The Macroeconomic Effects of Exogenous Fiscal Policy Shocks in Germany: A Disaggregated SVAR Analysis

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Summary

We investigate the effects of fiscal policy shocks on the German economy extending the SVAR approach of Blanchard and Perotti (2002). Direct government expenditure shocks are found to increase output and private consumption on impact. The output multiplier is smaller than one and is falling rather quickly reaching zero after 3 years. Government operating expenditure has sizeable positive effects on output, in the long run in particular due to public capital formation. Compensation of public employees is not effective in stimulating the economy. Government net revenue shocks do not affect output significantly. Indirect taxes have little effects, while direct taxes lower output significantly. Overall, the effects of fiscal policy are short-lived with the exception of public investment increases.

1 Introduction

The effects of fiscal policy on the macroeconomy are of ongoing interest to economic policymakers. Currently, the US, European, and various other governments intend to weaken or avoid a potential recession related to financial market turmoils by large fiscal stimulus packages. In particular, the German government implemented a stimulus package to counter the threat of recession due to the financial crisis. More generally, in the European Economic and Monetary Union (EMU) national fiscal policy might have to play a greater role in stabilizing national business cycles as monetary policy focuses on the euro area as a whole. While there are frequent calls for fiscal policy actions, stylized facts on the macroeconomic impact of fiscal policy have not been established yet – much in contrast to monetary policy effects.

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Most studies investigate fiscal policy in the US (Blanchard/Perotti 2002, Fatas/Mihov 2001, Mountford/Uhlig 2009, Ramey/Shapiro 1998 among others), while the number of papers concerning Europe is rather limited (Marcellino 2006 for some euro area countries, de Castro/de Cos 2008 for Spain, Biau/Girard 2005 for France and Giordano et al. 2007 for Italy as well as Hoeppner 2003 and Perotti 2005 for Germany). Roos (2007) provides a summary of the studies investigating the effect of fiscal policy in Germany. Regarding the model based studies, he refers to an overview article by Hemming et al. (2002). According to this study, quantitative models usually predict that expansive fiscal policy has positive output effects in the short run. The multiplier is quite heterogeneous across studies ranging between 0.1 and 2.7. The standard result is a multiplier of around 0.6.[1] Expenditure based expansions are found to have larger multipliers than revenue based expansions. Regarding empirical studies, Roos (2007) finds (also based on the working paper version of this paper) generally rather weak and short-lived effects. All studies with the exception of Giordano et al. (2007) look exclusively at very aggregate categories of spending or revenue. Moreover, the German studies suffer from short time series as they focus on pre-unification Germany. We contribute to the existing studies by providing disaggregated effects of fiscal policy actions on the largest economy in the EMU, Germany.

Keynesian and neoclassical models differ in their predictions of the effects of fiscal policy. While in principal both theories predict output to increase after a rise of unproductive expenditure financed via lump-sum taxes, the response of consumption is different. In a *neoclassical model*, Baxter and King (1993) show that an increase in government spending financed via non-distortionary, i. e., lump-sum, taxes generates a loss in wealth for the representative household, to which it responds by decreasing consumption and increasing labor supply leading to an increase in output. If the increase in government spending is financed by distortionary taxes, the results change due to intra- and intertemporal substitution effects of labor supply (Burnside et al. 2000). Moreover, Baxter and King (1993) show that public investment, if productive, has very strong output and consumption effects. In a *New Keynesian world*, a positive response of private consumption to a rise in government expenditure is achieved by introducing price rigidities and non-Ricardian ("rule-of-thumb") consumers (Galí et al. 2007).[2] Despite an expansion of labor supply after a rise in government spending financed via lump-sum taxes, real wages increase due to a decreasing price markup. The rise in labor income triggers an increase in consumption of rule-of-thumb households implying a rise in aggregate demand, leading to a further expansion of output and employment. In the case of distortionary taxes, intratemporal substitution effects of labor supply lead to a decrease in private consumption after its initial rise (Bilbiie/Straub 2004).

A number of empirical approaches have been used to estimate the effects of fiscal policy on the macroeconomy. They usually rely on aggregate government spending and aggregate revenue to gauge the macroeconomic effects of fiscal policy. However, as the theoretical discussion has shown, macroeconomic variables are expected to react very differently to investment vs. consumption spending. Similarly, lump-sum taxes have different effects than labor income taxes. From an empirical perspective, it is therefore crucial

[1] Also the Bundesbank model finds a multiplier smaller than one.

[2] Instead of rule-of-thumb consumers, Basu and Kimball (2000) employ a utility function exhibiting complementarity between consumption and labor; Linnemann (2005) implements a binding cash-in-advance constraint to capture non-Ricardian behavior.

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to distinguish between different fiscal variables. This is also crucial from a macroeconomic policy perspective: theoretical considerations indeed suggest that fiscal multipliers are very different for different fiscal variables. From a narrowly interpreted efficiency point of view, it would be thus desirable that policymakers choose those variables with the greatest impact on the economy given the use of scarce budget resources. We therefore present besides aggregate fiscal variables, the empirical estimates of disaggregated spending and revenue components in Germany.

Our approach builds on the seminal paper by Blanchard and Perotti (2002), who develop a structural VAR (SVAR) approach and apply it to US data.[3] They find rising private consumption after a spending shock. Furthermore, output increases (decreases) in response to a positive expenditure (tax) shock. However, spending and tax shocks trigger a fall in private investment. For West Germany (1975:1 – 1989:4), Perotti (2005) obtains a significant positive cumulative response of GDP to a government spending shock at 4 quarters which becomes negative at 12 quarters. For the same sample period, private consumption and private investment show insignificant responses at 4 quarters and a significant decline at 12 quarters. Hoeppner (2003) finds a negative response to revenue shocks and a positive one to expenditure shocks.

Our main findings are that a government expenditure shock triggers an output increase, while a government revenue shock does not affect output significantly. Private consumption reacts weakly positive to a spending shock, whereas private investment increases more strongly. The output multiplier of government expenditure is smaller than one, however, and decreases over time. Looking at disaggregated fiscal variables provides a more nuanced picture. With respect to the expenditure side, our results suggest that government operating expenditure and, in particular, government investment have strong, persistent, and significant effects on macroeconomic activity. In contrast, government personnel expenditure and government consumption have only negligible effects. When considering sub-components of government revenue, our results indicate that direct tax shocks have stronger effects than indirect tax shocks, perhaps due to the more distortionary nature of the former. Generally, we find typical response patterns of prices and the interest rate.

The remainder of this paper is organized as follows: Section 2 presents the empirical approach. In section 3, a detailed description of the utilized data is given. The effects of fiscal policy on disaggregated macroeconomic variables are discussed in section 4. In section 5, the results of shocks to disaggregated government budgetary items are presented. Finally, section 6 concludes.

2 The empirical approach

Since the work of Sims (1980), the use of VARs has become very popular in macroeconomics. However, while there is abundant literature on the effects of monetary policy in such a setting, only few researchers have investigated fiscal policy in a VAR context. Our empirical approach relies on a structural VAR analysis. In particular, identification of fiscal policy shocks is based on the methodology originally proposed by Blanchard and Perotti (2002). This study is one of the seminal papers for assessing the effects of fiscal policy. Moreover, its identification approach is simple and intuitive. The

[3] We rely on this time-series approach as natural experiments in German post-war history are rare.

main idea is to exploit fiscal policy decision lags to compute discretionary fiscal policy shocks, which are unaffected by the macroeconomic variables in the VAR model. In particular, Blanchard and Perotti (2002) argue that governments cannot react within the same quarter to changes of the macroeconomic environment, since fiscal policy decision-making is a rather long process, involving many agents in parliament, government, and civil society. Therefore, reactions of fiscal policy to current developments only result from so called "automatic" responses, which are defined by existing laws and regulations. All fiscal policy developments in a given quarter, which do not reflect automatic responses, are basically seen as structural fiscal policy shocks, which are exogenous to the macroeconomy.[4]

In general, the reduced-form VAR has the following form:

$$Y_t = C(L)Y_{t-1} + U_t, \qquad t = 1, \ldots, T, \tag{1}$$

where Y_t is a $N \times 1$ vector of endogenous variables, $C(L)$ is a $N \times N$ matrix lag polynomial, and U_t is a $N \times 1$ vector of reduced-form innovations, which are independent and identically distributed with variance-covariance matrix $\Sigma_U = E(U_t U_t')$.[5] The so-called AB-model of Amisano and Giannini (1997) suggests the following relation between the reduced-form innovations U_t and the objects of ultimate interest, the structural shocks V_t:

$$AU_t = BV_t, \tag{2}$$

where the $N \times N$ matrices A and B describe the instantaneous relation between the variables and the linear relationship between the structural shocks and the reduced form residuals, respectively. The structural shocks are assumed to be orthogonal in order to investigate the impact of an isolated shock.

Consequently, the structural form of the VAR can be obtained by pre-multiplying (1) by A:

$$AY_t = AC(L)Y_{t-1} + AU_t = AC(L)Y_{t-1} + BV_t. \tag{3}$$

Solving the latter equation for Y_t yields the structural moving-average representation, whose coefficients are the structural impulse response functions, which are the primary analytical tool in this analysis:

$$Y_t = [I - C(L)L]^{-1}A^{-1}BV_t. \tag{4}$$

Please note, that when Y_t contains integrated variables, the operator $[I - C(L)L]$ is not invertible and representation (4) is not valid as it requires stability of the VAR. Even though in this case, the VAR process does not possess a valid moving-average representa-

[4] The current economic and financial crisis underscores, how difficult it is for fiscal policy makers to react quickly in real time. The most significant parts of the fiscal policy stimulus in Germany have occurred with some lag to the diagnosis of the problem and the sharp contraction in GDP. In particular, while the crisis was at its peak in the last quarter of 2008 and first quarter of 2009, the greatest part of the stimulus occurred as of late spring 2009 and continues up to 2010. In Germany, fiscal decisions are taken rather slowly and become effective only with a significant lag of more than one quarter.

[5] For an overview of VARs, see for example Hamilton (1994).

tion, the impulse response matrices and forecast error variance decompositions for a finite horizon can be computed in the usual fashion, i.e., as in the case of a stationary, stable VAR (Lütkepohl 1991, Chapter 11). An important difference to the latter case, however, is that impulse responses do not necessarily taper off to zero as the horizon goes to infinity.

More specifically, in our benchmark specification Y_t consists of the following five variables for Germany: real GDP (y_t), the GDP deflator (p_t), the nominal short-term interest rate (i_t), real government direct expenditure (e_t), and real government net revenue (r_t), i.e. $Y_t = [y_t \ p_t \ i_t \ e_t \ r_t]'$.[6] The frequency of the time series used is crucial for the identification approach. In order to exclude the possibility of discretionary fiscal policy actions within one time period, quarterly data are used. The VAR is estimated in levels and a constant, a time trend, and a shift dummy to account for the effects of German re-unification are included as deterministic terms. The number of lags for the VAR is chosen to be two as suggested by the Hannan-Quinn criterion (HQ).[7]

With respect to the time series properties of the variables under consideration, they are found to be integrated of order 1 ($I(1)$). We apply both standard unit root and stationarity tests such as the augmented Dickey-Fuller (ADF) test (Dickey/Fuller 1979) and, for the latter null hypothesis, the test of Kwiatkowski et al. (1992). When checking the properties of the fiscal variables, we have to take into account the level shift due to unification, since a standard ADF test may be distorted if we just ignore this fact. Consequently, we apply the unit root test of Saikkonen and Lütkepohl (2002) and Lanne et al. (2002), which takes into account such a break in the series. When testing for cointegration using the Johansen trace test (Johansen 1995), it indicates two cointegration relationships for our benchmark model. Thus, we could specify a vector error correction model (VECM) and thereby take account of the cointegration relations, possibly obtaining more efficient estimates. We choose, however, to estimate a VAR in levels, since it also provides us with consistent estimates of the VAR coefficients and impulse response functions.[8] Furthermore, we want to be comparable to the results found in the literature, where also overwhelmingly VARs in levels are considered. Finally, when estimating models with many disaggregated time series it is difficult to find economically interpretable cointegration vectors.

The estimation proceeds in four steps following Giordano et al. (2007). In the first step, the reduced form VAR is estimated, yielding the reduced form residuals

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6 A more detailed description of the variables used in this investigation can be found in section 3.

7 The other information criteria we looked at (FPE, AIC, SC) either suggested a larger model featuring four lags (FPE, AIC) or indicated a more parsimonious specification with only one lag (SC). After investigating the (auto)correlation properties of the residuals for the different lag specifications, we opted for the intermediate value suggested by the HQ criterion. For an extensive survey of model selection criteria, see Lütkepohl (1991).

8 This course of action, however, implies that the asymptotic covariance matrix of the parameter estimator is singular, which has important consequences in certain inference settings. The usual χ^2 distribution, for instance, does not result asymptotically for Granger-causality tests, but rather some nonstandard distribution. There are also, however, a lot of situations where this type of problem does not occur. Tests that consider null hypotheses, which do not restrict elements of each of the parameter matrices, will have their respective standard asymptotic distribution. The usual t-test, for instance, for a VAR which has a lag order strictly larger than 1 still has a limiting standard normal distribution. The latter may not hold, however, for the parameters corresponding to the deterministic terms (Hamilton 1994, Lütkepohl/Krätzig 2004).

$U_t = [u_t^y \ u_t^p \ u_t^i \ u_t^e \ u_t^r]'$. As mentioned by Perotti (2005), the innovations in the fiscal variables u_t^e and u_t^r can be thought of as a linear combination of three types of shocks: i) the *automatic* response of government expenditure and revenue to real output, price, and interest rate innovations; ii) the *systematic, discretionary* response of fiscal policy to shocks to the macro variables; and iii) the *random, discretionary* fiscal policy shocks, which are the underlying structural shocks to be identified. This leads to the following formal representation of the reduced form residuals:

$$u_t^e = \alpha_y^e u_t^y + \alpha_p^e u_t^p + \alpha_i^e u_t^i + \beta_r^e v_t^r + v_t^e \tag{5}$$

$$u_t^r = \alpha_y^r u_t^y + \alpha_p^r u_t^p + \alpha_i^r u_t^i + \beta_e^r v_t^e + v_t^r, \tag{6}$$

where v_t^e and v_t^r are the structural shocks to government direct expenditure and government net revenue, respectively. Here, the observation of Blanchard and Perotti (2002), that the fiscal authorities need more than one quarter to react to macroeconomic shocks, becomes relevant. Basically this means that the second type of shock mentioned above is irrelevant and the α_i^j's only reflect the first channel, i.e. the automatic response of the fiscal variables to macroeconomic developments. Since the reduced form residuals are correlated with the v_t's, it is not possible to simply estimate the α_i^j's by OLS. Instead, motivated by the considerations stated above, we plug in exogenous elasticities to compute cyclically adjusted reduced-form fiscal policy shocks:[9]

$$u_t^{e,CA} = u_t^e - \alpha_y^e u_t^y - \alpha_p^e u_t^p - \alpha_i^e u_t^i = \beta_r^e v_t^r + v_t^e \tag{7}$$

$$u_t^{r,CA} = u_t^r - \alpha_y^r u_t^y - \alpha_p^r u_t^p - \alpha_i^r u_t^i = \beta_e^r v_t^e + v_t^r. \tag{8}$$

This is the second step of the estimation procedure. In the third step, in order to identify the structural shocks to the fiscal variables, it is necessary to make a decision with respect to the relative ordering of the fiscal variables. Setting $\beta_e^r = 0$ means that tax decisions come first, whereas setting $\beta_r^e = 0$ postulates the priority of spending decisions. In the baseline specification the latter assumption is used, a reverse ordering does not affect the results. Consequently, in this third step it is possible to estimate β_e^r by OLS and retrieve the structural shocks to the fiscal variables, v_t^e and v_t^r, as illustrated by the following two equations:

$$u_t^{e,CA} = v_t^e \tag{9}$$

$$u_t^{r,CA} = \beta_e^r v_t^e + v_t^r. \tag{10}$$

In particular, note that this specification allows for an immediate response of government revenue to spending shocks. In this regard, we capture the interaction of the expenditure and revenue side of government activity.

In the final step, the remaining coefficients of the equations for the macroeconomic variables are estimated:

[9] Those exogenous elasticities will be discussed in more detail in subsection 3.2.

$$u_t^y = \alpha_e^y u_t^e + \alpha_r^y u_t^r + v_t^y \tag{11}$$

$$u_t^p = \alpha_e^p u_t^e + \alpha_r^p u_t^r + \alpha_y^p u_t^y + v_t^p \tag{12}$$

$$u_t^i = \alpha_e^i u_t^e + \alpha_r^i u_t^r + \alpha_y^i u_t^y + \alpha_p^i u_t^p + v_t^i. \tag{13}$$

This is done recursively by means of instrumental variables regressions, in order to account for the correlation of the respective regressors and error terms.[10] Since the structural shocks v_t are orthogonal, they can be used as instruments. In particular, v_t^e and v_t^r are used as instruments when estimating equation (11), yielding the structural shock to the first macroeconomic variable, v_t^y. To estimate equation (12), we expand the previous set of instruments by this structural shock, whereby we obtain the structural shock to the next macroeconomic variable, v_t^p. Finally, we combine this shock with the previous three to get our set of instruments for the estimation of equation (13).

These four steps yield all necessary elements to construct the A and B matrices:

$$\begin{bmatrix} 1 & 0 & 0 & -\alpha_e^y & -\alpha_r^y \\ -\alpha_y^p & 1 & 0 & -\alpha_e^p & -\alpha_r^p \\ -\alpha_y^i & -\alpha_p^i & 1 & -\alpha_e^i & -\alpha_r^i \\ -\alpha_y^e & -\alpha_p^e & -\alpha_i^e & 1 & 0 \\ -\alpha_y^r & -\alpha_p^r & -\alpha_i^r & 0 & 1 \end{bmatrix} \begin{bmatrix} u_t^y \\ u_t^p \\ u_t^i \\ u_t^e \\ u_t^r \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & \beta_e^r & 1 \end{bmatrix} \begin{bmatrix} v_t^y \\ v_t^p \\ v_t^i \\ v_t^e \\ v_t^r \end{bmatrix}.$$

Considering the restrictions imposed on those two matrices, it follows that the order condition for identification is satisfied and, in particular, the model is found to be just identified. This can be seen from the following expression, relating the variance-covariance matrices of the reduced form innovations, Σ_U, and structural shocks, Σ_V:

$$\Sigma_U = A^{-1} B \Sigma_V B' (A^{-1})'. \tag{14}$$

The order condition in this case is that A, B, and Σ_V have no more unknown parameters than Σ_U. The latter, being symmetric, has $N(N+1)/2$ nonredundant elements. In the case of $N = 5$ this implies 15 distinct parameters. In our benchmark specification, we estimate the 5 diagonal elements of the matrix Σ_V, 9 parameters of the matrix A,[11] and 1 parameter of the matrix B. The remaining parameters are either set to zero or one, or equal to the respective exogenous elasticity.[12] Thus, in sum we estimate 15 parameters, implying that the model is just identified.

Computing the structural impulse response functions and corresponding forecast error variance decompositions is based on these estimated matrices as illustrated above. In this investigation the point estimate as well as 90 % pointwise bootstrap confidence intervals based on 5000 replications are shown, where we perform a bias correction using the bootstrap-after-bootstrap procedure of Kilian (1998).[13] We rely on a bootstrap procedure in order to take account of the full estimation uncertainty of the four-step estima-

[10] Note, that if the interest rests only on the identification of the structural fiscal policy shocks, the ordering of the remaining variables is irrelevant.

[11] The α_i^j's in the first three rows of A.

[12] The latter are the α_i^j's in the last two rows of A.

[13] An introduction into bootstrapping impulse responses can be found in Lütkepohl and Krätzig (2004: 177 ff.).

tion approach. This is a very cautious approach. Furthermore, we plot 90 % confidence intervals, compared to for example one-standard deviation bands (68 % under normality) in Blanchard and Perotti (2002), which explains relatively wide confidence bands.[14] Moreover, the impulse response functions are plotted for the first 12 quarters, only. Since we estimate the VAR in levels there are unit roots or near unit roots in the system. For these cases Phillips (1998) shows that estimated long period ahead impulse responses are inconsistent, i. e., they tend to random variables and not to the true impulse responses. Thus, in such a setting confidence in impulse responses for longer periods ahead does not seem to be advisable.[15]

3 Data

3.1 Data sources and description

We use quarterly data ranging from 1974:1 – 2008:4. The macroeconomic variables in terms of GDP, private consumption and investment, 3-month money market rate to capture monetary policy, GDP deflator, consumer price index, and government consumption deflator stem from the Statistisches Bundesamt (Federal Statistical Office Germany – destatis). Graphs of these data are presented in the appendix. The macroeconomic variables are adjusted for the German re-unification jump in 1991 by prolonging the series backwards with West-German growth rates.[16] Overlapping time series for West-Germany with data of unified Germany enables this procedure.

Sources of the fiscal variables are the Federal Statistical Office Germany and the Deutsche Bundesbank. Fiscal variables are cash data. In contrast to data based on ESA 1995, they are available at a higher than annual frequency and reflect actual cash payments. A shift dummy in the estimation approach captures the German re-unification jump in the fiscal data as overlapping time series are missing. All variables except for the interest rate are in logs, whereas all variables except for prices and the interest rate are expressed in real terms, deflated by the GDP deflator.[17] Where required, the data are seasonally adjusted by applying US Census Bureau's X12-ARIMA procedure. Using seasonally adjusted data could potentially lead to unreliable estimation results in our time-series context. Consequently, in subsection 4.3 we check the robustness of our findings by employing the series which are not seasonally adjusted, while including the respective seasonal dummies in the VAR.

[14] For ease of comparison and in order to convey a sense of the degree of significance of a given response, for selected specifications we also show 68 % confidence intervals in addition to the wider bands. In particular, for the sake of clarity of the presentation, we only plot both sets of confidence intervals in those cases, where we reach different conclusions depending on which bands we look at. A dynamic response, for instance, might be significantly positive on impact when considering 68 % confidence intervals while insignificant for 90 % bands.

[15] Finally, note that a standard VAR is a linear model and therefore cannot capture potential non-linear economic effects, where dynamic responses, for instance, vary for different sizes of a shock. While under normal circumstances, linearity provides an appropriate approximation, this might not be the case in the current state of severe market turbulence and policy responses at an unprecedented scale. It is, however, beyond the scope of this paper to extent the analysis to a non-linear setting. It should be furthermore noted, that it is standard in the literature studying the effects of fiscal policy to employ conventional linear VARs. This includes, in particular, contributions considering the US over an extended period of time, which features phases of both major and minor shocks.

[16] We checked for sub-sample stability by estimating the model separately for the time before and after unification; see subsection 4.3 on robustness.

[17] The index is set at 100 in 2000.

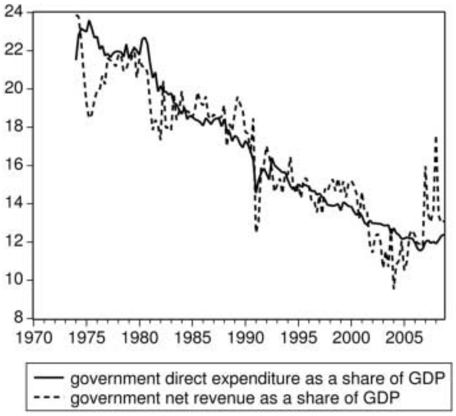

Figure 1 Government direct expenditure and net revenue in percent of GDP, seasonally adjusted.

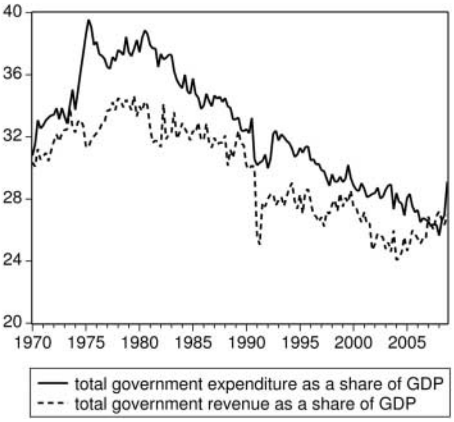

Figure 2 Total government expenditure and revenue in percent of GDP, seasonally adjusted.

To reflect the actual withdrawal of resources from the private sector we define – following Blanchard and Perotti (2002) – net revenue as total revenue of central, state and local government less transfers to social security funds, current grants paid to the private sector and public enterprises[18] and interest payments.[19] The social security sector is disregarded in this approach as social security contributions are assumed to be redistributed to the private sector and do not constitute a withdrawal of resources from the private sector as a whole. Accordingly, on the expenditure side the focus is on an aggregate labeled government "direct" expenditure. It consists of three categories: personnel expenditure, other operating expenditure,[20] and capital formation. Figure 1 plots the evolution of the measures of revenue and expenditure used in our baseline specification – here in percent of GDP. We observe a clear and common downward trend of both net revenue and direct expenditure in the period under consideration. Due to their construction, the slope is steeper than of the shares of total government revenue and expenditure (see Figure 2 for comparison). Furthermore, the net revenue to GDP ratio partly exceeds the direct expenditure ratio, which is in contrast to total aggregates. The reason for this finding is that direct expenditure does not include transfers.

On the expenditure side, Figure 3 illustrates that personnel expenditure far exceed other operating expenditure. The jump in 1991 reflects German re-unification. Capital forma-

[18] These current grants are derived as a residuum by subtracting the following expenditure categories from total expenditure of central, state and local government: personnel and other operating expenditure, fixed asset (capital) formation, financial aid, interest payments, and transfers to social security funds. Current grants plus transfers to social security funds, labeled total transfers paid, are depicted in Figure A4 in the appendix.

[19] EU transfers are still included as they are not passed on to the domestic private sector directly. As regards financial aid, it does not diminish the revenue variable as it rather reflects "indirect" expenditure in terms of expenditure on investment grants, loans, and acquisition of participating interests.

[20] This item includes, for example, administrative expenditure and military procurement ("Laufender Sachaufwand").

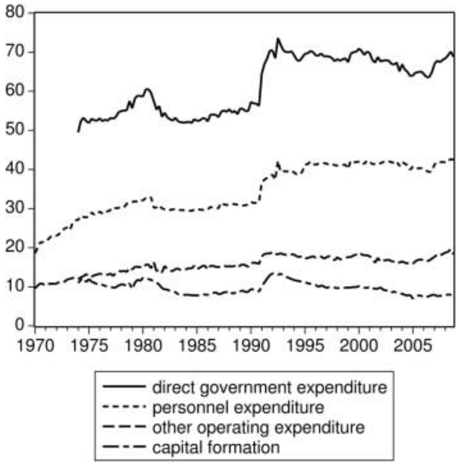

Figure 3 Real government direct expenditure and sub-categories in billion euros, seasonally adjusted.

Figure 4 Government investment in Germany in percent of GDP, seasonally adjusted.

tion is small and in absolute real terms almost unchanged in the investigated period, leading to a declining share in GDP over the last thirty years. This downward trend is noteworthy. As is depicted in Figure 4, the share decreases from over 7 to below 3 percent. Only in the late 1970s, after re-unification, and in the course of the recent crisis period public investment somewhat increases. The latter increase is almost exclusively driven by financial aid to investment.

On the revenue side, we can distinguish three tax sub-components: indirect taxes, wage taxes, and profit related taxes (Figure 5). The upward shift at the beginning of the 1990s

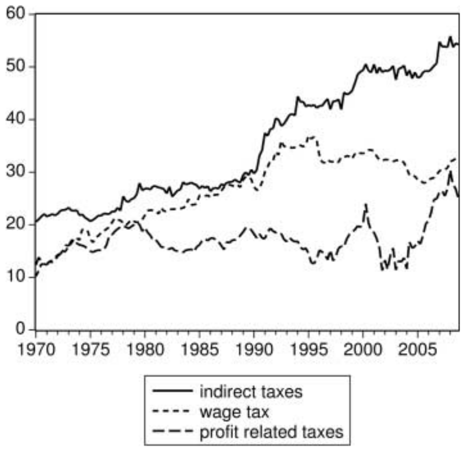

Figure 5 Real taxes in billion euros, seasonally adjusted.

Table 1 Exogenous elasticities

	real GDP	nominal interest rate	GDP deflator
direct expenditure	0	0	−1
net revenue	0.95	0	−0.05
public personnel expenditure	0	0	−1
other operating expenditure	0	0	−1
capital formation	0	0	−1
wage tax	1.58	0	0.58
indirect taxes	0.92	0	−0.08
direct taxes	1.62	0	0.62
profit taxes	0	0	−1
non-profit taxes	1.19	0	0.19

Notes: Authors' calculations based on Mohr (2001) and Kremer et al. (2006).

of indirect taxes, which comprises taxes on special excises and VAT, and of income taxes are due to German re-unification. Also the most recent hike in the VAT on January 2007 is clearly visible in the graph. Profit related taxes are subject to a sharp decrease after 2000. This phenomenon can be explained partly by changes in tax legislation and the development of entrepreneurial and investment income, and also by the exceptional high tax level reached in 2000 (see Bundesbank 2006).

3.2 Exogenous elasticities

In order to estimate the contemporaneous effects of budgetary items on the macroeconomic variables we need to adjust fiscal variables for the contemporaneous effects of the macroeconomy to address endogeneity issues. To do so, exogenous elasticities are required. To obtain the elasticity of a fiscal category with respect to GDP, the elasticity of the budgetary item to its macroeconomic base is multiplied with the elasticity of this base with respect to GDP. These sub-elasticities are derived from exogenous information (e. g., on the sensitivity of taxes on labor income to the compensation per employee in the public sector and on the sensitivity of this compensation to GDP). The calculations are based on Mohr (2001) and Kremer et al. (2006). The GDP deflator elasticity is simply the real GDP elasticity of the fiscal variable less 1.[21]

Table 1 provides an overview of the quarterly elasticities in use. The elasticities of the fiscal variables with respect to real private consumption and investment are not shown here. They are equal to the elasticities with respect to real GDP, weighted by the shares of each GDP component in the sum of both (private consumption (investment) amounts to 74 % (26 %)).

The elasticities of the aggregated fiscal variables are derived by weighting the elasticities of their sub-components with their relative amounts. Government net revenue, for instance, responds to real GDP by 0.95. This number contains output elasticities of direct taxes on households (1.58), indirect taxes (0.92), direct taxes on operating surplus and mixed income (0 as – in accordance with tax legislation – the payment of corporate in-

[21] This is based on the assumption that the response of the nominal fiscal variable is the same to both price and real GDP movements, which is, in turn, given by the real GDP elasticity of the real fiscal variable. Provided nominal prices do not influence real GDP, the GDP deflator elasticity as specified above follows.

come tax does not react to an increase in operating surplus instantaneously), other revenue, interest payments and unemployment aid (all equal to 0), and remaining transfers to private households, private and public enterprises, and social security funds (0.95 altogether). The close-to-one GDP-elasticity of transfers to social security funds is driven by transfers to the pension scheme. Reason for their high sensitivity to real GDP is the fact that such transfers are widely predetermined to amount to a fixed proportion of the pension scheme contributions and that the macroeconomic base of the latter responds to changes in GDP by nearly 1 on average. As the output elasticity of government revenue differs across SVAR-studies, robustness checks were carried out. They are described in subsection 4.3.

We assume that government direct expenditure do not respond to real GDP within a quarter as expenditure are predetermined in a budgetary plan and therefore rather inflexible in the short run. Furthermore, no fiscal variable is sensitive to the nominal interest rate contemporaneously. In particular, changing interest rates has only very gradually effects on government expenditure via interest payments on its debt, since only a small fraction of debt is rolled over in a given quarter.[22] Moreover, note that coupon payments on bonds are not usually made in the first quarter in which the bond is issued.

4 Fiscal policy effects on macroeconomic variables

4.1 Benchmark results

Figure 6 depicts the results of our 5-variable benchmark regression. We present the responses of GDP, prices, and the short-term interest rate to a unit shock either to government direct expenditure (upper row) or to government net revenue (lower row). We find that on impact government expenditure raises real GDP, the impact response is clearly significant at a 10 percent level.[23] Regarding the effects of revenue shocks, the impulse response illustrates that output basically does not react to a net revenue shock. The point estimate is very small and insignificant except for period 0, where the response is only marginally significant. Furthermore, this result for the impact response is not a very robust finding. In the next section, for instance, when we consider disaggregate fiscal variables, the output response to a government revenue shock turns out to be insignificant over the *entire* horizon. Prices respond with a significant upward jump to an increase in expenditure, while its response to a revenue shock is insignificant. The response of the short-term interest rate to government expenditure and revenue is insignificant.

In addition, Table 2 provides the output multipliers of government expenditure and revenue shocks, respectively.[24] With 0.83, the impact multiplier of government expenditure is smaller than one and subsequently it declines further. The output multiplier of government revenue is even smaller for the most part of the 12 quarters under consideration.

[22] If the average bond has a time to maturity of 5 years, then only 1/20 of government debt is rolled over.

[23] This particular response is even significant at a 5 % level. The results are available from the authors upon request.

[24] Those multipliers are computed as the ratio of the cumulative increase in output (in euros) to the cumulative increase in the respective fiscal variable (in euros) due to the corresponding fiscal shock. Since we employ the logs of those variables in the estimation, the coefficients of the impulse response function can be interpreted as elasticities. Consequently, we have to multiply the ratio of the sums of the impulse response coefficients by the ratio of output to the respective fiscal variable to obtain those multipliers.

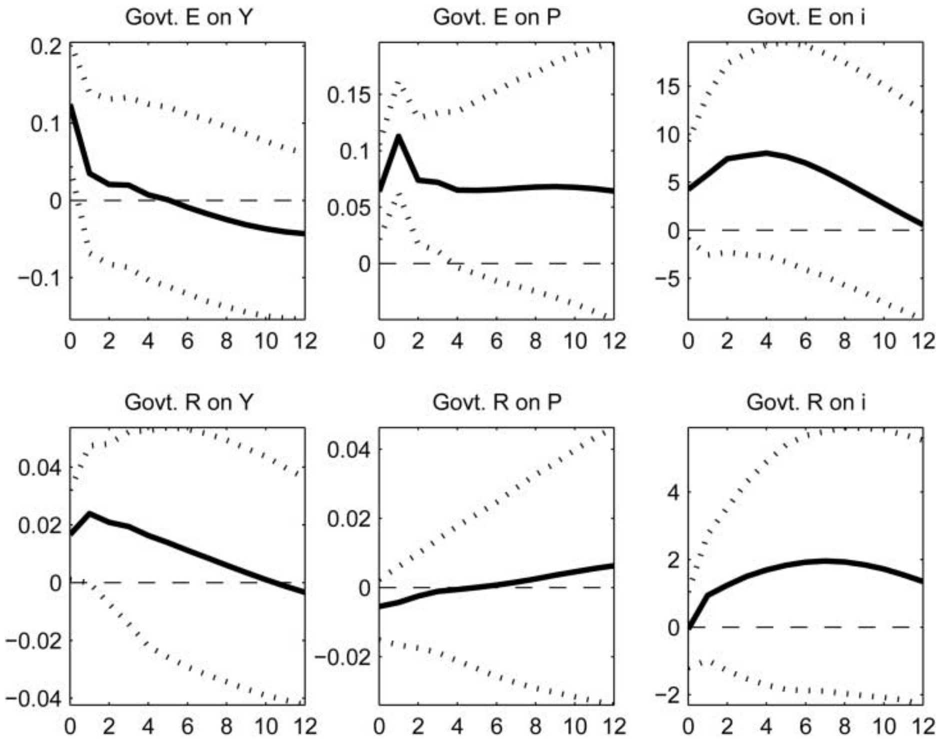

Figure 6 Basic 5-variable specification. Dotted lines: 90 % bootstrap confidence bands.

Thus, concerning the policy relevant question of the output multipliers of fiscal policy, we find a multiplier below one for government expenditure and an even weaker response to government revenue.

In order to get a sense of the relative importance of the various shocks, we perform forecast error variance decompositions at horizons of 1 to 12 quarters. The results are presented in Figures A5 and A6 in the appendix. These graphs show that the largest part of the forecast error variance of each variable up to a horizon of 6 quarters is explained by the respective shock to the variable itself. In the case of GDP, even at 12 quarters over 80 percent of the variance is explained by the output shock. Consequently, with respect to GDP, fiscal and monetary policy shocks play only a minor role. In the case of prices and interest rates, output shocks become more important than the respective own shock after 8 quarters. In sum, for the macroeconomic variables, apart from the respective own shock and the shock to GDP, only interest rate shocks explain a non-negligible – but still small – fraction of the variability, in particular at longer horizons. The fiscal shocks, on the other hand, do not play an important role in this respect. The only exception is perhaps prices, where government expenditure shocks have some contribution at shorter horizons. Their share decreases at larger horizons, however. Similarly, for the fiscal variables, the respective own fiscal shock explains the major share of the forecast error variance. In the case of government expenditure, GDP shocks become more important than government spending shocks after 8 quarters. This suggest that government spending is

Table 2 Output multipliers

quarter	0	1	2	3	4	5	6
Govt. E	0.83	0.70	0.62	0.61	0.58	0.56	0.52
Govt. R	0.10	0.17	0.20	0.23	0.25	0.27	0.28
quarter	7	8	9	10	11	12	
Govt. E	0.47	0.40	0.33	0.23	0.13	0.01	
Govt. R	0.29	0.30	0.30	0.30	0.30	0.29	

Notes: Entries are output multipliers with respect to government expenditure and revenue shocks, respectively.

indeed influenced quite a bit by GDP developments. The variability of revenue, finally, is mostly driven by revenue shocks itself.[25]

Finally, our identification approach finds support in the identified shock series. The largest structural shocks to expenditure as well as revenue occur in the quarters, where major fiscal policy measures were implemented.[26] The shock series are shown in the appendix in Figures A7 and A8. For example, the income tax reform of the Schröder government in 2002, 2003, and 2004 is clearly visible as a downward shock to revenue in the first quarter of each of those years. Moreover, the introduction of the "Solidaritätszuschlag," a tax surcharge, to finance German re-unification is clearly noticeable as an upward shock to revenue in the third quarter of 1991, while its (temporary) suspension one year later is also visible as a negative shock to revenue (although slightly below our threshold). Finally, the recent hike in the VAT on January 2007 is also reflected positively in the net revenue shock series.

4.2 Effects on private consumption and investment

To obtain a more detailed picture of the effects of fiscal policy, we look at the response of GDP components, in particular private consumption and investment. Neoclassical theory broadly predicts that consumption should fall in response to a (temporary) spending shock, while (New) Keynesian models predict that consumption increases. In Figure 7 the responses of consumption and investment to a spending and revenue shock in a 6-variable VAR are given. Real GDP is dropped in this specification and replaced by real consumption and real investment. Again, this model is just identified. The recursive ordering of the macroeconomic variables[27] and the additional exogenous elasticities impose the required extra restrictions. Analogous to the case of the benchmark specification outlined in section 2, there are 21 distinct parameters in Σ_U, while we estimate the 6 diagonal elements of Σ_V, 14 parameters of A, and 1 parameter of B.

[25] Please note, that this exercise, in general, is silent on the importance of the *systematic* component of the respective variable. In particular, the results cannot say something about the relative importance of the systematic component of fiscal or monetary policy. Only the contribution of the respective *shock* to the *forecast error* variance of a particular variable at different horizons is calculated, i.e., the focus is on the unsystematic component.

[26] We only look at those shocks that in absolute value exceed the standard deviation of the shock series by a factor of 1.96. In this regard, note that the variability of the net revenue shock series is considerably larger than the variability of the government spending shock series. The standard deviation of the former series is about four times the standard deviation of the latter.

[27] The ordering is as follows: real private consumption, real private investment, the GDP deflator, and finally the short-term interest rate.

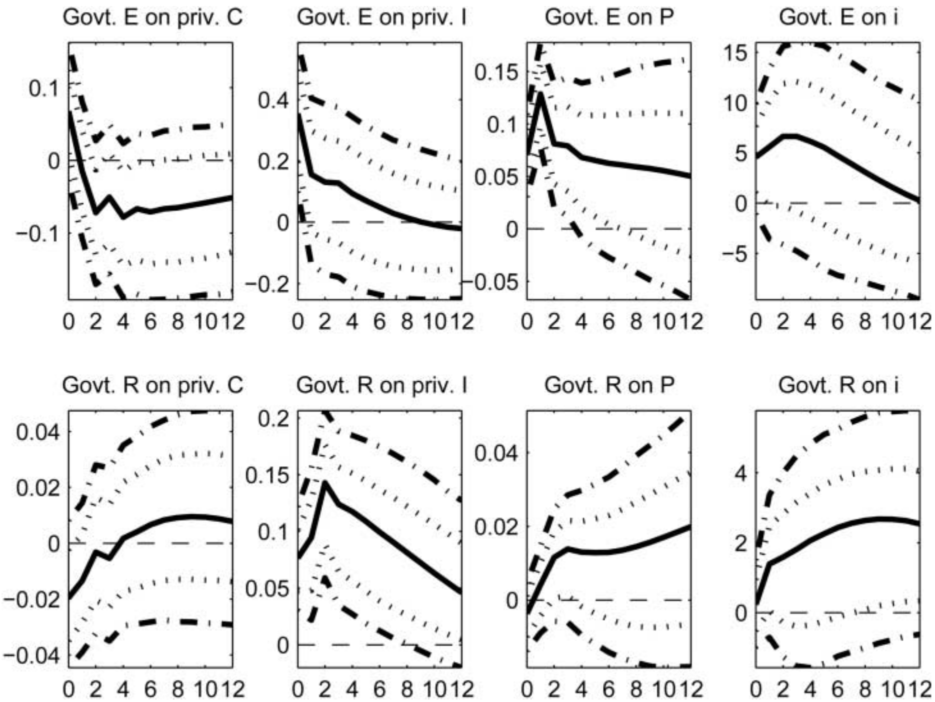

Figure 7 Separating private consumption and investment, 6-variable specification. Dotted lines: 68 % bootstrap confidence bands; dash-dotted lines: 90 % bootstrap confidence bands.

The impulse responses show an insignificant response of private consumption on impact to a spending shock at the 10 % level. In order to get a more nuanced picture, we also plot 68 % bootstrap confidence bands in this set of graphs. Indeed, focusing on these confidence intervals, private consumption increases significantly in response to a government expenditure shock. Thus, the consumption response is rather weakly significant. Private investment, on the other hand, reacts unambiguously positive to a government expenditure shock, regardless which of the two sets of confidence bands are considered. The effects of government revenue on consumption are again insignificant at the 10 % level. However, for the narrower bands, the consumption response is significantly negative on impact. Interestingly, the investment response to a government revenue shock is positive, which is not in line with Blanchard and Perotti (2002). The responses of prices and the short-term interest rate are very similar to the previous specification.

4.3 Robustness checks

We performed a variety of robustness checks to our 5-variable benchmark specification. First of all, it is worth mentioning that the responses of output and prices to a short-term interest rate shock are in line with standard monetary (S)VAR findings. Output decreases and prices only decline after an initial upward hike, the usual price puzzle (Bernanke/Blinder 1992). Instead of using a short-term interest rate we looked at a 10-year interest

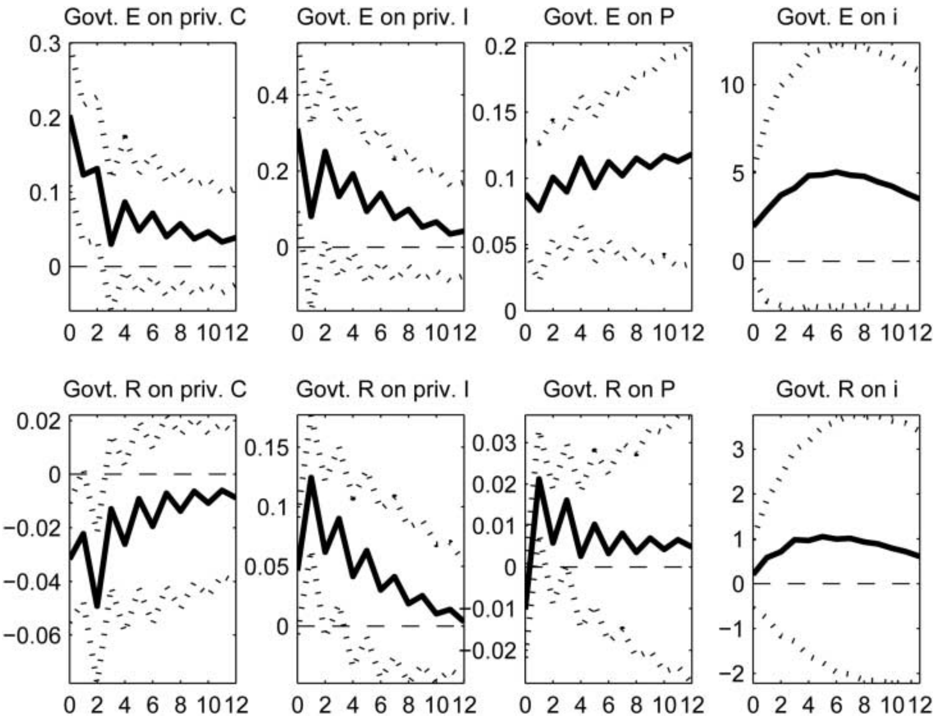

Figure 8 Separating private consumption and investment, 6-variable specification. Data are not seasonally adjusted. Dotted lines: 90 % bootstrap confidence bands.

rate to see whether the results change when long-run financing conditions are taken into account, and find our previous results confirmed.

We also employed different deflators. Besides the GDP deflator, we employed the CPI with no change in results. In a next step, we deflated government expenditure with the government consumption deflator without any significant changes.

Furthermore, we performed robustness checks regarding the definition of the fiscal variables. Disregarding interest payments or transfer payments when constructing our revenue measure does not change our results.

Our empirical findings are essentially confirmed when we estimate the model with data that are not seasonally adjusted and include the respective seasonal dummies in the VAR. Figure 8 gives the results. We now find a stronger response of consumption to a government spending shock, which is even significantly positive at the 10 % level in the first three quarters. However, we acknowledge that this procedure to handle the seasonality in the data is not completely taking away this pattern and the impulse-response results could be to some extent driven by seasonal factors.

To address issues of sub-sample stability, we performed the estimation procedure for the sample ranging to German re-unification and 1991-2007. Again, we find in both parts of the sample the expected responses to government spending with a (weakly) significant output response on impact. We also performed CUSUM tests, which do not show signs of coefficient instability. Our estimation results thus do not depend much on the exact choice of the sample period, even though some variation in the estimates obviously occurs. Furthermore, they are similarly not driven by re-unification related shocks, as they are controlled for by a shift dummy.

Central to the identification strategy are the elasticities, which are taken from exogenous sources. Even though we are confident that the elasticities we employ accurately capture the working of automatic stabilizers, we performed robustness checks by varying these values. The central elasticity is the one of net revenue with respect to GDP, a_y^r. Here we have calculated a value of 0.95 from different income tax statistics.[28] When we re-estimated the SVAR assuming that this elasticity amounts to only 0.5, our results do not change substantially. This also holds, when we increase the elasticity to 1.5.[29]

5 Disaggregating fiscal variables

In this section we investigate the effects of different components of fiscal policy on output, prices, and interest rates. To do so, we augment our basic 5-variable specification by splitting up either expenditure or revenue. Accordingly, we estimate VARs with six variables, respectively, seven variables by splitting up fiscal variables and additionally GDP into private consumption and investment. Each of those models is just identified. The additional restrictions arise, on the one hand, from the recursive ordering of the respective set of macroeconomic variables. These orderings are the same as in the two models described in the previous section. On the other hand, further restrictions are imposed by the additional exogenous elasticities and the relative ordering of the fiscal variables. Analogous to equations (9) and (10), we impose a recursive ordering in the relation between the cyclically adjusted reduced-form innovations to the fiscal variables and the structural fiscal fiscal policy shocks. This implies additional zero restrictions on both the *A* and *B* matrix. With respect to the relative ordering, we are always consistent with the assumptions made in section 2, i.e., we postulate the priority of the respective spending categories relative to the particular revenue categories used. More details on those orderings are given below.

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[28] Perotti (2005: 25), for example, additionally presents the response of GDP assuming a higher value of this elasticity. When increasing the elasticity, a tax cut results in significantly higher output in the sample period 1975 – 89. Also, Blanchard and Perotti (2002) assume a very high value for this elasticity, equaling 2. Driving force of this high value for the US is the very strong reaction of corporate tax income to corporate profits on a quarterly basis. Checking the German tax codes (i.e., EStG § 37(3) (Einkommensteuergesetz), KStG § 31(1) (Körperschaftsteuergesetz), and GwStG § 19(2) (Gewerbesteuergesetz)), we are confident, that corporate tax payments do not react to changes in profits on a quarterly basis, as corporations do not have to make statements about their profits to the fiscal authorities within the quarter. Rather, their tax payments are based on average profit patterns in the previous year. We therefore set this sub-elasticity to 0, which is in line with Perotti's (2005) assumption. Regarding the other components of a_y^r, we do not have any indication for assuming a higher elasticity so that we are confident, that $a_y^r = 0.95$ is a reasonable value.

[29] Our robustness checks can obviously cover only some variation in the elasticities. It appears very unlikely, however, that elasticities would increase or decrease massively beyond the values presented here as this would imply huge variations in government revenue in response to GDP changes. Certainly, elasticities beyond 2 are implausible, especially for taxes covering larger tax bases.

5.1 Expenditure components

In a first disaggregated specification, we include – in addition to net revenue – personnel and operating expenditure as fiscal variables in the VAR. These two expenditure components add up to our previous government direct expenditure variable, which is dropped. For the sub-components of government expenditure we assume a zero exogenous elasticity. Concerning the relative ordering of the fiscal variables, we assume the priority of personnel expenditure relative to operating expenditure, and then the priority of those two expenditure categories relative to net revenue.[30] Figure 9 presents the responses to shocks to these three fiscal variables. The effects of government net revenue

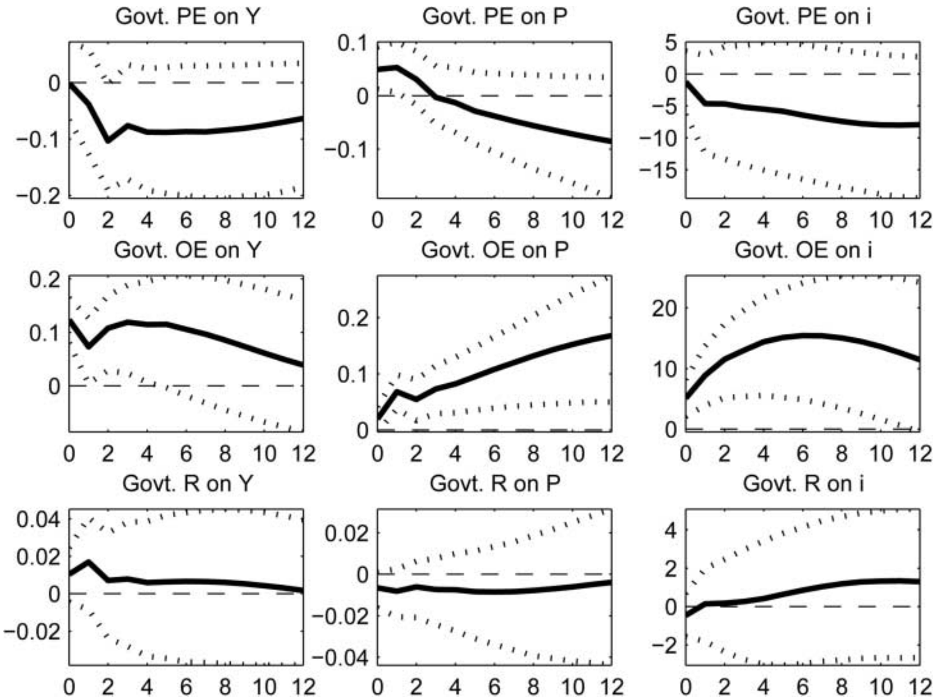

Figure 9 Separating personnel and operating expenditure, 6-variable specification. Dotted lines: 90 % bootstrap confidence bands.

[30] The analogous equations to (9) and (10) are as follows:

$$u_t^{pe,CA} = v_t^{pe} \tag{15}$$

$$u_t^{oe,CA} = \beta_{pe}^{oe} v_t^{pe} + v_t^{oe} \tag{16}$$

$$u_t^{r,CA} = \beta_{pe}^{r} v_t^{pe} + \beta_{oe}^{r} v_t^{oe} + v_t^{r}, \tag{17}$$

where $u_t^{pe,CA}$ and $u_t^{oe,CA}$ are the cyclically adjusted reduced-form innovations to personnel and operating expenditure, respectively. Furthermore, v_t^{pe} and v_t^{oe} are the structural shocks to government personnel and operating expenditure.

Table 3 Output multipliers

quarter	0	1	2	3	4	5	6
OE	1.90	1.96	2.18	2.43	2.61	2.77	2.90
Govt. I	0.08	−0.46	−0.42	−0.30	−0.04	0.34	0.79
Dir. T	−0.82	−0.73	−0.66	−0.61	−0.57	−0.54	−0.51
quarter	7	8	9	10	11	12	
OE	2.99	3.05	3.10	3.13	3.14	3.15	
Govt. I	1.28	1.77	2.25	2.69	3.07	3.40	
Dir. T	−0.49	−0.46	−0.43	−0.41	−0.38	−0.36	

Notes: Entries are output multipliers with respect to shocks to the respective fiscal variable.

are, as before, small and insignificant. Government personnel expenditure (PE) has equally no significant effect on output and interest rates, only prices increase significantly on impact. In contrast, government operating expenditure (OE), consisting of capital formation and other operating expenditure, has a clear and persistent positive effect on output. This is further confirmed by the output multiplier presented in Table 3. The impact multiplier is larger than one and subsequently increases substantially to reach a level of about 3 at 12 quarters. The multiplier can be compared to the one of total government spending. For the latter, we found a multiplier below one, which further decreases over time.

In a next step, we combine personnel expenditure and other operating expenditure to obtain government consumption (C). In addition, we include government investment (I), consisting of capital formation and financial aid to investment.[31] The impulse responses are depicted in Figure 10. We find a significant response of output to a shock to government consumption on impact. The positive effect, however, disappears quickly. The effect of government investment, in contrast, is quite different. Initially, GDP does not respond significantly. After some quarters, however, the response turns significantly positive when considering the 68 % confidence bands. Moreover, the cumulative output multiplier increases steadily, as indicated in Table 3. The long-run positive effect of operating expenditure found above thus seems to result from the effect of public capital formation. In turn, the positive output response to government consumption on impact appears to result from other operating expenditure and not government personnel expenditure. The output multiplier of public investment reaches a value above 3 after 12 quarters. Furthermore, from quarter 12 onward the multiplier is even slightly larger than the comparable one for operating expenditure. It is worth noting that the positive effect of government investment is not a result of the strong downward trend in government investment in the last 30 years (see Figure 4) as we control for deterministic trends in the estimation procedure.

The finding with respect to the investment multiplier is in line with theoretical predictions by Baxter and King (1993), who found very large positive output multipliers for government investment depending on the productivity parameter of public capital. Empirically, large effects have also been found by e.g. Aschauer (1989). These empirical results indicate that weak German economic performance in the last decade might partly result from persistently weak and declining public investment (see Figure 4).

[31] The relative ordering in this model is as follows: government consumption, government investment, and net revenue.

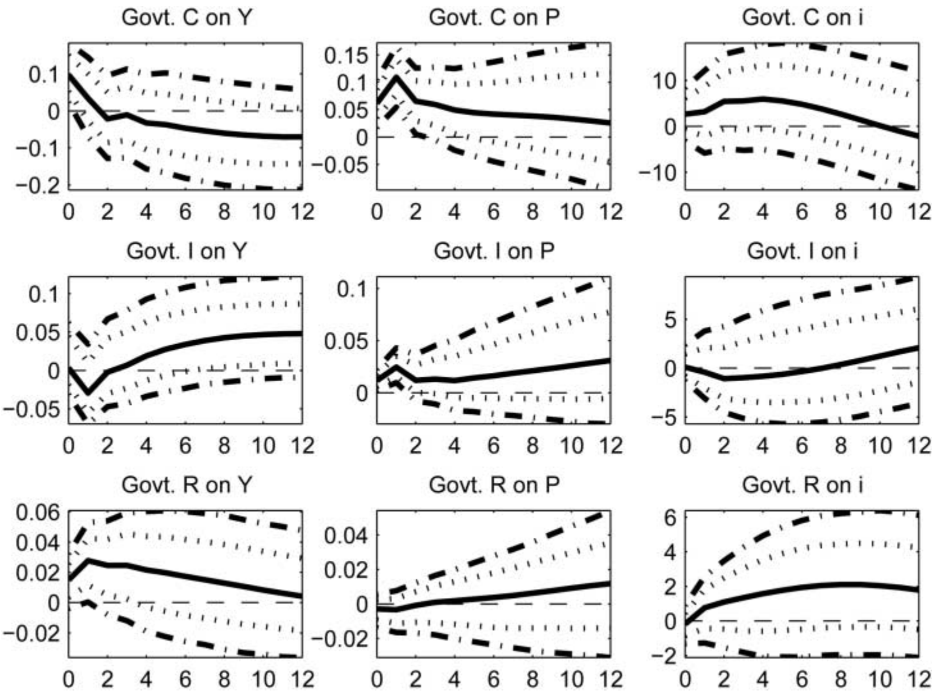

Figure 10 Separating government consumption and investment, 6-variable specification. Dotted lines: 68 % bootstrap confidence bands; dash-dotted lines: 90 % bootstrap confidence bands.

In a further step (Figure 11), we investigate the response of the GDP components private consumption and investment to public consumption and investment shocks, respectively.[32] While the neoclassical model of Baxter and King (1993) predicts very strong positive output effects of public investment, especially in the long run, private consumption is expected to fall on impact. This effect is driven by the direct resource absorption that an increase in government investment constitutes. Only after some years, consumption can surpass its initial level when output has increased sufficiently due to the increase in production factors. In line with the predictions of the neoclassical model, we find that government investment shocks initially have no significant effect on private consumption, while after some quarters, the effect turns more and more positive.[33] This is in line with increasing income generated from the larger public capital stock. Private consumption further increases after the positive investment shock. This suggests that public investment generates resources that lead to higher consumption in the longer run. This is confirmed by our result for the output response. In contrast, private consumption decreases significantly after a couple of quarters in response to a government consumption shock. Again, this result can be reconciled with medium-term arguments of resource constraints. Private consumption is negatively affected via an increased tax burden.

[32] The relative ordering of the fiscal variables is unchange to the previous model.
[33] It is significantly positive after 4 quarters, when considering the 68 % confidence intervals.

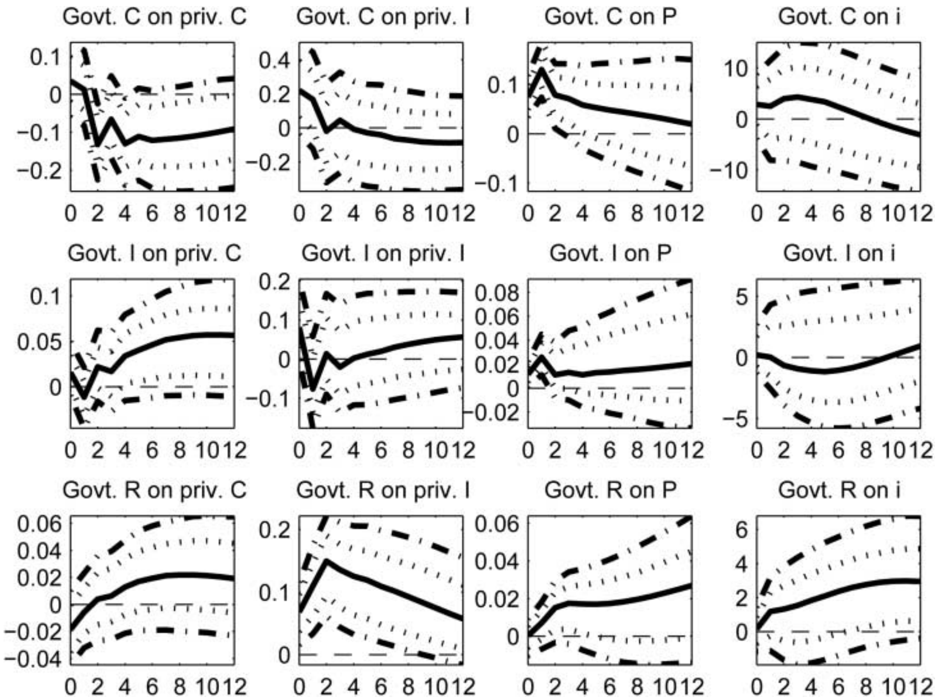

Figure 11 Separating government consumption and investment and private consumption and investment, 7-variable specification. Dotted lines: 68 % bootstrap confidence bands; dash-dotted lines: 90 % bootstrap confidence bands.

5.2 Revenue components

In this section, we investigate the effects of different sub-components of net revenue on real GDP. In particular, we include indirect and direct (wage and profit related) taxes.[34] Figure 12 shows that government expenditure has similar effects as before. Indirect taxes are found to affect output very little and the response is not significant. Regarding the effects of direct taxes, our results show a clear and significant negative impact on output, which is also reflected in the output multipliers shown in Table 3. This evidence thus indicates that only some components of taxes have detrimental effects on output. The difference might result from stronger distortions of direct taxes – via shifts in relative prices across labor and capital, for instance – as compared to indirect taxes. In theory, indirect taxes influence the consumption/leisure choice. However, it appears unlikely that the elasticity between consumption and leisure is high. In line with this, our estimation results show little output effects. In general, the effect of tax shocks is rather weak, which might be explained by Ricardian behavior of consumers.

[34] Consistent with the previous specifications, we postulate the priority of spending decision relative to the two revenue categories. Among those two revenue components, we order indirect taxes first.

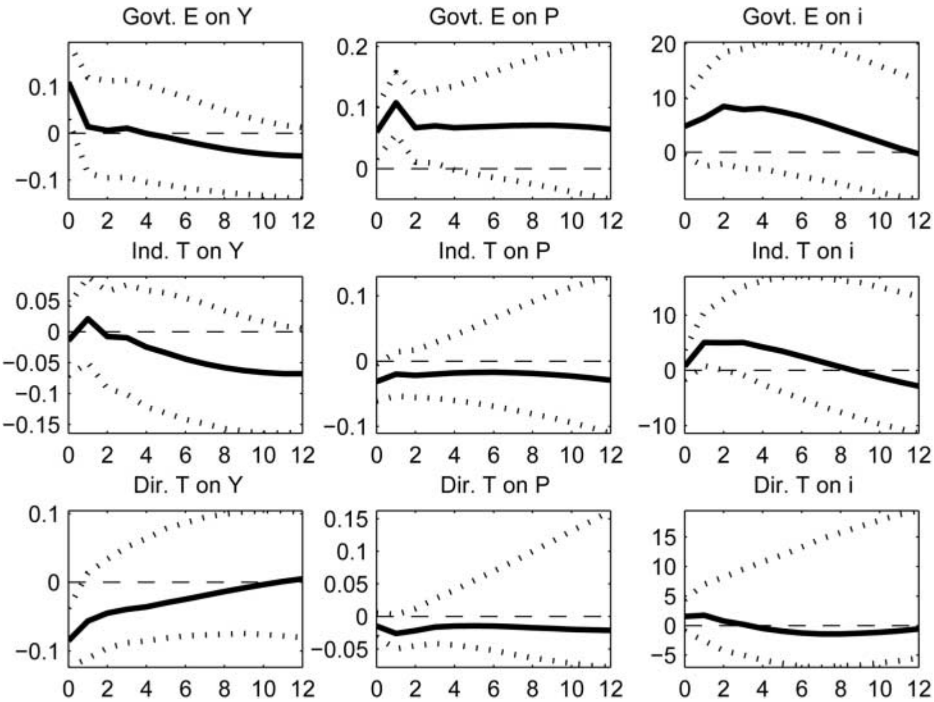

Figure 12 Separating indirect and direct taxes, 6-variable specification. Dotted lines: 90 % bootstrap confidence bands.

6 Conclusion

We investigate the short-term effects of fiscal policy shocks on the German economy in the framework of Blanchard and Perotti (2002).[35] Direct government expenditure shocks are found to increase output and private consumption on impact and with low statistical significance. The output multiplier of government expenditure, however, is smaller than one and decreases over time. Turning to sub-components of government direct expenditure gives a more detailed view of the effects of government spending. Operating expenditure in terms of capital formation plus other operating expenditure increase output statistically significant on impact and the output multiplier is larger than one and increases with time. In contrast, shocks to government personnel expenditure have no significant effect on output. The positive output effect of operating expenditure

[35] It is beyond the scope of this paper to discuss the performance of a macroeconomic SVAR model compared to other empirical approaches to assess the impact of fiscal policy. Clearly, all empirical approaches have their advantages and disadvantages. In the area of monetary policy, SVAR models have been quite successful in establishing stylized facts, which act as a guidance for theoretical modeling efforts. No least motivated by this success, empirical results based on SVAR models, such as the one employed in the current paper, have recently been chosen as starting points for further theoretical developments also in the area of fiscal policy, e. g. in Galí et al. (2007). The current paper fills a gap in that literature on Germany with a special focus on the effects of disaggregate fiscal variables.

on impact is driven by other operating expenditure, which consists of direct purchases. When looking only at the effects of government investment, we find no significant effect on impact but the output response turns positive with weak statistical significance after 7 quarters. Moreover, the output multiplier of government investment increases after a couple of quarters and becomes as large as 3 after 12 quarters. Government consumption – here defined as personnel expenditure plus other operating expenditure – has only negligible and very short-lived effects on the economy.

While Baxter and King (1993) show strong positive effects of government investment in their model, they still find a negative response of private consumption on impact to the government investment shock due to the resource absorption of the investment shock. We only find an insignificant impact of government investment on private consumption. Moreover, our results cannot support the view that a rise in public personnel expenditure, which might reflect a change in both employment and compensation per employee, has positive effects on output. In sum, the responses of output and consumption on impact to spending shocks as described above are broadly in line with standard (New-)Keynesian theory in the spirit of Galí et al. (2007).

Small shocks to net revenue are found to matter little for GDP. Looking at sub-components of taxes provides a more detailed picture. Shocks to direct taxes lower output significantly, while small shocks to indirect taxes have no statistically significant effect. To the extent that direct taxes are distortionary, this result supports Baxter and King (1993), who show that the response of GDP to distortionary taxes is negative. In contrast, indirect taxes are comparatively little distortionary as they affect mostly the labor-leisure choice, for which a low elasticity of substitution can be assumed. In line with this, we find little impact of indirect taxes on output. However, this result does not preclude that the intertemporal consumption profile will be altered due to massive changes in indirect tax rates. Overall, however, the empirical results on the revenue side are less robust than those on the expenditure side and should therefore not be interpreted mechanistically.

From a more philosophy-of-science point of view, it is important to note that we are only able not to falsify central insights of New-Keynesian theory. This does not mean that we have actually validated the model or all its underlying microeconomic assumptions. However, it is worthwhile stressing that the New-Keynesian model is a fully-fledged general equilibrium model. Its results are thus not based on missing items in the national income accounts identities. Also the empirical results are not determined by a missing budget item. For the derivation of the empirical result, the model even allows that government revenue can be adjusted in the same quarter to government spending. To the extent that the revenue increase does not match the expenditure increase, a deficit emerges. The general equilibrium effect of deficits via the increased demand for capital is captured by controlling for the interest rate. In an open economy with international capital markets, this effect should be relatively small. The subsequent revenue increases are also fully incorporated in the dynamic model. In that sense, impulse responses of government spending shocks also reflect the effects of the subsequent revenue increases.

Productive public capital formation is the main expenditure category with positive effects. Overall our results show that government fiscal policy shocks have weak impact multipliers. Future research appears worthwhile to uncover the anticipation effects of fiscal policy and the relevance of the size of shocks in greater detail.

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A Appendix

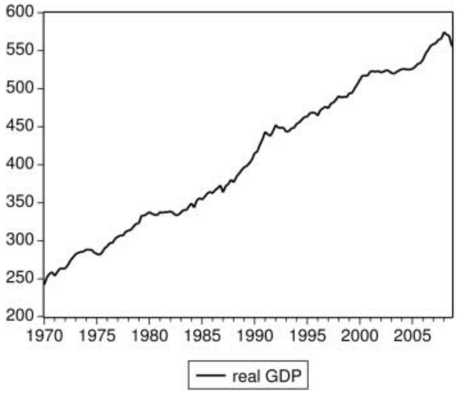

Figure A1 Real GDP in billion euros, seasonally adjusted.

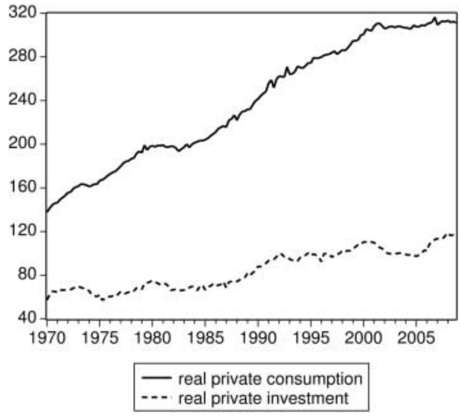

Figure A2 Real private consumption and investment in billion euros, seasonally adjusted.

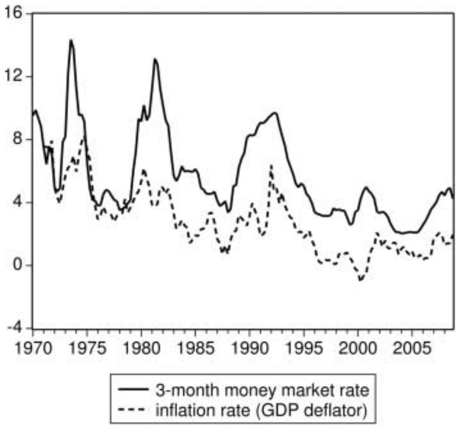

Figure A3 Short-term interest rate and rate of inflation.

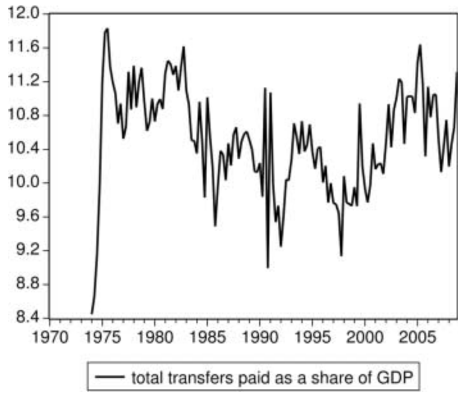

Figure A4 Total transfers paid in percent of GDP.

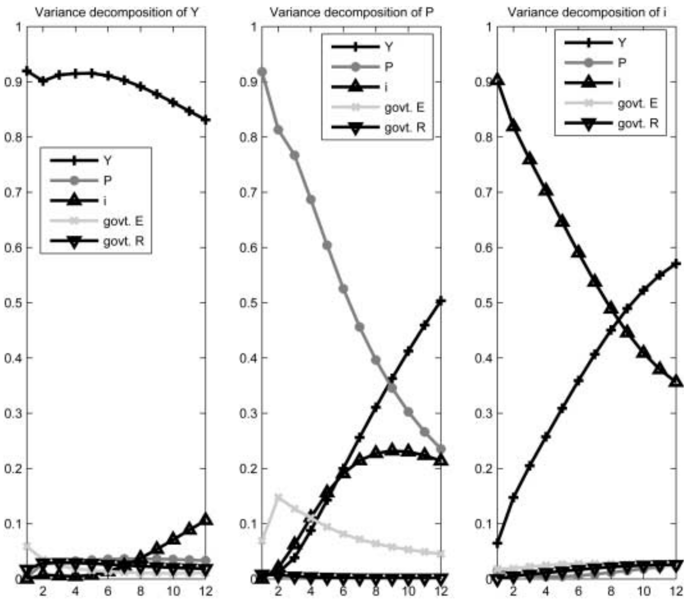

Figure A5 Basic 5-variable specification: variance decomposition of real GDP, the GDP-Deflator, and the 3-month money market rate at a horizon of one to twelve quarters.

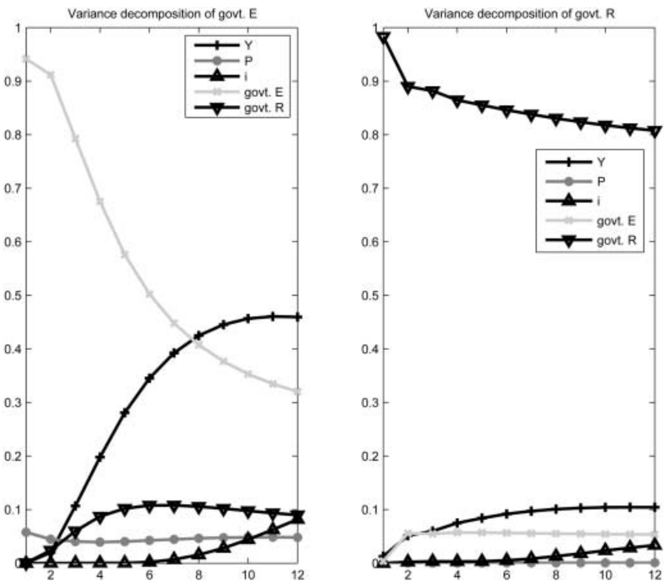

Figure A6 Basic 5-variable specification: variance decomposition of government direct expenditure and net revenue at a horizon of one to twelve quarters.

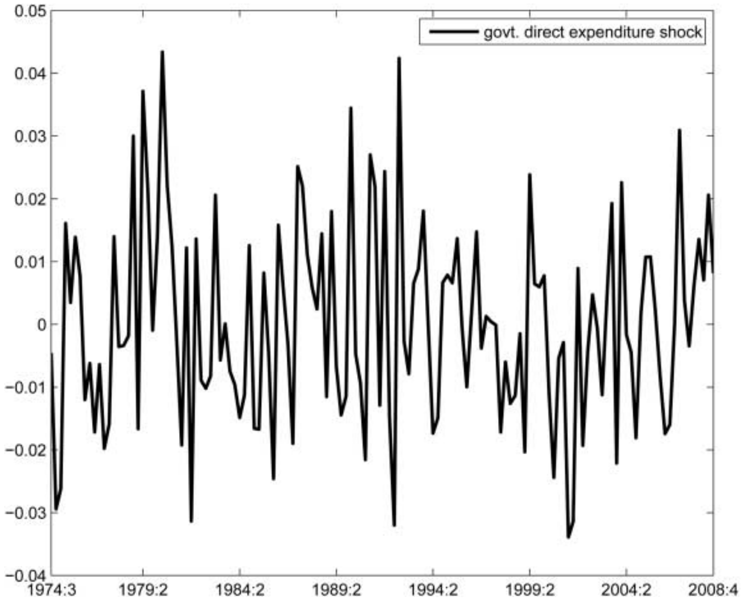

Figure A7 Basic 5-variable specification: structural government direct expenditure shock.

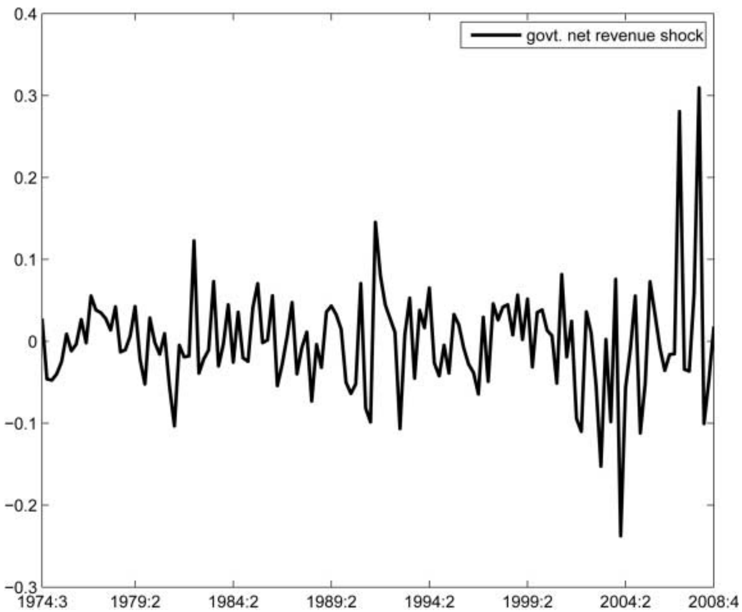

Figure A8 Basic 5-variable specification: structural government net revenue shock.

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