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The Impact of Military Expenditures on the Indebtedness of the Czech Republic and Lithuania

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Abstract

While several studies have examined the relationship between military expenditures and economic growth, only few studies have focused on the nexus between these expenditures and indebtedness. The authors have been focused on the analysis of the impact of military expenditures on the indebtedness of the Czech Republic and Lithuania over the period 1999-2022. The aim of the paper is to investigate whether the increase in military expenditures has an impact on the countries' indebtedness. The authors have used nine variables characterizing the economic development to identify the relationship between the trends in military expenditures and economic indebtedness based on the results of the estimated models. The results of the correlation analysis showed the expected effect only in the case of Lithuania. The results of the estimated ARDL model did not show the effect of military expenditures on the countries´ indebtedness.

KEY WORDS: *military expenditures, indebtedness, correlation analysis, ARDL model.*

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1. Introduction

The development of the economic environment characterized by gross domestic product, inflation, budget deficit or the level of indebtedness is one of the so-called economic determinants of military expenditures, which is the subject of a number of empirical studies examining the influence of defined factors on the size of military expenditures. The changing security situation in Europe brings a natural pressure for an increase in military expenditures, which, however, especially for many European economies suffering from government budget deficits, naturally leads to an increase in the country's indebtedness. The authors of this paper build on previous research and through an estimated ARDL model analyze the relationship between military expenditures and indebtedness of the Czech Republic and Lithuania over the period 1999-2022 by using nine variables characterizing the economic development. The analysis itself follows the work of Smyth and Narayan (2009) that focused on observing the effect of military expenditures on the external indebtedness of 6 Middle Eastern countries, where a panel study confirmed the relationship between these variables. Sheikh et al. (2013) further observed the relationship between defense expenditures and debt for two rival neighboring countries, Pakistan and India, concluding that funding of significant military expenditures strongly affects the debt of both countries. The following findings by Azam and Feng (2015) confirm the negative impact of military expenditures on external debt accumulation for 10 selected Asian countries. Similarly, empirical results from a study by Khan et al. (2021) found that military expenditures by 35 arms-importing countries increase foreign indebtedness. Çolak and Özkaya (2020) also confirmed the weakening impact of military expenditures on economic performance and indebtedness of 12 transition economies. To analyze the relationship between military expenditures and the size of economic indebtedness of the Czech Republic and Lithuania, the authors of the paper use nine variables characterizing the economic development of the two countries analyzed in order to identify the relationship between the trends in military expenditures and economic indebtedness based on the results of the estimated model.

Results from studies which observe the relationship between military expenditures and external debt are mixed. The contribution of this study is that it continues with the newest findings for two countries in the period where it has not been statistically analyzed.

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2. Method of investigation

For the analysis itself, the authors of the paper use correlation analysis and the ARDL model (Pesaran and Shin, 1999) examining the link between the indebtedness of the economy and selected economic characteristics, namely military expenditures, GDP, exports, imports, total government spending, total investment, foreign investment and inflation.

Economic variables were chosen to estimate the model in accordance with the findings of the above mentioned studies. It is examined whether the increase in military expenditure affects the level of indebtedness of both countries. In general, the effect of military expenditures on indebtedness can be expected for several reasons. First of all, military expenditures are financed by the government budget as a pure public good. It can be expected that if there is a need to increase military expenditures, the need for financing by foreign borrowing may arise from some point. The other input variables chosen were imports and exports, which also affect external indebtedness as a consequence of foreign trade transactions. The authors also address the relationship between overall macroeconomic stability and external indebtedness by considering GDP, total investment, consumer price index and inflation rate.

The authors used an autoregressive distributed lag model ARDL(p, q_1, q_2, ..., q_k), where p is the number of lags of the dependent variable Y_t, $q_1, q_2, \dots, q_k$ are numbers of lags of explanatory variables X_{it}, $i = 1,2, \dots, k$. The model can be written as

$$Y_t = \alpha + \sum_{i=1}^{p} \gamma_i Y_{t-i} + \sum_{j=1}^{k} \sum_{i=0}^{q_j} \beta_{j,i} X_{j,t-i} + \varepsilon_t, \quad (1)$$

where ε_t is a one-dimensional zero mean error term. The model can be transformed into a long-run representation that demonstrates the dependent variable's response to a change in the explanatory variables over time (Baltagi, 2011; Mills, 2019). The long run estimates are given by (Pesaran and Shin, 1999; Pesaran et al. 2001)

$$\hat{\theta}_j = \frac{\sum_{i=1}^{q_j} \hat{\beta}_{j,i}}{1-\sum_{i=1}^{p} \hat{\gamma}_i}. \quad (2)$$

The ARDL approach not only provides a dynamic description but also allows for testing of cointegration. The cointegrated system of time series can be estimated as an ARDL model (Pesaran and Shin, 1999) with the advantage that variables in the cointegrating relationship can be either $I(0)$ or $I(1)$ without needing to specify which are $I(0)$ or $I(1)$. For cointegration analysis, we use the form of (1) in differences.

$$\Delta Y_t = \sum_{i=1}^{p-1} \gamma_i^* \Delta Y_{t-i} + \sum_{j=1}^{k} \sum_{i=0}^{q_j-1} \beta_{j,i}^* \Delta X_{j,t-i} - \hat{\phi} EC_{t-1} + \varepsilon_t, \quad (3)$$

where $EC_t = Y_t - \hat{\alpha} - \sum_{j=1}^{k} \hat{\theta}_j X_{j,t}$, and $\widehat{\phi} = 1 - \sum_{i=1}^{p} \widehat{\gamma}_i$. (Pesaran et al., 2001) proposed a methodology for testing existence of long-run relationship between independent variable and regressors. For so called bounds testing they use the following representation of (3)

$$\Delta Y_t = \sum_{i=1}^{p-1} \gamma_i^* \Delta Y_{t-i} + \sum_{j=1}^{k} \sum_{i=0}^{q_j-1} \beta_{j,i}^* \Delta X_{j,t-i} - \rho Y_{t-1} - \alpha - \sum_{j=1}^{k} \delta_j X_{j,t-1} + \varepsilon_t. \quad (4)$$

The test for existence of long-run relationship is a test of $\rho = 0$ and $\delta_1 = \delta_2 = \cdots = \delta_k = 0$. The distribution of the test statistic based on (4) depends on the fact whether the regressors are $I(0)$ or $I(1)$. (Pesaran et al., 2001) provide critical values for the cases where all regressors are $I(0)$ and the cases where all regressors are $I(1)$. These critical values are used as bound for the more typical cases where the regressors are a mixture of $I(0)$ and $I(1)$.

3. Investigation Results

Based on previous research, the paper analyze the relationship between military expenditures and indebtedness of the Czech Republic and Lithuania over the period 1999-2022 by using selected variables characterizing the economic development (government indebtedness, military expenditures, GDP, exports, imports, total government spending, total investment, foreign investment and inflation). To investigate mainly the association between military expenditures and external debt in the context of the two above mentioned countries the authors used data from the time period 1999-2022, that is sufficient time frame to examine the relationship. The main source of the data of variables was International Monetary Fund. Table 1 contains the basic descriptive characteristics of the studied variables.

Table 1.

Descriptive statistics

Czech Republic	n	Mean	Min	Max	Median	$Q_{0.25}$	$Q_{0.75}$	St. deviation	Skewness	Kurtosis
Debt	24	18.53	- 1.26	29.92	19.75	13.61	26.5	9.39	- 0.63	- 0.73
Milex	24	1.37	0.95	1.89	1.32	1.07	1.72	0.34	0.32	- 1.49
GDPpc	24	33588.19	24026.62	41061.76	33998.56	30067.44	37528.05	5226.36	- 0.28	- 1.1
Export	24	7.19	- 9.83	29.68	7.05	4.09	9.83	8.08	0.37	1.12
Import	24	7.03	- 11.08	25.59	6.5	3.09	11.73	7.56	- 0.21	0.76
Gov.exp	24	42.85	38.98	49.12	42.5	41.01	44.43	2.45	0.73	- 0.03
Total.invest	24	28.76	25.01	32.39	28.77	26.69	30.44	2.33	0.11	- 1.5
Foreing.invest	24	5.05	0.9	10.34	4.54	3.47	5.96	2.61	0.64	- 0.64
Inflation	24	2.87	0.12	15.1	2.3	1.46	3.19	2.98	2.84	9.03

Lithuania	n	Mean	Min	Max	Median	$Q_{0.25}$	$Q_{0.75}$	St. deviation	Skewness	Kurtosis
Debt	24	23.24	7.89	40.86	27.01	10.68	33.14	11.69	- 0.07	- 1.79
Milex	24	1.32	0.76	2.52	1.16	1.05	1.54	0.47	0.89	- 0.25
GDPpc	24	26542.95	13285.19	39896.01	26427.33	20636.11	32446.92	8187.15	0	- 1.21
Export	24	7.95	- 16.37	21.21	9.81	3.87	13.78	9.23	- 1.05	0.73
Import	24	7.56	- 28.65	19.9	10	5.12	14.53	10.88	- 1.65	2.87
Gov.exp	24	35.86	32.1	43.71	34.56	33.42	37.13	3.32	0.99	- 0.34
Total.invest	24	21.1	12.66	32.31	20.06	19.16	22.2	4.29	0.58	0.5
Foreing.invest	24	3.53	- 0.96	7.91	3.46	2.23	4.71	2.19	0.17	- 0.57
Inflation	24	3.12	- 1.08	18.86	1.9	1.09	3.85	4.19	2.37	5.94

Notes: *(n* – number of measurements, Mean – arithmetic mean, Min – minimum value, Max – maximum value, Median – median, $Q_{0.25}$ – lower quartile, $Q_{0.75}$ – upper quartile, St. deviation – sample standard deviation, Skewness – skewness, Kurtosis – kurtosis*)*.Variables description (Debt – government indebtedness, Milex – military expenditures, GDPpc – gross domestic product per capita/per person, Export – export of goods and services, Import – import of goods and services, Gov.exp – government expenditures, Total.invest – total investment, Foreign.invest – investment from foreign countries, Inflation - rate of increase in prices)

The development of indebtedness is displayed in Figure 1 and the development of military expenditures is shown in Figure 2. In the first decade we could observe stagnant debt-to-GDP ratio. With the global economic crisis in 2008, the debt burden of both countries increased significantly. The moderate economic growth in 2010-2011 subsequently helped to reduce the rate of growth of the debt of both countries. In 2019, the negative impact of the Covid pandemic can be observed in both countries. In the case of military expenditure, a gradual decline in the amount as a percentage of GDP can be seen in both countries since 2004. This trend has been intensified since 2008 by the aforementioned global economic crisis. A reversal of the trend has been observed since 2014, when NATO countries declared at the Wales Summit their commitment to reach 2% of GDP for defence spending. Given the security threats related to the Crimea annexation, a more significant increase in the military-to-GDP ratio can be identified especially in the case of Lithuania.

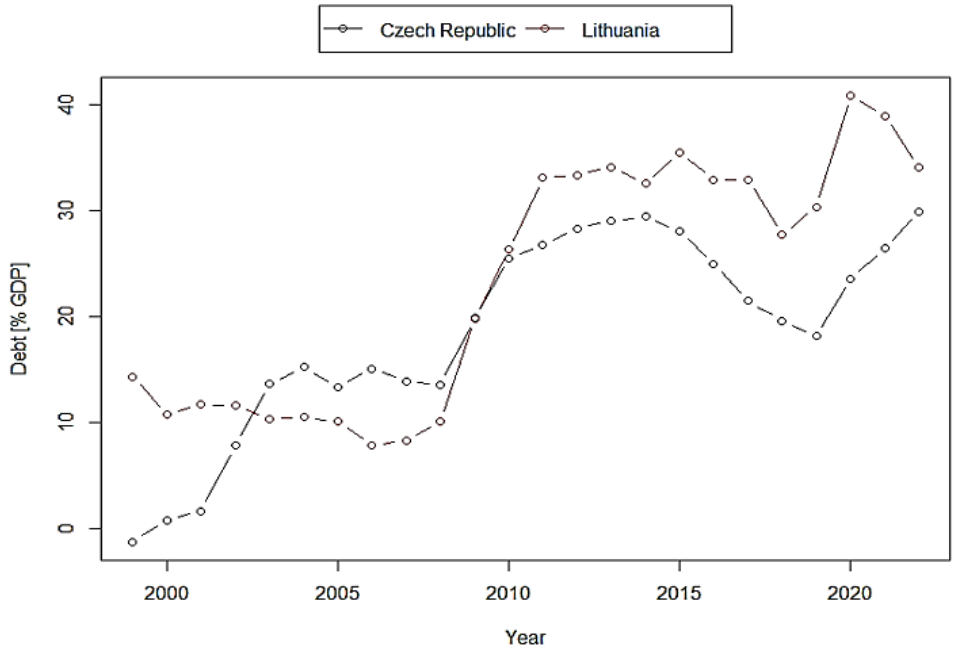

Fig. 1. The graphic interpretation of indebtedness

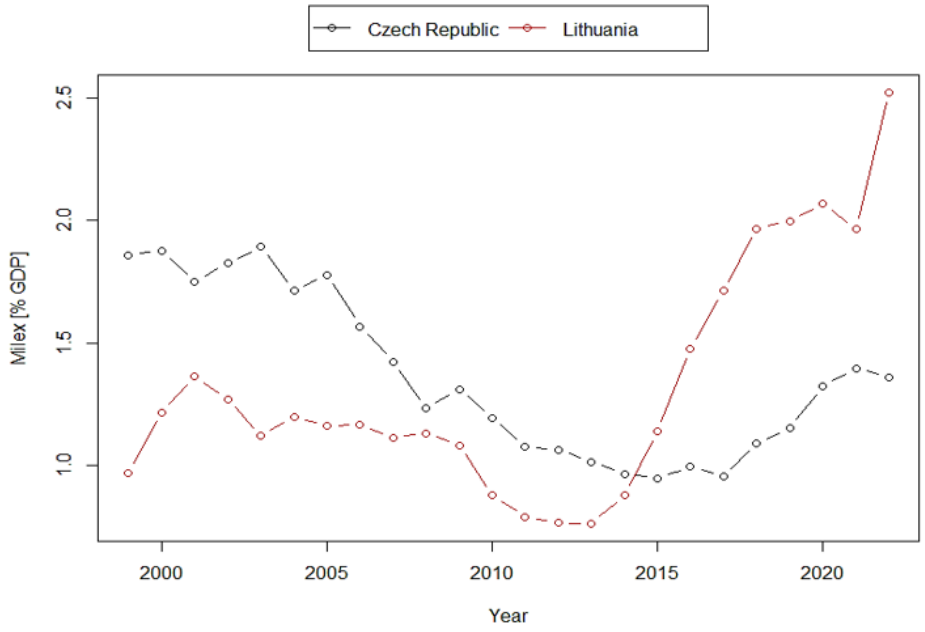

Fig. 2. The graphic interpretation of MIL Expenditure

The authors used correlation analysis and the ARDL model to analyze the relationship between the size of military expenditures and the selected variables. The strength of the effect of the given variable is determined by the size of the circle and its colour indicates a positive or negative effect. The aim of this paper is to observe the relationship between the level of military expenditure and indebtedness, therefore this relationship is characterized in a more detail. The results of the correlation analysis in case of the Czech Republic, see Figure 3, did not confirm the expected relationship between military expenditures and the country's indebtedness, with the correlation coefficient taking negative values. In the case of Lithuania (see Figure 4), the correlation coefficient is positive (statistically significant at the 0.10 level), confirming the expected link between the increase in military expenditure and the country's increasing indebtedness.

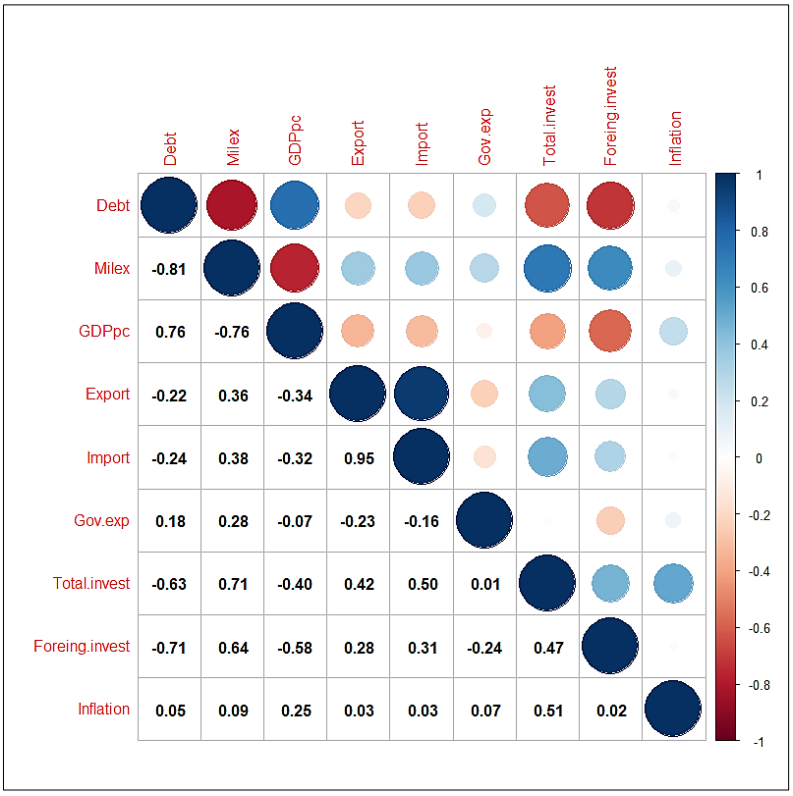

Fig. 3 Correlation matrix (Czech Republic)

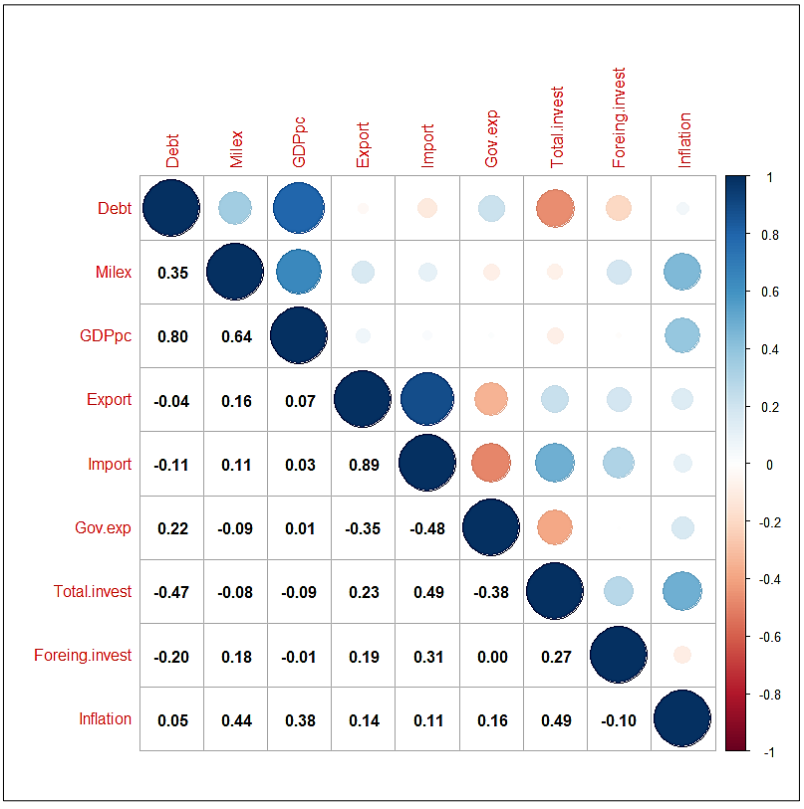

Fig. 4 Correlation matrix (Lithuania)

Table 2 shows the estimation of the ARDL model (1). For both countries, the full model and the reduced final model are developed. In the full model and reduced, all the parameters were displayed and the significance of each variable was

assessed, standard errors are in brackets. Then the final model was determined for each country separately using so called "backward selection".

Table 2.

ARDL model (standard errors in parenthesis)

	Czech Republic				Lithuania			
	Full model		Final model		Full model		Final model	
Variable	Coefficient				Coefficient			
$DEBT_{t-1}$	0.72462	**	0.698103	***	0.65584		0.82880	***
	(0.27614)		(0.10789)		(0.65420)		(0.09381)	
$MILEX_t$	- 7.11827		- 5.390785	*	- 3.71278		- 4.55817	***
	(7.87031)		(2.96711)		(10.77828)		(1.15491)	
$MILEX_{t-1}$	- 9.72046				- 1.62447			
	(12.72141)				(18.92986)			
$GDPpc_t$	- 0.00187		- 0.000765	*	- 0.00036		0.00032	**
	(0.00109)		(0.00036)		(0.00224)		(0.00015)	
$GDPpc_{t-1}$	0.00211		0.0008	**	0.00095			
	(0.00122)		(0.00035)		(0.00214)			
$EXPORT_t$	0.67003				0.12665			
	(0.48743)				(0.47518)			
$EXPORT_{t-1}$	- 0.00989				0.17485			
	(0.33775)				(0.29009)			
$IMPORT_t$	- 0.44863				- 0.03752		0.15076	**
	(0.48703)				(0.51274)		(0.05533)	
$IMPORT_{t-1}$	- 0.11759				- 0.10176			
	(0.32862)				(0.32215)			
GOV_EXP_t	0.74372		0.672861	***	0.84719		1.12856	***
	(0.40149)		0.181045		(0.77018)		(0.23099)	
GOV_EXP_{t-1}	0.88808		0.518215	**	- 0.09681		- 0.56380	**
	(0.56825)		0.190175		(0.61202)		(0.20891)	
$TOTAL\_INVEST_t$	1.08182				- 0.34109		- 0.51589	**
	(0.85779)				(1.23783)		(0.13931)	
$TOTAL\_INVEST_{t-1}$	0.16611				0.04395			
	(0.67092)				(0.97143)			
$FOREING\_INVEST_t$	0.45275				0.15443			
	(0.40575)				(0.58273)			
$FOREING\_INVEST_{t-1}$	0.81035				- 0.13791			
	(0.48096)				(0.96340)			
$INFLATION_t$	- 0.63850				- 0.01382			
	(0.46097)				(0.66196)			
$INFLATION_{t-1}$	0.60040				- 0.76952			
	(0.60031)				(1.11481)			
C	- 89.96887	*	- 37.6099	***	- 19.43910		- 8.36432	
	(40.22844)		(7.56578)		(62.79131)		(6.46435)	
R^2	0.992		0.982		0.989		0.985	
R^2_{adj}	0.964		0.975		0.950		0.978	

***p < 0.01, ** p < 0.05,* p < 0.10

Table 3 illustrates the estimation of the long-run equilibrium relationship. This table contains the results only for the reduced final model for the two studied countries. In the case of the Czech Republic, the long-run equilibrium relationship can be estimated using military expenditures, GDP and government expenditures, nevertheless, GDP is not statistically significant. In the case of Lithuania, a model including military expenditure, GDP, imports, government expenditure and total investment can be used for the long-run relationship, but imports, government expenditure are not significant.

Table 3.

ARDL – long-run relationship (standard errors in parenthesis)

	Czech Republic		Lithuania	
Variable	Coefficient		Coefficient	
$MILEX_t$	- 17.85635	***	- 26.62486	*
	(5.39144)		(14.13578)	
$GDPpc_t$	0.00012		0.00188	***
	(0.00031)		(0.00046)	
$IMPORT_t$			0.88062	
			(0.56681)	
GOV_EXP_t	3.94530	***	3.29881	
	(1.03362)		(2.11988)	
$TOTAL\_INVEST_t$			- 3.01335	**
			(1.31053)	
C	- 124.57840	***	- 48.85700	
	(42.15665)		(51.96093)	

***p < 0.01, ** p < 0.05,* p < 0.10

The results of the estimated ARDL model show the following equations describing the long-run relationship between these variables.

Czech Republic

$$EC_t = DEBT_t - (-17.8564\, MILEX_t + 0.0001\, GDPpc_t + 3.9453\, GOV\_EXP_t - 124.5784)$$

Lithuania

$$EC_t = DEBT_t - (-26.6249\, MILEX_t + 0.0019\, GDPpc_t + 0.8806\, IMPORT_t + 3.2988\, GOV\_EXP_t - 3.0133\, TOTAL\_INVEST_t - 48.8570)$$

In the case of the Czech Republic, the relationship between indebtedness and military expenditures, GDP and government spending is demonstrated. However, the expected negative effect of an increase in military expenditures and an increase in the country's indebtedness has not been demonstrated in the long run. In the case of Lithuania, it is possible to observe the relationship between indebtedness and military expenditures, GDP, import size, government spending and total investment. However, as in the case of the Czech Republic, the expected link has not been established in terms of the impact of military expenditures on the country's indebtedness.

Table 4 shows the dynamics of the model describing the short-run relationship between debt and the estimated variables. In the case of the Czech Republic, the short-run significant variable is GDP per capita and government expenditure, whereas in the case of Lithuania, only government expenditure is statistically significant in the short-run.

Table 4

ARDL – short-run relationship (standard errors in parenthesis)

	Czech Republic		Lithuania	
Variable	Coefficient		Coefficient	
Δ $GDpc_t$	- 0.000765	***		
	(0.00022)			
Δ GOV_EXP_t	0.672861	***	1.12856	***
	(0.11145)		(0.10661)	
$CointEq_{t-1}$	- 0.301897	***	- 0.17120	***
	(0.02787)		(0.01703)	

***p < 0.01, ** p < 0.05,* p < 0.10

F-bound test for the Czech Republic 18.75, the critical values are 2.79 for $I(0)$ and 3.67 for $I(1)$. *F*-bound test for Lithuania 10.731, the critical values are 2.39 for $I(0)$ and 3.38 for $I(1)$. Based on these results, the existence of cointegration can be assumed.

4. Conclusions

Military expenditures as a part of government spending belong to the economic category of variables in which, especially in the case of the European NATO countries, can be noted a significant change in their size depending on the change in the security environment. This trend can be observed in both analyzed countries, especially in connection with the conclusions of the NATO Summits in Wales (2014) and consequently in Vilnius (2023). The increase in military expenditures associated with the growth of military capabilities brings with it different economic effects, which can have positive effects on the economic development of a country, e.g. the multiplier effect, but also negative effects, e.g. the growth of the state budget deficit or the indebtedness of a country. The authors of the paper focused on the analysis of the impact of military expenditures on the country's indebtedness. They aimed to confirm whether rising military expenditures are one of the factors influencing the indebtedness of the economy. The results of the correlation analysis showed the expected effect only in the case of Lithuania. The results of the estimated ARDL model did not show the effect of military expenditures on the countries´ indebtedness.

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