# Testing the sustainability of the Croatian public debt with dynamic models

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**Summary**

*Almost all macroeconomic indicators change upon shocks influenced by the global financial crisis that has also spilled over to the public sector, seriously threatening fiscal sustainability. The aim of this paper is to estimate public debt sustainability in the crisis and post-crisis period from 2011 to 2015. For estimation of public debt movements, decomposition of basic flows that lead to its change will be considered, and each one will be separately modeled dynamically. It is shown that in the period up to 2015 the share of public debt in GDP in optimistic scenarios does not exceed the margin of 60%, prescribed by the Maastricht criteria. In baseline scenarios we get two-sided results, so in the first model public debt slightly exceeds the limit of 60% with a share of 62.6% of GDP in 2015, while in all other baseline scenarios public debt stays at the level of 45.8, or 52.5% of GDP. Therefore, we conclude that in the medium-term period up to 2015 there is a real danger of public debt increasing over its acceptable limit and the major threats lie in contingent liabilities and exchange rate shocks, while minor vulnerability can be observed in case of real GDP growth and nominal interest rate shocks.*

*Keywords: public debt, fiscal sustainability, dynamic models, deficit, stock-flow adjustment, the Croatian economy*

## 1 INTRODUCTION

The global financial crisis that started on the subprime mortgage loans market in the United States of America in the second half of 2007 has showed that a sufficiently strong external shock (in this case the shock of defaulted mortgage loans in the USA) can contagiously spread to sectors and institutions that were strongly indebted in the previous cycle. There are five main mechanisms through which the crisis spreads, and these are: direct real channel initiated by a financial accelerator/decelerator, banking balance channel (losses channel), interest rate channel, fiscal channel and complexity channel. The first relation within the fiscal channel – public revenue decline, has had a strong negative effect in Croatia, while all other relations within the fiscal channel that have short-term positive effects on economic activity have not occurred. The negative effect of deficit widening, raising the question of its sustainability, has probably been intensified by the complexity channel (Croatian Banking Association, 2010a).

The main theme of this paper is the effects of the fiscal crisis that have come out of the global financial crisis and been manifested in the serious destabilization of public finance. If some country faced deficits even before the crisis, it is quite probable that during the crisis it would be unable to hold the level of the deficit below the limit of 3%, prescribed by the Maastricht criterion. Almost at the same time all other indicators that have effect on public debt increase record negative trends, putting an additional pressure on the level of country's indebtedness. Therefore most countries in times of crisis record significant growth of the share of public debt in GDP (Reinhart and Rogoff, 2009). All mentioned may lead to

exceeding the public debt sustainability level, which means that the debt starts to rise faster than the debtor's ability to pay it off.

Testing the sustainability of the Croatian public debt is the basic aim of this paper and the main hypothesis tested is that the share of public debt in GDP up to 2015 will stay below the limit of 60%, at which it can be considered acceptable according to the Maastricht criterion. The analytical background of the Maastricht convergence criterion is very simple, implying that any debt exceeding the limit of 60% should converge to the target level of 60% of GDP in the long run, but with the assumption of annual nominal GDP growth of 5% and of keeping the level of deficit below the level of 3%. Besides that, the analytics are based on the assumption that the level of public debt between two points in time changes only by the realized deficit in that period, which differs from the reality (Gros, 2003). According to the Budget Act (Zakon o proračunu, NN 87/08), the upper limit of the government debt at the end of the year should not be higher than 60% of the GDP[1]. Still, there are many studies that oppose the referentiality of the defined public debt level of 60% of GDP, stressing that the limit of sustainability of public debt in developed and emerging markets may significantly differ, which implies potentially unsustainable public debt on even lower levels than that prescribed by the Maastricht criterion (see for instance IMF, 2003a or Croatian Banking Association, 2010b).

To test the hypothesis of the sustainability of the Croatian public debt in the medium-term period up to 2015, we will use dynamic models with the decomposition of the debt changes to basic measurable debt-creating flows. This gives rise to logical questions such as: which variables have a significant impact on the movements of the public debt, how will the current financial crisis affect the movements of those variables, what do we expect in future and what will happen in the event of additional stress from one or several variables? The answers to these questions may help us in drawing conclusions about the sustainability of the Croatian public debt up to 2015.

This paper is organised as follows: after the introduction, the second part of the paper considers the estimated impact of the crisis on fiscal indicators, comparison with the actual data and a theoretical overview of potential implications. In the third part, projections of the Croatian primary budget balance in three basic scenarios are made and in the fourth part we quantify and project other variables that have an effect on the change of the public debt. The fifth part deals with different

[1] Government debt is defined as the debt of the central budget, while public debt means the debt of general government. Still, the Budget Act defines conditions and limits for the indebtedness of local and regional self-government units in a way that a long-term borrowing is acceptable only for investments that are financed from their budget and in case when total annual liability of a local and regional self-government unit amounts to maximum 20% of gained revenue in a year that preceded the year in which it gets into debt (Zakon o proračunu, NN 87/08). Therefore, the level of public debt is mainly determined by the level of government debt. At the end of 2010, the government debt amounted to 40.5% of GDP, while the public debt amounted to 41.2% of GDP (Ministry of Finance, 2010).

dynamic model projections of the public debt and tests its sustainability in the period up to 2015. This is followed by a conclusion.

## 2 FISCAL INDICATORS IN TIMES OF CRISIS

A financial (banking) crisis can be defined in several different ways. According to Laeven and Valencia (2009), a crisis can be defined as various episodes in which the financial and corporate sectors of individual states face major difficulties with the timely payment and collectability of their agreed debts, a significant increase in the number of unused loans and the exhaustion of most of the capital of the banking system. Financial crises mainly occur in developing markets, but they also affect other markets. Therefore, even more developed countries such as EU or OECD member states can feel a crisis (Laeven and Valencia, 2009).

In times of crisis public finance inevitably face serious destabilization. Decline in economic activity is often connected to unemployment and retirement rate increases, which bring increased expenditure from the government budget in the form of social benefits, aids and different subsidies. At the same time, revenues from income tax and contributions decrease, which negatively affects the revenue side of the budget. On the other hand, negative trends on the labour market and uncertainty of future economic trends make people spend their money rationally, which consequentially leads, together with the above-mentioned growth of the unemployment, to private consumption decrease, i.e. to lower revenues of indirect taxes (value added tax and excise). Lower private consumption also means lower production needs, which implies a decrease in profit tax revenue, but also an additional decline in economic activity, growth in unemployment, etc. It is clear that such a sequence of causal connections (in this case simplified) can very easily get out of control and lead to spiral effects with catastrophic proportions.

Financial crises are not an unknown term in public finance and there are many findings from the literature about the effect of financial crises on fiscal indicators. Reinhart and Rogoff (2008) analyzed crisis periods in 66 developed and emerging markets and concluded that banking crises dramatically weaken fiscal positions in all countries with government revenues invariably contracting and fiscal expenditures often expanding sharply. Three years after a financial crisis, central government debt increases, on average, by about 86 percent. Laeven and Valencia (2008) showed that during 40 observed crisis episodes monetary policy tended to be fairly neutral, while the fiscal stance tended to be expansive, arguably to support the financial and real sectors, and to accommodate bank restructuring and debt restructuring programs. On average, the fiscal balance was about -3.6 percent of GDP during the initial years of a banking crisis. Fiscal costs, net of recoveries, associated with crisis management can be substantial, averaging about 13.3 percent of GDP on average and can be as high as 55.1 percent of GDP. The European Commission (2009) in its empirical analysis of the effects of previous crises on fiscal indicators covered a total of 49 crisis episodes between 1970 and 2007, 22

of them in EU-27 and OECD member countries, the average duration of the crisis being four and a half years. Table 1 shows total revenue and expenditure before and after the crisis.

**Table 1**

*Total revenue and expenditure before and after the crisis (% of GDP)*

| | Revenue | | | Expenditure | | | Budget balance | | |
|---|---|---|---|---|---|---|---|---|---|
| | Year before the beginning of the crisis | Year of the end of the crisis | Change | Year before the beginning of the crisis | Year of the end of the crisis | Change | Year before the beginning of the crisis | Year of the end of the crisis | Change |
| EU-27 | 41.0 | 40.1 | -0.9 | 42.7 | 43.8 | 1.1 | -1.7 | -3.7 | -2.0 |
| EU-15 | 45.4 | 45.9 | 0.5 | 42.2 | 51.7 | 9.5 | 3.2 | -5.8 | -9.0 |
| OECD | 36.4 | 35.8 | -0.6 | 38.7 | 41.0 | 2.3 | -2.3 | -5.2 | -2.9 |
| OECD and EU | 33.8 | 34.1 | 0.3 | 36.4 | 38.3 | 1.9 | -2.6 | -4.2 | -1.6 |
| Other | 25.2 | 25.6 | 0.4 | 27.3 | 27.9 | 0.6 | -2.1 | -2.3 | -0.2 |
| Average | 36.4 | 36.3 | -0.1 | 37.5 | 40.5 | 3.1 | -1.1 | -4.2 | -3.1 |

*Source: European Commission (2009).*

Data from table 1 indicate that revenue on average were slightly reduced, whilst expenditure in all considered groups increased and the average increase was about 3.1% of GDP. The change of the budget balance from the year before the beginning to the year of the end of the crisis amounted to -3.1 percentage points on average, but it is interesting that the greatest difference was found in the EU-15 budget balance, amounting to as much as 9 percentage points.

Sopek (2010) in a parallel analysis observed the new EU member states and the EU and Euro zone average in the middle of the current global financial crisis and emphasizes that the highest deficit increase can be noted in 2009 in almost all observed countries, which is a consequence of the expansion of the crisis. Table 2 shows budget balance and public debt actual data as shares in GDP in 2007 (pre-crisis period), preliminary estimation for 2010 (crisis period) and forecast for 2012 (post-crisis period) for Croatia, the new EU member states (EU-10) and the average of all 27 EU member states.

**TABLE 2**

*Actual data and projections of the budget balance and public debt (% of GDP)*

| Country | Budget balance | | | | | Public debt | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 2007 | 2010 est. | Change 2007-10 | Min. 2002-10 | 2012 f. | 2007 | 2010 est. | Change 2007-10 | Max. 2002-10 | 2012 f. |
| Croatia | -1.0 | -4.4 | -3.4 | -4.4 | -3.4 | 33.2 | 41.2 | 8.0 | 41.2 | 49.9 |
| EU-27 av. | -0.9 | -6.8 | -5.9 | -6.8 | -4.2 | 58.8 | 79.1 | 20.3 | 79.1 | 83.3 |
| Slovenia | 0.0 | -5.8 | -5.8 | -5.8 | -4.7 | 23.4 | 40.7 | 17.3 | 40.7 | 47.6 |
| Hungary | -5.0 | -3.8 | 1.2 | -9.3 | -6.2 | 66.1 | 78.5 | 12.4 | 78.5 | 81.6 |
| Slovakia | -1.8 | -8.2 | -6.4 | -8.2 | -5.0 | 29.6 | 42.1 | 12.5 | 43.4 | 47.4 |
| Czech R. | -0.7 | -5.2 | -4.6 | -6.8 | -4.2 | 29.0 | 40.0 | 11.0 | 40.0 | 45.2 |
| Poland | -1.9 | -7.9 | -6.1 | -7.9 | -6.0 | 45.0 | 55.5 | 10.6 | 55.5 | 59.6 |
| Estonia | 2.5 | -1.0 | -3.6 | -2.8 | -2.7 | 3.7 | 8.0 | 4.3 | 8.0 | 11.7 |
| Bulgaria | 1.1 | -3.8 | -5.0 | -4.7 | -1.8 | 17.2 | 18.2 | 0.9 | 52.4 | 20.8 |
| Romania | -2.6 | -7.3 | -4.7 | -8.6 | -3.5 | 12.6 | 30.4 | 17.8 | 30.4 | 34.1 |
| Latvia | -0.3 | -7.7 | -7.4 | -10.2 | -7.3 | 9.0 | 45.7 | 36.7 | 45.7 | 56.6 |
| Lithuania | -1.0 | -8.4 | -7.3 | -9.2 | -6.9 | 16.9 | 37.4 | 20.5 | 37.4 | 48.3 |

*est. – preliminary estimation; f. – projection*

*Source: AMECO database; Ministry of Finance.*

Column minimum 2002-10 indicates the lowest realized budget balance as a percentage of GDP in the period from 2002 to 2010. It is shown that most countries reached minimum budget balance, i.e. the highest deficit in crisis years, that is, in 2009 and 2010. Column maximum 2002-10 indicates the highest recorded public debt to GDP ratio in the period from 2002 to 2010 and it is shown that almost all countries recorded the highest level of public debt as a percentage of GDP in 2010. Only Slovakia and Bulgaria had recorded the highest debt to GDP ratio in some earlier periods (in 2002), after which it decreased drastically up to 2008 (AMECO database). Columns noted as change 2007-10 indicate total change of share of budget balance and public debt in GDP from pre-crisis period to crisis period. Croatia has had a lower negative change of budget balance in the period from 2007 to 2010 than the other observed countries. Only Hungary, the only country that managed to record a positive change of the budget balance in the observed period, had a better result than Croatia. However, while all the other observed countries expect positive movements up to 2012 with regard to 2010, Hungary and Estonia are the only countries that expect an additional deterioration of the budget balance. The share of Croatian public debt in GDP increased by the end of 2010 by 8 percentage poin-

ts[2]. Additional concerns raise a projection that forecasts an increase of the public debt to almost 50% of GDP by the end of 2012 in a baseline scenario. According to that indicator in 2010, Croatia is situated roughly in the middle among the observed countries with a lower level of public debt than Hungary and Poland, but a much higher level than Estonia and Bulgaria.

According to the Stability and Growth Pact (SGP), which relates to all EU member states, there are two fiscal criteria prescribed that these countries definitely must comply with. These are deficit below the limit of 3% of GDP and ratio of public debt to GDP of below 60%. In the event of the violation of one of these two criteria, the Excessive Deficit Procedure (EDP), which defines guidelines and deadlines for the gradual stabilization of public finance (Eur-Lex, 2008a; 2008b), will be initiated. If some country faced deficits even before the crisis, it is almost certain that it will not be able to hold the level of deficit below the limit of 3% of GDP in times of crisis. This is exactly what happened to almost all EU-27 member states in the current financial crisis, only Estonia and Sweden being exempted from EDP (European Commission, 2011).

During the global financial crisis, most countries recorded a considerable rise in the public debt to GDP ratio. IMF (2010) represents the level of public debt with probability density function by analyzing the debt level in 41 emerging markets in 2007 and 2010, which gives a clear comparable picture of debt movements in different years. Figure 1 shows probability density function of public debt to GDP ratio in 2007, 2010 and 2012 estimated on actual data and projections for 32 countries in the AMECO database (European Commission, 2010).

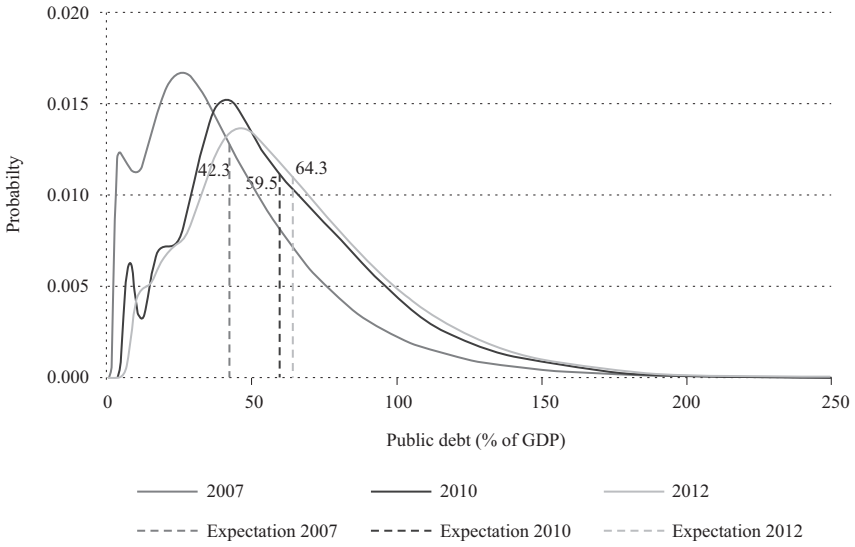
Probability density function from the figure is estimated by a non-parametric kernel method with chosen normal (Gauss) kernel function and with limitation of non-negativity of the public debt[3]. Data include 32 European countries from the AMECO database, all EU-27 member states, four acceding countries (Turkey, Croatia, Macedonia and Iceland) and Norway. It is shown that the average share of public debt in GDP rose from 42.3% in 2007 to an estimated 59.5% in 2010 and an additional increase of the public debt to 64.3% of GDP in 2012 is expected. Similar conclusion can be drawn from a probability density function constructed from the IMF data (IMF, 2010), which shows an obvious and worrying trend of public debt increase in crisis periods.

[2] According to the Budget Act (Zakon o proračunu, NN 87/08), public debt or the debt of the public sector from 1 January 2009 comprises the debt of general government, which no longer includes the so-called contingent debt in the form of financial and performance guarantees issued, and the debt of Croatian Bank for Reconstruction and Development (HBOR). Transactions of Croatian Motorways (HAC) were also been excluded from general government with the budget rebalance for 2008, as a result of the harmonization with the European statistical methodology ESA 95, and are categorized in a subsector of public non-financial enterprises. Therefore, HAC transactions are no longer recorded within the general government sector.

[3] For technical details of the kernel method see Silverman (1986).

**FIGURE 1**

*Probability density function of public debt in 2007, 2010 and 2012 (% of GDP)*




*Source: AMECO database; author's calculation.*

A high level of public debt has several adverse long-term economic consequences like the increase of long-term interest rates (Baldacci and Kumar, 2010), future distortionary taxation and the impossibility of monetary policy independence (Piergallini and Rodano, 2009). Also, high debt may limit space for countercyclical fiscal policies, which can result in higher volatility and lower growth, and can also increase vulnerability to crises (IMF, 2010). Kumar and Woo (2010) showed by an econometric analysis that higher initial public debt level is related to lower subsequent economic growth. On average, a 10 percentage points increase in the initial debt to GDP ratio is associated with a slowdown in annual real per capita GDP growth of around 0.2 percentage points per year, with the impact being somewhat smaller in advanced economies. The authors (Kumar and Woo, 2010) also stressed that there is some evidence of nonlinearity of this relationship, implying that higher levels of initial debt have a proportionately larger negative effect on subsequent growth.

## 3 PROJECTIONS OF THE CROATIAN PRIMARY BUDGET BALANCE

In analytical overviews of the public debt stock, it is often possible to observe a simple equation describing debt level with public debt stock at the end of previous year, realized deficit and stock-flow adjustment that comprises all other flows (see for instance Hagen and Wolff, 2004 or Campos, Jaimovich and Panizza, 2006). This can be shown with the following expression:

$$D_t = D_{t-1} - (B_t^p - K_t) + S_t \qquad (1)$$

where $D_t$ denotes nominal debt stock at the end of year $t$, $B_t^p$ realized primary budget balance, $K_t$ the amount of interest expense, and $S_t$ stock-flow adjustment in year $t$. For our analytical purposes, we need a relevant share in GDP of specific variables, so it is necessary to transform the equation (1), which is shown with the following expression:

$$d_t = \frac{\mathrm{d}}{1 + g_t^N} \cdot d_{t-1} - (b_t^p - k_t) + s_t \qquad (2)$$

where $d_t$ denotes the share of public debt in GDP at the end of year $t$, $g_t^N$ nominal GDP growth rate, $b_t^p$ primary budget balance of the general government, $k_t$ share of interest expense on the outstanding public debt, and $s_t$ stock-flow adjustment as a percentage of the GDP in year $t$.

The basic aim of this part of the paper is to construct projections of the Croatian primary budget balance, after which we will model the effect of other measurable variables from the equation (2) in the next part of the paper. For the purpose of projections of Croatian primary balance movements, as well as the other key variables, we define three scenarios: baseline, optimistic and pessimistic[4]. Since we decided to choose three different scenarios, we assume that there is no need for the estimation of confidence intervals, for any deviations from the baseline scenario will be covered by the optimistic and pessimistic scenarios.

If there is a new crisis wave, it is very probable that the weakened economy will record new downfalls, so we may assume that the Croatian primary balance will change its trend again. In other words, the less likely and extremely unfavourable pessimistic scenario up to 2015 can be described with the same function as in Sopek (2009), which is shown with the following equation:

$$\begin{aligned} f_{pes}(t) = f(t) = &-0.5726 - 1.2824(t - 2008.5) - 0.1364(t - 2008.5)^2 \\ &+ 0.0923(t - 2008.5)^3 + 0.0104(t - 2008.5)^4 - 0.003(t - 2008.5)^5 \end{aligned} \qquad (3)$$

where $t \in [2006, 2015]$ denotes the time mark in years and $f(t)$ function of movements of primary budget balance in crisis and post-crisis periods. Function (3) is a polynomial of the fifth degree obtained by a regression analysis based on historical experiences of the effect of crisis in EU-12 member states and afterwards adjusted to Croatian data[5]. Since the observed function changes the trend from rise to fall after 2013, it can be useful in this form only as a formulation of a pessimistic scenario.

[4] Baseline scenario actually means baseline medium-term projection, i.e. the movements of variables expected in expected economic conditions. On the other hand, optimistic and pessimistic scenarios mean equivalent movements in favourable, i.e. adverse economic conditions.

[5] The method of projection of the primary budget balance in Sopek (2009) is mainly founded on statistical estimates, since the author considers most macroeconomic variables as exogenous. It also has to be mentioned that in this projection the considered function is chosen exclusively in order to satisfy local characteristics, i.e. theoretical assumptions on the movements of primary balance are satisfied up to 2013, which was the considered time frame in this paper.

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The baseline scenario is formed with assumption that the impact of crisis will leave long-term consequences on the fiscal system and that it will need several years for the system to stabilize. In other words, economic recovery, and therewith the recovery of the general government primary balance, will be slower than its initial decline upon the global financial crisis. The function of the movements of Croatian primary budget balance in baseline scenario is separated in two parts, from 2010 to 2013 (polynomial of the fifth degree) and from 2013 to 2015 (linear function), which can be expressed with the following equation:

$$f_{base}(t) = \begin{cases} f(t) & : \text{for } t \in [2006, 2013] \\ f(2013) + f'(2013) \cdot (t - 2013) & : \text{for } t \in [2013, 2015] \end{cases} \quad (4)$$

where $f'(2013)$ represents derivative of the function $f(t)$ at the point $t = 2013$, and all other marks stay the same as before. The linear function that describes the movements of the primary budget balance in the period 2013-2015 is actually tangent of the function $f$ at the point $t = 2013$. Such a defined baseline scenario is in accordance with the theoretical findings of the effect of crisis on fiscal balance, which was elaborated in the previous section of this paper.

IMF (2011a) in its medium-term outlook up to 2016 also predicts a gradual decrease of deficit levels (and accordingly primary deficit levels) in most countries. Deficit reduction in advanced economies will slow in 2013 and largely cease in 2014, leaving deficits above pre-crisis levels in several of them. IMF predictions show that most advanced and emerging economies may record deficit levels in 2016 similar to those prior to the crisis. These findings justify the function choice for the movements of the Croatian primary balance in the baseline scenario.

With the assumption that Croatian fiscal policy will show decisiveness and manage to start the economy, we may suppose a more optimistic scenario than the one in baseline projection. In this case, we construct function of the Croatian primary balance movements from 2013 to 2015 as slightly convex function in such a way that in 2015 it reaches same level of function $f$ as in 2006, which is its local maximum in the period 2006-13. This will be modeled by adding a quadratic term to the linear trend from the expression (4), which can be expressed with the following formula:

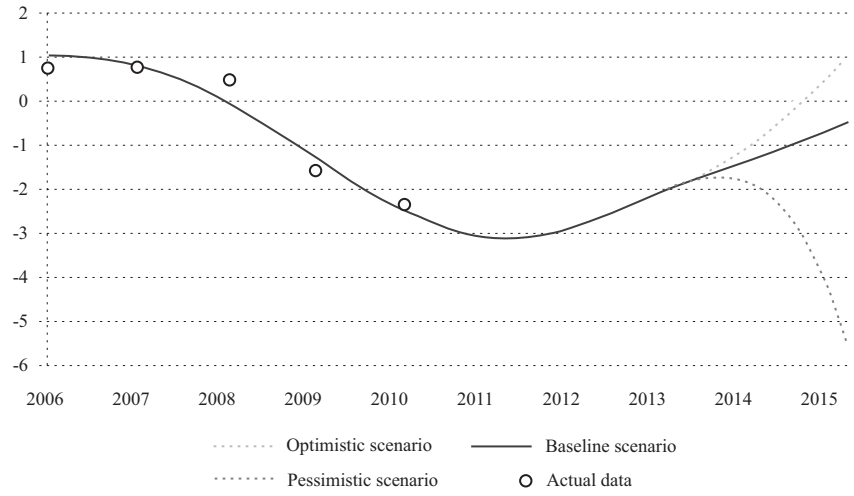
$$f_{opt}(t) = \begin{cases} f(t) & : \text{for } t \in [2006, 2013] \\ f(2013) + f'(2013) \cdot (t - 2013) + \alpha \cdot (t - 2013)^2 & : \text{for } t \in [2013, 2015] \end{cases} \quad (5)$$

where $\alpha = \frac{f(2006) - f(2013)}{(2015 - 2013)^2}$ denotes a coefficient of the translated quadratic term and all other marks stay the same as before. Such a function choice ensures that $f_{opt}$ in any time period $t \in [2013, 2015]$ increases faster than the function $f_{base}$.

It is very important to stress that all three scenarios of the movements of the Croatian primary budget balance described with the above mentioned functions are technically constructed in such a way as to meet local conditions up to 2015. In case of longer-term projections one should definitely avoid such a method for several already discussed reasons. A graphic preview of the primary balance movements of general government in the period 2006-15 in all three defined scenarios and the actual data in the period 2006-10 are shown in figure 2.

**Figure 2**

*Projections of the primary budget balance for the period 2006-15 in three different scenarios (% of GDP)*




*Source: Ministry of Finance; author's calculation.*

In the baseline scenario, the primary budget deficit in 2015 will amount to 0.49% of GDP, in the pessimistic scenario it will amount to 5.57% of GDP, while in the optimistic scenario a primary budget surplus of 1.04% of GDP will be produced. The period 2013-15 brings huge uncertainties which will be reflected on the general government budget, since Croatia should become the member of the European Union on the 1st of July 2013. Actual data of the all costs of EU accession are not publicly available and the existing research does not give concrete answers. However, the accession process leads to a negative net fiscal impact on general government budget, which varies depending on the degree of harmonization and can amount to up to 3% of GDP in the first years after member status is obtained (Antczak, 2003). Sopek (2011) in a detailed analysis of financial flows estimates the short-term effect of EU accession on Croatian budget of -0.15% of GDP. In the pessimistic scenario, the negative effect on the Croatian budget will be as much as -1.24% of GDP, while in the optimistic scenario the effect is positive and amounts to 1.07% of GDP. These results justify deviations of three defined projections of the Croatian primary budget balance movements.

## 4 SOURCES OF PUBLIC DEBT CHANGES

A decrease in a primary budget balance directly affects changes of public sector debt. Nevertheless, for the country's indebtedness, except primary deficit there are other economic indicators that may directly or indirectly influence changes in the debt. One of the most important is definitely the gross domestic product (GDP) of observed country, i.e. its annual change, since GDP growth acts like an automatic stabilizer of the share of public debt in GDP, which can be clearly seen from equation (2). Aizenman and Jinjarak (2011) stated that the higher projected growth rate implies that the flow costs of public debt are lower, increasing their fiscal space. Besides GDP, interest rates on public debt stock and exchange rate changes, activation of government liabilities etc. may also have an important role in public debt movements.

For modeling GDP growth we will use a simple formula that dynamically projects real GDP growth based on the historical average and that produced in the previous year, which can be expressed with the following formula:

$$g_t = k \cdot g_{t-1} + (1 - k) \cdot \bar{g} \tag{6}$$

where $g_t$ denotes real GDP growth in the year $t$, $\bar{g}$ average GDP growth in the observed period, and $k \in [0, 1]$ the weighted factor of the importance of real GDP growth recorded in the previous year with regard to the historical average. The higher this weighted factor is (i.e. closer to 1), the bigger attention is dedicated to realized GDP growth in the previous year. For the average annual GDP growth rate we will use the average of the period of stable GDP growth from 2002 to 2007, amounting to 4.5% (CBS, 2011a). A question arises as to how to choose the optimal weighted factor. Figure 3 shows projections of the real GDP growth rate in seven different variations of the choice of weighted factor.

As in primary budget balance projections, for GDP projections we will also use three different scenarios. A weighted factor of 0.6 best matches the real GDP growth in baseline scenario and is compliant with actual estimations of the GDP growth for 2011 at the moment of writing this paper, which predicts real GDP growth between 1 and 1.3 percent (see for instance CNB, 2011a and EIZ, 2011), while in 2012 it should amount to approximately 2.4 percent (EIZ, 2011). The pessimistic scenario can be imagined as gradual, but extremely slow economy recovery, in which the major part of real GDP movements is determined by last year's realized GDP, which would correspond to a weighted factor of 0.8. The optimistic scenario assumes a relatively fast economy recovery, which will be described by a weighted factor of 0.4. Such a choice of weighted factors is nearly equal to deviations from the baseline scenario for two standard deviations of the period 2000-07 (CBS, 2011), which actually makes sense taking into account the relatively low probability of individual shocks higher than two standard deviations for real GDP growth, interest rates or GDP deflator estimated between 0 and

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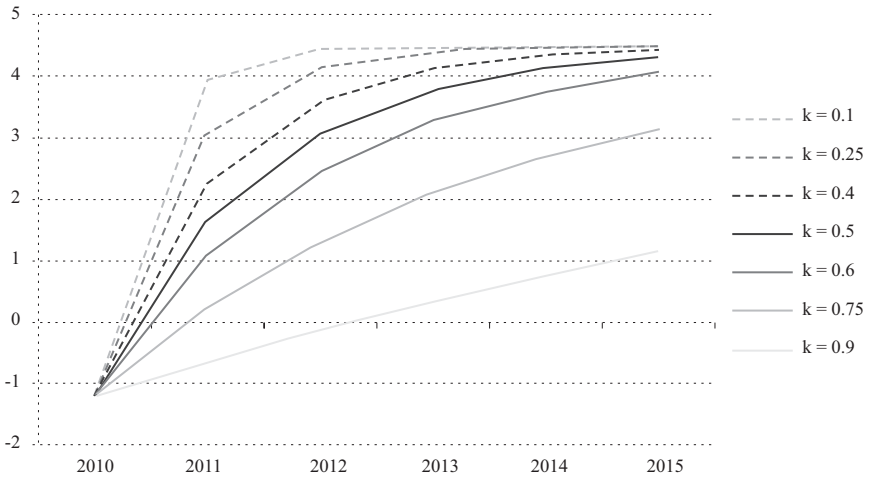
3 percent (IMF, 2002). For projections of the nominal GDP growth, it is necessary to correct real GDP growth by the inflation rate. The Institute of Economics from Zagreb (2011) predicts an inflation rate of 2.7% in 2011 and 2.9% in 2012. For further projections we assume a stable inflation rate in the whole period from 2013 to 2015 of 3% annually, which corresponds to the average inflation rate of the period 2000-10 measured by consumer price index (CBS, 2011b).

**Figure 3**

*Projections of the real GDP growth for the period 2010-15 in addition to weighted factor choice*




*Source: Author's calculation.*

For the movements of interest rates on public debt we will use historical data of the period 2002-10, shown in the table 3.

**Table 3**

*Interest expense and nominal interest rates on public debt*

| | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | Average 2002-10 |
|---|---|---|---|---|---|---|---|---|---|---|
| Interest expense (% of GDP) | 1.8 | 1.8 | 1.8 | 1.9 | 1.9 | 1.8 | 1.5 | 1.7 | 2.0 | 1.8 |
| Nominal interest rate (% annually) | 5.6 | 5.6 | 5.4 | 5.5 | 5.4 | 5.4 | 4.8 | 5.6 | 5.6 | 5.4 |

*Source: Ministry of Finance; author's calculation.*

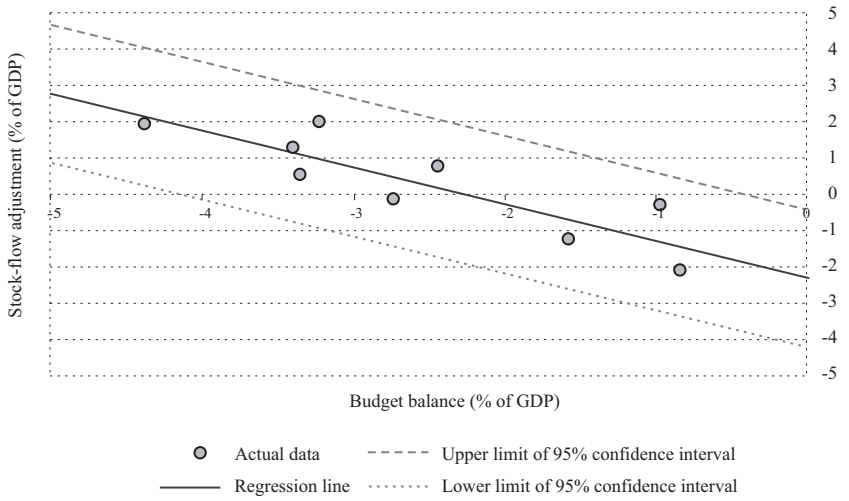
Average nominal interest rates on public debt are calculated as a nominal amount of interest expense on the consolidated general government level in some year and divided by the public debt stock of the general government at the end of previous year. Average nominal interest rate on public debt in the period 2002-10 amounts to 5.4% and has recorded an increase from 4.8% in 2008 to 5.6% annually in 2010. For the movements of nominal interest rates up to 2015 we may assume a slight linear increase to 6% in the baseline scenario, a bit sharper increase to 7.5% in the pessimistic scenario and a decrease to 4.5% in the optimistic scenario. A good argument for baseline scenario so defined, with a higher average interest rate than recorded in 2010, is that the last 3 bonds issued in 2010, i.e. Series 13 (D-20), Series 14 (D-20) and Series 15 (D-17), were issued with interest rates from 6.25%-6.75% (Ministry of Finance, 2010), which is over 1 percentage point higher than the average of period 2002-10. From familiar nominal interest rates (label $i_t$), the share of interest expense in GDP can be easily calculated, which is shown with the following expression:

$$k_t = \frac{i_t}{1 + g_t^N} \cdot d_{t-1} \tag{7}$$

Sopek (2009) finds a correlation between the variables Croatian primary deficit and stock-flow adjustment (SFA) and emphasizes that in years in which primary deficit has been recorded, stock-flow adjustment has been mainly positive and vice versa. Stock-flow adjustment depends on many exogenous variables, mainly connected to market trends. Therefore in hard times, apart from negative budget balances being recorded, more government liabilities may be activated (e.g. guarantees), domestic currency is more likely to depreciate, the state is forced to recapitalize firms in trouble, etc. Such conditions lead to a rise in stock-flow adjustment and accordingly to an increase in public debt. Theoretically, this indicator should tend to be cancelled over time, while if the opposite is true, this may indicate constant inappropriate recording of budgetary operations and can lead large ex-post upward revisions of deficit levels (Hagen and Wolff, 2004).

In this paper we will use similar method of stock-flow adjustment projections as in Sopek (2009), but it will be modeled in relation to budget balance, instead of primary budget balance. However, the analysis based on which we build our assumptions contains a time series of only 9 years, which may be considered insufficient for performing quality analysis and it is not quite clear if these results may be considered confident and applicable or just a random outcome. Furthermore, in 2008 Croatian Motorways (HAC) was excluded from general government, as a result of the harmonization with the ESA 95 methodology, so there is a small inconsistency in the observed time series. Scatter plot of the Croatian budget balance and stock-flow adjustment with estimated regression line and 95% confidence intervals are shown on a figure 4.

**FIGURE 4**
*Scatter plot of the Croatian deficit and stock-flow adjustment and regression line with 95% confidence intervals*




*Source: Author's calculation.*

Linear regression model shows a relatively satisfactory fit measured by determination coefficient ($R^2$ statistics) of 72% and adjusted determination coefficient of 68%. For the purpose of baseline scenario we will observe a variant of stock-flow adjustment, which will be modeled by the estimated regression line expressed from historical data of the period 2002-10. This regression line can be expressed with a following formula:

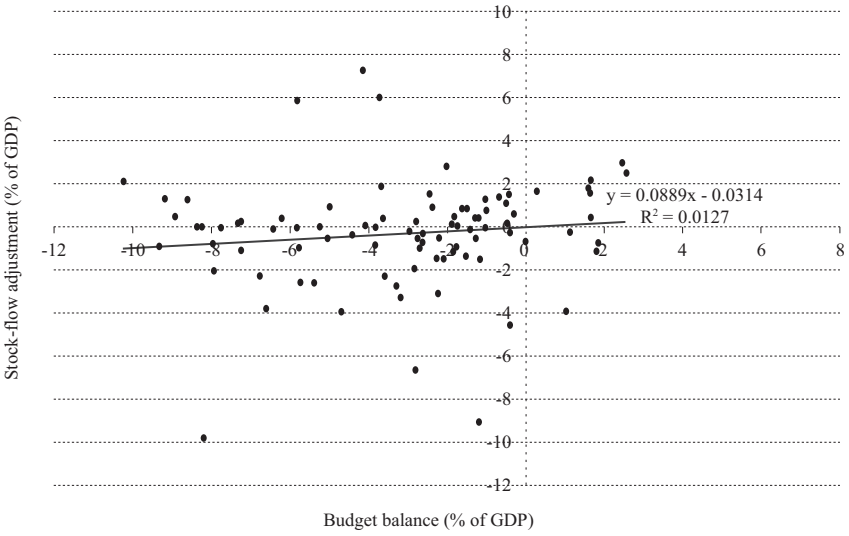
$$s_t = -0.95 \cdot b_t - 2.14 \qquad (8)$$

We can model optimistic and pessimistic scenario with lines that correspond to boundaries of 95% confidence intervals, which is actually just a vertical shift of the equation (8) by 1.51 downwards in the optimistic scenario, or upwards in the pessimistic scenario.

From figure 4 it is easy to note a strong negative correlation of Croatian budget balance and stock-flow adjustment in the period 2002-10. However, we are interested if a similar relation can be perceived among data of some other countries. Figure 5 shows a scatter plot of budget balance and stock-flow adjustment (% of GDP) for EU-10 member states for the period 2002-10.

**FIGURE 5**

*Scatter plot of budget balance and stock-flow adjustment for EU-10 member states for the period 2002-10 (% of GDP)*




*Source: AMECO database; author's calculation.*

It is obvious that a similar relation of budget balance and stock-flow adjustment cannot be noticed in new EU member states data, where the slope of a line has an opposite sign from the slope of the regression line estimated from Croatian data. Besides that, the associated linear regression model shows extremely unsatisfactory model fit of just 1.3%, measured by the determination coefficient.

Since the relation of budget balance and stock-flow adjustment identified in Croatian data cannot be noticed in EU-10 member states data, the given results should be observed and interpreted with caution. Therefore, as well as testing the sustainability of public debt with the model that includes stock-flow adjustment, we will use the well known dynamic model (see for instance IMF, 2003b; Babić et al., 2003), which decomposes annual public debt changes to four basic debt-creating flows, and these are: (1) primary budget balance; (2) automatic debt dynamics; (3) other identified flows; (4) residual (unidentified flows).

Automatic debt dynamics explain debt changes that happen outside the fiscal sphere, i.e. changes of real interest rate, real GDP growth and nominal exchange rate. According to IMF (2003b), total automatic debt dynamics in year $t$ can be described with the following expression:

$$
\begin{aligned}
a_t &= \frac{r_t - \pi_t (1 + g_t) - g_t + (1 + r_t)\, \alpha_{t-1}\, \varepsilon_t}{(1 + g_t)(1 + \pi_t)} \cdot d_{t-1} \\
&= \frac{r_t - \pi_t (1 + g_t)}{(1 + g_t)(1 + \pi_t)} \cdot d_{t-1} + \frac{-g_t}{(1 + g_t)(1 + \pi_t)} \cdot d_{t-1} \\
&+ \frac{(1 + r_t)}{(1 + g_t)(1 + \pi_t)} \cdot \alpha_{t-1} \cdot \varepsilon_t \cdot d_{t-1}
\end{aligned} \tag{9}
$$

where α denotes share of public debt in foreign currency, ε nominal exchange rate change, *r* real interest rate, *g* real GDP growth, π annual inflation rate, and *d*, the same as before, debt stock at the end of observed period. First addend in formula (9) denotes contribution of the real interest rate, the second one contribution of real GDP growth and the last one the contribution of the exchange rate change to the increase in the debt.

Other identified flows comprise privatization receipts and recognized implicit and explicit contingent liabilities of the government, which consist of different contingent, i.e. potential liabilities that contribute to public debt increase upon activation, i.e. if a particular event occurs. Explicit contingent liabilities comprise different state guarantees recognized by law or contract, such as: guarantees for non-sovereign borrowings and obligations issued to sub-national governments and public and private sector entities; umbrella state guarantees for various types of loans (such as for mortgages, students studying agriculture, and small businesses); state guarantees (for trade and the exchange rate borrowing by a foreign sovereign state, private investments); state insurance schemes (for deposits, minimum returns from private pension funds, crops, floods, war risk), etc. Implicit contingent liabilities are a "moral" obligation of the government that mainly reflects public expectations and pressures by some interest groups. These liabilities include: default of a sub-national government and public or private entity on nonguaranteed debt and other liabilities; cleanup of the liabilities of privatized entities; bank failure (beyond state insurance); investment failure of a nonguaranteed pension fund, employment fund, or social security fund (social protection of small investors); default of the central bank on its obligations (foreign exchange contracts, currency defense, balance of payments stability); bailouts following a reversal in private capital flows; residual environmental damage, disaster relief, military financing, etc. (Polackova, 1998).

If the debt change cannot be explained with these variables, there must be some unidentified flows (residual) present. These are debt-creating flows that can be considered statistical errors or mistakes in the debt and debt-creating flows accounts. This flow is particularly of our interest, since it shows the real quality of the model, which we rely on.

According to IMF (2003b) the change of public debt in this dynamic model can be described with the following equation:

$$
d_t - d_{t-1} = -b_t^p + a_t + (-r_t^{priv} + l_t) + \varepsilon_t \tag{10}
$$

where $d_t$ denotes public debt, $b_t^p$ primary budget balance, $a_t$ automatic debt dynamics expressed from formula (9), $r_t^{priv}$ privatization receipts, $l_t$ recognized implicit and explicit contingent liabilities of the government and $\varepsilon_t$ unidentified flows (residual) in a specific moment of time *t*, where all variables are expressed as shares in GDP.

Values of all projected variables in baseline scenario are shown in table 5 in the next part of the paper. Expected projections of the primary budget balance, real GDP growth, inflation rate and nominal interest rate are taken from the previously defined baseline scenarios. For projections of implicit and explicit contingent liabilities of the government and privatization receipts, we will use IMF (2011b) projections.

In a press release of the Croatian National Bank (2011b) it is stated that given the high level of euroization and large dependence of the Croatian economy on imports, the maintenance of the stability of the exchange rate of the kuna against the euro (HRK/€) is essential both for the maintenance of price stability and the stability of the domestic banking system. In the same press release it is stressed that the monetary and exchange rate policies will remain the same, which is exactly the type of policies that, in the given circumstances, can ensure price and financial system stability (CNB, 2011b). From everything mentioned we may assume a stabile HRK/€ exchange rate in the baseline scenario, so the effect of the exchange rate on public debt change will be negligible.

According to the Ministry of Finance of the Republic of Croatia (2011b), the share of public debt denominated in foreign currencies at 30 September 2010 amounted to 70.7% and we assume an identical share in this analysis at 31 December 2010. On the other hand, in baseline projection for the period 2011-15 we assume linear decline of this share to 50% in 2015. The reason for this assumption may be found in Public Debt Management Strategy for the period 2011-13 (Ministry of Finance, 2011b) in which is predicted the elimination of a part of the currency risk by introducing hedging instruments (currency swaps), i.e. by substituting the majority of the USD-denominated debt by the debt in euro. It has to be noted that risks connected to currency risk (primarily with the part denominated in euro) can be partially mitigated by a systematic promotion and development of a domestic reference yield curve, while in the longer term it can be neutralized by the country's joining the European Monetary Union (EMU), i.e. by accepting the euro as a national currency. However, although the accession of Croatia to the EU is expected by the end of the observed time period in this analysis, we assume that Croatia will not become the member of the EMU up to 2015 and therefore it will not eliminate currency risk.

All that is left is the assumption on residual deviations, which we consider to be probably equal to zero in the baseline scenario in the whole time period. This actually means that, except for the already mentioned flows, we do not expect any effect on the change of public debt due to some possible flows that are not included in this model.

## 5 TESTING THE SUSTAINABILITY OF THE PUBLIC DEBT

Public debt sustainability is defined as a debtor's ability to fulfill his financial obligations to creditors in the long run, with an economically acceptable revenue and expenditure balance. If the debt starts to grow faster than the debtor's ability to pay it off, it becomes unsustainable (Mihaljek, 2003). In order to test sustainability of the public debt upon adverse market cycles, one may use stress tests which indicate different scenarios with shocks of one or more key variables that lead to deviation from the baseline medium-term projection. In this paper, sustainability of the Croatian public debt will be tested by dynamic analyses with several scenarios of the variables from the equation (2) and with shock scenarios of variables from the equation (10).

**TABLE 4**

*Key variables projection and public debt sustainability in the period 2010-15*

| **Optimistic scenario** | **2010** | **2011** | **2012** | **2013** | **2014** | **2015** |
|---|---|---|---|---|---|---|
| Real GDP growth (% annually) | -1.19 | 2.22 | 3.59 | 4.14 | 4.35 | 4.44 |
| Nominal GDP growth (% annually) | -0.19 | 4.98 | 6.59 | 7.26 | 7.48 | 7.57 |
| Nominal interest rate (% annually) | 5.64 | 5.41 | 5.19 | 4.96 | 4.73 | 4.50 |
| Primary budget balance (% of GDP) | -2.38 | -3.08 | -2.79 | -1.97 | -0.85 | 1.04 |
| Interest expense (% of GDP) | 1.99 | 2.13 | 2.23 | 2.27 | 2.22 | 2.06 |
| Budget balance (% of GDP) | -4.37 | -5.20 | -5.02 | -4.24 | -3.07 | -1.02 |
| Stock-flow adjustment (% of GDP) | 1.98 | 1.32 | 1.14 | 0.40 | -0.72 | -2.68 |
| Public debt (% of GDP) | 41.23 | 45.80 | 49.13 | 50.44 | 49.27 | 44.15 |
| **Baseline scenario** | **2010** | **2011** | **2012** | **2013** | **2014** | **2015** |
| Real GDP growth (% annually) | -1.19 | 1.09 | 2.45 | 3.27 | 3.76 | 4.06 |
| Nominal GDP growth (% annually) | -0.19 | 3.81 | 5.42 | 6.37 | 6.88 | 7.18 |
| Nominal interest rate (% annually) | 5.64 | 5.71 | 5.79 | 5.86 | 5.93 | 6.00 |
| Primary budget balance (% of GDP) | -2.38 | -3.08 | -2.79 | -1.97 | -1.23 | -0.49 |
| Interest expense (% of GDP) | 1.99 | 2.27 | 2.64 | 2.98 | 3.24 | 3.42 |
| Budget balance (% of GDP) | -4.37 | -5.35 | -5.43 | -4.94 | -4.46 | -3.92 |
| Stock-flow adjustment (% of GDP) | 1.98 | 2.97 | 3.05 | 2.58 | 2.13 | 1.60 |
| Public debt (% of GDP) | 41.23 | 48.03 | 54.03 | 58.32 | 61.16 | 62.58 |
| **Pessimistic scenario** | **2010** | **2011** | **2012** | **2013** | **2014** | **2015** |
| Real GDP growth (% annually) | -1.19 | -0.05 | 0.86 | 1.59 | 2.17 | 2.64 |
| Nominal GDP growth (% annually) | -0.19 | 2.65 | 3.78 | 4.63 | 5.23 | 5.71 |
| Nominal interest rate (% annually) | 5.64 | 6.01 | 6.39 | 6.76 | 7.13 | 7.50 |
| Primary budget balance (% of GDP) | -2.38 | -3.08 | -2.79 | -1.97 | -1.98 | -5.57 |
| Interest expense (% of GDP) | 1.99 | 2.42 | 3.09 | 3.83 | 4.57 | 5.41 |
| Budget balance (% of GDP) | -4.37 | -5.49 | -5.88 | -5.80 | -6.54 | -10.98 |
| Stock-flow adjustment (% of GDP) | 1.98 | 4.62 | 5.00 | 4.91 | 5.63 | 9.86 |
| Public debt (% of GDP) | 41.23 | 50.28 | 59.33 | 67.41 | 76.23 | 92.95 |

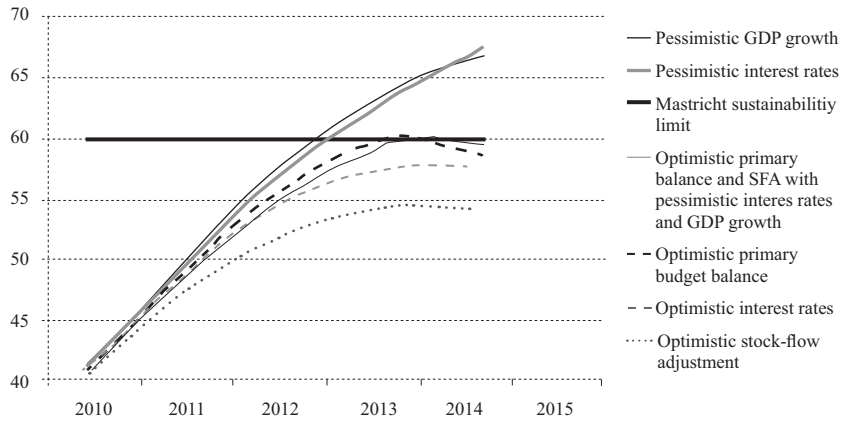
*Source: Author's calculation.*

The defined main three scenarios from the equation (2) are called optimistic, baseline and pessimistic and they relate to movements of all key variables from the model in the same direction. In other words, the optimistic scenario assumes optimistic movements of all variables, the baseline scenario the expected movements of all variables and the pessimistic scenario adverse movements of all variables that impact the change of public debt in defined model. Projections of all key variables and public debt sustainability testing in given conditions are shown in table 4.

Only in the case of the optimistic scenario does the public debt stay within the limit prescribed by the Maastricht criterion of 60% of GDP. Especially concerning may be the fact that in the defined baseline scenario up to 2015 the share of public debt in GDP exceeds that limit, although by only 3 percentage points. The pessimistic scenario predicts an extreme rise in the public debt to 93% of GDP. It is also interesting to observe different combinations of the main scenarios, as shown on figure 6.

**FIGURE 6**

*Movements and sustainability of the public debt in different scenarios (% of GDP)*




*Source: Author's calculation.*

Only two of the total six tested scenarios of key variable combinations fully satisfy the sustainability test in the period up to 2015. These are scenario with optimistic stock-flow adjustment and expected movements of other variables (54.3% of GDP in 2015) and scenario with optimistic interest rates and expected movements of other variables (57.8% of GDP). The scenario with an optimistic primary budget balance projection and expected movements of other variables and the scenario of a combination of optimistic primary budget balance and stock-flow adjustment and pessimistic nominal interest rates and real GDP growth slightly exceed the limit of 60% in 2014 (60.4%, or 60.3% of GDP), while as soon as 2015 the public debt again goes below 60% with shares equal to 58.8%, i.e. 59.8% of GDP.

The scenario with pessimistic nominal interest rates and the scenario with pessimistic GDP growth rates significantly exceed the sustainability limit with shares in GDP of 67.6%, i.e. 67.1% respectively.

As well as the above mentioned scenarios of the sustainability of the public debt with variables from equation (2), we will test sustainability with shock scenarios of variables from equation (10). Babić et al. (2003) use dynamic analysis with ten different scenarios for testing the sustainability of the public debt, and these are: scenario of the historical averages, "status quo" scenario, 5% scenario, interest rate shock scenario, real GDP growth shock scenario, public expenditure shock scenario, revenue shock scenario, scenario of combination of moderate shocks, depreciation shock scenario and contingent liabilities shock scenario. However, since individual shocks almost never occur, in this paper the attention will be drawn primarily to different combinations of these shocks. Table 5 shows baseline medium-term scenario of dynamic analysis of the public debt sustainability.

In a baseline medium-term scenario, public debt stays below the sustainability limit with a share of 45.8% of GDP in 2015. However, one of the main criticisms of the model is definitely the case of relatively high average annual residual in the period from 2002 to 2010, amounting to 1.6% of GDP with a standard deviation of 1% of GDP.

For the purpose of testing the sustainability of public debt up to 2015, we define four different scenarios that include historically recorded averages of some variables and combination of variables shocks. The first scenario is very similar to the baseline scenario from table 5, but projections include historical averages of recognized liabilities, unidentified flows and nominal exchange rate change in the whole period 2011-15. In addition to this scenario, we define the scenario with shocks of recognized liabilities, unidentified flows and nominal exchange rate change as historical averages enlarged by one standard deviation in the whole period 2011-15. Furthermore, we assume that the share of public debt denominated in foreign currencies will be kept at a level of 70% in the whole period.

The third shock scenario predicts the historically recorded average of unidentified flows in the period 2011-15 and shocks of recognized liabilities of the government amounting to 10% of GDP in 2011 and 5% in 2012. This scenario also predicts constant depreciation shocks of domestic currency (kuna) with regard to euro of 10% in 2011, 7.5% in 2012, 5% in 2013 and 2.5% in 2014. Furthermore, we assume that the share of the public debt denominated in foreign currencies will be kept on a level of 70% in the whole period. Shock of liabilities recognition is defined having in mind the constant increase of the share of potential debt in GDP in the last few years and the probability of some of the state guarantees being invoked. According to the Ministry of Finance (2010) data, at the end of 2010 total potential debt amounted to 17.5% of GDP, of which 13.3% of GDP related to issued guaran-

**TABLE 5**

*Baseline scenario of the public debt sustainability in the period 2010-15, with key variables and debt-creating flows projections*

| | Actual | | | | | | Projections | | | | | Average 2002-10 | Std. dev. 2002-10 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | | |
| 1) Public debt | 38.39 | 35.80 | 33.25 | 29.27 | 35.41 | 41.23 | 44.06 | 46.06 | 46.86 | 46.73 | 45.76 | 35.77 | 3.37 |
| 1a) Share of public debt in foreign currency | 26.83 | 22.52 | 19.46 | 16.74 | 23.32 | 29.15 | 29.08 | 28.55 | 27.18 | 25.23 | 22.88 | 21.99 | 3.93 |
| 2) Change in public sector debt (3+7) | 0.48 | -2.58 | -2.58 | -4.09 | 6.14 | 5.82 | 2.83 | 2.00 | 0.81 | -0.14 | -0.97 | 0.64 | 3.59 |
| 3) Identified debt-creating flows (-4+5+6) | -2.29 | -3.61 | -4.49 | -4.00 | 3.35 | 4.24 | 2.83 | 2.00 | 0.81 | -0.14 | -0.97 | -0.97 | 3.10 |
| 4) Primary budget balance | -0.52 | 0.33 | 0.79 | 0.63 | -1.54 | -2.38 | -3.08 | -2.79 | -1.97 | -1.23 | -0.49 | -0.75 | 1.13 |
| 5) Automatic debt dynamics (5a+5b+5c) | -2.70 | -2.37 | -2.80 | -3.16 | 1.42 | 1.95 | -0.35 | -1.09 | -1.56 | -1.77 | -1.86 | -1.53 | 1.87 |
| 5a) Contribution from real interest rate | -0.47 | -0.59 | -0.96 | -2.44 | -0.29 | 1.27 | 0.08 | -0.07 | -0.14 | -0.12 | -0.09 | -0.62 | 0.95 |
| 5b) Contribution from real GDP growth | -1.48 | -1.68 | -1.79 | -0.72 | 1.75 | 0.42 | -0.43 | -1.02 | -1.42 | -1.65 | -1.77 | -0.92 | 1.22 |
| 5c) Contribution from exchange rate change | -0.75 | -0.10 | -0.06 | 0.00 | -0.04 | 0.26 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.34 |
| 6) Other identified debt-creating flows (-6a+6b) | -0.10 | -0.90 | -0.90 | -0.20 | 0.40 | -0.10 | 0.10 | 0.30 | 0.40 | 0.40 | 0.40 | -0.20 | 0.43 |
| 6a) Privatization receipts | 0.50 | 1.40 | 1.00 | 0.30 | 0.20 | 0.10 | 0.20 | 0.20 | 0.10 | 0.10 | 0.10 | 0.58 | 0.51 |
| 6b) Recognition of contingent liabilities | 0.40 | 0.50 | 0.10 | 0.10 | 0.60 | 0.00 | 0.30 | 0.50 | 0.50 | 0.50 | 0.50 | 0.28 | 0.25 |
| 7) Unidentified debt-creating flows (residual) | 2.77 | 1.03 | 1.92 | -0.09 | 2.79 | 1.59 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.61 | 0.99 |
| Real GDP growth (in percentages) | 4.21 | 4.74 | 5.47 | 2.36 | -5.81 | -1.19 | 1.09 | 2.45 | 3.27 | 3.76 | 4.06 | 2.71 | 3.82 |
| Inflation (GDP deflator change) | 3.31 | 3.41 | 4.04 | 6.38 | 3.35 | 1.02 | 2.70 | 2.90 | 3.00 | 3.00 | 3.00 | 3.63 | 1.36 |
| Average nominal interest rate on public debt | 5.49 | 5.39 | 5.42 | 4.82 | 5.62 | 5.64 | 5.71 | 5.79 | 5.86 | 5.93 | 6.00 | 5.44 | 0.25 |
| Average real interest rate on public debt | 2.10 | 1.91 | 1.32 | -1.47 | 2.20 | 4.58 | 2.93 | 2.80 | 2.77 | 2.84 | 2.91 | 1.77 | 1.54 |
| Nominal exchange rate change (HRK/€) | -3.85 | -0.41 | -0.27 | -0.01 | -0.25 | 1.08 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.04 | 1.77 |

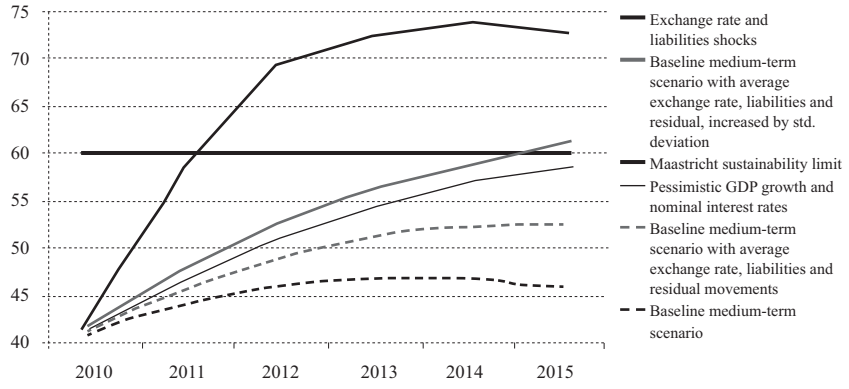
*Source: Ministry of Finance; IMF; Croatian Bureau of Statistics; Croatian National Bank; author's calculation.*

tees and 4.2% of GDP related to HBOR debt[6]. In the Public Debt Management Strategy for the period 2011-13 it is stated that during 2011 expected a takeover of some of the guaranteed liabilities according to the plans of shipyards restructuring may be expected. As the shipyards restructuring plans are accepted and because of their privatization, it can be expected that some of the mentioned potential liabilities will become direct government debt, with new conditions and multi-annual maturity of return (Ministry of Finance, 2011b). In Babić et al. (2003) an exchange rate shock of 30% was used, which the authors explained with the so-called *overshooting effect*, i.e. the phenomenon that moderate exchange rate corrections (for instance a currency devaluation of 10 to 15 percent) often cause strong market reaction after which the exchange rate rapidly slides more than would be necessary to solve the initial imbalance in the case of stabile conditions. The depreciation shock in 2011 that we use in this paper amounts to 10% and it is defined in accordance with shock used by the Croatian National Bank in its analyses of macroeconomic shocks on credit risk of enterprises (CNB, 2011). However, due to potential residual shocks arisen from this initial exchange rate shock, in this paper we use constant depreciation shocks up to 2014, but with decreasing intensity.

The last shock scenario is based on defined pessimistic real GDP growth and nominal interest rate projections from the previous part of the paper. Public debt movements in the baseline scenario and four other defined scenarios are shown on figure 7.

**Figure 7**

*Movements and sustainability of the public debt in different scenarios of dynamic analysis (% of GDP)*




*Source: Author's calculation.*

In the baseline scenario conditions, public debt stays sustainable with the share of 45.8% of GDP in 2015. Even when the average annual exchange rate, recognized

[6] In line with the Act on the Croatian Bank for Reconstruction and Development (HBOR) (Zakon o Hrvatskoj banci za obnovu i razvitak, NN 138/06) the state guarantees all its debts, so that the HBOR debt is often added to the total amount of guarantees.

liabilities and residual deviations are added, public debt records the share of 52.5% of GDP in 2015. Below the limit of 60% public debt stays also in scenario with pessimistic GDP growth and nominal interest rates with the share in GDP of 58.7%. In the baseline medium-term scenario with historically recorded exchange rate, liabilities and residual averages and enlarged by one standard deviation, public debt insignificantly exceeds the sustainability limit with a recorded share in GDP of 61.1%. Dynamic analysis of public debt sustainability shows the strongest sensitivity to combined liabilities and exchange rate shocks with a recorded share of 72.8% of GDP in 2015.

In the Public Debt Management Strategy in Croatia press release, Bajo and Primorac (2011) emphasize deficiencies in public debt management related to currency structure and potential liabilities. The debt currency structure is still far from optimal, since the share of foreign currency debt in total debt was over 70% in September 2010, while a target maximum amounts to 40%. Besides that, public debt management strategies have mainly been focused only on direct government liabilities. Including the information on the structure and maturities of government guarantees into the strategy would improve the public debt management and reduce the risks related to the amount and structure of the debt.

By taking everything mentioned into account, it is clear that public debt sustainability in the medium-term period highly depends on expectations of the future movements of variables that affect the change of public debt. In optimistic scenarios Croatian public debt may be mainly considered sustainable, but baseline scenarios give us two-sided results. In the model in which we use stock-flow adjustment, public debt in 2015 exceeds the limit of 60%, while in all other baseline scenarios it should remain sustainable up to 2015.

Sopek (2010) stresses that the limit of debt to GDP ratio of 60% is probably set too high for economies like Croatian, since emerging markets have much smaller chances to borrow on international financial markets, and, due to their generally lowest credit ratings, their terms of borrowing are far less favorable than those offered to developed countries. This can potentially cause huge problems, since the budget deficit in Croatia is mainly financed with new borrowings. In the Croatian Banking Association (2010b) analysis it is stressed that the sustainable ratio of public debt to GDP in developing countries is about 20 percentage points lower than that in advanced economies and according to several analyses the sustainable public debt for countries like Croatia totals between 40% and 50% of GDP. This conclusion is additionally confirmed by IMF (2003a) research results, according to which in 55 percent of the recorded government defaults, public debt was below 60% of GDP in the year before the default, and in 35 percent of the cases the default actually occurred at a debt ratio of less than 40% of GDP. Therefore the defined acceptable limit of public debt of 60% should definitely be interpreted with caution.

The burden of debt that will be left to future generations is also an important issue when considering the optimal public debt level. Future generations will be additionally burdened with a reform of the pension system and, almost certainly, of the health care system. Therefore, unnecessary public debt accumulation needs to be avoided. According to Smilaj (2004), the public debt burden will be equitably shared between the present and future generations only if it is used for investment in development programs which will be for the benefit of the future generations, too. Otherwise, future generations should be exempted from public debt burden.

## 6 CONCLUSION AND RECOMMENDATIONS

In times of crisis public finances are seriously threatened by budget balance destabilization and an increase in indebtedness. The current global financial crisis shows consequences to fiscal sustainability relatively similar to those of the crises recorded in history. Generally, higher public debt has several negative long-term economic consequences, like increase in long-term interest rates, limitations on room for countercyclical fiscal policy and lower future economic growth. Moreover, public debt will be left as a burden to future generations that will have to pay off not only the whole amount of the constantly increasing principal, but also the interest amounts.

Dynamic analysis results show that public debt may generally be considered sustainable in optimistic scenarios. Baseline scenarios give us two-sided results, so in the model in which we use stock-flow adjustment, public debt slightly exceeds the limit of 60% with the share of 62.6% of GDP in 2015, while in all other baseline scenarios it remains at levels of 45.8%, or 52.5% of GDP, by which it may be considered acceptable. The strongest vulnerability of the Croatian public debt in the conducted dynamic analyses can be noted in the parallel shocks of contingent liabilities and exchange rate, with a recorded share in GDP of 72.8%. Minor vulnerability is registered in the case of real GDP growth and nominal interest rates shock.

Hence, from the analysis results we may conclude that sustainability of the Croatian public debt up to 2015 depends highly on future movements of variables that affect change in the public debt. We may also conclude that in the observed five years period there are many risks that threat at the sustainability of the Croatian public debt and that continuous monitoring and strategic managing of public debt should be definitely taken into account. As well as risks that are directly influenced by the fiscal policy, i.e. future budget balances, there are also some significant indirect risks. Among these risks related to unfavorable currency structure of the debt and risks of potential liabilities activation, primarily issued state guarantees, should be mentioned without fail. To a lesser extent, but not negligibly, an adverse economic situation and an increase in interest rates may also produce risks for the sustainability of the public debt.

This whole analysis should be continuously improved by adding and monitoring the variables that are in this analysis considered as given and which could not be better analytically examined from the publicly available data. One should definitely try to find out reasons for relatively high stock-flow adjustment and investigate if the statistics can be improved and how. Improving the accounting recordings of budgetary operations would definitely lead to better quantification of the public debt movements in the future.

In the Public Debt Management Strategy, baseline public debt projections should be explained by an analytical model, and stress testing by the main categories elaborated in this paper should be included. Furthermore, there should be an endeavour for a better and more transparent recording of all potential liabilities of the government by information on issued guarantees, their maturity and level of risk should be made publicly available. This may help to manage and mitigate exposure to such risks.

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