A VAR Analysis of the Effects of Fiscal Policy in Germany

Florian Höppner,[*]
Institute for International Economics, University of Bonn

Revision date: November 2001

Abstract:

This paper presents an analysis of the effects of fiscal policy in Germany based on a structural VAR approach. Fiscal policy shocks are identified as the structural residuals related to unexpected government expenditure and tax revenues. Impulse responses are then used to simulate the dynamic response of key macroeconomic variables to these shocks. The analysis shows a negative response of GDP to tax shocks and a positive to expenditure shocks. Moreover private consumption reacts negatively to taxation but increases in response to a shock to public expenditure. Altogether the results are consistent with Keynesian models of the business cycle.

JEL classification: E62, C32
Key Words: vector autoregression, fiscal policy, private consumption

[*] I would like to thank Mathias Drehmann, Jan Gottschalk, seminar participants at the Money, Macro and Finance conference 2000 in London as well as two anonymous referees for helpful comments on an earlier version of this paper.

1 Introduction

This paper presents a VAR study of the short run effects of fiscal policy in Germany. During the last years, not least because of the European Monetary Union and its consequences for public finances in the EMU member countries, fiscal policy issues have moved to the core of academic and public interest in Europe. Central to this debate is the role of fiscal policy as an instrument of national economic policy, likewise intense monitoring and forecasting of fiscal positions is required in the light of the Stability and Growth Pact, to name only two of the many issues. For all these analyses, a sound theoretical and empirical knowledge of the characteristics of the transmission mechanism of fiscal policy is indispensable.

Yet when examining the literature on the macroeconomic effects of fiscal policy it is striking that the issue of fiscal transmission is relatively unexplored. With respect to the theoretical effects of fiscal policy in the business cycle, the two major schools of macroeconomics have reached contrasting views about the sign of the fiscal multiplier and its magnitude. Both neoclassical and Keynesian approaches predict an increase in output after an exogenous increase in government expenditure and a decrease in output after an increase in taxation. However, whereas neoclassical models typically predict a decline in private consumption after an increase in public expenditures due to negative wealth effects, (new) Keynesian models predict an increase in private consumption following such a policy. In the extreme case of Ricardian equivalence, tax policy has no effect at all.[1] Furthermore, the few rigorous empirical studies available do not even yield a coherent picture of some stylised facts the effects of fiscal policy in the business cycle. The immediate policy consequences of this lack of information have been vigorously pointed out by Perotti (2000, p. 24), who argues that

[1] For a neoclassical perspective on the effects of fiscal policy see Baxter and King (1993), more recent studies include Ludvigson (1996) and Ramey and Shapiro (1998). Keynesian models are set out e.g. in Rotemberg and Woodford (1992) and Devereux et al. (1996). For brief but useful surveys of the theory see also Ramey and Shapiro (1998) as well as Giavazzi, Jappelli and Pagano (2000).

"[…] we should honestly admit that, at present, our area of ignorance even on basic signs of fiscal multipliers is too great. At a minimum, this should suggest using fiscal policy very sparingly." As a starting point for a more extensive analysis of fiscal policy therefore additional empirical work is needed to generate basic stylised facts of the effects of fiscal policy. This research in turn is beneficial for a broader attempt to discriminate between the competing theories of the business cycle with the aim to consolidate the overall basis for policy analysis, monitoring and implementation.

This paper uses quarterly data on German tax revenues and government expenditures to identify unexpected shocks tax revenues and government spending in a structural VAR set up, where identification follows closely the VAR study of the effects of fiscal policy in the U.S. by Blanchard and Perotti (1999). In a second step a four variable VAR including taxes, government expenditure, private disposable income and private consumption is estimated to identify the effects of fiscal policy on private consumption. The fundamental result is a negative reaction of GDP to tax shocks and a positive reaction to public expenditure shocks. Compared to the theoretical literature, this is consistent with both Keynesian and Neoclassical approaches. The four variable VAR moreover indicates a crowding in of private consumption by government expenditure, which is a standard Keynesian prediction. Overall the empirical results therefore tend to support Keynesian models of the business cycle.

The paper is structured as follows: the next section starts with a discussion of the main empirical approaches of identifying fiscal policy proposed in the literature. Section three then describes the data used for the study and the structural VAR identification of the policy shocks. Section four presents the results and discusses them in the light of the existing theoretical and empirical literature. The last section concludes.

2 Identifying Fiscal Policy

One key problem for an empirical analysis of fiscal policy is identifying discretionary policy action from the aggregate data available. The main methodological problem thereby is that budget variables move in reaction to discretionary policy but also due to automatic stabilisers built into the tax and welfare system of the economy. There is no commonly accepted method to disentangle these two effects to get the 'pure' policy effect out of fiscal data.

Past research on the effects of fiscal policy has usually focused either on estimating dynamic multipliers from large macroeconometric models or on reduced form studies that concentrate on summary indicators like the structural deficit or other constructed indicators.[2] The latter is problematic because theory usually does not suggest that one single indicator covers the whole effect of a policy action so that it is at least questionable that these indicators adequately capture the discretionary component of fiscal policy. Furthermore fiscal policy indicators are not able to take into account the structure of the budget and thereby do not discriminate between different budget items like expenditure and revenues.

More recently it has been tried to identify discretionary fiscal policy using both the 'narrative' and the VAR approach. These approaches essentially identify discretionary policy changes as unexpected policy *shocks* and thereby disentangle the discretionary policy component from any systematic and predictable policy move as well as from automatic built-in responses of the economy. Once identified, the effects of the policy shocks on the economy can be simulated with the help of dynamic econometric techniques.[3]

Ramey and Shapiro (1998) use the 'narrative' approach previously used by Romer and Romer (1989) for the analysis of monetary policy to identify episodes in the American history that

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[2] A very good comparison of estimates from different large scale macroeconometric models is presented in Bryant et. al. (1988). For a discussion of fiscal indicators see Blanchard (1993), for reduced form studies of fiscal policy see for example Barro (1981) or Ahmed and Rogers (1995).

[3] The identification of policy as exogenous policy shocks is close to the concept of policy analysis in rational expectations models, see e.g. Breitung (2001) for an exposition of this issue.

led to large military build-ups. Based on these episodes they construct military build-up dates which represent unanticipated shifts in defence spending and hence can be used as an indicator of exogenous discretionary shifts in fiscal policy. Edelberg, Eichenbaum and Fisher (1999) develop this idea further by using these build-up dates as a dummy variable with an entry at each date in a standard VAR framework. The dynamic response of the economy to the war dummy is then calculated by an expansion of the estimated VAR lag polynomial.

In contrast to the 'narrative' approach, a number of studies identify fiscal policy shocks as the residuals of a VAR, a method so far almost exclusively used for the identification of monetary policy shocks. Rotemberg and Woodford (1992) identify the reduced form residuals of a univariate regression of defence purchases on a number of macroeconomic variables as policy shocks. These residuals are then used in a VAR to simulate the dynamic response of the economy to these shocks. The study by Blanchard and Perotti (1999) is the first attempt to construct a structural VAR model for the US economy to recover shocks related to unexpected government expenditures and tax revenues within the system. The basic set-up is a three variable VAR, including output and a breakdown of the budget into the two components government expenditures and tax revenues at the quarterly frequency. Their structural identification strategy is based on institutional details of the tax and welfare system, where the essential assumption is that within a quarter there is no discretionary response of fiscal policy to unexpected movements in output. With additional knowledge about the automatic responses of fiscal variables to movements in output one is able to recover the orthogonalised structural shocks that can be interpreted as unexpected discretionary fiscal policy actions. The structural shocks are then used to simulate the dynamic response of the economy to these shocks using standard impulse response techniques. Other recent SVAR studies of fiscal policy include Bruneau and de Bandt (1999), Dalsgaard and de Serres (1999) and Fatás and Mihov (2001). A slightly different approach to the identification of fiscal policy in a VAR framework is proposed by Mountford and Uhlig (2000), who impose a priori sign restrictions on some impulse responses, but leave the key responses of interest unrestricted.

Minimisation of a criterion function then yields the final impulse responses of interest without the need to impose further 'standard' VAR identification assumptions.

Note that impulse responses can be thought of as the result of a particular 'policy experiment' implemented within the VAR system. Take for instance the response of the system to a tax shock: this policy experiment assumes that for one period tax rates are unexpectedly increased.[4] The impulse responses then indicate the dynamic and joint endogenous response of the variables included in the system to this one-off exogenous policy shock. Although this scenario may not be very 'realistic' in the sense that fiscal policy is actually implemented in this way, it is nevertheless a very useful analytical exercise, as due to the orthogonality assumption it isolates the response of the macroeconomic system to this particular exogenous policy shock. To generate stylised facts of the response of a macroeconomic system to specific policy shocks, the VAR analysis thus seems to be a good starting point.

3 A VAR Analysis for Germany

The following section presents in detail the VAR analysis of fiscal policy in Germany, where two specifications are used. The basic VAR includes the three variables government tax revenues, government expenditures and GDP. To extend the analysis to the controversial issue of the effects of fiscal policy on private consumption, a second VAR set up includes the four variables taxes, expenditure, private disposable income as well as private consumption. After introducing the VAR set-up, the section starts with a presentation and discussion of the quarterly time series used in the analysis, followed by a discussion of the VAR specification and the issue of structural identification.

[4] This interpretation certainly assumes that there is a direct and immediate connection between tax *rates* and tax *revenues*.

3.1 The VAR

The basic VAR set-up used in the empirical analysis of the paper is of the form

$$Y_t = A_0 + A_1 Y_{t-1} + \ldots + A_p Y_{t-p} + U_t, \qquad (1)$$

where Y_t is the n - dimensional vector of variables, the A_i are $(n \times n)$ coefficient matrices and U_t is a vector containing the reduced form residuals which are assumed to be normally distributed white noise with a constant covariance matrix $E(U_t U_t') = \Sigma_U$. For a detailed exposition of the general VAR model see e.g. Lütkepohl (2001).

3.2 The Data on Fiscal Policy

In the basic VAR analysis of the present paper the vector Y_t contains government tax revenues, government expenditures and GDP. The two fiscal series are taken from the Bundesbank Monthly Bulletin covering the general government, including the central government budget, the 'Länder' and 'Gemeinden' budgets, but excluding social security funds. All variables are on a cash basis and at the quarterly frequency, the time series run from 1970:1 to 2000:4. Expenditures are defined as total government expenditures, including government consumption, investment and public transfers like subsidies. Tax revenues are total revenues from direct and indirect taxes. Output is real GDP based on the quarterly national accounts of the German Institute of Economic Research (DIW). A second VAR specification includes the two fiscal series along with disposable income and private consumption expenditures, where the latter two series are taken from the German federal statistical office and the DIW database, respectively. All series are seasonally adjusted. GDP is deflated by the GDP deflator, all other series by the CPI index.

A first visual impression of the fiscal time series used in the empirical analysis is given by figure 1 which presents plots of tax revenues and government expenditures as a share of GDP.

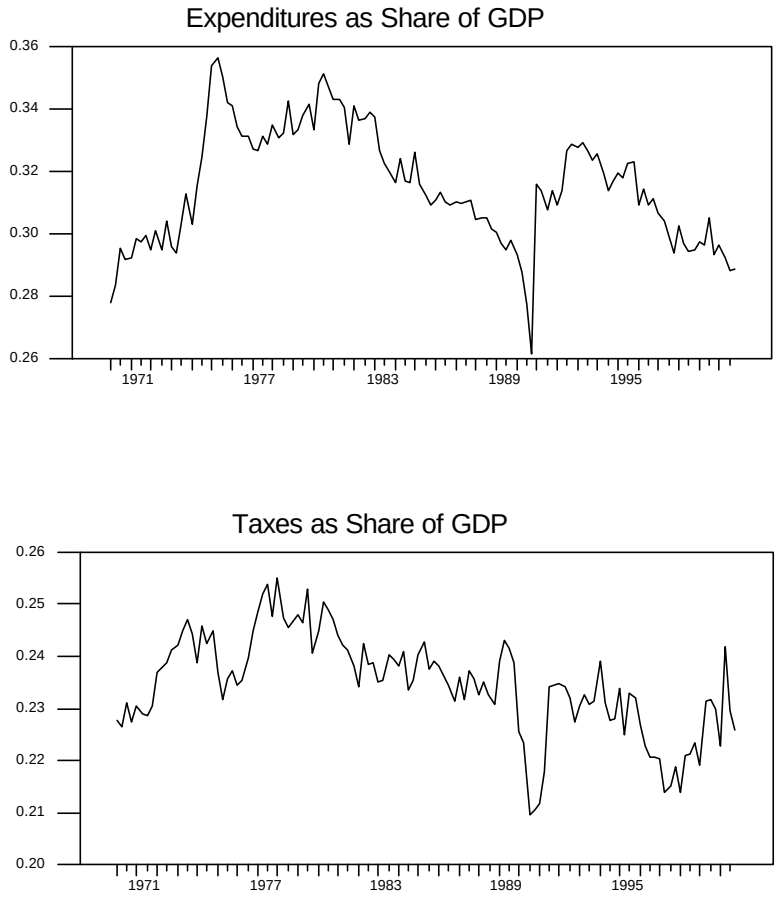

Figure 1: Government Expenditures and Taxes in Germany (Shares of GDP)

Clearly visible in the expenditure series and to a lesser extent also in the tax series is the structural break induced by German unification at the beginning of the 90s. As can be seen from the plot of the original series in levels given in appendix A, all series exhibit a discrete 'jump' due to the enlargement of the federal republic of Germany. This level effect occurs in the first quarter of 1991 for expenditures and taxes and in the third quarter of 1990 for GDP, leading to the sizeable decrease of taxes and expenditures as shares of GDP in the third quarter of 1990 and the increase in the first quarter of 1991 in figure 1. For the estimations presented in this paper, the time series are adjusted for the level shift due to German unification by regressing the series in first differences on a dummy that has a unit entry at the

date the shift occurs. The level of the data then is adjusted by removing the effect captured by the dummy.[5]

Fiscal policy is usually considered as consisting of two components: the working of automatic stabilisers and discretionary policy actions. In contrast to the automatic stabilisers that are directly tied to the economy's general tax and welfare system and thereby are a stable and predictable component of fiscal policy, the role of discretionary policy – being closely connected to the prevailing political paradigm – has changed considerably over time.

Figure 1 illustrates this point. After the first significant post-war recession in Germany 1966/67, Keynesian anticyclical fiscal policy became a tool of active economic policy. The huge increase in the expenditure share in 1974/75 visible in the graph reflects the substantial stabilisation programs launched to overcome the then prevailing recession. Although some stabilisation attempts have been made during the 70s, only the new coalition between Christian and Free Democrats that started with the clearly formulated aim of consolidating the excessively high debt that had accumulated over the years, was able to reverse the tendency of growing public expenditures and debt in the 80s. Clearly, German unification reversed this downward trend in expenditures with the massive amount of public transfers initiated for the stabilisation of the East German economy. The Maastricht consolidation process then led to new attempts to reduce public expenditures in the second part of the 90s.

The second panel of figure 1 clearly shows the overall downward trend in the total tax share beginning in the end of the 1970s. While the ratio of direct taxes over GDP has been quite stable over time, this trend is dominated by the development of the indirect tax share that has

[5] In figure 2 in the appendix the adjusted series are given by the dashed lines. Note that every adjustment faces a considerable identification problem as it is not possible to identify what portion of the shift in the variables should be attributed to the enlargement of the area (i.e. an exogenous level effect) and what part should be counted as a change in policy that has taken place at this time. Furthermore the more deeply rooted institutional changes in the economy that are part of such a wide-ranging political process and that are not restricted to a single period can not be captured by such a method. To check, whether the inclusion of the post-unification period has a considerable influence on the results, all estimations are also performed using the smaller sample up to the fourth quarter of 1989. The conclusion is that though magnitudes may differ in detail, the general results are not changed. Therefore only the results from the estimations including the post-unification period are presented below, while the reader should bear the abovementioned qualifications in mind.

been increasing until roughly 1978 and then declining afterwards. Note that the displayed total tax series does not include social security contributions, which actually exhibited an increasing trend over the sample period under consideration. Unless the cyclical elasticity of government expenditure and tax revenues is unity, the series also reflect movements that are due to the working of automatic stabilisers. It is the aim of the following VAR analysis to disentangle these two effects and to isolate the effect of discretionary policy measures from the overall movement of the aggregate fiscal time series as discussed in section 2.

Besides the specific difficulty of adjusting for German unification addressed above, every empirical analysis of fiscal policy has to face more general data problems. Tax revenues for example are not always received by the government in the same quarter as the underlying transaction these revenues are attributed to has taken place. The same is true for public expenditures, where the quarter the cash flow appears in the cash statistics does not necessarily reflect the exact dating of the realisation of the underlying economic transaction. Quarterly data therefore potentially are characterised by a complicated 'seasonal' structure that goes beyond that of usual seasonality that can be found in other macroeconomic time series. From an economic point of view, revenue and expenditure transactions counted on a cash basis ideally have to be allocated to the period in which the underlying economic transaction has taken place. National accounting procedures are designed to overcome this problem, but this allocation is not always obvious and thus any national accounting methodology involves considerable judgement.

Using annual data would be a remedy of this specific problem as the budget is decided on an annual basis and every tax and expenditure position refers to a specific fiscal year. On the other hand, quarterly series leave considerably more degrees of freedom than annual data, one therefore encounters a trade-off between potential noise effects in the data structure and the accuracy of the estimation itself. Moreover, as will be discussed in more detail below, the particular identification strategy of the SVAR in this paper requires using data at a high

frequency.[6] Therefore, for the final results presented in this paper quarterly series are used. A sensitivity analysis using annual data from the OECD database indicates qualitatively and quantitatively very similar results.

3.3 Data Properties and Model Specification

As a first step of a more detailed examination of the data properties and the final model specification, the stationarity property of the series has been analysed using the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests, the results are summarised in table 1. It can be seen from the table that all variables appear to be integrated of order one, i.e. I(1). For disposable income the null hypothesis of non-stationarity of the first difference of the series is rejected only at the 5% level, for all other series the null is clearly rejected at the 1% significance level.

In a second step the time series are analysed for potential cointegration. This is done by applying the Johansen 'trace test' which is a sequence of Likelihood Ratio tests, for a description of the testing procedure see Johansen (1995). The Johansen test is performed within the vector error-correction (VECM) representation of the VAR, for details on the VECM see Lütkepohl (2001). The VECM is specified by allowing for a constant in both the I(0) and the I(1) component but no trend in either of the components, the model is estimated using 4 lags. Using this specification, the test indicates two cointegration relationships for the four variable VAR using private consumption and disposable income and one cointegration relationship for the basic three variable VAR.

Furthermore, the cointegration vector(s) can be identified by imposing linear restrictions on the long run parameters of the VECM and testing these restrictions by likelihood ratio tests. For the four variable system, the first vector can be identified as a long run Keynesian

[6] One central assumption of the identification strategy proposed in Blanchard and Perotti (1999) is that the fiscal authorities are not able to react to shocks within the same period the shocks occur, see section 3.4 for more details.

Table 1: Unit Root Tests[(1)]

Variable	ADF Test	PP Test	Variable	ADF Test	PP Test
Tax	-0.40	-0.43	Ätax	-6.28$^{(**)}$	-11.56$^{(**)}$
Gexp	-2.16	-2.32	Ägexp	-4.14$^{(**)}$	-14.32$^{(**)}$
Gdp	-0.06	-0.16	Ägdp	-4.11$^{(**)}$	-11.37$^{(**)}$
Dispinc	-0.91	-0.43	Ädispinc	-2.97$^{(*)}$	-10.47$^{(**)}$
Cons	-1.17	-0.62	Ächons	-3.24$^{(**)}$	-13.04$^{(**)}$

(1): The table refers to the quarterly data. Ä is the first difference operator. ADF refers to the Augmented Dickey-Fuller test, whereas PP is the Phillips Perron test. The null hypothesis is the existence of a unit root. (*) indicates the rejection of the null hypothesis at the 5%, (**) at the 1% significance level, where critical values are taken from MacKinnon (1991). All tests are specified including an intercept but no trend. Only significant lags are included in the ADF regressions.

consumption function with a stable proportional relationship between private consumption and income, implying a cointegrating vector of $b_1 = (0,0,1,-1)$. The second vector is less clear. Trehan and Walsh (1988) have shown that the validity of the intertemporal budget constraint of the public sector imposes restrictions on the long-run relationship between expenditures and revenues so that the deficit is stationary. Specifically, expenditures including interest payments, tax revenues and seigniorage revenues then have to be cointegrated with the vector $(1,-1,-1)$, where Bohn (1991) showed that it can be a valid simplification to exclude interest payments from the expenditure variable.[7] Including seigniorage revenues in the revenue variable this implies a cointegrating vector of $b_2 = (1,-1,0,0)$. Imposing both b_1 and b_2 is though rejected in the model. Imposing b_1 and letting the coefficient of the second vector being unrestricted, i.e. $b_2 = (1,-d,0,0)$ is significantly accepted with a p-value of 0.54. The coefficient d is estimated with a value of 2.28 and with a t-value of 6.5. This clearly

[7] The argument is that debt enters the cointegrating vector only weighted with the interest rate r. A small interest rate (in the limit r) thus allows the simplification of approximating the deficit by the primary deficit *excluding* interest payments.

contradicts the intertemporal budget constraint, but can be interpreted as evidence for tax smoothing behaviour of the government (see Trehan and Walsh ,1988, p. 433).

For the basic three variable VAR specification, the Johanson trace-test for cointegration significantly indicates the existence of one cointegrating vector. Further testing accepts a long run relationship between tax revenues and expenditures, where the coefficient $\ddot{a}$ is now estimated with a value of 2.78 and a t-value of 8.7. The significance level of this test is 0.65.

As for both specifications cointegration is accepted, the VAR models can be estimated in levels. Nevertheless, for relatively small samples the cointegration test is known to have relatively weak power, moreover the results of the test are quite sensitive to the choice of the lag length and the trend specification of the VAR. Two sensitivity checks are therefore made. First, the VAR is estimated in first differences, which is the right specification if no cointegration is existent among the variables. Second, as an alternative to specifying the model in levels, cointegration is imposed explicitly and the final VAR is estimated in VECM form. Both sensitivity checks give results that are qualitatively very much in line with the results presented in this paper, although magnitudes sometimes differ. The final results presented in this paper are generated from the model with variables included in levels, where a lag length of 4 is imposed.[8]

3.4 Structural Identification

To proceed to the impulse response analysis, economically interpretable 'structural' shocks have to be identified from the estimated reduced form of the VAR. In order to obtain these orthogonal innovations for each variable included in *Y*, one has to factorise the variance-covariance matrix Σ_U obtained by the estimation of the reduced form given by

[8] Results from the other specifications are available upon request. All estimations have been performed using the RATS procedure MALCOLM, version 2.22.

equation (1). Defining a vector of structural innovations E_t as linear combinations of the reduced form residuals leads to

$$A \cdot U_t = B \cdot E_t, \tag{2}$$

where the elements of E_t are normally distributed with unit variance, i.e. $e_t \sim N(0, I_n)$. It follows immediately that $A\Sigma A' = BB'$, where this factorisation of the estimated variance-covariance matrix leaves $2n^2 - n(n+1)/2$ free elements in the system. To fully identify the structural innovations hence additional contemporaneous restrictions have to be imposed on the system.

In modelling the contemporaneous restrictions this paper follows the idea of Blanchard and Perotti (1999). The basic identification method can be formulated in the following empirical model:

$$\begin{aligned} u_r &= a_1 u_y + e_r \\ u_e &= b_1 u_y + e_e \\ u_y &= g_1 u_r + g_2 u_e + e_y. \end{aligned} \tag{3}$$

In the preceding equations, u_r, u_e and u_y represent the reduced form residuals for tax revenues, government expenditure and GDP, whereas e_r, e_e and e_y are the structural shocks to be recovered. The reduced form residuals can be interpreted as the unexpected deviations from the 'policy rules' implicitly estimated in the reduced form. One important identifying assumption is that there is no discretionary response of fiscal policy to unexpected movements in GDP within the same quarter. To illustrate this point, take for instance the second equation of system (3),

$$u_e = \underbrace{b_1 u_y}_{autom.stab.} + \underbrace{e_e}_{policy}.$$

If there is no response of discretionary policy to unexpected movements in output within the quarter (u_y), the coefficient b_1 solely captures the working of the automatic stabilisers in the

economy, the same is true for the coefficient a_1. All three equations given by (3) then define a recursive structure on the contemporaneous interaction between the endogenous variables.

To fully identify the model, some additional assumptions on the coefficients are necessary. Concerning the automatic stabilisers, defining the expenditure variable as government consumption and investment *excluding* social security transfers, one can assume that there is no automatic feedback from movements in output on government expenditure, setting $b_1 = 0$. The value of the elasticity a_1 is certainly positive but can not be properly estimated within the model due to the potential endogeneity of output. Therefore, following Blanchard and Perotti (1999) the distinction between automatic stabilisers and discretionary policy in the VAR is achieved by using additional information about the output elasticity of tax revenues.

The overall tax elasticity is computed as the weighted sum of the elasticities of the revenue components total indirect taxes and direct taxes paid by the corporate sector and the household sector. The components are weighted by their relative share in total tax revenue. Using OECD estimates of individual tax elasticities presented in Giorno et al. (1995), Leibfritz (1999) estimates an overall average tax elasticity for Germany of 1.04.[9] The contemporaneous reaction of output to unexpected movements in tax revenues is captured by g_1, the contemporaneous reaction of output to movements in expenditure by g_2, both coefficients remain unrestricted and are estimated in the model. Based on the discussed assumptions, the structural model can be written in the following form:

$$\begin{bmatrix} 1 & 0 & -1.04 \\ 0 & 1 & 0 \\ -g_1 & -g_2 & 1 \end{bmatrix} \begin{bmatrix} u_r \\ u_e \\ u_y \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} e_r \\ e_e \\ e_y \end{bmatrix} \qquad (4)$$

[9] The OECD estimates of the elasticities for indirect taxes, direct taxes paid by the corporate sector and direct taxes paid by the household sector are 1.0, 2.5 and 0.9, respectively. Alternatively using individual tax elasticity estimates of the German ifo-institute, namely 0.7, 1.0 and 1.6, respectively, Leibfritz (1999) arrives at an average elasticity of 1.06, which is very close to the OECD average. Nevertheless, the imposed value for the output elasticity should be regarded as tentative as the estimation of this elasticity itself is connected to huge methodological problems, note that it moreover may not be time-invariant.

In a second step, a four variable VAR is estimated to analyse the reaction of private consumption to tax and expenditure shocks. The identification is based on the presented basic system, where private disposable replaces GDP and private consumption is added as a fourth variable.

The coefficients d_1, d_2 and d_3 in the following system are unrestricted. The structural model then can be written as

$$\begin{bmatrix} 1 & 0 & -1.04 & 0 \\ 0 & 1 & 0 & 0 \\ -g_1 & -g_2 & 1 & 0 \\ -d_1 & -d_2 & -d_3 & 1 \end{bmatrix} \begin{bmatrix} u_r \\ u_e \\ u_y \\ u_c \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} e_r \\ e_e \\ e_y \\ e_c \end{bmatrix}. \tag{5}$$

The parameter a_1 now captures the income elasticity of overall tax revenues, where the value of the GDP elasticity is taken as an approximation. Hence again a value of 1.04 is imposed.

4 Results

4.1 The Three Variable VAR

The basic VAR estimated is the three variable VAR including total tax revenues (Taxes), government expenditure (Expenditures) and output (GDP). The estimated coefficients of the structural identification given by equation (4) are summarised in table 2.[10] The overidentifying restrictions imposed on the data are significantly accepted with a p-value of 0.35. The two estimated coefficients of the model exhibit the expected sign and are significant at the 5% level. Expenditure has a positive and significant effect on output whereas the tax

[10] Note that these are the impact elasticities capturing the reaction of the respective variable in the same quarter.

Table 2: Three Variable VAR with GDP

	a_1	g_1	g_2
coefficient	1.04	-0.12	0.08
t - value	-	-2.57	2.06

(p-value of overidentification LR test : p = 0.35)

effect on output is negative. The impulse responses generated by this model are presented in figure 3 in appendix B. All impulse responses presented in this paper indicate the deviation of the shocked variable in percent from some baseline value in response to a one percent shock measured at this baseline value.

The impulse responses given in figure 3 indicate a decrease in output after a shock to tax revenues (figure 3a) and an increase in output after a shock to government expenditure (figure 3b). In response to the tax shock, GDP converges relatively smooth to its new lower long run level at which GDP is about 0.35 percent lower. Clearly there is a significant long run effect of tax changes on output. The expenditure shock induces an impact increase of GDP of about 0.07 percent, which afterwards falls and in the long run increases again. In contrast to the reaction to a tax shock, this response is with the exception of the impact effect insignificant. The response indicates that in contrast to a tax revenue shock an unexpected fiscal expansion has almost no effect on the economy. To get an idea of the actual magnitude of these effects, one can transform the impulse responses from percent deviations into currency values. Taking the year 1998 as a baseline, a one DM increase in tax revenues leads in the long run to a reduction in GDP by 1.59 DM, the impact effect on GDP of a one DM increase in expenditure is about 0.23 DM.

In addition to the direct effects of the policy shocks, some information on the working of automatic stabilisers in the German economy can be gained from the impulse response analysis. Figure 3(c) presents the response of income tax revenues to an unanticipated shock to output growth which indicates the degree of the cyclical sensitivity of tax revenues. After the impact effect of 1.04 percent, the value in fact imposed to identify the model, tax revenues

increase further and peak after around four quarters, revenues then being about 2.3 percent higher compared to the baseline value. In the longer run revenues decrease again but remain positive. Although the exact source of the tax revenue response depicted in figure (c) is not identified, it seems quite reasonable to assume that in contrast to monetary policy discretionary fiscal policy does not strongly react systematically to output changes over the cycle. Rule-based, and therefore anticipated systematic fiscal policy by this assumption works predominantly through automatic stabilisers, at least on the tax side of the budget, the discretionary and thereby unsystematic component of fiscal policy is captured by the structural policy shocks. It follows that the response of tax revenues to an output shock is mainly due to the automatic response of tax revenues.[11] Figure 3(d) indicates that after a one percent income tax shock, revenues slowly decrease back to the baseline value. If there is almost no systematic discretionary reaction of fiscal policy to the business cycle, this response again reflects the working of automatic stabilisers in the economy, more specifically it is the negative output response to the initial tax shock that leads to the decline in tax revenues over time. The revenue gain of the initial policy shock hence is after some quarters annihilated by the endogenous working of automatic stabilisers in the economy.[12]

Figure 3(e) shows that expenditures react strongly and significantly to a business cycle shock, due to the assumptions made above this reaction reflects discretionary policy and not the working of automatic stabilisers. Figure 3(f) indicates the persistent effect of a positive business cycle shock.

Finally, some information about the interaction of revenues and public expenditures can be gained form figures 3(g) to (i). It can be seen that a positive expenditure shock has no persistent effect on the level of expenditures, it follows that it is cut back again very fast after

[11] Remember that due to the definition of the expenditure variable excluding current transfers the automatic response of fiscal variables is restricted to the tax side of the budget.

[12] Note that the impulse responses shown in figures 3 (a)and (b) implicitly depend on the magnitude of the automatic policy response given in figures 3(c) and (d). For a discussion of this issue in the context of monetary policy VARs see the paper by Cochrane (1998), a more detailed application to the analysis of automatic stabilisers in VAR models is given in Höppner (2001).

an unexpected increase. Note that figure (d) indicates a somewhat more persistent response of tax revenues to a tax shock, although only a small amount of the response is permanent. Tax revenues increase on impact after an expenditure shock, but return to the base line level immediately, a considerable amount of the expenditures are thus financed by running a budget deficit and not by an immediate and total adjustment of taxes. In addition, expenditures respond positively to an unexpected increase in taxes after two quarters, returning however to the base line value after some years. Altogether the described patterns give some support to the 'tax and spend' hypothesis, that is, on average expenditures seem to follow tax revenues in Germany.[13]

4.2 The Four Variable VAR

In a second step the four variable VAR is estimated to analyse the response of private consumption to tax and expenditure shocks in the German economy. In this model GDP is replaced by private disposable income and private final consumption expenditures is added as a fourth variable to the system. The estimated structural coefficients are summarised in table 3, again the overidentifying restrictions are significantly accepted with a p-value of 0.32. The elasticities capturing the effect of tax and expenditure shocks on disposable income are strongly significant and of greater magnitude compared to the GDP case. The coefficients d_1 to d_3 indicate the contemporaneous reaction of consumption to tax, public expenditure and income shocks, respectively, where d_1 is significant but exhibits the wrong sign, whereas d_2 has the right sign, but is imprecisely estimated. As consumption contemporaneously mainly reacts to disposable income, d_3 captures the bulk of the consumption response. This coefficient is very precisely estimated with a t-value of 9.48.

Figures 4(a) to (c) present the response of consumption to tax, expenditure and income shocks respectively. After a negative impact effect on consumption expenditures of 0.12 percent an

[13] Bohn (1991) presents a discussion and an empirical analysis of this issue for the US.

Table 3: Four Variable VAR with Consumption

	a_1	g_1	g_2	d_1	d_2	d_3
coefficient	1.04	-0.30	0.28	0.08	0.05	0.58
t - value	-	-4.33	4.23	2.20	1.38	9.48

(p-value of overidentification LR test : p = 0.32)

unexpected increase in taxes leads to a decrease in private consumption by around 0.35 percent after 5 years. Transformed into currency values this implies that a one DM tax shock reduces private consumption in the long run by 0.91 DM. Consumption exhibits a positive response to unexpected government expenditure on impact of around 0.2 percent, but afterwards decreases back to a long run value of around 0.1 percent. The immediate response of consumption to public expenditure is equivalent to 0.38 DM. The reaction of consumption to government expenditure is insignificant after a few quarters, whereas the tax response is significant in the long run. Finally, a shock to disposable income increases consumption expenditures by around 0.7 percent, which afterwards converges to a long run level of around 0.5 percent. In money values a one DM shock to disposable income increases private consumption on impact by 0.62 DM, in the long run consumption expenditures converge to 0.44 DM.

Figures 4(d) and (e) present the response of disposable income to a tax and an expenditure shock. As in the case of GDP, a positive tax shock reduces disposable income and a positive expenditure shock increases disposable income. The reaction of disposable income to the tax shock exhibits a slight increase after the negative impact effect of around 0.35 percent, where in the long run it decreases again to a value which is about 0.45 percent lower than the base line value. The response of income to an expenditure shock is on impact 0.2 percent and then decreases to 0.05 percent, this response is only significant in the first period. Transformed into currency values, a one DM tax shock reduces disposable income in the long run by 1.32 DM whereas a positive expenditure shock has an impact effect of around 0.43 DM.

Figures 4(f) and (g) present the response of tax revenues to a tax revenue shock and the response of tax revenues to an income shock, respectively. As has been argued in section 4.1 of the paper, these responses reflect the working of automatic stabilisers in the economy. Here, tax revenues fall in response to a tax shock in the long run below the base line value, while the response of tax revenues to a shock to disposable income is weaker than to a GDP shock.

4.3 Discussion of the Results

In the introduction it has been argued that the theoretical and empirical literature so far has not been able to reach a conclusive picture on the macroeconomic effects of fiscal policy. It is therefore useful to look a bit closer at how the results of the present paper compare to the propositions of the competing models of the business cycle and other empirical studies on the effects of fiscal policy available.

Generally, the negative response of GDP to a tax shock and the positive response of GDP to the expenditure shock is compatible with both Keynesian and neoclassical models of the business cycle. However, the significant increase of private consumption following a public expenditure shock contradicts the standard neoclassical model where private consumption decreases, see e.g. Baxter and King (1993). In this model, the need to finance additional government expenditures lowers lifetime wealth and hence increases the marginal utility of wealth. As firms labour demand is fixed the increase in labour supply due to the change in the marginal utility of wealth leads to higher output but to a fall in private consumption expenditures. This theoretical result rests on the assumption that public expenditures are non-productive and hence do not affect private marginal products, the time series for government expenditures used in the empirical analysis however includes public investment. If public investment though is at an optimal level, a small change in investment should not affect household lifetime wealth. The VAR analysis moreover looks at a change in public

expenditures which lasts for only one period, the public investment effect on private consumption therefore may on the whole be negligible.[14]

On the other hand, Keynesian models usually predict a positive response of private consumption to an expenditure shock. Rotemberg and Woodford (1992) demonstrate that in a new Keynesian model with oligopolistic pricing an increase in government expenditures has indeed an effect on firms labour demand as long as it lowers the mark-up of prices over marginal costs. This leads to an increase in real wages, private consumption and output even with a constant labour supply, see also the model by Devereux et al. (1996). Note that for a comparison of the theoretical predictions and the empirical results one again has to bear in mind that the theoretical results are derived for unproductive government expenditures, assuming that public and private consumption are separable in the utility function. To arrive at a positive effect of government expenditures on private consumption, another class of models like Perotti (1999) emphasises the importance of liquidity constraint agents. Overall the empirical results of the present study therefore tend to support Keynesian models of the business cycle.

The finding of a positive response of consumption to an increase in government expenditure is consistent with the empirical findings of the other structural VAR studies of the response of private consumption to fiscal policy, namely Blanchard and Perotti (1999), Fatás and Mihov (2001) and Mountford and Uhlig (2000). This indicates that Keynesian models with some sort of the above mentioned imperfections might give a better fit to the data than the standard neoclassical model. In particular, a huge empirical literature on private consumption has demonstrated an 'excess sensitivity' of private consumption in response to predictable movements in disposable income. This is typically motivated by the existence of liquidity constraints, contradicting the permanent income hypothesis of consumption which is a

[14] Note that a positive effect of government consumption on private consumption may be generated even in model with intertemporal optimising agents by assuming that both components are not separable in the utility function and hence private consumption is a complement for government consumption, see e.g. Aschauer (1985). In a general equilibrium setting therefore both this channel and the wealth channel discussed above may be apparent.

building block for many neoclassical models. The possible role of liquidity constraints in the transmission process of fiscal policy shocks thereby is still an open question, see Evans and Karras (1996) for some evidence.

In contrast to the VAR results, Ramey and Shapiro (1998), using the 'narrative approach' as discussed in section 2, find that the US economy behaves consistent with the neoclassical model. They find a significant decrease in consumption of durables to a positive expenditure shock. In addition, real wages decrease and after some quarters return to the baseline value. This altogether contradicting evidence compared to the VAR studies hints at the considerable problems of identifying fiscal policy shocks properly. First the magnitude of the policy shocks identified in the VAR approach are not comparable to the effects of a war build-up. In addition, the expenditure series used in the VAR covers both productive and unproductive expenditures, whereas the narrative approach just covers the effect of one budget item, namely defence spending. A more disaggregated analysis would be useful to see the importance of different budget items. Moreover, a war build-up very likely constitutes a break in the expectations of the households about the future, it thus might not be directly comparable to the structural shocks identified in a VAR model.

5 Concluding Remarks

This paper has presented new evidence on the effects of discretionary fiscal policy on the economy in Germany based on the structural VAR approach. The result of this analysis is that there is a negative response of GDP to tax shocks and a positive to expenditure shocks. Moreover private consumption declines after an increase in taxation but rises in response to public expenditure. As there are virtually no studies available on the business cycle effects of fiscal policy and on the magnitude and timing of these effects in Germany, these results constitute some first basic stylised facts about the working of fiscal policy in Germany. Due

to the weak effect of public expenditure on consumption and the almost insignificant effect on output combined with the considerable time lag in the reaction of output to tax changes, the present analysis supports the widely held notion that fiscal policy is not a very useful tool for active stabilisation policy.

The discussion of the results however has shown that overall the relevant empirical literature has not been able to generate a coherent picture of the macroeconomic effects of fiscal policy. While there is a general disagreement especially on the effect of government expenditures on private consumption, the positive effect found in the present study is consistent with the results of the other VAR studies on fiscal policy. More work therefore has to be done to better understand the adequacy of the different identification strategies surveyed in section 2 of the paper and their implications for the effects of fiscal policy measures on the economy. Another area where more research is highly warranted is the analysis of potential non-linearities in the effects of fiscal policy. Too disturbing are at present the differences in the results of the available empirical studies.

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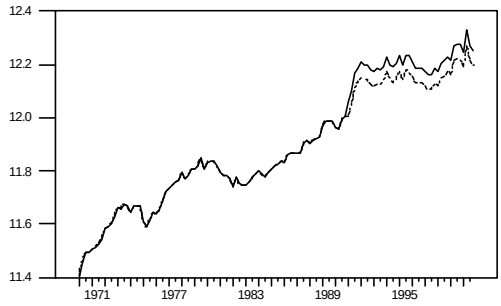
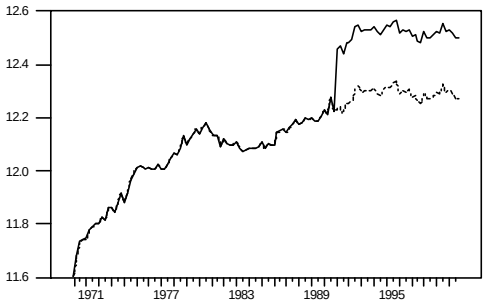
Appendix A: Plot of Data Used

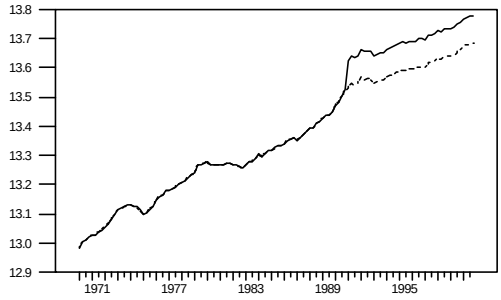
The following graphs plot the quarterly time series used in the VAR, the sample period runs from 1970:1 to 2000:4. All variables are in levels, in real terms and transformed into logarithms. Every graph plots the original series (solid line) and the series adjusted for the German unification (dashed line), see the discussion in section 3.2 of the paper.



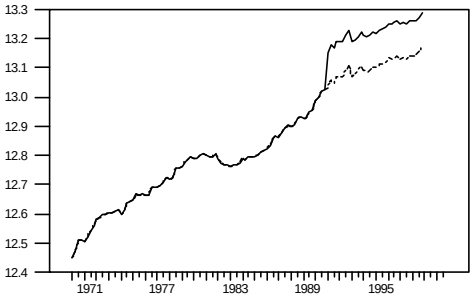
(a) Tax Revenues



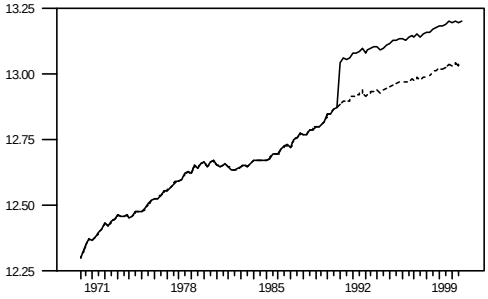
(b) Public Expenditures



(c) GDP



(d) Disposable Income

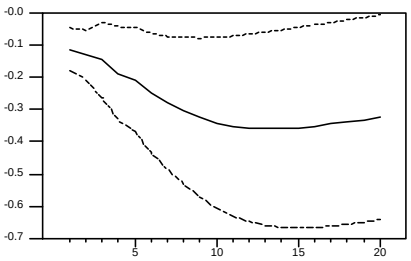


(e) Private Consumption Expenditures

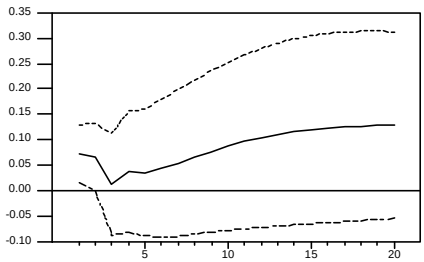
Figure 2: Plot of the Data

Appendix B : Impulse Responses

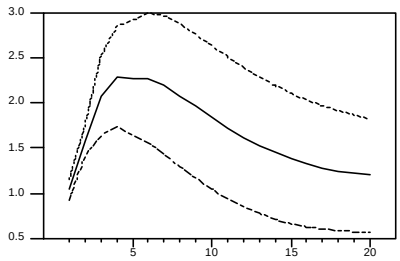
The figures plot the structural impulse response functions and 5% asymptotic error bands.



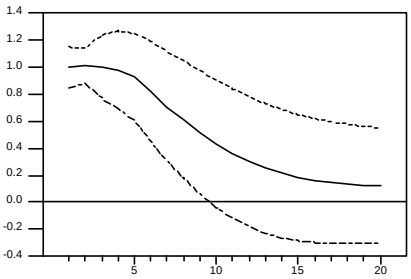
(a) Response of GDP to Taxes



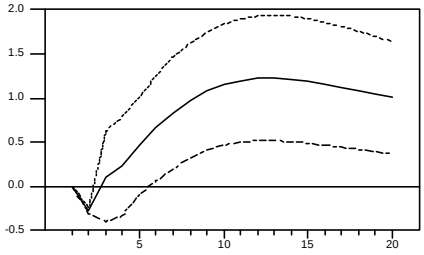
(b) Response of GDP to Expenditures



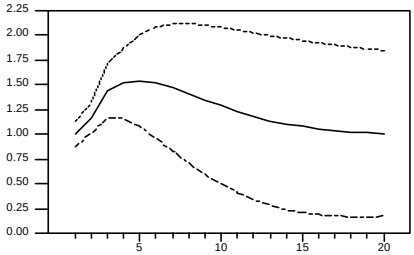
(c) Response of Taxes to GDP



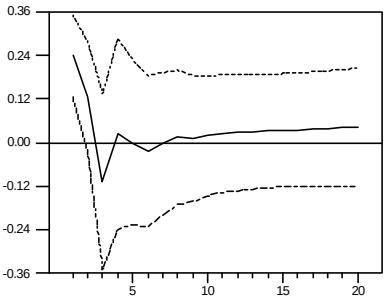
(d) Response of Taxes to Taxes



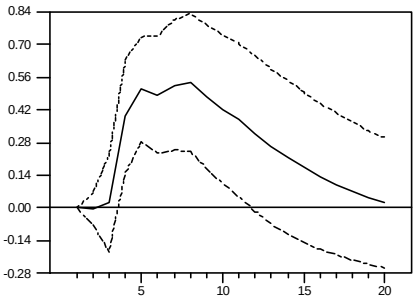
(e) Response of Expenditure to GDP



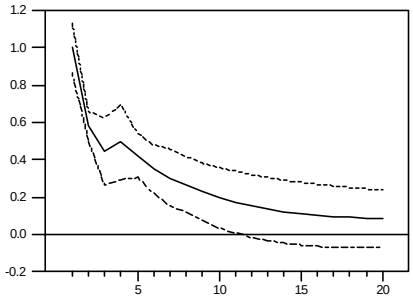
(f) Response of GDP to GDP



(g) Response of Taxes to Expenditure

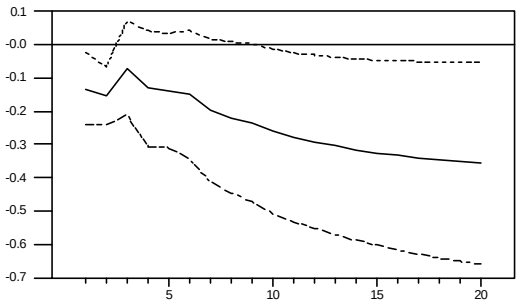


(h) Response of Expenditure to Taxes

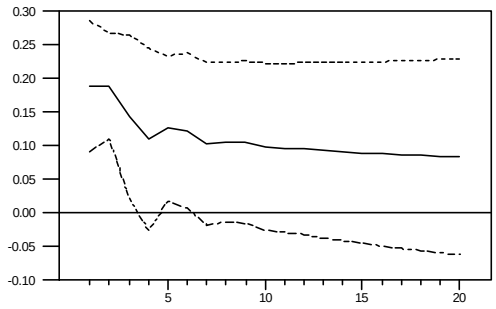


(i) Response of Expenditures to Expenditures

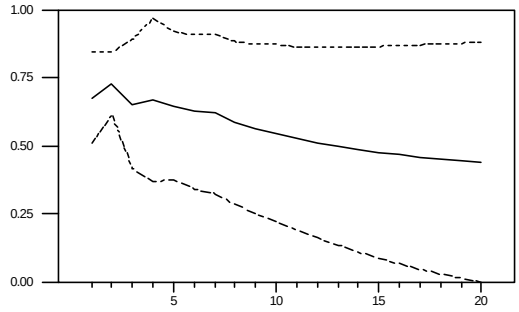
Figure 3: Impulse Response Functions of Three Variable VAR



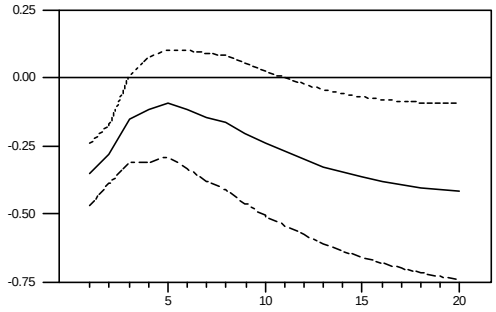
(a) Response of Consumption to Taxes



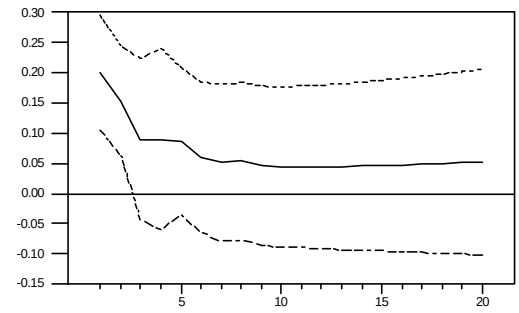
(b) Response of Consumption to Expenditures



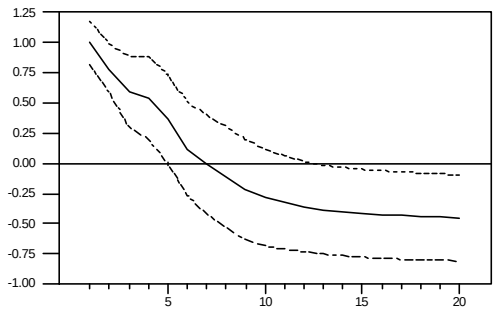
(c) Response of Consumption to Income



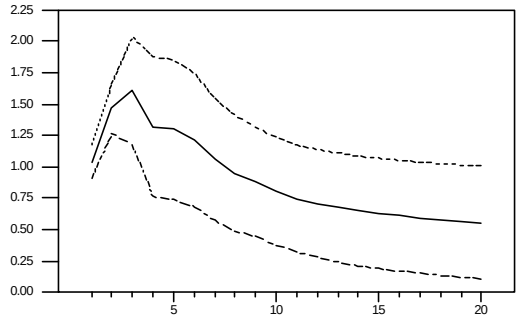
(d) Response of Income to Taxes



(e) Response of Income to Expenditures



(f) Response of Taxes to Taxes



(g) Response of Taxes to Income

Figure 4 : Impulse Response Functions of Four Variable VAR