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Dynamic effects of fiscal policy in Croatia: confronting New-Keynesian SOE theory with empirics*[1]

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Abstract

In this paper we calibrate a small open economy (SOE) New-Keynesian DSGE model for the Croatian economy. The main focus of the paper is on the effects of fiscal policy, more precisely government consumption, on employment, output, inflation and trade balance. After we analyse the model impulse responses we confront these results with the empirical results of VAR model. Our results indicate that the presented DSGE model can be a useful starting point and a toolkit in fiscal policy analysis in Croatia as estimated impulse responses from VAR model mostly match impulse responses from the calibrated model. Also, empirical results indicate that fiscal policy has a significant effect on macroeconomic developments in Croatia. Thus, it is a responsibility of fiscal policy makers to prudently use and adjust fiscal instruments in such a way that fiscal policy can always have a counter-cyclical, stabilizing effect on Croatian economy.

Key words: *fiscal policy, DSGE, VAR, Croatia*

JEL classification: *E62, H30*

1. Introduction

Croatia is a small open economy (SOE) with a managed floating exchange rate regime. More precisely, monetary authority in Croatia uses nominal exchange rate as a nominal monetary policy anchor due to a high degree of financial euroisation in the economy.

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Such structural characteristics of Croatian economic and financial system make monetary policy instruments fairly ineffective in terms of business cycle management as central bank cannot use nor exchange rate nor key policy rate channels to steer the economy through the boom-bust cycles (for details on the limitations of monetary policy in Croatia see for example Vujčić, 2003; Lang and Krznar, 2004; Šimović, Ćorić and Deskar-Škrbić, 2015). Thus fiscal policy can be seen and understood as the key economic policy instrument in Croatia, especially when we focus on its stabilization function[3].

In addition, size of the government, measured through the share of general government expenditures in GDP (45.3% of GDP[4]) and share of public employment in total employment (around 30%[5]), makes the government an important economic agent in Croatian economy. The role and importance of fiscal policy in Croatia will become even more pronounced after the introduction of euro as monetary sovereignty of national central bank will be formally terminated. Already now, under the European semester framework, fiscal policy, its effectiveness and sustainability, are in the focus of both, local policy makers and European authorities. All these factors make the understanding of key fiscal policy instruments, mechanisms, limitations and possibilities in Croatia important for academics, researchers and policy makers.

The main goal of this paper is to determine whether the effects of government consumption, as one of the key fiscal policy instruments, on economic growth fit into a New-Keynesian theoretical framework by comparing impulse response functions from calibrated DSGE model with empirical impulse response functions from VAR model. Adequate answer to this research questions has important implications for: (i) future research as modelling and simulations of fiscal policy have to have firm theoretical background and (ii) policy making process as fiscal policy measures can have different effects on economic growth under different theoretical assumptions.

The main hypotheses of this paper are:

H1: Fiscal policy has a significant effect on macroeconomic developments in Croatia

H1a: Government consumption has positive effect on GDP ($\uparrow G \rightarrow \uparrow Y$)

H1b: Government consumption has positive effect on employment ($\uparrow G \rightarrow \uparrow N$)

H1c: Government consumption has negative effect on trade balance ($\uparrow G \rightarrow \uparrow NX$)

H1d: Government consumption has positive effect on CPI ($\uparrow G \rightarrow \uparrow \pi$)

[3] According to Musgrawe and Musgrawe (1989), from this point of view, the fiscal policy makers should make an effort to eliminate the macroeconomic fluctuations associated with a suboptimal allocation of resources and take an active role in the process of meeting basic economic policy targets. This approach to fiscal policy corresponds with a conception of business cycles as a manifestation of macroeconomic disequilibrium.

[4] Eurostat data for 2017 (Annual Government Finance Statistics); available at: Eurostat

[5] EBRD data for 2016 (Structural Change Indicators); available at: EBRD

H2: New-Keynesian DSGE models can be used for simulations of the effects of government consumption on GDP, employment, trade balance and inflation in Croatia.

The main contribution of this paper stems from the fact that it represents the first publicly available attempt of fiscal modelling in New-Keynesian DSGE analytical framework in Croatia.

The rest of the paper is structured as follows. After the Introduction, in the second part of the paper we give a brief literature overview focused on literature related to economic modelling and macroeconomic effects of fiscal policy in Croatia. In the third part we present a theoretical, New-Keynesian open economy DSGE model, and analyze theoretical impulse response function, after calibration. In the fourth part of the paper we confront these impulse responses with empirical ones obtained from VAR model.

2. Literature review

2.1. Economic modelling in Croatia

Most of papers in this field of literature in Croatia are based on (static) computable general equilibrium (CGE) models[6].

Pioneers of CGE modelling in Croatia are Adelman and Šohinger (2000) who developed a CEGCRO model suitable for the analysis of the effects of structural changes in taxes and tariffs on various sectors in Croatia (based on data from input-output tables for 1987). Šohinger, Galinec and Harrison (2001) analysed the possible welfare effects of Croatian accession to World Trade Organization. Thus, authors were mostly focused on tariffs and concluded that Croatian path towards WTO (and later CEFTA and EU) would not have notable negative impact on overall welfare. Škare and Stjepanović (2011) built a computable general equilibrium (CGE) model (based on Salter-Swan analytical framework) and analysed the effects of external shocks on various sectors of Croatian economy. Authors concluded that their model is suitable for the analysis. Škare and Stjepanović (2013) use so-called 1-2-3 model and analyse the effects of changes in nominal exchange rate and inflation on Croatian economy. Most recent CGE papers in Croatia are Nadoveza and Penava (2016) and Nadoveza, Sekur and Beg (2016). In the first paper authors described the structure of the computable general equilibrium for Croatia based on five sectors (including government) and showed that their CGE model resembles real data on Croatian economy in 2010. In the second paper authors used the

[6] For detailed explanation of CGE models see Nadoveza and Penava (2016).

aforementioned CGE model to analyse the effects of one of the fiscal policy instruments, namely income tax, on the economy. Results (among others) showed that reduction of labour tax burden increases production and disposable income in the economy while and that rise in tax revenues supported by stronger demand in the economy offsets the negative effects of lower income tax receipts in the budget.

Unlike CGE models, literature on dynamic stochastic general equilibrium (DSGE) in Croatia is relatively scarce, although we could see rising interest for this kind of economic modelling in recent years.

First publicly available paper in which authors conduct the analysis of Croatian economy through the lens of DSGE model is Bokan et al. (2010). This model was developed for the analysis of mechanisms by which the 2008 crisis propagated throughout the Croatian economy and for the analysis of monetary policy reaction. Model contains nine sectors whose behaviour is modelled in the New Keynesian framework of price stickiness and rigidities on the labour market. However, it is important to note that this model does not model fiscal authority behaviour. The authors showed that real data fitted well to the results of model which improved the understanding of crisis propagation channels and possibilities of the stabilization role of monetary policy. Palić (2015) analysed the effects of various shocks in real business cycle (RBC) models and New Keynesian models and compared the theoretical impulse responses with impulse responses obtained from VAR analysis. Author concluded that the assumptions of New Keynesian models are more suitable for the analysis of Croatian economy than assumptions of RBC models. Arčabić et al. (2016a) used a small open economy DSGE model to analyze the effects of productivity shock on Croatian economy and showed that impulse responses from the empirical VAR model do not resemble those from the theoretical one for all the variables and that that the productivity shocks do not play a significant role in determining the variation of macroeconomic variables. Arčabić et al. (2016b) used the same DSGE model to analyze the effects of external shock on Croatian economy. Authors concluded that fits the data well as long as monetary policy is modelled as a fixed exchange rate regime. Palić, Dumičić and Barbić (2017) confronted DSGE impulse responses with SVAR impulse responses and confirmed the hypothesis that New-Keynesian models have stronger explanatory power for Croatian economy than RCB models. Palić (2018) tested the compliance of monetary policy shock in calibrated DSGE model which includes financial frictions with the empirical impact of monetary policy shock in Croatia estimated using VAR model.

The results show that monetary policy shock has positive initial impact on interest rate and negative initial impact on house prices and output gap and they indicate that empirical impact of the monetary policy shock adequately reflects the impact of monetary shock in DSGE model with financial frictions.

2.2. Macroeconomic effects of fiscal policy in Croatia[7]

As we explained in the introduction, fiscal policy is the main economic policy instrument in Croatia and as such fiscal policy was in the focus of many published papers. For detailed literature overview on the effectiveness of fiscal policy see Šimović, Ćorić and Deskar-Škrbić (2015), while in this paper we will briefly present the results of papers based on (S)VAR methodology. Benazić (2006) used VAR/VEC methodology to analyse the effects of consolidated general government revenues and expenditures on GDP and concluded that expenditures have positive effect on GDP in the short run while in the long run is mostly neutral. Based on structural VEC model (SVEC) Rukelj (2009) analysed the interaction of fiscal and monetary policy and stated that the effects of economic policy on economic activity has not proven to be clear enough to bring out strong conclusions. Ravnik and Žilić (2011) based their research on structural VAR model (SVAR), based on Blanchard-Perotti identification scheme. Authors analysed the effects of fiscal shocks on various short-term indicators and concluded that shocks in government expenditures have a short-term negative effect on the industrial production (approximation of GDP). Sever, Drezgić and Blažić (2011) analysed the effects of various components of government expenditures on GDP. Main conclusions are that capital expenditure, goods and services consumption and subsidies have positive effect on GDP, while wages, current expenditures and subsidies decrease economic growth rate in the long run. Šimović and Deskar-Škrbić (2013), Deskar-Škrbić, Šimović and Ćorić (2014) and Šimović, Ćorić and Deskar-Škrbić (2015) used SVAR methodology and showed that government consumption has positive effects on GDP and various components of GDP in both, closed economy and open economy model frameworks, although the size of fiscal multipliers is lower in open economy framework. Grdović Gnip (2013) used SVAR model and showed that government consumption has positive impact on GDP, consumption and investments and Grdović Gnip (2014) used STVAR model (regime switching model) and concluded that fiscal policy is more effective in the recessionary period.

3. Methodology

Based on the conclusions from the existing literature and discussion on the characteristics of Croatian economy in this paper we use a New-Keynesian open economy model.

Following Castanheira (2015), the model has four sectors: households, government, firms and external sector. Households and government operate in an open

[7] For a detailed review of presented papers see Šimović and Deskar-Škrbić (2013) and Šimović, Ćorić and Deskar-Škrbić (2015)

economy framework which means that they consume both domestic and foreign goods and their behaviour is determined by domestic and foreign prices of goods. It is important to point out that we assume that government consumption can directly affect consumer's utility, depending on the relations between the two, i.e. whether private and government consumptions are substitutes, complements or unrelated. In addition, consumer behaviour is also affected by a return on cross-currency security, due to international risk sharing assumption. Firms operate in a monopolistic competition environment and adjust prices in a staggered manner. Aggregate demand in our model is determined by domestic effective consumption and external demand. This narrative can be analytically expressed as follows.[8]

3.1. Households

A typical small open economy is inhabited by a representative household who seeks to maximize utility function made of two components effective consumption C_t and hours worked N_t:

$$E_0 \sum_{t=0}^{\infty} \beta^t U(\hat{C}_t, N_t) = E_0 \sum_{t=0}^{\infty} \beta^t \left(\frac{\hat{C}_t^{1-\sigma}}{1-\sigma} - \frac{N_t^{1+\varphi}}{1+\varphi}\right) \quad (1)$$

where σ^{-1} is the measure of relative risk aversion and the inverse of the intertemporal elasticity of substitution, φ is the inverse of the elasticity of labour supply and β is the subjective discount factor. Effective consumption is a composite index of private consumption (C_t) and government consumption (G_t) and it is given by:

$$\hat{C}_t \equiv \begin{cases} [(1-\vartheta)C_t^{1-v} + \vartheta G_t^{1-v}]^{\frac{1}{1-v}}, & if\ v \neq 1 \\ C_t^{(1-\vartheta)} G_t^{\vartheta}, & if\ v = 1 \end{cases} \quad (2)$$

The parameter v^{-1} defines intertemporal complementarity or substitutability between private and public consumption. If these two types of consumption are substitutes, government consumption would crowd out private consumption and reduce the effectiveness of fiscal policy. If $\sigma^{-1} > v^{-1}$ private and public consumption are complements, if $\sigma^{-1} < v^{-1}$ then private and public consumption are substitutes and if $\sigma^{-1} = v^{-1}$ goods are not related.

Both private consumption and government consumption are based on the basket of products which contains both, domestically produced (H) and imported goods (F):

[8] In this section we will present only fundamental equations which are important for our research question while fully developed model can be found in Castanheira (2015).

$$C_t = \left[(1-\alpha)^{\frac{1}{\eta}}(C_{H,t})^{\frac{\eta-1}{\eta}} + \alpha^{\frac{1}{\eta}}(C_{F,t})^{\frac{\eta-1}{\eta}}\right]^{\frac{\eta-1}{\eta}} \quad (3)$$

$$G_t = \left[(1-\chi)^{\frac{1}{\eta}}(G_{H,t})^{\frac{\eta-1}{\eta}} + \chi^{\frac{1}{\eta}}(G_{F,t})^{\frac{\eta-1}{\eta}}\right]^{\frac{\eta-1}{\eta}} \quad (4)$$

The parameter η defines complementarity or substitutability of domestic and imported goods and α and χ are shares of products purchased abroad. If domestic and foreign goods are complements than the increase of consumption will increase imports. Opposite holds in case the goods are substitutes.

Household budget constraint is defined by:

$$P_t^C C_t + E_t\{Q_{t,t+1}D_{t+1}\} \leq D_t + W_t N_t + T_t \quad (5)$$

where $P_t^C \equiv \left[(1-\alpha)(P_{H,t})^{1-\eta} + \alpha(P_{F,t})^{1-\eta}\right]^{\frac{1}{1-\eta}}$ is CPI, α is the share of imported goods in consumer basket, $P_{H,t}$ represents domestic prices and $P_{F,t}$ prices of imported goods. D_{t+1} is the nominal payoff in the period $t+1$ of the portfolio, Q_{t+1} is the subjective discount factor for this payoff, W_t are wages per every hour work and T_t are lump sum transfers which don't affect incentives to work.

3.2. Government

Government budget constraint is defined similarly to household budget constraint given the same structure of private and government consumption:

$$P_t^G G_t + E_t\{Q_{t,t+1}D_{t+1}\} \leq T_t + D_t \quad (6)$$

where $P_t^G \equiv \left[(1-\chi)(P_{H,t})^{1-\eta} + \chi(P_{F,t})^{1-\eta}\right]^{\frac{1}{1-\eta}}$ is government price index, χ is the share of imported goods in government consumption basket, while other variables are identical to those in the households constraint. For simplicity we assume that government runs a balanced budget policy which means that there is no bond-financing of public deficit so the constraint can be written as:

$$P_t^G G_t \leq T_t \quad (7)$$

In this paper we focus on the effects of increased government consumption, which is exogenous and defined as an autoregressive process:

$$g_t = \rho_g g_{t-1} + \varepsilon_t^g \quad (8)$$

where $\rho_g \in [0,1]$ is a autocorrelation parameter accounting for the persistence of shock. ε_t^g is assumed to be *IID* process.

3.3. Consumer prices

We have defined CPI and government consumption prices index above. Here we introduce the effective bilateral terms of trade which are defined as the ratio of foreign prices $P_{F,t}$ and domestic prices $P_{H,t}$:

$$S_t = \frac{P_{F,t}}{P_{H,t}} = \left(\int_0^1 S_{i,t}^{1-\gamma} \right)^{\frac{1}{1-\gamma}} \tag{9}$$

γ represents substitutability between goods produced in different foreign countries.

Log-linearization of CPI, government price index and effective terms of trade and some analytical adjustments give us expressions for consumer price and government price inflation:

$$\pi_t^C = \pi_t^H + \alpha \Delta s_t \tag{10}$$

$$\pi_t^G \equiv \pi_t^H + \chi \Delta s_t \tag{11}$$

This model assumes a complete exchange rate pass-through to import prices in every time horizons or there are no trade frictions. Pass-through effect can be described through the (log log-linearized) expressions:

$$p_{F,t} = e_t + p_t^* \tag{12}$$

$$s_t = e_t + p_t^* - p_{H,t} \tag{13}$$

where e_t is the nominal exchange rate and p_t^* is the world price index. Thus, both consumer and government price inflation are affected by changes in world prices and changes in nominal exchange rate.

3.4. International risk sharing

In SOE models it is commonly assumed that financial markets are complete which means that the return on a cross-border security affects the intertemporal allocation of households' budget The ratio current vs. future consumption depends on the expected return of the security:

$$\beta \left(\frac{C_{t+1}^i}{C_t^i} \right)^{-v} \left(\frac{\hat{C}_{t+1}^i}{\hat{C}_t^i} \right)^{v-\sigma} \left(\frac{\varepsilon_{i,t}}{\varepsilon_{i,t+1}} \right) \left(\frac{P_t^{C,i}}{P_{t+1}^{C,i}} \right) = Q_t \tag{14}$$

3.5. Firms

Production function of firms which produce products j in this model is determined by labour N_t and technology A_t:

$$Y_t(j) = A_t N_t \tag{15}$$

Technology is defined as an AR(1) process $a_t = log\, A_t = \rho_a a_{t-1} + \varepsilon_t$.

Linearised production function takes the form $y_t = a_t + n_t$. Profit maximizing firms have real marginal costs defined as:

$$mc_t = -\delta + w_t - p_{H,t} - a_t \tag{16}$$

where δ is an employment subsidy $\log(1 - \tau)$.

Firms set prices in a staggered manner (Calvo, 1983) which means that part of firms are selected to re-optimize profits changing prices with regard to new contingencies. Thus the domestic price index can be defined as:

$$\bar{p}_{H,t} = \mu + (1 - \beta\theta) \sum_{k=0}^{\infty} (\beta\theta)^k E\{mc_{t+k} + p_{H,t+k}\} \tag{17}$$

where $\theta \in [0,1]$ is the share of firms which keep their prices fixed. $\mu = {}^{\varepsilon}/_{(\varepsilon - 1)}$ is a mark-up. Domestic price inflation is given by:

$$\pi_{H,t} = \beta E_t\{\pi_{H,t+1}\} + \lambda \widehat{mc}_t \tag{18}$$

where $= \frac{(1-\beta\theta)(1-\theta)}{\theta}$ is a coefficient that relates the probability of resetting prices with the time discount rate. If $\lambda = 0$ prices are fully flexible and $\pi_{H,t} = \beta E_t\{\pi_{H,t-1}\}$.

3.6. Equilibrium

Domestic demand side of the economy is determined by private and government consumption which includes domestically produced products and foreign production which is consumed domestically and it is defined by:

$$\begin{aligned} Y_t(j) = {} & (1 - \vartheta)\left(\frac{P_{H,t}(j)}{P_{H,t}}\right)^{-\varepsilon}\left[(1-\alpha)\left(\frac{P_{H,t}}{P_t^C}\right)^{-\eta} C_t + \alpha \int_0^1 \left(\frac{P_{H,t}}{\varepsilon_{i,t} P_{F,t}^i}\right)^{-\gamma}\left(\frac{P_{F,t}^i}{P_t^{C,i}}\right)^{-\eta} C_t^i\, di\right] + \\ & \vartheta\left(\frac{P_{H,t}(j)}{P_{H,t}}\right)^{-\varepsilon}\left[(1-\chi)\left(\frac{P_{H,t}}{P_t^G}\right)^{-\eta} G_t \;\; + \chi \int_0^1 \left(\frac{P_{H,t}}{\varepsilon_{i,t} P_{F,t}^i}\right)^{-\gamma}\left(\frac{P_{F,t}^i}{P_t^{G,i}}\right)^{-\eta} G_t^i\, di\right] \end{aligned} \tag{19}$$

Net exports are defined as:

$$nx_t = \frac{NX_t}{Y} \approx \frac{1}{Y}\left[Y_t - \frac{P_{H,t}}{P_t^C} C_t - \frac{P_{H,t}}{P_t^G} G_t\right] \tag{20}$$

As for the supply side, natural level of output is affected by domestic and foreign variables and represented by (* represents foreign):

$$y_t^n = \Gamma_0 + \Gamma_{y^*} y_t^* + \Gamma_{c^*} c_t^* + \Gamma_{\hat{c}^*} \hat{c}_t^* + + \Gamma_{\hat{c}} \hat{c}_t + \Gamma_g g_t + \Gamma_{g^*} g_t{}^* + \Gamma_a a_t \tag{21}$$

If output gap is defined as $\hat{y}_t = y_t - y_t^n$ dynamic IS equation for the open economy in terms of the output gap can be expressed as:

$$\begin{aligned} & y_t^n = E_t[y_t^n + 1] - \Upsilon\left(i_t - E_t\left[\pi_{H,t+1}\right] - r_t^n\right) \\ & - \left[\Upsilon + \Lambda + \left(\frac{1-\vartheta}{\nu}\right)\left(\frac{\alpha \Upsilon_{\varphi+1}}{\Upsilon_{\varphi+1}}\right)\right](\sigma - \nu) E_t\{\Delta \hat{c}_{t+1}\} \end{aligned} \tag{22}$$

where r_t^n is the natural rate of interest of the domestic economy.

In the empirical part of the analysis, where we calculate empirical impulse response responses we use VAR model, based on real data. Reduced form VAR model is defined as:

$$X_t = \alpha + \sum_{i=1}^{p} A_i X_{t-i} + u_t \tag{23}$$

X_t is a vector of five endogenous variables, government consumption, number of employed, GDP, CPI and net exports. Based on economic theory we assume Cholesky ordering of variables in a form[9] $X_t = [G_t, L_t, Y_t, CPI_t, NX_t]$. α is a constant, A_i are $(K \times K)$ parameter matrices, u_t is a noise process characterized by the assumption $u_t \sim (o, \sum_e)$ and p is number of lags.

The number of time lags in our model is set at two, according to AIC information criteria. The analysis is carried out on quarterly data from the first quarter of 2000 to the last quarter of 2016. VAR adequacy tests (Appendix 1) show that specified VAR model is stable and that null hypotheses of no autocorrelation and no heteroscedasticity of error terms are confirmed. Detailed data description is provided in Appendix 2.

[9] Results are not sensitive to other specifications of ordering; available upon request

4. Empirical data and analysis

4.1. Calibration of the model

In our simulation we will assume a fixed exchange rate regime, taking into account the fact that fluctuations of exchange rate in Croatia are small, with standard deviation of monthly EUR/HRK in 2000-2016 period standing at 0.14. Thus, monetary policy framework is described under the assumption of $e_t = 0$. This assumption can also be found in Palić (2015), Arčabić et al. (2016a) and Arčabić et al. (2016b).

So-called deep parameters of our model are presented in Table 1.

Table 1: Calibrated parameters

Parameter	Description	Value	Source
α	share of private imports (average 2000-2016)	0.21	authors calculations
χ	share of public imports	0.14	Mikulić (2018)
ϑ	share of government expenditures in effective consumption (average 2000-2016)	0.25	authors calculations
φ^{-1}	elasticity of labour supply	0.33	Bokan et al. (2010)
ν^{-1}	intratemporal elasticity of sub. btw private and public consumption	0.33	Bouakez & Rebei (2007)
σ^{-1}	intertemporal elasticity of substitution of effective consumption	0.50	Havranek et al. (2013)
γ	substitutability between goods produced in different foreign countries (perfect complements)	1.00	assumption
η	substitutability between domestic and foreign goods (perfect complements)	1.00	assumption
ε	elasticity of substitution between varieties produced within countries	4.00	Bokan et al. (2010)
β	time discount factor	0.99	Bokan et al. (2010)
θ	share of firms unable to reset prices	0.72	Pufnik & Kunovac (2013)
ρ_g	AR(1) government consumption (2000-2016)	0.80	authors calculations

Source: Author's

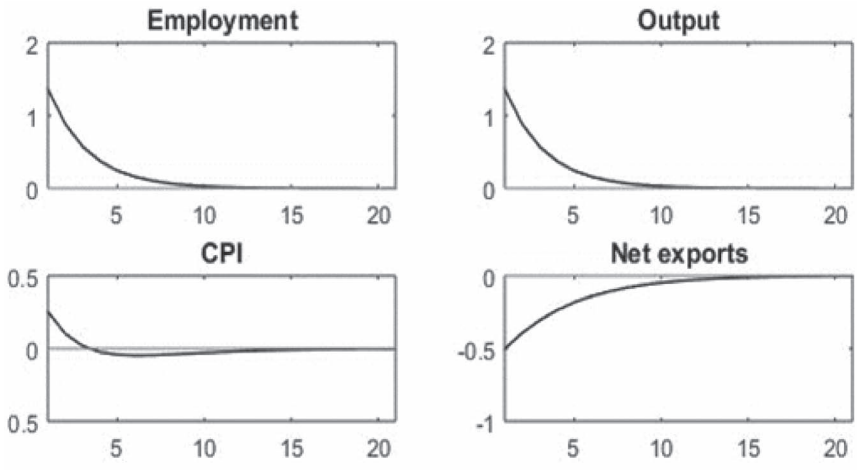
Share of private imports α is obtained from Mikulić (2018) who estimates import dependency of government consumption at 14%, based on input-output analysis. Share of government consumption in effective demand is calculated from CBS National accounts data as a ratio of final government consumption and the sum of total final household and government consumption. For elasticity of labour supply we follow Bokan et al. (2010) who modelled Croatian economy. Intratemporal

elasticity of substitution between private and government consumption is obtained from Bouakez and Rebei (2007) there is no similar research for Croatia. Assumption on the complementarity of private and government consumption in Croatia seems plausible as correlation between real growth rates of private consumption and government consumption from 2000-2016 is 0.37. Intertemporal elasticity of substitution of effective consumption is obtained from Havranek et al. (2013). Assumptions on the substitutability of foreign and domestic goods indicate that we treat these products as perfect complements, which is a common approach in the literature. Elasticity of substitution between varieties produced within countries and time discount factor are obtained from Bokan et al. (2010). As a share of firms unable to reset prices we take results of a survey on Croatian firms conducted by Pufnik and Kunovac (2013) which indicate that 72% of firms change their prices only once a year or less. AR(1) model of government consumption is estimated using data on total final consumption of government from CBS National accounts data.

4.2. Effects of government consumption in calibrated DSGE model

In this section we present the effects of government consumption on selected variables, based on the calibrated DGSE model explained in the previous section. As noted above, our focus is on the effect of government consumption shock on employment, output, prices and net exports. Those variables are chosen as they reflect most common goals of economic policy, internal stability (full employment and price stability) and external stability.

Figure 1: Effects of government consumption in calibrated DSGE model



Source: Author's calculations; Dynare 4.4.3 and MATLAB R2015a

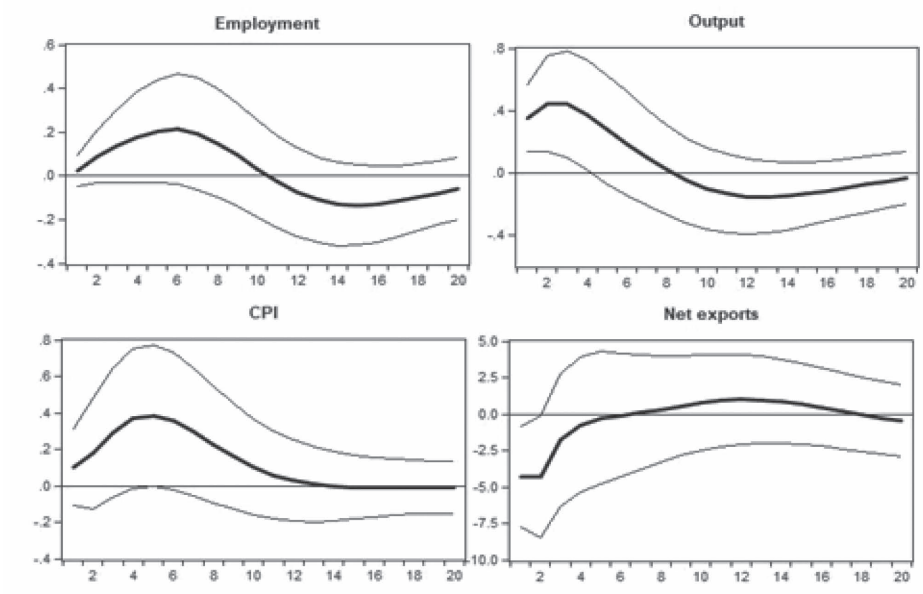
On Figure 1 we present the response of these macroeconomic variables to a one standard deviation increase in the steady state level of government expenditure. The responses are expressed in terms of impulse response functions (IRF). The vertical axis of impulse response functions measures the percentage deviations of the variables from the respective steady state values while the horizontal axis measures quarters.

Results of simulation show that employment and output react positively to increase of government consumption, which is in line with Keynesian theory. Higher government consumption in our model increases inflation through the mechanism of New-Keynesian Phillips curve. Finally, net exports deteriorate as increased consumption leads to stronger imports.

4.3. Effects of government consumption in estimated VAR model

In this section we present the results from estimated VAR model (23). All data is obtained from the Croatian Bureau of Statistics, seasonally-adjusted and expressed as deviations from steady states[10] to capture the nature of DSGE model where, as noted above, fundamental equations are also defined as deviations of variables from steady state. Variables used in VAR model are presented in Appendix 2.

Figure 2: Effects of government consumption in estimated VAR model



Source: Author's calculations; EViews 8

[10] Steady states are calculated using HP filter; only trend for net exports was calculated as a polynomial.

Figure 2 shows the effects of a one standard deviation shock in government consumption on other variables in the system. Bold lines represent the impulse response and thicker lines 95% confidence interval.

5. Results and discussion

As Figure 2 suggests, increase in government consumption has positive effect on employment, in line with the results of simulation but this effect is not statistically significant. Output reacts positively to increase of government consumption, in line with the results of simulation and this effect is statistically significant for four quarters after the shock. Developments of CPI are also in line with the simulation as CPI reacts positively to government consumption shock, although the effect is statistically significant between fourth and sixth quarter after the shock. Finally, net exports deteriorate in both, simulation and VAR model, but this effect is statistically significant only in first two quarters.

Presented results indicate that fiscal policy can have a significant impact on economic developments in Croatia. Its effects are Keynesian in nature as increased government consumption results in increased employment, output and inflation. These results are also in line with the conclusions of the existing literature on the effects of fiscal policy in Croatia, such as Sever, Drezgić and Blažić (2011), Šimović and Deskar-Škrbić (2013), Grdović Gnip (2013), Grdović Gnip (2014), Deskar-Škrbić, Šimović and Ćorić (2014) and Šimović, Ćorić and Deskar-Škrbić (2015).

These results have important contribution to the existing literature as they show that fiscal policy in Croatia can be modelled through the lens of New-Keynesian small open economy theory. Models are a useful policy toolkit for academics, researchers and policy makers which provide framework for policy simulations and better understanding of fundamental factors that determine effectiveness of fiscal policy. As fiscal policy in Croatia is mostly based on discretionary *ad hoc* measures fiscal policy modelling could bring more analytical rigor and stability in planning and implementation of fiscal policy measures.

6. Conclusions

Based on the previous discussion we can conclude that results of simulation and empirical analysis mostly confirm our main hypotheses. Firstly, results of estimated VAR model show that government consumption has positive and statistically significant impact on output and prices and negative impact on trade balance. Effect on employment is positive but it is not statistically significant.

Secondly, such reactions of macroeconomic variables on shocks in government consumption correspond to the results of calibrated New Keynesian DSGE model. Thus we can conclude that this model can be used in fiscal policy simulations in Croatia. The main contribution of this paper stems from the fact that it represents the first attempt of fiscal policy modelling in New Keynesian DSGE framework and the first paper in which author compares simulations of the effects of fiscal policy with estimated empirical results in Croatia. So far DSGE models in Croatia were used in the analysis of external shocks and/or reactions of monetary policy. In future research this model can be expanded with additional sectors (such as financial intermediaries), fiscal instruments (e.g. taxes) and variables (e.g. investments and capital formation). Presented results have important policy implications as they indicate that fiscal policy, as the key economic policy instrument in Croatia, has an important role in business cycle management and the responsibility of fiscal policy makers is to prudently use and adjust fiscal instruments in such a way that fiscal policy can always have a counter-cyclical, stabilizing effect on Croatian economy.

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Dinamički učinci fiskalne politike u Hrvatskoj: suprotstavljanje novo-kejnezijanske teorije male otvorene ekonomije empirijskim podatcima[1]

Milan Deskar-Škrbić[2]

Sažetak

U ovom se radu kalibrira novo-kejnezijanski DSGE model male otvorene ekonomije za hrvatsko gospodarstvo. Fokus rada je na učincima fiskalne politike, tj. državne potrošnje, na zaposlenost, dohodak, inflaciju i trgovinsku bilancu. Nakon analize funkcija impulsnog odziva iz teorijskog modela one se uspoređuju s empirijskim rezultatima VAR modela. Rezultati pokazuju kako prezentirani DSGE model može služiti kao polazište i koristan alat u analizi učinaka fiskalne politike u Hrvatskoj budući da funkcije impulsnog odziva iz VAR modela većinom odgovaraju onima iz kalibriranog modela. Također, empirijski rezultati pokazuju da fiskalna politika ima značajan utjecaj na makroekonomska kretanja u Hrvatskoj. Zato je pred nositeljima fiskalne politike odgovornost da fiskalne instrumente koriste i prilagođavaju na način da fiskalna politika može uvijek imati anti-ciklički, stabilizirajući učinak na hrvatsko gospodarstvo.

Ključne riječi: *fiskalna politika, DSGE, VAR, Hrvatska*

JEL: *E62, H30*

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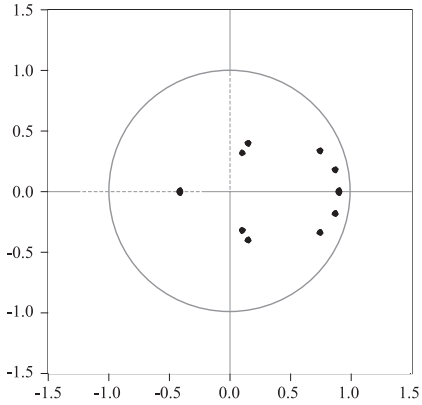
Appendices

Appendix 1: VAR adequacy tests, lag length criteria and stationarity test

Inverse Roots of AR Characteristic Polynomial



Source: Author's calculations; Eviews 8

VAR Residual Serial Correlation LM Tests
Null Hypothesis: no serial correlation at lag order h
Date: 02/04/18 Time: 19:22
Sample: 2000Q1 2016Q4
Included observations: 66

Lags	LM-Stat	Prob
1	29.40625	0.2473
2	44.73911	0.0690
3	33.75198	0.1133
4	34.23607	0.1030
5	15.97813	0.9155
6	25.66633	0.4256
7	9.053659	0.9985
8	38.50351	0.0413
9	30.32563	0.2123
10	24.31936	0.5010
Probs from chi-square with 25 df.		

Source: Author's calculations; Eviews 8

VAR Residual Heteroskedasticity Tests: No Cross Terms
Date: 02/04/18 Time: 19:23
Sample: 2000Q1 2016Q4
Included observations: 66
Joint test:

Chi-sq	df	Prob.
350.6897	300	0.0833

Source: Author's calculations; Eviews 8

VAR Lag Order Selection Criteria
Endogenous variables: CG CZAP CCPI CY CNX
Exogenous variables: C
Date: 05/31/18 Time: 22:38
Sample: 2000Q1 2016Q4
Included observations: 64

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-872.2464	NA	553809.4	27.41395	27.58261	27.48039
1	-659.8920	384.8922	1591.610	21.55913	22.57110*	21.95779*
2	-628.2471	52.41196*	1312.011	21.35147*	23.20676	22.08236
3	-602.7482	38.24834	1340.266*	21.33588	24.03448	22.39900
4	-571.7963	41.59158	1195.721	21.14988	24.69180	22.54522

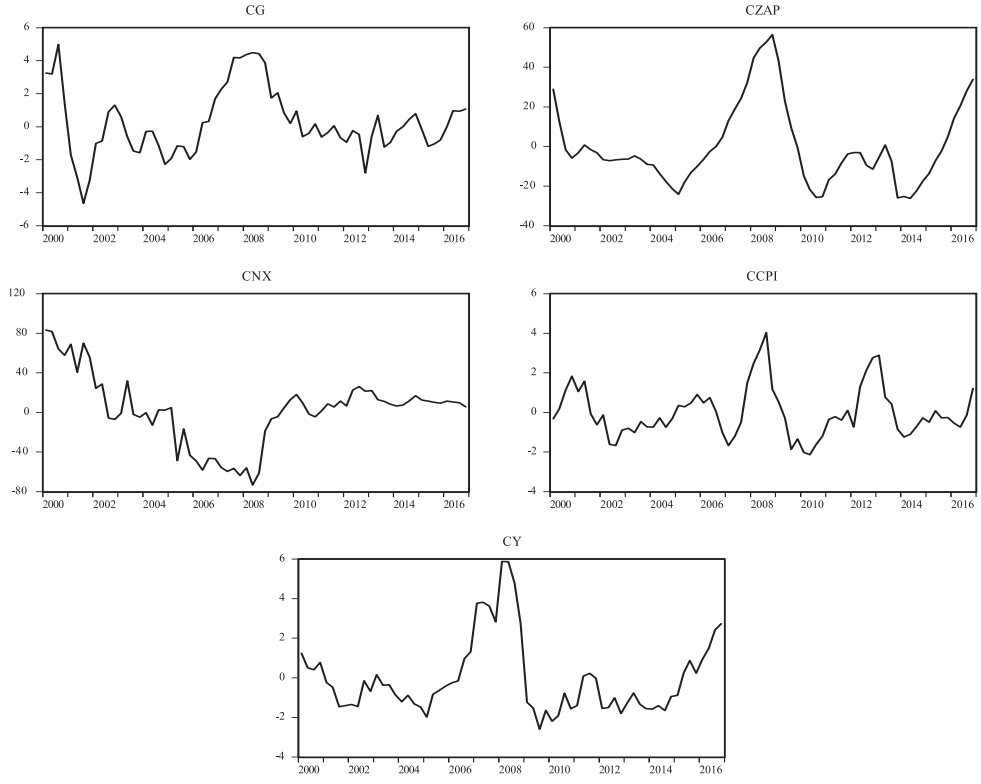
* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Source: Author's calculations; Eviews 8

Appendix 2: Data definitions and graphical representation of variables

Variable	Definition	Source
Government consumption G	Government final consumption expenditure (ESA 2010) includes two categories of expenditures: the value of goods and services produced by general government itself other than own-account capital formation, and purchases by general government of goods and services produced by market producers that are supplied to households – without any transformation – as social transfers in kind (% of GDP)	Croatian Bureau of Statistics
Gross Domestic Product Y	The sum of the final uses of goods and services (all uses except intermediate consumption) measured in purchasers' prices, minus the value of imports of goods and services	Croatian Bureau of Statistics
Employment ZAP	Employment is defined as the number of people engaged in productive activities in an economy. The concept includes both employees and the self-employed (million)	Croatian Bureau of Statistics
Net exports (NX)	Difference between exports and imports from National Accounts (% of GDP)	Croatian Bureau of Statistics
Inflation (CPI)	The consumer price index, abbreviated as CPI, measures the change over time in the prices of consumer goods and services acquired, used or paid for by households (%)	Croatian Bureau of Statistics

Source: Author



CG – cyclical component of government consumption; CZAP – cyclical component of employment; CNX – cyclical component of net exports; CCPI – cyclical component of CPI, CY – cyclical component of GDP

Source: Author