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FURTHER EVIDENCE ON DEFENCE SPENDING AND ECONOMIC GROWTH IN NATO COUNTRIES

Abstract. *The main purpose of this paper is to analyze the causal relationships between defence spending and economic growth using the Toda–Yamamoto approach to Granger causality test in the case of selected NATO countries for the period of 1949-2006. NATO countries spend biggest proportion of defence spending in the world. Granger causality test on defence-growth issue employed by number of scholars but this paper is firstly used Toda–Yamamoto approach to granger causality to analyze relationship between defence spending and growth. The results show that unidirectional causality exists in seven NATO countries while for five countries no causal relationships were found. On the other hand, Turkey differs from other countries in that the relationship is bilateral.*

Keywords: *Defence spending, Turkish economy, Granger causality, NATO, economic growth, Toda–Yamamoto approach.*

JEL Classification: H56, C22

1 Introduction and Recent Literature Review

This paper provides causal relationships between defence spending and economic growth for selected NATO countries. It is generally assumes that defence spending is an exogenous variable relative to economic growth. From a Keynesian perspective, it can be argued that defense spending might play a crucial role in fascinating economic activities.

Due to the international terrorist attacks and technological developments, defence industry grows rapidly. Defence expenditures have a significant share in government expenditures in many countries. Therefore, it is more likely that defence expenditures deter economic growth in the long run. The large body of literature investigates the causality between defence expenditure and economic growth since 1970's by using numbers of different empirical methods. Benoit (1973) and Deger and Smith (1983) examined the relationship between military expenditure and economic growth in less developed countries. Their results are contradictory. Although Benoit (1973) found positive relationship between these two variables, Deger and Smith (1983) points to negative relationship.

Antonakis (1999) found that the annual output growth rate in Greece is negatively affected by the size of the defense sector. Dakurah et al. (2001) investigated causal relations between defence spending and economic growth in 62 developing countries. They found that unidirectional causality was found in 23 countries, from either defence expenditures to economic growth or vice versa, while bidirectional causality existed in 7 countries. Causality did not exist in 18 countries that were integrated of the same order, while in 14 countries the data were integrated of differing orders. The long run effects were distinguished from short run causality when co-integration existed. Dritsakis (2004) investigated the relationship between the defence spending and economic growth for two adjacent countries, members of NATO, namely Greece and Turkey. He found that there is no co-integrated relationship between the two variables, while the Granger causality results indicate a unidirectional causal relationship between economic growths and defence spending for both countries. Besides, they indicated that there is a bilateral causal relationship between defences spending of the two countries.

Turkey is a developing economy in an unsecure military and political environment. The critical position of Turkey as a NATO country and a neighbor of the Soviet Russia pushed the Turkish government to have strong military power. After the cold war, due to increasing terrorism in the southeast of the country, Turkey has continued to spend military expenditures for defense purposes. In the literature, the military spending in the Turkish economy is investigated from different purposes. For example, as recent empirical evidence, Karagianni and Pempetzoglu (2009) employs linear and non-linear Granger causality methods to examine the causal relationship between defense spending and economic growth in Turkey for the period 1949-2004. They provide evidence regarding the nonlinear causal dependence between military spending and economic growth in Turkey with both linear and non-linear causality models. In the literature, the empirical works on the economic aspects of Turkish military expenditures are in general academically examined in the framework of Turkish-Greek relationships. Sahin and Ozsoy (2009) use an annual data set running from 1958 to 2004 for Turkey and Greece and employ a Markov switching approach. They conclude that a Markov switching approach allows estimation of military spending of each country if both sides compete with each other to have higher spending or if they behave independently of each other.

In this paper, we examine the relationship between defense spending and economic growth in the NATO countries. Due to data restrictions, the focus is given on thirteen countries. The originality of this paper is that it employs the Toda-Yamamoto approach to Granger causality test to detect the long-run relationships between the economic growths and defence spending. That methodology enables us to use data without relying on any restrictions on stationarity. Especially when using data with small sample size, stationarity might appear as a restrictive problem in time series analysis. However, the methodology applied in our paper solves the data stationarity problem as explained in the next chapter. Another contribution of the paper is that empirical findings show that only Turkey among the NATO countries has a bilateral relationship between economic growth and defence spending. That distinguishing evidence for Turkey is worthy to be investigated in terms of politics and economy.

In the next part, we explain how to use Bound Test approach developed by Pesaran et al. (2001) and WALD method developed by Toda and Yamamoto (1995) to examine causality between defense spending and economic growth. In the third part, the descriptive statistics of the data employed in the paper is shared. In the fourth part, empirical findings are displayed and their distinguishing features are discussed. The paper lasts proving suggestions for future research in the conclusion part.

2 Methodology

When we examine the methodology used to test a long term cointegration relationship, we see that cointegration tests performed by Engle-Granger (1987), Johansen (1988) and, Johansen and Juselius (1990) are used widely. In order to perform these tests, the condition must be sought out that all series should not be stationary on the level and they should become stationary when the same difference is taken. If one or more of the series is stationary that is to say I(0), the cointegration relationship should not be searched with these tests. However, Bound Test approach developed by Pesaran et al. (2001) removes this problem. According to this approach, the existence of a cointegration relationship can be examined between the series regardless of whether they are I(0) or I(1). With this new approach, the problem of not being able to search the cointegration relationship resulted from the difference between the stationary levels of series used in many studies is solved.

When the methodology used in causality aspect is examined, it is determined that causality test developed by Granger (1969) is performed if the series are stationary in their level conditions. Vector error correction (VEC) model developed by Engle and Granger (1987) used widely if cointegration occurs between series which become stationary when the same difference is taken. In the vector error correction model which is a limited WALD model, F test is used for testing the causality. However; if the series are cointegrated, traditional F test statistics used for testing the Granger causality may not be valid because it does not fit into the standard distribution (Toda and Yamamoto, 1995). In the causality testing performed with modified WALD method developed by Toda and Yamamoto (1995), cointegration relationship between the series is not important and it is enough to determine the right model and to know the maximum cointegration level of the variables in the model.

2.1 The bounds test approach to cointegration

Firstly an unrestricted error correction model (UECM) is formed. The form of this model adapted into our study is as follows.

$$\Delta LY_t = \alpha_0 + \sum_{i=1}^{m} \alpha_{1i} \Delta LY_{t-i} + \sum_{i=0}^{m} \alpha_{2i} \Delta LME_{t-i} + \alpha_3 LY_{t-1} + \alpha_4 LME_{t-1} + \mu_t \qquad (1)$$

Where, LY_t is log of real GDP and LME_t is log military expenditures. F test is applied on fist period lags of dependent and independent variables to test the existence of cointegration relationship. Basic hypothesis for this test is established as ($H0{:}\alpha 3=\alpha 4=0$) and calculated F statistics is compared with table bottom and top critical levels in Pesaran et al. (2001). If the calculated F statistics is lower than Pesaran bottom critical value, there is no cointegration relationship between the series. If the calculated F statistics is between the bottom and top critical values, no exact opinion can be made and there is a need to apply other cointegration test approaches. Lastly; if the calculated F statistics is higher than the top critical value, there is a cointegration relationship between the series.

2.2. The Toda–Yamamoto approach to Granger causality test

Toda and Yamamoto (1995) has stated that WALD hypothesis test which is to be performed with adding extra lag to WALD model in accordance with the maximum cointegration relationship of the series will have chi-square (χ^2) distribution. Toda and Yamamoto (1995) approach fits into a standard WALD model in variable levels (instead of first differences as in Granger causality tests) and accordingly minimizes the risks resulted from the possibility of wrong detection of cointegration levels of the series (Mavrotas and Kelly, 2001). WALD model with two variables comprise of Gross Domestic Product (LY) and Military Expenditures (LME) series has been formed as follows.

$$LY_t = \alpha_0 + \sum_{i=1}^{k} \alpha_{1i} LY_{t-i} + \sum_{j=k+1}^{d\max} \alpha_{2j} LY_{t-j} + \sum_{i=1}^{k} \phi_{1i} LME_{t-i} + \sum_{j=k+1}^{d\max} \phi_{2j} LME_{t-j} + \mu_{1t} \quad (2)$$

$$LME_t = \beta_0 + \sum_{i=1}^{k} \beta_{1i} LME_{t-i} + \sum_{j=k+1}^{d\max} \beta_{2j} LME_{t-j} + \sum_{i=1}^{k} \delta_{1i} LY_{t-i} + \sum_{j=k+1}^{d\max} \delta_{2j} LY_{t-j} + \mu_{2t} \quad (3)$$

In WALD model, “k” represents the number of lags, and “dmax” represents the maximum cointegration level of the variables entered into the model. Basic idea of this approach is to increase the number of lags in the WALD model up to the maximum cointegration level of the variables entered into the model. Hypothesis for the equation (2) if $\phi_{1i} \neq 0$ military expenditure is the reason for the economic growth. Similarly, Hypothesis for the equation (3) if $\delta_{1i} \neq 0$ economic growth is the reason for the military expenditure.

3 Data

In this paper, we use annual data for defence expenditure and GDP in real terms to examine causal relationship between defense expenditures and economic growth. Our target economies are the member states of NATO. We obtain the data various issues of SIPRI Yearbooks. The data period is different among the countries. Due to lack of data, we are not able to focus on all NATO countries. Our sample is restricted to 13 countries for which we have enough data. The descriptive statistics of the data are presented in Table 1.

Table 1. Descriptive Statistics of Data

Countries	**Variables**	**Sample Size**	**Min.**	**Max.**	**Mean**	**St. Deviation**
Belgium	LY	54	14,6051	16,2365	15,4208	0,4811
	LME	54	11,5815	11,7515	11,6665	0,4032
Canada	LY	58	11,9078	14,0413	12,9746	1,5086
	LME	58	8,0656	9,5969	8,8312	1,0828
Denmark	LY	41	13,3074	14,1714	13,7394	0,6110
	LME	41	9,6718	9,9071	9,7894	0,1664
England	LY	58	12,5129	13,9160	13,2145	0,9921
	LME	58	9,7279	10,1528	9,9404	0,3004
France	LY	57	14,2374	16,1625	15,2000	1,3612
	LME	57	11,3445	12,4373	11,8909	0,7728
Germany	LY	47	14,0023	15,2695	14,7389	0,3765
	LME	47	10,7846	11,3567	11,1279	0,1525
Greece	LY	58	15,4345	17,8212	16,6278	1,6876
	LME	58	12,6053	14,3100	13,4576	1,2054
Netherlands	LY	51	12,1061	13,8189	12,9625	1,2111
	LME	51	9,2577	9,6198	9,4387	0,2560
Italy	LY	37	13,8890	14,7041	14,2965	0,5763
	LME	37	10,1255	10,6064	10,3660	0,3400
Norway	LY	41	12,9816	14,4047	13,6931	1,0062
	LME	41	9,6485	10,2026	9,9255	0,3918
Portugal	LY	47	15,1276	17,0444	16,0860	1,3554
	LME	47	11,9393	12,9014	12,4203	0,6803
Turkey	LY	58	16,1771	18,8888	17,5329	1,9174
	LME	58	12,9416	15,3363	14,1390	1,6932
USA	LY	58	14,3069	16,2505	15,3514	0,3088
	LME	58	11,3272	13,0092	12,5248	0,5571

4 Empirical Evidence

Before testing for cointegration and causality, we tested for unit roots to find the stationarity properties of the data. Augmented Dickey-Fuller (ADF) t-tests (Dickey and Fuller 1979) and Phillips and Perron (PP) (1988) tests were used on each of the two time series for each country.

Table 2. Stationary Test Results

Countries	Variables	ADF Test		PP Test	
		Without Trend	With Trend	Without Trend	With Trend
Belgium	LY	-1.902	-1.331	-1.902	-1.374
	ΔLY	-6.244*	-6.477*	-6.244*	-6.474*
	LME	-4.815*	-5.270*	-5.000*	-5.383*
	ΔLME	-8.115*	-8.050*	-21.786*	-23.790*
Canada	LY	-2.407	-1517	-3.301**	-1.761
	ΔLY	-5.855*	-6.433*	-5.874*	-6.377*
	LME	-5.799*	-5.427*	5.045*	-4.498*
	ΔLME	-4.268*	-4.247*	-3.948**	-3.732**
Denmark	LY	-1.292	-3.196	-1.249	-3.241
	ΔLY	-1.879	-3.675**	-5.196*	-5.159*
	LME	-2.352	-2.343	-2.300	-2.215
	ΔLME	-6.855*	-6.923*	-6.855*	-7.193*
England	LY	-0.180	-2.146	-0.322	-2.327
	ΔLY	-6.260*	-6.198*	-5.413*	-5.328*
	LME	-3.539**	-3.120	-3.566**	-3.288
	ΔLME	-4.772*	-4.846*	-4.418*	-4.544*
France	LY	-3.365**	-0.771*	-4.716*	-0.758
	ΔLY	-1.729	-5.230*	-3.736*	-5.241*
	LME	-4.170*	-4.917*	-4.124*	-4.800*
	ΔLME	-7.380*	-7.395*	-9.113*	19.356*
Germany	LY	-1.772	-2.454	-2.296	-1.725
	ΔLY	-4.632*	-4.906*	-4.567*	-4.760*
	LME	-1.026	-1.341	-2.197	-2.456
	ΔLME	-4.756*	-3.172**	-5.115*	-5.666*
Greece	LY	-3.216**	-2.933	-3.112**	-1.523
	ΔLY	-3.149**	-6.625*	-6.151*	-6.848*
	LME	-1.791	-1.187	-1.794	-1.187
	ΔLME	-6.944*	-7.097*	-6.944*	-7.096*
Netherlands	LY	-1.030	-1.858	-0.981	-1.674
	ΔLY	-5.519*	-5.536*	-5.512*	-5.530
	LME	-1.332	-2.083	-1.117	-2.174
	ΔLME	-6.846*	-6.777*	-6.936*	-6.933*
Italy	LY	-2.907	-1.209	-5.090*	-0.938
	ΔLY	-5.594*	-4.490*	5.623*	-7.334*

	LME	-2.275	-1.465	-2.207	-1.791
	ΔLME	-4.053*	-4.198*	-3.992*	-4.165*
Norway	LY	-0.155	-2.323	-0.982	-2.222
	ΔLY	-3.675*	-3.660*	-3.725*	-3.427**
	LME	-1.212	-0.287	-1.595	-1.204
	ΔLME	-6.744*	-4.854*	-6.804*	-7.641*
Portugal	LY	-1.929	-2.002	-2.582	-1.873
	ΔLY	-7.640*	-8.148	-7.639*	-8.281*
	LME	-5.127*	-4.464*	-4.999*	-4.398*
	ΔLME	-7.033*	-7.090*	-7.159*	-7.264*
Turkey	LY	-1.815	-0.589	-2.349	-1.053
	ΔLY	-5.331*	-5.699*	-6.362*	-7.208*
	LME	-1.122	-3.808**	-1.242	-2.355
	ΔLME	-6.181*	-6.214*	-5.514*	-5.471*
USA	LY	-1.743	-2.666	-1.965	-3.152
	ΔLY	-5.761*	-5.737*	-7.527*	-8.234*
	LME	-5.384*	-3.670**	-3.996*	-4.431*
	ΔLME	-4.641*	-4.716*	-4.260*	-4.472*

The results show that all series are found to be first difference stationary. However, it should be emphasized that the stationary level does not make any difference for the methodology employed in this paper.

The results display the fact that the pre-condition for examination of long term relationship between variables by Paseran bounds test that the independent variables are I(0) or I(1) is satisfied according to both ADF and Phillips-Perron unit root tests. Besides, as the maximum cointegration degree is found I (1) for each country, 1 will be added to the lag number of each country when Toda Yamamoto causality test is applied. Cointegration test results are shown in Table 3 and the diagnostic results of the countries which have long term relationships are shown in Table 4.

Table 3. Tests for Cointegration using the ARDL approach

Countries	**Dependent Variable**	**F statistic Without trend**	**F statistic with trend**	**Long run coefficient**	**Error Correction Term**
Denmark	ΔLY	1.367	7.137*	-0.372**	-0.353*
France	ΔLY	9.410**	1.576	-0.697	-0.042**
Greece	ΔLME	6.660***	7.937**	1.312*	-0.373*
Netherlands	ΔLME	3.719	6.932***	0.206**	-0.127**

Italy	ΔLY	7.243**	1.057	0.277**	-0.212**
Turkey	ΔLME	5.173	12.818*	0.302**	-0.589*

Significant at *%1, **%5, ***%10

Table 4. Diagnostic Tests

Countries	X^2_{BG}	χ^2_{NORM}	χ^2_{WHITE}	X^2_{RAMSEY}
Denmark	1.722(0.189)	0.834(0.659)	2.553(0.116)	0.285(0.593)
France	1.645(0.200)	3.490(0.106)	0.097(0.755)	2.465(0.670)
Greece	2.468(0.116)	1.220(0.543)	0.071(0.789)	0.078(0.779)
Netherlands	1.362(0.243)	2.782(0.249)	1.884(0.170)	0.018(0.893)
Italy	1.137(0.286)	1.965(0.399)	1.532(0.161)	2.142(0.781)
Turkey	0.780(0.377)	2.185(0.196)	0.186(0.666)	1.546(0.214)

χ^2_{BG} , χ^2_{NORM}, χ^2_{WHITE}, χ^2_{RAMSEY} *are autocorrelation, normality, heterosceasticiy and model specification error test statistics, respectively.*

According to the UECM model in which the economic growth is dependent variable, cointegration is detected in Denmark, France and Italy. On the other hand, where the defense spending is dependent variable, cointegration is detected in the UECM model for Greece, Netherlands and Turkey. In the ARDL models constructed after UECM models, the coefficient for Denmark is negative and statistically significant. For Greece, Netherlands, Italy and Turkey, the coefficients are positive and statistically significant. The error correction term showing how much of the disequilibrium in the short term will be removed in the long term is found negative, between 0 and -1, and statistically significant for 6 countries.

Table 5. Toda Yamamoto Test Results

		From LME to LY		From LY to LME		
Countries	**d**	**p-value**	**Sum of lagged coefficients**	**p-value**	**Sum of lagged coefficients**	**Direction of Causality**
Belgium	2	0.201	1.634	0.896	0.016	No
Canada	1	0.725	0.123	0.356	0.851	No

Denmark	1	0.495	0.465	0.126	2.336	No
England	3	0.001	7.448*	0.461	1.913	LME $\Rightarrow$ LY
France	1	0.039	4.233**	0.299	1.075	LME $\Rightarrow$ LY
Germany	4	0.252	5.363	0.846	1.384	No
Greece	2	1.464	0.480	0.008	9.578*	LY $\Rightarrow$ LME
Netherlands	2	0.346	2.896	0.026	5.644**	LY $\Rightarrow$ LME
Italy	2	0.273	1.198	0.333	0.935	No
Norway	1	0.009	6.712*	0.803	0.062	LME $\Rightarrow$ LY
Portugal	2	0.222	1.488	0.013	6.669**	LY $\Rightarrow$ LME
Turkey	4	0.015	12.233**	0.000	36.916*	LY $\Leftrightarrow$ LME
USA	2	0.983	0.034	0.822	0.390	No

The Toda–Yamamoto approach to Granger causality model is estimated using Seemingly Unrelated Regression (SUR). The result of this test is given in the Table 5. The findings show that there is a unilateral causality from military expenditures to growth in England, France and Norway. On the contrary, the unilateral relationship from economic growth to military expenditures exists in Greece, Netherlands and Portugal. According to test results, Turkey is a special case in which the relationship is bilateral.

There might be alternative political or economic arguments to justify the econometric results above. As economists, we prefer to use economic reasons for the findings, and wait for the political reasons from political scientists. We explain the findings that the military spending leads to economic growth in leading developed countries such as France and England by using Keynesian arguments in that the spending of military industry creates economic facilities and growth. On the other hand, the relatively less developed and secured countries such as Portugal only spend on defense if she has economic growth. Turkey is a special case that should be examined both economical and political perspectives. We do not think that the distinguishing result for Turkey is a coincidence as she has a distinguishing geopolitical positions and only the developing country in our sample. Turkey needs defense spending, and she spends as her economy grows. On the other hand, as she is a developing country, the economically expansionist feature of defense spending is observable in the empirical results.

5 Conclusion

The cointegration relationship between the economic growth and defense spending is examined by bounds testing approach developed by Paseran et al. (2001) and the causality relationship is examined by Toda Yamamoto (1995) causality analysis.

The findings show that there exist a causality between economic growth and defense spending in 7 NATO countries. However, the direction of that relationship varies on the economies under examination. In developed economies such as France, England and Norway which are also exporters in military industry, there is a unilateral relationship from military expenditure to economic growth. On the other hand, for Portugal and Netherlands, the unilateral relationship works from economic growth to military expenditures. Portugal and Norway spends on defense if there are in economical expansion. The most interesting part of the empirical findings appears when we examine the results for Turkey. The causal relationship between economic growth and military spending works bilateral in Turkish economy. Though we have certain economic arguments for that distinguishing result, the future research might concentrate on the subject from political and international finance perspective. The important role of Turkey within the NATO countries during the cold war, and developing nature of her economy might explain that bilateral relationship between growth and defense spending. In that sense, the paper provides an original and distinguishing empirical result for Turkish military economy which worthies to be examined further.

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