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HOW DO FISCAL SHOCKS AFFECT THE MACROECONOMIC DYNAMICS IN THE SLOVENIAN ECONOMY

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ABSTRACT

This paper analyses the dynamic effects of fiscal policy on macroeconomic developments in Slovenia. Although there is a substantial volume of work examining the effects of fiscal policy internationally, there are no such estimates for Slovenia. In this study, the structural VAR approach of Blanchard and Perotti (2002) is followed. It relies on institutional information about the tax and transfer systems and the timing of tax collection to identify the automatic response of taxes and spending to economic activity as well as to infer fiscal shocks.

The main finding of this paper is that positive government spending shocks in Slovenia have an immediate positive effect on output, private consumption and investment. The effect becomes insignificant in the period following the shock. On the other hand, positive tax shocks have a negative effect on GDP, private consumption and investment in the period of a shock. The effect again becomes statistically insignificant afterwards. Taking the above facts into account, one-off changes in government spending and taxes in Slovenia are short-lived and can not be used to support economic activity.

POVZETEK

V raziskavi smo analizirali dinamične učinke fiskalne politike na razvoj makroekonomskih agregatov, kar je prvo tovrstno delo za Slovenijo. Izračuni so narejeni na podlagi strukturnega VAR modela, ki temelji na raziskavi Blanchard in Perotti (2002). Ta se opira na institucionalna dejstva o davčnem sistemu in sistemu transferjev ter časovnem horizontu pobiranja davkov. Omenjene informacije se potem uporabijo za identifikacijo avtomatičnih odzivov davkov in državne potrošnje na gibanje gospodarske aktivnosti in za določitev fiskalnih šokov.

Glavne ugotovitve so, da pozitivni šoki državne potrošnje pozitivno vplivajo na BDP, privatno potrošnjo in investicije takoj, ko šok nastopi. Učinek postane statistično neznačilen v obdobju za tem. Pozitivni davčni šoki pa imajo v času šoka negativne učinke na BDP, privatno potrošnjo in investicije. Učinek ponovno postane statistično neznačilen v obdobju, ki sledi šoku. Iz omenjenega je možno sklepati, da imajo enkratne spremembe v državni potrošnji in davkih v Sloveniji kratkotrajen učinek in se jih ne da uporabiti pri pospeševanju ekonomske aktivnosti na daljši rok.

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1. Introduction

Fiscal policy is assessed to have significant effects both on micro-decisions of economic agents as well as on aggregate economic activity. Nevertheless, compared to the large empirical evidence on the effects of monetary policy, research on fiscal policy effects has received much less attention. In many ways this is due to its political dependence but also because of its complexity and distributional dimension. Consequently the knowledge on the effects of fiscal policy remains limited (e.g. Leeper, 2010). This lack of attention contrasts with recent public debates on the role of fiscal policy, both in the euro area and worldwide, and specifically so in the period of economic crisis (e.g. Spilimbergo, 2008, or Alfonso et al., 2010). Furthermore, researchers' views on both the short-run and long-run effects of fiscal policy remain rather mixed.[2] This heterogeneity is also in line with divergent theoretical underpinnings: neoclassical models state that private consumption should fall following a positive shock to government consumption via the so-called crowding out effect, while models with (neo-)Keynesian features find the opposite (see e.g. Woodford, 2010).

Fiscal policy represents the only policy instrument on the demand side, which individual Member States of the euro area countries may use to offset shocks. Fiscal shocks in an economic union, especially those in big countries, may also cause important spill-over effects (e.g. Guiliodori and Beetsma, 2004). It is also important to keep in mind that fiscal policy has important supply side effects through infrastructure expenditures, spending aimed at human capital enhancement, and taxes that directly affect the returns to labour and capital. Although there is a rather substantial volume of work that examines the effects of fiscal policy internationally, almost no investigation has been directed to estimate these effects in the case of Slovenia.

This paper thus analyses the dynamic effects of fiscal policy on macroeconomic developments in Slovenia, both from the expenditure as well as from the revenue side. The main issue in the estimation of fiscal policy effects is the identification of a fiscal shock, where approaches range from using simple VARs to structural models. In this paper, the approach of Blanchard and Perotti (2002) is followed, where a structural VAR is used. It relies on institutional information about the tax and transfer systems and the timing of tax collection to identify the automatic response of taxes and spending to activity as well as to determine fiscal shocks. The empirical investigation of the role of fiscal policy in Slovenia shows that in the period examined, positive government spending shocks have a positive effect on output, private consumption and investment on impact. The effect becomes insignificant afterwards. Positive tax shocks have a negative immediate effect on output, private consumption and investment. The effect again becomes insignificant in the period following the shock. To sum up, one-off changes in government spending and taxes in

[2] This paper only deals with the effects of fiscal policy on output and does not include an analysis of fiscal policy price effects. For an overview of studies on price effects and an assessment of empirical results one may refer e.g. to Henry et al. (2004).

Slovenia are short-lived and can not be used for long-lasting purposes. The size of the effects is similar to those in other studies. After a 1% shock to government spending, GDP contemporaneously rises by approximately 0.3%, while it decreases by close to 0.1% at a time of 1% shock to net taxes.

The remainder of the paper is organized as follows. A literature review is provided in section 2. Section 3 describes fiscal policy in Slovenia. The empirical approach is presented in section 4. Section 5 includes a detailed description of the data. The effects of fiscal policy on GDP, private consumption and investment are presented in section 6. Section 7 presents robustness checks. Section 8 concludes.

2. Literature review

Various methodologies have been applied to study the effects of fiscal policy shocks. Aside from structural models, discussed and evaluated in Coenen et al. (2010) or in Cogan et al. (2009), four major strands of research stand out. First, transforming a seminal approach of Romer and Romer (1989) of identifying monetary policy shocks into a fiscal policy experiment, as done by the same authors (2007) in the so-called "event-study",[3] one can trace the effects of fiscal policy using dummy variables to detect fiscal episodes, such as presidential speeches, wars or well-documented fiscal expansions.

The second approach by Canova and Pappa (2003) and by Mountford and Uhlig (2009) consists of identifying fiscal shocks by sign and near-zero restrictions of impulse responses in a VAR. This approach too follows the methodology, originally applied to monetary policy by Uhlig (1999). Restrictions at work here come from making fiscal variables independent of both business cycle shocks and monetary policy shocks or by defining the "revenue" shock by allowing that tax revenues increase while government spending does not. Identifying restrictions are also applied so that the fiscal variables do not respond for a certain time period. On the other hand, no sign restrictions are imposed on the response of GDP to fiscal shocks.

The third approach to investigating the effects of fiscal policy by Fatas and Mihov (2001) or by Favero (2002) relies on the Choleski ordering to identify fiscal shocks in a VAR. In the former, government spending is ordered first, assuming that all contemporaneous elasticities of fiscal variables to other variables are 0, while in the latter fiscal shocks are ordered last, mimicking the fiscal policy reaction function. Finally, Blanchard and Perotti (2002) apply a

[3] An even more restrictive identification of exogenous shocks for US is represented by Ramey and Shapiro (1998), dealing only with the so-called "war-dates", including only three instances of a military build up, i.e. instances not related to the macroeconomic developments (Korean War, Vietnam War and the US response of a New Cold War to the Afghanistan invasion by USSR) and the related increase in government spending. In the most recent study by Ramey (2010), 9/11 related spending is added.

methodology which combines institutional information and SVAR analysis. This is also the approach taken in this paper and is discussed further in the following sections.

Following the divergences in theoretical and methodological approaches, the existing empirical evidence on the effects of fiscal policy is rather heterogeneous. An overview of studies dealing with the effects of fiscal policy on economic activity may be found in Spilimbergo et al. (2009) or in Hemming et al. (2002). As these overviews point out, the size (and even the sign) of fiscal multipliers varies across countries, time, and depends on many factors and circumstances in which fiscal policy is applied, among others also on the current stance of the monetary policy (e.g. Eggertsson, 2009) and its response to changes in fiscal policy (e.g. Woodford, 2010). The findings of Ilzetzki et al. (2010) support the view of an effective fiscal policy in closed economies and only negligible effects of fiscal policy in open economies, especially those with a flexible exchange rate. Contrary to that, Dellas et al. (2005) find no significant relationship between the exchange rate regime and the effects of fiscal policy. The study by Ilzetzki et al. (2010) also reveals that government consumption has smaller short-run and less persistent effects in developing than in high-income countries. The size of the multiplier for the United States in Blanchard and Perotti (2002) or in Romer and Romer (2008) is estimated at 1 in the first year (i.e. a fiscal stimulus of one percent of GDP increases GDP by about one percent), while the size of a cumulative multiplier is almost 3, when the effect of a shock peaks a few years later. On the other hand, Perotti (2005) finds much smaller multipliers for European countries,[4] a finding which is also at odds with the findings of structural models as presented in Coenen et al. (2010) or in ECB (2010).

Some empirical studies find a negative relationship between fiscal spending and aggregate economic activity. The most notable studies with negative multipliers are found in the literature on expansionary fiscal contractions initiated by Giavazzi and Pagano (1990). Following that, Perotti (1999) finds evidence of a negative co-movement of household consumption and government spending during episodes of fiscal consolidation (and hence large spending cuts) in circumstances of "fiscal stress" (defined by unusually high debt to GDP ratios), but the opposite sign in "normal" times, a finding similar to Galí et al. (2007). In the same vein, a study by Guidice et al. (2003) confirms the expansionary effect of fiscal tightening on economic activity for roughly half of the consolidation episodes studied. Their simulations show that consolidations may be expansionary in the short to medium run, provided that they are obtained through expenditure cuts rather than revenue increases. Although these positive 'non-Keynesian' effects on private demand are not always strong enough to offset the negative impact of the fiscal consolidation on GDP in the period of a shock, they begin to dominate in consecutive years.

[4] Some other examples include e.g. Alfonso and Sousa (2009) for Portugal, Benetrix and Lane (2009) for Ireland, de Castro Fernandez and Hernandez de Cos (2006) for Spain, Giordano (2006) for Italy and Heppke-Falk et al. (2006) for Germany.

It is generally accepted that the effects of fiscal policy depend to a large extent on the instrument used. In general, multipliers associated with changes in spending, and within that in targeted transfers, are higher than those related to tax cuts, as found by Coenen et al. (2010). As a rule of thumb, Spilimbergo et al. (2009) suggest that the effect of fiscal policy when acting on the revenue side is about half of the spending multipliers. This is also close to the findings, presented in this paper. On the other hand, Mountford and Uhlig (2009), emphasize that the multipliers associated with tax cuts are much higher than spending multipliers. Their analysis, however, also includes assumptions on how the expansionary fiscal actions are financed. In the evidence provided by Blanchard and Perotti (2002) and by Galí, López-Salido and Vallés (2005), private consumption rises significantly after a positive spending shock, while Cogan et al. (2009) find that private consumption and investment react to expansionary government spending in a similar manner. Fatas and Mihov (2001) find that increases in government consumption are always expansionary, while increases in public investment do not affect output significantly. According to the same study, increases in government employment (wage spending) are assessed to have the largest effect on the economy.

3. Fiscal policy in Slovenia in the period 1995-2010

The fiscal situation in Slovenia is characterised by deficits throughout the period 1995-2010. Even in the good times no surplus was achieved, and the smallest deficit was achieved in 2007 (0.1% of GDP). Structural deficits[5] have been present throughout the period as can be seen from Figure 1. However, government indebtedness has been relatively low with government debt ratio below 20% of GDP in 1995, increasing to 38% of GDP by 2010, still well below the 60% reference value.

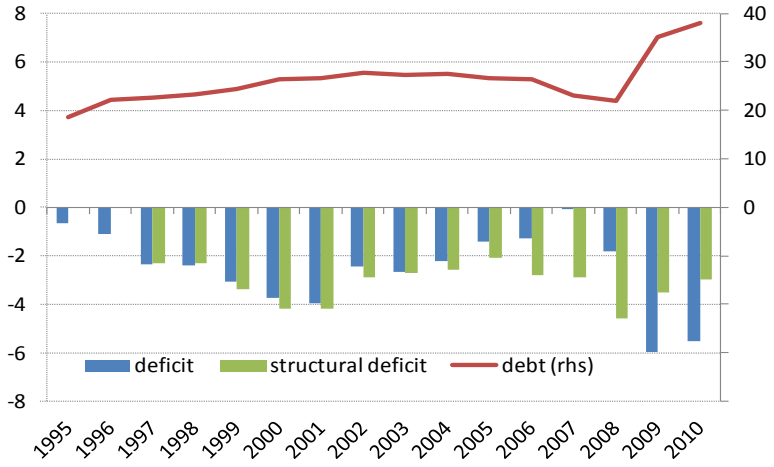
After gaining independence in 1991 the goal of fiscal policy in Slovenia was initially to support the economic stabilisation. Later on, fiscal policy has become oriented to reduce the deficit, to reach a position close to structural balance and to secure the fulfilment of the Maastricht fiscal criteria in order to support the adoption of the euro as soon as possible.

The main consolidation occurred in the period from 2002 to 2005, i.e. prior to the EU accession and euro adoption. The main consolidation measures included an increase in the VAT rates in 2002 and an expenditure restraint. The structural deficit increased substantially in the period 2006-2008, mainly as a consequence of the tax reform, e.g. a gradual reduction of the payroll and corporate income tax rates. During the recent economic and financial crisis the deficit increased substantially due to the working of automatic stabilisers. Fiscal

[5] The structural balance is an indicator of the underlying position of the budget balance. It is calculated by substracting the cyclical component, which denotes the part of the fiscal position that is explained by the current cyclical position, from the actual budget balance. European Commission excludes from the actual budget balance also one-off and other temporary measures.

consolidation is needed now and an excessive deficit should be corrected by 2013 at the latest as required under the EU excessive deficit procedure.

Figure 1: Main fiscal ratios, Slovenia 1995-2010, in % of GDP.



Source: Statistical Office of the Republic of Slovenia, European Commission.

4. The VAR model

Our identification of fiscal policy shocks is based on the methodology originally proposed by Blanchard and Perotti (2002), a seminal paper on fiscal policy SVAR analysis. The main idea is to exploit fiscal policy decision lags to identify discretionary fiscal policy shocks, which are unaffected by the macroeconomic variables in the VAR model.

4.1 Specification

The reduced form VAR model is:

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

where $Y_t = [T_t \;\; g_t \;\; y_t]'$ with real net taxes, T_t, real government spending, g_t, and real GDP, y_t. All variables are log-transformed. $C(L)$ is an autoregressive lag polynomial and U_t is the vector of reduced form residuals. We use quarterly data, because this is essential for identification of the fiscal shocks. Our benchmark specification also includes a constant, a linear time trend and a dummy[6] variable for the crisis, which we omit from the notation for convenience. The number of lags for the VAR is chosen to be four as suggested by the Akaike

[6] The dummy holds a value of 1 from/including the fourth quarter of 2008 and 0 before that.

information criterion (AIC).[7] The residuals of the 4-lag VAR model appear to be serially uncorrelated, further supporting this lag length choice.

4.2 Identification

The identification strategy proposed by Blanchard and Perotti (2002) is followed, where the reduced from residuals U_t can be written as linear combinations of the underlying "structural" shocks V_t:

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

where the structural innovations V_t are assumed to be orthonormal, i.e. the covariance matrix is assumed to be an identity matrix $E(V_t V_t') = I$. The matrices A and B describe the instantaneous relations between the reduced form residuals and the structural shocks.

From the reduced form representation and from the relationship between the reduced form residuals and the structural shocks, we can obtain the structural form of the VAR by pre-multiplying (1) by the matrix A:

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

In the remaining part of this section we follow the four step approach of Giordano et al. (2005) to identify the fiscal shocks.

In the first step the reduced form VAR is estimated, from where we obtain the reduced form residuals $U_t = [u_t^T \; u_t^g \; u_t^y]'$. We can express the reduced form residuals of net taxes, u_t^T, and government spending, u_t^g, as linear combinations of the underlying structural fiscal shocks v_t^T, v_t^g and of the reduced form residuals of GDP, u_t^y:

$$u_t^T = \alpha_y^T u_t^y + \beta_g^T v_t^g + v_t^T \tag{4}$$
$$u_t^g = \alpha_y^g u_t^y + \beta_T^g v_t^T + v_t^g \tag{5}$$

where the coefficients α_y^T and α_y^g capture both the automatic response of economic activity to net taxes and government spending under existing policy rules and any discretionary adjustment of fiscal policy in response to unexpected movements in output. The coefficients β_g^T and β_T^g measure how the structural shock to government spending or net taxes contemporaneously affects net taxes or spending, respectively.

[7] The other information criteria we looked at (FPE, HQ, SC) also suggest at most four lags.

The main interest of this paper is the identification of structural shocks v_t^T and v_t^g, and the study of the response of real GDP to these shocks. To identify these two structural shocks we need to impose further restrictions on the system above. Here we use the observation made by Blanchard and Perotti (2002) that it takes policymakers and legislatures more than a quarter to react to a GDP shock. This virtually eliminates the possibility of discretionary adjustment of fiscal policy in response to unexpected movements in GDP. As a consequence, with the use of quarterly data, the coefficients α_y^T and α_y^g capture only the automatic elasticity of the government spending and net taxes to real GDP.

Due to the correlation of reduced form residuals, u_t^j, with structural shocks, v_t^i, it is not possible to estimate the α_i^j's by OLS. Thus, we use exogenous elasticities α_j^i in order to identify the shocks. Derivation of both elasticities is described in the next section. The use of exogenous contemporaneous elasticities allows us to compute cyclically adjusted reduced-form residuals for the fiscal variables. This represents the second step of our identification procedure:

$$u_t^{T,CA} = u_t^T - \alpha_y^T u_t^y = \beta_g^T v_t^g + v_t^T \quad (6)$$

$$u_t^{g,CA} = u_t^g - \alpha_y^g u_t^y = \beta_T^g v_t^T + v_t^g \quad (7)$$

To be able to identify the system we need to make a decision about the ordering of the fiscal variables, which represents our third step. If we want to impose the restriction that tax decisions come first, we need to set β_g^T=0, whereas if we want spending decisions to come first we set β_T^g=0. In our benchmark case, we assume that tax decisions come first. The reverse ordering makes little difference to the impulse response of output. Since tax decisions come first under our assumption, cyclically adjusted residuals of taxes equal the tax shock. Spending decisions in that case come second and can therefore be adjusted for the decision on taxes. This allows us to estimate β_T^g by an OLS regression of cyclically adjusted residuals of spending on the estimate of the tax shock:

$$u_t^{T,CA} = v_t^T \quad (8)$$

$$u_t^{g,CA} = \beta_T^g v_t^T + v_t^g \quad (9)$$

Finally, we can estimate the remaining coefficients in the equation for real GDP. To do that we need to use instrumental variables to take into account the correlation between the regressors and the error term. Following Blanchard and Perotti (2002), we use cyclically adjusted reduced-form residuals as instruments for the fiscal variables. Those may still be correlated with each other, but are no longer correlated with v_t^y:

$$u_t^y = \alpha_T^y u_t^T + \alpha_g^y u_t^g + v_t^y \quad (10)$$

With the above mentioned four steps, we estimate all the coefficients, needed to construct the A and B matrices, which we use to compute the impulse responses to fiscal shocks:

$$\begin{bmatrix} 1 & 0 & -\alpha_y^T \\ 0 & 1 & -\alpha_y^g \\ -\alpha_T^y & -\alpha_g^y & 1 \end{bmatrix} \begin{bmatrix} u_t^T \\ u_t^g \\ u_t^y \end{bmatrix} = \begin{bmatrix} \sigma^T & 0 & 0 \\ \beta_T^g & \sigma^g & 0 \\ 0 & 0 & \sigma^y \end{bmatrix} \begin{bmatrix} v_t^T \\ v_t^g \\ v_t^y \end{bmatrix}$$

The elements on the main diagonal of the B matrix are the standard deviations of the structural shocks.

After the VAR is estimated and identified we can compute impulse responses to evaluate the dynamic effects of structural shocks to taxes and spending. Solving equation (3) for Y_t gives the structural moving average representation, whose coefficients represent the structural impulse response functions:

$$Y_t = [I - C(L)]^{-1} A^{-1} B V_t \tag{11}$$

5. The Data

5.1 Data sources and description

We use quarterly data based on the ESA95 methodology from 1995:1 to 2010:4. It is crucial for our approach to use quarterly data for two reasons. The first one is the fact that available dataset is short and the second one is our assumption, required by the chosen approach, that discretionary fiscal policy actions are not taken within one time period. In Slovenia, quarterly national accounts data on general government are available only for the period from 1999 onwards, while annual data exists from 1995. Therefore, we have constructed quarterly profiles of the relevant series, based on cash data, also for the period 1995-1999.[8] This still represents quite a short sample compared to other studies, which usually use longer datasets.[9] Using cash data would enlarge somewhat the sample (from 1992 on), but we decided to use ESA95 data due to their more frequent use.

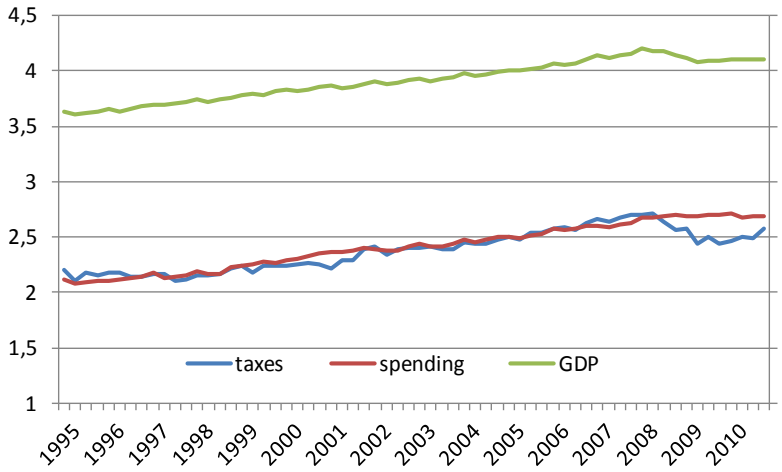
[8] There is no unique best way to perform the interpolation. We have made the interpolation on the basis of quarterly growth rates from the cash data in a way that ensures that quarterly values sum up to the published annual figures. Additionally we have taken out from the 1995 figure two specific transactions, which were booked as capital transfers (restitution in cash of private property nationalised after the Second World War and due to financial improvement of banks), which contributed to the deficit in that year in the amount of around 7.7% of GDP.

[9] In the paper of Blanchard and Perotti (2002) the dataset covers around 50 years (1947-1997 period). Some other studies use the sample which covers around 25 years (for example Burriel et al. (2009), de Castro Fernandez and Hernandez de Cos (2006)) or 30 years (Heppke-Falk et al. (2006)).

The basic VAR includes three variables: net taxes, government spending and GDP. We define revenue and expenditure variables in line with Blanchard and Perotti (2002). The revenue variable is defined as total tax revenue minus transfers and interest payments (also referred to as taxes or net taxes in the rest of the paper). The expenditure variable is called government spending (also referred to as spending in the rest of the paper) and consists of government consumption (mainly compensation of employees and intermediate consumption) and government investment. The difference between the two variables is the primary deficit.

All these variables have been seasonally adjusted using TRAMO-SEATS. They are expressed in real terms, which we obtained by using the GDP deflator[10] and they are used in logarithms. All three variables are presented in Figure 2.

Figure 2: Log-transformed taxes, spending and GDP



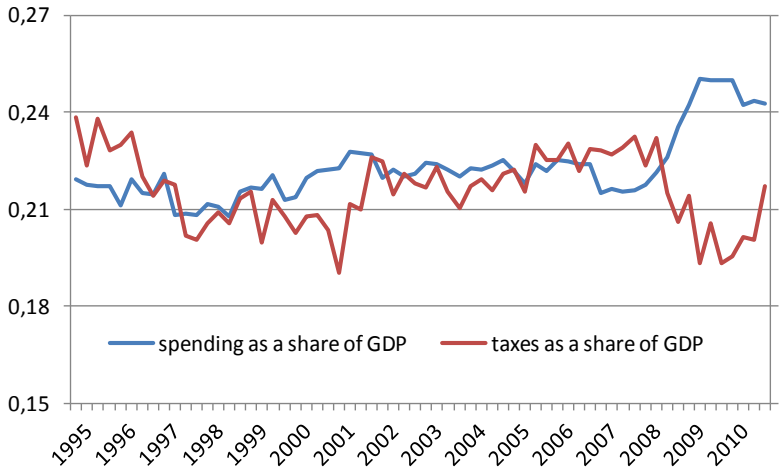
Source: Statistical Office of the Republic of Slovenia and authors' calculations.

All variables used in our basic VAR model are showing an upward trend, with GDP and taxes declining strongly during the crisis. This was the period in which (primary) deficit (the difference between taxes and spending) increased the most.

Seasonally adjusted series in real terms, expressed as a share of GDP, are plotted in Figure 3. We can see that the tax to GDP ratio exhibits a downward trend in the beginning of the period up to 2001, and an upward trend to the middle of 2008. The spending to GDP ratio has been relatively stable in the period up to mid 2008, fluctuating at around or below 22% of GDP, with the exception of 1997 and 1998. At the end of 2008 the economic and financial crisis resulted in a reduction of the tax to GDP ratio and in an increase in the spending to GDP ratio.

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

Figure 3: Taxes and spending as shares of GDP



Source: Statistical Office of the Republic of Slovenia and authors' calculations.

5.2 Unit root and cointegration tests

Visual inspection suggests that all three series included in the analysis, are non-stationary in levels. Table 1 presents the results of the standard augmented Dicky Fuller and Phillips-Perron unit-root tests. The test was performed with the inclusion ob both an intercept and a linear trend. Results indicate the existence of unit roots in taxes, but are significant i.e. suggesting the rejection of a null hypothesis of a unit root at 5% level for spending and GDP. On the other hand, the null hypothesis of a unit root can be rejected for taxes and spending on the basis of ADF, when series are represented by first differences. This is not the case for GDP, which seems to have a unit root. However, when the Phillips-Perron test is used, taxes and GDP have a unit root in levels, while the hypothesis of a unit root in first differences can be rejected at 1% significance for all three variables tested.

Table 1: Unit-root test

	ADF test		Phillips-Perron test	
	level	1st difference	level	1st difference
taxes	-2.44	-10.46**	-2.55	-10.16**
spending	-3.64*	-10.21**	-3.64*	-11.49**
GDP	-3.72*	-1.87	-1.17	-8.43**

Notes: ADF and Phillips-Perron test statistics. * significant at 5% level, ** significant at 1% level.
Source: Authors' calculations.

As unit root tests indicate the existence of a unit root in our time series, a co-integration test was the next step in testing for time series properties. The results are presented in Table 2. The results of the Johansen co-integration test points to one long run relationship among the variables. Such a result suggests that a structural vector error correction model could be estimated to take the cointegration relation into account. However, this would be beyond the scope of this paper. Also, Blanchard and Perotti (2002) find no significant difference in results when imposing the cointegration relationship among the variables. Consequently, the SVAR model in this analysis is specified in levels.

Table 2: Co-integration test

Hypothesized No. of CE(s)	Trace Statistic	Probability**
None*	45.4528	0.0273
At most 1	16.1997	0.4766
At most 2	3.3511	0.8324

Note: Johansen trace test. * denotes rejection of the hypothesis at the 0.05 level;
**MacKinnon-Haug-Michelis (1999) p-values
Source: Authors' calculations.

5.3 Exogenous elasticities

For the identification of structural shocks, exogenous elasticities are required. The elasticity α_y^T represents the elasticity of net taxes to output. For the calculation of the output elasticity we follow the OECD methodology as proposed in Giorno et al. (1995). On the revenue side the calculation takes into account four different tax categories, i.e. the personal income tax, the corporate income tax, indirect taxes and social security contributions, while on the expenditure side the elasticity of transfers is considered separately. The output elasticity is a weighted average of the elasticities of different net tax components, including transfers. It is computed on the basis of information on institutional arrangements, like tax rates. The contemporaneous output elasticity of net taxes has been calculated as:

$$\alpha_y^T = \sum_i \varepsilon_{\tilde{T}_i,B_i}\,\varepsilon_{B_i,y}\,\frac{\tilde{T}_i}{\tilde{T}} \tag{12}$$

where $\varepsilon_{\tilde{T}_i,B_i}$ is the elasticity of the ith category of net taxes to its own tax base and $\varepsilon_{B_i,y}$ is the GDP elasticity of the tax base of the ith category of net taxes. The $\tilde{T}_i$'s are positive in the case of taxes and negative in the case of transfers.

According to our estimation, the output elasticity of net taxes stands at 0.87 in Slovenia (see also appendix).[11] This is similar to the elasticity estimated for Germany at 0.95 (Heppke-Falk et al., 2006). However, different SVAR studies give very different estimates of the output elasticity of net taxes, as can also be seen from Table 3 below. For example, the output elasticity of net taxes (α_y^T) was estimated to be 0.62 for Spain, while it was estimated as 1.54 in the case of EMU. We use those two values for the robustness check.

Table 3: Comparison of Slovenian output elasticities of net taxes to EMU and Spain

	Slovenia	EMU	Spain
$\varepsilon_{tdirh,y}$	0.09	0.90	0.17
$\varepsilon_{ss,y}$	0.09	0.64	0.17
$\varepsilon_{tdirc,y}$	1.53	1.08	1.04
$\varepsilon_{tind,y}$	0.72	0.97	0.30
$\varepsilon_{transf,y}$	-0.2	-0.2	-0.2
$\boldsymbol{\alpha_y^T}$	**0.87**	**1.54**	**0.62**

Sources: Slovenia: Authors' calculations, EMU: Burriel et al. (2009), Spain: de Castro Fernandez and Hernandez de Cos (2006).

Regarding government spending we assume, following Heppke-Falk et al. (2006), that it does not respond to real GDP within a quarter, as expenditure is planned on an annual basis within the budgetary process and is therefore rather inflexible in the short run. Also Blanchard and Perotti (2002) state that they could not identify any automatic feedback from economic activity to government purchases of goods and services. In other words, we set elasticity of government spending to output, α_y^g, to 0.

[11] Elasticities vary over time due to changes in tax legislation and due to changes in the composition of net taxes. For that reason, constant elasticities reflect at best, the "average" response of net taxes over a sample period. The response of tax bases to changes in activity may depend on the nature of economic shock(s) that produced the boom or the recession (Van den Noord, 2000).

6. Fiscal policy effects on macroeconomic variables

When displaying the impulse response functions we show both the point estimate and the 95% bootstrapped confidence intervals based on 5000 replications. We present the impulse responses for 12 quarters (i.e. 3 years) ahead.

6.1 Benchmark results

In Figure 4 we show the results of our basic model. The responses of GDP to a 1% shock in spending and taxes are presented. We can see that higher government expenditure raises real GDP on impact (when a shock occurs), namely a 1% shock to government expenditure raises real GDP by 0.34%, which is also the highest point it reaches. The impact multiplier is therefore smaller than 1. The reaction of GDP remains positive also in the first period after the shock, but is already insignificant. Figure 5 shows the cumulative response of output to a 1% expenditure shock. With the cumulative response we present the total increase of GDP in a certain time period due to a shock in the fiscal variable. The cumulative response of GDP to a shock in spending is positive throughout the shown period, but it becomes insignificant already in the second quarter.

Regarding taxes we can see that a 1% shock decreases real GDP at a time of a shock by 0.08%, which is also the lowest point it reaches. The impact multiplier is again smaller than 1 and is also smaller than the spending multiplier, which is in line with the majority of the literature from that field. The GDP reaction turns positive and insignificant already in the first quarter. It stays insignificant throughout the presented period. The cumulative response of GDP to a tax shock is negative in the period of a shock and in the first quarter, when it already turns insignificant. It becomes positive in the second quarter and remains positive (but insignificant) until the end of the presented period.

Figure 4: Response of GDP to a 1% shock in fiscal variables

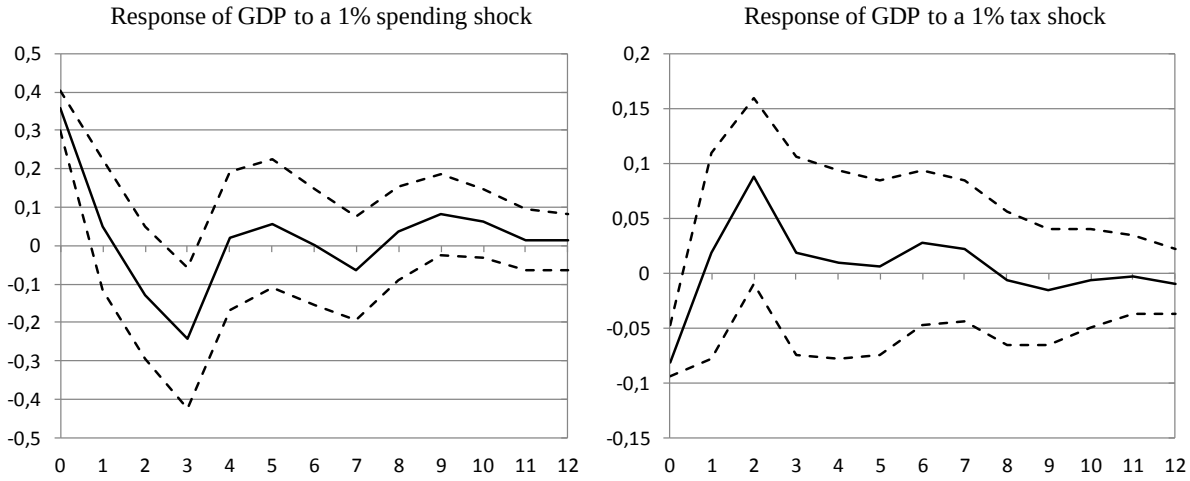
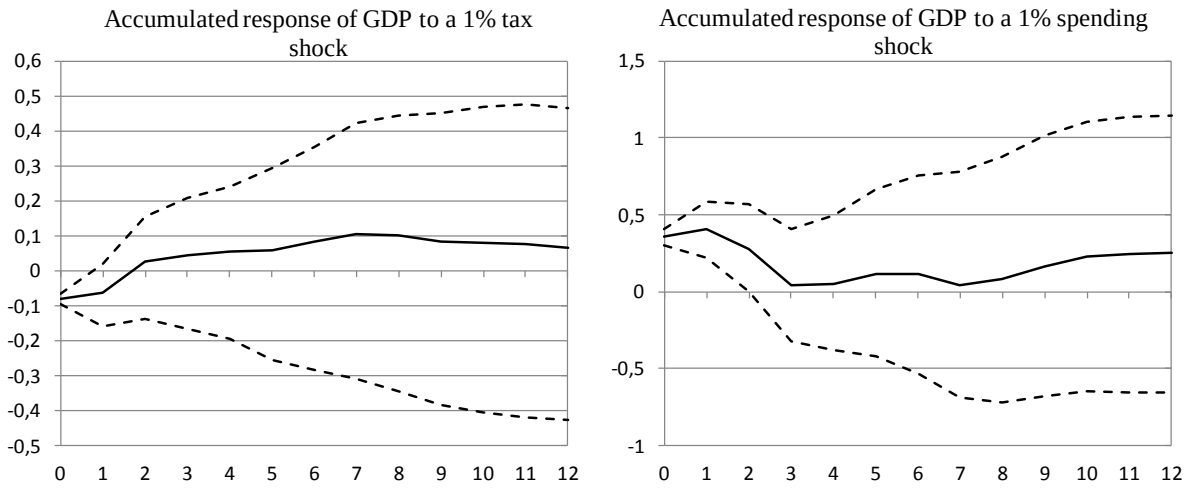


Figure 5: Accumulated response of GDP to a 1% shock in fiscal variables



6.2 Effects on private consumption and investment

To get a more detailed picture, we also check how different GDP components react to a shock in spending and taxes. More specifically, we check the effect of fiscal shocks on private consumption and investment. With this exercise we can check how are alternative theories supported by the Slovenian data. For example, both neoclassical theory and Keynesian models predict a positive effect of government spending on GDP. Their views are, however, opposing when it comes to a reaction of private consumption to a spending shock. Keynesian models imply that consumption increases after a spending shock, while the neoclassical theory predicts that private consumption should fall. We use the approach of Blanchard and Perotti (2002) to estimate the effects of fiscal shocks on private consumption and investment. We estimate a 4-variable VAR by adding one more equation for the component of GDP to our basic model, resulting in an additional equation for the residual:

$$u_t^{y_i} = \alpha_T^{y_i} u_t^T + \alpha_g^{y_i} u_t^g + v_t^{y_i} \quad (13)$$

$u_t^{y_i}$ stands for the reduced form residual of the GDP component, either private consumption or investment in our case. $v_t^{y_i}$ and v_t^y form equation (10) will in general be correlated.

Figures 6 and 7 show the responses of consumption and investment to 1% spending and tax shocks. The impulse response of real GDP changes slightly with each component added to the system, however the results in terms of statistical significance do not change, so we do not report them in this section.

The reaction of both private consumption and investment to a government spending shock is positive and significant on impact. More specifically, a 1% spending shock raises private consumption by 0.44% and investment by 1.4%. The impact multiplier for consumption is therefore smaller than 1 and for investment higher than 1. The reactions of both GDP components turn insignificant after that. Figures 8 and 9 present the cumulative responses of both output components to a 1% shock to fiscal variables. The cumulative response of private consumption to a shock in spending is positive throughout the shown period, but it becomes insignificant already in the third quarter. The cumulative response of investment to a spending shock is also significantly positive until (including) the second quarter. It becomes insignificant after that and even turns negative in the sixth quarter. Our positive private consumption response is in line with the findings of Blanchard and Perotti (2002) and the above mentioned Keynesian theory. Our results for investment are comparable to those of Cogan et al. (2009), who find that private consumption and investment react to expansionary government spending in a similar manner.

The reaction of both private consumption and investment to a tax shock is negative and significant on impact. A 1% shock in taxes decreases private consumption by 0.02% and investment by 0.29% on impact. The impact multipliers are in both cases smaller than 1. After

that the reactions of both GDP components turn insignificant. The cumulative response of private consumption to a tax shock is mostly negative throughout the shown period, although insignificant after the initial response. The cumulative response of investment to a tax shock is significantly negative until (including) the second quarter. It becomes insignificant after that and even turns positive in the eighth quarter. Our negative consumption and investment responses are consistent with the results of Blanchard and Perotti (2002). Our investment response is also in line with the Keynesian theory, which predicts that the response of investment to a tax shock should have the opposite sign than the response to spending shock.

Figure 6: Response of private consumption to a 1% shock in fiscal variables

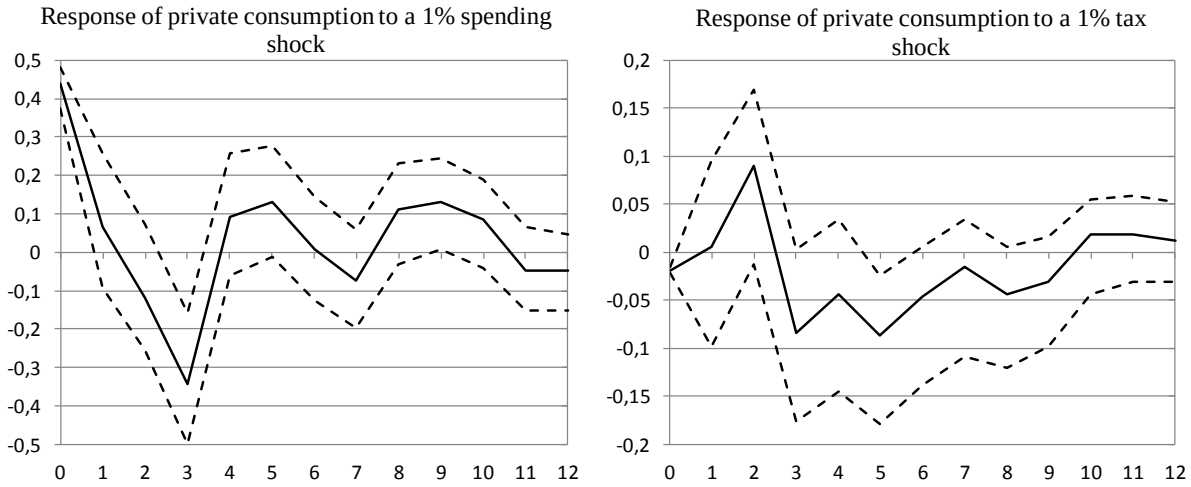


Figure 7: Response of investment to a 1% shock in fiscal variables

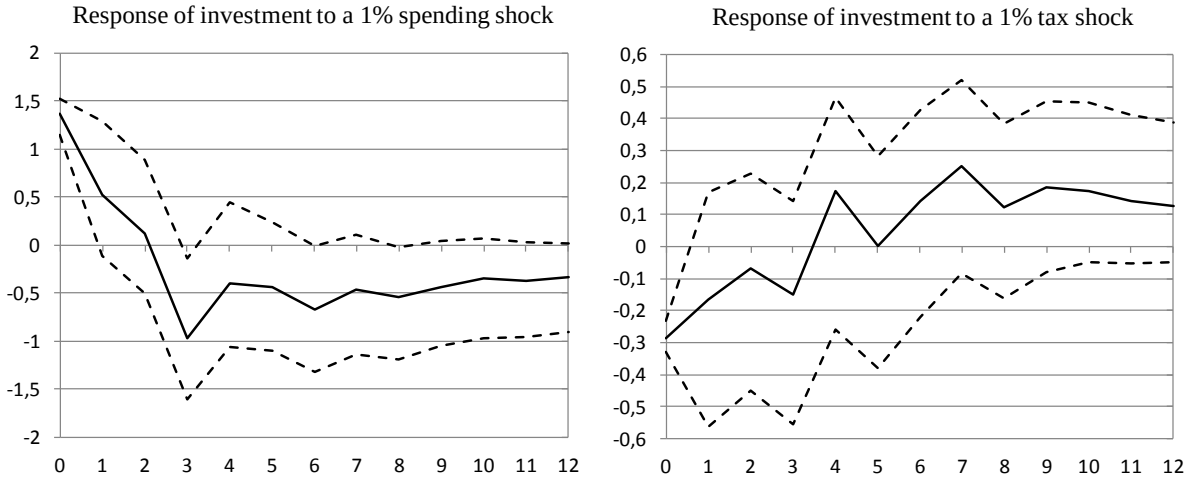
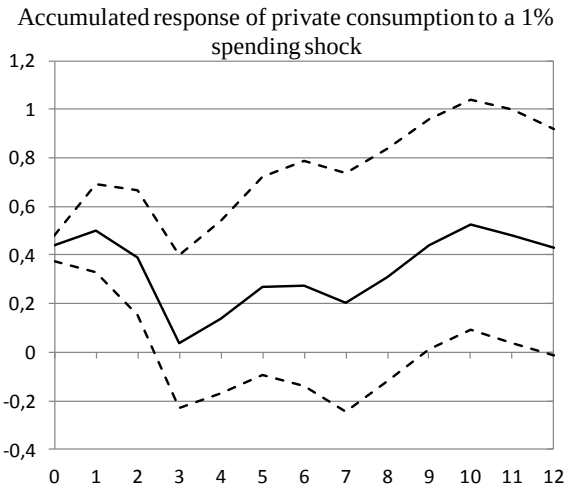


Figure 8: Accumulated response of private consumption to a 1% shock in fiscal variables



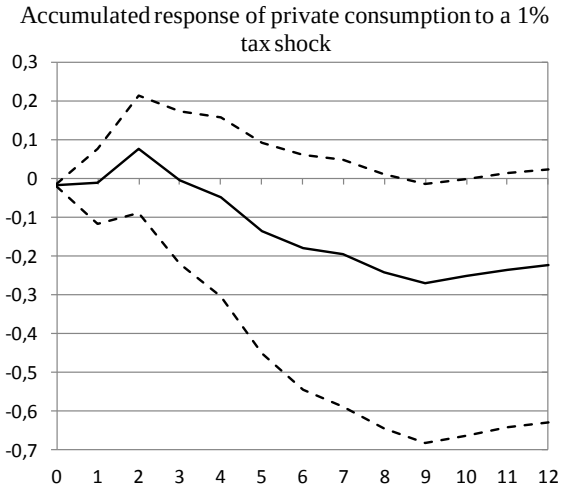
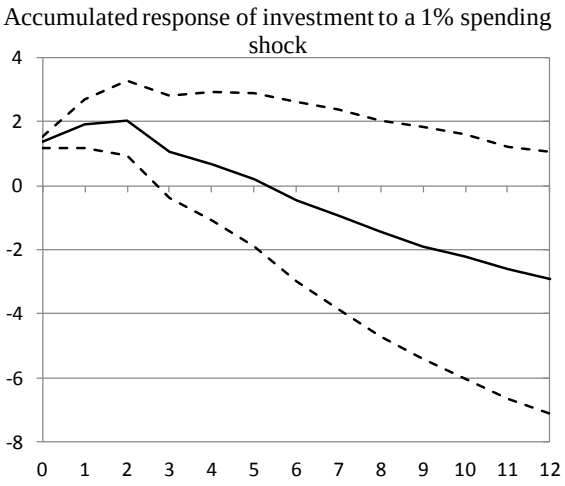
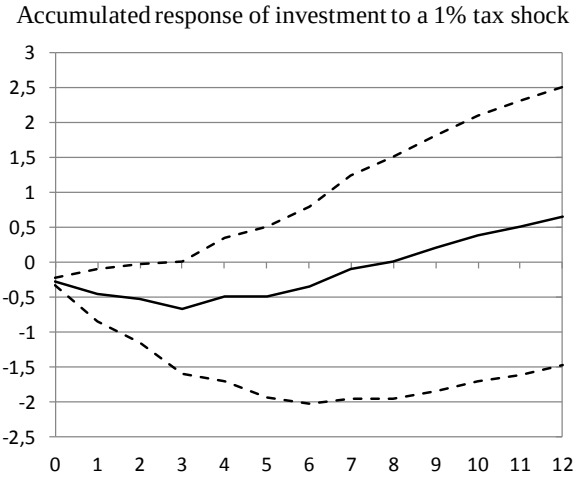


Figure 9: Accumulated response of investment to a 1% shock in fiscal variables



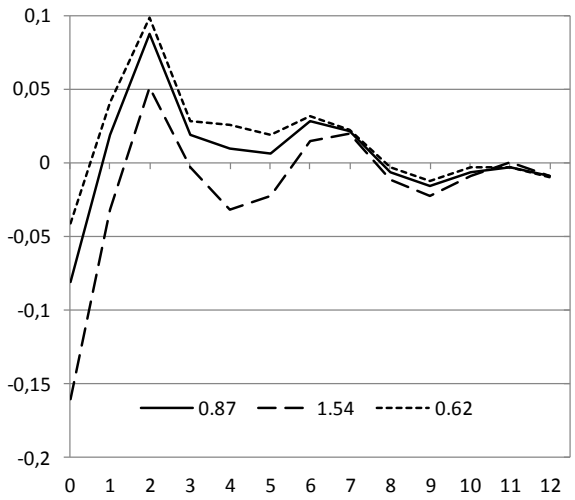


7. Robustness checks

7.1 Alternative net tax elasticities

Crucial to our identification procedure are the exogenously determined elasticities. Here we test how sensitive our results are to alternative values of the elasticity of net taxes with respect to GDP, α_y^T, which is the central elasticity in our case. To calculate it, we use the same procedure as de Castro Fernandez and Hernandez de Cos (2006) for Spain and Burriel et al. (2009) for EMU, so we take their elasticities to implement the robustness test. In Figure 10 we show the effects of a tax shock on GDP for three different values of α_y^T: the Spanish value of 0.62, our baseline value of 0.87 and the value for the EMU of 1.54. We believe that this range covers the relevant range of values for α_y^T. The results do not change much with different values of elasticities, so the response of GDP is robust in this sense. It should be noted however, that the higher the value of α_y^T, the more negatively GDP reacts to a rise in taxes. Other variables are unaffected by this change.

Figure 10: Response of GDP to a 1% tax shock under alternative tax elasticities



7.2 Additional robustness checks

We performed some additional robustness checks with our baseline model. We have tested how the use of different deflators affects the results. First we tried the CPI instead of the GDP deflator and we obtained very similar results. We also deflated government spending with the government consumption deflator and our results did not change significantly. Furthermore we have tried seasonal adjustment with quarterly dummies and our results stayed very similar. Finally, we estimated our basic VAR only for the pre-crisis period and we again obtained very similar results as for the whole period.

8. Conclusions

In this paper, the effects of fiscal policy shocks on the Slovenian economy are quantified, using the Blanchard and Perotti (2002) SVAR approach. The main finding of the paper is that in Slovenia, fiscal spending shocks increase output, private consumption and investment on impact, but the effect becomes statistically insignificant in the period following the shock. Tax shocks on the other hand decrease output, private consumption and investment on impact, but the effect also becomes statistically insignificant afterwards. The results indicate that fiscal policy shocks have weak impact multipliers. It is also clear that one-off changes in government spending and taxes do not have long-lasting effects on macroeconomic variables in Slovenia. In general, investment reacts stronger than private consumption to either fiscal spending or tax shocks. However, as in the case of aggregate output, the effect is not significant after the initial period. Our findings regarding the direction of response are in line with the bulk of other research on this issue. The results have been confirmed by various robustness checks, including applying a range of deflators, seasonal adjustment techniques, periods of estimation and also a range of different values for the exogenous elasticities, crucial to identify the shocks.

The findings of the paper suggest two conclusions. First, although expansionary, as shown by structural deficits in the past, fiscal policy has not contributed significantly to a rise in economic activity according to the model results. Rather, an expansionary stance and the resulting rise in public debt have caused related costs, which will have to be taken care of in the future. Second, the currently urgent fiscal consolidation is assumed to have just temporary negative effects on the economy in the future. However, it needs to be emphasised that the applied SVAR model only simulates the effects of temporary shocks, whereas the fiscal consolidation requires a use of permanent fiscal measures. Furthermore, the SVAR model used in the paper is a very simple one, where the modelling exercise does not incorporate agents' expectations, which might strongly affect the results. Such issues could in principle be better addressed with a structural model, which is beyond the scope of this paper.

Adding some additional characteristics to the SVAR, such as estimating shocks by disaggregating the spending and revenue sides and re-estimating the model may enrich our current knowledge of the fiscal policy effects in Slovenia. Furthermore, the cointegration relationship between the variables suggests that a structural vector error correction model should be used. These are some of the possible extensions of the exercise, undertaken in this paper.

Appendix: Calculation of output elasticity of net taxes

In the OECD approach (Giorno et al., 1995), the elasticity of various taxes with respect to their base is calculated on the basis of tax legislation and related fiscal data, while the sensitivity of the different tax bases with respect to output is estimated econometrically using time-series data. Regarding the elasticity of various tax proceeds with respect to their base in Slovenia, we take into account mainly the tax legislation. For the proportional taxes, it has a value of unity. However, it can exceed unity (progressivity) or fall below it (regressivity) in the case of several tax rates. The sensitivity of different tax bases with respect to output was estimated econometrically.

Personal income tax in the period under consideration accounts for 5.7% of GDP. The personal income tax is progressive in Slovenia, as in most other countries, as the tax rate rises with taxable income. Its elasticity with respect to the tax base was set at 1.5.[12] The output elasticity of personal income tax ($\varepsilon_{tdirh,y}$) is computed as follows (see also Burriel et al., 2009):

$$\varepsilon_{tdirh,y} = (\varepsilon_{tdirh,w}\varepsilon_{w,emp} + 1)\varepsilon_{emp,y} \qquad \text{(A1)}$$

where $\varepsilon_{tdirh,w}$ represents the elasticity of personal income tax to earnings, $\varepsilon_{w,emp}$ the employment elasticity of the real wage and $\varepsilon_{emp,y}$ the output elasticity of employment.

Social security contributions represent an important source of revenue, reaching 14.7% of GDP on average from 1995 to 2010. As social security contributions represent a fixed percentage of wage and since there is no upper limit for contributions, their elasticity with respect to tax base is set to 1. Elasticity with regard to output ($\varepsilon_{ss,y}$) is calculated similarly as for the personal income tax, where $\varepsilon_{ss,w}$ is the elasticity of social security contributions to earnings:

$$\varepsilon_{ss,y} = (\varepsilon_{ss,w}\varepsilon_{w,emp} + 1)\varepsilon_{emp,y} \qquad \text{(A2)}$$

Corporate income tax represents in the analysed period on average 1.7% of GDP. However, it varied a lot during the period, ranging from less than one percent at the beginning of the period to the highest value of 3.2% of GDP in 2007. Due to the complexity of the tax system, the elasticity of corporate income tax to its base, i.e. profits and mixed income, it is hard to estimate and therefore often set to 1. This is also the case in our calculations as corporate income tax is levied at a single rate. The output elasticity of corporate income tax revenues is obtained by multiplying the elasticity of tax revenues to gross operating surplus ($\varepsilon_{tdir,gos}$) and

[12] This is the average elasticity of the personal income tax base to wage (compensation per employee) estimated for EU countries in Bouthevillain et al. (2001). The estimated elasticities of personal income tax to wage vary from 1.2 for France, Denmark and the UK to 2.6 for Netherlands. Changing this parameter does not influence the final estimate of output elasticity of net taxes substantially.

the output elasticity of the gross operating surplus ($\varepsilon_{gos,y}$). It was calculated in the following way:

$$\varepsilon_{tdirc,y} = \varepsilon_{tdir,gos}\varepsilon_{gos,y} \quad \text{(A3)}$$

Indirect taxes represent another important revenue source, similar in value to social security contributions, i.e. on average 15.3% of GDP in the period from 1995 to 2010. Their elasticity to tax base, i.e. consumption ($\varepsilon_{tind,c}$), is set to 1. Although there are reasons for which this elasticity could be different, this seems the most reasonable number.[13] The output elasticity of indirect taxes ($\varepsilon_{tind,y}$) is calculated by taking into account the private consumption elasticity of indirect taxes ($\varepsilon_{tind,c}$) and the output elasticity of private consumption ($\varepsilon_{c,y}$):

$$\varepsilon_{tind,y} = \varepsilon_{tind,c}\varepsilon_{c,y} \quad \text{(A4)}$$

The output elasticity of *net transfers* was set to -0.2, similar to other studies and following Perotti (2002). The unemployment benefits respond to the underlying economic conditions. In Slovenia these have been low, so the estimate might be on the upper side.

Table A1: Output elasticities of net taxes

			Output elasticities
$\varepsilon_{tdirh,w}$=1.5	$\varepsilon_{w,emp}$=0.0	$\varepsilon_{emp,y}$=0.09	$\varepsilon_{tdirh,y}$=0.09
$\varepsilon_{ss,w}$=1.0			$\varepsilon_{ss,y}$=0.09
$\varepsilon_{tdirc,gos}$=1.0		$\varepsilon_{gos,y}$=0.72	$\varepsilon_{tdirc,y}$=1.53
$\varepsilon_{tind,c}$=1.0		$\varepsilon_{c,y}$=1.53	$\varepsilon_{tind,y}$=0.72
			$\varepsilon_{transf,y}$=-0.20
			$\varepsilon_{t,y}$= 0.87

Source: Authors' calculations.

The output elasticities of the relevant tax bases were estimated using the following equation (see also Burriel et al.):

$$\Delta Ln(B_t^i) = \gamma + \varepsilon_i \Delta Ln(Y_t) + \eta_t \quad \text{(A5)}$$

where $B^i$is the relevant tax base for the ith tax category and ε_i is the output elasticity of this tax base. Due to the likely contemporaneous correlation between the independent variable and the error term, the equations have been estimated using instrumental variables estimation techniques.

[13] It could be larger due to the fact that in the economic upswing the consumption of products which are taxed at higher rates increased more, and vice versa in a downturn. But on the other hand indirect taxes include also taxation of products, where the amount of tax is determined by real consumption (like excise duties), which represent the regressive element in taxation.

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