J. F. Kennedy sq. 6
10000 Zagreb, Croatia
Tel +385(0)1 238 3333
www.efzg.hr/wps
wps@efzg.hr

EFZG WORKING PAPER SERIES
EFZG SERIJA ČLANAKA U NASTAJANJU

No. 17-05

Hrvoje Šimović

Impact of public debt (un)sustainability on fiscal policy effectiveness in Croatia

Impact of public debt (un)sustainability on fiscal policy effectiveness in Croatia*

Hrvoje Šimović
hsimovic@efzg.hr
Faculty of Economics and Business
University of Zagreb
Trg J. F. Kennedy 6
10 000 Zagreb, Croatia

* This work has been supported by the Croatian Science Foundation under project "Public Finance Sustainability on the path to the Monetary Union - PuFiSuMU" (IP-2016-06-4609).

Abstract

This paper analyses the impact of public debt level and (un)sustainability on fiscal spending effectiveness in Croatia. Public debt sustainability is analyzed using standard indicators of fiscal vulnerability and fiscal stability, accompanied with identification of regime changes in the public debt trajectory. Public debt sustainability analysis is used to analyze trends and tendencies, as well as to indicate periods of fiscal unsustainability in Croatia in period from 2001 to 2015. Using switching regression and SVAR approach it is also empirically tested how public debt level affects the effectiveness of fiscal policy in Croatia in the same period. Results show a negative impact of recession on public debt sustainability and confirm the main thesis that public debt level significantly affects and reduces the effectiveness of fiscal policy in Croatia.

Key words
public debt, fiscal policy, Croatia

JEL classification
H68, H50, E62

1. Introduction

Croatia is one of the EU countries with the highest level of public debt. The main reason for such fiscal stance can be found in the extensive deficit financing, especially during recent economic crisis. Croatia also had the longest recession period in EU that lasted for six consecutive years (2009-14).

Public debt level is one of major structural determinants of fiscal policy effectiveness. Dynamic effects of fiscal policy are usually measured by the size of fiscal multipliers. It is hard to directly assess the effects of public debt on the size of fiscal multipliers, but generally a higher debt levels imply lower fiscal multipliers and lower fiscal policy effectiveness. The main mechanisms could be explained through the effects of risk assessment and confidence. High levels of public debt, especially in the recessionary environment, usually imply lower credit rating and higher risk spreads. That lead to a higher level of interest rates on government debt, which directly and indirectly "spill over" into higher interest rates for private sector, thus discouraging private consumption and investment (Batini et al, 2014). Another channel goes through expectations as consumers and corporate sector can expect that increased spending or tax cuts at higher levels of public debt will eventually lead to higher taxes and/or spending cuts, they restrain from spending/investing (Ricardian equivalence).

The main goal of this paper is to analyze the impact of the public debt level and its (un)sustainability on the fiscal policy effectiveness in Croatia in period 2001-15.[1] In the first part of the paper, a simple public debt sustainability indicators i.e. static stability indicator were used to distinguish periods when the Croatian public debt became unsustainable and could affect the fiscal policy effectiveness. Empirical identification of the breakpoints and regime changes suggested that unsustainability of the public debt in Croatia occurred with recession, i.e. after 2008Q4 (see Appendix 2).

Taking that into account, in the empirical part of the paper two approaches are used to test public debt impact on fiscal policy effectiveness. In the first part of the empirical analysis, a switching regression approach is used to distinguish different regimes when government spending, i.e. fiscal policy has more or less impact on economic growth, regarding different cycle. In the second part, the structural VAR model is used to analyze the dynamic effects of government spending on domestic demand in Croatia. To observe the public debt effects on a fiscal policy, a "closed" model is compared with an "extended" model which includes debt-to-GDP indicators. Detailed methodological explanations are given later in the paper.

[1] Empirical papers regarding impact of public debt on fiscal policy effectiveness are rather scarce for Croatia. Only one paper, using SVAR, is found where structural characteristics like trade openness and public debt level are used to analyze fiscal multipliers in Croatia along with Slovenia and Serbia (see Deskar-Škrbić & Šimović, 2017). Regarding analysis of public debt sustainability, there are many papers which deal with certain types of public debt sustainability issues. The most common are static analyses of stability indicators (for example Mihaljek, 2003; Sopek, 2010; Šimović & Batur, 2017), or certain dynamic analyses of fiscal sustainability (Babić et al., 2003; Sopek, 2011), and analyses that involve composite indicators (Mihaljek, 2009; Cota & Žigman, 2011; Bajo & Primorac, 2013; Šimović & Batur, 2017). Almost all papers alert to mostly unsustainable projections of public debt level and fiscal policy in general.

For public debt sustainability analysis, annual data is used for period 2001-15. For empirical part of the paper, as well as for the empirical identification of the breakpoints and regime changes, quarterly data is used for same period as in previous analysis (2001:Q1-2015:Q4). Sources for all variables used in empirical part are Eurostat (National accounts, ESA 2010) and/or AMECO (2016).

2. Public debt sustainability in Croatia

There are many different approaches for measuring the public debt sustainability. Usually, the sustainability of public debt is observed through a broader framework called fiscal or public finances sustainability. Such analyses include three groups of indicators: fiscal vulnerability indicators, fiscal stability indicators and composite indicators[2]. For the purpose of this paper, only several indicators will be observed. Main aggregate indicators of the public debt, budget balance and interest payments will be observed as vulnerability indicators.[3] Stability indicators of fiscal balance and interest rate needed to stabilize the public debt are analyzed as well as breakpoints and regime changes in the public debt trajectory.

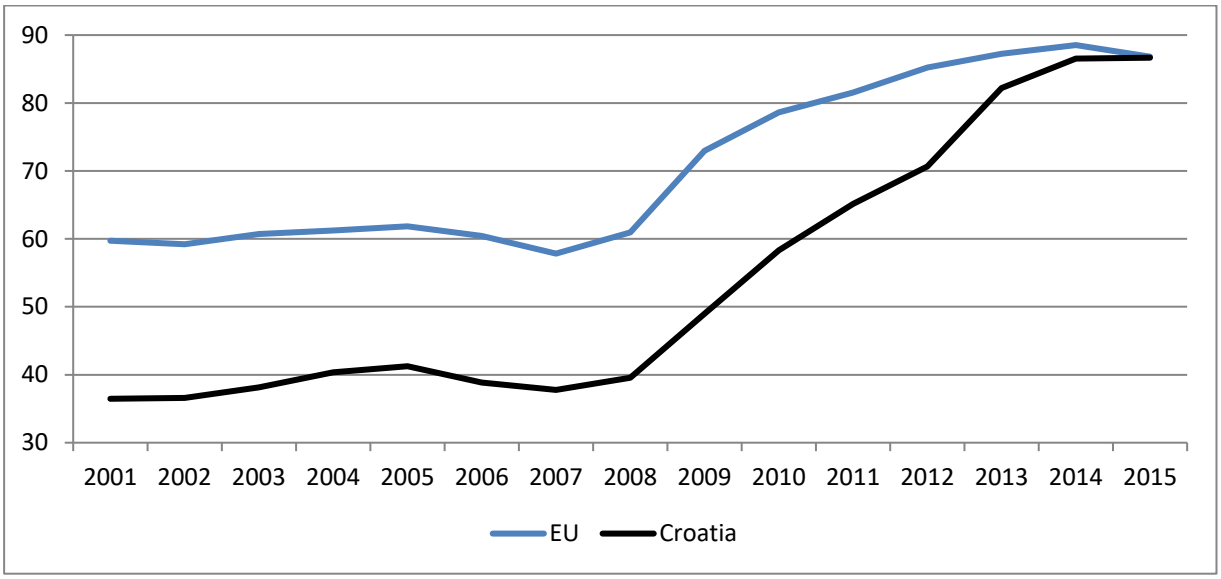
2.1. Public debt and fiscal balance dynamics

Fiscal sustainability analyses in Croatia imply inadequate fiscal policy and public debt management (Šimović et al., 2014). Mentioned policies are proved to be particularly ineffective during the period of recession in Croatia, in which public debt has increased more than twice. In 2008 public debt was 39.6% of GDP and at the end of 2014 it amounted up to 86.5% of GDP. Figure 1 presents the public debt level in Croatia and EU average in 2001-15 period. Figure clearly shows the dynamic of Croatian public debt where Croatia overtakes EU average in its recession years.

[2] Composite (complex) indicators are omitted form this analysis. Most common composite (complex) indicators are credit rating, bond spreads and credit default swaps which contribute to observe current financial market assessment of observed county.

[3] Beside aggregate indicators like public debt level, or liquidity indicators like interest payments level, vulnerability indicators include analysis of maturity and currency risk

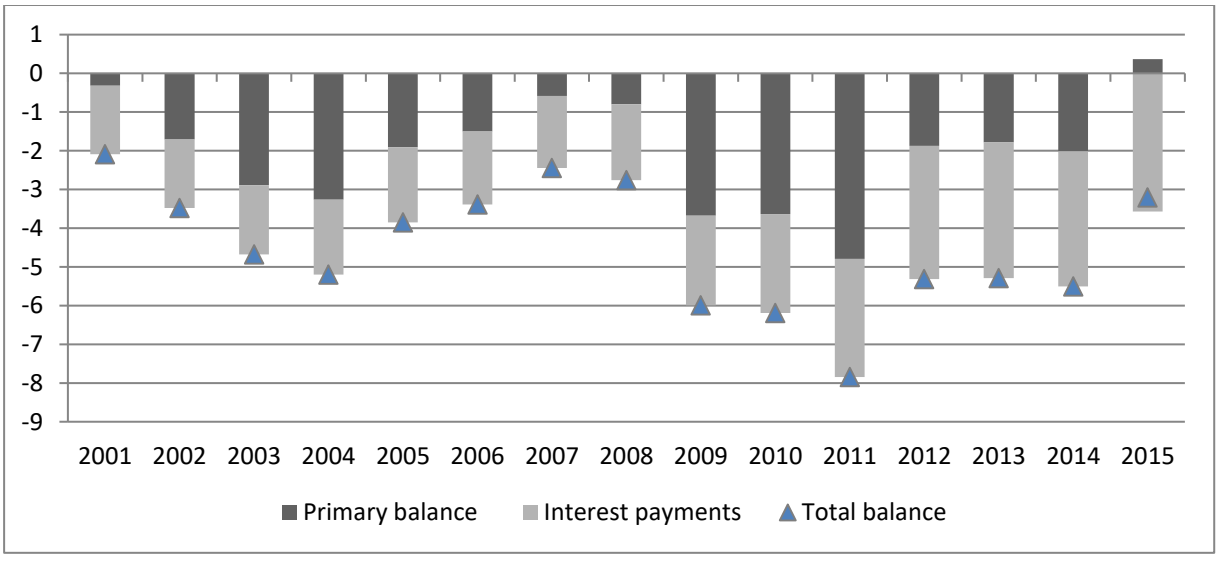
Figure 1 Public debt in Croatia and EU (% of GDP)



Source: AMECO (2016).

In the period before the recession there was a decreasing trend in the public debt to GDP ratio, while at the same time the amount of nominal debt was slightly increasing. In the pre-crisis period Croatia implemented a strategy of public borrowing on domestic markets which resulted in growth of internal debt more than the external. Since 2009, due to influence of the global economic and financial crisis, which generated decreased revenue and increased budget deficit, there has been a sudden increase of public debt and its part in GDP. Trend of increasing public debt was influenced mostly by the growth of total general government deficit. Apart from loss in tax revenues, growth of budget deficit was a result of inadequate adjustment of public expenditure and raising interests on the public debt. Figure 2 presents government budget balance in the period 2006-2015 and it is decomposed into primary balance and interest expenses.

Figure 2 Total balance, primary balance and interest payments (% of GDP)



Source: AMECO (2016).

Primary balance shows the connection between current expenditure and revenue, i.e. what would be the amount of budget deficit if interest expenses did not exist. Figure clearly shows that in the period of recession the government did not adjust primary balance. Moreover, due to raising principal and global interest rates there has been a dramatic increase of interest expenses which amounted to 3.56% of GDP by the end of 2015.

Furthermore, budget deficit and public debt growth was largely contributed by a change in interest rates, the so called snowball effect. The effect arises from the interaction between differential cost of refinancing debt and economic growth on one hand, and the level of public debt on the other hand. Considering that in the time of recession the cost of (re)financing debt was raising, the level of public debt would have been unsustainable even if it the government had not generated (primary) budget deficit. In other words, public debt would have increased due to rising interest rates even if the government had been able to carry out fiscal adjustment and decrease budget deficit.

2.2. Stability indicators

Stability indicators of public debt and fiscal balance present values needed to stabilize public debt at previous year level. Main stability indicators are total balance (b_t^*), primary balance (b_t^{*p}) and interest rate (r_t^*) needed to stabilize the public debt:[4]

$$b_t^* = -\frac{g_t^n}{(1+g_t^n)} d_{t-1} \quad (1)$$

$$b_t^{p*} = \frac{i_t^n - g_t^n}{(1+g_t^n)} d_{t-1} \quad (2)$$

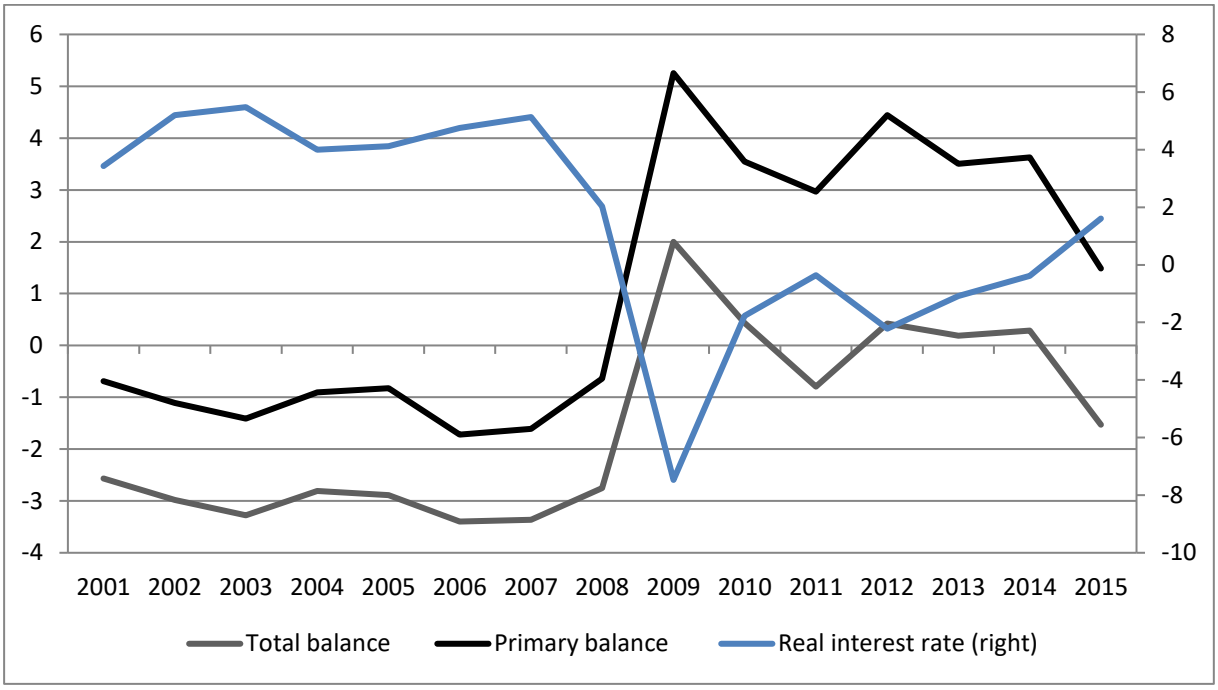
$$r_t^* = g_t + (1+g_t)\frac{b_t^p}{d_{t-1}} \quad (3)$$

where g_t^n presents the nominal GDP growth rate, d_t is the public debt-to-GDP ratio, i_t^n is the nominal interest rate, g_t the real GDP growth rate and b_t^p is the primary balance.

Figure 3 presents total fiscal balance, primary balance and real interest rate needed to stabilize the public debt in Croatia in 2001-15 period.[5] Results imply similar conclusions as previous sustainability analysis where the end of 2008 i.e. beginning of 2009 implies disruption in the fiscal stability and inverse relation between fiscal balances and interest rates needed to stabilize the public debt.

[4] Methodology is adjusted according to Hiebert & Rostagno (2000) and Mihaljek (2003).
[5] Results of all indicators of stability indicators are presented in Appendix 1 – Table A1.1.

Figure 3 Total balance, primary balance and real interest rate needed to stabilize the public debt



Source: author's calculations.

In the first regime, 2001-08 period, both total and primary balances needed to stabilize the debt were rather stable and had rather small negative values. After 2009, Croatia continuously needs fiscal (primary) surpluses to stabilize the debt level at previous year level. Due to numerous factors like political instability and huge social state (see Šimović, 2014), that goal was impossible to achieve. Instead, Croatia had excessive (total and primary) deficits which largely contributed to the instability and unsustainability of the public debt.

Furthermore, Croatian credit rating and real interest rates development also did not contribute to the fiscal stability. Real interest rate needed to stabilize the debt reached negative values, which was also impossible goal to achieve. On the contrary, in the same period Croatian credit ratings dropped as real interest rates increased, so the interest payments and before mentioned snowball effect additionally contributed to the fiscal instability.

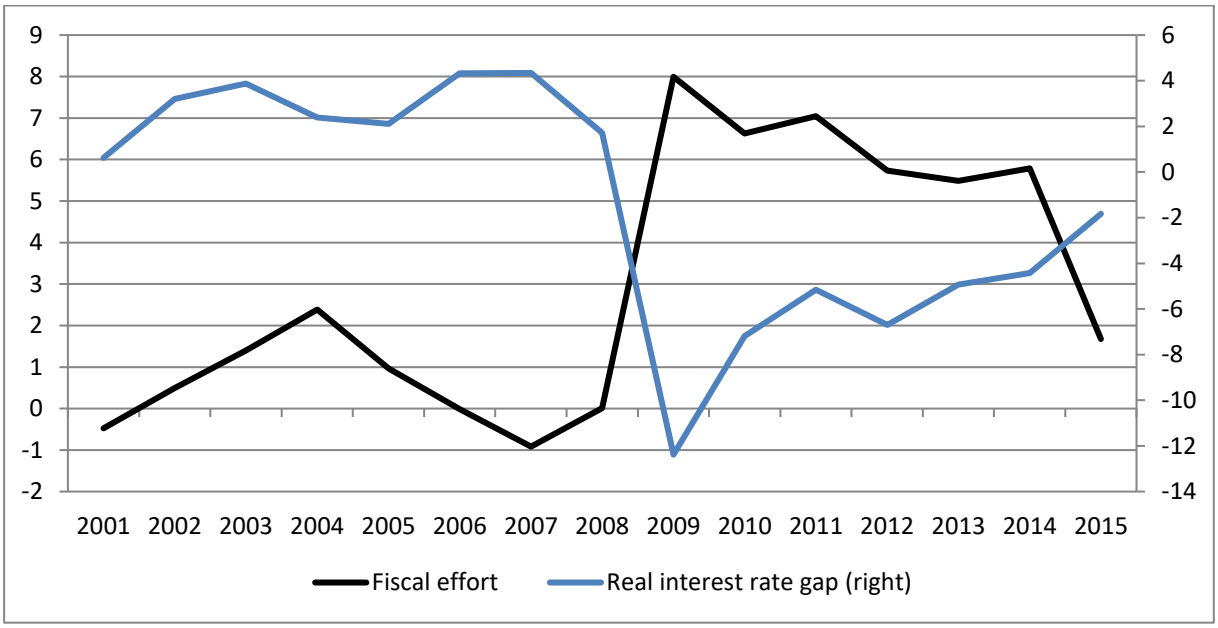
Next part of the analysis includes a calculation of total fiscal effort (FE_t) needed to stabilize the public debt and real interest rate gap (i_{gap}) given in the following expressions:

$$FE_t = b_t^* - b_t \quad (4)$$

$$i_{gap} = r_t^* - r_t \quad (5)$$

This part of analysis presents even more disappointing results regarding the stability issues after 2009. Figure 4 presents the fiscal effort and the real interest rate gap needed to stabilize the public debt. Results again present inverse relation between the fiscal effort and the real interest rate needs, and 2009 as the breakpoint year for both indicators.

Figure 4 Fiscal effort (in % of GDP) and real interest rate gap (in pp)



Source: author's calculations.

The fiscal effort presents difference between realized general government balance and balance needed to stabilize the public debt. In 2009 Croatia should have had fiscal effort of 8% of GDP just to stabilize the public debt at 2008 level. Such effort could have been done by decreasing expenditures and/or increasing taxes. Due to political and economic circumstances, such goal was impossible to accomplish. After 2009, owing to certain fiscal consolidation efforts, a trend declined a bit. During recession period (2009-14) in Croatia, average fiscal effort needed to stabilize the debt was 6.45% of GDP. With economic recovery in 2015, again regime changes, there is more fiscal space in context of the public debt stability.

The real interest rate gap presents difference between real interest rate needed to stabilize the debt and realized real interest rate. Again, 2009 saw the largest gap of 12.4 percentage points between the real interest rate realized (4.9%) and the one needed to stabilize debt (-7.5).

2.3. Breakpoints and regime changes in the public debt trajectory

Simple "eyeball metrics" suggests that the period of public debt unsustainability occurs parallel with economic crisis. Beforehand analysis based on annual data suggests that in 2009 major disruption occurs in fiscal stance and fiscal sustainability. Looking at quarterly data, the last quarter of 2008 can be observed as the main breakpoint in the public debt trajectory. However, for the purpose of empirical research and in order to make this analysis more robust, a formal, empirical, analysis of breakpoints in the public debt trajectory is conducted.

Common approach in the breakpoint literature is to describe a trajectory of the variable of interest as an AR(1) process so as a starting point we define a following regression:

$$d_t = c + d_{t-1} + \varepsilon_t \quad (6)$$

where *c* is a constant, d_t is a debt-to-GDP ratio and ε_t is an error term.

Based on the estimation of this regression, two multiple break tests are used: (i) Quandt-Andrews and (ii) Bai-Perron test. The results of these tests are presented in Appendix 2 (Tables A2.1 and T2.2). Presented results are in line with before mentioned assumption as both tests indicate the last quarter of 2008 as the formal breakpoint in the public debt trajectory. In addition, interestingly, Bai-Perron indicates two more breaks, first in 2011Q2 when public debt in Croatia officially broke the 60% of GDP benchmark and 2013Q4 when we could see a gradual deceleration of the rise of debt-to-GDP ratio. However, in the rest of the analysis we will mainly focus on 2008Q4 as a most important breakpoint date.

3. Effects of public debt level on fiscal policy effectiveness

3.1. Switching regression approach

As stated previously, 2008:Q4 can be seen as a (negative) turning point in the Croatian economy. After 2008:Q4, dynamics of the economic and fiscal system substantially changed. GDP growth rate decreased from average 4.3% in 2001-2008 to average -1.6% in 2009-2015. Debt-to-GDP ratio increased from average 38.6 % of GDP in 2001-2008 to average 71.2% of GDP in 2009-15. Again, by simply looking at data it is visible that Croatia went through two different economic regimes. Thus, to formally test this assumption and to see whether the regime changes have an effect on the effectiveness of fiscal policy, a regime-switching regression approach is used.

The switching model assumes that there is a different regression model associated with each regime. Given regressors X_t and Z_t, the conditional mean of dependent variable y_t in regime *m* is assumed to be the linear specification:

$$\mu_t(m) = X_t{}'\beta_m + Z_t{}'\gamma \tag{7}$$

where β_m and γ are vectors of coefficients. Note that the β_m coefficients for X_t are indexed by regime and that the γ coefficients associated with Z_t are regime invariant.

Lastly, it is assumed that the regression errors are normally distributed with variance that may depend on the regime. In that case the model is:

$$y_t = \mu_t(m) + \sigma(m)\varepsilon_t. \tag{8}$$

Our baseline model is defined as follows:

$$\dot{y_t} = \beta_0 + \beta_1\dot{g_t} + \beta_2\dot{d_t} + \beta_3\dot{f_t} + \dot{y_{t-1}} + \epsilon_t \tag{9}$$

where y_t, g_t, d_t and f_t represent annual change in real GDP, government consumption, debt-to-GDP ratio and foreign demand[6], respectively, while y_{t-1} is a lagged dependent variable (to avoid problem of autocorrelation). Such structure of the model allows us to analyze the effects

[6] Foreign demand is introduced as an important control variable as Croatia is small open economy with high level of synchronization of the business cycle with the Eurozone.

of fiscal policy and debt-to-GDP ratio directly on the growth figure, but also to assess the interconnection among fiscal spending and debt. Regime switching regression results are presented in Table 1.

Table 1 Results of the regime switching model

Variable	Coefficient	Std. Error	z-Statistic	Prob.
Regime 1				
C	0.002331	0.015496	0.150424	0.8804
G	**-0.014609**	**0.259704**	**-0.441305**	**0.6590**
F	1.741589	0.443133	3.930174	0.0001
GDEBT	**-0.212218**	**0.108420**	**-1.957361**	**0.0503**
AR(1)	0.353556	0.203918	1.733813	0.0830
Regime 2				
C	0.011061	0.014346	0.771047	0.4407
G	**1.085977**	**0.258152**	**4.206726**	**0.0000**
F	1.183918	0.491312	2.409708	0.0160
GDEBT	**-0.357553**	**0.110556**	**-3.234143**	**0.0012**
AR(1)	0.904157	0.240194	3.764281	0.0002

Source: author's calculations.

According to results, model recognizes two regimes, coinciding with the change in the mean of the dependent variable between 2001-2008 and 2009-2015. In the first regime the effect of changes in government spending on economic growth was marginally negative but statistically insignificant. On the other hand, changes in the debt indicator had a negative and statistically significant effect on the growth figure. In the second regime government spending became an important growth determinant, with statistically significant coefficient above 1 (approximation of the multiplier), in line with theoretical and empirical fact that fiscal policy (government expenditures) has a stronger effect on growth in recessions (see Auerbach & Gorodinchenko, 2012). Change in debt ratio remained statistically significant but its negative effect strengthened with the rise of instability. Thus, it can be concluded that despite the fact that the fiscal spending effectiveness rises in recessions, related increase of the debt unsustainability mitigates the effects of anti-cyclical fiscal policy.

3.2. SVAR approach

To analyze the effects of fiscal policy on the economic activity the structural VAR (SVAR) model is used. Blanchard & Perotti (2002) identification method is often used as a benchmark for such analyses. The structural VAR approach predicts that a positive spending shock (deficit financed, i.e. leaving taxes unchanged) has a positive effect on output.[7] The original Blanchard & Perotti (1999) model takes only three variables: government spending, net taxes and real GDP, which is often called closed model. Depending on structural characteristics of given economy, model can be extended by introducing variables that present different determinants

[7] Also, a positive tax shock (leaving government spending unaffected) has a negative effect on output.

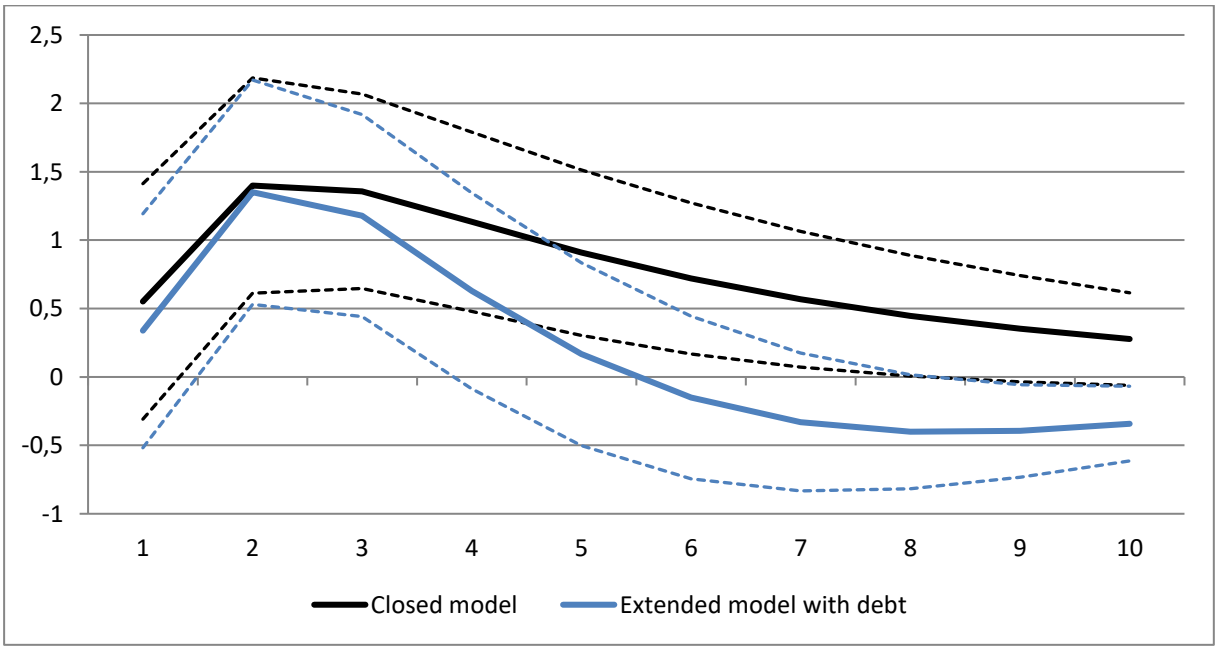
which can affect fiscal policy effectiveness (trade openness, labor market rigidness, exchange rate regime, level of public debt etc.).[8]

Analysis starts with a three-variable (closed) model:

$$X_t = \alpha + \sum_{i=1}^{p} A_i X_{t-i} + +D_t \ + I_t + u_t \ . \qquad (10)$$

Following Blanchard & Perotti (2002) vector $X_t = [T_t, G_t, DD_t]$' includes deflated and seasonally adjusted log-values of net indirect tax revenue (T_t) total general government spending (G_t) and domestic demand (DD_t). Exogenous variables included in the model are constant (α), time trend (I_t) and a dummy variable (D_t) which represents structural breakpoint of fiscal unsustainability and takes a value of 1 in 2008:Q4. Vector I_t includes long-term trends of corresponding variables.[9] Finally, vector $u_t = [t, g, dd]'$ represents the vector of innovations of the reduced model (RF), $u_t \sim (0, \sum_u)$. Time lags are set according to AIC and SIC criteria. In the second step, for purpose of this paper, mentioned closed model is extended by including the fourth endogenous variable (public debt) in model (10). Identification scheme follows Blanchard & Perotti (2002) approach for closed model and Deskar-Škrbić & Šimović (2017) approach for extended model. Model specification details are available in Deskar-Škrbić & Šimović (2017). Because of listing length, stability, serial correlation, normality and heteroskedasticity tests are available upon request.

Figure 5 Impulse responses



Note: dotted lines represent 68% confidence indicator
Source: author's calculations.

[8] For example, Ravn & Spange (2012) extended model for Denmark by introducing variables that represent external (foreign) demand shocks. Similar was done for Croatia by Deskar-Škrbić et al. (2014).

[9] It is assumed that long term trends of corresponding variables have no influence on the long term trends of other variables. This assumption is compatible with view that fiscal policy has no long run effects on the economy. Focus of this analysis is on the effectiveness of public spending in steering short term fluctuations. To capture the effects of this cyclical interdependence between fiscal shocks and economic activity we use HP filter to de-trend all of the variables and proceed our analysis on the cyclical components of all variables (see more Deskar-Škrbić & Šimović 2017).

Figure 5 presents the impulse response functions based on the SVAR model presented previously. It can be seen that the effects of discretionary government spending shock in the closed model is positive and statistically significant in the first eight quarters after the shock. On the other hand, in the extended model with the debt-to-GDP indicators, fiscal shocks have a positive but milder statistically significant effect on economic growth in the second and third quarter, while this effect turns to negative and statistically significant impact in the eight quarter. To get a clearer view on the size of fiscal impact on economic growth, in Table 2 we present the IRF coefficients (fiscal multipliers) in the first and the second year after the shock.

Table 2 Multiplier effects of structural fiscal spending shock on domestic demand

	Closed model	**Extended model with public debt**
4th quarter	1.14	0.63
8th quarter	0.45	-0.40

Note: the effects are statistically significant
Source: author's calculations.

According to results, in the first year after the shock fiscal impact in the closed model is almost twice the size of the fiscal impact in the extended model with public debt. In the second year first model indicates milder, but positive multipliers, while second model shows negative multipliers. Based on the impulse response analysis, it seems that public debt posts limitations to the effectiveness of fiscal spending in Croatia.

4. Conclusion

The period 2001-2015 in Croatia was followed by changes in regimes regarding the public debt level and the fiscal policy influence. Growing public debt and fiscal unsteadiness were progressing from 2009, i.e. last quarter of 2008, due to beginning of a long economic and financial crisis. By the end of 2015 the level of public debt was 86.7% of GDP, which was significantly higher than The Maastricht criteria of 60% of GDP. The analysis of the public debt sustainability in Croatia has shown that public debt was mainly sustainable until 2008 i.e. unsustainable after 2009 with exemption of 2015. Analysis of the sustainability indicators has shown that total budget deficit, primary deficit and real interest rates are still too high and that there is still a great difference between achieved and stabilizing levels. Therefore, further fiscal efforts are required in order to reach sustainable levels and thus stabilize the public debt. Furthermore, the fiscal sustainability analysis shows high public finance vulnerability in Croatia. The level of public debt did not contribute to this as much as the perceived liquidity risk connected with high interest dues. It can be concluded that the fiscal unsustainability i.e. the growth of public debt was equally influenced by negative economic trends and the lack of fiscal adjustment, as it was by worsening in financing terms and the increase of interest rates in the period of recession.

Empirical results confirm thesis that public debt level significantly affects and reduces the effectiveness of fiscal policy. Regime switching model proved the importance of public debt in both regimes. Despite the fact that fiscal spending effectiveness rises in recessions, related increase of debt unsustainability mitigates the effects of possible anti-cyclical fiscal policy. Extended SVAR model with public debt, compared to the closed economy model, clearly proved reducing impact on the size of fiscal multipliers, making them even negative after 5 quarters.

Acknowledgments

This work has been supported by the Croatian Science Foundation under project "Public Finance Sustainability on the path to the Monetary Union - PuFiSuMU" (IP-2016-06-4609).

References

AMECO. 2016. "Annual macro-economic database (AMECO)". European Commission, Directorate General for Economic and Financial Affairs.

Auerbach, J. Alan, and Yuriy Gorodnichenko. 2012. "Measuring the Output Responses to Fiscal Policy." *American Economic Journal: Economic Policy,* 4(2): 1–27.

Babić, Ante, Ivo Krznar, Danijel Nestić, and Sandra Švaljek. 2003. "Dinamička analiza održivosti javnog i vanjskog duga Hrvatske." *Privredna kretanja i ekonomska politika,* 13(97): 77-126.

Bajo, Anto, and Marko Primorac. 2013. "The cost of government borrowing and yields on Croatian government bonds." *Newsletter*, No. 83. Institute of Public Finance, Zagreb. Available at: http://www.ijf.hr/upload/files/file/ENG/newsletter/83.pdf

Batini, Nicoletta, Luc Eyraud, Lorenzo Forni, and Anke Weber. 2014. "Fiscal Multipliers: Size, Determinants, and Use in Macroeconomic Projections." *IMF Technical Notes and Manuals* 14/04.

Blanchard, Olivier, and Roberto Perotti. 2002. "An Empirical Characterization of the Dynamic Effects of Changes in Government Spending and Taxes on Output." *The Quarterly Journal of Economics*, 117(4): 1329-1368.

Cota, Boris, and Ante Žigman. 2011. "The impact of fiscal policy on government bond spreads in emerging markets." *Financial Theory and Practice*, 35(4): 385-412.

Deskar-Škrbić, Milan, and Hrvoje Šimović. 2017. "Effectiveness of fiscal spending in Croatia, Slovenia and Serbia: the role of trade openness and public debt level." *Post-Communist Economies*, 29 (forthcoming).

Deskar-Škrbić, Milan, Hrvoje Šimović, and Tomislav Ćorić. 2014. "The Effects of Fiscal Policy in a Small Open Transition Economy: The Case of Croatia." *Acta Oeconomica,* 64(S1): 133-152.

Eurostat. 2017. National accounts (ESA 2010).

Hiebert, Paul, and Massimo Rostagno. 2000. "Close to Balance or in Surplus: A Methodology to Calculate Fiscal Benchmarks". *Fiscal Sustainability,* 95-133. Banca d'Italia.

Mihaljek, Dubravko. 2003. "Analiza održivosti javnog i vanjskog duga Hrvatske pomoću standardnih financijskih pokazatelja." Privredna kretanja i ekonomska politika, 13(97): 29-75.

Mihaljek, Dubravko. 2009. "The global financial crisis and fiscal policy in Central and Eastern Europe: the 2009 Croatian budget odyssey." *Financial Theory and Practice*, 33(3): 239-272.

Ravn, Søren Hove, and Morten Spange. 2012. "The Effects of Fiscal Policy in a Small Open Economy with a Fixed Exchange Rate: The Case of Denmark." *Danmarsk Nationalbank Working Papers*, No. 80.

Sopek, Petar. 2010. "Budget Deficit and Public Debt in Croatia." *Newsletter*, No. 49. Institute of Public Finance, Zagreb. Available at: http://www.ijf.hr/eng/newsletter/49.pdf

Sopek, Petar. 2011. "Testing the sustainability of the Croatian public debt with dynamic models." *Financial Theory & practice*, 35(4): 413-442.

Šimović, Hrvoje, and Batur, Antonia. 2017. "Fiskalna održivost i održivost javnog duga u Hrvatskoj". In: H. Blažić, M. Dimitrić & M. Pečarić (ed.) *Financije na prekretnici: Imamo li snage za iskorak?*. Rijeka: Ekonomski fakultet, forthcoming.

Šimović, Hrvoje, Tomislav Ćorić, and Milan Deskar-Škrbić. 2014. "Mogućnosti i ograničenja fiskalne politike u Hrvatskoj." *Ekonomski pregled*, 65(6): 541-575.

Appendix 1 Indicators of public debt stability

Table A1.1 Total balance, primary balance and real interest rate needed to stabilize the public debt

	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
1. Public debt (% of GDP)	36,5	36,6	38,1	40,4	41,3	38,9	37,7	39,6	49,0	58,3	65,2	70,7	82,2	86,5	86,7
2. Nominal GDP (yoy, %)	7,8	8,9	9,8	8,0	7,7	9,0	9,5	7,9	-4,8	-0,9	1,4	-0,6	-0,3	-0,3	1,8
3. Real GDP (yoy, %)	3,4	5,2	5,6	4,1	4,2	4,8	5,2	2,1	**-7,4**	-1,7	-0,3	-2,2	-1,1	-0,4	1,6
4. General government balance (% of GDP)	-2,1	-3,5	-4,7	-5,2	-3,9	-3,4	-2,4	-2,8	**-6,0**	-6,2	-7,8	-5,3	-5,3	-5,5	-3,2
5. Total balance needed to stabilize the public debt	-2,6	-3,0	-3,3	-2,8	-2,9	-3,4	-3,4	-2,8	2,0	0,4	-0,8	0,4	0,2	0,3	-1,5
6. Total fiscal effort (% of GDP)	-0,5	0,5	1,4	2,4	1,0	0,0	-0,9	0,0	**8,0**	6,6	7,0	5,7	5,5	5,8	1,7
7. Interest payments (% of GDP)	1,8	1,8	1,8	1,9	1,9	1,9	1,9	2,0	2,3	2,6	3,0	3,4	3,5	3,5	3,6
8. Nominal interest rate (%)	5,7	5,6	5,6	5,4	5,5	4,4	4,9	6,0	7,8	6,3	6,5	6,1	4,7	4,1	3,6
9. Primary balance (% of GDP)	-0,3	-1,7	-2,9	-3,3	-1,9	-1,5	-0,6	-0,8	**-3,7**	-3,6	-4,8	-1,9	-1,8	-2,0	0,4
10. Primary balance needed to stabilize the public debt (%)	-0,7	-1,1	-1,4	-0,9	-0,8	-1,7	-1,6	-0,6	**5,3**	3,5	3,0	4,4	3,5	3,6	1,5
11. Real interest rate (%)	2,8	2,0	1,6	1,6	2,0	0,4	0,8	0,3	4,9	5,4	4,8	4,5	3,8	4,0	3,4
12. Real interest rate needed to stabilize the public debt (%)	3,4	5,2	5,5	4,0	4,1	4,7	5,1	2,0	**-7,5**	-1,8	-0,4	-2,2	-1,1	-0,4	1,6
13. Real interest rate gap	0,6	3,2	3,9	2,4	2,1	4,3	4,3	1,7	**-12,4**	-7,2	-5,2	-6,7	-4,9	-4,4	-1,8

Source: author's calculation according to Eurostat (2017), AMECO (2016), Sopek (2010) and Mihaljek (2003).

Appendix 2 Results of breakpoint tests

Table A2.1 Quandt-Andrews test

Statistic	**Value**	**Prob.**
Maximum LR F-statistic (**2008Q4**)	16.90209	**0.0000**
Maximum Wald F-statistic (**2008Q4**)	33.80417	**0.0000**

Source: author's calculations.

Table A2.2 Bai-Perron test

Schwarz criterion selected breaks: 2
LWZ criterion selected breaks: 1

Breaks	**# of Coefs.**	**Sum of Sq. Resids.**	**Log-L**	**Schwarz* Criterion**	**LWZ* Criterion**
0	2	126.2874	-100.9004	0.976948	1.068870
1	5	75.94741	-86.91609	0.687011	0.919523
2	8	59.53235	-80.21925	0.662071	1.038780
3	11	52.98193	-77.01361	0.764084	1.289071

* Minimum information criterion values displayed with shading

Estimated break dates:
1: **2008Q4**
2: **2008Q4**, 2013Q4
3: **2008Q4**, 2011Q2, 2013Q4

Source: author's calculations.