Causal Analysis of Economic Growth and Military Expenditure

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Abstract: The purpose of this paper is to analyze the long-term temporal series of military expenditure and economic growth and to prove the existence of the above theoretical links on realistic data by means of structural analysis (Granger causality) in VAR models and in VECM models for cointegrated time series. In theory it is possible to distinguish 4 types of links between military expenditure and economic growth: a mutual link between anticipated variables, a link showing influence of military expenditure on economic growth, a link showing influence of economic growth on the level of military expenditure, non-existence of any links between anticipated variables. SIPRI and OECD (Belgium, Denmark, France, German, Greece, Italy, the Netherlands, Portugal, Spain, and the UK) database were used to analyze the links between military expenditure and economic growth.

Key–Words: economic growth, military expenditure, Granger causality, VAR, VECM, cointegration

1 Introduction

Military expenditure of the armed forces of the North Atlantic Treaty Organization represents almost 64% of total world military expenditure. The expenditure level depends especially on the danger of imminent external conflicts, requirement for guaranteeing internal safety or government safety policy and public finances. The paper follows from the study [6] where the authors simultaneously attempt to identify the link between military expenditure as a percentage of GDP and economic growth of the given country for the analyzed period 1961–2000. Using the Granger causality test, they prove that a link between economic growth and military expenditure has been identified in 7 EU countries (Germany, Greece, Italy, the Netherlands, Spain, Sweden and the UK) and come to the conclusion that economic development of selected EU states determines their military expenditures, i.e. the economic standing of European countries is a key factor influencing the level of their military expenditure.

The purpose of this paper is to identify the link, theoretically delimited in [1], [2] and empirically established in [6], [3] between military expenditure and economic growth in selected NATO states for the extended period from 1950s to 2009 reflecting a quality of security environment and the current financial situation as factors influencing the level of military expenditure of the chosen NATO states. To identify possible links between the two mentioned variables (mutual link between anticipated variables, link showing influence of military expenditure on economic growth, link showing influence of economic growth on the level of military expenditure, non-existence of any link between anticipated variables) the authors employ the Granger causality test (see [7]).

2 The economic effects of military expenditure

The military expenditure proper as a part of government spending can, according to [6], influence the economy in various possible ways. Stimulating economic growth by means of the multiplication effect of government spending in periods when the economy was under the so-called potential product, was one of the instruments of Keynesian Economics. Military Keynesianism as a type of economic policy pursued, for instance, in Germany in the first half of the 20th century or in the U.S.A. at the end of the 20th century represented a massive application of military expenditure to stimulate economic growth. This type of economic policy is based on the (Kaleckis) theory, however today, academic debates are being held about the success of this policy pointing out ambiguous effects of military expenditure on the economic growth (see [10]). Extensive use of military expenditure to stimulate economic growth has a negative aspect, namely the untapped human, financial or material potential in the civilian sector of the economy entailing considerable expenses. The empirical con-

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clusions concerning the opportunities passed up to realize the potential arrived at, for example, in [4] the study shows the results of investing USD 1 billion in health services, education and the armed forces. It is estimated that the invested sum would make it possible to create nearly 20,000 new jobs in health service and more than 29,000 in education. However, 1 billion of military expenditure would create only 11,600 jobs. A similar adverse effect of military expenditure on economic growth is referred to in specialist studies [3], [6] as the crowding out effect where military expenditure results in crowding out part of capital expenditure due to increased interest rate. The "crowded out" investments fail to contribute to GDP and therefore to the economic growth of the given economy.

In [3] the authors identified three effects through which military expenditure can encourage economic growth: demand, supply and safety. The demand effect means the influence of the Keynesian multiplication effect of military expenditure on domestic product, however, similarly to [6], the authors point out the negative aspects of crowding out investments. In [3] it is simultaneously emphasized that the increase in military expenditure often entails higher taxes or a larger state budget deficit, which has an adverse effect on household consumption and profitability of companies, and increases the external debt, places a severe burden on future generations, or leads to the country losing credibility among potential investors respectively. The current developments in countries suffering from deficit in public finances intensify pressures for cutting military expenditure, which is noticeable in the NATO countries as well where only a small group of member states fulfills the recommended 2% of GDP investment in military expenditure. In the article [3] the authors connect the supply effect with the operation of production factors and highlight the existence of possible positive externalities having a beneficial effect on the civilian sector. They especially emphasize secondary effects of military research and development and education and training of military personnel who, after having abandoned their military career, use their professional expertise and experience in the civilian sector. According to [3], the safety effect of military expenditure means especially reduced safety related risks thanks to the functioning armed forces when low risks of armed attacks are considered a key competitive factor. Guaranteeing the security of the country is therefore understood as one of the prerequisites of economic growth.

3 Granger causality in VAR and VECM models

The Granger causality test is a statistical hypothesis test for determining whether one time series is useful in forecasting another. In this part we briefly describe the concept of Granger causality in vector autoregressive (VAR) and vector error correction models (VECM).

Definition 1 *A stochastic process $\{\boldsymbol{Y}_t\}$ is called n-dimensional autoregressive process VAR(p), if*

$$\boldsymbol{Y}_t = \boldsymbol{\Phi}_1 \boldsymbol{Y}_{t-1} + \cdots + \boldsymbol{\Phi}_p \boldsymbol{Y}_{t-p} + \boldsymbol{\Lambda}\mathbf{D}_t + \boldsymbol{\epsilon}_t, \quad (1)$$

for $t = 1, 2, \ldots, T$, for fixed values of $\boldsymbol{Y}_{-p+1}, \ldots, \ldots, \boldsymbol{Y}_0$,, and independent identically distributed (i.i.d.) n-dimensional errors $\boldsymbol{\epsilon}_t$ that are $N_n(\mathbf{0}, \boldsymbol{\Omega})$. where $\boldsymbol{\Phi}_1, \ldots, \boldsymbol{\Phi}_p$ are matrices of coefficients $(n \times n)$, $\boldsymbol{\Lambda}$ is an $(n \times s)$ matrix of coefficient of deterministic term $\mathbf{D}_t$ $(s \times 1)$, which can contain a constant, a linear term, seasonal dummies, intervention dummies or other regressors that we consider non-stochastic.

The process defined by the equation (1) can be written in *error correction* form (VECM)

$$\Delta \boldsymbol{Y}_t = \boldsymbol{\Pi} \boldsymbol{Y}_{t-1} + \sum_{i=1}^{p-1} \boldsymbol{\Gamma}_i \Delta \boldsymbol{Y}_{t-i} + \boldsymbol{\Lambda}\mathbf{D}_t + \boldsymbol{\epsilon}_t, \quad (2)$$

for $t = 1, \ldots, T$, where $\boldsymbol{\Pi} = \sum_{i=1}^{p} \boldsymbol{\Phi}_i - \mathbf{I}$, $\boldsymbol{\Gamma}_i = - \sum_{j=i+1}^{p} \boldsymbol{\Phi}_j$. This error correction form of VAR process is used in the analysis of cointegration.

Definition 2 *Let $\{\boldsymbol{\epsilon}_t\}$ be independent identically distributed random variable with zero mean and variance matrix $\boldsymbol{\Omega}$. A stochastic process $\boldsymbol{Y}_t$ which satisfies that $\boldsymbol{Y}_t - E\boldsymbol{Y}_t = \sum_{i=1}^{\infty} \mathbf{C}_i \boldsymbol{\epsilon}_{t-i}$ is called $I(0)$ process if $\mathbf{C} = \sum_{i=0}^{\infty} \mathbf{C}_i \neq 0$.*

Definition 3 *A stochastic process $\{\boldsymbol{Y}_t\}$ is called integrated of order d, $I(d)$, $d = 1, 2, \ldots$, if the process $\Delta^d(\boldsymbol{Y}_t - E\boldsymbol{Y}_t)$ is $I(0)$ process.*

The idea of cointegration can be shown on two one-dimensional processes of order $I(1)$. We say that the processes X_t a Y_t are cointegrated if there exists any linear combination $aX_t + bY_t$ which is stationary.

Definition 4 *Let $\boldsymbol{Y}_t$ be n-dimensional process integrated of order 1. We call this process cointegrated with a cointegrating vector $\boldsymbol{\beta}$ $(\boldsymbol{\beta} \in R^n, \boldsymbol{\beta} \neq 0)$ if $\boldsymbol{\beta}'\boldsymbol{Y}_t$ can be made stationary by a suitable choice of its initial distribution.*

The basic test of cointegration based on the maximum likelihood estimation (so-called MAX and TRACE tests) are described in [5] or [7]. Another test of cointegration can be found in [7] (Saikkonen and Lüthepohl S&L test)

The idea of *Granger causality* can be expressed as follows: If variable Y affects variable Z, the former should help improve the prediction of the latter variable. To formalize this idea, suppose that Ω_t is the information set containing all relevant information available up to and including period t. Let $Z_t(h|\omega_t)$ be the optimal (minimum MSE – mean square error) h-step predictor of the process Z_t at origin t, based on the information in Ω_t. The corresponding forecast MSE will be denoted $\Sigma_Z(h|\Omega_t)$. The process Y_t is said to *cause Z_t in the Granger sense* if

$$\Sigma_Z(h|\Omega_t) < \Sigma_Z(h|\Omega_t - \{Y_s|s \leq t\})$$

for at least one $h = 1, 2, \ldots$. The expression $\Omega_t - -\{Y_s|s \leq t\}$ is a set containing all relevant information except for the information in the past and the present of the process Y_t

Assume the two-dimensional stable VAR process

$$\begin{bmatrix} Y_t \\ Z_t \end{bmatrix} = \begin{bmatrix} \Phi_{11}^1 & \Phi_{12}^1 \\ \Phi_{21}^1 & \Phi_{22}^1 \end{bmatrix} \begin{bmatrix} Y_{t-1} \\ Z_{t-1} \end{bmatrix} + \cdots + \\ + \begin{bmatrix} \Phi_{11}^p & \Phi_{12}^p \\ \Phi_{21}^p & \Phi_{22}^p \end{bmatrix} \begin{bmatrix} Y_{t-p} \\ Z_{t-p} \end{bmatrix} + \begin{bmatrix} \mu_1 \\ \mu_2 \end{bmatrix} + \begin{bmatrix} \epsilon_{1t} \\ \epsilon_{2t} \end{bmatrix}.$$

In this model it can be seen (see [7]) that Y_t does not Granger cause Z_t if and only if $\Phi_{21}^i = 0$ for $i = 1, \ldots, p$; analogously Z_t does not Granger cause Y_t if and only if $\Phi_{12}^i = 0$, $i = 1, \ldots, p$. If one wants to test Granger causality, the usual F-statistic for a regression model can be used (see [7]). It is easy to derive the corresponding restrictions for the error correction form (VECM)

$$\begin{bmatrix} \Delta Y_t \\ \Delta Z_t \end{bmatrix} = \begin{bmatrix} \Pi_{11} & \Pi_{12} \\ \Pi_{21} & \Pi_{22} \end{bmatrix} \begin{bmatrix} Y_{t-1} \\ Z_{t-1} \end{bmatrix} + \\ + \sum_{i=1}^{p-1} \begin{bmatrix} \Gamma_{11}^i & \Gamma_{12}^i \\ \Gamma_{21}^i & \Gamma_{22}^p \end{bmatrix} \begin{bmatrix} \Delta Y_{t-i} \\ \Delta Z_{t-i} \end{bmatrix} + \begin{bmatrix} \mu_1 \\ \mu_2 \end{bmatrix} + \begin{bmatrix} \epsilon_{1t} \\ \epsilon_{2t} \end{bmatrix}.$$

Then Y_t does not Granger cause Z_t if and only if $\Pi_{21} = 0$ and $\Gamma_{21}^i = 0$, $i = 1, \ldots, p-1$. In the case of cointegrated processes, testing these restrictions is not as straightforward as for stationary processes (see [7]).

4 Numerical results

To analyze the link between military expenditure and economic growth, temporal series of military expenditure expressed as a percentage of GDP from the SIPRI database and economic growth (the growth rate in per cent) from the OECD database have been selected. The SIPRI definition of military expenditure includes all current and capital expenditure on the following activities: the armed forces (including peacekeeping forces), the civil administrations of the military sector (defense ministries and other government agencies engaged in defense activities), paramilitary forces (non-regular armed forces which are judged to be trained, equipped and available for military operations) and military space activities. Such expenditure should include the following components: personnel, operations and maintenance, arms procurement, military research and development (R&D), military construction and military aid (in the military expenditures of the donor country). To prove the existence of the relationship between economic development and military expenditure NATO countries have been selected (Belgium, Denmark, France, Germany, Greece, Italy, the Netherlands, Portugal, Spain and the UK). For this purpose we employ the Granger causality test.

At first we test the stationarity of these time series using unit roots tests (the Augmented Dickey-Fuller test and the KPSS test). The null hypothesis of the augmented Dickey-Fuller (ADF) test is that the generated process is a non-stationary $I(1)$ process, the null hypothesis of the KPSS test is opposite to that of the ADF: under the null hypothesis, the process is stationary; the alternative hypothesis is that it is $I(1)$. The results of the mentioned test are summarized in tables 1 and 2. Almost all studied time series can be considered non-stationary (non-stationarity is acceptable according to at least one of the tests). Only time series of economic growth in the UK seems to be stationary. Subsequently, we performed tests of cointegration (see table 3). The two-dimensional time series consisting of time series of economic growth and military expenditure in the countries analyzed can be considered cointegrated except for Greece and Spain. Finally, we computed the Granger causality test in the VAR and VECM models (for Greece and Spain in the VAR model and the VAR model for differences). The results are described in table 4. Based on the VAR models, we can say that economic growth causes, in the Granger sense, military expenditure in Germany and Portugal (the significance level $\alpha = 0.05$); military expenditure causes, in the Granger sense, economic growth in Belgium, Denmark, France, Germany, Italy, the Netherlands and Portugal. Given that the analyzed time series are non-stationary and cointegrated for most countries, we should focus on Granger causality tests in the VECM model and for non-cointegrated time series on the VAR model for differences. We have come to the following findings: economic growth causes, in the Granger sense, mil-

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itary expenditure in Germany and Portugal; military expenditure causes, in the Granger sense, economic growth in France, Germany and Italy.

5 Conclusion

The relationship between military expenditure as a ratio of GDP and economic growth in percent is a controversial area of National Defence Economy. Generally, this relationship was examined (e.g. in [1], [2], [3], [6] and [10]) but the studies did not reveal uniformity among empirical results. To identify possible links between two the mentioned variables in selected NATO states (Belgium, Denmark, France, German, Greece, Italy, the Netherlands, Portugal, Spain, and the UK) the authors employ the Granger causality test. The time series were chosen from the SIPRI and OECD database and characterized for the time period from 1950s to 2009. From the empirical results we can conclude that economic growth causes, in the Granger sense, military expenditure in Germany and Portugal. Causality identified from growth to military expenditure confirms that government makes defence spending policy decisions based on the state of their economy in the case of Germany and Portugal. In three countries causality appeared to run from growth to military spending. These are France, Germany and Italy. Similar studies were published in [6] with the results proving that causality appeared from growth to military spending in Germany, Italy, the Netherlands, Spain, Sweden and the UK. Differences in results may be due to the use of unequal length of used time series (authors in [6] used causality tests for the period 1961–2000).

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Belgium	lag	test statistic	p-value
military expenditures	1	-1.4460	0.5612
first difference	1	-4.8837	$3.51 \cdot 10^{-5}$
economic growth	2	-2.4179	0.1367
first difference	1	-6.9010	$6.108 \cdot 10^{-10}$
Denmark	lag	test statistic	p-value
military expenditures	2	-1.1833	0.6840
first difference	1	-4.8949	$3.333 \cdot 10^{-5}$
economic growth	1	-3.8066	0.00286
first difference	2	-6.2487	$2.952 \cdot 10^{-8}$
France	lag	test statistic	p-value
military expenditures	3	-2.0757	0.2547
first difference	1	-8.7803	$2.273 \cdot 10^{-15}$
economic growth	2	-1.0886	0.7226
first difference	2	-5.0382	$1.704 \cdot 10^{-5}$
Germany	lag	test statistic	p-value
military expenditures	2	-0.4297	0.9019
first difference	1	-5.7742	$4.105 \cdot 10^{-7}$
economic growth	1	-3.7538	0.0034
first difference	4	-4.9944	$2.096 \cdot 10^{-5}$
Greece	lag	test statistic	p-value
military expenditures	2	-0.4297	0.9019
first difference	1	-5.7742	$4.105 \cdot 10^{-7}$
economic growth	3	-1.4189	0.5746
first difference	2	-6.1600	$4.890 \cdot 10^{-8}$
Italy	lag	test statistic	p-value
military expenditures	1	-1.5768	0.4945
first difference	1	-7.3453	$3.734 \cdot 10^{-11}$
economic growth	1	-1.9104	0.3278
first difference	5	-5.4512	$2.228 \cdot 10^{-6}$
Netherlands	lag	test statistic	p-value
military expenditures	1	-0.8402	0.8071
first difference	1	-4.0501	0.0012
economic growth	1	-3.4307	0.0100
first difference	4	-4.3906	0.0001
Portugal	lag	test statistic	p-value
military expenditures	1	-0.9534	0.7716
first difference	1	-5.7709	$4.179 \cdot 10^{-7}$
economic growth	1	-3.5090	0.0078
first difference	4	-4.7506	$6.428 \cdot 10^{-5}$
Spain	lag	test statistic	p-value
military expenditures	2	-0.8787	0.7956
first difference	1	-3.0014	0.0348
economic growth	1	-3.0435	0.0311
first difference	2	-5.2958	$4.874 \cdot 10^{-6}$
UK	lag	test statistic	p-value
military expenditures	1	-1.3728	0.5973
first difference	3	-5.0435	$1.662 \cdot 10^{-5}$
economic growth	2	-4.1393	0.0008
first difference	3	-5.5298	$1.488 \cdot 10^{-6}$

Table 1: The ADF unit root tests

Belgium	test statistic	10%	5%	1%
military expenditures	0.9207	0.351	0.469	0.727
first difference	0.1884	0.351	0.469	0.727
economic growth	0.5852	0.351	0.469	0.726
first difference	0.1384	0.351	0.469	0.726
Denmark	test statistic	10%	5%	1%
military expenditures	0.90421	0.351	0.469	0.727
first difference	0.2152	0.351	0.469	0.727
economic growth	0.5285	0.351	0.469	0.727
first difference	0.2430	0.351	0.469	0.727
France	test statistic	10%	5%	1%
military expenditures	0.9533	0.351	0.469	0.727
first difference	0.0951	0.351	0.469	0.727
economic growth	0.8684	0.351	0.469	0.727
first difference	0.0999	0.351	0.469	0.727
Germany	test statistic	10%	5%	1%
military expenditures	0.9531	0.351	0.469	0.726
first difference	0.0742	0.351	0.469	0.726
economic growth	0.7452	0.351	0.469	0.726
first difference	0.0798	0.351	0.469	0.726
Greece	test statistic	10%	5%	1%
military expenditures	0.3790	0.351	0.469	0.727
first difference	0.1067	0.351	0.469	0.727
economic growth	0.6763	0.351	0.469	0.727
first difference	0.1322	0.351	0.469	0.727
Italy	test statistic	10%	5%	1%
military expenditures	0.9507	0.351	0.469	0.727
first difference	0.1100	0.351	0.469	0.727
economic growth	1.0211	0.351	0.469	0.727
first difference	0.1271	0.351	0.469	0.727
Netherlands	test statistic	10%	5%	1%
military expenditures	1.1087	0.351	0.469	0.727
first difference	0.1140	0.351	0.469	0.727
economic growth	0.6032	0.351	0.469	0.726
first difference	0.0765	0.351	0.469	0.726
Portugal	test statistic	10%	5%	1%
military expenditures	0.6781	0.351	0.469	0.727
first difference	0.1774	0.351	0.469	0.727
economic growth	0.6225	0.351	0.469	0.726
first difference	0.1235	0.351	0.469	0.726
Spain	test statistic	10%	5%	1%
military expenditures	0.5574	0.354	0.476	0.711
first difference	0.1140	0.354	0.477	0.710
economic growth	0.5016	0.351	0.469	0.726
first difference	0.1109	0.351	0.469	0.726
UK	test statistic	10%	5%	1%
military expenditures	0.9903	0.351	0.469	0.727
first difference	0.0774	0.351	0.469	0.727
economic growth	0.2206	0.351	0.469	0.727
first difference	0.1562	0.351	0.469	0.727

Table 2: The KPSS unit root tests

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Belgium – VAR(1)						
r	TRACE	p-value	MAX	p-value	S&L	p-value
0	27.993	0.0003	23.651	0.0009	26.10	0.0001
1	4.342	0.0372	4.342	0.0372	2.67	0.1211
Denmark – VAR(2)						
r	TRACE	p-value	MAX	p-value	S&L	p-value
0	23.529	0.0020	22.808	0.0013	14.43	0.0205
1	0.721	0.3959	0.721	0.3959	1.41	0.2729
France – VAR(3)						
r	TRACE	p-value	MAX	p-value	S&L	p-value
0	42.323	0.0000	26.969	0.0002	25.59	0.0001
1	15.354	0.0001	15.354	0.0001	1.02	0.3583
Germany – VAR(2)						
r	TRACE	p-value	MAX	p-value	S&L	p-value
0	18.504	0.0156	18.451	0.0087	16.44	0.0086
1	0.054	0.8167	0.054	0.8167	1.54	0.2498
Greece – VAR(3)						
r	TRACE	p-value	MAX	p-value	S&L	p-value
0	4.9524	0.8118	4.4108	0.8098	3.60	0.7658
1	0.542	0.4617	0.542	0.4617	0.24	0.6858
Italy – VAR(1)						
r	TRACE	p-value	MAX	p-value	S&L	p-value
0	31.571	0.0001	23.082	0.0011	25.72	0.0001
1	8.4894	0.0036	8.4894	0.0036	1.33	0.2880
Netherlands – VAR(1)						
r	TRACE	p-value	MAX	p-value	S&L	p-value
0	30.545	0.0001	27.802	0.0001	24.03	0.0003
1	2.7434	0.0977	2.7434	0.0977	2.48	0.1362
Portugal – VAR(1)						
r	TRACE	p-value	MAX	p-value	S&L	p-value
0	30.950	0.0001	30.278	0.0000	30.69	0.0000
1	0.6720	0.4124	0.6720	0.4124	0.50	0.5405
Spain – VAR(1)						
r	TRACE	p-value	MAX	p-value	S&L	p-value
0	3.9339	0.9022	2.7861	0.9497	4.25	0.6763
1	1.148	0.2840	1.148	0.2840	0.75	0.4415
UK – VAR(3)						
r	TRACE	p-value	MAX	p-value	S&L	p-value
0	29.666	0.0001	16.624	0.0188	21.54	0.0008
1	13.042	0.0003	13.042	0.0003	0.91	0.3902

Table 3: The tests of cointegration

Belgium	VAR		VECM	
	test stat.	p-value	test stat.	p-value
H_{0a}	0.0003	0.9853	0.0199	0.8881
H_{0b}	4.3275	0.0399	1.5904	0.2102
Denmark	VAR		VECM	
	test stat.	p-value	test stat.	p-value
H_{0a}	0.0119	0.9882	0.5984	0.5517
H_{0b}	4.6363	0.0118	1.1789	0.3120
France	VAR		VECM	
	test stat.	p-value	test stat.	p-value
H_{0a}	0.6303	0.5972	0.9664	0.4121
H_{0b}	4.8608	0.0034	3.2005	0.0270
Germany	VAR		VECM	
	test stat.	p-value	test stat.	p-value
H_{0a}	4.0099	0.0211	4.2425	0.0172
H_{0b}	5.6302	0.0048	3.3397	0.0397
Greece	VAR		VAR-differenced	
	test stat.	p-value	test stat.	p-value
H_{0a}	2.1159	0.1031	2.3134	0.1041
H_{0b}	1.5997	0.1944	2.5023	0.0869
Italy	VAR		VECM	
	test stat.	p-value	test stat.	p-value
H_{0a}	1.0265	0.3132	0.0000	0.9951
H_{0b}	14.126	0.0003	7.7342	0.0064
Netherlands	VAR		VECM	
	test stat.	p-value	test stat.	p-value
H_{0a}	0.0377	0.8464	0.0051	0.9431
H_{0b}	6.2593	0.0139	0.4773	0.4913
Portugal	VAR		VECM	
	test stat.	p-value	test stat.	p-value
H_{0a}	8.5594	0.0042	8.0696	0.0055
H_{0b}	5.8063	0.0177	0.5139	0.4752
Greece	VAR		VAR-differenced	
	test stat.	p-value	test stat.	p-value
H_{0a}	0.3337	0.5660	0.0520	0.8205
H_{0b}	0.7654	0.3857	0.0421	0.8382
UK	VAR		VECM	
	test stat.	p-value	test stat.	p-value
H_{0a}	0.2753	0.8431	0.2719	0.8456
H_{0b}	1.6612	0.1802	1.3082	0.2764

Table 4: The Granger causality tests, H_{0a}: economic growth do not Granger-cause military expenditures, H_{0b}: military expenditures do not Granger-cause economic growth

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