RIGA TECHNICAL UNIVERSITY
Faculty of Engineering Economics and Management
Institute of Business Engineering and Management
Department of Corporate Finance and Economics

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(Doctoral study program "Management Science and Economics")

GOVERNMENT DEBT POLICY MODELING

Summary of the Doctoral Thesis

Field: Economics
Sub-field: Macroeconomics

Scientific advisor
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DOCTORAL THESIS

PROPOSED TO RIGA TECHNICAL UNIVERSITY

FOR THE PROMOTION TO THE SCIENTIFIC DEGREE OF DOCTOR OF ECONOMICS (*Dr. oec.)*

The Doctoral Thesis has been submitted for the defence at the open meeting of RTU Promotion Council "RTU P-09" on June 27, 2015, 2 p.m., at the Faculty of Engineering Economics and Management, RTU, Riga, 6 Kalnciema Street, Room 309.

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DECLARATION OF ACADEMIC INTEGRITY

I hereby declare that the Doctoral Thesis submitted for the review to Riga Technical University for the promotion to the scientific degree of Doctor of Economics is my own and does not contain any unacknowledged material from any source. I confirm that this Thesis has not been submitted to any other university for the promotion to other scientific degree.

Nadezhda Semjonova …….

....., 2015

The Doctoral Thesis has been written in Latvian. The Thesis contains an introduction, five chapters, conclusions and proposals, bibliography with 145 reference sources, 18 appendices, 76 figures and 46 tables. The volume of the Thesis is 173 pages; the volume of appendices is 47 pages.

The Doctoral Thesis and the Summary are available at the Scientific Library of Riga Technical University, 5 P. Valdena Street.
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GENERAL DESCRIPTION OF THE RESEARCH

Topicality of the Research

Government debt has always been a significant aspect of the macroeconomic system of any country. It can be explained by the fact that financial relations associated with the development, service and settlement of the government debt have a considerable impact on the financial position of the country, cash flow, investment climate, consumption structure, and the development of international relations.

The government policy that does not ensure the balance between public revenue and expenditure is the most common reason for the accumulation of the government debt. However, it should be pointed out that absolutely every country in the world in some period of its history has used the opportunities to borrow money to improve its financial prospects and has eventually faced the problems associated with government debt management. Another reason worth being mentioned is the impact of the global financial crisis. Along with the globalization of the world economy, the impact of the financial crisis has increasingly spread over other countries, and the local national status of the financial stress has become international. No country in the world is fully protected against financial, economic, bank system or currency crisis, no matter the level of its development. Crises can be caused by various reasons; however, the following factors are considered to be the most important: inadequate macroeconomic policies, foreign market shock (price fall for some goods or services in the world market), weak financial system, political instability, etc. The speculative factor in the asset markets is not less significant, e. g., the inflow of capital in the sectors that bring quickly returns and put a speculative pressure (real estate, securities and other markets).

Government debt is an inherent element of the global financial system. Almost any country plays a role of either a lender or a borrower in the financial market. International financial organizations provide the largest money flow that ensures the countries with the necessary resources. The aim of these organizations is to accumulate even larger financial resources as a result of granting loans. In a borrowing country, government debt policy, cash flow, the level of inflation, and refinancing rate are interdependent, and the growth of irresponsible government borrowing leads to the decrease in investment resources and later also to the slowdown of economic development. Sooner or later, enormous borrowings surpass the country's financial abilities to service its debts, and that leads to the necessity to cut down government expenditure for social, investment and other state programs. Thus, formidable tension could occur in the society and undermine political stability.

The determining task of government debt management is to ensure control over the execution of state obligations. The schedule of repayment of state obligations should be organized so that the government debt burden is minimal independently of the economic conditions, either growth or recession. Government debt management policy should be sufficiently elastic to regularly balance the amount of payment in accordance with the economic conditions.

Hypothesis: government debt policy, which is coordinated with economic cycles as well as with the length of cycle stages, provides the opportunity to minimize government debt burden in the long-term perspective, which, in its turn, increases financial security of the state.

The Object of the Doctoral Thesis is government debt policy.

The Subject of the Doctoral Thesis is the impact of the government debt policy on the state financial stability.

The Aim of the Doctoral Thesis is to develop a model for the selection of the optimal government debt policy in the cyclic economy considering the aspects of the state financial stability.

In order to reach the aim stated in the Doctoral Thesis, the following **tasks** are set:

- To study theoretical background on the government debt policy principles;
- To evaluate the influence of the government debt on the economic and financial indicators in different regions of the world, the EU member states in general, and Latvia in particular;
- To determine the basic elements of the system of state financial stability and to develop the methodology for the assessment of state financial stability in the government debt policy perspective;
- To develop the model of government debt policy based on the cyclic economic development.

Research Limitations and Constraints: the research covers the period from 1995 to 2012. The number of countries studied is 176; however, analyzing definite parameters, the countries, for which the data are not available, have been excluded from the sample. The data of the EU member states have been used in order to develop and approbate the criteria of financial stability. The developed cycle model is empirical and is not envisioned for the forecasting and analysis of the reasons of GDP growth rate change. Due to restricted volume of the Thesis, all calculations in the government debt model are made on the 10-year cycle basis only.

Methods of Research: the following generally accepted scientific methods of analysis and synthesis have been used in the Thesis: content analysis, expert evaluation method, methods of statistical analysis (comparison, clustering, descriptive statistics, correlation analysis, least squares method), methods of mathematical analysis (graphical method, algebraic method), as well as the methods of mathematical and computer modeling.

Theoretical and Methodological Framework of the Research is based on the research conducted by the Latvian and foreign scholars; as well as norms, regulations, guidelines, and recommendations developed by the IMF, World Bank, international rating agencies and government debt management institutions.

The research is based on the publications by the following authors: Ozoliņa, V., Počs, R., Ketners, K., Afonso, A., Jalles, J. T., Avramovic, D., Bassetto, M., Kocherlakota, N., Barro, R. J., Checherita-Westphal, C., Rother, Ph., Domar, E., Drudi, F., Giordano, R., Faraglia, E., Mendoza A. G., Marcet, A., Scott, A., De Paoli, B., Hoggarth, G., Saporta V., Sardoni, C., Stieglitz, J. E., Vavilov A., Kovalishin E., etc.

Main Contribution to the Scientific Novelty

Within the framework of the Thesis, the following new results have been achieved:

1. Newly enhanced classification of the debt management tools, especially suitable for the unstable economic situation and original default classification;
2. New list of the criteria for the evaluation of the state financial security, based on the results of the content analysis of scientific papers as well as documents published by international financial institutions and credit rating agencies;
3. New original state financial security indicator and corresponding financial security evaluation method;
4. New, suitable for the cyclic economics government debt accumulation model that takes into account GDP growth rate and duration of the growth and recession periods;
5. New method to select an optimal debt policy in the cyclic economy to minimize long-term debt burden.

Thesis Statements to Be Defended

- In global economic recession, there is no opportunity to define a government debt safety threshold: at the world scale, a higher level of debt is always correlated with lower GDP growth.
- The consolidated indicator for evaluation of the state financial security within the framework of government debt policy management should include the following ratios: government debt to GDP, government debt service costs to tax collections, general budget deficit to GDP, inflation rates, long-term interest rates for government securities, external public debt to total government debt, government debt per capita, money supply (M2) to GDP.
- Application of the model of the government debt policy management, which takes into account GDP growth rates and durations of the economic growth and recession periods, could reduce debt burden for the economy in the long-them perspective.

Approbation and Practical Application of Research Results

The results of the research conducted have been applied:

- Within RTU FEEM lecture courses "Principles of Finances", "Regional Finance" and "Regional Management";
- Within summer school lectures at Donetsk National University;
- Taking part in international scientific conferences and seminars in Latvia, Ukraine, and Russia.

Articles published in the recognized peer-reviewed scientific proceedings:

1. Semjonova, N. Assessment of the Government Debt Position Impact on the General Taxation Policy // International Scientific Conference Economic Science for Rural Development, April 23–24, 2015, Jelgava. – Jelgava: the Latvia University of Agriculture, 2015, in press.
2. Semjonova, N. Evaluation of the Latvian Financial Security: Government Debt Policy Aspects // Safety of Technogenic Environment, RTU press, 2014. – vol. 6. pp. 36–42, ISSN 2255-6923, doi: 10.7250/ste.2014.013.
3. Semjonova, N. Government Debt and Long-term Economic Growth in the World's Regions // Proceedings of the International Scientific Conference Economic Science for Rural Development, April 25–26, 2014, Jelgava. – Jelgava: the Latvia University of Agriculture, 2014. – No. 33. pp. 56-65. ISBN 978-9934-8466-0-4;
4. Semjonova, N. Effect of the Government Debt on Some Economic Indexes in EU States // Proceedings of the 54th International Scientific Conference of Riga Technical University "Scientific Conference on Economics and Entrepreneurships" SCEE'2012, October 12–16, 2013, Riga. – Riga: RTU, 2014. – vol. 25. pp. 68–73. DOI: 10.7250/eb.2014.010 ISSN 1407-7337.
5. Semjonova, N. Application of Government Debt Models for Baltic States // Proceedings of the XIV International Scientific Conference "Creating the Future: Communication. Education. Business", May 30, 2013, Riga. – Riga: Biznesa augstskola Turība, 2013, pp. 89–101. ISSN 1691-6069.
6. Semjonova, N. Application of Government Debt Models for the Situation of Latvia // Proceedings of the International Scientific Conference Economic Science for Rural Development, April 25–26, 2013, Jelgava. – Jelgava: the Latvia University of Agriculture, 2013. – No. 30 pp. 214–220. ISBN 978-9934-8304-6-4.
7. Semjonova, N. Structure of the National Debt, Credit Rating and State Financial Security // Proceedings of the 53rd International Scientific Conference of Riga Technical University "Scientific Conference on Economics and Entrepreneurship" SCEE'2012, October 12–16, 2012, Riga. – Riga: RTU, 2012. – 6 p. ISBN 978-9934-10-355-1.

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9. Семёнова, Н. Проблемы управления госдолгом Латвии, как страны ЕС // „Проблемы развития внешнеэкономических связей и привлечения иностранных инвестиций: региональный аспект", Донецкий национальный университет – Украина, Донецк: ДонНУ, 2012. 344-350 с. ISSN 1991-3524 [Semjonova, N. The Problems of the Government Debt Management in Latvia as an EU Member State].
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11. Semjonova, N., Ķipsna, J. The Problems of the Government Debt Management // Proceedings of the 50th International Scientific Conference of Riga Technical University "Scientific Conference on Economics and Entrepreneurship" SCEE'2009, October 15–16, 2009, Riga. – Riga: RTU, 2009. – pp. 411–416. ISBN 978-9984-32-173-8.
12. Семёнова, Н. Развитие финансового рынка Латвии // Материалы конференции „Страны с переходной экономикой в условиях глобализации", Российский университет дружбы народов, 28-30 марта 2007 г. – Россия, Москва: РУДН, 2007 г. 302–305 с. ISBN 978-5-209-02529-0. [Semjonova, N. Development of the Latvian Finance Market].

Reports on the main results of the research at the international scientific conferences:

1. The 55th International Scientific Conference of Riga Technical University, Riga, October 14-17, 2014. Report: *Evaluation of the Latvian Financial Security: Government Debt Policy Aspects*.
2. The 55th International Scientific Conference of Riga Technical University, Riga, October 14–17, 2014. Report: *Correlation between the Government Debt and Economic Indicators in the World Regions*.
3. The 15th International Scientific Conference of Latvia University of Agriculture "Economic Science for Rural Development", Jelgava, April 24–25, 2014. Report: *Government Debt and Long-term Economic Growth in the World's Regions*.
4. The 54th International Scientific Conference of Riga Technical University "Scientific Conference on Economics and Entrepreneurship", Riga, October 14–16, 2013. Report: *Impact of Government Debt on Definite Economic Indicators in EU States*.
5. The XIV International Scientific Conference "Creating the Future: Communication. Education. Business", Riga, May 30, 2013. Report: *Application of Government Debt Models for Baltic States*.
6. The 14th International Scientific Conference of Latvia University of Agriculture "Economic Science for Rural Development", Jelgava, April 25–26, 2013. Report: *Application of Government Debt Models for the Situation of Latvia*.
7. The 53rd International Scientific Conference of Riga Technical University "Scientific Conference on Economics and Entrepreneurship", Riga, October 12–16, 2012. Report: *Structure of the National Debt, Credit Rating and State Financial Security*.
8. The 50th International Scientific Conference of Riga Technical University, Riga, October 15-16, 2009. Report: *Problems of Government Debt Management*.

Contents and Volume of the Doctoral Thesis

The Thesis is structured into five chapters. Detailed tables, diagrams and calculation results are given in the appendices.

The *first chapter* extends the classification of the government debt crisis management tools and develops the classification of defaults on the basis of historical review and modern situation analysis.

The *second chapter* examines the Latvian government debt policy and debt management legal and regulatory provisions as well as analyzes public debt trends in Latvia.

The *third chapter* analyzes public debt trends in the economy of the world, world regions and, particularly, in the EU, as well as evaluates the relationship between the state debt and economic and financial indicators.

The *fourth chapter* develops the national financial security evaluation methodology on the basis of content analysis of the scientific articles and international rating agency documents and expert pool opinions.

The *fifth chapter* develops a government debt policy model, which is tested on the basis of Baltic state data, and proposes the method for the elaboration of the government debt policy depending on the economic growth and recession period.

MAIN SCIENTIFIC RESEARCH RESULTS

1. GOVERNMENT DEBT AND STATE FINANCIAL STABILITY

1.1. Aspects of Government Debt Theory

Government debt theories are related to the consequences of the debt that have an impact on the national economy. In economics, there are four approaches to the assessment of the consequences of government debt:

- The first approach is based on the premise that government debt is a burden;
- The second approach is based on the premise that short-term debt is not a burden, it is only the long-term debt;
- The third approach is based on the premise that government debt stimulates economic development;
- The fourth approach is based on the premise that the economy is not affected by the increase of government debt.

Numerous studies demonstrate that government debt can both simulate and hinder economic development of a country (Barro, 1987; Barro, Lee, 1994; Ludvigson, 1996; Bassetto, Kocherlakota, 2004). Some authors point at the presence of a "threshold" of the amount of debt: adverse impact on the economy occurs only if the debt exceeds that threshold (Checherita-Westphal, Rother, 2012; Afonso, Jalles, 2013). However, according to different sources, the threshold value ranges from 40 % up to 100 %. Therefore, the question whether the growth of government debt has ever helped the countries to recover their economic growth still remains open.

1.2. Classification of Government Debt

Government debt classification scheme was created on the basis of data from the publications and internal documents of international rating agencies and international financial institutions (World Bank, 2012; Moody's, 2012; Standart&Poor's, 2012) and combining the approaches used by these institutions.

1.3. Aspects of Government Debt Management under Unstable Conditions

Inability to ensure long-term budget balance along with the decrease of foreign currency inflow makes countries look for other opportunities for government debt management, choosing adequate mechanisms with an intention to meet creditor claims.

The classification of methods of debt management has been developed in the Doctoral Thesis. The methods characterized in the Thesis are illustrated with numerous real-life examples having occurred in the international financial market.

Studying the methods of government debt management, default as a country's repudiation to meet its obligations is considered in more detail. The classification of the types of default is provided (Fig. 1), default cycle phases are also analyzed.

The concept of American economist J. Stieglitz is addressed in the Thesis. He considers that the mistakes of international financial organizations, of IMF in particular, and too rapidly increasing globalization were the main causes of financial crises in the developing countries in 1990–2000 (Stieglitz, 2002). Although a majority of economists regard this position as too critical, it cannot be denied that the development of economic globalization, even if it does not increase the likelihood of default, definitely so far has not found any safe mechanisms to reduce default probability. This leads to the opinion that currently the parties guilty of cases of default are not only developed country institutions and speculators, but also

the debtors themselves that do not timely organize operative control over state financial indicators, not to mention the forecasting of the future financial indicators.

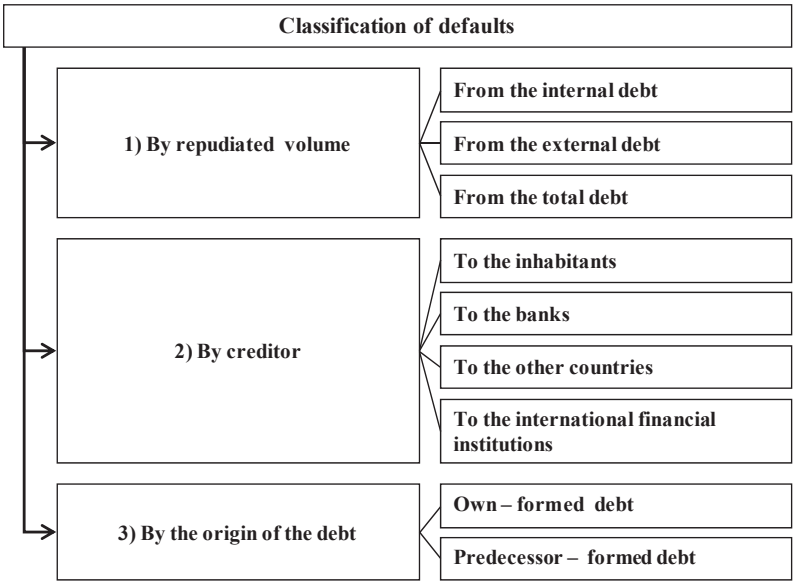


Fig. 1. Types of defaults (here **repudiation**).

2. ASSESSMENT OF LATVIAN GOVERNMENT DEBT POLICY

2.1. Role of Latvian Government Institutions in Government Debt Policy and Management

The Ministry of Finance of the Republic of Latvia and the subordinated Treasury develop government debt policies and the core of the government debt management system. The guidelines defined in the Government Debt Management Strategy of Latvia are developed by the Treasury and approved by the Minister of Finance; prior to approval the opinions are coordinated with the Bank of Latvia.

The Ministry of Finance organizes the international borrowing program, coordinates cooperation with lending institutions and countries, predicts the limit for annual borrowings of municipalities and guarantees issued by municipalities, and prepares a part of annual government budget bill of municipal borrowings, guarantees and long-term liabilities (Ministry of Finance, 2012). The Minister of Finance authorizes the Treasury to perform all activities connected with the issue, IPO and redemption of all government securities (Regulations on the Issue of Government Securities, 2013).

Within the framework of government debt management, the Treasury organizes visits of the analysts from four international rating agencies — "Fitch Ratings", "Standard & Poor's", "Moody's Investors Service" and "R&I" — to Latvia, in such a way ensuring the opportunity for investors to regularly receive the most recent information on Latvia, to analyze the opinions on the tendencies of Latvia's development and possible risks.

2.2. Amount and Structure of Latvia's Government Debt and Application of Borrowed Funds

2.2.1. Constituents of Government Debt and Amount Dynamics

Starting from 1995 till 2007, the amount of government debt in monetary terms was growing moderately, but starting from 2004 to 2007 government debt with relation to GDP even decreased and reached the level of 1998 (Eurostat, 2013).

Under the conditions of the global financial crisis and recession of the national economy in 2008, the International Monetary Fund, European Commission, World Bank, European Bank for Reconstruction and Development and numerous EU member states agreed on providing financial support to Latvia amounting to 7.5 billion EUR. In 2009, government debt constituted 45 % of GDP. Starting with 2010, government debt was decreasing gradually and reached 41 % in 2012 (Fig. 2).

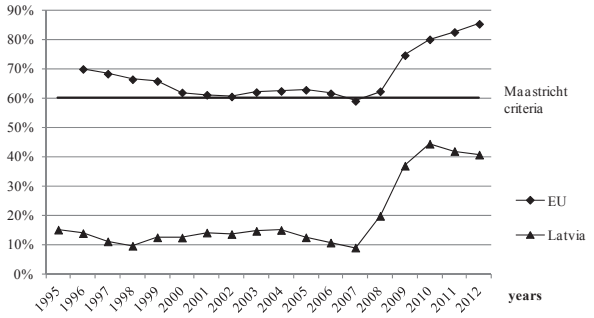


Fig. 2. Changes in government debt as proportion of GDP.

Undertaking of government debt commitments is the cause of government budget expenses connected with servicing the debt. In this case, the portion of collected taxes, which is allocated to servicing the debt, increases. Therefore, the tax burden on a country appears that is related to the servicing of the government debt. It should be noted that social insurance contributions are not included into the tax amount, because the government does not use the resources of social insurance fund to repay the debt.

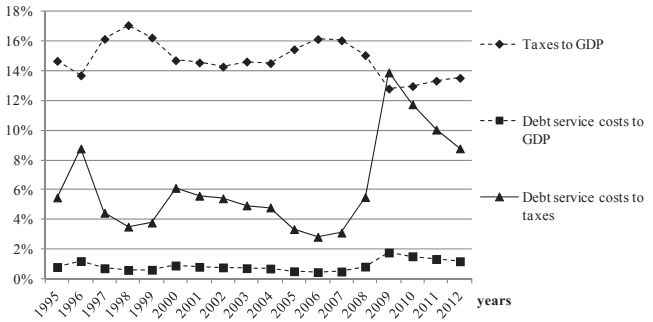


Fig.3. Dynamics of the collected taxes and interest payments expressed as a ratio to GDP.

Fig. 3 demonstrates that 2009 was the most difficult year for the Latvian society, when 14 % of tax collections were paid to service the debt. Although in 2010, 2011 and 2012 expense amount grew, tax burden decreased because the total amount of collected taxes had a tendency to grow.

Planning the amount of borrowing and the size of government debt, the Minister of Finance takes into consideration the following factors: total amount of necessary financing, which is formed by the financial balance of the government budget, and the size of government debt to be repaid, as well as other liabilities. The forecasted amount of borrowing is shown in Table I (Notes to the Law "On the Government Budget for 2014", 2014).

Table I

Estimation of Financing Needs for 2014–2016, *bn. EUR*

	2014	**2015**	**2016**
Financial balance of the government budget, net borrowings, current account balance and other flows*	−425	164	−468
Settlement of government debt **:	−1,682	−1,483	−377
Actual settlement of internal debt	*−246*	*−184*	*−260*
Actual settlement of external debt	*−1,436*	*−1,299*	*−118*
Minimal reserve of freely transferrable funds that should be provided as of 1 January of the next year	−155	−155	−155
Financing need (−)/surplus (+) in total	**−2,262**	**−1,475**	**−1,000**

* Net borrowings funded are the difference between government securities and settlement of securities
** Debt obligations undertaken before November 30, 2013

Demographic situation is one of the most serious problems of Latvia. As the number of inhabitants decreases and the relative size of debt grows, debt burden for the payers will increase in the long term. Analyzing demographic situation in Latvia, it can be mentioned that in the period from 1995 till 2012 the population decreased by 20 %. Future forecasts are also not too favorable. The State Regional Development Agency of the Republic of Latvia anticipates that population will further decrease.

2.2.2. Government Debt Structure in Respect to the Links with External Market and Financial Instruments

From 2000 to 2008, both internal and external government debts grew moderately and at the end of 2008 the proportion of the external debt constituted 48 % of the total debt. As it can be seen in Fig. 4, starting from 2009 it is the external government obligations that grew rapidly.

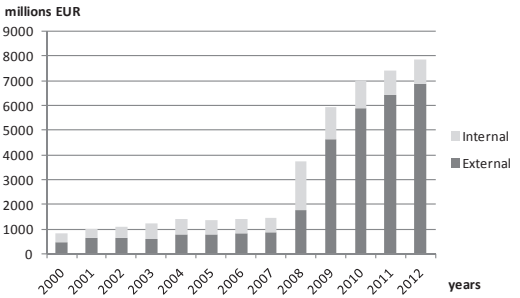


Fig. 4. Central government debt structure.

In 2012, external debt constituted the largest proportion in the government debt structure, amounting to 75.3 % in the central government debt structure. In turn, the proportion of internal government debt was 24.7 % of the total central government debt.

At the beginning of 2012, Latvia issued 1 bn. USD in five-year bonds with fixed coupon rate 5.25 % per year and 1.25 bn. USD in seven-year bonds with coupon rate 2.75 % per year, which historically is the lowest security interest rate.

In order to promote new private individual (inhabitant) investment into the internal financial market, government has been offering the opportunity to purchase government savings bonds since 2013. Savings bonds have four settlement terms — 6 months, 12 months, 5 years and 10 years. It is expected that both the amount invested by the inhabitants via the savings bonds and the investment terms will grow in the coming years, thus the saving bonds become a permanent part of basic financing.

2.2.3. Use of the Borrowed Funds

At the end of December 2008, the European Commission, IMF, World Bank, European Bank for Reconstruction and Development (further referred to as ERAB) and numerous EU member states agreed on providing financial support to Latvia amounting to 7.5 bn. EUR. Borrowed funds were made available to Latvia in several instalments over the period of three years (Table II).

Table II

Borrowed Funds Available to Latvia in 2009-2011 (*bn. EUR*)

Creditor	2009	2010	2011	Total
IMF	0.8*	0.3	0.6	1.7
European Commission	2.2	0.7	0.2	3.1
Northern Countries (Finland, Sweden, Estonia, Denmark, Norway)			1.9	1.9
World Bank	0.2	0.1	0.1	0.4
Other (ERAB, Czech Republic and Poland)	0.1		0.3	0.4
Total per year:	3.3	1.1	3.1	7.5

*including 600 million EUR received on December 29, 2008

It should be mentioned that the ERAB support is not a loan to Latvia, but rather investment in the shares and subordinated debt of Parex Banka (International Lending Program, 2012). Overall use of the borrowed funds is summarized in Fig. 5.

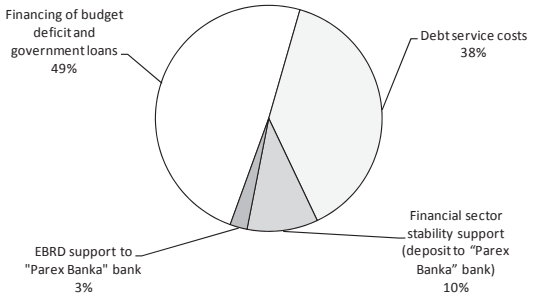


Fig.5. Actual application of international loans (as of 20.06.2011) (International Lending Program, 2012).

Other support measures were additionally used to provide enterprises with the access to credit resources. For example, the Latvian Mortgage and Land Bank that existed at that time received government guarantee for raising additional financial resources to 71 million EUR within competitiveness promotion program, which was focused on facilitating export capacity of Latvian enterprises and development of new markets.

2.3. Assessment of Government Guarantee Policy

Government guarantees are planned within the law on annual budget. Only the Minister of Finance is eligible to grant guarantees on behalf of the state that impose obligations on the state funds. Government guarantees are provided only for the implementation of study and student crediting and business support programs, as well as for the implementation of government investment projects.

The present Thesis analyzes guarantee structure and application of guaranteed loans by industries / projects. Analyzing the current government guarantee policy, it can be concluded that government guarantees as an efficient instrument promoting investment is not working. New regulations of the Cabinet of Ministers have been developed exercising extreme financial caution, on the one hand, and introducing numerous excessively formal procedures, on the other. To improve the opportunity to use government guarantee policy, it is necessary to develop flexible crediting and guarantee granting regulations, as well as solve the problems of "short-term" insolvency of debtors, providing "principal repayment holiday".

3. ASSESSMENT OF GOVERNMENT DEBT POLICY IN COUNTRIES ACROSS THE WORLD

3.1. Government Debt Tendencies in World Regions

The problem of government debt is not a specific problem of some particular country. At present, about 190 countries in the world, which constitutes 96 % of the total number of countries, are involved in the international external financing scheme. Aggregate government debt is roughly estimated to be more than 57 trillion USD.

The aim of the research conducted in this chapter is to assess the world tendencies in government debt policies and their role in economic development of the countries under the conditions of global crisis.

The author studied the financial indicators of 176 countries, the data on which was available from the databases of IMF (International Monetary Fund, 2013) and World Bank (World Bank, 2013). The period from 2003, when HIPC initiative by IMF and World Bank Par was launched, till 2011 was chosen as the research period, as the data for 2012 were not fully available then.

Table III

Countries with the Lowest Proportion of Debt to GDP

2003		2011	
Country	%	Country	%
Brunei	0.0	Libya	0.0
United Arab Emirates	4.4	Brunei	2.4
Estonia	5.6	Saudi Arabia	5.4
Luxemburg	6.2	Oman	5.5
Botswana	11.7	Estonia	6.0
Chile	12.6	Kuwait	8.2
Equatorial Guinea	12.9	Equatorial Guinea	9.0
Australia	13.2	Uzbekistan	9.1
Turkmenistan	13.4	Turkmenistan	10.0

Considering the data presented in Table III, it can be concluded that among the "countries — best performers" the ratio of debt to GDP decreased: in 2003 the highest indicator was 13.4 %, but in 2011 it was only 10 %. Only four countries managed to retian their poistion in the list: Brunei, Estonia, Equatorial Guinea and Turkmenistan.

Based on the data in Table IV, it can be concluded that debt ratio to GDP decreased among the "underperforming" countries, too: in 2003 the highest figure was 931.6 %, but in 2011 it was 230.3 %. There is no doubt that it is connected with debt relief programs implemented by the largest creditors: the IMF, World Bank and the members of Paris Club. One of the most important events on the world scale is an increase in the number of developed countries with extremely large obligations: if in 2003 there were no such countries, then in 2011 there were four countries of this kind, three of these countries "represented" the European Union. Japan's government debt has the highest value in the world. This is the so-called "Japanese variant". Almost all Japan's government securities, i. e., more than 95 % according to the data for 2011, are held by residents, including large banks and pension funds.

Table IV

Countries with the Highest Proportion of Debt to GDP

2003		2011	
Country	%	Country	%
Liberia	931.6	Japan	230.3
Iraq	493.7	Greece	170.3
São Tomé and Principe	307.0	Saint Kitts and Nevis	153.6
Guinea-Bissau	252.5	Jamaica	141.6
Mauritania	216.4	Lebanon	137.5
Congo	204.4	Eritrea	133.0
Eritrea	192.0	Italy	120.8
Democratic Republic of the Congo	180.4	Portugal	108.4
Seychelles Islands	175.7	Grenada	106.4

In order to conduct an in-depth analysis, the author divided all 176 countries into two groups and six regions. The countries with the largest economies in the world are included in Group 1 (USA, Canada, Germany, France, Italy, United Kingdom, Spain, Japan and Korea), according to the World Bank category — G9. Group 2 includes G9 countries and the countries that, in the author's opinion, play an important role in the international debt market, according to the opinion of the organization "*Debt Clock*" (World Debt Clock, 02.01.2014): Argentina, Australia, Brazil, China, Greece, India, Ireland, Mexico, Portugal, Russia, and Saudi Arabia. Division into six regions is based on the geographical position: Western Europe; Eastern Europe and Central Asia (former CIS countries); South and East Asia and Pacific; Middle East and North Africa; Sub-Saharan Africa; Latin America and Caribbean.

Analyzing the changes of government debt to GDP ratio in the research period, a mean index in world regions, except Western Europe, decreased; the same cannot be said about country groups. In the leading world countries, the situation with the government debt deteriorated. Thus, in G9 group a mean index grew from 63.3 % to 84.3 %, but in "Debt Clock" group it grew from 60.9 % to 75.4 %. In both cases, the reason is the growth of the Japan's government debt (Table V).

It should be noted that in the "*Debt Clock*" group of 20 states, 6 countries decreased their debt to GDP ratio; these are Argentina, Brazil, India, Mexico, Russia and Saudi Arabia. For example, Saudi Arabia's government debt in the research period decreased from 79.5 % to 5.4 % and now the country is in the list of countries with the lowest debt to GDP ratio.

Table V

Government Debt by Statistical Groups and Regions (% of GDP)

Country groups and regions	Mean index		Highest index		Lowest index	
	2003	2011	2003	2011	2003	2011
G9 countries	63.3	84.3	169.6	230.3	21.6	34.2
"*Debt Clock*" countries	60.9	75.4	169.6	230.3	13.2	5.4
Western Europe	47.2	49.2	104.1	170.3	5.6	6.0
Eastern Europe and Central Asia	31.6	28.4	106.9	50.1	13.4	9.1
South and East Asia and Pacific	47.6	42.0	169.6	230.3	0.0	2.4
Middle East and North Africa	64.4	38.6	493.7	137.5	4.4	0.0
Sub-Saharan Africa	86.0	37.6	931.7	133.0	11.7	9.0
Latin America and Caribbean	59.9	44.4	155.2	153.6	12.6	11.1
World total	59.0	43.8	931.7	230.3	0	0

In G9 group, the number of countries whose obligations exceed 60 % of GDP doubled in the research period.

Southern Korea is the only country whose obligations do not exceed the given threshold and grew only from 21.6 % to 34.2 %. In addition, 5 countries from G9 group are the EU member states (Fig. 6).

Considering the data presented in Fig 6, it can be seen that in Western Europe the situation in the field of government debt is similar to G9 and "*Debt Clock*" countries. The mean indicator grew, but not so rapidly as by country groups, by 2 %, and in 2011 it constituted 49.2 %. Maximum indicator in 2003 was observed in Italy — 104.1 %, but in 2011 it was observed in Greece — 170.3 %. In turn, the lowest obligations were detected in Estonia, and at the end of the research period it constituted only 6.01 %. Seven out of 37 countries that are included in the region reduced the indicators by more than 25 % in relation to 2003; moreover, two countries represent the EU (Sweden and Bulgaria).

Other regions analyzed on the whole demonstrated the decrease in the amount of obligations. In Eastern Europe and Central Asia, the mean debt amount decreased from 31.6 % to 28.4 %. Maximum debt in this group grew twice less, from 106.9 % to 50.1 %. In Latin America and the Caribbean region, the number of countries with heavy debts decreased, respectively, the average value also decreased, but the maximum debt value in this group remained virtually the same. Similar moderate changes of the value of mean debt amount were observed in the Middle East, North Africa, South America and Asia, and in the Pacific region. Considerable reduction with the remaining maximum debt value in the Middle East is related to writing off a considerable fraction of Iraq's debt.

The most significant reduction of government debt occurred in Sub-Saharan Africa. Mean debt value grew twice less. Maximum debt value decreased from 931 % in 2003 to 133.03 % in 2011 (Eritrea). This reduction is undoubtedly related to joint IMF–World Bank "HIPC initiative". Out of 36 countries included in the list, 30 are from Sub-Saharan Africa, the others include Afghanistan and 5 countries from Latin America and the Caribbean region: Bolivia, Guyana, Haiti, Honduras and Nicaragua. However, the reduction of debt amount in Latin America and the Caribbean region cannot be explained only by "HIPC initiative": out of 6 countries of that region, which had their debts reduced from more than 100 % till less than 100% of GDP, only two of them (Guyana and Nicaragua) participated in the HIPC initiative.

Summarizing the analyzed results, it can be stated that in the world there is a common tendency for reduction of government debt to GDP ratio: both mean and maximum value. Despite this common positive tendency, the debts of developed countries mainly keep growing. This may indicate that the developed countries are also not fully protected against crises. It can be even stated that they 'lose more', because in the period of recession the public expects the government to provide the same level of social security as in the period of economic growth.

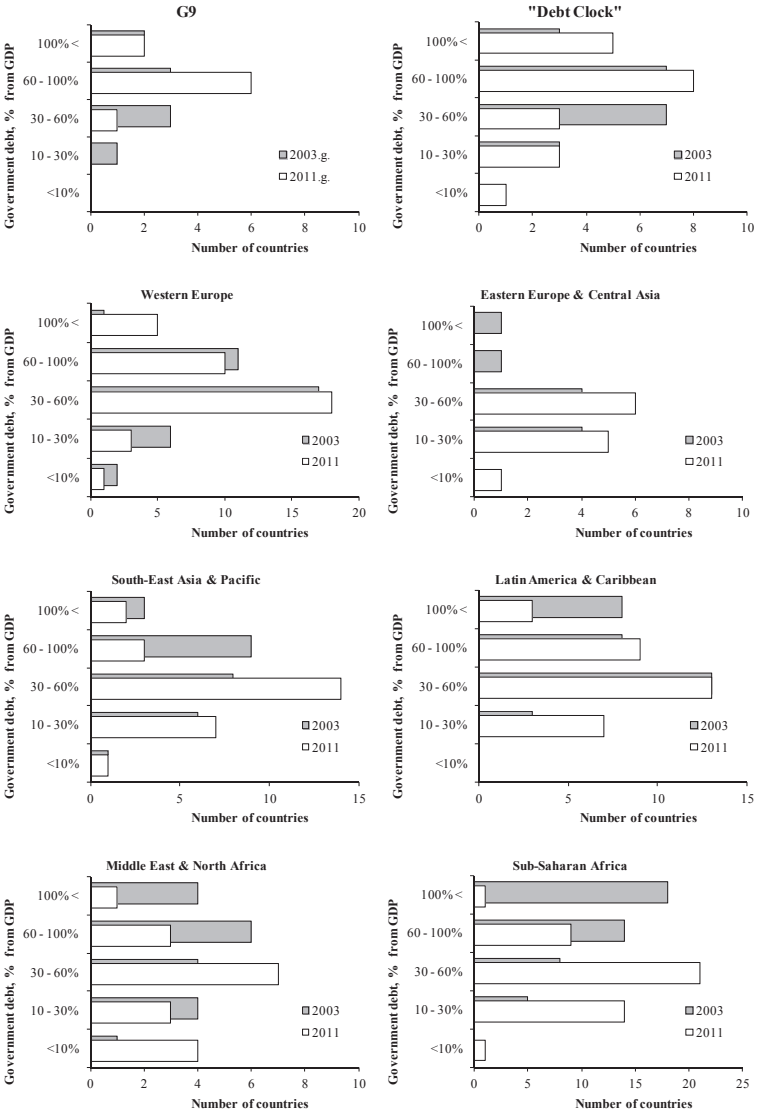


Fig. 6. Distribution of government debt amount in world regions.

The impact of government debt on economic indicators was evaluated using a correlation method. Pearson product-moment correlation coefficient was calculated for every economic indicator in relation to government debt value in 2003 and 2011 respectively; scatter diagrams were produced. Statistical significance of the correlation coefficient was

evaluated using Student's criterion *t*: the coefficient was considered as significant, if probability *P*, associated with *t*–statistics was less than the significance level of 0.05 accepted through the research.

Economic and financial indicators that characterized the economic condition of the country at the beginning and at the end of the research period were analyzed in the Doctoral Thesis, as well as the parameters that allow evaluating economic development tendencies in the long term.

The indicators used in the research are represented by the following notations:

Y — GDP in 2003 and 2011, bn. USD in actual prices;

r — GDP growth rate in 2003 and 2011 in comparison with the respective preceding year, %;

D — government debt in 2003 and 2011, bn. USD in actual prices;

D/Y — government debt in 2003 and 2011, percent from GDP;

α — government debt growth rate in 2003 and 2011, in comparison with the respective preceding year, %;

Def — budget deficit (−)/surplus (+), percent from GDP;

p — average interest rate on government borrowings in 2003 and 2011, which is calculated as a ratio of the total debt service costs to the government debt, %;

T — collected taxes (excluding social insurance) in 2003 and 2011, percent from GDP;

b(T) — debt burden in 2003 and 2011, which is calculated as the part of collected taxes, used to cover government debt service costs, percent from *T*;

R — GDP long-term growth index, which is calculated percent-wise as

$$R = \frac{GDP_{2011} - GDP_{2003}}{GDP_{2003}} \times 100\% \quad ; \qquad (1)$$

$\Delta D/Y$ — long-term government debt growth index, calculated using percentage points as

$$\Delta D / Y = \left(\frac{D}{Y}\right)_{2011} - \left(\frac{D}{Y}\right)_{2003} \qquad (2)$$

Δr — increase of GDP growth rate in 2011 compared to 2003, percentage points;

Δp — increase of average interest rate in 2011 compared to 2003, percentage points;

Δb — increase of tax burden in 2011 compared to 2003, percentage points.

Values of all indicators according to groups and regions are summarized in Appendix 1 of the Thesis.

In order to assess the impact of government debt on the national economy, the correlations between the following pairs of indicators were calculated: *D/Y* to *Y, D/Y* to *r, R* to *D/Y,* α to *Def, T* to *D/Y, b* to *D/Y,* ΔT to $\Delta D/Y$, *D/Y* to *p, p* to *r*.

To evaluate which countries with "large" and "small" economies borrow more, correlation coefficients between GDP and government debt amount were calculated (Table VI).

According to the data in Table VI, it can be stated that positive moderate correlation is observed in only one region – South and East Asia and Pacific region both at the beginning and the end of the period. Detailed analysis shows that Japan's indices influenced the correlation coefficient value.

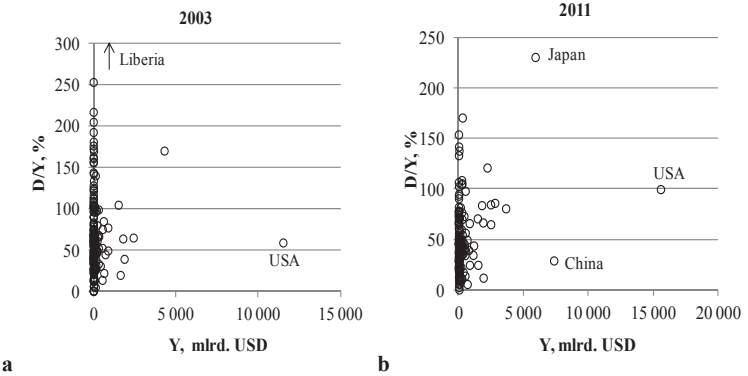
Table VI

Correlation between Government Debt and GDP (*D/Y - Y*)

Country groups and regions	2003		2011	
G9 countries	0.15	*(P = 0.71)*	0.28	*(P = 0.46)*
"*Debt Clock*" countries	0.11	*(P = 0.63)*	0.18	*(P = 0.46)*
South and East Asia and Pacific,	**0.47**	***(P = 0.01)***	**0.46**	***(P = 0.02)***
− excluding Japan	−0.29	*(P = 0.15)*	−0.12	*(P = 0.22)*
Countries of Western Europe	0.32	*(P = 0.06)*	**0.34**	***(P = 0.04)***
Countries of Eastern Europe and Central Asia	−0.19	*(P = 0.60)*	−0.32	*(P = 0.31)*
Latin America and Caribbean	−0.11	*(P = 0.57)*	−0.03	*(P = 0.86)*
Middle East and North Africa	−0.10	*(P = 0.70)*	−0.34	*(P = 0.16)*
Sub-Saharan Africa	−0.15	*(P = 0.32)*	−0.07	*(P = 0.67)*
World total	−0.01	*(P = 0.88)*	**0.26**	***(P = 0.00*)***

* ***P*** is less than 0.005

In turn, in Western Europe and in the world on the whole such correlation can be observed only in 2011 (see Fig. 7.b), but the correlation is too weak to precisely determine whether the countries with "large" economies have larger government debts.



a **b**

Fig. 7. Correlation between the government debt and GDP, world data.

Planning government budget revenues, the government relies on GDP forecasts. If it is envisioned that GDP growth rate will decrease, the government will have to deal with smaller government budget revenues and, possibly, with larger borrowings. Table VII demonstrates whether low GDP growth rate has an impact on the amount of government debt.

Table VII

Correlation between Government Debt and GDP Growth Rate (*D/Y–r*)

Country groups and regions	2003		2011	
G9 countries	−0.20	*(P = 0.61)*	−0.22	*(P = 0.56)*
"*Debt Clock*" countries	0.03	*(P = 0.89)*	**−0.73**	***(P = 0.00*)***
South and East Asia and Pacific	0.12	*(P = 0.55)*	−0.35	*(P = 0.07)*
Western Europe	−0.16	*(P = 0.33)*	**−0.61**	***(P = 0.00*)***
Eastern Europe and Central Asia	−0.14	*(P = 0.70)*	−0.38	*(P = 0.22)*
Latin America and Caribbean	0.01	*(P = 0.94)*	**−0.43**	***(P = 0.01)***
Middle East and North Africa	**−0.68**	***(P = 0.00*)***	−0.06	*(P = 0.82)*
- excluding Libya			**−0.61**	***(P = 0.01)***
Sub-Saharan Africa	**−0.59**	***(P = 0.00*)***	−0.19	*(P = 0.20)*
World total	**−0.33**	***(P = 0.00*)***	**−0.31**	***(P = 0.00*)***

* ***P*** is less than 0.005

It can be seen from Table VII that a small negative correlation is observed across the world, which indicates that a low level of economic development is connected with larger borrowing amount. It was particularly characteristic of African countries, which borrowed improvidently by 2003, and that led the region to technical default. Countries from "Debt Clock" group, Western Europe and Latin America and Caribbean region in 2011 were characterized by strong significant correlation, which indicated lack of economic stability also in the post-recession period, and this consequently led to large borrowings.

As seen in Fig. 8, the correlation coefficient is weak, and exclusion of the countries with extreme values does not change the overall picture. Thus, it can be concluded that on the whole the interdependence between the indicators in the world is minimal.

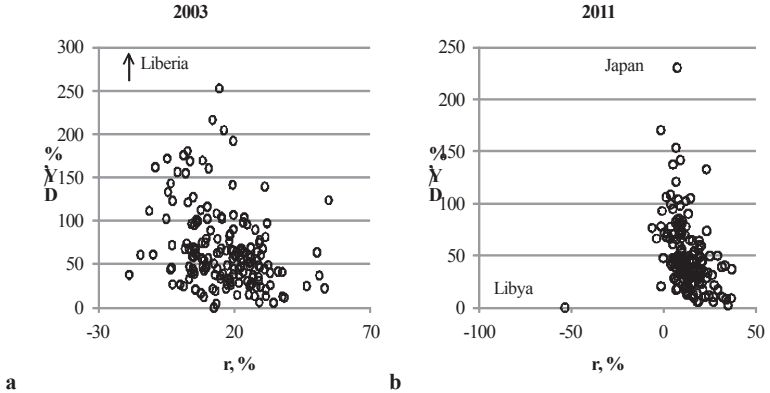


Fig. 8. Correlation between the government debt and GDP growth rate, world data.

As described above, there are different opinions in the world regarding the positive or negative impact of government debt on the economic development. Interrelations between long-term GDP growth index and the amount of government debt at the beginning and the end of research period are summarized in Table VIII.

Table VIII

Correlation between Long-term GDP Growth Index and Government Debt (*R–D/Y*)

Country groups and regions	2003		2011	
G9 countries	−0.25	*(P = 0.52)*	−0.45	*(P = 0.23)*
"*Debt Clock*" countries	−0.12	*(P = 0.62)*	**−0.59**	***(P = 0.01)***
South and East Asia and Pacific	0.19	*(P = 0.34)*	−0.23	*(P = 0.24)*
- excluding Japan and China	**0.63**	**(P < 0.01)**		
Western Europe	**−0.38**	***(P = 0.02)***	**−0.67**	***(P = 0.00*)***
Eastern Europe and Central Asia	−0.33	*(P = 0.35)*	−0.50	*(P = 0.10)*
Latin America and Caribbean	−0.12	*(P = 0.50)*	**−0.48**	***(P = 0.01)***
Middle East and North Africa	−0.28	*(P = 0.28)*	−0.19	*(P = 0.48)*
Sub-Saharan Africa	−0.03	*(P = 0.87)*	−0.27	*(P = 0.07)*
World total	−0.02	*(P = 0.77)*	**−0.39**	***(P = 0.00*)***

* ***P*** is less than 0.005

The correlation coefficient in Western Europe region was equal to − 0.38, which corresponds to weak negative correlation: increase of government debt yields smaller growth. This might indicate that, for example, European countries did not invest the borrowed funds into economic development but were forced to meet excessive public needs in the period of crisis. Moderate negative correlation is significant for "*Debt Clock*" group, Western Europe and Latin America.

This may mean that the increase in borrowing by these countries is a reaction to a low growth rate, and the borrowed funds are used to meet growing public needs. On the other hand, it is clear that the developed countries do not have the opportunity to rapidly develop their economy (growth limit has been reached). The countries use borrowed funds to sustain the growing welfare level, but government revenues do not grow as quickly. In any case, negative correlation between growth in 2003–2011 and debt amount in 2003 demonstrates that intensive government borrowing did not help in stabilizing the economy in the post-crisis period.

In South and East Asia, except the over-developed Japan and China antique with regard to its human resources, there is a moderate positive correlation ($r = 0.63$) between the growth index and government debt at the beginning of the period. This may indicate that countries in this region implement cautious debt policies and invest borrowed funds in economic development.

Correlation coefficients in the other groups are not significant ($P > 0.05$); however, they all are negative that corresponds to the overall global tendency.

Concerning the world on the whole, there is no significant correlation between the government debt and economic growth (Fig. 9.a). In contrast to other studies (e. g., Afonso, Jalles, 2013), the author did not manage to detect a clear threshold for a negative influence of government debt over the economy in the regions as well as in the world on the whole. The research conducted confirms the opinion of Ricardo (Barro, 1987).

The analysis of correlations between long-term growth rate and government debt after the period of growth raises additional interest. There is a significant negative correlation in the entire world. This may mean that the increase of borrowing by these countries is a reaction to a low growth rate, and the loans are used to meet the growing public needs.

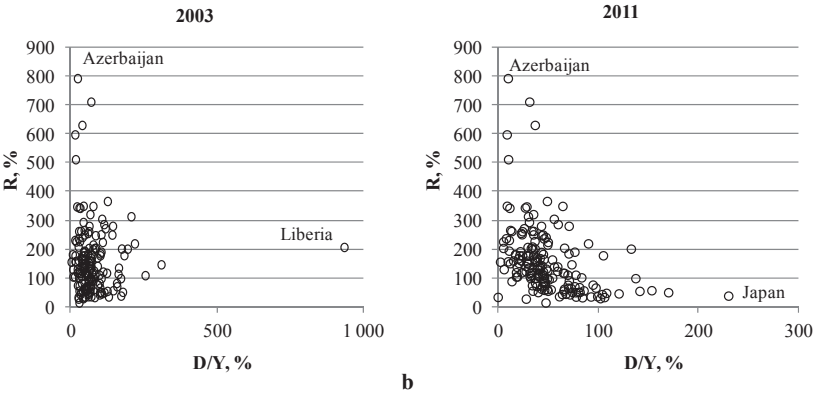


Fig. 9. Correlation between the long-term GDP growth index and government debt, world data.

The data presented in Fig. 9.b show that in the countries with government debt less than 60 % of GDP, long-term GDP growth rate (R) in the research period was higher: 183 % on the average, compared with 94 % in the group with the debt ≥ 60% of GDP. This difference is highly significant, as being estimated by t-test ($P << 10^{-3}$). Although this "threshold" value corresponds to previous findings (Checherita-Westphal, Rother, 2012), (Afonso, Jalles, 2013), one could not unanimously conclude whether the low economic growth caused the growth of the debt or, vice versa, large debt negatively influenced the

economic development. Moreover, due to general falling tendency, the choice of the threshold between "high" and "low" debt at the level of 80, 50 or 40 percent does not affect significance of the difference in *R* between "high" and "low" debt groups.

To determine the source of budget deficit financing, the increment of government debt was correlated with the budget deficit (Table IX).

Table IX

Correlation between Government Debt Growth Rate and Budget Deficit (α–*Def*)

Country groups and regions	2003	2011
G9 countries	−0.54 *(P = 0.14)*	−0.60 *(P = 0.09)*
− excluding Japan		**−0.73** ***(P = 0.03)***
"*Debt Clock*" countries	**−0.66** ***(P = 0.00*)***	**−0.70** ***(P = 0.00*)***
South and East Asia and Pacific	**−0.59** ***(P = 0.00*)***	−0.25 *(P = 0.22)*
Western Europe	−0.25 *(P = 0.13)*	**−0.79** ***(P = 0.00*)***
Eastern Europe and Central Asia	−0.51 *(P = 0.16)*	−0.17 *(P = 0.60)*
Latin America and Caribbean	**−0.35** ***(P = 0.05)***	**−0.52** ***(P = 0.00*)***
Middle East and North Africa	**−0.72** ***(P = 0.00*)***	−0.44 *(P = 0.07)*
− excluding Qatar and Kuwait		**−0.68** ***(P = 0.00*)***
Sub-Saharan Africa	**−0.36** ***(P = 0.02)***	−0.21 *(P = 0.16)*
World total	**−0.37** ***(P = 0.00*)***	**−0.36** ***(P = 0.00*)***

* ***P*** is less than 0.005

Significant negative correlation may mean that countries borrow with an intention to cover budget deficit. It was typical of the countries from "Debt Clock" group, Latin America and Caribbean region to borrow in 2003 and 2011 to meet public needs. It was characteristic of the countries in South and East Asia and Pacific region, Middle East and North Africa and Sub-Saharan Africa in 2003. Moreover, if indicators of Qatar and Kuwait are excluded from Middle East and North Africa region calculation, correlation will get stronger and more significant (See Appendix 4 to the Thesis). For the whole world, small but significant correlation was observed (Fig. 10).

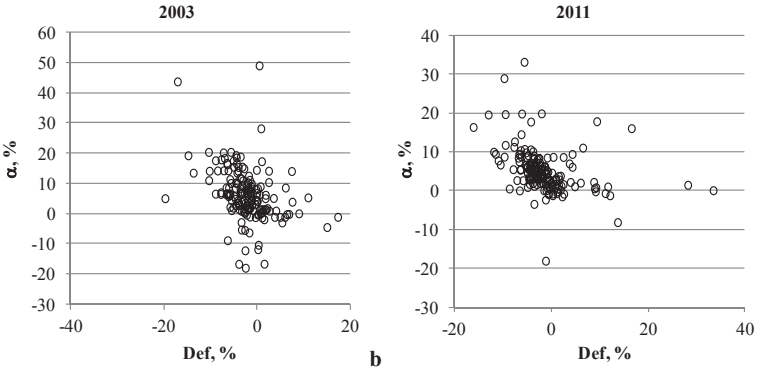


Fig. 10. Correlation between the government debt growth rate and budget deficit, world data.

Considering the indicators, presented in Appendix 1 to the Thesis, one can observe that both in 2003 and 2011 a newly established government debt (α) in almost all countries was larger than budget deficit. But only South and East Asia and Pacific region countries implemented policy that ensured both current public needs and economic development.

There is one more important issue: to what extent government debt is related to the state tax policy and influences it. In other words, do governments increase government debt to decrease tax burden on the economy? For example, in the USA, there is a tendency to increase debt to sustain the existing tax rates and to reduce the tax burden (Martin, 2009). The situation in the regions of the world is shown in Table X.

Table X

Correlation between Collected Taxes and Government Debt (*T–D/Y*)

Country groups and regions	2003		2011	
G9 countries	−0.23	*(P = 0.56)*	−0.19	*(P = 0.62)*
"*Debt Clock*" countries	−0.26	*(P = 0.31)*	0.06	*(P = 0.83)*
South and East Asia and Pacific	**−0.46**	***(P = 0.05)***	−0.29	*(P = 0.26)*
Western Europe	0.23	*(P = 019)*	0.18	*(P = 0.31)*
Eastern Europe and Central Asia	−0.43	*(P = 0.29)*	0.02	*(P = 0.95)*
Latin America and Caribbean	0.30	*(P = 0.20)*	**0.50**	***(P = 0.03)***
Middle East and North Africa	**0.65**	***(P = 0.04)***	0.15	*(P = 0.68)*
Sub-Saharan Africa	−0.31	*(P = 0.23)*	**0.51**	***(P = 0.04)***
World total	−0.05	*(P = 0.59)*	0.13	*(P = 0.17)*

* ***P*** is less than 0.005

On the basis of the data in Table X, it can be concluded that, in general, in the world the government debt was not related to a tax level both in 2003 and in 2011. The conclusion confirms the scientific premise that the government should borrow on the financial market and use refinancing to settle government debt, rather than raise taxes, so that the public feels secure regarding the stability of its revenues.

In 2003, in South and East Asia and Pacific, on the contrary, the countries with lower tax collections borrowed more, which is attested by moderate negative correlation (see also Appendix 5).

In 2011, it was typical of the countries with large tax rates from Latin America and Caribbean, as well as Sub-Saharan Africa to have a large government debt; this is demonstrated by a moderate positive correlation. The same situation was observed in the countries of Middle East and North Africa in 2003. The world situation is illustrated in Fig. 11.

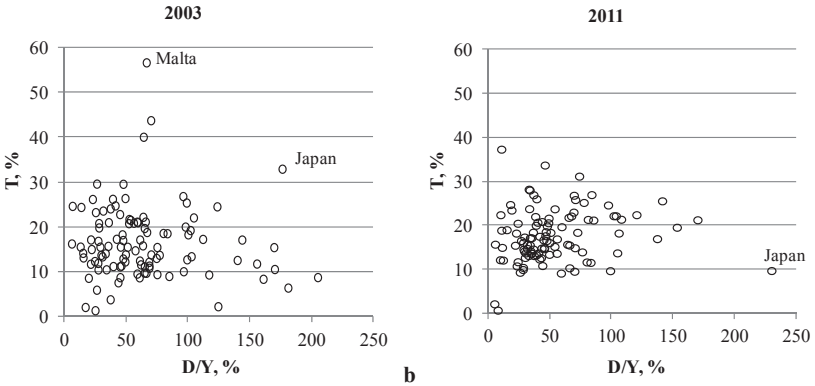


Fig. 11. Correlation between collected taxes and government debt, world data.

The experience of many countries attests that along with the growth of the government debt, the portion of taxes channeled to servicing the debt also increases. Table XI shows

whether this situation occurs in all world regions (insignificant correlations are presented in bold).

Table XI

Correlation between the Government Debt Burden and Government Debt (*b–D/Y*)

Country groups and regions	2003		2011	
G9 countries	0.68	*(P = 0.05)*	0.84	*(P = 0.01)*
"*Debt Clock*" countries	0.56	*(P = 0.01)*	**0.45**	***(P = 0.07)***
− excluding Brazil and India			0.90	*(P = 0.00)*
South and East Asia and Pacific	**0.31**	***(P = 0.23)***	**0.23**	***(P = 0.37)***
− excluding Japan and Singapore	0.68	*(P = 0.01)*	0.56	*(P = 0.03)*
Western Europe	0.76	*(P = 0.00*)*	0.77	*(P = 0.00*)*
Eastern Europe and Central Asia	0.80	*(P = 0.02)*	0.78	*(P = 0.01)*
Latin America and Caribbean	0.58	*(P = 0.01)*	0.69	*(P = 0.00*)*
Middle East and North Africa	0.87	*(P = 0.00*)*	0.91	*(P = 0.00)*
Sub-Saharan Africa	**0.21**	***(P = 0.41)***	0.51	*(P = 0.04)*
World total	0.51	*(P = 0.00*)*	0.54	*(P = 0.00*)*

* ***P*** is less than 0.005

Considering the data in Table XI, it can be observed that only in the countries of South and East Asia and Pacific region in 2003 and 2011 the correlation between debt amount and debt burden was insignificant until Japan and Singapore were excluded. This may mean that government debt service costs in these countries are very low. For more information see Appendix 6 to the Thesis.

It is also important to investigate whether the countries raise tax rates to service large government debt throughout the entire research period. Results are presented in Table XII.

Table XII

Correlation between Long-term Changes in Government Debt and Long-term Changes in Tax Rate (*ΔD/Y–ΔT**)

Country groups and regions	In the period from 2003-2011	
G9 countries	0.44	*(P* = 0.24)
"*Debt Clock*" countries	−0.28	*(P* = 0.28)
South and East Asia and Pacific	−0.11	*(P* = 0.68)
Western Europe	0.10	*(P* = 0.60)
Eastern Europe and Central Asia	0.17	*(P* = 0.71)
Latin America and Caribbean	−0.19	*(P* = 0.48)
Middle East and North Africa	0.22	*(P* = 0.61)
Sub-Saharan Africa	−0.22	*(P* = 0.50)
World total	−0.16	*(P* = 0.13)

* *ΔT* is calculated as tax rate difference between 2011 and 2003.

Based on the results presented in Table XII, it can be stated that the countries do not raise taxes to service government debt (see also Appendix 7 to the Thesis). This means that government debt refinancing is used for this purpose.

In the developed countries, it could be connected to the fact that tax rates are already sufficiently high and tax increase can cause social tension.

It often happens that the larger government debt amount is, the higher interest rate will be imposed on new borrowings. In Table XIII, the borrowing interest rate is correlated with the value of government debt.

Table XIII

Correlation between the Government Debt and Borrowing Interest Rate (*D/Y–p*)

Country groups and regions	2003		2011	
G9 countries	−0.52	*(P = 0.15)*	−0.41	*(P = 0.27)*
"*Debt Clock*" countries	−0.36	*(P = 0.14)*	−0.33	*(P = 0.20)*
South and East Asia and Pacific	−0.33	*(P = 0.20)*	−0.29	*(P = 0.26)*
Western Europe	0.17	*(P = 0.35)*	0.03	*(P = 0.86)*
Eastern Europe and Central Asia	−0.62	*(P = 0.19)*	−0.38	*(P = 0.32)*
Latin America and Caribbean	−0.22	*(P = 0.35)*	−0.08	*(P = 0.76)*
Middle East and North Africa	**0.87**	***(P = 0.00*)***	**0.78**	***(P = 0.01)***
Sub-Saharan Africa	**−0.57**	***(P = 0.02)***	0.26	*(P = 0.33)*
World total	−0.12	*(P = 0.21)*	−0.03	*(P = 0.79)*

* ***P*** is less than 0.005

As attested by data in Table XIII, strong correlation both in 2003 and in 2011 existed in the Middle East and North Africa only: in this region interest rate grows along with the growth of the government debt. In other regions and the world as the whole, government debt volume does not influence the borrowing interest rate (Appendix 8 to the Thesis).

GDP growth rate is one of the indicators that may also influence the loan interest rate. Correlation is shown in Table XIV. Figures indicate that there is no correlation between the indicators, except the only case of South and East Asia and Pacific in 2003 that could be interpreted as outlier.

Table XIV

Correlation between the Borrowing Interest Tate and GDP Growth Rate (*p–r*)

Countries	*2003*		*2011*	
G9	0.17	*(P = 0.66)*	0.09	*(P = 0.83)*
"*Debt Clock*" countries	0.10	*(P = 0.70)*	0.27	*(P = 0.30)*
South and East Asia and Pacific	**0.63**	***(P = 0.01)***	0.19	*(P = 0.48)*
Western Europe	−0.09	*(P = 0.61)*	−0.23	*(P = 0.20)*
Eastern Europe and Central Asia	0.37	*(P = 0.47)*	0.39	*(P = 0.29)*
Latin America and Caribbean	0.01	*(P = 0.97)*	−0.03	*(P = 0.91)*
Middle East and North Africa	−0.40	*(P = 0.25)*	−0.52	*(P = 0.15)*
Sub-Saharan Africa	0.44	*(P = 0.08)*	−0.03	*(P = 0.92)*
World total	0.11	*(P = 0.28)*	−0.08	*(P = 0.40)*

* P is less than 0.005

It is also necessary to study in detail how the government debt policy changes within the framework of cyclical economy, in other words, when definite countries borrow more: in the periods of recession or growth.

To conduct an in-depth analysis, the author used the data for the period from 1996 to 2011, based on the indicators from the IMF database. The data on all countries is presented in Appendix 10 to the Thesis, but the present chapter analyzes the data on selected countries only.

Figs. 12, 13 and 14 present the countries that borrow more in the period of decrease of GDP growth rate, borrow more in the period of increase of GDP growth rate and borrow irrespectively of GDP growth rate, respectively.

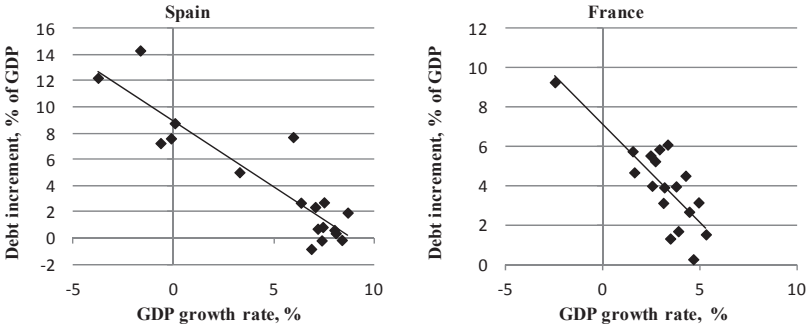


Fig. 12. Countries that borrow more during recession.

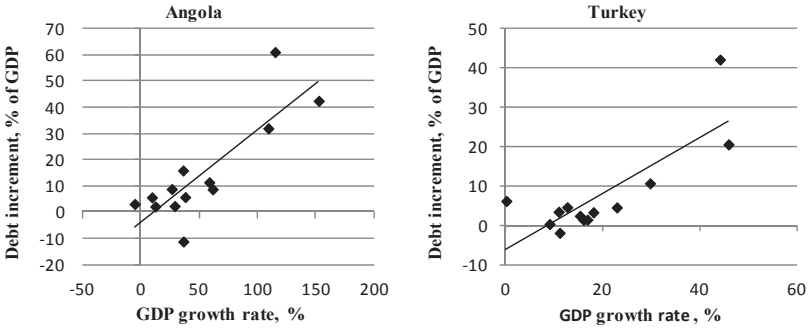


Fig. 13. Countries that borrow more during economic growth.

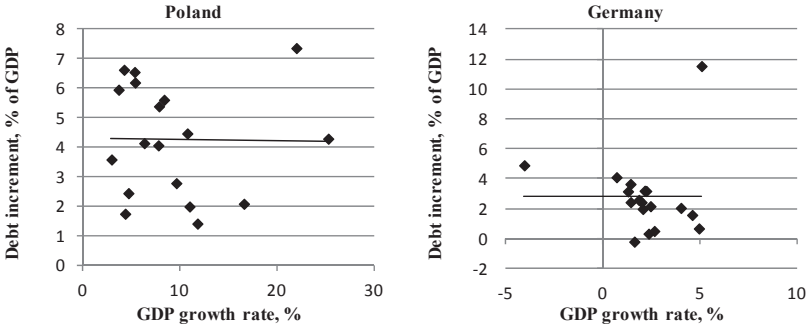


Fig. 14. Countries that borrow independently on the phase of economic cycle.

Having conducted the research, a question remains open: which phase of economic cycle is more favorable for borrowing to minimize the government debt burden over the public.

3.2. Government Debt Tendencies in the EU Member States

This chapter evaluates the correlation between the growth of government debt and selected economic indicators in the EU member states. The analysis was based on the public available data from the IMF and "Eurostat" databases (IMF, 2013; Eurostat, 2013), covered the period from 2003 to 2011. 27 EU member states were analyzed, including Romania and Bulgaria that joined the EU in 2007. Research results are summarized in Table XV.

Table XV

Correlation between the Government Debt and Definite Economic Indicators

Indicator	Debt in 2003	Debt in 2011
GDP, Y	0.34 ($P = 0.08$)	0.34 ($P = 0.08$)
GDP growth rate, r	−0.19 ($P = 0.34$)	−0.70 ($P < 0.01$)
Borrowing interest rate, p	0.13 ($P = 0.51$)	0.25 ($P = 0.21$)
Collected taxes, T	0.35 ($P = 0.07$)	0.26 ($P = 0.18$)
Tax burden, b	0.90 ($P < 0.01$)	0.88 ($P< 0.01$)
Long-term GDP growth, R	−0.59 ($P < 0.01$)	−0.70 ($P < 0.01$)
Debt growth, α	−0.44 ($P = 0.02$)	0.13 ($P = 0.52$)
Changes in the growth rate, Δr	−0.24 ($P = 0.22$)	−0.40 ($P = 0.04$)
Change in the interest rate, Δp	0.06 ($P = 0.78$)	0.13 ($P = 0.50$)
Tax burden change, Δb	−0.23 ($P = 0.25$)	0.39 ($P = 0.04$)

From the data in Table XV, one can conclude that there is no correlation between the government debt amount and borrowing interest rate; there is no correlation between the government debt amount and tax collections (excluding social security contributions); there is a positive correlation between the government debt amount and the portion of collected taxes, channeled to the government debt service.

There is a significant positive correlation between the long-term GDP growth in the period from 2003 to 2011 and the government debt at the beginning of this period (2003). Correlation coefficient value is –0.59 ($P < 0.01$), which attests that there is a moderate correlation between these indicators. Detailed analysis shows that the group of countries with small debts and large growth comprises only the newly accepted EU member states, the economy of which is still developing. The connection between the debt and GDP growth in any other group of countries has not been detected. Thus, it can be concluded that in these countries the increase of government debt does not facilitate the GDP growth.

In the EU member states, a statistically significant negative correlation between the long-term GDP growth and government debt at the end of the reporting period (2007) is observed, and this may mean that the countries borrow more exactly when GDP growth rates are low.

4. STATE FINANCIAL SECURITY WITHIN THE FRAMEWORK OF GOVERNMENT DEBT MANAGEMENT

4.1. Significance of State Financial Security

Economic security and methods for assessment of the level of security are among preconditions that ensure political stability of a country. Country credit rating ascribed by rating agencies is one of the indicators widely accepted in the word; it characterizes financial security of the country. Since the 1970s, the number of established international rating agencies has dealt with the evaluation of state financial stability, the most recognized ones

are Standard & Poor's (USA), Moody's (USA), Fitch Rating (USA, United Kingdom) and Japan Credit Rating Agency (Japan). Credit rating is a widely used tool to evaluate a range of economic indicators, including also financial stability of the country. Assessment given by rating agencies is taken into consideration by national and foreign investors in the process of selecting the optimal area for investment.

The agencies use numerous approaches to the assessment of the economic state of the countries to ascribe credit ratings. The rating is determined by many quantitative and qualitative indicators, the following being the most significant: GDP growth, consumer price index, GDP per capita, aggregate government debt, aggregate external debt in particular industries, government budget deficit / surplus, current account balance, cash reserves, etc. Rating agencies also assess a political situation; however, they do not always objectively evaluate the real situation in the country.

4.2. Evaluation of Credit Ratings of World Countries

In this section, it is evaluated to what extent country credit ratings reflect financial security of the states. One of the financial security indicators related to the independence of a country on foreign creditors, namely, external government debt to total government debt ratio, has been chosen as a criterion.

The research is based on the rating agency "Standard & Poor's" (S&P) data as provided at the end of 2011 (Standard & Poor's, 2012). Both internal and external S&P ratings (further — rating in the national currency and rating in the foreign currencies) were used in the research.

In order to perform the quantitative analysis, original S&P rating was substituted by numerical equivalent in a manner that value 0 corresponds to the lowest rating (D), but value 9.67 – to the highest rating (AAA).

The data on internal and external debts of 18 EU member states and 21 countries outside the EU were extracted from the World Bank statements for the last quarter of 2011, available at the World Bank web page (World Bank, 2012), i. e., The proportion of external debt was calculated for each country. To find out to what extent the proportion of external debt influences country credit rating, correlation coefficients between the ratings and external debt proportions were calculated. The results of correlation analysis are summarized in Table XVI.

Table XVI

Correlation Coefficients between S&P Ratings and Proportion of External Debt

S&P rating	**EU member states**	**Courtiers in other regions**	**World total**
National currency	−0.27 (P^* = 0.30)	−0.64 (P = 0.003)	−0.41 (P = 0.01)
Foreign currencies	−0.27 (P = 0.30)	−0.60 (P = 0.005)	−0.37 (P = 0.02)

*P–value in brackets corresponds to the statistical null hypothesis of no correlation.

Table XVI demonstrates that on the world scale there is a statistically significant negative correlation between credit ratings and proportion of external debt. This means that as the proportion of foreign debt grows, credit rating decreases — a result fully in accord with common sense. Moreover, the regression analysis performed shows that the increase of the proportion of external debt decreases country's rating. However, small values of the coefficient of determination ($r^2 < 50$ %) indicate that the proportion of external debt has a rather small impact on the credit rating: the influence of the proportion of external debt can explain variability of the final rating in the range of 13–17 %. Therefore, S&P rating is not sensitive to an important parameter that determines financial security of a country.

In case of "outside EU" countries, the increase of the absolute value of correlation coefficient indicates that the dependence of credit rating on the proportion of foreign debt is

more pronounced for these countries. On the contrary, in the EU member states this correlation is insignificant and credit rating is not directly connected with the proportion of external debt. This could indicate that some political factors have an impact on rating values. Therefore, it can be concluded that credit rating cannot be used straightforwardly as the only indicator that characterizes financial security of a country with regard to its government debt.

4.3. Development of Methodology for Assessment of Financial Security

Having summarized the data presented in literature, the author selected eight indicators to assess state financial security: 1) government debt to GDP ratio; 2) government debt service costs to collected taxes ratio; 3) budget deficit to GDP ratio; 4) inflation rate; 5) long-term interest rate on government securities; 6) proportion of external debt in the total government debt; 7) government debt per capita; 8) money stock (M2) to GDP ratio. The choice of indicators was validated using the content analysis of 108 text documents: scientific papers available from the Science Direct and EBSCO databases, as well as the documents of the International Monetary Fund and international rating agencies. As a result, the following conclusions were made:

- the content analysis demonstrated that all indicators presented in Table XVII could be used to characterize government debt policies and state financial stability, i. e., all indicators are united within one concept;
- document authors most frequently write about problems related to servicing government debt, government debt burden for society, and government debt amount in the economy;
- great attention is paid to the problems of default of sovereign states that are frequently associated with external government debt.

For each of the selected indicators, the recommended / threshold values were determined on the basis of Maastricht criteria (Table XVII).

Table XVII

Thresholds of Economic and Financial Indicators of a Country

Indicator No.	Indicator formula		Threshold
1	Government debt / Gross domestic product	Not exceeding	60 %
2	Government debt service costs / Collected taxes*	Not exceeding**	Mean
3	Government budget deficit / Gross domestic product	Not exceeding	3 %
4	Inflation rate	Not exceeding***	+1.5 p.p.
5	Long-term interest rate of the government bonds	Not exceeding***	+2 p.p.
6	External government debt / Total government debt	Not exceeding	60 %
7	Government debt / Population	Not exceeding***	×2
8	Money stock (M2) / Gross domestic product	Not less than	60 %

* – not including social insurance contributions,
** – not exceeding the average indicator among the states whose Government debt/GDP ratio does not exceed 60%,
*** – not exceeding the average indicator of three best performing member states.

A consolidated indicator for the assessment of state financial security is proposed in the form:

$$X = \sum_{i=1}^{7} \frac{F_i}{R_i} \mu_i + \frac{R_8}{F_8} \mu_8 \rightarrow \min, \quad (3)$$

where F_i — an actual indicator;
R_i — a recommended indicator;

i — an indicator number in Table XVII,

μ_i — indicator's weights, here $\sum \mu_i = 1$.

In the selected model, with the growth of financial stability, X-indicator tends to zero. If the recommended indicators values fully match the actual ones, then $X = 1$.

To determine the weights of each indicator in formula (3), the author used the expert evaluation analysis method. Experts were requested to rate the above-mentioned indicators in order of significance. The expert pool included 27 respondents — members of academic personnel of Latvian universities: Riga Technical University, Latvia University of Agriculture, and the University of Latvia, as well as 7 respondents from the institutions that implement government debt policy and government debt management in Latvia, Spain, Slovakia, Slovenia and Switzerland. The mutual agreement between expert evaluations was analyzed using Kendall's coefficient of concordance and Harington's concordance grading scale.

Based on the results of the analysis of concordance of expert evaluations, three expert groups were recognized: two academic groups and one group of professionals. Evaluations by different groups noticeably differed; thus, the experts could not be united within one group.

Average indicators' weights were calculated for each group of experts as:

$$\mu_i = \frac{\sum_j M_{i,j}}{\sum_i \sum_j M_{i,j}}, \qquad (4)$$

where $M_{i,j}$ is weight of i^{th} criterion, ascribed after j^{th} questionnaire (7 — most significant, 0 — not significant). Estimated weights are summarized in Table XVIII.

Table XVIII

Indicators' Weights for Each Group

Indicator No.	Indicator formula	Academic group I	Academic group II	Professionals
1	Government debt / GDP	0.224	0.225	0.214
2	Government debt service costs / Collected taxes	0.121	0.188	0.173
3	Government budget deficit / GDP	0.156	0.195	0.184
4	Inflation rate	0.080	0.107	0.092
5	Long-term interest rate for government bonds	0.080	0.029	0.194
6	External government debt / Total government debt	0.223	0.123	0.087
7	Government debt / Population	0.018	0.091	0.020
8	Money stock (M2) / GDP	0.098	0.042	0.036

It should be noted that the long-term interest rate for government securities was rated as very important indicators by professionals, whereas academic experts, in particular group II, considered it not important.

4.4. Assessment of Financial Stability of the Republic of Latvia

X-indicator developed in the Doctoral Thesis was calculated using the data for Latvia in the period from 2000 to 2012 (Fig. 15). The evaluations made using different sets of weights are in good concordance; however, one can notice that in professionals' opinion, the criterion in question provides more pessimistic evaluation in case of recession in comparison with the rating by the rating agency.

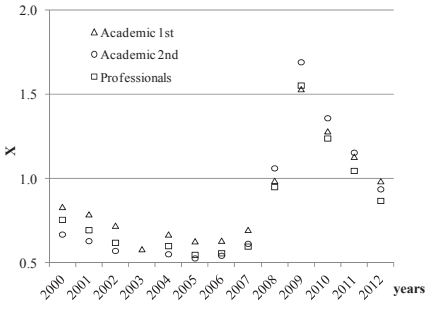


Fig. 15. Comparison of X-indicators ascribed by different groups of experts.

Fig. 16 demonstrates the comparison of calculated X-indicators with the Latvian credit rating ascribed by international rating agencies. X-indicator sufficiently well correlates with the ratings, in particular in the area of lower ratings. However, at high ratings the criterion "gets saturated", i. e., as the rating grows, X does not change any more. It can be noticed, considering S&P and Fitch rating in particular. It can indicate that rating agencies are too optimistic in the times of economic growth.

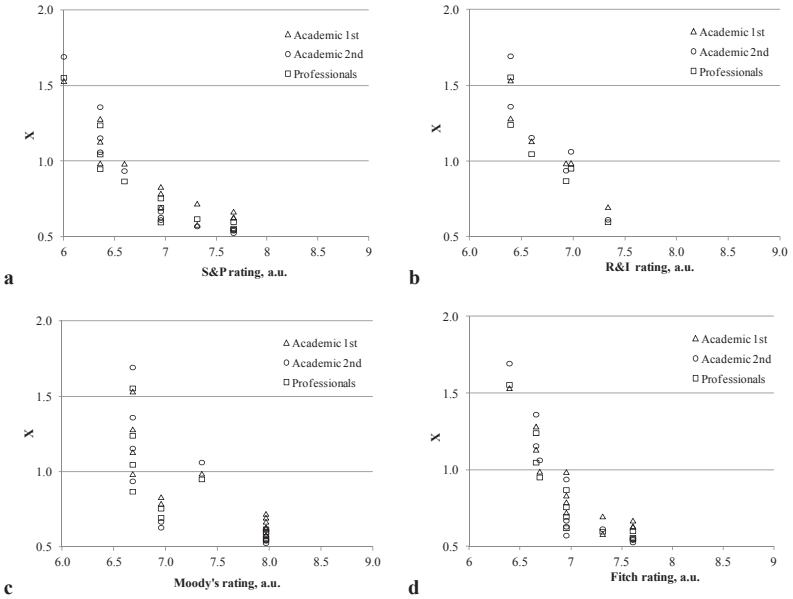


Fig. 16. Comparison of expert X-indicators with credit ratings.

In addition, X-indicators were also calculated using the data of other EU member states (United Kingdom, Italy, Belgium, Estonia and Sweden). The comparison between Fitch

rating and X-indicator is presented in Figs. 17 and 18. It should be noted that the choice of countries and rating agencies was determined by the availability of data in the open sources.

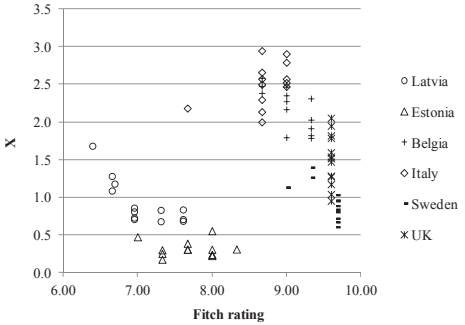
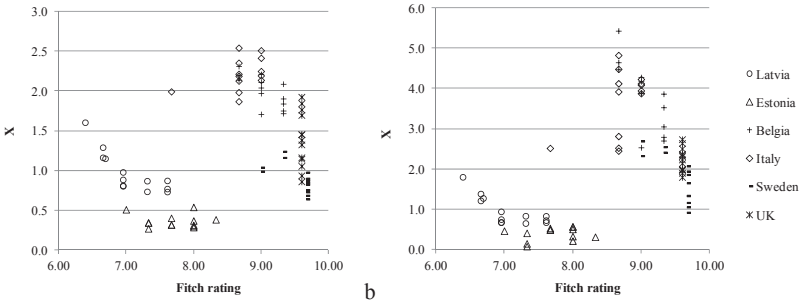


Fig. 17. Comparison of X-indicators by expert-professionals and credit ratings.



a b

Fig. 18. Comparison of X-indicators by academic experts and credit ratings
(a — Academic I, b — Academic II).

Considering the given figures, it can be concluded that X-indicator well correlates with the rating of new EU member states, Latvia and Estonia, whereas the rating remains too optimistic for 'old' EU member states, despite the increase of government debt.

In general, it can be concluded that the methodology developed by the author can be used as an additional indicator for the assessment of financial sustainability of a country within the framework of national security.

5. ELABORATION OF GOVERNMENT DEBT POLICY MODEL

5.1. Description of the Model

Numerous government debt policy models, described in the literature, are reviewed in the present chapter. Particular attention is paid to original Domar's model taken as the basis for the development of the elaborated cyclical model. Domar describes numerous government revenue and debt growth scenarios:

1) national income remains unchanged;
2) national income increases by one and the same absolute value;
3) national income grows at one and the same rate;
4) interest rates for government securities grow rapidly (wartime model).

Domar proved that only in case of exponential growth of national income, the ratio of government debt to national income would not increase to infinity, when government debt could not be managed by any means, i. e., the country should declare default. In Domar's "classic" model, national income grows according to the law:

$$Y = Y_0 e^{rt}, \tag{5}$$

where Y_0 — national income in the base period,
r — national income growth rate per year,
t — time, years.

Domar's "classic" model considers that government debt amount is constituted by annual constant borrowing growth rate as percentage from the national income. Therefore, total accumulated government debt sum D t a year is:

$$D(t) = D_0 + \int_0^t \alpha Y_0 e^{rt} dt = D_0 + \frac{\alpha Y_0}{r}\left(e^{rt} - 1\right), \tag{6}$$

where D_0 — government debt at the beginning of the year;
α — proportion of newly created government debt in the national income;

Domar's "classic" model demonstrates that if the government income growth rate is constant, the relation of government debt to the national income in the long-term tends to the finite threshold:

$$\lim_{t\to\infty} \frac{D}{Y}(t) = \frac{\alpha}{r}, \tag{7}$$

Domar's "war" model includes a "war" period, when the country borrows at higher interest rate β, but national income growth rate remains unchanged. Similarly to the classic Domar's model, the "war" model allows forecasting D/Y and U/T in long-term limits:

$$\text{maximum } \lim_{t\to\infty} \frac{D}{Y} = \frac{\alpha + Ke^{rp}}{r}; \tag{8}$$

$$\text{minimum } \lim_{t\to\infty} \frac{D}{Y} = \frac{\alpha + K}{r}, \tag{9}$$

$$\text{where } K = \frac{(\beta - \alpha)\left(e^{r\omega} - 1\right)}{e^{(p+\omega)r} - 1} \tag{10}$$

$$\text{average } \lim_{t\to\infty} \frac{D}{Y} = \frac{\sigma}{r}, \tag{11}$$

$$\text{where } \sigma = \frac{\alpha p + \beta\omega}{p + \omega}, \tag{12}$$

but p and ω are the lengths of "peace" and "war" periods. The result of Domar's "war" model is similar to the result of the "classic" model: average indicator D/Y also reaches a limited constant value, values D/Y fluctuate from a minimum value in the "peace" period to a maximum values in the "war" period. In should be noted that the assumption of Domar's model concerning constant national income growth rate seems unreal, as in the real economy a growth period is followed by the period of recession.

5.2. Elaboration of Cycle Model

Using Domar's model as the basis, a cycle model was developed in the Thesis. The model takes into account cyclical economic development. The development of the model is based on the conclusions that follow from Chapter Three:

− nominal value of the loan is not redeemed, refinancing is used for that purpose;

– governments do not change tax policies as government debt service costs grow.

The model considers two periods: 1) period of growth, when GDP grows more rapidly and 2) period of recession, when GDP grows slowly or decreases. In the period of economic development, government revenues grow at the rate r_A and the government borrows α from GDP yearly. In the period of recession, GDP grows at the rate r_B (which can also be negative), but the government borrows at a higher interest rate β, compensating the fall of GDP. Coordinating the model with the actual situation, a lag between the beginning of recession and reduction of GDP was introduced. Model equations in the period of growth are:

$$Y_n(t) = Y_{n-1} e^{r_A t}, \tag{13}$$

$$D_n(t) = D_{n-1} + \frac{\alpha Y_{n-1}}{r_A}\left(e^{r_A t} - 1\right), \tag{14}$$

where Y_{n-1} and D_{n-1} are GDP and government debt at the end of the pervious recession period, respectively. Formulas (13) and (14) can be used for the recession period, but in the equation r_A is substituted with r_B, α with β, also, Y_{n-1} and D_{n-1} are GDP and government debt at the end of the pervious growth period, respectively.

The parameters of the cycle model were calculated for the case of Latvia using the data of the Central Statistical Bureau of Latvia for the period from 1995 to 2011. Cycles with the period of about 10 years were observed in government revenue growth rate. Such a periodicity corresponds to the Juglar cycle described in literature (period is 8–11 years).

Elaborating the model, 10-year period was divided into 8-year growth period with positive r_A and 2-year recession period with negative r_B. The division considers one-year lag between the beginning of the crisis and the observed GDP decrease, as the crisis started at the end of eight-year growth period. Both GDP and government debt growth rates in 1995–2011 were approximated using Domar's "classic" model, Domar's "war" model and the elaborated cycle model. Model parameters (r, r_A, r_B, α, β) were adjusted to minimize the sum of squared deviations between the modeled and actual values in the period of n years:

$$\sigma = \frac{\sum_t \left(Y(t) - Y_{model}(t)\right)^2}{n}. \tag{15}$$

Approximation results of GDP and debt amount are presented in Figs. 19 and 20. Evaluating mean square deviation from the actual data in different models, it was observed that the cycle model ensures smaller deviation values for both GDP and government debt approximations, which means that the cycle model is more suitable for the description of Latvian GDP growth in the respective period. Parameters of all models are summarized in Table XIX.

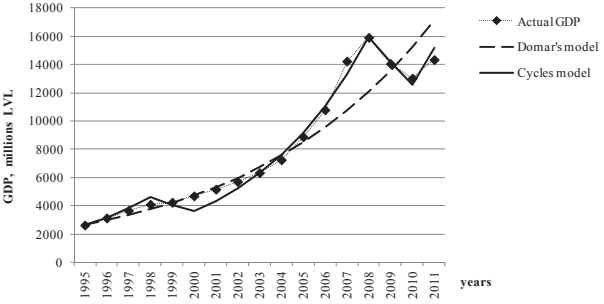


Fig. 19. GDP growth in Latvia in the period from 1995 to 2011.

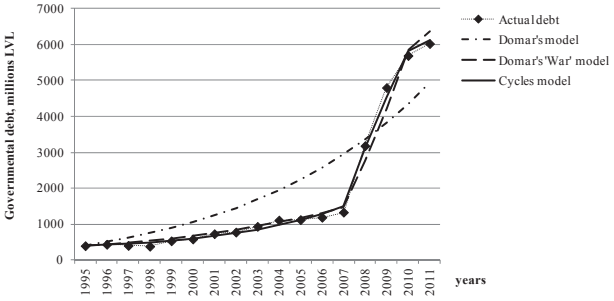


Fig. 20. Increase of government debt in Latvia in the period from 1995 to 2011.

Table XIX

Modeling of GDP and Government Debt Growth Parameters in the Economy of Latvia in 1995–2011

Indicators	Domar's "classic" model	Domar's "war" model	Cycle model
GDP growth, %			
in the growth period	11.7	11.7	18.5
in the recession period	–	–	−11.7
σ for GDP approximation *	**1597**	**1597**	**508**
Increase of government debt, %			
in the growth period	3.7	1.6	0.9
In the recession period		11.4	12.9
σ for government debt approximation,*	**845**	**218**	**109**

* figures in million LVL

Using the calculated model parameters, a short-term forecast of GDP and government debt accumulation was made (Fig. 21). The forecast for the period till 2031 comprises two full Juglar cycles. In the Domar's models, GDP growth rate was assumed in accordance with the IMF forecasts for the development of the European countries and was equal to 2.5 % (IMF, 2012). In the recession period, GDP growth rate was assumed as −5 %. "Recession" rate was obtained, assuming that *r* was equal to GDP decrease in the period of "moderate" recession in 1998–1999.

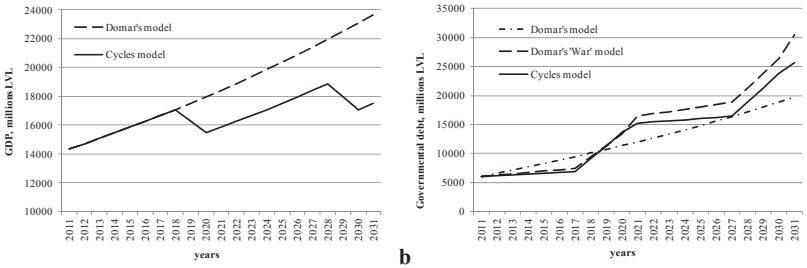
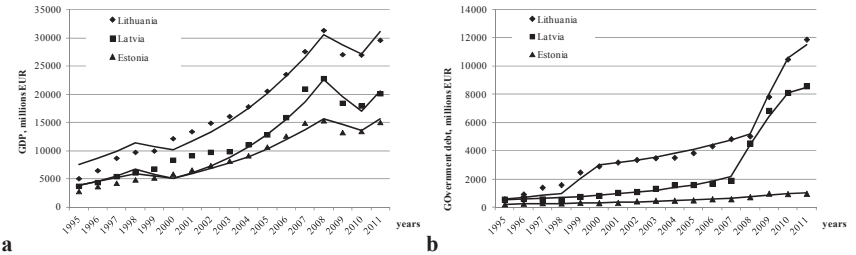


Fig. 21. Forecast of Latvian GDP (a) and government debt amount (b).

The elaborated cycle model was successfully applied for the description of debt accumulation in all three Baltic States in the period from 1995 to 2011 (Fig. 22). Model parameters are summarized in Table XX.



a b

Fig. 22. Approximation of GDP (a) and government debt increase (b) of the Baltic States using the cycle model.

Table XX

Cycle Model Parameters of the Dynamics of GDP and Government Debt in the Baltic States

Indicators \ Country	Latvia	Lithuania	Estonia
GDP growth, %			
in the growth period	18.5	13.8	13.9
in the recession period	−11.7	−5.9	−7.2
Increase of government debt, %			
in the growth period	0.9	1.4	0.3
in the recession period	12.9	9.3	0.8

5.3. Qualitative Analysis of the Cycle Model

The elaborated model also allows obtaining analytical solutions that give the opportunity to evaluate both long-term government debt limits and the impact of borrowing policies on the government debt. The following notations were used in the model:

Y_0, D_0 — GDP and government debt values at the beginning of the base period, actual prices;

Y_{Ai}, D_{Ai} — GDP and government debt values at the end of growth period of *i*-th cycle;

Y_{Bi}, D_{Bi} — GDP and government debt values at the end of recession period of *i*-th cycle;

g, k — length of growth and recession periods, years;

r_A, r_B — GDP growth rate in the growth and recession periods, respectively;

$\alpha(r)$ — proportion of newly created government debt, % from GDP.

Indicator $\alpha(r)$ shows what fraction of GDP the government borrows a year, which correlates with GDP growth rate, as it was previously demonstrated (Figs. 12–14). Therefore, it is assumed in the analysis that the government decides on the amount of borrowing, taking into consideration the current rate of economic development. Within this assumption, the dependence of government debt growth rate on GDP growth rate, which is described by function $\alpha(r)$, is the quintessence of government borrowing policy. That is why in this chapter this function is further referred to as "policy". Here, the aim of the analysis is to investigate the impact of different policies on the long-term accumulation of government debt.

The model is characterized by the following equations:
GDP values in n-th cycle at the end of growth period

$$Y_{A_n} = Y_0 e^{nr_A g} e^{(n-1)r_B k} = Y_0 e^{(r_A g + r_B k)n} e^{-r_B k} = Y_0 e^{\omega n} e^{-r_B k} \tag{16}$$

and at the end of recession period

$$Y_{B_n} = Y_0 e^{nr_A g} e^{nr_B k} = Y_0 e^{(r_A g + r_B k)n} = Y_0 e^{\omega n}, \tag{17}$$

where n is the number of the cycle, but parameter

$$\omega = r_A g + r_B k \tag{18}$$

can be interpreted as an average GDP growth rate. Relation of government debt value to GDP in n-th cycle is represented by formula

$$\frac{D}{Y} = \begin{cases} \dfrac{D_0 + \alpha(r_A)\dfrac{e^{r_A g}-1}{r_A}\dfrac{e^{\omega n}-1}{e^{\omega}-1} + \alpha(r_B)\dfrac{e^{r_B k}-1}{r_B}e^{r_A g}\dfrac{e^{\omega(n-1)}-1}{e^{\omega}-1}}{e^{\omega n}e^{-r_B k}} & (A_n) \\ \dfrac{D_0 + \alpha(r_A)\dfrac{e^{r_A g}-1}{r_A}\dfrac{e^{\omega n}-1}{e^{\omega}-1} + \alpha(r_B)\dfrac{e^{r_B k}-1}{r_B}e^{r_A g}\dfrac{e^{\omega n}-1}{e^{\omega}-1}}{e^{\omega n}} & (B_n) \end{cases}, \tag{19}$$

where A_n denotes the formula corresponding to the growth period and B_n — the formula corresponding to recession period.

To evaluate a long-term tendency, D/Y threshold values were analyzed in the paper, when the number of cycles tended to infinity. Presence of threshold values depends on the operator of parameter ω.

If **ω>0**, then, when $n \to \infty$, $e^{\omega n} - 1 \approx e^{\omega n}$, and formula (19) gets reduced to

$$\lim_{n\to\infty}\frac{D}{Y} = \begin{cases} \alpha(r_A)\dfrac{e^{r_A g}-1}{r_A}\dfrac{e^{r_B k}}{e^{\omega}-1} + \alpha(r_B)\dfrac{e^{r_B k}-1}{r_B}\dfrac{1}{e^{\omega}-1} & (A_n) \\ \alpha(r_A)\dfrac{e^{r_A g}-1}{r_A}\dfrac{1}{e^{\omega}-1} + \alpha(r_B)\dfrac{e^{r_B k}-1}{r_B}\dfrac{e^{r_A g}}{e^{\omega}-1} & (B_n) \end{cases} \tag{20}$$

In case, when **ω<0**, there is no threshold value, as at $n \to \infty$, $e^{\omega n} - 1 \approx -1$ and

$$\lim_{n\to\infty}\frac{D}{Y} \sim \frac{1}{e^{\omega n}} = e^{|\omega| n} \to \infty \tag{21}$$

D/Y tends to infinity also at $\omega \to 0$, as in this case in expression (20) $e^{\omega} - 1 \to 0$.

Non-existence of D/Y threshold at $\omega \le 0$ reflects a trivial fact that in the economy, which does not grow for a long time, GDP growth does not compensate for debt service costs, the borrowed funds are used for servicing the existing debt and the economy cannot bear the debt load.

D/Y behavior as the number of cycles grows is similar to the one obtained within Domar's "war" model: D/Y fluctuates between maximum possible value $(D/Y)_{\max}$ (which has been reached at the end of recession period) and minimum value $(D/Y)_{\min}$. Typical scenario of (D/Y) change is shown in Fig. 23.

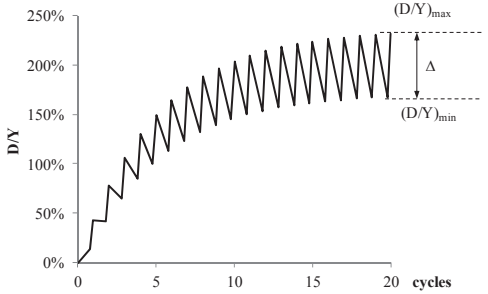


Fig. 23. Typical government debt growth curve in a cycle model.

The aim of further analysis is to evaluate how the borrowing policy influences $(D/Y)_{max}$, $(D/Y)_{min}$ and Δ. An economy with constant parameters r_A and r_B was modeled, i. e., GDP growth rate in the respective period was always constant. *D/Y* values were evaluated for the periods of growth and recession of different length.

As a result, a methodology was developed to select government debt policy depending on GDP growth rates in the growth and recession periods and on the lengths of these periods. The methodology allows deciding which period — growth or recession — is more beneficial for borrowing, in order to minimize *(D/Y)* value in the long term.

The impact of government debt policy on *D/Y* should be analyzed in three distinct cases:

$$\left.\begin{array}{l} \textbf{A}\text{: } r_B \le 0 \text{ (maximum } D/Y \text{ in the recession period);} \\ \textbf{B}\text{: } r_B > 0,\ \alpha(r_B) > \alpha(r_A)\dfrac{r_B}{r_A} \text{ (maximum } D/Y \text{ in the recession period);} \\ \textbf{C}\text{: } r_B > 0,\ \alpha(r_B) < \alpha(r_A)\dfrac{r_B}{r_A} \text{ (maximum } D/Y \text{ in the growth period).} \end{array}\right\} \qquad (22)$$

The assumptions made below were used to analyze the impact of government debt policy on debt threshold values. Having conducted analysis in Chapter Three, it has been observed that countries across the world implement different debt policies: in some countries α more rapidly grows in the recession period, but in other — in the growth period. Respectively, $\alpha(r)$ in the first case is a growing function, in the second case — a declining one (Fig. 24). As only two values are accepted in the cycle model r — r_A and r_B, α will also have only two values. Two alternative policies were compared in the analysis. Policy $\mathbf{P_1}$ corresponds to a declining $\alpha(r)$ function, when in the growth period: $\alpha(r_A) = a_1$ and in the recession period: $\alpha(r_B) = a_2$, in addition, $a_2 > a_1$, i. e., the country borrows more in the period of recession. Policy $\mathbf{P_2}$ corresponds to a growing $\alpha(r)$ function, when in the growth period: $\alpha(r_A) = a_2$, and in the recession period: $\alpha(r_B) = a_1$, but still $a_2 > a_1$, i. e., the country borrows more in the period of growth.

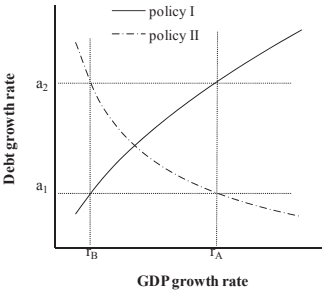


Fig. 24. Types of government debt policy.

To assess two policies: $\mathbf{P_1}$ and $\mathbf{P_2}$, respectively, maximum and minimum *D/Y* values were compared. It was necessary to take into consideration the cases mentioned above: **A**, **B** and **C**.

Case A: $r_B \le 0$

Here, maximum *D/Y* value related to policy $\mathbf{P_1}$ is:

$$\left.\frac{D}{Y}\right|_{\max}^{P_1} = a_1 \frac{e^{r_A g}-1}{r_A}\frac{1}{e^{\omega}-1} + a_2 \frac{e^{-|r_B|k}-1}{r_B}\frac{e^{r_A g}}{e^{\omega}-1}\ , \tag{23}$$

but with policy $\mathbf{P_2}$:

$$\left.\frac{D}{Y}\right|_{\max}^{P_2} = a_2 \frac{e^{r_A g}-1}{r_A}\frac{1}{e^{\omega}-1} + a_1 \frac{e^{-|r_B|k}-1}{r_B}\frac{e^{r_A g}}{e^{\omega}-1} \tag{24}$$

Deducting (23) from (24), after transformations we obtain criterion γ value

$$\gamma = \left.\frac{D}{Y}\right|_{\max}^{P_2} - \left.\frac{D}{Y}\right|_{\max}^{P_1} = \frac{a_2-a_1}{e^{\omega}-1}\left[\frac{e^{r_A g}-1}{r_A} - \frac{1-e^{-|r_B|k}}{|r_B|}e^{r_A g}\right] \tag{25}$$

The operator of this criterion defines in which case policy $\mathbf{P_1}$ is more beneficial in a sense that in comparison with $\mathbf{P_2}$ it ensures smaller maximum *D/Y* value. As by definition $a_2 > a_1$ and $\omega > 0$, the first multiplier of this expression will always be positive and operator of criterion γ is determined by the second multiplier. Criterion γ will be larger than 0, if:

$$k < -\frac{1}{|r_B|}\ln\left[1-\frac{|r_B|}{r_A}(1-e^{-r_A g})\right] \tag{26}$$

This result can be interpreted graphically. Inequality (26) determines the curve, which divides the plane *g* — *k* into two domains: domain **I**, where inequality (26) is valid and where $\gamma > 0$ and domain **II**, where $\gamma < 0$ (Fig. 25). Respectively, it is possible to determine, which policy will ensure smaller maximum *D/Y* value depending on the length of growth and recession periods. In should be noted that it is necessary to consider only such *k* values, which comply with inequality $k < g\, r_A/|r_B|$. In case when $r_A < |r_B|$ (Fig. 25.a.), any *k* value in the "tolerable" range (under line $k = g\, r_A/|r_B|$, complies with inequality (26)). This means that in case of explicit recession, borrowing policy $\mathbf{P_1}$ will always be more beneficial, i. e., countries should borrow in the times of crisis. However, if the GDP decrease rate is not larger than the GDP growth rate in the growth period, there is an area where policy $\mathbf{P_2}$ may be more efficient. This area corresponds to the largest *k* values, which means that borrowing in the growth period will be more beneficial, if recession periods are comparatively long.

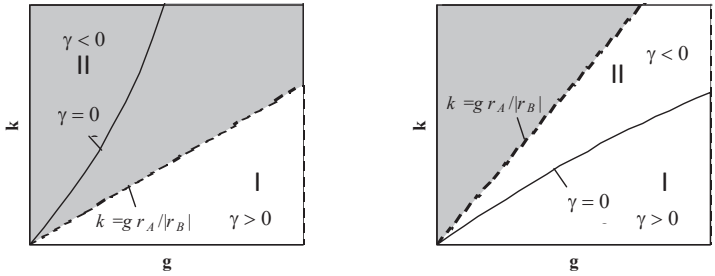


Fig. 25. Critical areas for selection of borrowing policy.

Areas marked with grey in Fig. 25 correspond to the case of $\omega<0$ for both cases, when $r_A < |r_B|$ (Fig. 25.a) and when $r_A > |r_B|$ (Fig. 25.b). Thus, in these areas *D/Y* grows with no limit. *D/Y* threshold can exist only in the "white" area. It should be noted that in the second case (Fig. 25.b) there is a domain with $\gamma < 0$ in the "white area", where policy **P₂** is more beneficial (domain **II**).

Analyzing inequality (26), one should separately consider the cases when the expression under logarithm is less or equal to zero. In this case one has always $\gamma > 0$. This is also valid at $r_B = 0$.

It is worth considering the case when r_A and g are small and exponent in the numerator allows expansion in Taylor series. With the expansion, accurate up to the first order, inequality (26) reduces to $k < g$. This qualitatively attests the conclusion made above that policy **P₂** is safer, if recession periods are longer than growth periods.

Considering the issue regarding the impact of the selection of borrowing policy on the maximum *D/Y* value, additional interest is caused by the question concerning the impact of policy on *D/Y* fluctuations, switching from growth to recession and back. Fluctuations that correspond to policies **P₁** and **P₂** are, respectively:

$$\Delta_{P_1} = \frac{D}{Y}\Big|_{\max}^{P_1} - \frac{D}{Y}\Big|_{\min}^{P_1} = \frac{e^{r_A g}-1}{e^{\omega}-1}(1-e^{-|r_B|k})\left[\frac{a_1}{r_A}+\frac{a_2}{|r_B|}\right] \tag{27}$$

$$\Delta_{P_2} = \frac{D}{Y}\Big|_{\max}^{P_2} - \frac{D}{Y}\Big|_{\min}^{P_2} = \frac{e^{r_A g}-1}{e^{\omega}-1}(1-e^{-|r_B|k})\left[\frac{a_2}{r_A}+\frac{a_1}{|r_B|}\right] \tag{28}$$

Subtracting (27) from (28) and applying algebraic transformations, we obtain the criterion

$$\delta = \Delta_{P_2} - \Delta_{P_2} = \frac{(e^{r_A g}-1)(1-e^{-|r_B|k})(a_2-a_1)}{e^{\omega}-1}\left[\frac{1}{r_A}-\frac{1}{|r_B|}\right], \tag{29}$$

whose sign determines the value of swing Δ conditioned by the application of each policy: if $\delta > 0$ — larger swings will occur if to borrow more in the growth period; if $\delta < 0$ — larger swings will occur if to borrow in the recession period. As the first multiplier — a fraction in formula (29) is always positive; the condition $\delta > 0$ corresponds to

$$r_A < |r_B| \tag{30}$$

Condition (30) does not contain the lengths of the periods of growth and recession, which means that if GDP growth rate in the growth period is lower than GDP decrease rate in the recession period, borrowing in the recession period will always yield smaller *D/Y* fluctuations, irrespective of how longs the periods are.

Typical government debt growth curves corresponding to different parameter combinations are shown in Fig. 26. Curves in Fig. 26.a correspond to the case when $r_A < |r_B|$. Curves in Figs. 26.b and 26.c correspond to the case when $r_A > |r_B|$, moreover, the graphs in Fig. 26.b were obtained with g and k values, which fell in domain **I** of Fig. 25.b, but in Fig. 26.c — with values from domain **II**. Respectively, in the latter case D/Y is smaller, if policy $\mathbf{P_2}$ is used, i. e., if a country borrows more in the growth period. It should be noted that fluctuations between maximum and minimum D/Y values in case when $r_A > |r_B|$ are smaller for "development" borrowing scheme, irrespective of whether this scheme is safer or not. Selecting in this case policy $\mathbf{P_1}$ (borrowing in the recession period), it should be taken into consideration that although the policy ensures a smaller D/Y, mid-term fluctuations will be sufficiently large.

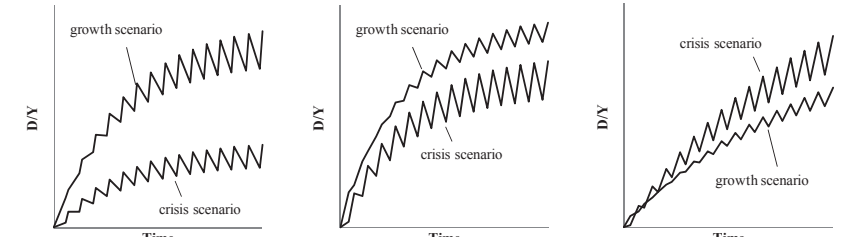


Fig. 26. Typical debt growth curves for different values of model parameters.

In Fig. 26 the following parameters were assumed: a) growth period 8 years, $r_A = 5$ %, recession period 2 years, $r_B = -10$ %; b) growth period 6 years, $r_A = 5$ %, recession period 4 years, $r_B = -2$ %; c) growth period 4 years, $r_A = 5$ %, recession period 6 years, $r_B = -2$ %. In all cases government debt growth rate is $a_1 = 1$ %, $a_2 = 6$ %.

Case B: $\mathbf{r_B > 0}$

In case when $r_B > 0$, the analysis should be performed taking into account inequalities (22), as at certain conditions the period, when D/Y reaches maximum values, changes. That does not refer to $\mathbf{P_1}$ policy case, as within this policy D/Y maximum is reached in the recession period; however, in case of policy $\mathbf{P_2}$, $\alpha(r_B)$ may get smaller, and in this case D/Y maximum could "switch" to the growth period.

Critical thresholds of respective criteria, which correspond to $\gamma > 0$, and the preference should be given to policy $\mathbf{P_1}$, are determined by inequality:

$$k < \frac{1}{r_B} \ln\left[1 + \frac{r_B}{r_A}(1 - e^{-r_A g})\right] \tag{31}$$

This inequality can be used without limitations at any r_A, r_B and g values, as under logarithm the value is always positive, and at $r_B > 0$ total GDP growth rate ω is positive.

D/Y fluctuation swing difference δ can be obtained by analogy using equation (29):

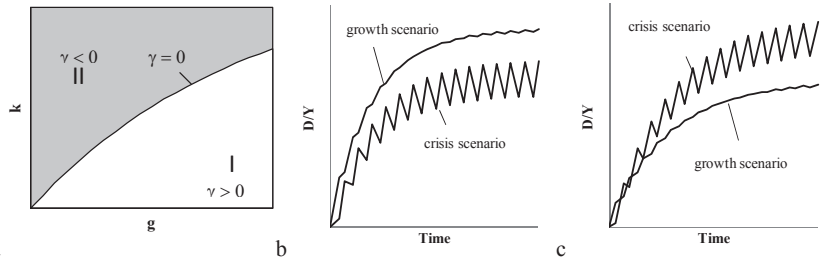
$$\delta = \Delta_{P_2} - \Delta_{P_2} = -\frac{(e^{r_A g} - 1)(e^{r_B k} - 1)(a_2 - a_1)}{e^{\omega} - 1}\left[\frac{1}{r_A} + \frac{1}{r_B}\right], \tag{32}$$

The value of this criterion is always negative, i. e., in case when $r_B > 0$ and $a_1 > a_2 r_B / r_A$, D/Y fluctuations will always be larger within policy $\mathbf{P_2}$.

Comparing inequalities (31) and (26), it can be noticed that the former transgresses into the latter, as recession GDP growth rate r_B changes the operator. The same is true about equations (32) and (29). This means that the domains determining the choice of either policy

P₁ or **P₂** can be described in a joint approach both at $r_B \le 0$ and $r_B > 0$ under condition that $a_1 > a_2 r_B/r_A$. It should be noted that this inequality holds automatically, if $r_B \le 0$.

Graphically, the domains defined by inequality (31) are shown in Fig. 27.a, but typical debt growth curves — in Fig. 27.b and 27.c. It should be noted that in both cases the growth borrowing scheme ensures smaller fluctuations of *D/Y* values.



a b c

Fig. 27. Critical domains of government debt policy selection in case when $r_B > 0$ and $a_1 > a_2 r_B/r_A$.

Typical debt growth curves for different values of model parameters are presented in Fig. 27: length of growth period — 6 years, length of recession period — 4 years (Fig. 27.b), and length of growth period — 4 years, length of recession period — 6 years (Fig. 27.c). In all cases, GDP growth rates are $r_A = 5$ %, $r_B = 0.5$ % and government debt amount growth is $a_1 = 1\%$, $a_2 = 6\%$.

Case C: $r_B >> 0$

If r_B is sufficiently large, inequality is

$$a_1 < a_2 \frac{r_B}{r_A} \tag{33}$$

In this case, within policy **P₂** debt maximum corresponds to the growth period and critical threshold, which corresponds to $\gamma > 0$, and advantages of policy **P₁** (Fig. 28.a) are determined by inequality

$$k < \frac{1}{r_B} \ln \left[\frac{\frac{(1-e^{-r_A g})}{r_A}\left(\frac{r_A}{r_B} a_2 - a_1\right) + \frac{1}{r_B}(a_2 - a_1)}{\frac{(1-e^{-r_A g})}{r_A}\left(\frac{r_A}{r_B} a_2 - a_2\right) + \frac{1}{r_B}(a_2 - a_1)} \right], \tag{34}$$

which is more complicated than similar inequalities in other cases and also contains special a_1 and a_2 values. Nevertheless, numerical modeling shows that a_1 and a_2 values do not significantly influence the critical threshold (Fig. 28.b). *D/Y* fluctuation swing range δ is obtained by analogy with equation (29) taking into account the change of maximum and minimum in case of policy **P₂**:

$$\delta = \Delta_{P_2} - \Delta_{P_2} = -\frac{(e^{r_A g} - 1)(e^{r_B k} -)(a_2 + a_1)}{e^{\omega} - 1}\left[\frac{1}{r_B} - \frac{1}{r_A}\right], \tag{35}$$

As $r_A > r_B$, the last bracket figure is positive and the value of criterion δ is always negative, i. e., in case when $r_B > 0$ and $a_1 < a_2 r_B/r_A$, *D/Y* fluctuations will also be always larger in case of policy **P₁**.

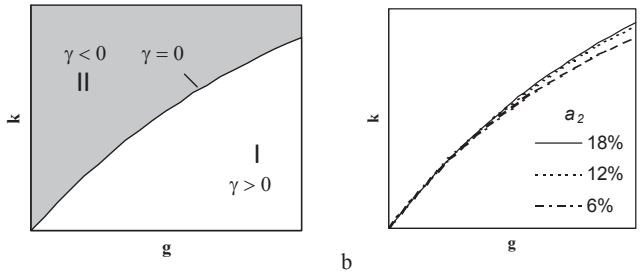


Fig. 28. Critical domains of government debt policy selection in case when $r_B > 0$ and $a_1 < a_2 r_B / r_A$.

It can be seen in Fig. 28.b that the critical curve changes along with the change of borrowing rate a_2. The rate is $a_1 = 1$ % per year.

Typical debt growth curves are presented in Fig. 29. It can be seen that maximums in the "development" scheme appear when minimums appear in the "crisis" scheme, which comply with the condition $a_1 < a_2 r_B/r_A$.

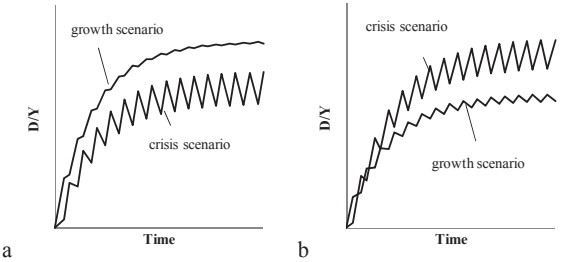


Fig. 29. Typical debt growth curves at $r_B > 0$ and $a_1 < a_2 r_B/r_A$.

Parameter values of the model reflected in Fig. 29 are: growth period — 6 years, recession period — 4 years (29.a) and growth period — 4 years, recession period — 6 years (Fig. 29.b). In all cases, GDP growth rates are $r_A = 5$ %, $r_B = 2$ % and government debt growth rates are $a_1 = 1$ %, $a_2 = 6$ %.

The analysis conducted allows formulating the methodology, which can be used to select the optimal government borrowing policy, minimizing D/Y in the long term, based on the length of the periods of economic development and recession.

The cycle model for the economic conditions of Latvia elaborated in this chapter can be considered as an example. Within this model $g = 8$ years, $k = 2$ years, $r_A = 2.5$ % and $r_B = -5$%. As $r_B < 0$, inequality (26) should be used. Calculations yield:

$$-\frac{1}{|0.05|}\ln\left[1-\frac{|0.05|}{2.5}(1-e^{-0.025\cdot 8})\right] = 9 > k = 2.$$

As the inequality is valid, criterion γ will be larger than 0, which means that in case of Latvia it is more beneficial to borrow in the time of recession.

CONCLUSIONS AND PROPOSALS

Having conducted the research, the following important conclusions have been made:

1. In the times of recession, the Republic of Latvia intensively borrowed on the international capital market. Despite this fact, Latvia has always met the Maastricht criteria with regard to the government debt to GDP ratio.
2. Analyzing public report of the Latvian government bodies, absence of the standardized data on utilization of the borrowed funds has been observed.
3. There is a tendency for reduction of the relative government debt amount on the world level that could be related to the "HIPS" initiative of the IMF and World Bank. However, the developed countries tend to increase the amount of government debt in relation to GDP.
4. In the research period a weak negative correlation between government debt and long-term economic growth rate has been detected on the global level: the slower economic growth in almost all countries is related to the larger amount of debt. This is particularly typical of Western Europe. The region of South and East Asia and the Pacific is the only region where a high level of debt positively correlates with economic development. Alongside, no any government debt "security threshold" has been observed.
5. Significant negative correlation between budget deficit and government debt growth both in separate regions and in the world on the whole indicates that countries borrow with an aim to compensate budget deficit. The only exceptions are countries of Eastern Europe and Central Asia, where the correlation is insignificant.
6. At the beginning and the end of the research period generally no correlation between government debt and tax rate has been observed. However, in 2011 a positive correlation existed in Latin America and Sub-Saharan Africa: countries with larger taxation in these regions were characterized by a more intensive borrowing policy. Strong interconnection between the government debt and tax burden has been observed all over the world, with the exception of only a few countries. No long-term connection between the growth of government debt and increase of tax rates has been observed. This could imply that governments use refinancing for servicing government debt rather than raise taxes.
7. Countries of Middle East and North Africa region demonstrated both in 2003 and 2011 a significant positive correlation between the government debt and borrowing interest rate. In other regions and in the world on the whole government debt and the borrowing interest rate did not correlate.
8. The content analysis of scientific papers and international rating agency documents revealed the following concepts closed to ones of *government debt*, *sustainability* and *default*: government debt to GDP ratio; debt service costs to collected taxes ratio; budget deficit to GDP ratio; inflation rate; long-term interest rate of the government bonds; external government debt to total government debt ratio; government debt per capita; money stock (M2) to GDP ratio. The analysis of the poll of invited experts has demonstrated that there are different opinions on indicator significance.
9. The indicator X developed for the assessment of the state financial security in the case of Latvia well correlates with the estimates of the rating agencies in the range of low ratings. At higher ratings, the methodology gives a more pessimistic outlook. It has been observed that the interdependencies between the value of state financial security indicator X and rating agency estimates differ for "old" and "new" EU member states, which may be caused by the political impact.
10. As a result of the research, it has been demonstrated that the existing government debt policy management models do not consider cyclic economic development. The cycle model elaborated in the Doctoral Thesis adequately characterizes government debt accumulation in the Baltic States in the period from 1995 to 2011. In case of Latvia and

Lithuania, the elaborated cycle model forecasts in the long term that tax burden in a 30–year perspective will grow up to almost 5 % given the government borrowing policy does not change.

11. The method elaborated on the basis of the cycle model allows selecting the optimal government debt policy taking into consideration the length of the periods of economic growth and recession, thus minimizing debt burden in the long term.
12. The proposed Thesis Statements have been proven.

Based on the conclusions presented above, the following proposals have been made:

For the development of the study process:

1. The theoretical consideration on the classification of the government debt management tools, including classification of defaults, should be enhanced to account for instability of the economic situation;
2. The courses of the university curriculum in Economics should include the classification of the government debt management tools and defaults.

For the government bodies:

3. The Ministry of Finances and/or the Treasury could include standardized detailed information on the utilization of the borrowed funds in order to acquaint the society;
4. Developed indicator of the state financial security could be used as an additional tool for the evaluation of the national security. The indicator could be used by the government bodies that develop and implement the state debt policy as well as it could be used by potential investors;
5. State debt policy should be developed, taking into account economic development and recession cycle duration and corresponding GDP growth / decrease rates.

For the future research:

6. The indicator of the state financial security should be tested on the basis of the defaulted countries to establish thresholds for default forecast.

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