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Sustainability of Local Government Sector Debt. Evidence from Monte-Carlo Simulations

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ABSTRACT The financial standing of local governments across the European Union was strongly affected by the economic crisis. The local government sector conducted vast investment policies reaching 10.2% of all investments in the EU countries in 2010. However, at the same time its indebtedness expanded significantly. The current low interest rate environment makes the sector vulnerable to future interest rate increases. The presented research analyses the impact of several scenarios of interest rate changes in Poland on the local governments' ability to service their current debt burdens. Simulations are conducted with the Monte Carlo method. Some scenarios indicate a high vulnerability of local governments to adverse changes in market interest rates, but only if they are combined with a reduction of sector's operating surplus. Such an economic setup may give rise to systemic problems for the whole public sector.

KEYWORDS: • local government • debt sustainability • interest rate increase • Monte Carlo method

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1 Introduction

The methods of financial risk assessment and scenario testing have been employed in finance and economics for a long time. Initially, they were mostly used by banking and insurance sector supervisory bodies as well as the individual market players. They aimed to monitor the financial position of single entities and whole sectors in order identify vulnerabilities to different types of risks and plot future scenarios so as to mitigate adverse consequences. They evolved into stress testing methods, whose significance has additionally grown since the outbreak of the financial crisis in 2008. A comprehensive description of the methodologies used in the testing is presented, i.a. in (Vasilopoulos, 2013), and guidelines are in (BIS 2011, 2013).

Simultaneously, numerous analyses devoted to fiscal sustainability of individual countries have been made. Research in this area has intensified since 2008, when several Mediterranean European Union (EU) members experienced serious fiscal troubles. For example, the sustainability of sovereign debt for Greece is analyzed in (Cline, 2013) and (IMF, 2013). Debt projections for numerous alternative scenarios for Italy and Spain are presented in (Cline, 2012b), confirming future debt stability in these countries. The impact of interest rate shock on Italy's Sovereign Debt is presented in (Cline, 2012a), showing both the maximum sustainable interest rate level as well as contingent risks from such scenarios as liquidity squeeze. (Eller, Urvova, 2012) conduct a thorough analysis of public debt sustainability in Central and Eastern European Countries, based on the stochastic debt sustainability analysis. This research in general confirms the debt stability of these countries in the medium term, although they also show that the primary balance is not responsive enough to fiscal and macroeconomic shocks.

Analyses of country sustainable debt levels are conducted by (Ghosh et al., 2013). Using stochastic models authors derive the areas of fiscal solvency failures for individual countries. They also show that the marginal response of the primary balance to lagged debt (ie. fiscal multipliers) is non-linear. It remains positive at moderate debt levels but starts to decline when debt reaches around 90–100% of GDP. Similar conclusions for the EU countries are delivered by stochastic simulations of debt ratios in (Medeiros, 2012), confirming that a fiscal fatigue is associated with high sovereign debt levels regardless of an initially positive primary balance. Simultaneously, budgetary policy reacts to lagged debt and the current output gap, allowing for partial reversion of past trends. The analyzed phenomena do not limit to changes in a monetary and fiscal policy. They also encompass demographic issues. For example, the impact of population ageing on the public finances of the euro area is analyzed in (Balassone et al., 2011). This research shows under which demographic and economic scenarios certain social policies and provision of public goods such as pensions, health care, and education may become unsustainable in a long-term horizon.

The recent crisis had also a negative impact on local government (LG) budgets across the EU. The adverse economic environment influenced in a negative way the financial standing of LGs and questioned the sustainability of their investment policies. In 2013, LG investments in relation to GDP amounted to 1.6%, i.e. the lowest level since 2005. Their share in total investment dropped from 10.2% in 2010 to 8.6% in 2013, but still remain an important component of aggregate demand. The LGs' debt to GDP ratio in the EU countries grew from an average of 5.5% in 2008 to 7.7% in 2013. In Central European countries, indebtedness of the LG sector is lower than in the EU-15, although it also has grown since 2008 (see Table 1).

Table 1: The LG debt as % of GDP in Central European countries.

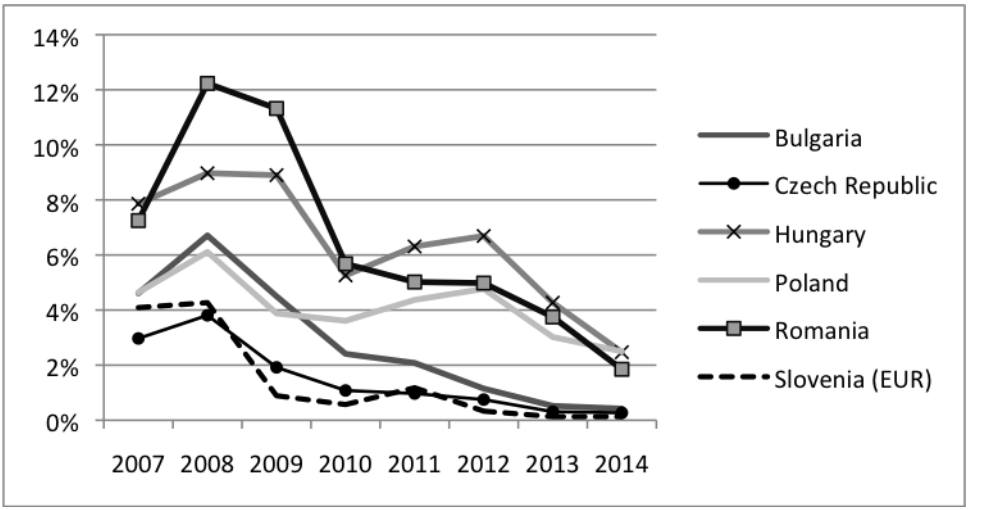
	2008	2011	2013
Bulgaria	0.6%	1.3%	1.2%
Czech Republic	2.1%	2.5%	2.8%
Hungary	3.7%	3.9%	1.6%
Poland	2.0%	4.0%	4.3%
Romania	1.7%	2.5%	2.5%
Slovenia	0.9%	1.9%	2.1%
Slovakia	1.7%	2.5%	2.3%

Source: Eurostat

Such a situation may hinder future economic growth from three basic perspectives: a decrease in investment demand, negative side effects of fiscal consolidation and a growth of credit risk. The impact of fiscal policy tightening on growth is analyzed in (Barrell et al. 2012). It shows the possible adverse impact of fiscal consolidation on growth in the short-term horizon. Macroeconomic risks associated with deleveraging, including their impact on consumption, are modelled in (Eggertsson, Krugman, 2012). There is also indicated a risk that increased productivity can reduce output in the case of the deleveraging process. Flaws of the fiscal austerity model for municipalities as a response to the crisis are in (Peck, 2014) and (Donald et al. 2014). The worsened risk profile of local governments is analyzed in (Vammalle, Hulbert, 2013). It is important to notice that since 2010, the local government sector in the EU countries has experienced an overall decrease in its productivity, accompanied by a relative deterioration of its financial standing. This research is presented in (Author, 2014).

The above-mentioned negative factors and macroeconomic processes were partly alleviated by the low interest rates environment, which reduced the impact of high debt on LGs' operating surpluses and postponed the deleveraging process, so far. However, that exposed the sector to future negative scenarios as the debt levels remain remarkably high. As the Figure 1 shows, the trend of decreasing interest rates was very strong among the Central European countries.

Figure 1: Interbanking interest rates (1-month rates) in the Central European countries



Source: Eurostat

This research investigates the impact of interest rates increase on the LGs' ability to service their current debt burden. Firstly, it presents information on LG indebtedness and operating surpluses as well as trends in the cost of financing and banks' interest margins. Then, it conducts an analysis of the financial standing of Polish LGs from the corporate finance perspective. That includes the calculation of ratios based on free operating cash flow, which unfortunately are seldom considered by public sector entities. The constructed risk measures are based on (Palepu et al. 2004, ch. 9 and 14) and (Peterson, 1998), who describes a dedicated approach to measure and manage LG credit risk.

The second part of this paper is devoted to simulations of risk profile variations under specific scenarios of interest rate changes. The modelling is conducted with the use of the Monte Carlo method, developed by Metropolis and Ulam (1949). Monte Carlo simulations are useful tools in finances. They are employed, inter alia, for estimating the value of real estate investments (Kelliher, Mahoney, 2000), risk of investment projects (Pawlak, 2012), valuation of companies (Białas, 2012) as well as the evaluation of public sector policies for example in the health care sector (CP Yeh et al. 2014). The method has also a vast application in the banking sector in credit risk assessment (Chyliński, 1999). The method involves random sampling of variables representing probability distributions for particular financial parameters. In this research, it allows us to measure changes of debt repayment capacity for LGs and their vulnerability to interest rate changes as well as other scenarios.

The third part of the paper briefly discusses the current statutory limit on LG debt in Poland, which is defined in the par. 243 of Public Finance Law (PFL, 2009). Based on the results of the simulations, some changes in formula of this statutory ratio are recommended in order to increase the sector's protection against adverse economic scenarios.

2 Methodological notes

The empirical analysis encompasses all local governments (LGs) in Poland, i.e. 2,809 entities: rural boroughs (RB), municipal-rural boroughs (MRB), municipal boroughs (MB), towns with county rights (TWCR), counties and provinces. All data about Polish LGs used in this research comes from the BESTI@ system run by the Ministry of Finance of Poland. Data regarding the European Union countries, including interbanking interest rates, comes from the Eurostat online database at http://ec.europa.eu/eurostat/data/database. Calculations for the Monte Carlo method were conducted with Microsoft Excel 2010 and Microsoft Visual Basic for Applications 7.0. Random numbers were generated with the Excel RAND function (pseudorandom number generator).

Note that the analyzed debt of LGs does not include the liabilities of LGs' public health care entities, which amounted to PLN 3.9 bn at the end of 2013, as well as liabilities of cultural entities and similar institutions (PLN 0.5 bn). Including these contingent liabilities in LG debt would raise the gross debt to total revenues ratio in 2013 from 37.7% to 40.1% (without increasing the denominator by the revenues of these entities). The debt ratios also do not include the debt of utilities and other municipal companies, which are separate legal entities.

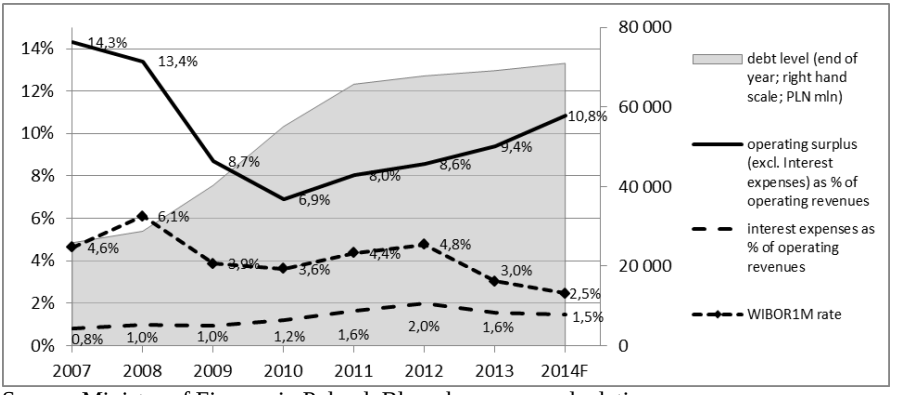
3 Local governments in Poland – overview of financial standing and external financing

During the recent economic crisis, there were three major factors which influenced the level of interest expenses in Polish LGs. These were the level of market interest rates, the interest margin asked by financial intermediaries and demand for new financing.

The Polish economy has recorded a strong drop in interest rates since 2008. The first cycle was in the 2009-2010 period, when the average WIBOR 1M rate reached 3.6% in 2010. Then, after moderate tightening of monetary policy in the 2011-2012 period, a liberal cycle started again, which brought the WIBOR 1M rate to record low annual averages in 2013-2014: 3.0% and 2.5% respectively (see Figure 2). In addition, low interest rates were accompanied by stabilization of interest margins on LG external debt.[1] Although the margins did not reach the very low pre-crisis levels of approx. 0.25%, they converged gradually from 1.5%-2.0%

in 2009 to approx. 0.9%-1.0% in 2014. This clearly facilitated acquiring new financing by LGs.

Figure 2: Operating surplus, interest expenses, market interest rates and debt level of the LG sector

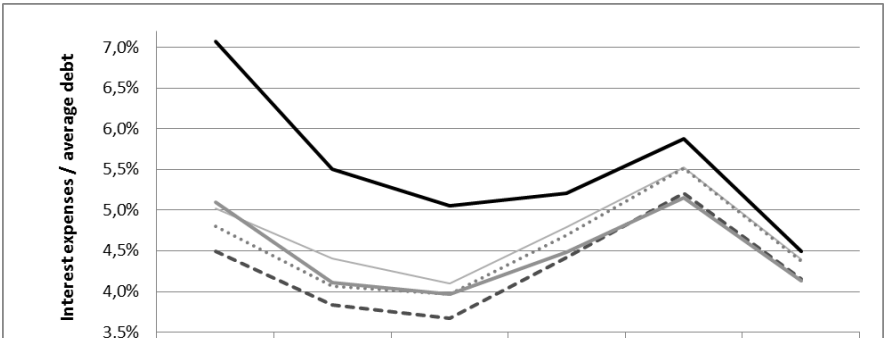


Source: Ministry of Finance in Poland, Bloomberg, own calculations

Simultaneously, the debt of the LG sector in Poland increased from PLN 28.8 bn in 2008 to PLN 69.2 bn in 2013, with an annual growth rate (CAGR) of 19%. In relative terms, it grew from 2.3% of GDP in 2008 to 4.2% of GDP in 2013. To some extent, this was a result of a slowdown of their revenue growth combined with an increased amount of carried out commissioned tasks. However, growth of LG investments was the most important factor responsible for the debt build-up. LG investments amounted on average to 13% of total investment in the Polish economy in the 2008-2013 period. The peak stage of LG investment spending took place in the 2009-2010 period, with their 3.2% share in GDP. In 2013, LG investments dropped to 2.1% of GDP, the lowest for the last eight years, showing that former sizable investment policies of LGs appeared to be hardly sustainable in the context of servicing the accumulated debt burden.

As the result of the above phenomena, the interest expenses of LGs visibly fluctuated during the economic slowdown period. Initially they grew from 0.8% of operating revenues in 2007 to 2.0% in 2010. Then, despite the growing debt level they were gradually falling, with a forecasted value of 1.5% for 2014 (see Figure 2). Compared to average debt, interest expenses changed in a similar way, though with a more moderate magnitude. In addition, this indicator was much more diversified among LG subcategories in the beginning of the crisis in 2008 than in 2013. Currently, it converged to the level of 4.1%-4.5% for all subcategories (see Figure 3).

Figure 3: Interest expenses in relation to debt level – break down by local government subcategories



	2008	2009	2010	2011	2012	2013
County	7,07%	5,50%	5,06%	5,20%	5,87%	4,50%
MB	5,02%	4,41%	4,10%	4,79%	5,53%	4,40%
MRB	4,80%	4,06%	3,97%	4,70%	5,51%	4,37%
RB	4,49%	3,84%	3,67%	4,42%	5,21%	4,15%
TWCR	5,10%	4,11%	3,96%	4,48%	5,15%	4,14%

Source: Ministry of Finance in Poland, own calculations

Lower interest expenses created a space for LGs for additional external financing. However, higher debt generates credit risk arising, i.a. from refinancing perspective and from interest rate increases, since the whole LG debt in Poland is based on floating interest rates.

The LG risk profile can be analyzed based on statutory debt ratios as well as using the corporate finance approach. Flaws of statutory debt ratios from a risk assessment perspective are shown in (Author, 2015). The preferred alternative is the usage of such ratios as EBITDA/GI and FOCF/ND, which show debt service capacity and net indebtedness of LGs in relation to their operating flows.[2] Indicators based on total debt service (encompassing both principal and interest payments), e.g. debt service to recurring revenues as proposed by (Peterson 1998), are not recommended for assessment of Polish LGs due to the high level of refinancing loans and bonds each year by LGs in Poland. As a result, such indicators are highly distorted.

In the case of EBITDA/GI, the typical warning signal is generated if this indicator is below the value of 2.0 for a given entity. Values below 1.0 show alarmingly low debt service capacity, approaching Ponzi-schemes. In the case of FOCF/ND, this indicator should amount to at least 20% for financially sound entities. The values below 10% denote alarmingly high indebtedness.

The indicators for the total LG sector (see Table 2) show that the worst financial situation of Polish LGs was in 2011. Although in 2013 there was some improvement of indicators based on operational surpluses, the free resources of LGs were systematically reduced as the net debt grew, and in 2013 for the first time it exceeded 30% of their revenues. In addition, the improvement between the years 2011 and 2013 was to a large extent the effect of a drop in market interest rates. In 2011, the average WIBOR 1M rate amounted to 4.37% compared to 3.04% in 2013, which had a direct impact on EBITDA/GI ratios.

The financial standing of LGs strongly differs between LG subcategories as presented in Table 2 below. Notably, the rural boroughs hold relatively low debt as well as adequately large operating surpluses to service it. TWCR have the worst financial standing among LGs from the perspective of debt service capacity. Their Net debt/Total revenues ratio already reached 40% in 2013 and their average FOCF/ND ratio is dangerously low – for the last four years it has fluctuated around the 20% level. As a result, more than half of TWCR do not exceed the 0.2 threshold regarded as a safe level for the FOCF/ND ratio. Moreover, 17% of TWCR have an EBITDA/GI ratio below 2.0.

Table 2: Financial standing changes – break-down by local government subcategories

	2008	2011	2013		2008	2011	2013
	TWCR (65 entities)				RB (1571 entities)		
EBITDA/Gross Interest	10.39	3.42	4.33		24.06	7.84	10.05
% of LGs with EBITDA/GI below 2.0	3%	22%	17%		3%	14%	2%
FOCF/Net Debt	0.90	0.18	0.21		11.58	0.44	0.59
% of LGs with FOCF/Net Debt below 0.2	5%	62%	57%		5%	32%	15%
	MB (241 entities)				Counties (314 entities)		
EBITDA/Gross Interest	14.10	4.46	5.57		6.69	5.23	5.71
% of LGs with EBITDA/GI below 2.0	8%	22%	10%		15%	12%	9%
FOCF/Net Debt	2.15	0.25	0.30		1.58	0.39	0.35
% of LGs with FOCF/Net Debt below 0.2	8%	44%	31%		13%	25%	26%
	MRB (602 entities)				Provinces (16 entities)		
EBITDA/Gross Interest	14.33	5.05	6.50		32.77	7.52	7.20
% of LGs with EBITDA/GI below 2.0	4%	20%	5%		0%	6%	0%
FOCF/Net Debt	1.54	0.27	0.34		no ND	0.43	0.35
% of LGs with FOCF/Net Debt below 0.2	8%	44%	26%		0%	12%	12%
	Total LG sector						
EBITDA/GI	13.76	4.94	5.96				
% of LGs with EBITDA/GI below 2.0	5%	16%	5%				
FOCF/ND	1.75	0.27	0.31				
% of LGs with FOCF/ND below 0.2	7%	36%	21%				
Net Debt / Total revenues	7.7%	29.3%	30.3%				

Source: own analysis

4 Monte-Carlo simulations of debt service indicators

The above analyses show that several local governments have a relatively constrained financial standing at the end of 2013. This makes them vulnerable to future interest rate increases. Simulations of changes in the financial standing of local governments with respect to different economic parameters may be carried out with the Monte Carlo method. This method was initially described by (Metropolis and Ulam, 1949). A detailed description of the method and its vast applications can be found, for example, in (Hendry, 1984) and (Niemiro, 2013). In short, the method, instead of solving a numerical problem, is based on estimating a solution with the use of a random variable. The variable is chosen n times in a series of independent drawings. With the increasing number of repetitions, the obtained solution tends to be an effective estimator of the mean of simulated phenomenon. The random numbers used in simulations should reflect a relevant distribution consistent with the properties of the analyzed process.

Monte Carlo simulations are often used in solving risk assessment problems in financial analysis. In this research, triangular distributions of variables were implemented in the simulations. Such distributions are preferred in simulating many phenomena in finance and risk areas due to their natural ease of reflecting scenarios for which there are predicted both the asymmetric changes of variables and the most likely outcome (Chyliński, 1999). From the perspective of this research, their additional desired property is that they do not have thick tails or an infinite range, which would result in a non-zero probability of breaching the warning signal for any LG with a growing number of iterations.

A triangular distribution is a continuous probability distribution with a probability density function shaped like a triangle. It is defined by three values: the minimum value (min), the maximum value (max), and the peak value (mode), where min ≤ mode ≤ max.
The probability density function is defined as:

$$fx=2(x-min)(max-min)(mode-min),min\leq x<mode1-2(max-x)(max-min)(max-mode),mode\leq\&x\leq max$$

The cumulative distribution function is defined as:
Fx=(x-min)2(max-min)(mode-min),min≤x<mode1-(max-x)2(max-min)(max-mode),mode≤&x≤max

For the purpose of conducting the simulations, the inverse function of the cumulative distribution function is used. It has a form as follows:
F-1P=min+P(max-min)(mode-min),p<mode-minimax-minimax-(1-P)(max-min)(max-mode),P≥mode-minimax-min

In the simulations P is drawn randomly from the <0, 1> uniform distribution. In the case of the Monte Carlo method it is also important to determine the adequate number of iterations. The method assesses the estimation error based on the number of repetitions. It is possible to derive the minimal required number of repetitions for a specific error level, using the equation as follows:

$\varepsilon=3\sigma N$,

where σ is the standard deviation of the random variable and N is the number of repetitions. For the triangular distribution the variance (σ^2) and the mean (x) are defined as:

$x=min+mode+max3,$

$x=min+mode+max3,\ \sigma=min2+mode2+max2+min\ mode+min\ max+mode\ max18$

The distributions analyzed in this paper are within the range <80%·mode; 120%·mode> and <80%·mode; 140%·mode> depending on the parameter and the scenario (see Table 4). That brings the minimal required number of iterations to N = 49 for 5% expected value error, N = 308 for 2% expected value error or N = 1230 for 1% expected value error. Since this research is devoted to depicting some general trends in credit standing changes for local governments, it does not require the top precision (i.e. a very high number of iterations) which is time and capacity consuming. However, as Figure 4 shows, 50 iterations may not adequately reflect the desired distribution.

Figure 4: Histograms for triangular distributions obtained with various numbers of iterations

Note: presented distributions have the same parameters i.e. mode = 100 and the range: <80%·mode; 140%·mode>.

To find an acceptably small value for the number of iterations, goodness of fit tests (c^2) were conducted between distributions presented on Figure 4. The 5000-iteration distribution was compared with other distributions depicted in Figure 4. The results of the tests, presented in Table 3, demonstrate that 50-iteration distribution is close to significant difference from a model distribution (5000 iterations): p-value 7.77%, thus it does not have the properties of a desired triangular distribution. Increasing the number of iterations to 100 significantly increases certainty that the obtained distribution is not statistically different from the model distribution (p-value 22.24%). As a result, all simulations of LG financial ratios were conducted with 100 drawings of the random variable.

Table 3: The results of goodness of fit tests (χ^2) between the model distribution (5000 iterations) and distributions obtained with smaller number of iterations.

5000-iteration distribution compared to:	χ^2 statistics	p-value
50-iteration distribution	15.52	7.77%
100-iteration distribution	11.84	22.24%
200-iteration distribution	7.70	56.45%

Note: all analyzed distributions have the same parameters, i.e. mode = 100 and the range: <80%·mode; 140%·mode>. Degrees of freedom = 9.

The Monte Carlo simulations were run for four financial categories: operating revenues, operating expenses (excl. debt service expense), debt service expenses, cash and cash equivalents (balance sheet category). Based on the simulation results, the ratios of EBITDA/GI and FOCF/ND were calculated for the next year. The simulated financial categories are independent from each other. In practice, some indirect dependence takes place, especially between operating revenues and operating expenses, as decision-makers take into consideration operating deficit among other key indicators during the budgeting process. However, the interdependence of these two categories is not strict since usually a larger proportion of expenses is fixed (in nominal terms or as indexed categories) compared to revenues, which are more flexible and subject to current managerial and political decisions.

Table 4 shows assumptions for each evaluated scenario. In the 'status quo' scenario, the nominal growth of operating revenues and operating expenses is the only change and the random variables change within a relatively conservative range of <80%·mode; 120%·mode> leading to an improved financial situation of LGs in the next year. Other scenarios test the impact of interest rate increases on LGs' financial standing. Scenarios 2A, 2B and 2C are designed under the assumption of a 100 bps interest rate increase. The 2A scenario tests the sole impact of higher interest rates, i.e. there is only a change of the mode value for

debt service expenses. In the 2B scenario, there is also a simulated change of random variable distribution – max parameter increases from 120%·mode to 140%·mode. Such an effect is very likely to occur for two basic reasons. Firstly, with the growing interest rates, more indebted borrowers tend to reduce payments of principal (negotiate a new repayment schedule) in order to maintain the stable level of financial outflows. As a result, the average debt level is higher, leading to higher interest expenses. Such a situation was common in Poland in the 2009-2012 period. Secondly, due to the adverse impact of higher interest rates on LG's financial standing, interest margins on a new and refinanced debt are higher. The 2C scenario is similar to the 2B scenario, but also includes a decrease of cash and cash equivalents in LGs as a result of the interest increase. It encompasses more completely the main effects of an interest rate increase on LG's financial standing.

The 3A, 3B and 3C scenarios test the increase of interest rates by 150bps with the same assumptions as in the 2A, 2B and 2C scenarios. The last group of scenarios – 4A, 4B and 4C – is an option of additional stress testing of an 150 bps interest rate increase. It shows what the effect will be if, in addition to simulation from the 3A, 3B and 3C, we assume a slightly higher value of the max parameter for operating expenses, ie. 130%·mode. A comparison of all the scenarios is presented in Table 4. The simulations for these scenarios were conducted for each local government in Poland. As a result, 5 618 000 observations were obtained (for ratios EBITDA/GI and FOCF/ND).

Table 4: Scenario assumptions for Monte Carlo simulations

	1. Status quo scenario		
	min	mode*	max
Operating revenues	-20%	102	20%
Operating expenses (excl. debt service expenses)	-20%	102	20%
Debt service expenses	-20%	100	20%
Cash and cash equivalents	-20%	100	20%

	2A. Scenario			2.B Scenario			2.C Scenario		
	min	mode*	max	min	mode*	max	min	mode*	max
Operating revenues	-20%	102	20%	-20%	102	20%	-20%	102	20%
Operating expenses (excl. debt service expenses)	-20%	102	20%	-20%	102	20%	-20%	102	20%
Debt service expenses	-20%	**125**	20%	-20%	**125**	**40%**	-20%	**125**	**40%**

Cash and cash equivalents	-20%	100	20%	-20%	100	20%	-20%	**80**	20%

	3A. Scenario			3.B Scenario			3.C Scenario		
	min	mode*	max	min	mode*	max	min	mode*	max
Operating revenues	-20%	102	20%	-20%	102	20%	-20%	102	20%
Operating expenses (excl. debt service expenses)	-20%	102	20%	-20%	102	20%	-20%	102	20%
Debt service expenses	-20%	**140**	20%	-20%	**140**	**40%**	-20%	**140**	**40%**
Cash and cash equivalents	-20%	100	20%	-20%	100	20%	-20%	**80**	20%

	4A. Scenario			4.B Scenario			4.C Scenario		
	min	mode*	max	min	mode*	max	min	mode*	max
Operating revenues	-20%	102	20%	-20%	102	20%	-20%	102	20%
Operating expenses (excl. debt service expenses)	-20%	102	**30%**	-20%	102	**30%**	-20%	102	**30%**
Debt service expenses	-20%	**140**	20%	-20%	**140**	**40%**	-20%	**140**	**40%**
Cash and cash equivalents	-20%	100	20%	-20%	100	20%	-20%	**80**	20%

* mode = 100 denotes using as a mode the value from the previous year for the given financial category;
e.g. mode = 102 denotes using as a mode the value from the previous year increased by 2%.
Note 1: min and max parameters are presented as % difference from mode value.
Note 2: Values in bold indicate the parameters changed in different scenarios in comparison with the 'Status quo' scenario.

A summary of the simulation results is in Table 5. Proportions of local governments which exceed warning levels for EBITDA/GI and FOCF/ND indicators are presented there. The warning levels of 2.0 and 0.2 for EBITDA/GI and FOCF/ND, respectively, are typical thresholds which, in the case of commercial entities, indicate high risk of non-repayment of the existing debt. However, in the case of public sector entities, which by definition do not face market risk and have legislative instruments to secure additional revenues, these levels are rather of an indicative nature, showing the overall financial strength of the sector. The alarming levels for EBITDA/GI and FOCF/ND ratios amount to 1.0 and 0.1 respectively.

Assumption of the unchanged interest rates results in a slightly improved financial standing of LGs as presented in Scenario 1, due to a growth of LG operating

surplus. Other scenarios, assuming the increases of interest rates, show modest deterioration of LG finances. Firstly, it is worth to noticing that the increase of interest rates in a range of 100 bps – 150 bps (Scenarios 2-3) does not produce a significantly negative impact on LGs. The proportion of LGs with EBITDA/GI ratios below 1.0 grows from 1.4% (40 entities) to 2.0%-2.5% (up to 70 entities). A more visible change is perceptible from the perspective of the 2.0 value of the indicator. The scenarios show that approx. 10% of LGs are located in this warning area. An additional 2-3% of entities may migrate there, although the probability of such a situation is below 50% (this is reflected by the 'hitting the barrier' ratio in Table 5). Corresponding FOCF/ND ratios reflect the inferior financial standing of LGs; however, the predictive and warning power of these indicators is lower than in the case of EBITDA/GI.

The stronger alarming picture comes from the Scenarios 4A-4C, which also assume an additional growth of operating expenses. Combining interest rate increases with a diminished operating surplus means that over 10% of LGs may have EBITDA/GI ratios below 1.0 and close to 20% of LGs may have FOCF/ND ratios below 0.1. Moreover, an additional 30% of LGs are likely to experience occasionally EBITDA/GI ratios below 1.0 under the employed triangular distribution. This indicates a high vulnerability of local governments with a currently weak financial standing to adverse changes in market interest rates, but only if they are combined with a reduction of their operating surplus. Such an economic setup may give rise to systemic problems for the whole public sector.

Table 5: Results of Monte Carlo simulations for all local governments

	EBITDA/GI				FOCF/ND			
% of all LGs	ratio below 1.0	hitting the 1.0 barrier*	ratio below 2.0	hitting the 2.0 barrier*	ratio below 0.1	hitting the 0.1 barrier*	ratio below 0.2	hitting the 0.2 barrier *
Initial situation (real data for 2013)	1.4%	-	4.7%	-	4.8%	-	21.0%	-
1. Status quo scenario	1.4%	1.4%	4.5%	4.5%	4.7%	7.4%	20.1%	29.3%
2.A Scenario	2.0%	2.0%	7.8%	7.8%	4.7%	7.6%	20.2%	29.9%
2.B Scenario	2.1%	2.5%	8.8%	10.3%	4.7%	7.6%	20.2%	29.9%
2.C Scenario	2.1%	2.4%	8.7%	10.1%	5.0%	8.0%	21.9%	30.8%
3.A Scenario	2.3%	2.3%	9.5%	9.5%	4.8%	7.7%	20.8%	30.2%
3.B Scenario	2.5%	2.9%	10.7%	12.4%	4.7%	7.2%	20.3%	28.8%
3.C Scenario	2.5%	2.9%	10.7%	12.7%	4.9%	8.0%	21.0%	30.8%
4.A Scenario	10.4%	40.4%	23.5%	54.4%	16.8%	42.2%	36.8%	56.2%
4.B Scenario	12.1%	43.0%	26.6%	58.8%	18.3%	42.7%	38.0%	56.7%
4.C Scenario	11.6%	45.2%	26.6%	60.1%	18.5%	45.3%	39.2%	59.5%

* This ratio indicates % of entities which have in their ratio simulated distributions at least one observation below the indicated ratio level. Although the average value of a given ratio

for such entities may be above the warning level, there exists a perceptible probability that a specific scenario may end up with them falling below the warning level.
Note: the statistics are shown for the mean values of each entity's distribution.

5 Analysis implications for statutory debt ratios

Maximum debt levels for LGs are regulated in Poland by the Public Finance Law (PFL).[3] At the beginning of 2014, the new debt limit was introduced as a statutory ratio for LGs.[4] It is defined in par. 243 of the PFL. It states that for an n-th year the relationship of financial outflows to total revenues (Left Hand Side of equation) cannot exceed the 3-year average surplus defined as the relationship of operating revenues plus sales of fixed assets minus operating expenses to total revenues (Right Hand Side of equation, RHS). The formula from par. 243 of the PFL is as follows:

$$\frac{Financial\ outflows}{Total\ Revenues}\ n \leq 13 * Dbn-1+Smn-1-Wbn-1 Total\ Renenuesn-1+Dbn-2+Smn-2-Wbn-2 Total\ Renenuesn-2+Dbn-3+Smn-3-Wbn-3 Total\ Renenuesn-3$$

where:
Financial outflows – sum of installment payments (incl. refinancing) and interest expenses for loans, bonds and other instruments classified as financial liabilities.
Db – operating revenues.
Sm – gross revenues from sale of fixed assets.
Wb – operating expenses (including interest expenses).
The financial liabilities and flows related to the EU co-financed projects are excluded from the formula.

The above formula (RHS) derives LG debt capacity based on their historical revenues and expenses, including interest expenses. As a result, lower interest rates explicitly create room for higher LG debt, regardless of future interest rates predictions. Such a situation generates a perceptible risk that the debt levels achieved during the low interest rate periods will become unsustainable from a debt service perspective in the case of a reversed interest rate cycle. The Monte Carlo simulations show that within a reasonable range of interest rate increases more than 10% of LGs (i.e. 300 entities) may be strongly negatively affected by such a scenario and result in credit default events.

To avoid such crucial risk for the public sector, and consequently for the whole economy, it is important to reconsider the design of the statutory debt limit from par. 243 of the PFL. From this perspective, two specific changes should be implemented. Firstly, the statutory debt limit should take into account not only the historical results of a given entity, but also a two- or three-year financial forecast as well. The forecast should be based on economic projections published by the central government in the Budget Act. Secondly, the forecasted financial statements should contain sensitivity analysis, including the tests of different

interest rate levels. The annual debt ceiling for a given LG should be determined based on testing the negative scenario projections such as an interest rate increase of 100-200 bps. Such an approach would create an appropriate financial cushion for future adverse scenarios.

6 Concluding comments

The recent economic crisis had a visibly negative impact on public sector finances, including local government budgets. As a result of weaker operating surpluses and implementation of active investment policies, local governments' indebtedness increased significantly across the European Union. Such a situation poses a threat to the sustainability of certain public policies in the context of future debt repayments and the required deleveraging process. In addition, some local government categories, like highly indebted major municipalities, may become a burden on central budget finances in the case of further negative macroeconomic shocks.

Until now, these risks were partly mitigated by the gradual decrease of market interest rates, which relieved local governments' expenditure budgets. However, the current low interest rate environment makes the sector vulnerable to future interest rate increases. This research contains an analysis of the impact of interest rate changes on the local governments in Poland from the perspective of financial ratios based on free operating cash flow and operating surplus (EBITDA/GI and FOCF/ND ratios). Simulations were conducted with the use of the Monte Carlo method applied to triangular distributions of individual entities' operating revenues, operating expenses, interest expenses and liquid receivables (cash equivalents).

The simulations showed that interest rate increases in the range of 100 bps-150 bps cause only a modest deterioration of local government financial standings as only 2.0%-2.5% of entities will exhibit alarmingly low space for debt servicing, compared to the current proportion of 1.4%. The strong warning signal comes from the last group of scenarios (Scenarios 4A-4C), where the interest rate increases are combined with a diminished operating surplus. In such circumstances, more than 10% of local governments migrate to the range of alarmingly low debt service indicators. Moreover, an additional 30% of entities move occasionally to this range, depending on the Monte Carlo iteration, i.e. although on average they have higher EBITDA/GI ratios, in some drawings they end up below the 1.0 value for this ratio.

This indicates a high vulnerability of local governments with a currently weak financial standing to adverse changes in market interest rates, but only if they are combined with a reduction of their operating surplus. Such an economic setup may give rise to systemic problems for the whole of the public sector.

The above situation requires reconsideration of statutory debt limits in Poland, in order to design more resilient regulations to such adverse economic scenarios. The author proposes directions according to which the debt limit formula from par. 243 of the Public Finance Law in Poland should be modified. Exact legislative change should be based on further research in this area, including modelling changes of a wider set of macroeconomic and financial parameters.

Notes

[1] Interest margin is defined based on the effective interest rate approach, e.g. it comprises both interest expenses and annualized fees and commissions.

[2] EBITDA/GI = Earnings before Interest, Taxes, Depreciation and Amortization / Gross Interest;
FOCF/ND = Free Operating Cash Flow / Net Debt. Exact definitions are presented in (Author, 2015).

[3] Public Finance Law of August 27, 2009 as amended (Journal of Laws 2009, no. 157, pos. 1240).

[4] The statutory limits set by the Public Finance Law till 2013 were:
a. Gross Debt / Total Revenues ≤ 60% as calculated for the given year
b. Financial Outflows / Total Revenues ≤ 15% as calculated for the current year.
The debt and interest payments related to the EU co-financed projects were excluded from the statutory limits.

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