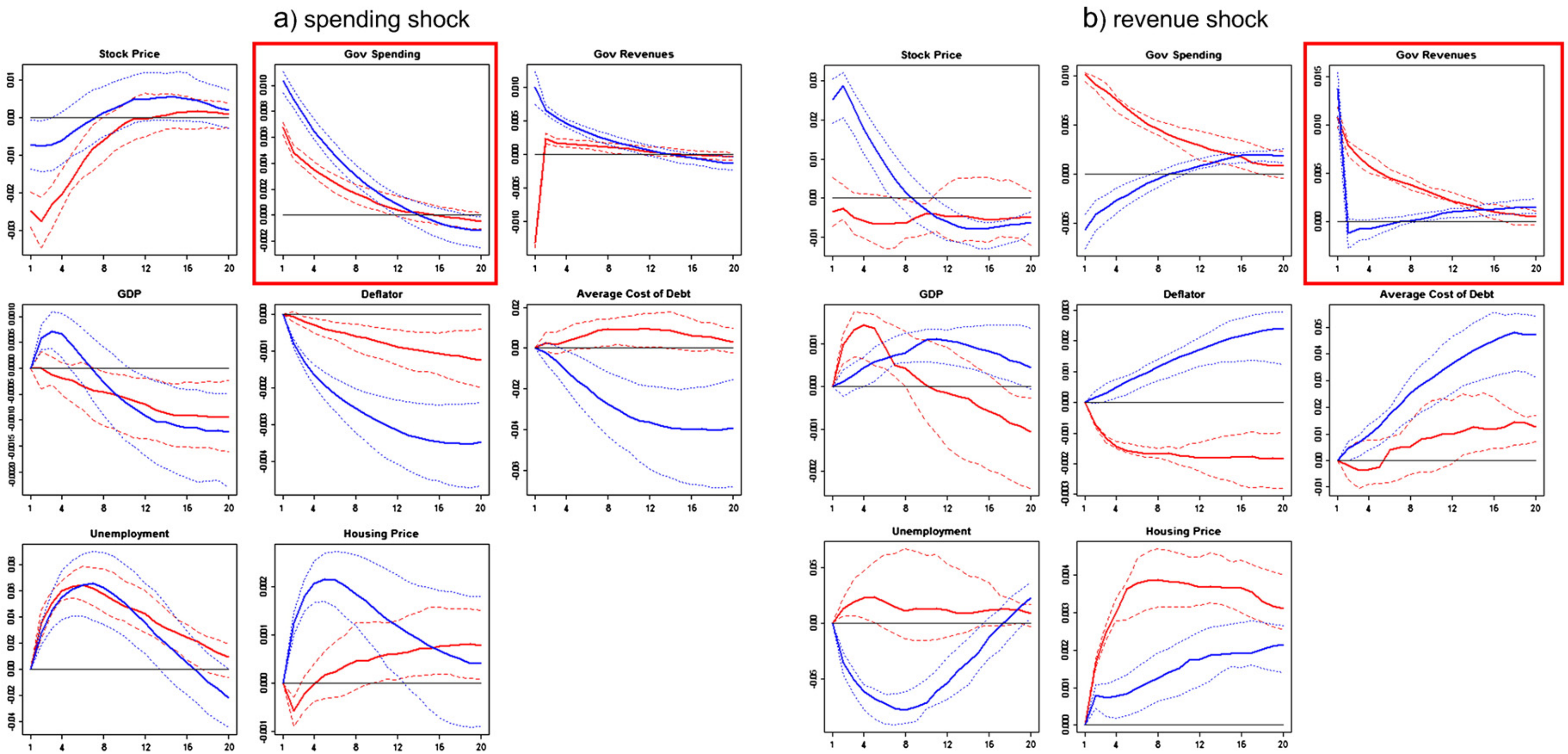

Fig. 5. Impulse–response functions, Germany. Note: Y-axis, percent deviations from the unshocked path; and X-axis, qtr. Blue solid and dotted lines — median response and 68% posterior probability intervals *without* the debt feedback, respectively; and red solid and dotted lines — median response and 68% posterior probability intervals *with* the debt feedback, respectively.

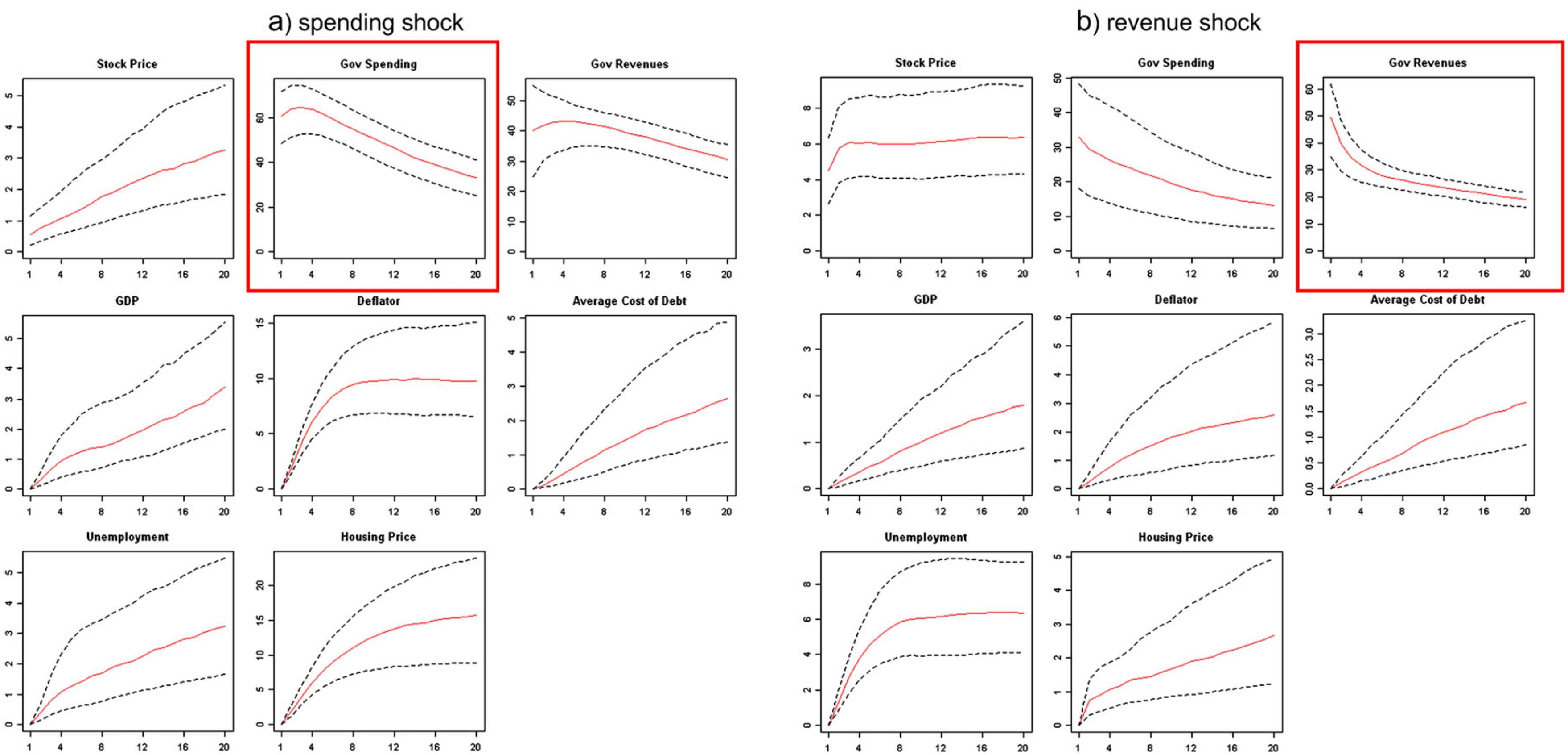

Fig. 6. Forecast-error variance decomposition, Germany. Solid line — the median estimate; and dashed lines — 68% posterior confidence intervals, with debt feedback.

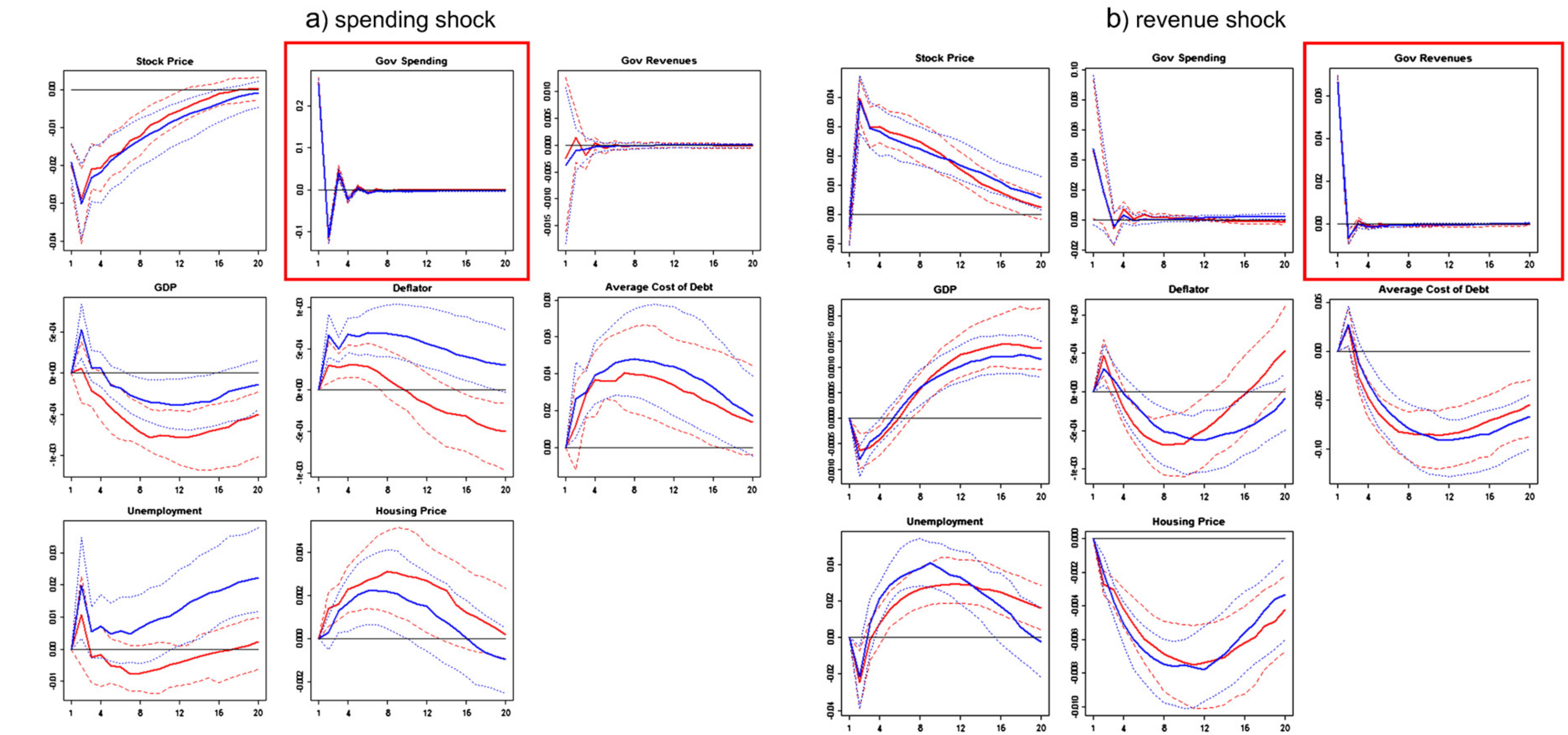

Fig. 7. Impulse–response functions, Italy. Note: Y-axis, percent deviations from the unshocked path; and X-axis, qtr. Blue solid and dotted lines — median response and 68% posterior probability intervals *without* the debt feedback, respectively; and red solid and dotted lines — median response and 68% posterior probability intervals *with* the debt feedback, respectively.

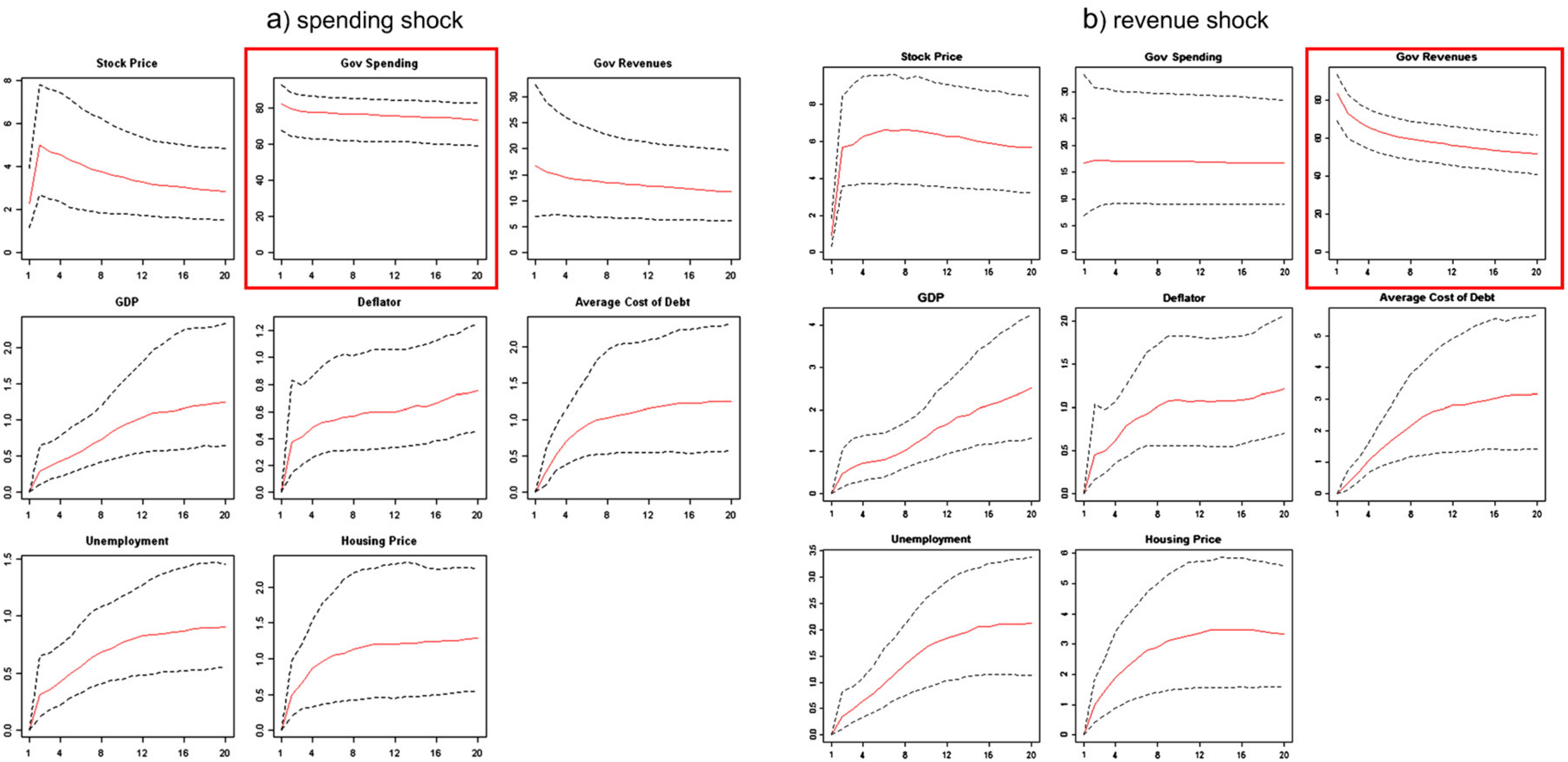

Fig. 8. Forecast-error variance decomposition, Italy. Solid line — the median estimate; and dashed lines — 68% posterior confidence intervals, with debt feedback.

Fig. 2a plots the forecast error-variance decomposition of all variables to a shock in government spending. The results show that government spending shocks explain only a small percentage of the forecast-error variance decomposition of the majority of the variables included in the VAR. Interestingly, while the forecast-error variance decomposition of stock prices remains roughly constant at around a 2% level over time (reflecting the quick response of stock markets to the shock), the forecast-error variance decomposition of housing prices slightly increases up to 5% (in accordance to a slow adjustment of housing markets to the shock). In addition, government spending shocks explain a very important share of the forecast-error variance decomposition of government spending: initially, they represent more than 90% of the forecast-error and even after 20 qtr they correspond to around 40%, therefore, implying a high degree of persistence. The forecast-error variance decompositions plotted in Fig. 2b are also similar to the ones for the government spending shock, and show that government revenue shocks play a minor role.

4.2.2. U.K.

Fig. 3a displays the impulse–response functions of the variables to a shock in government spending in the U.K. Contrary to the U.S., the results from the model estimated without including the feedback from government debt show that although government spending declines following the shock, this occurs at a very slow pace so the effect does not vanish even after 20 qtr. This is also reflected on government revenue, which increases persistently after the shock. On the other hand, the effects on GDP tend to be similar to the ones for the U.S.: they are positive and persistent and in accordance with Perotti (2004). The evidence also suggests that government spending shocks have a negative effect on the price level. As for the long-term interest rates, the effects are negative, peaking at after 10 qtr. In the case of asset markets, housing prices increase with a lag of around 4 qtr and remain at a persistently higher level, boosted by the combination of an expansionary output effect and a fall in the long-term interest rates. Regarding stock prices, they record a small fall following the spending shock, but they recover after 8 qtr and reach a persistently higher level. Contrary to the U.S., unemployment initially rises but the effect mean reverts after 14 qtr and even becomes negative.

When considering the debt feedback, the results suggest that, following the shock in government spending, government revenues increase but the effect is now less persistent and erodes after around 8 qtr. Additionally, while there is still a negative impact on long-term interest rates, the effect is substantially smaller in magnitude and less pronounced. This, therefore, explains why GDP initially falls and mean-reverts after around 12 qtr, while the price level initially goes up and mean-reverts at after 8 qtr. The debt dynamics is also responsible for the response patterns of the asset markets: housing prices are now negatively impacted by the shock, while the initial negative effect on stock prices becomes more pronounced. This result cannot be seen isolated from the boost in output and the fall in long-term interest rates, which help in supporting the rise in asset prices. Finally, the rise in unemployment is more persistent.

Fig. 3b shows the impulse–response functions of all variables to a shock in government revenue. Similarly to a shock in government spending, the results show that government revenue declines following the shock, but at a very slow pace so the effect vanishes only after 20 qtr. The shock is also followed by a persistent fall in government spending. On the other hand, the effects on GDP are marginally positive for around 12 qtr but then become negative, while the price level is negatively impacted by the shock on government revenue. Interest rates fall after the shock in government revenue but the effect becomes positive after around 10 qtr. Regarding the reaction of asset markets, the results suggest that the effects of revenue shocks tend to be significant and positive both for housing

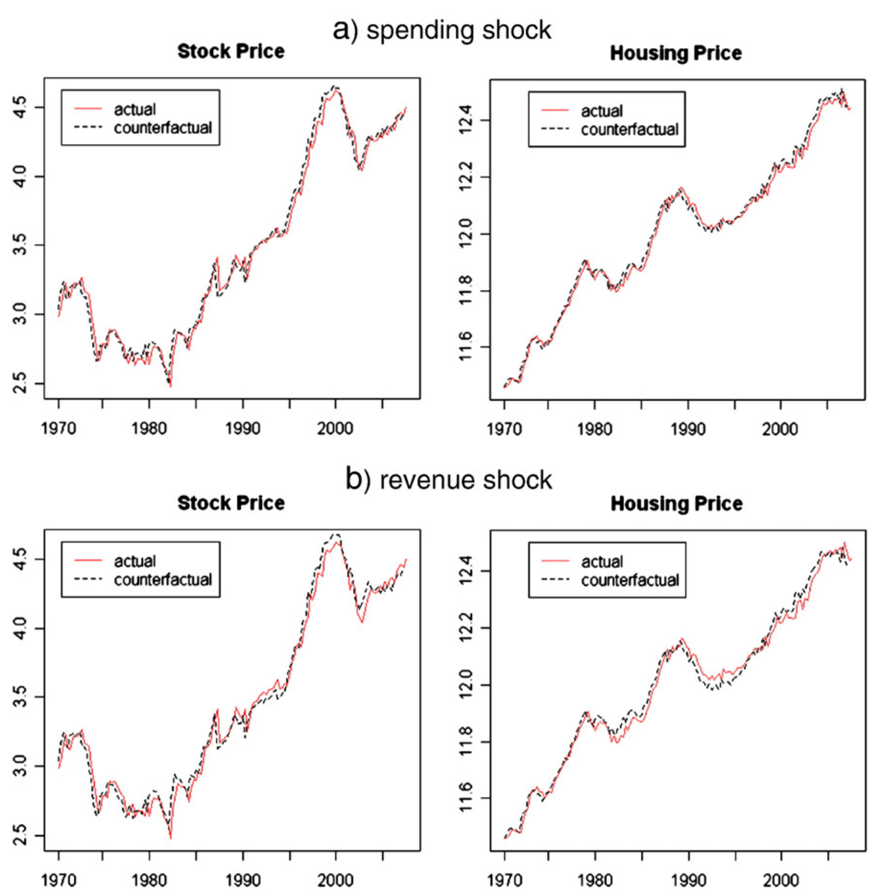

Fig. 9. VAR counterfactual, U.S.

and stock prices, although more persistent in the first case: housing prices remain at a persistently higher level after 20 qtr with the peak of the effect being reached at after around 12 qtr; and stock prices increase for around 12 qtr, but then the effect disappears and becomes negative as a result of the downturn in GDP. As a result, the dynamics of asset prices seem to be driven by the income effects associated with the fiscal policy measure. The effect on unemployment is negative peaking at after 8 qtr. A major difference relative to the previous findings is that the average cost of financing the debt is roughly unaffected — while it is negatively affected when the debt dynamics is not included — as a result of the smaller GDP growth.

Fig. 4a depicts the forecast-error variance decomposition of all variables in the VAR. Government spending shocks explains around 20% of the forecast-error variance decomposition of government spending. In addition, spending shocks explain around 5% of the forecast-error of stock prices, and only 2% of housing prices. Fig. 4b displays the forecast-error variance decompositions and shows that government revenue shocks explain around 35% of the forecast-error in housing prices and 15% of the forecast-error in stock prices.

4.2.3. Germany

Fig. 5a displays the impulse–response functions of the variables to a shock in government spending in Germany. Similarly to the U.S., the results from the model that does not include the feedback from government debt show that government spending declines quickly after the shock, eroding after around 12 qtr. The shock is followed by a very short but positive impact on government revenue. The effects on GDP are positive, peak at after 4 qtr, and erode after 12 qtr. The expansionary effect of fiscal policy is also found in Perotti (2004) using data for West Germany and, more recently, in Heppke-Falk et al. (2006) using data for Germany. On the other hand, the evidence suggests that government spending shocks have a negative and persistent effect on the price level, although small in magnitude. As for the long-term interest rates, there is a negative effect that persists even after 20 qtr. This aspect is also an important determinant of the dynamics observed in the asset markets: housing prices go up persistently; stock prices also rise but the effect quickly disappears after 4 qtr. Finally, the results suggest that after a government spending shock, unemployment rises slightly.

When we include the debt feedback, the effect on GDP is smaller while the cost of refinancing debt is positively affected, highlighting the importance of the debt dynamics. As a result, stock prices are negatively impacted (before the effect was mostly positive) and housing prices react less positively to the shock. In fact, agents seem to rebalance their portfolios toward more liquid assets and away from risky wealth.

Fig. 5b shows 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 qtr, and being followed by a reduction in government spending that persists for around 8 qtr. A similar but not very robust result is reported by Perotti (2004), while Heppke-Falk et al. (2006) argue that the findings are not statistically significant. On the other hand, differently from the U.S. and despite a very small and negative initial impact, the effects on GDP are positive although small. Additionally, both the price level and the long-term interest rates are positively and persistently impacted by the shock. Regarding the reaction of asset markets, the empirical evidence suggests that the effects of revenue shocks tend to be positive only for housing prices, which react with a lag of around 4 qtr. Stock prices initially rise but the effect later means reverts and becomes negative after 8 qtr. These results suggest that the positive income effects generated by fiscal policy tend to drive the dynamics of stock

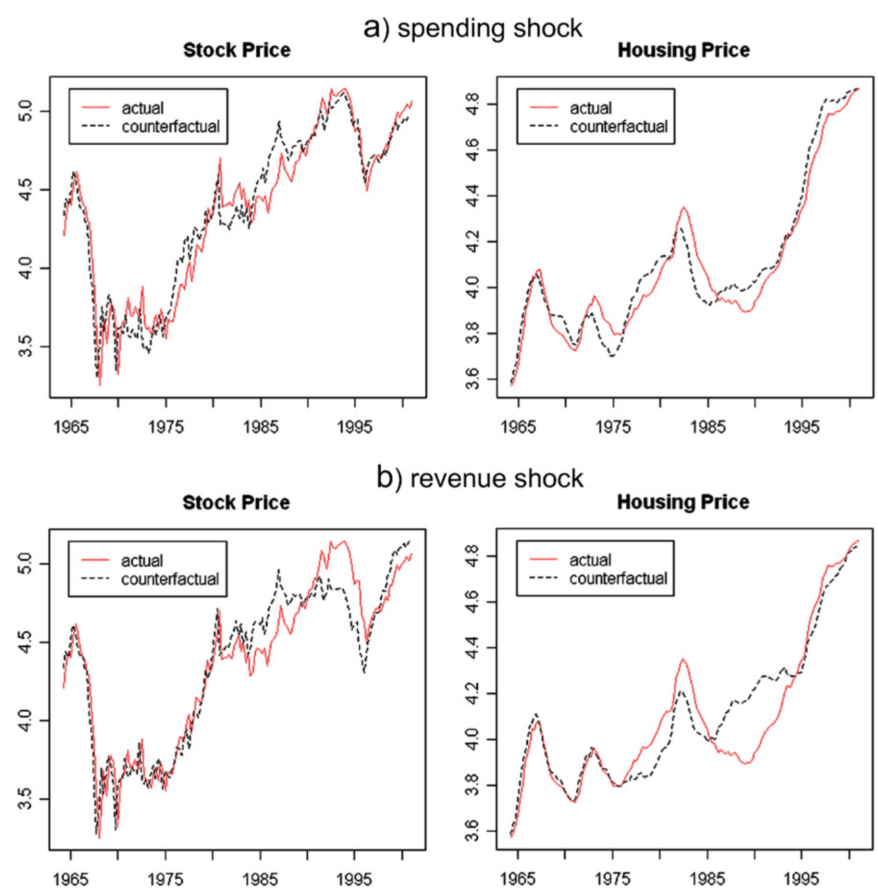

Fig. 10. VAR counterfactual, U.K. Note: All series are in logs of real terms.

prices, while, for housing prices, the strong negative reaction can be linked with the rise of the cost of refinancing debt. Finally, government revenue shocks have a very pronounced and negative effect on the unemployment rate, which peaks at after around 8 qtr.

The inclusion of the feedback from government debt implies that the average cost of financing debt is now negatively impacted as a result of the debt dynamics, related to the implicit fall in the debt-to-GDP ratio. The fall in long-term interest rates also affects the reaction of asset markets: by including the debt feedback, housing prices are more strongly and positively impacted and the effect on stock prices is not statistically significant, while before (i.e., without considering the debt feedback) both stock and housing prices reacted positively to the shock.

Fig. 6a shows the forecast-error variance decompositions of the variables to a shock in government spending. It can be seen that government spending shocks explain a large share (initially, close to 80%) of the forecast-error for government spending. Moreover, it shows that shocks to spending also play an important role for the forecast-error of the housing prices (around 20%), price level (10%), and just a small share (less than 5%) of stock prices.

Fig. 6b shows the forecast-error variance decompositions to a shock in government revenue. Interestingly and contrary to government spending, government revenue shocks explain a smaller percentage of the forecast-error variance decomposition for the majority of the variables included in the system.

4.2.4. Italy

Fig. 7a displays the impulse–response functions to a shock in government spending in Italy. The results obtained by estimating the model without the debt feedback show that government spending declines quickly after the shock, eroding after 2 to 4 qtr. The effects on GDP are also similar: GDP (despite a very small positive initial effect) falls after the shock in government spending, suggesting a "crowding-out" effect. Giordano et al. (2007) also report an expansionary effect of government spending, while no impact is uncovered for net taxes. The results also suggest that government spending shocks have a positive and persistent effect on both the price level and on the long-term interest rate. Concerning the reaction of asset markets, the shock in government spending has a positive impact on housing prices (peaking after around 6 to 8 qtr) and negative and very persistent effect on stock prices. The fall in stock prices peaks after 2 qtr showing that stock markets react quickly. Lastly, there is no evidence of a significant effect of government spending on the unemployment rate. The results do not differ much when the debt feedback is included, except from a more mitigated response of the price level.

Fig. 7b shows the impulse–response functions of all variables to a shock in government revenue. Similarly to a shock in government spending, the results show that government revenue declines quickly after the shock, eroding after 2 qtr. Additionally, the effects on GDP are negative, although not persistent as they vanish after 4 qtr. Regarding the reaction of asset markets, the empirical evidence shows 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. Finally, the evidence suggests that unemployment rate rises after the shock in government revenue, whereas there are no significant effects on the price level. The results are again similar to the case where the feedback from government debt is considered in the estimation.

Fig. 8a reports the error-forecast variance decompositions of all variables to a government spending shock and one can see that it plays a minor role for asset prices. Similarly, Fig. 8b displays the forecast-error variance decompositions and shows that government revenue shocks explain a small share of the forecast-error for the majority of the non-fiscal variables.

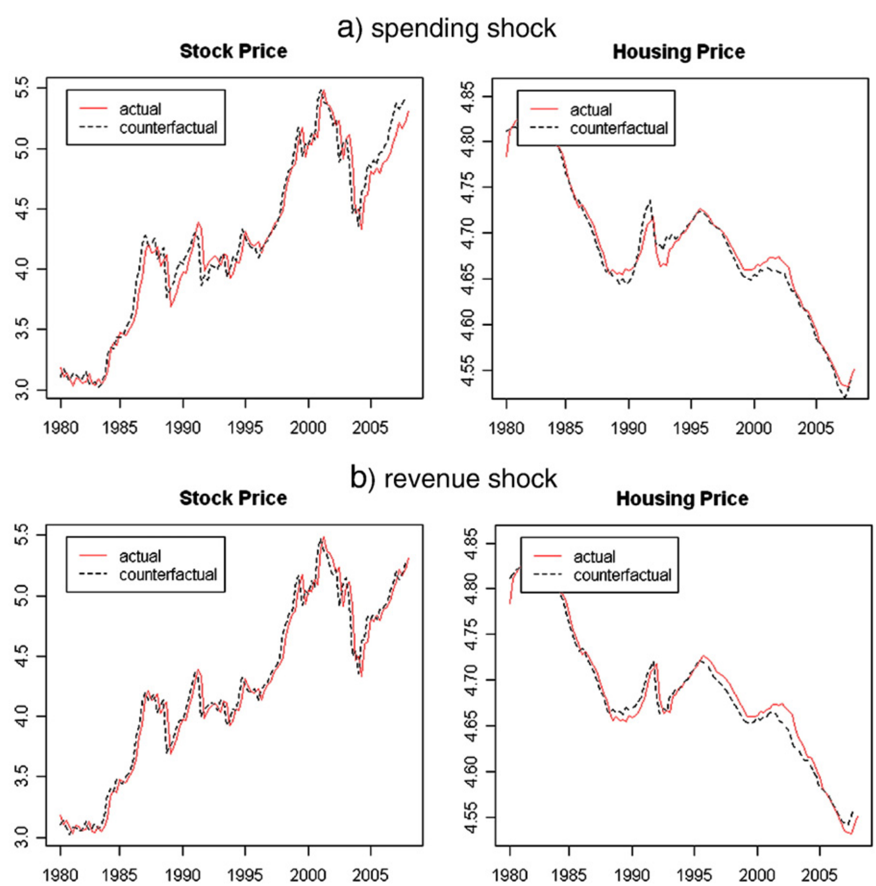

Fig. 11. VAR counterfactual, Germany.

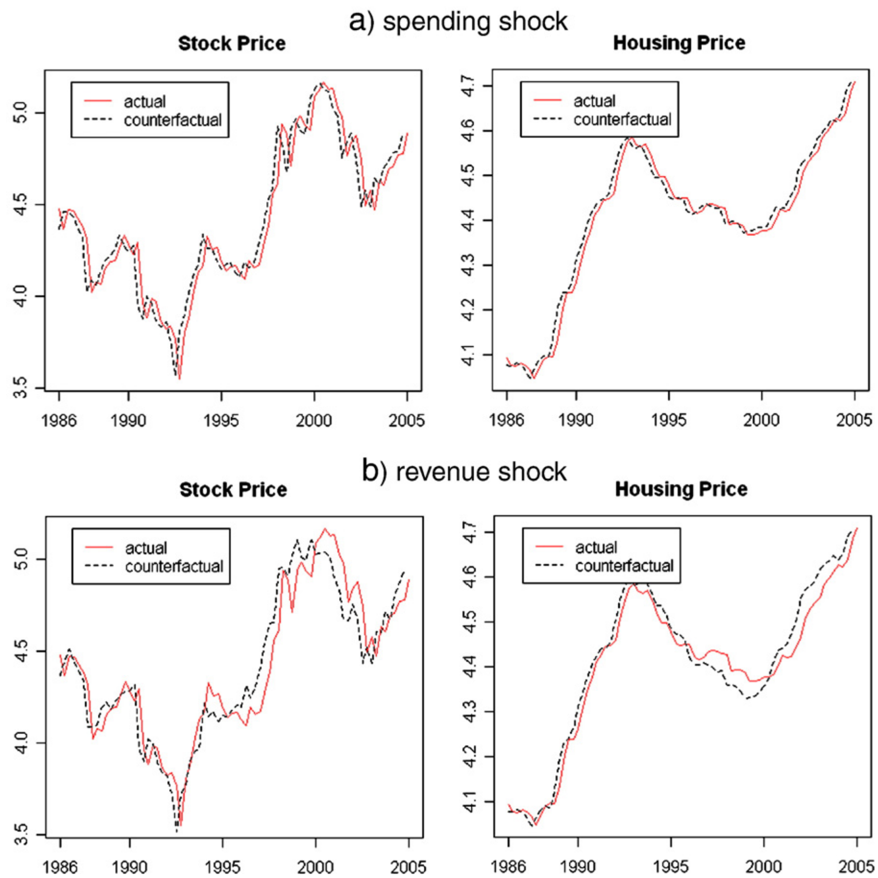

Fig. 12. VAR counterfactual, Italy. Note: All series are in logs of real terms.

4.3. A VAR counter-factual exercise

In this sub-section, we describe a VAR counter-factual exercise aimed at illustrating the effects of shutting down the shocks in government spending or government revenue. In practice, after estimating the fully simultaneous system of equations summarized by Eqs. (1), (2) and (3), we construct the counter-factual (*CFT*) series as follows:

$$\underbrace{\Gamma(L)}_{n\times n}\underbrace{X_t^{CFT}}_{n\times 1} + \gamma_i d_{t-1} = \Gamma_0 X_t^{CFT} + \Gamma_1 X_{t-1}^{CFT} + \ldots + \gamma_i d_{t-1} = c + \varepsilon_t^{CFT} \quad (5)$$

$$d_t = \frac{1+i_t}{(1+\pi_t)(1+\mu_t)} d_{t-1} + \frac{G_t - T_t}{P_t Y_t} \quad (6)$$

$$v_t^{CFT} = \Gamma_0^{-1}\varepsilon_t^{CFT}. \quad (7)$$

Since we are interested in analyzing the role played by fiscal policy shocks, this is equivalent to consider the following vector of structural shocks

$$\varepsilon_t^{CFT} = \left[\varepsilon_t^{SP}, 0, \varepsilon_t^{T}, \varepsilon_t^{Y}, \varepsilon_t^{P}, \varepsilon_t^{i}, \varepsilon_t^{U}, \varepsilon_t^{HP}\right]' \quad (8)$$

$$\varepsilon_t^{CFT} = \left[\varepsilon_t^{SP}, \varepsilon_t^{G}, 0, \varepsilon_t^{Y}, \varepsilon_t^{P}, \varepsilon_t^{i}, \varepsilon_t^{U}, \varepsilon_t^{HP}\right]', \quad (9)$$

where we shut down, respectively in Eq. (8) and in Eq. (9), the government spending shock and the government revenue shock. We then use these vectors of counter-factual structural shocks to build the counter-factual series for all endogenous variables of the system.

Fig. 9a and b plots the actual and the counter-factual series for stock prices and housing prices in the U.S. in the case of respectively, a shock to government spending and a shock to government revenue. The results show that fiscal policy shocks play a minor role as the difference between the actual and the counterfactual series are negligible.

Similarly, Fig. 10a and b plots the actual and the counter-factual series for stock prices and housing prices in the U.K. also for a shock to government spending and a shock to government revenue. Contrary to the U.S., the results show that fiscal policy shocks play an important role in the U.K. In fact, it can be seen that the actual and the counter-factual series are substantially different, in particular: during the nineties, in the case of stock prices; and in the late eighties and early nineties, for housing prices.

Fig. 11a and b depicts the actual and the counter-factual series for stock prices and housing prices in Germany for the two fiscal shocks. The results suggest that fiscal policy shocks are less relevant determinants of asset markets. In fact, while the difference between actual and counter-factual series is negligible for stock prices, in the case of housing prices that difference seems significant only after 2000 and contributed to a more stable performance of the market.

Fig. 12a and b shows the actual and the counter-factual series for stock prices and housing prices in Italy. The results show that fiscal policy shocks, in particular, those on the revenue side, are important determinants of asset markets. Moreover, they illustrate that unexpected variance in the fiscal policy stance has a disturbing effect on those markets, increasing their volatility.[5] This is particularly the case after the second half of the nineties and notably for a government revenue shock.

[5] In the same vein, Afonso and Claeys (2008) show that fiscal policy can indeed exacerbate economic instability.

5. Conclusion

This paper evaluated the effects of fiscal policy on economic activity, with a particular emphasis on the linkages between fiscal policy and asset markets. The fiscal policy shocks are identified using external information about the elasticity of fiscal variables to the economic activity. Moreover, we use a Fully Simultaneous System approach in a Bayesian framework, therefore, taking into account the posterior uncertainty of the impulse–response functions. In addition, we explicitly include in our framework the feedback from government debt.

We show that government spending shocks have a positive and persistent effect on GDP in the U.S. and the U.K., with a fiscal multiplier of around 0.2–0.3%. For Germany and Italy, the (positive) impact is temporary and becomes negative after 4 to 8 qtr, suggesting that expansionary fiscal policy is somewhat neutralized by a financial crowding-out effect via the increase in the average cost of the debt. Furthermore, spending shocks also have a positive and persistent effect on housing prices, although housing markets tend to respond with a lag of around 4 qtr; a negative effect on stock prices, although the time of reaction is faster than for housing prices; positive effects on the price level in the case of the U.K. and Italy, and negative effects for the U.S. and Germany; a reduction effect in unemployment only in the U.S.

On the other hand, government revenue shocks have: an initial negative effect on GDP that later becomes positive; a negative impact on housing prices for the U.S. and Italy, and a positive impact for the U.K. and Germany; a small and positive effect on stock prices; in general, a negative and persistent effect on the price level; and a positive and persistent impact on the unemployment rate. Long-term interest rates and GDP become more responsive and the effects on these variables also become more persistent when we explicitly include the debt feedback in the estimations.

We also find that government revenue shocks tend to have a persistent positive effect on growth in the U.S., in the U.K. and in Italy, while the effect reverts after 12 qtr in the case of Germany. Such effect can be related to a more Ricardian behavior whereby agents take into account the government's concern about fiscal imbalances. Therefore, consumers assume the need for lower taxes in the future, and a higher future disposable income, and may increase demand in the present.

Finally, in a VAR counter-factual exercise, we show that: fiscal policy shocks play a minor role in the patterns that one observes for stock prices and housing prices in the U.S. and Germany; both spending and revenue shocks have an important effect on asset markets in the U.K.; and for Italy, government revenue shocks increased the volatility in housing and stock prices, in particular, in the nineties.

A possible extension of the current work would be the analysis of the effects of shocks in the different components of government revenue (direct taxes on households, direct taxes on corporations, indirect taxes, and employers' social security contributions) and government spending (wages and non-wage expenditure).

Appendix A. Assessing posterior uncertainty in a fully simultaneous SVAR

To be able to identify the structural fiscal policy shocks we need at least $(n-1)n/2$ linearly independent restrictions. With enough restrictions in the Γ_0 matrix and no restrictions in the matrix of coefficients on the lagged variables, the estimation of the model is numerically simple since the log-likelihood will be

$$l(B,a,\Gamma_0) = -\frac{T}{2} + \log\left|\Gamma_0\right| - \frac{1}{2}trace\left[S(B,a)\Gamma_0'\Gamma_0\right] \tag{A.1}$$

where $S(B,a) = \sum_{t=1}^{T}(B(L)X_t - a)(B(L)X_t - a)'$. Integrating $l(B, a, \Gamma_0)$ (or the posterior with conjugate priors) with respect to $(B,\ a)$ the marginal log probability density function of Γ_0 is proportional to

$$-\frac{T-k}{2}\log(2\pi) + (T-k)\log\left|\Gamma_0\right| - \frac{1}{2}trace\left[S\left(\hat{B}_{OLS}, \hat{a}_{OLS}\right)\Gamma_0'\Gamma_0\right]. \tag{A.2}$$

The impulse–response function to a one standard-deviation shock is given by:

$$B(L)^{-1}\Gamma_0^{-1}. \tag{A.3}$$

This implies that to assess posterior uncertainty regarding the impulse–response function we need joint draws for both $B(L)$ and Γ_0.

Since Eq. (A.2) is not in the form of any standard probability density function, we cannot draw Γ_0 from it directly to make inference. Nevertheless, taking a second order expansion around its peak, we get the usual Gaussian approximation to the asymptotic distribution of the elements in Γ_0.

In addition, since this is not the true form of the posterior probability density function, we cannot use it directly to produce a Monte Carlo sample. Therefore, we follow an importance sampling approach, in which we draw from the Gaussian approximation but weigh the draws by the ratio of (A.2) to the probability density function from which we draw. The weighted sample cumulative density function then approximates the cumulative density function corresponding to (A.2).

Note also that the distribution of $B(L)$, given Γ_0, is the usual normal distribution:

$$vech(B(L))\,|\,\Gamma_0 \sim \mathrm{N}\left(vech\left(\hat{B}_{OLS}\right), \Gamma_0^{-1}\left(\Gamma_0^{-1}\right)' \otimes (X'X)^{-1}\right). \tag{A.4}$$

As a result, we can take joint draws using the following simple algorithm: (i) draw Γ_0 using importance sampling; and (ii) draw $vech(B(L))$ using the expression above.

Error bands for the impulse–response function are then constructed from the weighted percentiles of the Monte Carlo sample and computed as follows.

Denote $\hat{H}$ the numerical Hessian from the minimization routine at the point estimate and $\hat{\Gamma}_0$ the maximum-likelihood estimator, and follow the following algorithm:

1. Check that all the coefficients on the main diagonal of Γ_0 are positive. If they are not, flip the sign of the rows that have a negative coefficient on the main diagonal (that is, our point estimates are normalized to have positive elements on the main diagonal).
2. Set $i=0$.
3. Draw $vech(\Gamma_0)$ from a normal $N(vech(\Gamma_0), V)$, where $V=H^{-1}$ and $vech(.)$ vectorizes the unconstrained elements of a matrix. That is, this step draws from the asymptotic distribution of Γ_0. We handle draws in which some of the diagonal elements of Γ_0 are not positive, by rejecting them and going back to 2. to take another draw.
4. Compute and store the importance sampling weight, m,

$$m_i = \exp\begin{bmatrix} T\log\left|\det\left(\tilde{\Gamma}_0\right)\right| - \frac{1}{2}trace\left[S\left(\hat{B}_{OLS}, \hat{a}_{OLS}\right)\tilde{\Gamma}_0'\tilde{\Gamma}_0\right] \\ -\log\left|\hat{V}\right|^{-\frac{1}{2}} + .5\left(vech\left(\tilde{\Gamma}_0\right) - vech\left(\tilde{\Gamma}_0\right)\right)'\hat{V}^{-1}\left(vech\left(\tilde{\Gamma}_0\right) - vech\left(\hat{\Gamma}_0\right)\right) \\ -SCFT \end{bmatrix}$$

   where SCFT is a scale factor that prevents overflow/underflow (a good choice for it is normally the value of the likelihood at its peak).
5. Draw $vech\left(\tilde{B}(L)\right)$ from a normal $\mathrm{N}\left(vech\left(\hat{B}_{OLS}\right), \tilde{\Gamma}_0^{-1}\left(\tilde{\Gamma}_0^{-1}\right)' \otimes (X'X)^{-1}\right)$ to get a draw for $\tilde{B}(L)$.
6. Compute the impulse–response function and store it in a multi-dimensional array.

7. If $i<\#draws$, set $i=i+1$ and go back to 3.

The stored draws of the impulse–response function, jointly with the importance sampling weights, are used to construct confidence bands from their percentiles. Moreover, the draws of Γ_0 are stored to construct posterior confidence interval for these parameters from the posterior (weighted) quantiles.

Normalized weights that sum up to 1 are simply constructed as:

$$\omega_i = \frac{m_i}{\sum_{i=1}^{\#draws} m_i}.$$

Appendix B. Data sources

B.1. U.S. data

B.1.1. Housing sector

Housing prices are measured using two sources: (a) the Price Index of New One-Family Houses sold including the Value of Lot provided by the U.S. Census, an index based on houses sold in 1996, available for the period 1963:1–2006:3; and (b) the House Price Index computed by the Office of Federal Housing Enterprise Oversight (OFHEO), available for the period 1975:1–2007:4. Data are quarterly, seasonally adjusted.

B.1.2. Housing market indicators

Other Housing Market Indicators are provided by the U.S. Census. We use the Median Sales Price of New Homes Sold including land and the New Privately Owned Housing Units Started. We seasonally adjust quarterly data for the Median Sales Price of New Homes Sold including land using Census X12 ARIMA, and the series comprise the period 1963:1–2007:4. The data for the New Privately Owned Housing Units Started are quarterly (computed by the sum of corresponding monthly values), seasonally adjusted and comprise the period 1959:1–2007:4.

B.1.3. GDP

The source is Bureau of Economic Analysis, NIPA Table 1.1.5, line 1. Data for GDP are quarterly, seasonally adjusted, and comprise the period 1947:1–2007:4.

B.1.4. Price deflator

All variables were deflated by the GDP deflator. Data are quarterly, seasonally adjusted, and comprise the period 1967:1–2007:4. The source is the Bureau of Economic Analysis, NIPA Tables 1.1.5 and 1.1.6, line 1.

B.1.5. Stock market index

Stock Market Index corresponds to S&P 500 Composite Price Index (close price adjusted for dividends and splits). Data are quarterly (computed from monthly series by using end-of-period values), and comprise the period 1950:1–2007:4.

B.1.6. Government spending

The source is Bureau of Economic Analysis, NIPA Table 3.2. Government Spending is defined as primary government expenditure, obtained by subtracting from total Federal Government Current Expenditure (line 39) net interest payments at annual rates (obtained as the difference between line 28 and line 13). Data are quarterly, seasonally adjusted, and comprise the period 1960:1–2007:4.

B.1.7. Government revenue

The source is Bureau of Economic Analysis, NIPA Table 3.2. Government Revenue is defined as government receipts at annual rates (line 36). Data are quarterly, seasonally adjusted, and comprise the period 1947:1–2007:4.

B.1.8. Debt

Debt corresponds to the Federal government debt held by the public. The source is the Federal Reserve Bank of St Louis (series "FYGFDPUN"). Data are quarterly, seasonally adjusted, and comprise the period 1970:1–2007:4.

B.1.9. Average cost of financing debt

The average cost of financing debt is obtained by dividing net interest payments by debt at time $t-1$.

B.1.10. Long-term interest rate

Long-Term Interest Rate corresponds to the yield to maturity of 10-year government securities. Data are quarterly, and comprise the period 1960:1–2007:4. The source is the OECD, Main Economic Indicators (series "USA.IRLTLT01.ST").

B.1.11. Unemployment rate

Unemployment rate is defined as the civilian unemployment rate (16 and over) (series "LNS14000000"). Data are quarterly (computed from monthly series by using end-of-period values), seasonally adjusted and comprise the period 1948:1–2007:4. The source is the Bureau of Labour Statistics, Current Population Survey.

B.2. U.K. data

B.2.1. Housing prices

Housing prices are measured using two sources: (a) the Mix-Adjusted House Price Index (Feb 2002 = 100) provided by the Office of the Deputy Prime Minister (ODPM), seasonally adjusted, and available for the period 1968:2–2007:4; and (b) the All-Houses Price Index (1952Q4 = 100 and 1993Q1 = 100) computed by the Nationwide Building Society, which we seasonally adjust using Census X12 ARIMA, and is available for the period 1952:4–2007:4.

B.2.2. GDP

Data for GDP are quarterly, seasonally adjusted, and comprise the period 1955:1–2007:4. The source is the Office for National Statistics, Release UKEA, Table A1 (series "YBHA").

B.2.3. Price deflator

All variables were deflated by the GDP deflator. Data are quarterly, seasonally adjusted, and comprise the period 1955:1–2007:4. The source is the Office for National Statistics, Release MDS, Table 1.1 (series "YBGB").

B.2.4. Stock market index

Stock Market Index corresponds to the FTSE-All Shares Index (1962:2 = 100 or 1962 April = 100). Data are quarterly, and comprise the period 1962:2–2007:4. The source is Datastream.

B.2.5. Government spending

The source is the Office for National Statistics (ONS), Release Public Sector Accounts. Government Spending is defined as total current expenditures of the Public Sector ESA 95 (series "ANLT") less net investment (series "ANNW"), to which we subtract net interest payments (obtained as the difference between interest and dividends paid to private sector (series "ANLO") and interest and dividends received from the private sector and the Rest of World (series "ANBQ"). We seasonally adjust quarterly data using Census X12 ARIMA, and the series comprise the period 1947:1–2007:4.

B.2.6. Government revenue

The source is the Office for National Statistics (ONS), Release Public Sector Accounts. Government Revenue is defined as total current receipts of the Public Sector ESA 95 (series "ANBT"). We seasonally adjust quarterly data using Census X12 ARIMA, and the series comprise the period 1947:1–2007:4.

B.2.7. Debt

The source is the Office for National Statistics (ONS), Release Public Sector Accounts. Debt is defined as the Public Sector net debt (series "BKQK"). We seasonally adjust quarterly data using Census X12 ARIMA, and the series comprise the period 1962:4–2007:4.

B.2.8. Average cost of financing debt

The average cost of financing debt is obtained by dividing net interest payments by debt at time $t-1$.

B.2.9. Long-term interest rate

Long-Term Interest Rate corresponds to the yield to maturity of 10-year government securities. Data are quarterly, and comprise the period 1957:1–2007:4. The source is the IMF, International Financial Statistics (series "61…ZF").

B.2.10. Unemployment rate

The source is the Office for National Statistics, Labour Market Statistics. Unemployment rate is defined as the U.K. unemployment rate among all aged 16 and over (series "MGSX"). Data are: quarterly, seasonally adjusted and comprise the period 1971:1–2007:4.

B.3. Germany data

B.3.1. Housing prices

Housing prices correspond to the residential property price index. Data are quarterly, seasonally adjusted, and available for the period 1970:1–2006:4. The source is the Bank for International Settlements (BIS).

B.3.2. GDP

Data for GDP are quarterly, seasonally adjusted, and comprise the period 1960:1–2007:4. The source is the IMF, International Financial Statistics (series "IFS.Q.134.9.9B.B$C.Z.F.$$$").

B.3.3. Price deflator

All variables were deflated by the GDP deflator (2000 = 100). Data are quarterly, seasonally adjusted, and comprise the period 1960:1–2007:2. The source is the IMF, International Financial Statistics (series "IFS.Q.134.9.9B.BIR.Z.F.$$$").

B.3.4. Stock market index

Stock Market Index corresponds to the MSCI-Gross Return Index (1969:4 = 100). Data are quarterly, and comprise the period 1969:4–2007:4. The source is Morgan Stanley Capital International.

B.3.5. Government spending

The source is the Bundesbank and the Monthly Reports released by the German Ministry of Finance. Government Spending is defined as Central Government total expenditure (on a cash basis). We seasonally adjust quarterly data using Census X12 ARIMA, and the series comprise the period 1979:1–2007:3.

B.3.6. Government revenue

The source is the Bundesbank and the Monthly Reports released by the German Ministry of Finance. Government Revenue is defined as Central Government total revenue (on a cash basis). We seasonally adjust quarterly data using Census X12 ARIMA, and the series comprise the period 1979:1–2007:3.

B.3.7. Debt

The source is the Bundesbank and the Monthly Reports released by the German Ministry of Finance. Debt is as the Central, state and local government debt (excluding hospitals). We seasonally adjust quarterly data using Census X12 ARIMA, and the series comprise the period 1966:4–2007:4.

B.3.8. Average cost of financing debt

The average cost of financing debt is obtained by dividing net interest payments by debt at time $t-1$.

B.3.9. Long-term interest rate

Long-Term Interest Rate corresponds to the yield to maturity of 10-year government securities. Data are quarterly, and comprise the period 1957:1–2007:4. The source is the IMF, International Financial Statistics (series "61…ZF").

B.3.10. Unemployment rate

The source is the OECD, Main Economic Indicators. Unemployment rate is defined as the registered unemployment rate among all persons (series "MEI.Q.DEU.UNRTRG01.STSA"). Data are quarterly, seasonally adjusted, and comprise the period 1969:1–2007:4.

B.4. Italy data

B.4.1. Housing prices

Housing prices correspond to the residential property price index. Data are quarterly, seasonally adjusted, and available for the period 1970:1–2006:4. The source is the Bank for International Settlements (BIS).

B.4.2. GDP

Data for GDP are quarterly, seasonally adjusted, and comprise the period 1960:1–2007:3. The source is the IMF, International Financial Statistics (series "IFS.Q.136.9.9B.B$C.Z.F.$$$").

B.4.3. Price deflator

All variables were deflated by the GDP deflator (2000 = 100). Data are quarterly, seasonally adjusted, and comprise the period 1980:1–2007:2. The source is the IMF, International Financial Statistics (series "IFS.Q.136.9.9B.BIR.Z.F.$$$").

B.4.4. Stock market index

Stock Market Index corresponds to the MSCI-Gross Return Index (1969:4 = 100). Data are quarterly, and comprise the period 1969:4–2007:4. The source is Morgan Stanley Capital International.

B.4.5. Government spending

The source is the Bank of Italy and the Italian Ministry of Finance. Government Spending is defined as Central Government total expenditure (on a cash basis). We seasonally adjust quarterly data using Census X12 ARIMA, and the series comprise the period 1960:1–2007:4.

B.4.6. Government revenue

The source is the Bank of Italy and the Italian Ministry of Finance. Government Revenue is defined as Central Government total revenue (on a cash basis). We seasonally adjust quarterly data using Census X12 ARIMA, and the series comprise the period 1960:1–2007:4.

B.4.7. Debt

The source is the Bank of Italy. Debt is as the stock of General Government short-term ("S571730M"), and medium and long-term securities ("S605216M"). We seasonally adjust quarterly data using Census X12 ARIMA, and the series comprise the period 1984:4–2007:4.

B.4.8. Average cost of financing debt

The average cost of financing debt is obtained by dividing net interest payments by debt at time $t-1$.

B.4.9. Long-term interest rate

Long-Term Interest Rate corresponds to the yield to maturity of 10-year government securities. Data are quarterly, and comprise the period 1957:1–2007:4. The source is the IMF, International Financial Statistics (series "61…ZF").

B.4.10. Unemployment rate

The source is the OECD, Main Economic Indicators. Unemployment rate is defined as the registered unemployment rate among all persons (series "MEI.Q.ITA.UNRTSUTT.STSA"). Data are quarterly, seasonally adjusted, and comprise the period 1960:1–2007:4.

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