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Citation: AIP Conference Proceedings **1978**, 090004 (2018); doi: 10.1063/1.5043741
View online: https://doi.org/10.1063/1.5043741
View Table of Contents: http://aip.scitation.org/toc/apc/1978/1
Published by the American Institute of Physics

Security and Economic Determinants of the Demand for Czech Military Expenditure: ARDL Approach

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Abstract. This paper employs the Autoregressive Distributed Lag (ARDL) approach to cointegration to estimate a general model of Czech military expenditure over the period 2001–2015. The findings suggest that Czech military expenditures are determined by the level of military expenditure in previous year, by the risk for GDP growth, risk for inflation and risk of terrorism.

INTRODUCTION

Military expenditures of alliance countries represent most of the world's military spending, creating realistic assumptions for defending member states. However, differences in countries' access to economic support of their defense sector provide significant differences in the amount of funds allocated for defense purposes caused mainly by the different economic environments of the Alliance countries [1]. The development of military expenditures of individual members of the Alliance is currently influenced, in particular, by the quality of the security and economic environment constituting the so-called military expenditure determinants defined in [2] and [3]. The economic determinants of military expenditures in the form of analysis of the relationship between the gross domestic product and the size of the military expenditures are the subject of [3], [4], in which the authors demonstrate the significant influence of the country's economic power on the size of military expenditure, and thus the natural willingness of governments to allocate funds for the needs of individual armies, especially during the period of economic expansion characterized by real possibilities of building an army consisting in increasing the number of soldiers or in the implementation of a number of investment projects leading to the modernization of the armed forces. An economic factor analyzed by [5], [6], influencing the real purchasing power of military spending in individual economies, is also the rate of price inflation causing a decline in the real value of the military budget. The current security environment of the Alliance countries is subject to a number of risks, one of the most serious is represented by the terrorist attacks. The link between the risk of terrorism and the size of military spending is analyzed by Feridun and Shahbaz [7], when they naturally expect to increase military spending in times of increased risk of terrorist attacks. However, the authors [8] point out the existence of a negative relationship between the two variables analyzed during a massive increase in military expenditures which reduce the risk of terrorist attacks. On the other hand, Lum et al. [9] point out the ineffectiveness of the massive increase in military spending and anti-terror policy spending on the risk of terrorist attacks being shown on the example of the US. The authors generally define factors influencing military expenditures on security factors represented by variables characterizing the security risks of countries and economic factors characterizing economic risks.

Since 1999, the Czech Republic has been a NATO member state fully using security guaranties emerging from the membership. In 2002, an armed forces reform was launched. However, the reform was accompanied by an insufficient source ambit that was manifested in a significant decline in military expenses as a share in the Gross Domestic Product and a long-term falling behind the Alliance recommendations. The economic crisis which has affected the Czech Republic, similarly to the increasing deficit of public finances or the rate of public debt, have caused a pressure

International Conference of Numerical Analysis and Applied Mathematics (ICNAAM 2017)
AIP Conf. Proc. 1978, 090004-1–090004-4; https://doi.org/10.1063/1.5043741
Published by AIP Publishing. 978-0-7354-1690-1/$30.00

on further reduction of military expenses that were significantly reduced especially in 2010 and 2011. The current change in security environment has initiated a debate on long-term under-financing of the defence section in the Czech Republic and realization of the responsibility for the security of the country itself. The measures accepted as a result of the change in perceiving security threats will contribute to increasing military expenses to at least 1.4% of the Gross Domestic Product in 2020. The selected security and economic determinants of military expenditure of the Czech Republic, influencing the size of the gross domestic product allocated to the needs of the armed forces, are quantified and described in the next part of the contribution by the model of estimate of demand for military expenditures in the Czech Republic between 2001 and 2015 analyzing the link between military expenditures and the risk of terrorist attacks, the risk of economic recession and the risk of inflation.

DATA AND VARIABLES

The variables characterizing selected security and economic risks as determinants of military expenditures (measured as a share of military expenditures in GDP) in the Czech Republic in the analyzed period 2001 to 2015 were selected for the estimation of the demand for military expenditures. Risk characterization variables were used to quantify security and economic risks of terrorism, the risk of an economic recession, and inflation risk, see Table 1. Actual variables contained in the databases SIPRI and PRS[1] are further observed for analytical purposes on the scale shown below in Table 1. Therefore, lower values of these variables are interpreted as higher economic or security or risks.

TABLE 1. Input variables.

Variables	Description	Measurement
Military expenditures	Government expenditures devoted to military	Share of GDP (%)
Risk for terrorism	A score of 4 points equates to very low risk and a score of 0 points to very high risk	Maximum score of four points and a minimum score of 0 points
Risk for inflation	The estimated annual inflation rate (the unweighted average of the consumer price index) is calculated as a percentage change	e.g. less than 2%, 10 points, more than 66%, 2 points
Risk for GDP growth	The annual change in the estimated GDP, at constant 1990 prices, of a given country is expressed as a percentage increase or decrease	e.g. 6% change plus, 10 points, change 5 to 5.9, 9.5 points and e.g. −5.0 to −5.9, 0.5 points, −6.0 below, 0 points

METHODOLOGY AND EMPIRICAL RESULTS

Available data are from 2001 to 2015. Time series under scope are too sort for applying a vector autoregressive model, or a vector error correction model [10]. We employ autoregressive distributed lag model ARDL(p,q_1,q_2,..., p_k), where p is the number of lags of the dependent variable Y_t, $q_1, q_2, \ldots, q_k$ are numbers of lags of explanatory variables X_{it}, $i = 1, 2, \ldots, k$. The model can be written as

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

ϵ_t is a one-dimensional zero mean error term. The lag lengths in the model (1) can be determinate by the standard information criterion such as Akaike, Schwarz or Hannan-Qiunn information criterion. The ARDL model estimates the dynamic relationship between a dependent and explanatory variables. It is possible to transform the model into a long-run representation showing the long run response of the dependent variable to a change in the explanatory variables. The long run estimates are given by [10]

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

[1] https://www.sipri.org/databases, http://www.prsgroup.com

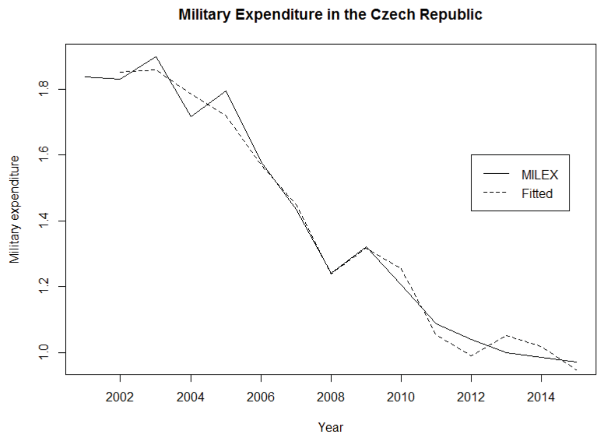

FIGURE 1. Military expenditure of the Czech Republic (solid line), ARDL(1,1,1,0) model estimates (dashed line).

The ARDL approach offers except for the dynamic description also testing of cointegration. The cointegrated system of time series can by estimated as ARDL model (Pesaran and Shin, 1999) with the advantage that variables in cointegrating relationship can be either $I(0)$ or $I(1)$ without needing to specify which are $I(0)$ or $I(1)$. For the purpose of cointegration analysis the form of (1) in differences is used

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

where $EC_t = Y_t - (\hat{\alpha} + \sum_{j=1}^{k} \hat{\theta}_j X_{j,t})$, and $\hat{\phi} = 1 - \sum_{i=1}^{p} \hat{\gamma}_i$. Pesaran, Shin and Smith (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)

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

The test for existence of long-run relationship is a test of $\rho = 0$ and $\delta_1 = \delta_2 = \ldots = \delta_k = 0$. The distribution of the test statistic based on (4) depends on the fact whether the regressors are $I(0)$ or $I(1)$. Pesaran, Shin and Smith [11] 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 $I(1)$.

According to Akaike information criterion (AIC) we employ the model ARDL(1,1,1,0) without a constant. We obtain estimation for the model (1) for the model

$$\begin{aligned} \widehat{MILEX}_t \quad = \quad & \underset{(0.057743)}{0.79131} \cdot MILEX_{t-1} + \underset{(0.033945)}{0.09935} \cdot INFLATION_t - \underset{(0.033195)}{0.07198} \cdot INFLATION_{t-1} + \\ & + \underset{(0.195790)}{0.47101} \cdot GDPPC_t - \underset{(0.199773)}{0.67717} \cdot GDPPC_{t-1} + \underset{(0.066929)}{0.18646} \cdot TERRORISM_t, \end{aligned} \tag{5}$$

where standard errors of the estimates are in the parenthesis. The error correction model (3) is estimated by

$$\Delta\widehat{MILEX}_t = \underset{(0.022877)}{0.09822} \cdot \Delta INFLATION_t + \underset{(0.135382)}{0.471012} \cdot \Delta GDPPC_t - \underset{(0.028210)}{0.208693} \cdot \widehat{EC}_{t-1}, \tag{6}$$

where

$$\widehat{EC}_t = MILEX_t - (\underset{(0.175657)}{0.131131} \cdot INFLATION_t - \underset{(0.417429)}{0.987864} \cdot GDPPC_t + \underset{(0.271006)}{0.893486} \cdot TERRORISM_t). \tag{7}$$

The existence of long-relationship can be tested by the bounds tests. All computations were conducted in statistical software EViews 9.5. The F-statistic is 9.95, the critical values at the significance level 0.05 for $I(0)$ and $I(1)$ are (2.45, 3.63), the t-statistic has value -3.61, the critical values are $(-1.95, -3.33)$. Both tests reject null hypothesis of no level relationship, analyzed time series are cointegrated. Time series of Czech military expenditure and ARDL estimates are displayed in Figure 1.

SUMMARY

Defense is considered a so-called public good, and the share of military expenditure in the gross domestic product of the Czech Republic should be positively dependent on the development of the economic cycle of the domestic economy. Thus, the period of economic growth naturally creates conditions for a rise in military spending. Similar dependence can be expected in the case of an indicator that characterizes the price inflation rate in a country where it is advisable to maintain a higher or at least the same rate of military expenditure growth as the rate of inflation growth in the country in order to sustain the purchasing power of military spending during the mild or so called galloping inflation. Similar conclusions can be expected in the event of a rise in the security risks represented in this model by the risk of terrorist attacks. From the results of ARDL model in levels (6), it is clear that the share of military expenditures in GDP in the Czech Republic is positively dependent on the amount of military expenditures of the previous year, the rising value of the Risk for inflation variable in the t and $t-1$ period (representing lower inflation risk in the country), and at the higher value of the Risk for terrorism variable (representing a lower risk of terrorist attacks). The variable Risk for GDP growth (in the period t and $t-1$) negatively affects the share of military spending on GDP, which paradoxically leads to a decrease in military expenditures when the value of the variable increases and the economy reaches the economic growth. Estimated long-run coefficients (7) confirm identified dependency trends even over a long period of time when the increase in military expenditure shares in GDP can be expected in times of low risk of terrorist attacks, low inflation risk, and in times of higher risk of economic crisis.

ACKNOWLEDGMENTS

The paper was supported by FML Development Projects AERO.

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