

INVESTIGATION OF FACTORS DETERMINING LITHUANIAN PUBLIC DEBT TO FOREIGN COUNTRIES

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Abstract

Research purpose. The study aims to examine which indicators influence the amount of Lithuanian public debt to foreign countries.

Design / Methodology / Approach. First of all, in order to find out what could be preliminary indicators influencing the public debt, a comprehensive literature review has been done. This was implemented with the main goal of finding out the influencing independent variables, which were used for the next calculation. Successively was the selection procedure of the appropriate methodology for solving similar tasks. The pairwise and multivariate regression analyses have been carried out with the collected data.

Findings. Empirical research has shown that all independent variables are significant and can be used for pairwise regression analysis. After doing this, the authors found that no regression equation could be completed with no variable, which means that none of the variables affects the dependent variable (altogether). A multivariate regression analysis was also performed to check the impact of the selected variables on public debt. The regression equation was succeeded only when the criterion “population” had been eliminated. The results show that GDP, the unemployment rate, inflation and the minimum wage (in composition) may have an impact on the government's external debt.

Originality / Value / Practical implications. Due to the emergency (pandemic) situation, the Lithuanian state borrowed a considerable amount of money from the European Commission - last year, it was planned to borrow 2.7 billion according to the initial budget, but due to the situation, the debt was increased by 5.1 billion Euros. The concept of reasoning the amount of public debt to foreign countries is valuable not only in the concept of the COVID pandemic. This empirical research analyses the critical substances which affect the public debt based on factual statistics, correlation analysis and pairwise and multivariate regression.

Keywords: public debt; impact calculation; regression analysis; unemployment; Lithuanian economy.

JEL codes: E01; D20

Introduction

Public debt makes a significant impact on the state, its government, and the country's citizens and future generation of it. However, first and foremost, public debt is a problem for public finances. Borrowing on behalf of the government is required to cover the difference between revenue and expenditure (deficit) to balance the cash flow, repay previous debts, and in other cases provided by the Law on Public Debt of the Republic of Lithuania. Usually, Governments borrow domestically by issuing government securities (liabilities) or borrowing on foreign capital markets by issuing Eurobonds and lending from international financial institutions.

In 2020, the coronavirus pandemic hit the Lithuanian and global economies (COVID-19). Due to the emergency, Lithuanian states borrowed money from the European Commission - last year, according to the first budget, it was planned to borrow 2.7 billion. Still, due to the situation, the debt was increased by EUR 5.1 billion (Committee on budgets and finance, 2020). Thus, in 2020, governments borrowed

EUR 7.9 billion - public debt to the European Union jumped to historic highs. According to the Bank of Lithuania's data, in 2020, at the end of the year, the public debt amounted to EUR 24.8 billion. This corresponds to almost 51% of gross domestic product (GDP). In 2019, Lithuanian schools reached 35.9% of GDP - it grew by 15% during the year. This phenomenon is explained by the inevitable consequence of the pandemic. According to the July data of the Ministry of Finance of the Republic of Lithuania, the government intends to borrow EUR 5.2 billion, which is EUR 0.1 million less than had been planned in December, to cover the budget deficit for other purposes as well (Ministry of Finance, 2022).

This study examines the dependence of government debt on foreign countries by several macroeconomic variables, such as inflation, minimum wage, GDP, unemployment rate and Country population.

The research problem was formulated as follows: what factors impact the Lithuanian state debt to foreign countries? Accordingly, the research object is the debts of the Lithuanian state to foreign countries. Before the final empirical research results, a brief scientific literature analysis is done.

Literature review

This section reviews the scientific publications/scholars who have analysed the potential impact of inflation, GDP, population, minimum wage, and unemployment rates on foreign debt. Later on, by conducting an empirical study, the theory will be confirmed or refuted concerning the information obtained in literature analyses.

Rapidly rising public spending risks overheating the economy and raising inflation. This is confirmed by a study by José Pablo Barquero Romero & Kerry Loaiza Marín (2017), whose results show that the increase in the debt-to-GDP ratio is not significant in developed countries but that the increase in the debt-to-debt ratio in indebted developing countries is strongly linked to high inflation. Thus, according to them, an increase in government debt tends to increase inflation in countries with high public debt (Bleaney M, 2017). Also, the results of the non-linear effects of government debt on inflation examined by Bogdan Dumitrescu et al. (2021) confirm the information from the source analysed earlier. The authors examined 22 economically developing countries and concluded that there is a marginal effect between inflation and government debt. The authors also predict that if the shadow economy exceeds a certain threshold (no threshold is specified), higher public debt increases inflation (Dumitrescu et al., 2021). Thus, inflation affects government debt when the government is developing, and its debt is already high.

However, from another hand, the Government debt-to-GDP ratio is one of the most important indicators for measuring the level of Government debt. This indicator shows the country's ability to repay debt and accrued interest. According to the data published in the 2019 issue of the "National Debt", the government's debt-to-GDP ratio increased by 2.4 per cent (from 33.8 per cent of GDP in 2018). Based on this, we can see that the possibilities for the government to pay off the public debt have decreased. Vladimir Arčabić et al. (Arčabić et al., 2018) examine in their work that a debt-to-GDP ratio of more than 90% has a detrimental effect on long-term economic growth. Moreover, a state of sustainability is achieved when the public debt-to-GDP ratio is at least 60%, reports Mihaiu Diana Marieta (Mihaiu Diana Marieta, 2017). They also found that the maximum sustainability of public debt in developed countries is 183-192% of GDP and 60-80% of GDP. Other researchers have analysed the impact of GDP on public debt. Chudik et al. (Chudik et al., 2018), in a study using data from 40 developing economies and four decades, have shown that long-term public debt is associated with lower levels of economic activity. They argue that rising public debt slows GDP growth in the long run. The more the state is forced to borrow from abroad, the harder the economy will grow, and the level of prosperity shown by GDP per capita will increase. This is also statistically proven by Law et al. (Law et al., 2021).

Another critical indicator which potentially can have an impact on public debt is the level of population in the country. Moreover, the ageing of the population is a topical problem in the Lithuanian state. The increase in the number of older people and the decrease in the number of young people - the search for a better life and the opportunity to pursue a career abroad are encouraging emigration. This process encourages the state to allocate more funds for the maintenance of the elderly. The departure of young

people is also reducing the number of taxpayers, which is forcing the state to borrow in order to keep its citizens. One foreign scholar (Narciso, 2010) predicts that public debt will rise sharply due to an ageing population. He argues that an ageing population is a challenge facing industrialised countries. An empirical study by the author does not prove that population ageing has affected public debt to date but presumes that this may change in the future. Abd Rahman et al. (Abd Rahman et al., 2021) also say the population is a current demographic challenge that could force the government to borrow more money. Furthermore, this is influenced by an ageing population - an increase in the population aged 65 and over. Public debt could increase due to rising health care costs, social security and pensions. Nevertheless, the author also has a different view: older people are minimally dependent on public finances for their savings. Therefore, the ratio of old age to external debt is insignificant. Studies have shown that population size does not affect the size of a country's external debt, but it is being speculated that this may change.

Analysing the impact of minimum wage on government external debt, some interesting facts have been noted. For example, a certain amount of money is deducted from the salary for taxes to the state budget each month. According to the State Tax Inspectorate, the most significant part is the Personal Income Tax - 20% (from the gross salary, if the tax-free income is not applied - a tax-free amount). Two social insurance contributions are also deducted: compulsory health insurance - 6.98%, others - 12.52%. It is also possible to deduct a certain percentage allocated to the pension accumulation fund depending on the person. The higher the salary is, the more the person pays to the state. Consequently, the higher the minimum wage, the higher the taxes. However, according to the information stated in the blog "Peter G. Peterson Foundation" (2021) on Feb. 24, a higher minimum wage would increase the budget deficit due to additional government spending on wages. Consequently, the state budget would decrease - in the event of a budget deficit, the state is forced to borrow from other countries. The Foundation also states that the introduction of a higher minimum wage would reflect in increased government spending. However, it would be partially offset by higher tax revenues (Peter G. Peterson Foundation, 2021a). From this, it can be presumed that the increased wages will encourage the state to borrow more from foreign countries.

There is not much new evidence to presume that the unemployment rate affects the country's external debt. However, Marieta (2017) found that there is a direct correlation between public debt and unemployment rates but at a low intensity. Reducing foreign debt by 50% will also reduce unemployment, says Heer & Schubert (Heer & Schubert, 2012). From this, we can conclude, however, that unemployment impacts the state's foreign debt. This is confirmed by a study conducted by four economists in Nigeria. The results show that a long-term link between public debt and unemployment exists in Nigeria. Unemployment rises as public debt grows, and more government borrowing from abroad suggests that rising public debt increases unemployment and borrowing from abroad has a greater impact on rising unemployment than domestic debt (Gwazawa, 2021). In the situation of high unemployment, the state is forced to maintain society by paying incapacity benefits. Many people have lost their jobs or had to stop working as a result of the COVID-19 pandemic in the country and around the world. In order for the population to survive, the state was forced to provide benefits to the affected citizens from the state budget. As a result, public debt peaked during this period. The state was forced to borrow large amounts of money from the European Union.

To summarise, the fact that all of those factors have been recognised by various sources as possibly having a relationship and affecting the amount of public debt in various countries provides an assumption that offers a research question about whether or not this is indeed the case statistically. All of these studies lack a quantitative or statistical assessment, in which the authors would use previously collected data or conduct a case study to evaluate the level of impact, taking into consideration each individual economic element as well as a combination of multiple of these factors.

An analysis of the work of various researchers suggests that four of the five variables may have an impact on the chosen independent variable. To confirm or refute this fact, in the next stages of this study, empirical research will be conducted, and the methodology will be suggested.

Research methodology

All calculations, including correlation analyses and linear and multivariate regression analyses, are being processed with SPSS software. In order to analyse the data, we have collected thirty years' worth of data (1991-2020) about the public debt level in Lithuania as a dependent variable (Y) and measures of five independent variables (x_1, x_2, \dots, x_5) (inflation, minimum wage, GDP, unemployment rate, and population) (Table 1).

Table 1. Statistical data for the research (Source: composed by author)

Public debt by Lithuania to foreign Countries	Inflation, %	Minimum wage, EUR	GDP, billion US dollars	Unemployment rate, %.	Population
14156,55	0,2	607,00	55,89	8,43	2794090
13239,90	2,7	555,00	54,64	6,26	2794184
11178,7	1,9	400,00	53,72	6,15	2808901
12151,6	3,9	380,00	47,76	7,07	2847904
10858,8	1,7	350,00	43,05	7,86	2888558
12306,2	-0,1	325,00	41,44	9,12	2921262
11476,42	-0,3	300,00	14,07	10,7	2943472
9489,34	0,4	299,76	13,37	11,77	2971905
10201,84	2,8	289,62	12,44	13,37	3003641
8951,95	3,4	246,18	12,62	15,39	3052588
7799,53	3,8	231,70	10,75	17,81	3141976
5515,38	1,3	202,73	10,83	13,79	3183856
32463,66	8,5	173,77	13,86	5,83	3212605
32653,3	8,1	173,77	11,5	4,25	3249983
29722,03	4,5	159,29	8,74	5,78	3289835
23300,44	2,7	159,29	7,56	8,33	3355220
21837,12	2,9	144,81	6,55	10,68	3398929
2150,9	-1,1	130,33	5,44	12,88	3431497
2669,51	0,4	124,51	4,13	13,01	3454637
2866,71	1,3	115,85	3,54	16,84	4386998
2878,63	0,9	95,57	3,34	15,93	3512074
2825,7	0,7	86,89	3,18	13,39	3536401
1959,52	5	60,82	3,26	13,71	3562261
1630,85	8,4	95,57	2,93	14,13	3588013
1400,49	13,1	43,44	2,43	16,4	3615212
977	26,7	28,96	1,94	17,54	3642991
577,36	45	1,28	7,47	13,8	3671296
359,21	118,7	1,28	8,6	13,8	3693929
340,05	1163	1,28	10,3	1,2	3706299
302,59	224,7	0,50	10,5	1,1	3704000

All calculations, including correlation analyses and linear and multivariate regression analyses, are processed with SPSS software.

Later the descriptive statistics are analysed. We performed calculations and systematised information about data centre measures: mode (most common value), median (divides the variation line into two equal parts), mean (mean value), data scatter measure: variance (data scatter about mean), and the highest and lowest values.

Next, we performed a correlation analysis of the coefficients. This method shows the relationship between the two phenomena, i.e. the influence of independent factors. The correlation coefficient must be between negative one and one. The closer the coefficient is to minus one, the stronger the connection.

In this case, the study checked whether the correlation is positive or negative, as well as is it linear or not. In order to analyse whether the variable is statistically significant or insignificant, the hypotheses are being raised:

$H_0: r = 0$ (*the correlation is considered statistically insignificant*)

In this case, the correlation between selected independent variables (inflation, minimum wage, GDP, unemployment rate, and population) would be considered as statistically insignificant)

$H_1: r \neq 0$ (*the correlation is considered statistically significant*)

In this case, the correlation between selected independent variables (inflation, minimum wage, GDP, unemployment rate, and population) would be considered as statistically significant, and this assumption suggests using selected variables for the further determination with linear and multivariate regression.

The significance of correlation coefficients is being calculated with t statistics:

$$t = r \sqrt{\frac{n-2}{1-r^2}} \quad (1)$$

Here:

r - Correlation coefficient;

n is the number of samples.

The critical value with the confidence level alpha (0.05) is calculated with the formula below. Two sides (to the right and left from scratch) are examined, so alpha is divided in half:

$$p = \frac{\alpha}{2} \quad (2)$$

Here:

α is the confidence level.

The degree of freedom is calculated:

$$df = n - 2 \quad (3)$$

Here:

n is the number of samples.

The calculated value t is compared with the critical value t_{kr} α , k. This is a condition for stochastic dependence. If the condition is met, the null hypothesis is rejected, and H₁ is accepted.

The correlation analysis is not enough to make statistical conclusions. Therefore, a pairwise regression is performed. The purpose of this method is to determine the functional relationship between several quantities and to predict the values of the dependent variable Y from the values of the independent variable X.

The regression line for the relationship between X and Y is being described as follows:

$$y = a_0 + a_1 * x \quad (5)$$

a_0 and a_1 coefficients are being calculated by the formulas:

$$a_1 = \frac{\overline{xy} - \bar{x} * \bar{y}}{x^2 - (\bar{x})^2} \quad (6)$$

$$a_0 = \bar{y} - a_1 \bar{x} \quad (7)$$

In order to interpret the equation, the coefficient of determination must be greater than 0.25, the significance coefficient less than 0.05, and the P-value less than 0.05. Only then the pairwise regression equation can be constructed.

Multivariate regression is also being performed, which determines the impact on Y by the more than one independent variable. Multivariate regression model:

$$\tilde{y} = a_0 + a_1 x_1 + \dots + a_n x_n \quad (8)$$

A multivariate regression equation can also be constructed and interpreted if a few conditions are met. To form an equation, the coefficient of determination must be greater than 0.25, the coefficient of significance less than 0.05, and all P-values except intercept less than 0.05. Only then can a multivariate regression equation be constructed using "coefficients": a_0 - intercept, a_1, \dots, a_n - independent variables.

In the next section, the empirical calculations will be performed using the presented methodology.

Research results

Correlation analysis was performed to determine whether there is a relationship between the factors under consideration. It identifies significant variables that will be followed up. The results of the calculation are presented in Table 2.

Table 2. Correlation coefficients (Source: composed by author)

	Public debt by Lithuania to foreign Countries
Public debt by Lithuania to foreign Countries	1
Inflation	-0,23763746
Minimum wage	0,369701309
GDP	0,237173296
Unemployment rate	-0,480182403
Population	-0,436684471

In order to determine whether the correlation relationship is statistically significant, the statistical hypotheses are raised:

H_0 : correlation coefficient insignificant

H_1 : correlation coefficient is significant

In order to check the significance of the coefficient, the t statistics are applied. It is calculated according to the formula provided in the methodology, and the results are listed in Table 3.

Table 3. t statistics results (Source: composed by author)

	t _{stat}
Inflation	-1,29454282
Minimum wage	2,105444832
GDP	1,291863392
Unemployment rate	-2,896690864
Population	-2,568562889

A critical value with a confidence level of alpha (0.05) is found below. Since we check two-sided, the alpha is 0.025, respectively. T critical in this case is 0.683353.

If the calculated statistic t is greater than the critical, then the null hypothesis is rejected, and the alternative is accepted: H1: the correlation coefficient is significant. We conclude that all values are statistically significant:

$$\begin{aligned}
 & | -1,29454282 | > 0,683353 \\
 & 2,105444832 > 0,683353 \\
 & 1,291863392 > 0,683353 \quad | -2,896690864 | > 0,683353 \\
 & | -2,568562889 | > 0,683353
 \end{aligned}$$

Before any further investigation, the information about the assumptions of linear regression needs to be checked. Are the residuals heteroscedastic, if the mean is not equal to zero, and if the variables are not multicollinear? In order to have evidence that all the assumptions related to linear regression are met, it is necessary to check the Variation Inflation Factor (VIF) and the tolerance. The results of VIF are below 4, and the tolerance is above 0,25, which indicates that there is no risk for multicollinearity, and further calculations can be done.

Next, we determine which data have the greatest influence on the independent variable by performing a pairwise regression. After several tests, the results showed that no pairwise regression equation could be constructed and interpreted with selected variables. All calculated parameters (p-value, significance F, R-square) show that we cannot construct a pairwise regression equation. This means that none of the selected variables has a significant statistical impact on the public debt of Lithuania.

Accordingly, the next step was to determine if the examined independent variables impact the public debt in its entirety or at least a part of it. Multivariate regression analysis is also being performed only with statistically significant indicators. First, the impact of all independent variables on public debt is being determined.

In a multivariate regression analysis, the same as in a pairwise regression analysis, the coefficient of determination (R Square) must be greater than 0.25. This shows what part of the variables explains the equation. In this case, the equation explains about 63 per cent (Table 4).

Table 4. Determination coefficients (Source: composed by author)

Regression Statistics	
R Square	0,625962415
Significance F	0,000144159

According to the calculations, it can be seen that there are x-es that affect Y because the significance level is less than 0.05 - the equation can be interpreted (Table 4). However, the results of the P-values (Table 5) calculation were contrary. The P-value results of the population variable are less than 0.05, meaning that the equation cannot be constructed and interpreted (Table 5). The value of the variable "population" is then eliminated, and new calculations are performed.

Table 5. P-value results and coefficients (Source: composed by author)

	Coefficients	P-value
Inflation	-21,21571708	0,00752199
Minimum wage	39,16959666	0,076930839
GDP	-475,4823054	0,00685691
Unemployment rate	-1814,468213	3,43891E-05
Population	-0,003534834	0,57404523

The determination of multivariate regression satisfied all the conditions in order to compose the equation and interpret it. In this case, the coefficient of determination was greater than 0.25– the equation can be interpreted, and it explains about 62 per cent. The significance level also satisfies the condition: $4.75311E-05 < 0.05$. In all cases, P-value values are significant, less than 0.05 meaning that the equation can be interpreted (Table 6). All coefficients met the conditions; the equation can be composed:

$$Y = 29992,38528 - 21,79238528 * x_1 + 46,16998154 * x_2 - 481,6014096 * x_3 - 1864,823463 * x_4$$

Table 6. P-value results and coefficients (Source: composed by author)

	Coefficients	P-value
Inflation	-21,79238528	0,005109717
Minimum wage	46,16998154	0,011971314
GDP	-481,6014096	0,005430128
Unemployment rate	-1864,823463	1,14836E-05

The equation can be interpreted statistically: if X_1 increases by one unit, the dependant variable Y will decrease by around 22 points, which says that economically an increase in government debt would decrease inflation by around 22. This will work statistically with the solution that the other variables remain unchanged.

Conclusions

1. Examining the literature prepared by different scholars, it can be seen that inflation affects the country's foreign debt when the country is developing and has already borrowed money. Also, according to the literature, GDP impacts public debt. In other words, rising public debt is slowing GDP growth. Upon examination of other variables, it can be concluded that it has not yet been demonstrated that population size can have an effect. However, researchers suggest that this may change in the future. Moreover, raising the minimum wage would increase governmental spending, but higher tax revenues would offset that. There is also a correlation between the state's external debt and the unemployment rate, but the low intensity will reduce unemployment by reducing foreign debt by 50%. Some studies

also show that the government found that rising public debt increases unemployment, and borrowing from abroad has a more significant impact on this variable than domestic debt.

2. Several statistical methods have been selected to analyse the data in order to achieve the scientific goal. First, the descriptive statistics were performed, then the correlation analysis was completed, and then the hypotheses were raised. Thus, significant dependent variables have been determined with which simple (pairwise) regression and multivariate regression were conducted. Pairwise regression analyses are the best methods to determine the dependence of one variable on another variable, as it defines the functional relationship of several variables. The multivariate regression was instrumental in determining the consequence of more than one independent variable on investigated Y.

3. Empirical research has shown that all independent variables are significant and can be used for pairwise regression analysis. After doing this, we found that no regression equation can be constructed with any investigated variables. This means that none of the variables (inflation, minimum wage, GDP, unemployment rate, population) directly (independently) affects the public debt of the country. This result confirmed the statement of only one of reviewed scientists, who declared that the size of the population might not affect the state's foreign debt. A multivariate regression analysis was also performed to check the dependence of public debt on all independent variables. The elimination of 'population' succeeded in constructing a regression equation, which means that GDP, the unemployment rate, inflation and the minimum wage (in composition) may have an impact on the government's external debt.

4. Empirical studies suggest that all independent variables are significant and can be used for pairwise regression analysis. After doing so, we found that the regression equation could not be constructed using one of the study variables. This means that none of the variables (inflation, minimum wage, GDP, unemployment rate, population) directly (independently) affects a country's public debt. This result confirmed the statement of reviewed researchers that the size of the population may not affect the amount of public debt directly. A multivariate regression analysis was also performed to examine the dependence of government debt on all independent variables. The omission of the 'population' has succeeded in constructing a regression equation, which means that GDP, the unemployment rate, inflation and the minimum wage (in terms of composition) may have an impact on the public debts of the government. This partly was confirmed by the reviewed scientific literature.

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