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Empirical assessment of stabilization effects of fiscal policy in Croatia

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Abstract

The aim of this paper is to assess the stabilization effects of fiscal policy in Croatia in a structural vector autoregression framework as proposed by Blanchard and Perotti (2002). Empirical studies of fiscal policy effects show that results are contradictory and do not unanimously agree, except for one fact: a positive government spending shock has a positive effect on output. This study inspects the effects of government spending and tax shocks on a set of macroeconomic variables (output, prices, interest rates, private consumption, private investment, employment and wages). Results prove that the fiscal transmission mechanism in Croatia works mainly in a Keynesian manner. Output reacts negatively to a tax shock and positively to government spending shock. The output multiplier is above 2 at impact and the effect is significant throught the whole time span. The negative effect of the tax shock is mostly driven by indirect (not direct) taxes, while the positive effect of a government spending shock is influenced by government consumption and government investment, but the effect of the latter is more significant when private consumption and private investment responses are observed.

Key words

fiscal policy, fiscal multiplier, spending shock, tax shock, SVAR, Croatia

JEL classification

C32; E62; H30

"Our area of ignorance even on basic signs of fiscal policy multipliers is too great."

Perotti (2000, p. 24)

1. Introduction[1]

Fiscal policy has been in center of debates in economic circles since decades, even more in periods of economic downturn (during the 1980s or recently in the 2010s), focusing merely on the role of expansionary fiscal policy in stimulating economic growth. Such a debate goes mainly around two issues: on one hand whether fiscal policy could be or is a potent stabilizing tool, and on the other hand whether fiscal policy could be or is effective in smoothing business cycles and boosting growth. In case of affirmative answers one main point emerges, i.e. What would be an optimal fiscal policy action not only with respect to the choice of instrument but also with respect to the size, timing and policy mix.

Nevertheless, comparing to the other main economic policy counterpart, i.e. monetary policy, empirical research of fiscal policy effects has not been so extensive and there is no absolute consensus on the effects of fiscal policy on the macroeconomics. Even theoretical literature suggests diverging positions with respect to the general effectiveness of fiscal policy (and fiscal stimuli packages at the end). Real business cycle models for instance predict that an increase in government consumption will be completely offset by the decrease in private consumption, while Keynesian models assume that the same increase will lead to an increase in private consumption because these models set households as non Ricardian. Moreover, Pappa (2003, p.2) points that fiscal shocks are difficult to identify in practice due to *"endogeneity of fiscal variables, interactions between fiscal and monetary policy variables, delays between planning, approval and implementation of fiscal policies and scarceness of reasonable zero-identifying restrictions"*.

The study of fiscal policy effects on economic activity proposes four main identification schemes for identifying fiscal policy shocks: (i) the recursive approach introduced by Sims (1980), (ii) the sign-restrictions approach developed by Mountford and Uhlig (2005), (iii) the event-study approach or «Dummy Variable» approach proposed by Ramey and Saphiro (1998) for studying the isolated effects of unexpected increases in government spending for defense purposes, and (iv) the structural vector autoregression (SVAR) approach introduced by Blanchard and Perotti (1999, 2002). Amid the aforementioned the latter is most extensively used[2].

Pappa (2004, p.2) emphasize that, besides the fragility of theoretical predictions of fiscal effects on the economy, evidence of the latter is, at best, contradictory. Namely, empirical results agree on one fact only, i.e. that *a positive government spending shock has a positive effect on output*. Caldara and Kamps (2008, p.28) show that, when controlling for differences in specification of the reduced-form model, all four identification schemes used in the literature *"yield qualitatively and quantitatively very similar result regards government spending shocks".* The effects of a tax shock on output as well as effects of expenditure and tax shocks on other macroeconomic variables (GDP components, employment, interest rate, inflation) provide contradictory evidence. Although the latter can be attributed in some extent to different variables, sample periods, dummies and trend, Caldara and Kamps (2008) prove that different methodologies applied to the same dataset lead to conflicting conclusions for responses of GDP components on a fiscal shock. Moreover, even when estimated responses to fiscal shocks are of the same sign and direction, the estimated magnitude and duration can quite differ.

[1] A similar version of the paper was presented at the Young Economist Seminar section from the Dubrovnik Economic Conference held by the Croatian National Bank in Dubrovnik in June 2013.

[2] Besides the VAR schemes, DSGE models are also widely used in identifying the transmission mechanism of fiscal policy.

The effects of fiscal policy in Croatia have been studied in five studies so far, Pivac and Jurun (2002), Benazić (2006), Rukelj (2009), Ravnik and Žilić (2011) and Šimović and Deskar-Škrbić (2013). The first three employ a structural VEC methodology and generally examine the effect of fiscal policy on economic activity, while the last two are focused on assessing fiscal multipliers using Blanchard and Perotti (2002) scheme in identifying fiscal policy shocks in Croatia. Although this research employs the same SVAR method, there are several novelties with respect to Ravnik and Žilić (2011) and Šimović-Deskar Škrbić (2013): (i) except the effects of fiscal shocks on output, prices and interest rates, the analysis embraces also the response of GDP components (private consumption and private investment), (ii) the study inspects fiscal shock effects on the labour market (employment and wages), and (iii) the investigation also includes effects of different government expenditure and revenue components on macroeconomic variables (GDP, GDP components, prices and interest rates). Moreover, this research has a different data frequency and/or longer time span, since it is based on a quarterly dataset with a time span 1996Q1 - 2011Q4.

Main results are in line with Keynesian theory. A spending shock positively affects output, private consumption and private investment and the response is significant. Moreover, when investigating the effect of government consumption versus government investment, the positive effect of both with respect to output and output components are significant. A tax shock leads to a drop in output, private consumption and private investment. Interesting enough is that output responds negatively on impact after a shock in direct taxes, but the negative effect lasts only for a quarter, being afterwards positive and significant for two years. Oppositely, the negative effect of indirect taxes on output is more persistent and lasts for three years. This is in line with the expectations because, among others, indirect taxes make more than 70% of total tax receipts (social security contributions excluded) in Croatia. The effects of a government spending or tax shock on the labour market is significant only in case of public sector wages, when the latter respond positively to a spending shock and negatively to a tax shock.

This paper is structured as follow: section two gives an overview of research results in the field of fiscal policy effects. The third section briefly underlines main fiscal policy events and trends in Croatia evidenced in the observed period. Section four explains the methodology and data, while section five presents the results. The last, sixth section is reserved for concluding remarks.

2. Literature review

Over the last years fiscal policy is in focus of academic and policy makers' debate mainly around one question: *what is the transmission of fiscal shocks?*

As mentioned earlier, the answer is conditioned by the methodology used to identify fiscal shocks and by the employed identification restrictions. The "Dummy Variable" approach considers fiscal shocks as significant exogenous episodes of unexpected increases in government expenditure for national defense. In such a setup, Edelberg et al (1999) and Burnside et al (2004) among others, find that a government expenditure shock for national defense decreases private consumption and real wages, while makes employment and (nonresidential) investment rise. Such evidence are consistent with basic neoclassical RBC models which assume that increases in government consumption should reduce the real wage and crowd out the private sector.

Oppositely, evidence from a SVAR approach is in line with Keynesian models. The SVAR approach is based on the assumption that fiscal variables do not react contemporaneously to changes in economic conditions (Blanchard and Perotti, 2002; and Perotti (2004) among others). In such a setup an expenditure shock makes private consumption, output, employment and real wages rise.

Evidence from a sign restriction approach is rather mixed, although generally a government expenditure shock has the propensity to increase employment and real wages (Canova and Pappa, 2006; Pappa, 2009 and Mountford and Uhlig, 2005, among others). Furthermore, using the sign

restriction and SVAR approach on data for US, Canada, Japan and UK from 1970 until 2007[3] Bermperoglou, Pappa and Vella (2012) show that there is no *trilemma* between government consumption, investment and employment in boosting the economy. They find that in case of all three government expenditure shocks output rises, however, government employment shocks have the largest output multiplier regardless of the sample, country or identification (Bermperoglou, Pappa and Vella, 2012, p. 3). Employment multipliers result to be always the highest among three for all horizons and in all examined countries.

Empirical research in the field of fiscal policy shocks is mainly focused on the case of developed (industrial) countries. The seminal paper by Blanchard and Perotti (2002) is based on US data, as well as the study done by Galí, López and Vallés (2004), Fatas and Mihov (2001) and Mountford and Uhlig (2002) among others. Blanchard and Perotti (2002) find evidence of Keynesian predictions in a case of a positive government expenditure shock as well as a negative tax shock, both exerting a positive and significant effect on output and private consumption. Nevertheless, they find that investment reacts negatively to the expenditure shock, which is in line with neoclassical models. Galí, López and Vallés (2004) find very similar evidence for output, consumption and investment, while Fatas and Mihov (2001) stress that an increase in expenditure leads to a persistent rise in output, with consumption and (residential) investment being the driving forces. Kirchner, Cimadomo and Hauptmeier (2010) show that in the Euro area the reaction of investment to an expenditure shock is positive and significant: a 1% GDP increase in expenditure raises investment by 1.6% GDP.

Perotti (2004) shows that the effects of fiscal policy on economic activity in five OECD countries (US, Canada, Australia, Germany and UK) have the propensity to be small and substantially weaker over time. Furthermore, in the case of European countries, Marcellino (2002) finds heterogenous responses to fiscal shocks in France, Germany, Italy and Spain, but concludes that expenditure shocks are usually rather ineffective in boosting the economy and that tax shocks have minor effects on output. Similarly, Heppke-Falk, Tenhofen and Wolff (2006), de Castro and de Cos (2008) and Biau and Girard (2005) evidence that a tax shock does not significantly affect output in Germany, Spain and France respectively.

Moreover, when investigating tax shocks on private consumption and investment, Heppke-Falk, Tenhofen and Wolff (2006) split the revenue category into *"profit taxes"* and *"non-profit taxes"* (indirect and wage taxes), following the intuition that profit taxes should reduce investment, while non profit taxes should have detrimental effects on private consumption. Still, they find a negative response of private consumption to a non-profit tax shock, and an insignificant response to a profit tax shock. Similarly, de Castro and de Cos (2008) inspect the effect of direct and indirect taxes (along with social security contributions) in the economic framework of Spain. They show that in the long-run private consumption decreases even more in case of a direct tax shock than in the case of an indirect tax shock. When taxes are considered as distortionary it is difficult to cause an increase in private consumption, or even harder to generate an increase in output in response to a tax-financed increase in government spending (Caldara and Kamps, 2008).

There are quite few studies that try to assess stabilization effects of fiscal policy in emerging economies. Baxa (2010) shows that the Czech economy behaves in line with Keynesian assumptions, because government expenditures positively affect economic activity, and GDP reaches the peak after about four quarter after the initial impact. Still, Baxa (2010, p. 27) finds that government tax shock exercises a *"very uncertain, very to zero, but most probably rather negative"* effect on output. Oppositely, by analyzing fiscal policy shocks in a group of six European transition economies (Czech Republic, Hungary, Poland, Slovak Republic, Bulgaria and Romania) Mirdala (2009) finds that output increases after a tax shock in the Czech Republic. The same is evidenced for Hungary, Slovak Republic, Bulgaria and Romania. Jemec, Strojan Kastelec and Delakorda (2011) show that in Slovenia a 1% GDP increase in government revenue makes output fall by 0.38%, but the negative effect is evidenced only in the first quarter after the shock. Furthermore, they find that the reaction of private

[3] They also include the Euro area in their analysis using the 1991-2007 data span.

consumption and investment to a tax shock is negative (being 0.05% GDP and 0.35% GDP respectively), while an expenditure shock positively affects both components (evidence show an increase of 1.1% GDP and 1.6% GDP respectively). In the case of Albania, Mancellari (2011) finds that the tax cut multiplier is higher than the government spending multiplier and reaches 1.65 after five quarters.

As mentioned earlier, the analysis of fiscal policy transmission mechanism on the Croatian case is very scarce. Benazić (2006) and Rukelj (2009) employ a structural vector error correction (SVEC) model when investigating the effects of fiscal policy on economic activity. The first concludes that a tax shock negatively affects economic activity, while an expenditure shock leads to an increase in GDP, pinpointing that the effect of a tax shock is much stronger. The second focuses the research on the interaction between monetary and fiscal policy and concludes that these policies can be thought as substitutes since they move in opposite directions.

More comparable to this study are results obtained by Ravnik and Žilić (2011) as well as Šimović and Deskar-Škrbić (2013) since the same methodology is applied. Based on a monthly data span 2001M1 to 2009M12 Ravnik and Žilić (2011) conclude that the strongest response after both fiscal shocks has the interest rate, while the lowest the price level. Moreover, they find non common results regarding the response of output (proxied with industrial production), since they show that output increases after a tax shock and decreases after a spending shock, and therefore conclude that on one hand industrial production may not be a good proxy variable for output, and on the other hand that maybe the crowding out effect predominates the output effect.

On the other hand Šimović and Deskar-Škrbić (2013) analyse fiscal multipliers in Croatia on different government consolidation level (consolidated general government, consolidated central government and central government) using a quarterly dataset spanning from 2004Q1-2012Q4 and conclude that values of fiscal multipliers vary across government level. If the short run is considered, they find the government spending multiplier being 2.18 at the consolidated general government level and 0.82 at the central government level. In the long run such difference is of smaller magnitude, being the multipliers 1.91 and 1.60 respectively. If tax multipliers are considered, Šimović and Deskar-Škrbić (2013) show that an increase in taxes leads to a decrease in output and the highest multiplier effect in the short run is evidenced at the consolidated central government level (-2.15). Interesting enough, authors show that at the central government level during the first two years after a positive tax shock output increases, while at the both level of consolidation (central and general) the same shock negatively affects output.

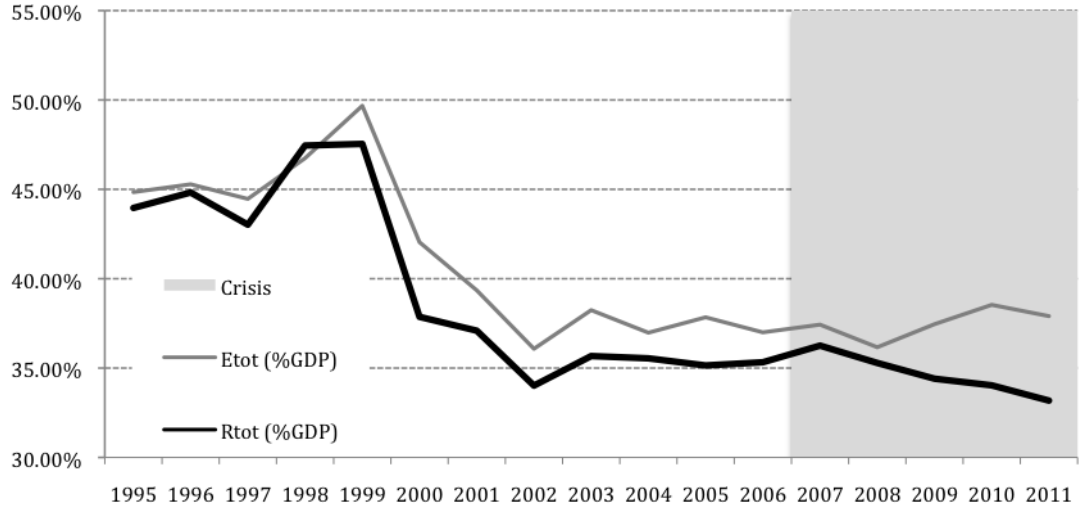
3. Fiscal policy in Croatia in the period 1995-2011

The first stabilization program adopted by the Croatian government in October 1993 announced the beginning of the transition process and numerous reforms, which in the field of tax policy were enacted a year after with the personal and corporate income tax legislation. In the following periods, among others, the government introduced excise duties as budget revenues, abolished the single stage sales tax and replaced it with the value added tax in 1998. These changes ensured a higher level of tax discipline and made the Croatian tax system comparable to those of developed countries. In the mean time, changes to improve government spending effectiveness and efficiency were also performed (e.g. introduction of the State Treasury, reforms of the pension and health insurance schemes).

As introduced by the stabilization program the enacted reforms improved economic growth. Figure 1 captures the movements of total revenues and expenditures of the consolidated central government according to the GFS 1986 methodology. It is noticeable a difference between the average values in the period post and ante year 2000. As mentioned earlier a higher share of fiscal variables in GDP ante 2000 is due to reforms that were legislated and due to a slower GDP growth with respect to the growth of fiscal variables during that period. If data are observed regarding year 2000 as two subsamples then on average consolidated central government expenditure count about 46% GDP before, and 38% GDP after, the mentioned period. Consolidated central government revenues follow the same pattern and

count for 45% GDP before, and 35% GDP after, year 2000. These make an average of 40% and 38% of GDP in the observed period for total consolidated central government expenditure and revenues respectively[4].

Figure 1. Public revenues *(Rtot)* and expenditures *(Etot)* at the consolidated central government level in Croatia in the period 1995-2011, % GDP



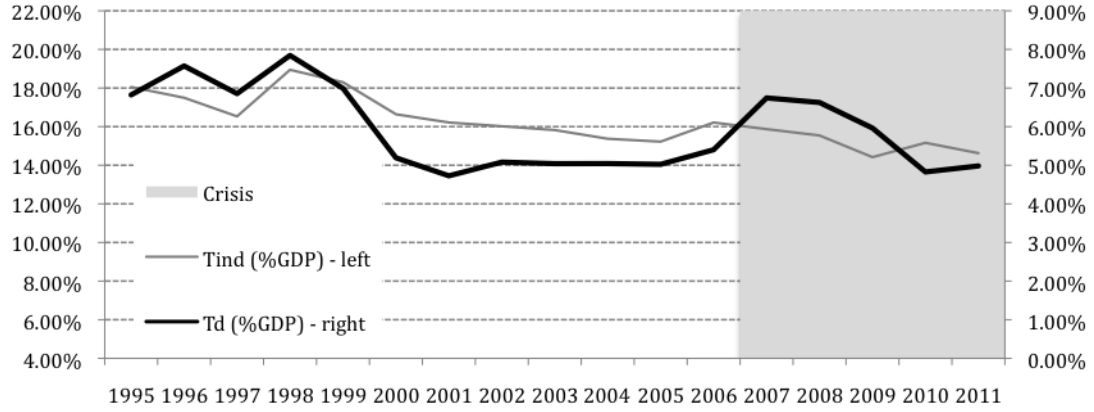
Note: Grey background surface stands for the period of the global financial crisis, which started in summer 2007.
Source: Croatian Ministry of finance and author's calculation.

The consolidated central government budget balance in Croatia in the observed period was in deficit of 2% GDP on average, registering the highest negative value in the last two observed periods due to the global financial crisis and its spill over effects among others. A surplus was registered only in 1998 when the VAT was newly introduced.

When looking different budget revenue components it is important to point out that in the Croatian case indirect taxes are the most plenteous taxes, followed by the social security contributions. Figure 2 shows the share of revenues from direct and indirect taxes in GDP in Croatia in the observed period. Indirect taxes count on average 16% GDP, while direct taxes 6% GDP. The average share of revenues from social security contributions in GDP, which is not shown here, is about 14%.

[4] It is common empirical practice to analyze fiscal policy of a country using general government data. Still, this paper (as many others that examine fiscal policy in Croatia (Benazić, 2006; Rukelj, 2009; Vučković, 2010; Grdović Gnip, 2011; Ravnik and Žilić, 2011)) bases the research on consolidated central government data. It is important to point out that quarterly fiscal data for Croatia at the general government level are not available for the period 1995-2004. Nevertheless, such a limitation should not pose significant differences amid results of fiscal policy effects in the Croatian case, principally for two reasons: (1) discretionary decisions are carried by the consolidated central government, and (2) the share of local governments' budgets in the general budget is on average less than 10% and embrace only 53 local units (20 regions, 32 cities plus the City of Zagreb, out of 555 cities and counties in total).

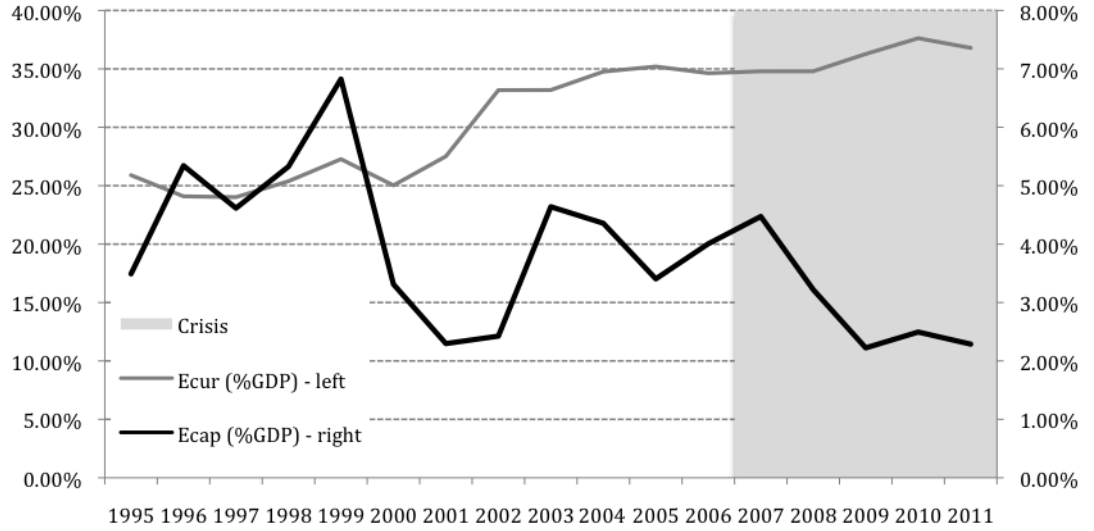
Figure 2. Revenues from indirect (*Tind*, left scale) and direct (*Td*, right scale) taxes in Croatia in the period 1995-2011, % GDP



Note: Grey background surface stands for the period of the global financial crisis, which started in summer 2007. Direct taxes include personal and corporate income taxes (social security contributions are excluded here, although often counted as direct taxes), while the category of indirect taxes embrace excise duties, the single stage sales tax until 1998 when it was replaced by the value added tax (VAT).
Source: Croatian Ministry of finance.

It is important to point out that more than 70% of indirect taxes' revenues are collected from the *general sales tax* (i.e. the single stage sales tax in the 1995-1997 period, and the VAT in the 1998-2011 period). Oppositely, in the case of direct taxes' revenues such a conclusion is not observed. Until year 2003 personal income tax revenues dominated corporate income tax revenues, and oppositely afterwards. A number of factors can influence such movements, but noteworthy are definitely numerous changes in the personal and corporate income taxation legislation (tax base, tax rates, tax reliefs, deductions, etc.).

Figure 3. Current (*Ecur*, left scale) and capital (*Ecap*, right scale) expenditure at the consolidated central government level in Croatia in the period 1995-2011, % GDP



Note: Grey background surface stands for the period of the global financial crisis which started in summer 2007.
Source: Croatian Ministry of finance.

Disentangling total expenditures into current and capital it is possible to notice that in Croatia in the observed period around 80% of total consolidated central government expenditure on average go for current spending. Figure 3 depicts these two categories and shows that in the observed period current and capital expenditure account on average for 31% and 4% of GDP respectively. The highest amount

of capital spending is registered in 1999 when the level of 6.8% GDP was reached. This peak was mainly due to expenses of road construction and of reconstruction of war-affected areas.

4. Methodology and data

4.1. Data description and VAR setup

The empirical analysis of the impact of fiscal policy on macroeconomic variables in this study is based on a structural vector autoregression (SVAR) approach, particularly on the methodology proposed by Blanchard and Perotti (2002), which is considered the pioneering paper for fiscal policy SVAR analysis.

Blanchard and Perotti (2002) argue that governments cannot react within the same quarter to changes of macroeconomic setting mainly because fiscal policy decisions involve many agents (parliament, government and society) and therefore need a long period of time for implementation. All fiscal policy events that do not reflect automatic responses are seen as structural fiscal policy shocks. The latter are unaffected by the macroeconomic variables in the VAR model, because discretionary fiscal policy shocks are analyzed using fiscal policy decision lags.

This paper uses a quarterly dataset from 1996Q1 to 2011Q4 for output (Y_t), government spending (Ebp_t), government revenue (Rbp_t - also referred to as taxes or net taxes in the rest of the paper), prices (π_t) and interest rates (r_t) in the 5 variable baseline SVAR model. Fiscal variables are defined as in the Blanchard and Perotti (2002) setup, i.e. both net of transfers, but at the consolidated central government level. The price level is measured by the Consumer Price Index, while the interest rate is represented by the short term interest rate on the interbank demand deposit trading. All variables, except the interest rate, are in logarithms, while output and fiscal variables are additionally seasonally adjusted using the ARIMA X12 algorithm[5]. Moreover, all variables are in real terms, they are CPI deflated 2000=100.

Unit root tests (see Table B1 in Appendix B) find conclusive evidence that only the interest rate variable is stationary in levels at the 1% significance level, while other variables present unit roots in levels, according to the Augmented Dickey Fuller (ADF) test. Moreover, results show the presence of co-integrating relations[6] and a possible specification of a vector error correction model, but as noted by Heppke-Falk, Tenhofen and Wolff (2006, p. 12), when estimating models that have many disaggregated time series it is difficult to find economically interpretable cointegration vectors. Moreover, Blanchard and Perotti (2002) find no significant differences between results obtained with and without taking the cointegration relation into account.

Although the system is stationary in first differences, the analysis is done using variable in levels, because the focus of the analysis is on the dynamics (i.e. impulse responses), not the coefficient estimation[7]. To choose the appropriate lag length the judgment is based on information criteria results, the length of the sample and economic sense. The AIC criterion suggests two lags, while the BIC and HQC indicate one lag as optimal (see Table B4 in Appendix B). This analysis will allow for dynamic interaction up to two lags as suggested by the Akaike criterion.

As mentioned previously five variables enter in the baseline model setup and their order is of particular importance since it defines the relationship structure amid innovations. It is common empirical practice to order variables according the timeline of their occurrence. This analysis orders

[5] Appendix A presents the original and seasonally adjusted series of output, government spending and revenue, plus prices and interest rate.
[6] See Table B2 in Appendix B.
[7] This is common empirical practice. Studies that estimate a SVAR in levels no matter of the stationarity in first differences are Perotti (2002), Heppke-Falk, Tenhofen and Wolff (2006), de Castro and de Cos (2006), Jemec, Strojan-Kastelec and Delakorda (2011), Ravnik and Žilić (2011).

the variables as in Caldara and Kamps (2008), i.e. government spending is ordered first, followed by output, prices, net taxes and interest rate[8].

The reduced form VAR model can be written as:

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

where $Y_t = \begin{bmatrix} g_t & y_t & \pi_t & r_t & i_t \end{bmatrix}'$ is vector of endogenous variables[9], *C(L)* is a $n \times n$ autoregressive lag polynomial matrix and $U_t = \begin{bmatrix} u_t^g & u_t^y & u_t^\pi & u_t^r & u_t^i \end{bmatrix}'$ is a vector of reduced form residuals[10].

The errors from a VAR in its reduced form are expected to be i.i.d., but correlated across equations. Perotti (2005) asserts that innovations in the fiscal variables u_t^g and u_t^r can be thought as a linear combination of three types of structural shocks, i.e. of (1) the *automatic* responses of government expenditure and revenue to real output, inflation and interest rate, (2) the *systematic discretionary* response of government expenditure and revenue to the same macroeconomic variables and (3) the *random discretionary* fiscal policy shocks. Since a u_t^j shock contains information about other shocks of the system, it is not possible to isolate a shock of just one of the variables. Thus, to be able to isolate the shocks in focus, i.e. fiscal shocks, there is a need of structure on the VAR. This structure is obtained by defining the contemporaneous effects (those that occur in lag=0) of variables among each other.

Reduced form residuals U_t can be written as a linear combination of structural shocks V_t:

$$AU_t = BV_t \quad (2)$$

where *A* and *B* are $n \times n$ matrices describing immediate relations between the reduced form residuals and the structural shocks. Therefore, the structural VAR can be obtained by multiplying (1) by matrix A:

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

and using (2) rewritten as:

$$AY_t = AC(L)Y_{t-1} + BV_t \quad (4)$$

Such a model is known as an AB-model in the terminology of Amisano Giannini (1997)[11].

To make the AB system (equation 2) just identified 35 restrictions should be imposed[12]. The matrix representation of the mentioned system is the following:

[8] Caldara and Kamps (2008, p.13) base such an ordering on the following assumptions: (a) government spending is placed first because does not react contemporaneously to shocks to other variables in the system and is not affected by business cycle fluctuation; (b) output is ordered as second, which implies that it does not react contemporaneously to prices, taxes and interest rate shocks but is affected by government spending shocks; (c) prices are ordered third, meaning that it is not affected contemporaneously by taxes and interest rate shocks but it reacts to government spending shocks; (d) net taxes are placed fourth, meaning that it is contemporaneously affected by government spending, output and price shocks; (e) interest rate is assumed to be at the last, fifth, place and affected by all shocks from the system. It is worth mentioning that fiscal variables are net of interest payments and therefore not sensitive to interest rate changes. This can be taken as the justification for the last place of the interest rate in ordering the variables. Several empirical researches use the same ordering as Caldara and Kamps (2008), amid which also Ravnik and Žilić (2011) who investigate fiscal policy shocks in for Croatia. One of the reason for the same ordering of variables in this research is also to make the results even more comparable.

[9] The notation of fiscal variables is slightly changed to make it more intuitive and convenient. Recalling, government spending g_t and taxes r_t refer to variables noted as Ebp_r and Rbp_r respectively in Appendix A and explained earlier in this section.

[10] Reduced form residuals *Ut* are a linear combination of different structural innovations and therefore have no economic interpretation.

[11] In such a set up *A* and *B* are *n x n* parameter matrices that require identifying restrictions to be imposed on *A* and *B* to obtain an unique relation, because reduced form residuals have no economic interpretation (and represent a linear combination of different structural innovations) and different structural forms can give the same reduced form VAR model (see for instance Gottshalk (2001)).

$$\begin{bmatrix} 1 & -\alpha_y^g & -\alpha_\pi^g & -\alpha_r^g & -\alpha_i^g \\ -\alpha_g^y & 1 & -\alpha_\pi^y & -\alpha_r^y & -\alpha_i^y \\ -\alpha_g^\pi & -\alpha_y^\pi & 1 & -\alpha_r^\pi & -\alpha_i^\pi \\ -\alpha_g^r & -\alpha_y^r & -\alpha_\pi^r & 1 & -\alpha_i^r \\ -\alpha_g^i & -\alpha_y^i & -\alpha_\pi^i & -\alpha_r^i & 1 \end{bmatrix} \begin{bmatrix} u_t^g \\ u_t^y \\ u_t^\pi \\ u_t^r \\ u_t^i \end{bmatrix} = \begin{bmatrix} \beta_g^g & 0 & 0 & \beta_r^g & 0 \\ 0 & \beta_y^y & 0 & 0 & 0 \\ 0 & 0 & \beta_\pi^\pi & 0 & 0 \\ \beta_g^r & 0 & 0 & \beta_r^r & 0 \\ 0 & 0 & 0 & 0 & \beta_i^i \end{bmatrix} \begin{bmatrix} v_t^g \\ v_t^y \\ v_t^\pi \\ v_t^r \\ v_t^i \end{bmatrix} \quad (5)$$

The imposed restrictions include the following:

- values across the main diagonal of matrix A are set to one, which makes five restrictions;
- matrix B contains 18 elements set to zero, which makes additional 18 restrictions;
- in the equation explaining reduced innovation in government spending α_y^g, α_r^g and α_i^g are set to zero because it is assumed that government spending is solely under the control of fiscal authority, while the impact of inflation α_π^g is assumed to be -0.5, as in Perotti (2002) among others; all these make additional four restrictions;
- the assumption that the short term interest rate innovation does not influence the other reduced innovations makes α_i^y, α_i^π and α_i^r zero; the reduced form innovation of output is not affected by the innovation of inflation, so α_π^y is also set to zero; all these add four restrictions;
- the impact of the innovation of output and prices on the innovation of taxes, i.e. α_y^r and α_π^r respectively, are estimated exogenously (see further in this section) which makes two addition restrictions;
- the remaining two restrictions depend on how the relationship between two fiscal variables are modeled. The impact of government spending on taxes is modeled through the B matrix, so α_g^r is set to zero, and assuming that government spending decisions come first means setting β_r^g to zero, which gives the last two needed restrictions.

The *random discretionary* fiscal policy shocks are actually of main interest and represent underlying structural shocks used to study the response of macroeconomic variables. Thus, to explain the relationship between fiscal variables, lets focus on the equations showing the reduced form innovations of government spending and revenues:

$$u_t^g = \alpha_y^g u_t^y + \alpha_\pi^g u_t^\pi + \alpha_i^g u_t^i + \beta_r^g v_t^r + v_t^g \quad (6)$$

$$u_t^r = \alpha_y^r u_t^y + \alpha_\pi^r u_t^\pi + \alpha_i^r u_t^i + \beta_g^r v_t^g + v_t^r \quad (7)$$

where v_t^g and v_t^r represent structural shocks to government spending and revenue respectively. The α_i^j coefficients capture the automatic responses of macroeconomic variables to a government spending and revenue shock under the existing fiscal policy rules as well as any discretionary adjustment of fiscal policy in response to unexpected movements in macroeconomic environment. The β_i^j coefficients express how the structural shock to government spending and revenue affects revenue or spending respectively.

Since the reduced form residuals are correlated with pure structural shocks v_t^g and v_t^r, in order to correctly identify the shocks *exogenous elasticities* are used to compute cyclically adjusted reduced form fiscal policy shocks:

$$u_t^{g,CA} = u_t^g - (\alpha_y^g u_t^y + \alpha_\pi^g u_t^\pi + \alpha_i^g u_t^i) = \beta_r^g v_t^r + v_t^g \quad (8)$$

$$u_t^{r,CA} = u_t^r - (\alpha_y^r u_t^y + \alpha_\pi^r u_t^\pi + \alpha_i^r u_t^i) = \beta_g^r v_t^g + v_t^r . \quad (9)$$

[12] The system needs $2k^2 - \left(\frac{k^2-k}{2} + k\right)$ restrictions, where *k* is the number of endogenous variables.

Next, it is necessary to make a *decision with respect to the relative ordering of the fiscal variables*. Assuming that tax decisions come first means setting β_g^r equal to zero, while oppositely, assuming that expenditure decisions represent government priority number one means setting β_r^g equal to zero.

Although Perotti (2002) points out that neither of the alternatives of priority has any theoretical or empirical basis, some of the empirical works assume that revenue decision comes first (Jemec, Strojan Kastelec and Delakorda, 2011) while other put forward expenditure decisions (Caldara and Kamps, 2006; de Castro and de Cos, 2006; Heppke-Falk, Tenhofen and Wolff, 2006; Mancellari, 2011). Still, most of the works as well as Blanchard and Perotti (2002) and this research test both assumptions to see whether the ordering makes difference to the impulse responses.

Assuming that a government tends to decide on expenditure first means that:

$$u_t^{g,CA} = v_t^g \text{ and} \tag{10}$$

$$u_t^{r,CA} = \beta_g^r v_t^g + v_t^r, \tag{11}$$

where β_e^r is estimated by OLS to retrieve the structural shocks to the fiscal variables.

Other reduced form residuals' equations are estimated recursively using instrumental variables regressions, in order to account for the correlation of the respective regressors and error terms. Since the cyclically adjusted variables are orthogonal, they are used as instruments (Blanchard and Perotti, 2002)[13]. The coefficients for the macroeconomic variables' equations are:

$$u_t^y = \alpha_g^y u_t^g + \alpha_r^y u_t^r + v_t^y, \tag{12}$$

$$u_t^\pi = \alpha_g^\pi u_t^g + \alpha_r^\pi u_t^r + \alpha_y^\pi u_t^y + v_t^\pi \text{ and} \tag{13}$$

$$u_t^i = \alpha_g^i u_t^g + \alpha_r^i u_t^r + \alpha_y^i u_t^y + \alpha_\pi^i u_t^\pi + v_t^i. \tag{14}$$

All mentioned produces all the necessary elements to construct the A and B matrices in the mentioned AB model $AU_t = BV_t$.

4.2. Exogenous elasticities

As mentioned previously, to achieve full identification in the SVAR setup, contemporaneous effects of output, prices and interest rate on fiscal policy variables are needed. The exogenous elasticities of a budgetary item with respect to output are obtained as product of the elasticity of the budgetary item to its macroeconomic base and the elasticity of this base with respect to output. If the elasticity of a budgetary item is constructed as an average value of two or more sub-components' elasticities, then their respective shares in the budgetary item's volume are used as weights[14]. For example the elasticity of taxes is a weighted average of the elasticity of personal income taxes, corporate income taxes, indirect taxes and social security contributions weighted by their respective share in total taxes. Additionally, the elasticity of each of the mentioned to GDP is the result of multiplication of its elasticity with respect to its macroeconomic base and the elasticity of the macroeconomic base with respect to output. To sum up, the tax elasticity to output is:

$$\alpha_y^r = \sum_{i=1}^{n} \alpha_{B_i}^{\tau_i} \cdot \alpha_y^{B_i} \cdot \frac{T_i}{T}. \tag{15}$$

[13] Since Blanchard and Perotti (2002) base their seminal work on a three variable VAR, cyclically adjusted fiscal variables are used as instruments only. Nevertheless in a five variable VAR, there is more then one equation to be estimated using the IV method, therefore obtained structural shocks are used as instruments as well (Perotti, 2005; Heppke-Falk, Tehnhofen and Wolff, 2006; Giordano et al, 2007; among others).

[14] For details on each tax item elasticity to its macroeconomic base, as well as the elasticity of the latter with respect to output or prices see Tables in Appendix C, where also shares of tax items in total taxes is shown.

Table 1 shows the elasticities of different budget components to output and prices[15]. It is important to note that the overall total tax elasticity is 0.93, but since the fiscal variable regarding government revenues used in the analysis is constructed following the Blanchard and Perotti (2002) assumptions, i.e. net of transfers, it is corrected by the elasticity of unemployment related expenditures to output weighted by the share of this expenditure in total government expenditure[16].

The elasticity of net taxes results to be 0.92, meaning that a 1% increase in output (GDP) generates 0.92% increase in taxes. This estimation is in line with results obtained by other studies covering other countries. It matches the tax elasticity with respect to output in the German case shown in Perotti (2002) but is lower than the same in the US or Canada for example. If compared to the tax elasticity obtained on the Croatian case by Ravnik and Žilić (2011) it is by 0.03 points lower and not significantly different.

Calculating the elasticity of taxes with respect to prices means adjusting equation (15) for the elasticity of the macroeconomic base with respect to prices, i.e. $\alpha_{\pi}^{B_i}$ instead of $\alpha_{y}^{B_i}$. The results indicate that the price elasticity of taxes (α_{π}^{r}) is 0.73, which is again does not deviate from results obtained by other studies in this field.

Table 1. Exogenous elasticities with respect to output and prices

	w.r.t. real output	**w.r.t. prices**
Budgetary item	α_{y}^{r}	α_{π}^{r}
Net taxes	0.92	0.73
Direct taxes	0.53	-0.32
Indirect taxes	1.36	1.90
Government expenditure	0	-0.5
Current expenditure	0	-1
Capital expenditure	0	-1
Public wages expenditure	0	0
Public purchases expenditure	0	-1

Note: For details on sub-components' elasticities see Appendix C; The price elasticity of total government expenditure and its components is set as in Perotti (2002).
Source: Perotti (2002) and author's calculation.

Same as in Heppke-Falk, Tenhofen and Wolff (2006) among others, this study assumes that expenditure do not respond to output within a quarter because they are predetermined in a budgetary plan and therefore not elastic in the short run. However, worth noting is that some recent studies challenge this assumption. Among others, Rodden and Wibbles (2010) find evidence of spending elasticity with respect to output at the state and local level in the US being 0.17. But, this work (as well as others in this field) is based on annual data, so it is reasonable to assume that such a procyclicality vanishes in quarterly frequencies.

At the end, after all the imposed restrictions and estimated exogenous elasticities, the just-identified five variable baseline SVAR model is the following:

[15] The elasticities of budgetary items with respect to other macroeconomic variables used in the non-baseline models (extended models to capture the response of GDP components and/or labour market variables) are not presented here, but in the corresponding further Section and/or Appendix C.
[16] Following Grdović Gnip (2011) the output elasticity of unemployment related expenditures is -0.58, and these expenditures amount to 0.85% of total consolidated central government expenditures, which allows for a -0.01 correction of the total tax elasticity, to obtain the output elasticity of net taxes.

$$\begin{bmatrix} 1 & 0 & 0.5 & 0 & 0 \\ -\alpha_g^y & 1 & 0 & -\alpha_r^y & 0 \\ -\alpha_g^\pi & -\alpha_y^\pi & 1 & -\alpha_r^\pi & 0 \\ 0 & -0.92 & -0.73 & 1 & 0 \\ -\alpha_g^i & -\alpha_y^i & -\alpha_\pi^i & -\alpha_r^i & 1 \end{bmatrix} \begin{bmatrix} u_t^g \\ u_t^y \\ u_t^\pi \\ u_t^r \\ u_t^i \end{bmatrix} = \begin{bmatrix} \beta_g^g & 0 & 0 & 0 & 0 \\ 0 & \beta_y^y & 0 & 0 & 0 \\ 0 & 0 & \beta_\pi^\pi & 0 & 0 \\ \beta_g^r & 0 & 0 & \beta_r^r & 0 \\ 0 & 0 & 0 & 0 & \beta_i^i \end{bmatrix} \begin{bmatrix} v_t^g \\ v_t^y \\ v_t^\pi \\ v_t^r \\ v_t^i \end{bmatrix} \quad (16)$$

5. Results

This section presents impulse response functions and multipliers derived from the baseline model as well as extended models. In all cases a shock correspond to a unit shock and its path is shown for a horizon of 20 quarters i.e. five years. Moreover, the 95% percentile confidence intervals coverages are shown, obtained from 100 bootstraps of the impulse response distribution[17].

According to the level specification, structural shocks are interpreted as one percentage point increase in the policy variables, while impulse responses represent the percent change of the responding variable.

5.1. Baseline model

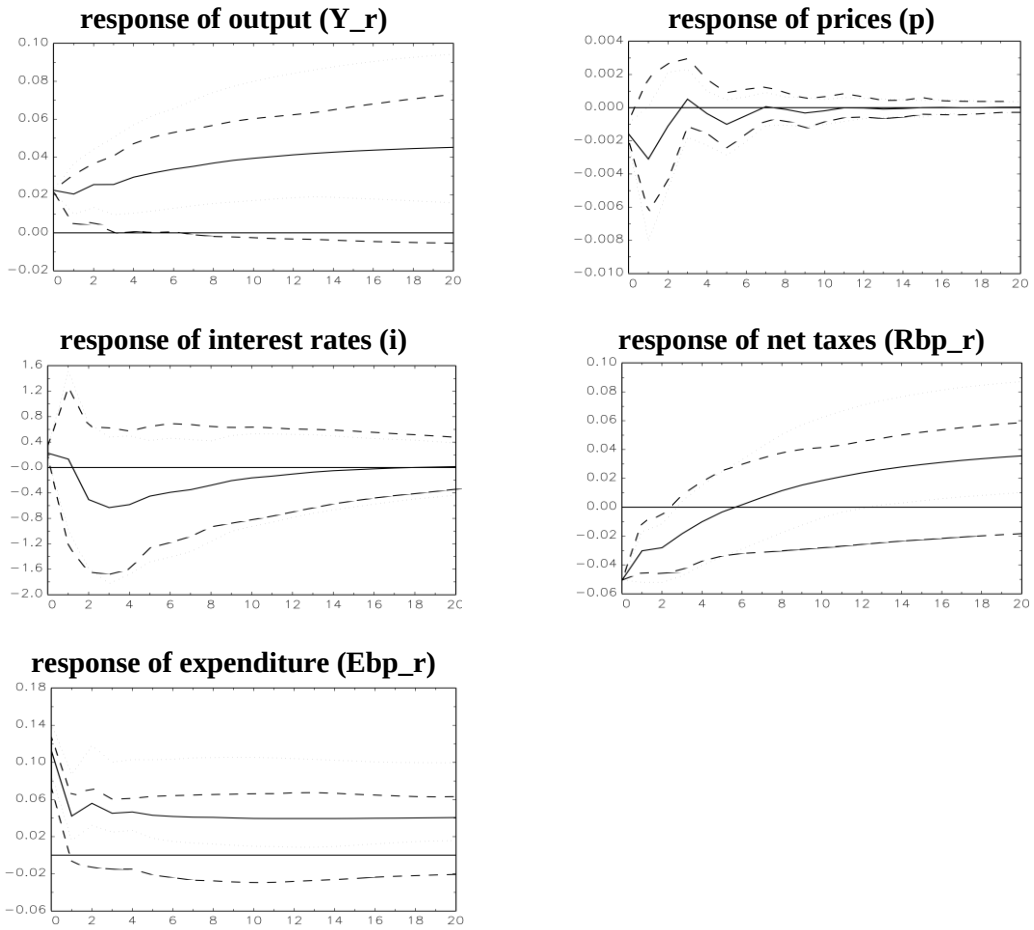
The effects of government spending

Figure 4 shows the impulse response functions to a government spending shock in the baseline model $[g_t \quad y_t \quad \pi_t \quad r_t \quad i_t]$'. Output responds positively and after a government spending shock. This positive impact is significant throughout the whole time horizon according to Efron confidence intervals, while for a year according to Hall's bootstrapping method. A long term positive effect is also evidenced in Blanchard and Perotti (2002), Perotti (2004) and Fatas and Mihov (2001), who show that in the case of the US the government spending positively affects output for more than five years[18].

[17] Confidence intervals are obtained using the Hall and Efron Bootstrap available in the JMulTi package, which was used along with Gretl software throught the estimations in this paper.

[18] In case of other developed countries the positive impact is more of short and/or medium term. Perotti (2004) and Marcellino, (2002) find evidence of a positive economic activity response in Germany for the first year, while Heppke-Falk, Tenhofen and Wolff (2006) stress that such a positive effect disappears much later, i.e. after three years. The positive impact of a government expenditure shock fades after two years in the case of France (Biau and Girard, 2005) and Italy (Giordano et al, 2007), and moreover, in case of Spain, it becomes significantly negative after four years (de Castro and de Cos, 2008).

Figure 4. Impulse responses to an increase in government spending (baseline 5VAR model)



Note: Solid line – impulse response; Dashed lines – Hall 95% percentile bootstrap confidence intervals; Dotteded lines – Efron 95% percentile bootstrap confidence intervals.
Source: Author's estimation.

Such a development is not found in Ravnik and Žilić (2011). Proxying ouput with industrial production, they find that in Croatia output reacts negatively to a government spending shock in the short run and that the total effect vanishes after two years. Moreover, such a pattern is not in line with empirical evidence, which actually in case of fiscal policy effects concur only on the positive effect of a spending shock on economic activity. Ravnik and Žilić (2011) see a possible justification of such a negative effect in the predominance of the crowding out effect against the output effect.

Although not of typical hump-shape, the response of output results to be similar to the same in developing countries. Mirdala (2009) shows that, after the initial positive impact, output starts to gradually increase in Romania, Slovak Republic, Poland and Hungary, and its effects vanish only in the long term. Lonzano and Rodriguez (2009) find similar conclusion in case of Colombia. Table 2 shows the cumulative output multipliers in Croatia[19]. Results show a multiplier above one in all presented periods, being the highest at impact.

[19] The cumulative output multiplier in a given quarter is calculated as the ratio between the cumulative response of output and the cumulative response of government expenditure after the government spending shock.

Table 2. Cumulative output multipliers to government spending shocks

	Quarters			
Shock to:	4th	8th	12th	16th
Government spending	2.45	1.79	1.49	1.33

Source: Author's estimation.

If the given multipliers are compared to those obtained by Šimović and Deskar-Škrbić (2013) for the same (consolidated central) government level then it is possible to observe that in the first year their multiplier is for almost one percentage point lower (being 1.58), while the one corresponding for first two years is almost the same (being 1.80 in their case). The difference that occurs in the short-run may be due to two things mainly: (1) a shorter time span in Šimović and Deskar-Škrbić (2013) and (2) a "smaller" VAR model which embraces three variables only.

Prices respond negatively to a government spending shock in Croatia. The effect is minimal and vanishes in two years. Empirical evidence does not find conclusive results here although theoretically one would expect an increase in the price level after a government spending shock either at impact or for a longer time period. Still, among developing countries evidence show a predominant, at least initially, positive effect[20], while in case of developed countries results are various[21]. In order to be able to provide an explanation to a negative response of prices to an innovation in spending, the effects of spending components are investigated and results discussed in Subsection 5.3.

As in Ravnik and Žilić (2011) a spending shock in this study has the largest (in magnitude) impact on the interest rate, but the response moves in the opposite direction and is insignificant. A spending shock positively affects interest rates only at impact, while afterwards the response is negative throughout the whole period, as in Caldara and Kamps (2006) or Mancellari (2011). Keynesian theory suggests that an increase in interest rates is due to an increase in income. Moreover, Barro (1987) argues that, when the increase in government spending is taken as permanent the increase in output will be realized without increasing interest rates.

The effects of taxes

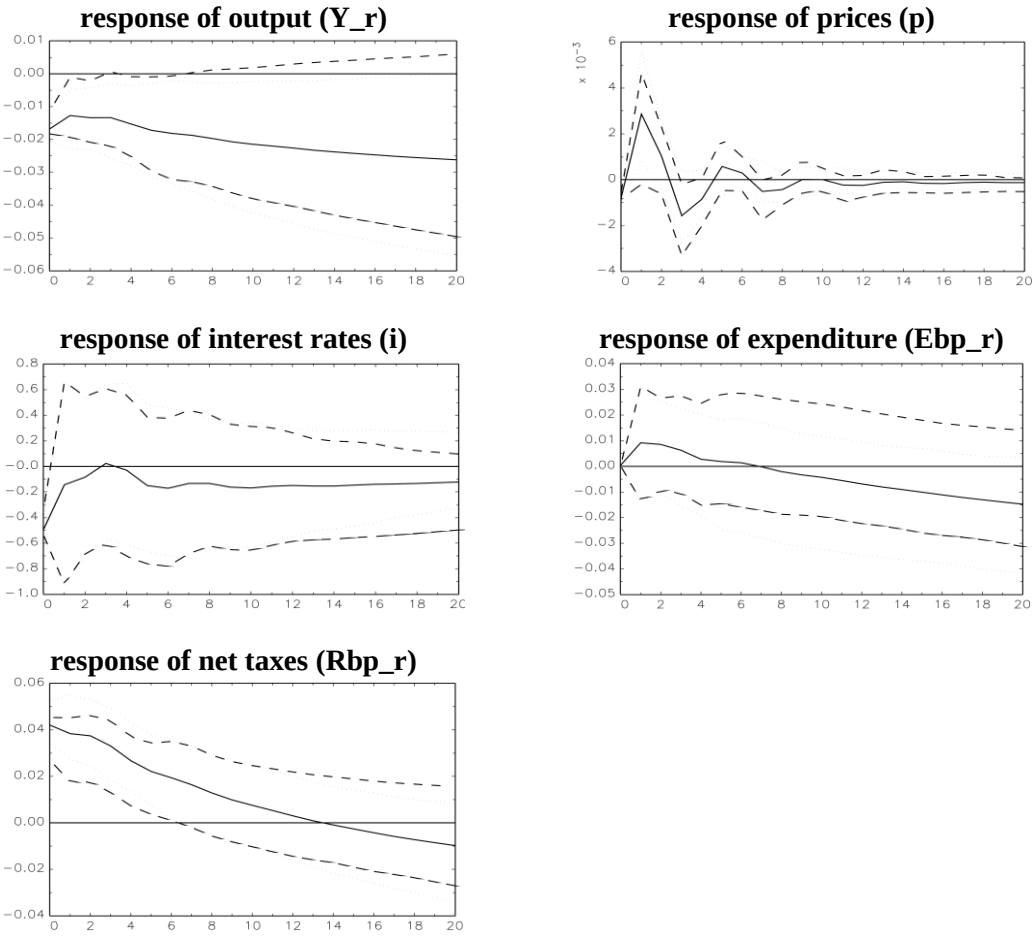
Figure 5 depicts the innovations of a tax shock in the baseline setup. The response of output on a tax shock is negative the whole time horizon of five years. Important to notice is that it shows to be permanent, not temporary, and moreover, as in case of a spending shock, the response is significant throughout the whole time horizon in case when Efron's intervals are considered, while for two years if Hall's confidence intervals are taken into consideration. This may be attributed to the fact that a discretionary change in taxes indeed has a permanent effect on tax revenues. If this is looked through the lenses of other empirical studies it maybe concluded that Croatia is closer to the average results of developed than developing countries, where one can find more evidence of a positive response of output initially or for a longer time horizon[22]. Moreover, the response of taxes after a tax shock confirms the hypothesis of permanent change.

[20] Mirdala (2009) shows that prices react positively after a spending shock in the Czech Republic, Hungary, Poland, Slovak Republic, Bulgaria and Romania, vanishing in the latter only in the long run.

[21] Similar to results of this study, Fatas and Mihov (2001), Mountford and Uhlig (2002) and Caldara and Kamps (2006) evidence that, prices react negatively through the whole time horizon. According to Perotti (2004) the effect of an expenditure shock in the US on prices is positive in the first quarter and negative afterwards, while Edelberg, Eichenbaum and Fisher (1998) show that the initially positive effect lasts four quarters before turning negative. On the other hand, evidence show that in Germany an expenditure shock on prices is positive (Perotti, 2004; Heppke-Falk, Tenhofen and Wolff, 2006) or turns positive after a year (Marcellino, 2002). Similarly, inflation rises after an expenditure shock also in case of Spain (de Castro and de Cos, 2008) and France (Biau and Girard, 2005).

[22] In case of the US Blanchard and Perotti (2002), Perotti (2004) and Mountford and Uhlig (2002) show that the negative response of economic activity lasts for more than five years. Empirical evidence based on German data does not provide such unanimous results. Namely, results suggest that the negative response of economic

Figure 5. Impulse responses to an increase in net taxes (baseline 5VAR model)



Note: Solid line – impulse response; Dashed lines – Hall 95% percentile bootstrap confidence intervals; Dotteded lines – Efron 95% percentile bootstrap confidence intervals.
Source: Author's estimation.

If tax multipliers are considered than it is possible to conclude that its size on impact is very similar to the same obtained by a spending increase except the direction of output response, which is opposite (Table 3). Moreover, the effect is highly comparable to Šimović and Deskar-Škrbić (2013, p. 67).

activity can last for more than five years (Perotti, 2004) or one year only (Marcellino, 2002). Additionally, Perotti (2004) shows that a revenue shock on GDP results to be positive in the first quarter before getting negative, while Heppke-Falk, Tenhofen and Wolff (2006) evidence that the same shock does not affect output significantly. Similarly, evidence show that in case of Spain, France and Italy output response to a revenue shock is insignificant, being negative in the first two cases and positive in case of Italy (de Castro and de Cos, 2008; Biau and Girard, 2005; and Giordano et al, 2005; respectively). On the other hand, Mirdala (2009) shows that after a tax shock output increases in Czech Republic, Hungary, Poland, Slovak Republic, Bulgaria and Romania, being positive throughout the whole time horizon in all cases except Poland. Same is evidenced for Albania (Mancellari, 2011), while in Colombia the positive response vanishes after two years.

Table 3. Cumulative output multipliers to tax shocks

	Quarters			
Shock to:	4th	8th	12th	16th
Taxes	-2.35	-1.66	-1.17	-0.81

Source: Author's estimation.

The response of prices to a tax shock is positive the first two quarters and then volatile around zero. Moreover, as in case of a spending shock, the effect is very minimal in sense of magnitude (units of measurement). Similar evidence can be found among other studies. The effect of a revenue shock on prices in the US is initially positive and then turns negative. According to Perotti (2004) inflation is evidenced only in the first quarter, while Mountford and Uhlig (2002) prove that it lasts for the first four quarters. Oppositely, the same effect in Germany is negative according to Perotti (2004), while Marcellino (2002) partly disagrees stating that the effect turns negative after being initially positive during the first year. Moreover, Giordano et al (2005) find the effects on inflation very small and insignificant in the case of Italy. In Poland, the Slovak Republic and Bulgaria a tax shock increases inflation, while in the Czech Republic, Hungary and Romania it decreases the rate of inflation (with differing intensity and durability in both cases) (Mirdala, 2009, p.11).

A tax shock exercises a negative and insignificant response of the interest rate in Croatia. A negative response of the interest rate on a tax shock is also evidenced in the case of Hungary, Poland, Slovak Republic and Bulgaria and remained permanent through the whole time horizon (Mirdala, 2009). Additionally, the effects on interest rates in Croatia showed to be insignificant after a tax shock, same as in Germany (Heppke-Falk, Tenhofen and Wolff, 2006), while in Spain, interest rates tend to increase persistently (de Castro and de Cos, 2008).

5.1.1. Robustness check

The robustness of the baseline results was checked by means of four alternatives:

1) Changing the values for α_y^r and α_π^r, i.e. using different elasticities of taxes with respect to output and prices. In this case elasticities obtained by Ravnik and Žilić (2011) are used to estimate the model and extract the impulse response functions. The results do not change substantially. The pattern of response is the same in case of all variables to both fiscal shocks, thus the effect of both fiscal shocks on interest rates on impact (in the first quarter) are slightly higher, but converge to the baseline results in the following period.

2) Changing the value of α_π^g, i.e. the price elasticity of government spending. It has been mentioned earlier that the price elasticity of spending is set to be -0.5 following Perotti (2002). Still, this elasticity ranges from -1 to 0, so both extreme cases of α_π^g are tested. The results do not change substantially.

3) Assuming that a government tends to decide on taxes first, i.e. defining that β_g^r=0. Doing so means changing equations (10) and (11) in $u_t^{r,CA} = v_t^r$ and $u_t^{g,CA} = \beta_r^g v_t^r + v_t^g$ respectively. Results do not change substantially. The response on impact is the same for all variables and in case of both shocks, except for the response of interest rate on a spending shock. Namely, under the baseline results, the effect of the spending shock on interest rate in the first period was positive, while under the assumption that taxes come first it is negative in the same period. Still, its magnitude and pattern are almost identical throughout the rest of the time horizon.

4) Using a first order lag polynomial as suggested by Schwarz and Hannan-Quinn criteria (see Table C4). Results again prove to be robust to those obtained from the baseline model, which adopted the Akaike suggestion.

Moreover, a simple three variable VAR including government spending, output and net taxes (as in the seminal paper of Blanchard and Perotti (2002)) is also run in order to check whether the responses of output move in the same direction after a government shock. Indeed, results are similar and the

responses are significant in cases of both confidence intervals bootstrapping method. Furthermore, nothing changes if the observed time period is shorten, starting from first quarter 2000[23].

5.2. The effects on private consumption and private investment

In order to examine the effects of fiscal shocks on GDP components (private consumption and private investment) the baseline five variable VAR model was extended to a six variable VAR. In such a setup the vector of endogenous variables Y_t is now $[g_t \quad y_t \quad z_t \quad \pi_t \quad r_t \quad i_t]$' where z_t corresponds to the (in turn) added variable, i.e. private consumption or private investment. This order follows the suggestion by Caldara and Kamps (2008), as in the case of the baseline model and the mentioned assumptions (see Footnote (7)). To recall, placing private consumption or private investment at the third place means it does not react contemporaneously to prices, taxes and interest rates shocks, but is contemporaneously affected by government spending and output shocks. Yet, the equations showing reduced form innovations of fiscal variables are:

$$u_t^g = \alpha_y^g u_t^y + \alpha_z^g u_t^z + \alpha_\pi^g u_t^\pi + \alpha_i^g u_t^i + \beta_r^g v_t^r + v_t^g \quad \text{and} \tag{17}$$

$$u_t^r = \alpha_y^r u_t^y + \alpha_z^r u_t^z + \alpha_\pi^r u_t^\pi + \alpha_i^r u_t^i + \beta_g^r v_t^g + v_t^r \tag{18}$$

where α_z^g and α_z^r represent the elasticity with respect to the GDP component (private consumption or private investment) of government spending and taxes respectively, while u_t^z are the reduced form innovations of the GDP component under analysis. In order to fully identify the SVAR the mentioned two elasticities have to be estimated. Recalling the assumption that government spending are solely under the control of fiscal authority, in the equation explaining reduced innovation in government spending all elasticities (except the price elasticity) are again set to zero. Therefore the spending elasticity with respect to private consumption and private investment is zero.

On the other hand, the tax elasticities with respect to private consumption and private investment have to be estimated. Following the same procedure as in case of previous exogenous elasticity estimation, the elasticity of (total) taxes with respect to private consumption and private investment results to be 0.84 and 0.49 respectively[24].

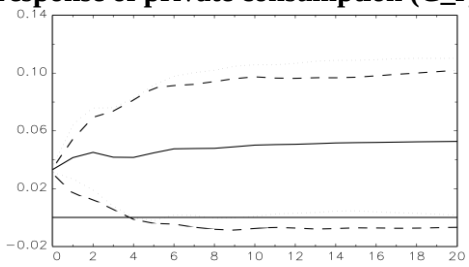
Figure 6 shows the effect of a spending shock on private consumption and private investment in Croatia. It is possible to notice that in both cases a spending shock exercise a positive effect with a slightly different development throughout the time horizon. Interesting enough is the fact that the effects are significant within a year only according to Hall's confidence intervals and while the significance is much longer in case of the private consumption increase according to Efron's bootstraping .

[23] The reasoning behind this decision is supported by the fact that the Croatian Bureau of Statistics started to publish a quarterly GDP estimation in 2000 (quarter by quarter). The quarterly GDP/output data prior to year 2000 are results of an a posteriori estimation done by Mikulić and Lovrinčević (2000), which is commonly and widely used in empirical studies on the Croatian case.

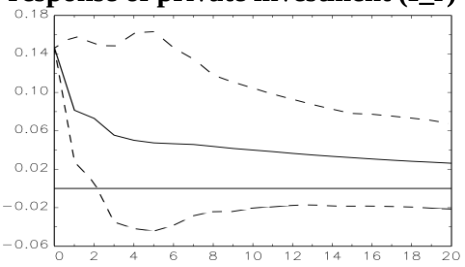
[24] To see the sub-elasticities of tax components used to construct the aggregate tax elasticity refer to the corresponding Table in Appendix C.

Figure 6. Responses to an increase in government spending (extended 6VAR model)

response of private consumption (C_r)



response of private investment (I_r)



Note: Solid line – impulse response; Dashed lines – Hall 95% percentile bootstrap confidence intervals; Dotted lines – Efron 95% percentile bootstrap confidence intervals.
Source: Author's estimation.

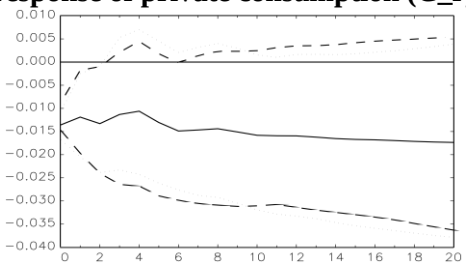
Fatas and Mihov (2001), Blanchard and Perotti (2002) and Caldara and Kamps (2006) outline that a positive government spending shock in the US increases significantly private consumption[25]. In case of Germany and Spain private consumption increases initially after the expenditure shock, falling subsequently to levels below the initial one (Heppke-Falk, Tenhofen and Wolff, 2006; and de Castro and de Cos, 2008, respectively). Giordano et al (2007) and Biau and Girard (2005) find that the response of private consumption to an expenditure shock in Italy and France respectively is hump-shaped, i.e. after the initial stimulation the effect decreases progressively in the medium term. Still, Kirchner, Cimadomo and Hauptmeiere (2010) find evidence that in the Euro area the reaction of private consumption is positive and significant. A 1% GDP increase in expenditure raises private consumption by 1.1% GDP.

Although both responses are persistent, the positive response of private investment to a spending shock is higher (in terms of units of measurment) throughout the whole time horizon. Kirchner, Cimadomo and Hauptmeiere (2010) find evidence that in the Euro area the reaction of investment to an expenditure shock is positive and significant. A 1% GDP increase in expenditure raises investment by 1.6% GDP. Oppositely, Fatas and Mihov (2001) show that investment does not react significantly to increases in government spending in the US. Similarly, in Spain investment does not appear too persistent to a government expenditure shock (De Castro and de Cos, 2008), while in Italy the impact is evidenced in the fourth quarter at about 0.2 percentage points of GDP (Giordano et al, 2007).
When investigating tax shocks of private consumption and private investment it is noticeable that the effect on impact is negative in both cases, but with a different development afterwards (see Figure 7).

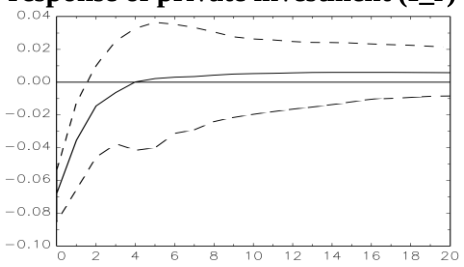
[25] Moreover on the case of the US, Mountford and Uhlig (2005) report that the response of private consumption is close to zero and statistically insignificant, while Ramey (2007) presents that private consumption will fall in response to a government spending shock. Similarly, Tenhofen and Wolff (2007) show that private consumption reacts positively to an expenditure shock, but when they extend the SVAR to allow for one period ahead anticipation of the shock, results change from being Keynesian to neoclassical, and private consumption falls one period before the shock.

Figure 7. Responses to an increase in taxes (extended 6VAR model)

response of private consumption (C_r)



response of private investment (I_r)



Note: Solid line – impulse response; Dashed lines – Hall 95% percentile bootstrap confidence intervals; Dotted lines – Efron 95% percentile bootstrap confidence intervals.
Source: Author's estimation.

After a tax shock private consumption drops and remains permanent and negative throughout the whole time horizon. On the other hand, the effect of the same shock on investment is much larger but it stabilizes after the first year. Blanchard and Perotti (2002) reveal that both increases in taxes and increases in government spending have a strong negative effect on investment spending in the US. Moreover, the response of investment after a tax shock is insignificant in Germany and Spain (Heppke-Falk, Tenhofen and Wolff, 2006; and de Castro and de Cos, 2008; respectively).

In the Croatian case it can be concluded that results go in favor of Keynesian assumptions because on one hand a spending shock affects positively private consumption, and on the other hand the response of private investment to a spending shock is opposite of its response to a tax shock.

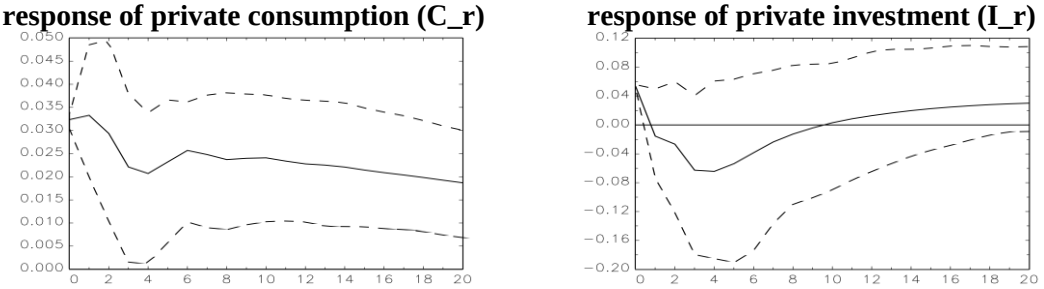
5.3. The effects of government spending components

Different government spending components can affect economic activity in a different manner. In order to inspect the effects of government consumption and government investment shocks on the macroeconomic environment in Croatia, total government spending g_t is replaced in the six variable model in turn by government consumption or government investment. Therefore, the vector of endogenous variables Y_t is now $\left[g_t^j \quad y_t \quad z_t \quad \pi_t \quad r_t \quad i_t\right]'$, being g_t^j a spending component. Government consumption is defined as in Heppke-Falk, Tenhofen and Wolff (2006), i.e. the sum of personnel and operating budget expenditure, while government investment corresponds to capital spending.

As mentioned in the previous Section, private consumption reacts in a Keynesian manner after a government spending shock; still the effect is not the same when the spending shock occurs due to increase in government consumption or due to government investment (Figures 8 and 9).

Figure 8. Responses to an increase in government consumption (current spending) in the 6 variable SVAR extended for private consumption and private investment respectively

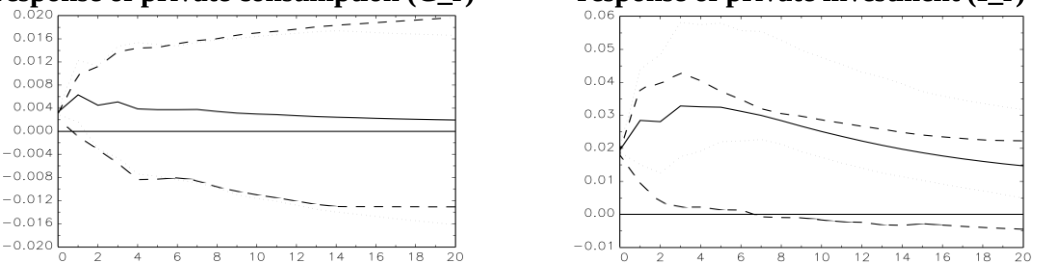
response of private consumption (C_r) **response of private investment (I_r)**



Note: Solid line – impulse response; Dashed lines – Hall 95% percentile bootstrap confidence intervals; Dotted lines – Efron 95% percentile bootstrap confidence intervals.
Source: Author's estimation.

Figure 9. Responses to an increase in government investment (capital spending) in the 6 variable SVAR extended for private consumption and private investment respectively

response of private consumption (C_r) **response of private investment (I_r)**



Note: Solid line – impulse response; Dashed lines – Hall 95% percentile bootstrap confidence intervals; Dotted lines – Efron 95% percentile bootstrap confidence intervals.
Source: Author's estimation.

Both (government consumption and investment) shocks increase private consumption, but the effect of government consumption is significant, permanent and larger throughout the whole period (Figures 8 and 9). If private investment is considered it can be concluded that a shock in government consumption doesn't affect it since the response is insignificant. Oppositely government and private investment seem to have a significant positive relationship since an increase in government investment results in an increase in private investment, which is permanent and significant for at least two years. Similarly, Heppke-Falk, Tenhofen and Wolff (2006) find that in Germany after a government investment shock private investment increase[26].

No matter of the GDP component included in the model and of the spending component under analysis, the effect on prices and interest rates results to be insignificant and of similar pattern as in the baseline model[27]. A government consumption shock makes prices fluctuate around zero (after an initial positive impact) and stabilize after a year, while the effect on interest rates is negative and permanent. A government investment shock exercises a small and negative effect on prices and a positive and permanent effect on interest rates, the latter being expected in accordance to the increase in output.

[26] Moreover, in this case Heppke-Falk, Tenhofen and Wolff (2006) find that output reaction is weak and insignificant in case of a government consumption shock, being strong, significant and persistent in case of a government investment shock.
[27] These responses are not shown here in order to preserve space but are available upon request.

5.4. The effects of government revenue components

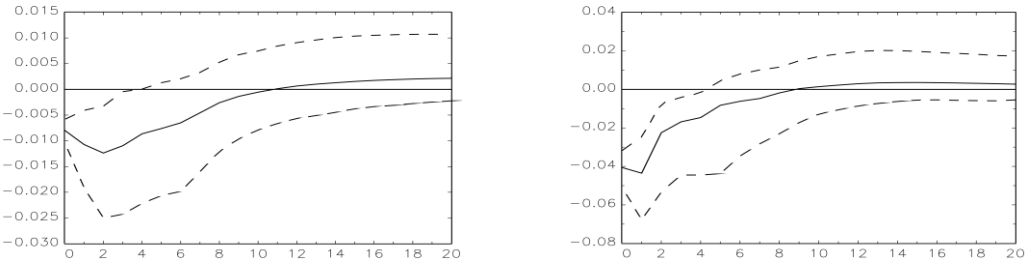
According to the similar rationale as in case of governments spending components' shocks, this Section offers the overview of the effects of the main tax shocks by component on the economic activity in Croatia. The vector of endogenous variables in this case is $Y_t = \left[g_t \quad y_t \quad z_t \quad \pi_t \quad r_t^j \quad i_t \right]'$, being r_t^j a tax component, i.e. direct taxes or indirect taxes. In order to correctly define the fiscal equation, the exogenous elasticities in case of different tax components with respect to output and prices were already presented in Table 1 of this work. Since it is important to inspect different tax components' effect on GDP components as well, the elasticities of direct and indirect taxes with respect to private consumption and private investment were estimated. In line with the previously explained methodology, the elasticity of direct taxes with respect to private consumption and private investment results to be in Croatia 0.23 and 0.29 respectively[28]. On the other hand, the elasticities of indirect taxes with respect to private consumption and private investment are 1.53 and 0.7 respectively.

Recalling that the baseline model results showed that a tax shock negatively affects output, it is yet possible to inspect whether the negative effect comes more from direct or indirect taxes. The results are in line with the expectations, since one would expect that, due to its high share in total taxes, indirect taxes category mainly affect economic activity.

Results show that an indirect tax shock negatively affects output and private consumption for three years, when the effect stabilizes around zero (Figure 10). De Castro and de Cos (2008) for instance show that in the long-run private consumption decreases even more in case of a direct tax shock than in the case of an indirect tax shock. Such a development is much alike to developed countries and/or those that collect the majority of tax revenues through direct taxes. Moreover, in the Croatian case, private investment also reacts negatively after an indirect tax shock shock, but the effect fades out after second year.

Figure 10. Responses to an increase in indirect taxes in the 6 variable SVAR extended for private consumption and private investment respectively

response of private consumption (C_r) **response of private investment (I_r)**

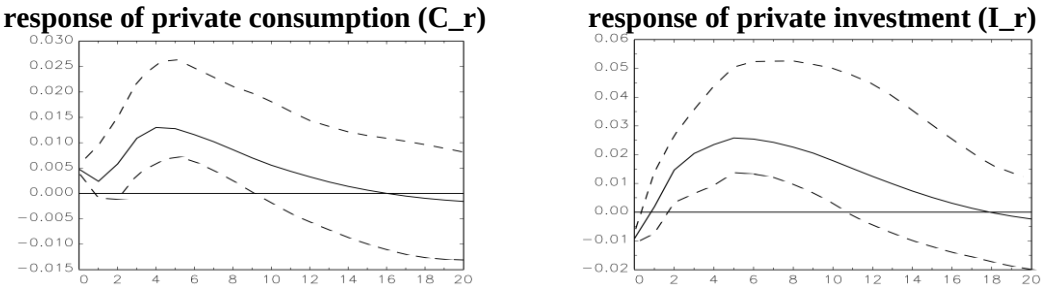


Note: Solid line – impulse response; Dashed lines – Hall 95% percentile bootstrap confidence intervals; Dotted lines – Efron 95% percentile bootstrap confidence intervals.
Source: Author's estimation.

The impact of direct taxes is lower (in magnitude) and interesting enough, the response of private investment is negative only at time of impact, while the effect on private consumption is positive in the same period. After the impact in all cases a direct tax shock implies a positive response in a long term and the effect is significant for more than two years (Figure 11).

[28] Refer to Appendix C for a detailed view of the sub-elasticities.

Figure 11. Responses to an increase in direct taxes in the 6 variable SVAR extended for private consumption and private investment respectively



Note: Solid line – impulse response; Dashed lines – Hall 95% percentile bootstrap confidence intervals; Dotted lines – Efron 95% percentile bootstrap confidence intervals.
Source: Author's estimation.

When comparing the effects of spending and tax shocks on the Croatian case, it is possible to notice that the responses after a tax shock on macroeconomic variables are much more significant than in the case of a spending shock.

5.5. The effects of fiscal policy on labour market

In order to account for the transmission mechanism of fiscal shocks to the labour market the baseline five variable model is extended for a labour market variable. The labour market variables that are taken into consideration are employment L_t and wages w_t.

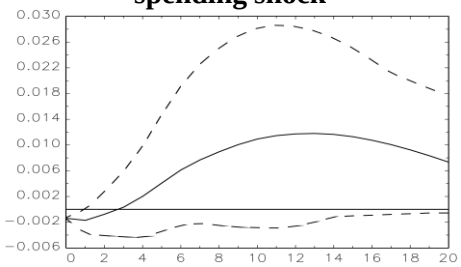
In case of employment measured as number of persons employed, the vector of endogenous variables Y_t becomes $\left[g_t \quad y_t \quad \pi_t \quad L_t \quad r_t \quad i_t\right]'$, meaning that employment does not react contemporaneously to taxes and interest rates. In case of wages two different categories are taken into account, i.e. average wages in the private and public sector. When assessing fiscal policy effects on wages, the latter is ordered fifth in the model and the vector of endogenous variables results in $\left[g_t \quad y_t \quad \pi_t \quad r_t \quad w_t^j \quad i_t\right]'$, where w_t^j are wages represented by three variables: average wages in the private sector, average wages in the public sector and the minimal wage. This implies that wages are affected contemporaneously by all variables in the model except the interest rate.

In order to fully identify the SVAR model, again in the fiscal equation regarding taxes there is need of additional exogenous elasticity. In case of tax elasticity with regard to employment a unitary elasticity is imposed as suggested by ECB and OECD studies. When considering the tax elasticity of wages then the estimated elasticity of the personal income tax with respect to its macroeconomic base (i.e. wage bill) is used.

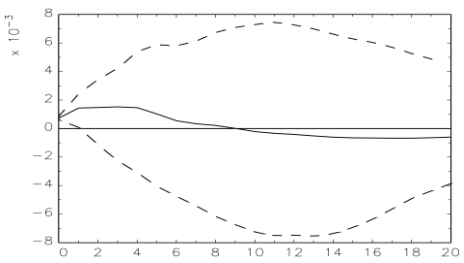
Figure 12 shows the impulse responses of the labour market. Results show that employment reacts negatively to a government spending shock only in the first two quarters (small units of measurement), while afterwards it shows a persistent increasing trend, which lasts for more than four years. This result is in line with those presented by Fatas and Mihov (2001) with the exception that in their case the response is positive at time of impact as well. Still, the effect is not significant in the case of Croatia. Furthermore, employment reacts positively to a tax shock for the first two years, but the response results to be as well insignificant.

Figure 12. Responses of employment to an increase in government spending and net taxes in the 6 variable SVAR

response of employment (L_pers) after a spending shock



response of employment (L_pers) after a tax shock



Note: Solid line – impulse response; Dashed lines – Hall 95% percentile bootstrap confidence intervals; Dotted lines – Efron 95% percentile bootstrap confidence intervals.
Source: Author's estimation.

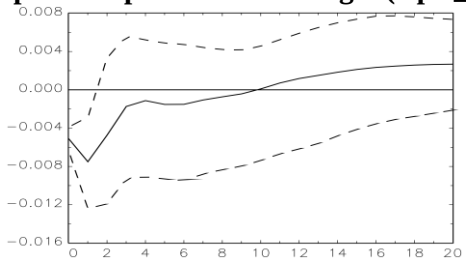
Interesting is the response of wages. Fatas and Mihov (2001) show that real wages respond positively to a government spending shock in the US. Croatia does not present such unanimous overall results. After differentiating the effect on private and public wages, public sector wages increase after a government spending shock and the effect is significant within two years while it fades out after three years; on the other hand private sector wages decrease after the same shock and the effect is insignificant, similar effects are visible in case of the minimal wage. The findings that a government spending shock increases employment and wages is consistent with Keynesian and RBC theories.

In case of a tax shock wages decrease no matter of the sector, although the negative response is much higher and significant in the case of public sector wages and even lasts almost two years longer than the same negative response of private sector wages before stabilizing. Moreover, it seems that increase in taxes do not affect minimal wage setup, as the response is not significant, which is expected.

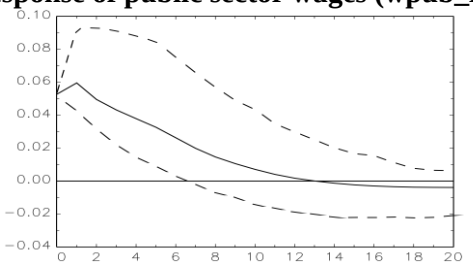
Figure 13. Responses to an increase in government spending and taxes in the 6 variable SVAR extended for wages in the private sector, public sector and minimal wages respectively

INCREASE IN GOVERNMENT SPENDING

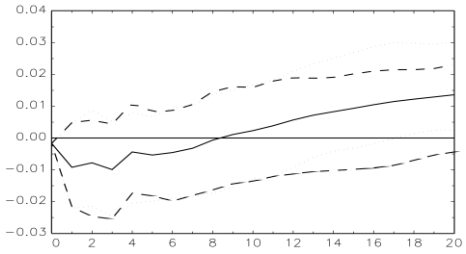
response of private sector wages (wpri_r)



response of public sector wages (wpub_r)

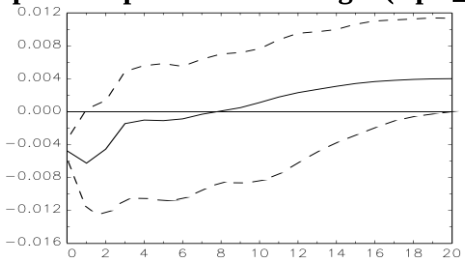


response of minimal wages (wmin_r)

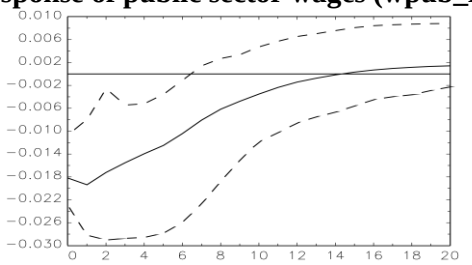


INCREASE IN NET TAXES

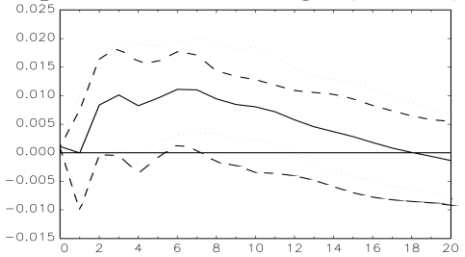
response of private sector wages (wpri_r)



response of public sector wages (wpub_r)



response of minimal wages (wmin_r)



Note: Solid line – impulse response; Dashed lines – Hall 95% percentile bootstrap confidence intervals; Dotted lines – Efron 95% percentile bootstrap confidence intervals.
Source: Author's estimation.

6. Conclusion

This paper assesses the stabilization effects of fiscal policy in Croatia in the period 1996-2011 using the structural vector autoregression model proposed by Blanchard and Perotti (2002). In the five variable (government spending, output, prices, taxes, interest rate) baseline VAR setup, results show that output moves in line with Keynesian propositions, i.e. it increases after a government spending shock and decreases after a tax shock. The impact multiplier is above 2 in both cases, but being positive when the government uses spending- and negative when using a tax-increase. Moreover the effects on output are permanent and significant in a long term. When extending the model for an additional macroeconomic variable, among others it is worth mentioning the following results: (a) private consumption and private investment follow the same responses as output after a government shock, (b) government consumption and investment lead to an increase in private consumption significantly, while government investment exercise an even more important effect on private investment, (c) a drop in output and private consumption after a tax shock is mainly driven by indirect (not direct) taxes, (d) public sector wages respond significantly to a spending and tax shock, showing a rise and drop respectively.

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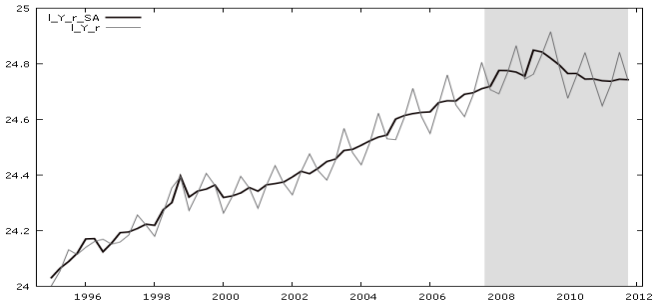
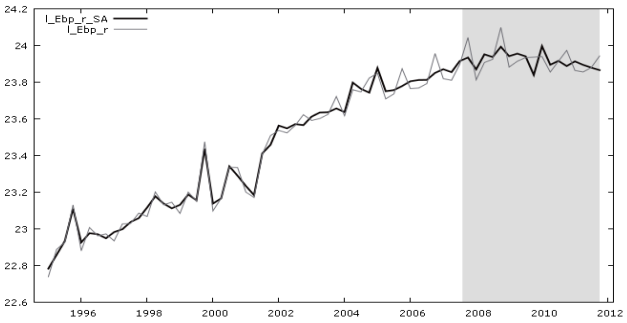
Appendix A. Macroeconomic and fiscal variables in Croatia in the period 1995Q1-2011Q4: baseline model

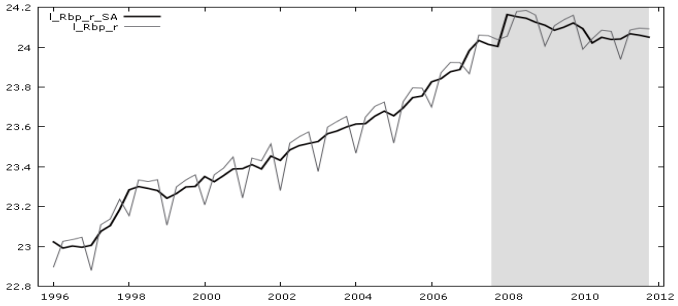
Panel A: Real GDP (original and seasonally adjusted), 2000=100 in logarithms



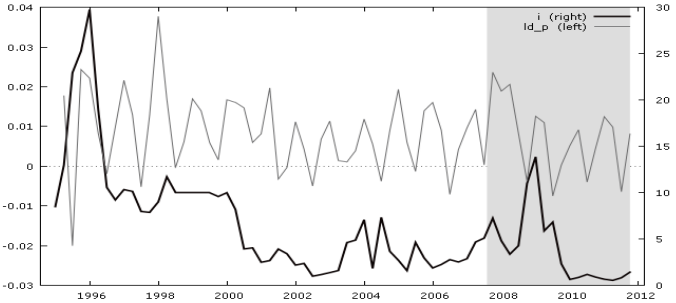
Panel B: Real consolidated central government expenditure (Ebp_r, original and seasonally adjusted), 2000=100 in logarithms



Panel C: Real consolidated central government taxes (Rbp_r, original and seasonally adjusted), 2000=100 in logarithms



Panel D: CPI (2000=100, left scale) and short-term interest rate on the interbank deposit trading (right scale)



Note: X12 ARIMA seasonal adjustment; "shading" in the period 2007Q3-2011Q4 correspond to the global financial crisis; fiscal variables values are according to the GFS 1986 methodology (for details see Section 4.1. or Grdović Gnip (2011)).
Source: Croatian Bureau of Statistics, Croatian National Bank, Ministry of finance.

Appendix B – Baseline model tests

Table B1. Augmented Dickey Fuller Test values (baseline model)

H0: The variable has a unit root.							
Variable	*Deterministic component*	test statistics	Lags (AIC)	Variable	*Deterministic component*	test statistics	Lags (AIC)
***L*Y_r**	*c,t*	-1.8110	0	**Δ*L*Y_r**	*c,t*	-9.4757***	0
	c	-1.8825	1		*c*	-9.2081***	0
***L*Ebp_r**	*c,t*	-0.3815	2	**Δ*L*Ebp_r**	*c,t*	-8.7127***	1
	c	-1.3053	2		*c*	-8.4404***	1
***L*Rbp_r**	*c,t*	-1.1244	0	**Δ*L*Rbp_r**	*c,t*	-7.9141***	0
	c	-1.8792	0		*c*	-7.7397***	0
***L*p**	*c,t*	-3.1001	4	**Δ*L*p**	*c,t*	-5.1666***	3
	c	-1.4882	4		*c*	-4.0552***	3
i	*c,t*	-4.1536***	0	**Δi**	*c,t*	-6.8582***	2
	c	-3.4415***	0		*c*	-6.6657***	0

Note: *Y_r* is real GDP, *Ebp_r* and *Rbp_r* correspond to consolidated central government expenditure and revenue as in Blanchard and Perotti (2002), while *p* and *i* are prices (CPI index) and interest rate (on interbank demand deposit trading on overnight credits) respectively; *L* is used to denote logarithms, while Δ refers to first differences; budget variables (Ebp_r and Rbp_r) and output (Y_r) are seasonally adjusted; constant included; maximum number of lags used is 12; optimal lag chosen according to Akaike Information Criterion (AIC); *** null hypothesis rejected on 1% level of significance; ** null hypothesis rejected on 5% level of significance; * null hypothesis rejected on 10% level of significance; Davidson and MacKinnon (1993) critical values.
Source: Author's calculation.

Table B2. Johansen cointegration test (baseline model)

r0	LR	pval
0	150.53	0.0000
1	72.89	0.0003
2	38.07	0.0221
3	20.63	0.0428
4	4.57	0.3454

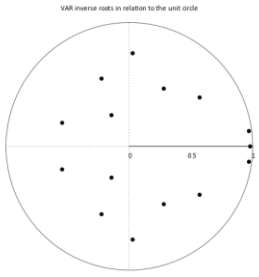
Source: Author's calculation.

Table B3. Lag length criteria (baseline model)

lags	logL	AIC	BIC	HQC
1	418.72773	-12.79094	-11.5692*	-12.31305*
2	453.34255	-13.11141*	-11.01707	-12.29220
3	470.27845	-12.84261	-9.87562	-11.68206
4	485.95960	-12.53198	-8.69235	-11.03009

Note: * indicate the best (that is, minimized) values of the respective information criteria, AIC = Akaike criterion, BIC = Schwarz Bayesian criterion and HQC = Hannan-Quinn criterion.
Source: Author's calculation.

Figure B1. Inverse Roots of AR Characteristic Polynomial



Source: Author's calculation.

Appendix C. Exogenous sub-elasticities estimation

Table C1. Exogenous sub-elasticities with respect to real GDP and share of tax item in total taxes (baseline model)

Budgetary item	**Elasticity of budgetary item to "macrobase"**	**Elasticity of "macrobase" to real GDP**	**Elasticity of budgetary item w.r.t. real GDP**	**Share in total taxes**
	$\alpha_{B_i}^{\tau_i}$	$\alpha_y^{B_i}$	$\alpha_{B_i}^{\tau_i} \cdot \alpha_y^{B_i}$	T_i/T
Personal income tax	1.77	0.49	0.87	0.126
Corporate income tax	3.62	0.33	1.19	0.048
Social security contributions	0.68	0.49	0.33	0.357
Indirect taxes	1.53	0.89	1.36	0.468

Note: For details on respective "macrobase" (macroeconomic base) see for instance Bouthevillain et al (2001).
Source: Author's calculation.

Table C2. Exogenous sub-elasticities with respect to prices and share of tax item in total taxes (baseline model)

Budgetary item	**Elasticity of budgetary item to "macrobase"**	**Elasticity of "macrobase" to prices**	**Elasticity of budgetary item w.r.t. prices**	**Share in total taxes**
	$\alpha_{B_i}^{\tau_i}$	$\alpha_\pi^{B_i}$	$\alpha_{B_i}^{\tau_i} \cdot \alpha_\pi^{B_i}$	T_i/T
Personal income tax	1.77	-0.29	-0.51	0.126
Corporate income tax	3.62	-0.20	-0.72	0.048
Social security contributions	0.68	-0.29	-0.20	0.357
Indirect taxes	1.53	1.24	1.90	0.468

Note: For details on respective "macrobase" (macroeconomic base) see for instance Bouthevillain et al (2001).
Source: Author's calculation.

Table C3. Exogenous sub-elasticities with respect to private consumption and investment

Budgetary item	**Elasticity of "macrobase" to private consumption**	**Elasticity of "macrobase" to investment**	**Elasticity of budgetary item w.r.t. private consumption**	**Elasticity of budgetary item w.r.t. investment**
	$\alpha_C^{B_i}$	$\alpha_I^{B_i}$	$\alpha_{B_i}^{\tau_i} \cdot \alpha_C^{B_i}$	$\alpha_{B_i}^{\tau_i} \cdot \alpha_I^{B_i}$
Personal income tax	0.21	0.27	0.37	0.48
Corporate income tax	0.14	0.19	0.51	0.69
Social security contributions	0.21	0.27	0.14	0.18
Indirect taxes	-	0.46	1.53	0.70

Note: For details on respective "macrobase" (macroeconomic base) see for instance Bouthevillain et al (2001).
All coefficients are significant at least at the 5% level.
Source: Author's calculation.