Should Portuguese Economy Invest in Defense Spending? A Revisit

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Abstract:

In this paper, we investigate the causal relationship between defence spending and economic growth in Portugal during the period of 1980-2010. We apply the ARDL bounds testing approach in the presence of structural break. These methods are robust to the violation of statistical assumptions especially when the sample size is small. The ARDL-ECM estimation results disclose that the relations between defense spending, capital, labor and economic growth are country specifics. The interesting finding of this study is that there is a U-shaped relation exists between defense spending and economic growth. In addition, the unidirectional causality from defense spending to economic growth exists in case of Portugal. Therefore, defence spending can play an important role in economic development of Portugal.

Keywords: Defence spending, economic growth, cointegration, causality, Portugal

Introduction

With the advent of globalization, the discussion over the link between defence spending and economic growth has been widespread. The direction between these variables has been an emerging area of investigation in recent decades. While a positive interaction between defence spending and economic growth is usually expected, findings in the existing literature do not necessarily confirm to this stereotyped direction. Two views of the existing literature explained that defence spending affects economic growth through the domestic production. According to the Keynesian framework, military spending raises the aggregate demand by generating output and creating employment opportunities in the country (Gold, 1990; Chan, 1995). In addition, it has a spill-over effect on human capital applying the expenditures on education, research and technological enhancements (see Barro, 1991; Adam and Gold, 1987). Furthermore, it also promotes the investment climate and promoting the international business opportunities in the economy (Heo, 2010). In contrast, however, the neoclassical model explained military spending has crowding-out effect on both public and private investment that will negatively influence economic growth (Sandler and Hartley, 1995). In general public sector are less concerned about the cost of production rather than the private sector. Therefore, the concept of technical efficiency are absent in the public sector.

Based on the earlier literature debate on defence spending and economic growth nexus, the examining the relationship between these variables on a country-by-country basis becomes important. Despite enormous amounts of literature on defence spending and economic growth, we will mainly focus on these studies because defence spending and economic growth can be different due to different countries' characteristics such as different public and private investment, structure of investment, political and economic histories, cultures, social security system and different institutional arrangements. A series of studies found that military spending neglected/reducing the economic growth [Smith, (1977); Boretsky, (1975); Sivard, (1977); Atesoglu (2002), Ocal and Brauer (2007) and Smith and Tuttle (2008)]. However, the opposite evidence also exists in the earlier literature that military spending promotes economic growth [Benoit (1973, 1978); Halicioglu (2003, 2004); Wijeweera and Webb (2009); Atesoglu, (2009) and, Wijewerra and Webb (2011)]. Therefore the relationship between defence spending and economic growth is still inconclusive in the literature.

An upward movement in economic growth and defence spending has raised some questions in Portugal's perspective such as: (1) Is there any long-term relationship between these variables? (2) What are the short-run relationships between these variables? (3) What are the directions of the causality? (4) What are the policy implications of the findings? Our study attempts to answer these questions in the context of Portugal. We also consider the influence of capital and labour within the growth-defence nexus. We apply newly developed methods based on simulations that are robust with respect to the violation of statistical assumptions, especially when the sample size is small in the case in this paper. The empirical analysis of this study employs the ARDL bounds testing approach (Pesaran, 1997; Pesaran and Shin, 1999; and Pesaran et al, 2001). This approach has a number of advantages compared to other cointegration techniques such as that of Johansen and Juselius (Engle and Granger, 1987; Johansen, 1988; Johansen and Juselius, 1990; Johansen, 1995). Firstly, it allows for smaller sample sizes. Secondly, It can be used regardless of whether the variables are purely I(0), purely I(1), or mutually cointegrated. Thirdly, it provides unbiased long-run estimates and valid t-statistics. Fourthly, this approach provides a method of assessing the short-run and long-run. Finally, the critical value bounds are computed by stochastic simulations.

The contribution of this approach is that it takes into account a number of potential advantages compare to the earlier literature. In addition, the empirical analysis of this study employs the ARDL bounds testing approach (Pesaran, 1997; Pesaran and Shin, 1999; and Pesaran et al, 2001) applying the supply side model (Mintz and Huang, 1990, 1991). This approach has a number of advantages compared to other cointegration techniques such as that of Johansen and Juselius (Engle and Granger, 1987; Johansen, 1988; Johansen and Juselius, 1990; Johansen, 1995). It allows for smaller sample sizes. Second, It can be used regardless of whether the variables are purely I(0), purely I(1), or mutually cointegrated. Third, the unit root properties are examined by applying structural break unit root test such as Zivot-Andrews, (1992). Fourth, it provides unbiased long-run estimates and valid t-statistics. Fifth, this approach provides a method of assessing the short-run and long-run. Finally, the critical value bounds are computed by stochastic simulations.

The remainder of this paper is structured as follows: Section-2 explains military spending in Portugal. Section-3 outlines a review of the literature on output-defence nexus. Section-4 we outline the econometric specification and estimation methodology and discuss how various hypotheses are tested, while section-5 provides a discussion of our empirical results. Finally, Section-6 discusses major findings and concludes the paper.

2. Portuguese Context

Portugal is one of the first countries that joined the North Atlantic Treaty, signed in Washington, D.C. on 4 April 1949, beside the Belgium, Netherlands, Luxembourg, France, United Kingdom, United States, Canada, Italy, Norway, Denmark, and Iceland. Based on the national laws, Portugal military mission is to protect the territorial integrity of the country and providing humanitarian assistance and security at home and abroad (CIA World Factbook, 2012). An important moment in Portugal's military history was the left-wing military coup in Lisbon, made by Portuguese military officers, in 1974, toppled the Caetano government. The main objective of this action was obtaining a radical change in government attitudes. Moreover, since 1975, this general military context has new changes: Portugal participation in peacekeeping missions in East Timor, Bosnia, Kosovo, Afghanistan, Somalia, Iraq (Nasiriyah), and Lebanon. In addition, the elimination of compulsory military service since 2000s has accelerated the growing trend of military spending (Dunne and Nikolaidou, 2005).

The Portuguese armed forces have been claimed in the international arena with regard to international security. There are many examples of Portuguese military missions. Portugal is a full member of the Atlantic Alliance, European Union, United Nations, and Portuguese speaking countries (PALOP). According to the data collected from the Ministry of Defence, in 1995 the mission that took place in Bosnia and Herzegovina (IFOR) had a contingent of nine hundred soldiers. To add to this sum, in 1999, Portugal secured a very significant presence in the Balkans and East Timor. In terms of humanitarian missions should be noted the presence in Kosovo and East Timor (INTERFET). In 2001, through the United Nations, Portuguese military forces were in Ukraine. The Portuguese military intervention was still in Afghanistan, Iraq and Lebanon. The prestige and recognition of Portuguese military forces has increased considerably in recent years. The participation in international missions by the Portuguese armed forces strengthened the bonds of Portugal with the European Union, the North Atlantic Alliance, and was decisive in the case of Timor East, reinforcing Portugal's position in the United Nations.

Thus, the amount of military spending had a positive trend in the period of 2005-2009, based on the rise of GDP’s rates, even if the military spending as percent of GDP degreased. If the military spending increased from US$ 403.919 billions, in 2005, at US$ 459.405 billions, in 2009, the military spending as percentage of GDP decreased from 2.11%, in 2005, at 1.97%, in 2009. In this analyzed period, the maximum level of military spending as percent of GDP was 2.11%, registered in the year 2005, and the minimum level was 1.89%, obtained in 2007. In the rest of the years, the military spending as percent in GDP was 2.02% in 2006, and 1.91% in 2008. In this case, the military spending as percent of GDP, in 2005-2008 periods, show a U-shape curve, but the real amount of military spending increases permanent.

In this context, the total real amount of military spending increased in tandem with the GDP growth’s rates. According to Nikolaidou (2008), the reduction of Portuguese military burden after 1974 is attributed to the end of the dictatorship but most importantly to the end of the Colonial Empire. More, the author stresses that the domestic defence industry was supplying arms and munitions to the army, but Portuguese defence industry is small, inefficient, and underdeveloped.

3. Review of the Literature

Despite enormous amounts of literature on defence spending and economic growth, we will mainly divided the results from earlier studies on the defence-growth nexus into two broad categories: 1) positive link between defence spending and economic growth, 2) negative link between defence spending and economic growth. Since the pioneering work of Benoit (1973, 1978) found that positive linkage between military spending and economic growth through positive spill-over effects. The validity of relationship also exists in the other studies [Kennedy (1974); Deger, (1986); Kollias, (1995); Sezgin, (1997, 1999)]. Theoretical and empirical evidence suggest that defence expenditures influencing the aggregate demand by stimulating output and creating employment opportunities in the country (MacNair et al. 1995). The positive nexus is also true for Turkey and Greece (Sezgin, 2001). Yildirm et al. (2005) found a positive interaction between military spending and economic growth for OECD countries applying dynamic panel data approach. The similar result also found in case for Fiji includes exports in production function Narayan and Singh, (2007). Recently, Using the VAR approach, positive linkage is also evident for Sri Lanka (Wijeweera and Webb, 2009); for US (Atesoglu, 2009); South Asia (Gupta et al. 2010); for India (Tiwari and Shahbaz, 2012).

The second line of research provides empirical evidence about the negative impact of military spending on economic growth [Deger and Smith, (1983); Fredericksen and Looney, (1982); Faini et al. (1984) and, Birdi and Dunne, (2002)]. The result is found for both time series and cross section analysis. The similar result is true for African economies, Lim (1983); South Korea, Heo (1999); Egypt, Israel and Syria, Abu-Bader and Abu-Qarm (2003); for Peru's economy, Klein (2004); for Turkey Karagol (2006); for Malaysia Tang (2008); for South Asia Robert and Alexander (2012); and for Pakistan Shahbaz and Shabbir (2012), Shahbaz et al. (2012) and for India Tiwari and Shahbaz (2012).

The third line of earlier from earlier studies on causality the fall into three broad categories: 1) bidirectional causality 2) unidirectional causality from defence spending to economic growth, and finally 3) unidirectional causality from economic growth to defence spending. The findings of bidirectional causality between defence pending and economic growth appear in the emerging economics such as Pakistan, Tahir (1995); Pakistan and India, Khilji and Mahmood (1997); South Africa, Dunne and Vougas (1999); and European Union, Kollias et al. (2007). Unidirectional causation from economic growth to defence spending is found in the Turkey, Karagol and Palaz (2004). The reverse is true for the case of Portuguese economy, Dunne and Nikolaidou (2005).

4. Theoretical Background and Estimation Strategy

There are two types of models investigating relationship between defence spending and economic growth: demand-side and supply-side models. Demand-side models provide the indirect impact of defence spending on economic growth dealing with numerous dependent variables such as savings, investment, education, or public health expenditures without the theoretical framework for empirical analysis. Although, Deger, (1986); Deger and Smith, (1983); Rasler and Thompson, (1988) and Mintz, (1989) applied many empirical models to investigate the relationship between defense spending and economic growth but provided inconsistent and biased results.

Supply-side models derived from a production function directly scrutinize the impact of defense spending on economic growth. Supply-side models provide traditional theoretical structure to investigate the relationship between defence spending and economic growth using aggregate production function (Heo, 2000). Existing studies in defense economics provide inconsistent findings regarding defense-growth nexus using supply-side models due to sample bias (Huang and Mintz, 1991; Mueller and Atesoglu, 1993; Ward and Davis, 1992; Ward et al. 1995).

We employ Mintz and Huang, (1990, 1991) to examine the impact of defense spending on economic growth using the data of Portuguese economy over the period of 1980-2009 without non-defense government expenditure due to non-availability of data. The general functional form of model is given below:

$$Y_t = f(D_t, TR_t, K_t, L_t) \quad (1)$$

Where Y_t is real GDP per capita for economic growth, D denotes real defense spending per capita, TR_t shows real trade per capita ((real exports + real imports) / population)), K_t for real capital per capita and L_t for labour force per capita. The linear specification of model has been converted into log-linear specification, since log-linear specification provides more appropriate and efficient results as compared to simple linear functional form of model (see for details Feridun and Shahbaz, 2010).

$$\ln Y_t = \phi_1 + \phi_1 \ln D_t + \phi_1 \ln TR_t + \phi_1 \ln K_t + \phi_1 \ln L_t + \mu_t \quad (2)$$

Where $\ln Y_t$ indicates natural log of real GDP per capita, $\ln D_t$ shows natural log of defense spending per capita, natural log of trade per capita is indicated by $\ln TR_t$, natural log of real capital use per capita is shown by $\ln K_t$ and $\ln L_t$ specifies labour force per capita. μ is residual term assumed to be normally distributed with constant variance and zero mean.

Prior to testing for cointegration, it is standard to check for stationarity properties of the series. The study period witnessed some major upheavals in the global stage which can cause structural breaks in the macroeconomic dynamics. The ARDL bounds test works regardless of whether or not the regressors are I(1) or I(0) / I(1), the presence of I(2) or higher order renders the F-test unreliable (See Ouattra, 2004). We check the stationarity properties using Ng-Perron (2001) with intercept and trend keeping in mind that it is not appropriate in the presence of structural break in the series. So, we apply the Zivot-Andrews (ZA) (1992) and Clemente et al. (1998) unit root tests which take care of structural break. The former identifies one structural break; and latter two structural breaks in the series. The Clemente et al. (1998) test has more power as compared to the ZA (1992) test.

We choose the ARDL bounds testing approach for its advantages. First, it is flexible and applies regardless the order of integration, as noted. The simulation shows that this approach is superior and provides consistent results for small sample (Pesaran and Shin, 1999). Moreover, a dynamic unrestricted error correction model (UECM) can be derived from the ARDL bounds testing through a simple linear transformation. The UECM integrates the short run dynamics with the long run equilibrium without losing any long run information. For estimation purposes, following the ARDL model to be used:

$$\begin{aligned}\Delta \ln Y_t &= \alpha_1 + \alpha_{DUM} DUM + \alpha_Y \ln Y_{t-1} + \alpha_D \ln D_{t-1} + \alpha_{TR} \ln TR_{t-1} + \alpha_K \ln K_{t-1} + \alpha_L \ln L_{t-1} + \sum_{i=1}^{p} \alpha_i \Delta \ln Y_{t-i} \\ &+ \sum_{j=0}^{q} \alpha_j \Delta \ln D_{t-j} + \sum_{k=0}^{r} \alpha_k \Delta \ln TR_{t-k} + \sum_{l=0}^{s} \alpha_l \Delta \ln K_{t-l} + \sum_{m=0}^{t} \alpha_m \Delta \ln L_{t-m} + \mu_t \end{aligned} \quad (3)$$

$$\begin{aligned}\Delta \ln D_t &= \alpha_1 + \alpha_{DUM} DUM + \alpha_Y \ln Y_{t-1} + \alpha_D \ln D_{t-1} + \alpha_{TR} \ln TR_{t-1} + \alpha_K \ln K_{t-1} + \alpha_L \ln L_{t-1} + \sum_{i=1}^{p} \beta_i \Delta \ln D_{t-i} \\ &+ \sum_{j=0}^{q} \beta_j \Delta \ln Y_{t-j} + \sum_{k=0}^{r} \beta_k \Delta \ln TR_{t-k} + \sum_{l=0}^{s} \beta_l \Delta \ln K_{t-l} + \sum_{m=0}^{t} \beta_m \Delta \ln L_{t-l} + \mu_t \end{aligned} \quad (4)$$

$$\begin{aligned}\Delta \ln TR_t &= \alpha_1 + \alpha_{DUM} DUM + \alpha_Y \ln Y_{t-1} + \alpha_D \ln D_{t-1} + \alpha_{TR} \ln TR_{t-1} + \alpha_K \ln K_{t-1} + \alpha_L \ln L_{t-1} + \sum_{i=1}^{p} \beta_i \Delta \ln TR_{t-i} \\ &+ \sum_{j=0}^{q} \beta_j \Delta \ln Y_{t-j} + \sum_{k=0}^{r} \beta_k \Delta \ln D_{t-k} + \sum_{l=0}^{s} \beta_l \Delta \ln K_{t-l} + \sum_{m=0}^{t} \beta_m \Delta \ln L_{t-m} + \mu_t \end{aligned} \quad (5)$$

$$\Delta\ln K = \alpha_1 + \alpha_{DUM}DUM + \alpha_Y \ln Y_{t-1} + \alpha_D \ln D_{t-1} + \alpha_{TR} \ln TR_{t-1} + \alpha_K \ln K_{t-1} + \alpha_L \ln L_{t-1} + \sum_{i=1}^{p} \vartheta_i \Delta\ln K_{t-i} + \sum_{j=0}^{q} \vartheta_j \Delta\ln Y_{t-j} + \sum_{k=0}^{r} \vartheta_k \Delta\ln D_{t-k} + \sum_{l=0}^{s} \vartheta_l \Delta\ln TR_{t-l} + \sum_{m=0}^{t} \vartheta_m \Delta\ln L_{t-m} + \mu_t \quad (6)$$

$$\Delta\ln L_t = \alpha_1 + \alpha_{DUM}DUM + \alpha_Y \ln Y_{t-1} + \alpha_D \ln D_{t-1} + \alpha_{TR} \ln TR_{t-1} + \alpha_K \ln K_{t-1} + \alpha_L \ln L_{t-1} + \sum_{i=1}^{p} \rho_i \Delta\ln L_{t-i} + \sum_{j=0}^{q} \rho_j \Delta\ln Y_{t-j} + \sum_{k=0}^{r} \rho_k \Delta\ln D_{t-k} + \sum_{l=0}^{s} \rho_l \Delta\ln TR_{t-l} + \sum_{m=0}^{t} \rho_m \Delta\ln K_{t-m} + \mu_t \quad (7)$$

where DUM is dummy for structural break and μ_t is residual term having normal distribution. Test of cointegration involves comparing the computed F-statistic with the critical bounds generated by Pesaran et al. (2001) i.e. upper critical bound (UCB) and lower critical bound (LCB). The null hypothesis $H_0 : \alpha_Y = \alpha_D = \alpha_{TR} = \alpha_K = \alpha_L = 0$ of no cointegration is tested against the alternate $H_a : \alpha_Y \neq \alpha_D \neq \alpha_{TR} \neq \alpha_K \neq \alpha_L \neq 0$ of cointegration[1]. The series are cointegrated if the computed F-statistic exceeds the UCB and not cointegrated if the computed F-statistic lies below the LCB. If computed F-statistic falls between the UCB and LCB, the test is uncertain. We use the critical bounds from Narayan (2005), which are more appropriate for small sample, 31 in this case, compared to Pesaran et al. (2001). The parameter stability is checked by applying the CUSUM and CUSUMSQ tests *proposed by* Brown et al. (1975).

For the long run relation among the series we use the following equation:

$$\ln Y_t = \theta_0 + \theta_1 \ln D_t + \theta_2 \ln TR_t + \theta_3 \ln K_t + \theta_4 \ln L_t + \mu_i \quad (8)$$

where, $\theta_0 = -\beta_1 / \alpha_Y, \theta_1 = -\alpha_D / \beta_1, \theta_2 = -\alpha_{TR} / \beta_1, \theta_3 = -\alpha_K / \beta_1, \theta_4 = -\alpha_L / \beta_1$ and μ_t is the error term assumed to be normally distributed. Once the long run relationship is

[1] Pesaran et al. (2001) have computed two asymptotic critical values - one when the variables are assumed to be *I(0)* and the other when the variables are assumed to be *I(1)*.

established among the series, we test the direction of causality using the following error correction representation[2]:

$$(1-L)\begin{bmatrix}\ln Y_t\\ \ln D_t\\ \ln TR_t\\ \ln K_t\\ \ln L_t\end{bmatrix}=\begin{bmatrix}\beta_1\\ \beta_2\\ \beta_3\\ \beta_4\\ \beta_5\end{bmatrix}+\sum_{i=1}^{p}(1-L)\begin{bmatrix}B_{11i}B_{12i}B_{13i}B_{14i}B_{15i}\\ B_{21i}B_{22i}B_{23i}B_{24i}B_{25i}\\ B_{31i}B_{32i}B_{33i}B_{34i}B_{35i}\\ B_{41i}B_{42i}B_{43i}B_{44i}B_{45i}\\ B_{51i}B_{52i}B_{53i}B_{54i}B_{55i}\end{bmatrix}\times\begin{bmatrix}\ln Y_{t-1}\\ \ln D_{t-1}\\ \ln TR_{t-1}\\ \ln K_{t-1}\\ \ln L_{t-1}\end{bmatrix}+\begin{bmatrix}\alpha_1\\ \alpha_2\\ \alpha_3\\ \alpha_4\\ \alpha_5\end{bmatrix}ECT_{t-1}+\begin{bmatrix}\varepsilon_{1t}\\ \varepsilon_{2t}\\ \varepsilon_{3t}\\ \varepsilon_{4t}\\ \varepsilon_{5t}\end{bmatrix} \quad (9)$$

where, $(1-L)$ is the lag operator and ECT_{t-1} is the lagged residual obtained from the long run ARDL relationship; $\varepsilon_{1t}, \varepsilon_{2t}, \varepsilon_{3t}, \varepsilon_{4t}$, and ε_{5t} are error terms assumed to be N($0,\sigma$,). Long run causality requires a significant t-statistic on the coefficient of ECT_{t-1}. A significant F-statistic on the first differences of the variables suggests short run causality. Additionally, joint long-and-short runs causal relationship can be estimated by the joint significance of both ECT_{t-1} and the estimate of lagged independent variables. For instance, $B_{12,i} \neq 0 \forall_i$ shows that defense spending Granger-causes economic growth while causality runs from economic growth to defense spending is indicated by $B_{21,i} \neq 0 \forall_i$.

The data on real GDP, defense spending, trade, capital and labour has been obtained from world development indicators (CD-ROM, 2011). We have population data to convert series into per capita and to normalise the data. The study covers the time period of 1980-2010[3].

5. Results and Discussions

Descriptive statistics and correlation matrix is presented in Table-1. According to the Jarque-Bera normality test, the results indicated that all the series are normally distributed with zero mean and constant variance. There is a positive correlation between defense spending and economic growth and same inference is drawn for economic growth and capital. Labour and economic growth are correlated positively and same conclusion can be drawn between trade openness and economic growth. A positive correlation exists between defence spending and capital (labour and trade openness). Labor and trade openness are

[2] If cointegration is not detected, the causality test is performed without an error correction term (*ECT*).
[3] Unavailability of defence spending data restricted us to choose this period for analysis

correlated with capital positively. Similarly, labour and trade openness are positively related.

Traditional unit root tests are not reliable in the presence of structural break. It is pointed by Baum, (2004) that empirical evidence on order of integration of the variable by ADF, P-P and DF-GLS unit root tests is not reliable. To overcome this issue, we have used Ng-Perron by Ng-Perron, (2001) to test the stationarity properties of defense spending, economic growth, trade openness, capital and labour.

Table-1: Descriptive Statistics and Correlation Matrices

Variables	$\ln Y_t$	$\ln D_t$	$\ln K_t$	$\ln L_t$	$\ln TR_t$
Mean	9.2301	5.4047	7.7569	4.1933	8.7638
Median	9.2567	5.4425	7.7578	4.2051	8.7732
Maximum	9.4684	5.5789	8.1449	4.2142	9.1802
Minimum	8.8559	5.1493	7.1463	4.1422	8.3028
Std. Dev.	0.2189	0.1314	0.2974	0.0230	0.2655
Skewness	-0.5410	-0.8583	-0.4965	-0.9640	-0.2992
Kurtosis	1.8453	2.3711	2.1722	2.4977	1.9319
Jarque-Bera	3.1301	4.1781	2.0895	4.9619	1.8736
Probability	0.2090	0.1237	0.3517	0.0836	0.3918
$\ln Y_t$	1.0000				
$\ln D_t$	0.5394	1.0000			
$\ln K_t$	0.8372	0.3248	1.0000		
$\ln L_t$	0.3670	0.1380	0.3000	1.0000	
$\ln TR_t$	0.5287	0.1041	0.5519	0.2620	1.0000

The results are pasted in Table-2. Empirical evidence indicates that the series are non-stationary at level and found to be stationary at 1^{st} difference. This implies that the series are I(1).

Table-2: Unit Root Analysis

Ng-Perron at Level with Intercept and Trend				
Variables	MZa	MZt	MSB	MPT
$\ln Y_t$	-4.8488	-1.3149	0.2711	17.4580
$\ln D_t$	-4.4447	-1.4507	0.3264	20.1586
$\ln TR_t$	-14.0699	-2.3071	0.1639	8.3407
$\ln K_t$	-13.0578	-2.3728	0.1817	7.9640
$\ln L_t$	-0.8565	-0.3567	0.4164	41.5504
Ng-Perron at 1st Difference with Intercept and Trend				
$\Delta \ln Y_t$	-36.5077*	-4.2700	0.1169	2.5090
$\Delta \ln D_t$	-26.0801*	-3.5914	0.1377	3.6083
$\Delta \ln TR_t$	-26.8186*	-3.5985	0.1341	3.7655
$\Delta \ln K_t$	-19.4185**	-3.0642	0.1578	5.0030
$\Delta \ln L_t$	-19.4494**	-3.0940	0.1590	4.8326
Note: *, ** and *** denote significance at the 1%, 5% and 10% levels.				

The results of Ng-Perron (2001) unit root test may be biased and inappropriate in the presence of structural break in the series. This deficiency of Ng-Perron, (2001) test has been covered by applying Zivot-Andrews, (1992) and Clemente et al. (1998) structural break unit root tests. Former contains information about one structural break and the latter has information about two structural breaks stemming in the series. The results for Zivot and Andrew, (1992) unit root test are presented in Table-3. These results suggest that we cannot reject the null of unit root for these variables in level but at 1st difference, it is possible to reject null hypothesis of unit root for all the variables.

Table-3: Zivot-Andrews Unit Root Test

Variable	At Level		At 1st Difference	
	T-statistic	Time Break	T-statistic	Time Break
$\ln Y_t$	-5.023 (1)	1998	-5.842(1)*	1990
$\ln D_t$	-3.593 (0)	1993	-5.234(0)**	1990

$\ln TR_t$	-3.835 (1)	2000	-5.229 (0)**	2006
$\ln K_t$	-4.237 (2)	2002	-5.447 (1)**	1989
$\ln L_t$	-2.374 (2)	1991	-5.933 (2)*	2003
Note: *, ** represents significance at 1%, 5% levels. Lag order is shown in parenthesis.				

Table-4: Clemente-Montanes-Reyes Unit Root Test

Variable	Innovative Outliers			Additive Outlier		
	t-statistic	TB1	TB2	t-statistic	TB1	TB2
$\ln Y_t$	-4.809 (6)	1984	1993	-5.887 (3)*	1983	1990
$\ln D_t$	-4.708 (3)	1986	1999	-5.467 (6)***	1985	1990
$\ln TR_t$	-4.743 (6)	1985	1996	-6.052 (6)*	1985	1990
$\ln K_t$	-3.688 (6)	1984	1993	-6.233 (3)*	1983	2000
$\ln L_t$	-2.858 (4)	1986	1988	-5.801 (2)**	1991	2007
Note: *, ** and *** indicates significant at 1%, 5% and 10% level of significance. TB1 and TB2 show structural break point 1 and 2. Lag order is shown in small parenthesis.						

To test the robustness of stationarity properties of the variables, Clemente et al. (1998) unit root test is also applied, which provides more consistent and reliable results as compared to Zivot-Andrews, (1992) unit root test. The main advantage of Clemente-Montanes-Reyes (1998) unit root test is that it has information about two unknown structural breaks in the series by offering two models i.e. an additive outliers (AO) model informs about a sudden change in the mean of a series and an innovation outliers (IO) model indicates about the gradual shift in the mean of the series. The additive outlier model is more suitable for the variables having sudden structural changes as compared to gradual shifts.

Table-4 reports the results of Clemente et al. (1998) unit root test. The results reveal that all the variables have unit root at level but to found to be stationary at 1st difference in the presence of various structural breaks. Unit root tests show that none of the variable is integrated at (2) or beyond that order of integration. The computation of the ARDL F-statistic for cointegration in the presence of structural break stemming in the series becomes unacceptable if any series is integrated at I(2) (Ouattara, 2004). The assumption of the ARDL bounds testing to cointegration is that integrating order of the variables should be I(1), or I(0) or I(1)/ I(0). Our results reveal that all the series are integrated at I(1). Because of the same integrating order of the variables, the ARDL bounds testing approach to cointegration must be applied to test whether cointegration exists or not among the series such as economic growth ($\ln Y_t$), defence spending ($\ln D_t$), trade openness ($\ln TR_t$), capital ($\ln K_t$) and labour ($\ln L_t$).

Table-5: ARDL Bounds Testing Analysis

Bounds Testing to Cointegration				Diagnostic tests		
Estimated Models	Optimal lag length	F-statistics	Structural Break	χ^2_{NORMAL}	χ^2_{ARCH}	χ^2_{RESET}
$F_Y(Y/D,TR,K,L)$	2, 2, 1, 2, 2	4.016	1998	2.8169	[1]: 0.0104	[1]: 3.2118
$F_D(D/Y,TR,K,L)$	2, 2, 2, 2, 2	8.531*	1993	0.5809	[3]: 2.3310	[1]: 0.4137
$F_{TR}(TR/Y,D,K,L)$	2, 2, 2, 2, 2	7.082**	2000	1.4908	[1]: 0.2404	[2]: 2.2076
$F_K(K/Y,D,TR,L)$	2, 2, 2, 2, 2	5.624**	2002	0.5371	[4]: 1.8349	[1]: 0.0074
$F_L(L/Y,D,TR,K)$	2, 2, 2, 2, 1	12.320*	1991	0.9944	[1]: 2.5344	[1]: 0.0109
Significant level	Critical values (T= 31)					
	Lower bounds $I(0)$	Upper bounds $I(1)$				
1 per cent level	6.428	7.505				
5 per cent level	4.535	5.415				
10 per cent level	3.770	4.535				

Note: The asterisks * and ** denote the significant at 1, 5 and 10 per cent levels, respectively. The optimal lag length is determined by AIC. [ ] is the order of diagnostic tests. # Critical values are collected from Narayan (2005).

Before proceeding to the ARDL bounds testing, appropriate lag length of the variables should be selected by using AIC and SBC criterions. It is pointed out by Lütkepohl, (2006) that AIC lag length criteria provide efficient and consistent results to capture the dynamic relation between the variables. So, using AIC criteria, optimal lag length of the variables is reported in 2 column of Table-5 with the results of the cointegration test.

To take decision whether cointegration between the variables exists or not, we have to compare our calculated F-statistic following null hypothesis i.e. no cointegration with critical bounds such as LCB (lower critical bound) and UCB (upper critical bound). The results reveal that there are four cointegrating vectors. This represents the cointegration relationship between the variables at 1 and 5 percent significance level once defence spending, capital, labour and trade openness are treated as dependent variables in the presence of structural break stemming in the series[4]. The results reported in Table-3 show that the long run relationship between economic growth, defence spending, trade openness, capital and labour exists over the study period in the case of Portugal.

The existence of the long run relationship among the variables helps us to find out partial effects of military spending, trade openness, capital and labour on economic growth in case of Portugal. Empirical evidence reported in Table-6 indicates that the relationship between defence spending and economic growth is positive and significant at 5 per cent level of significance. It implies that a 1 per cent increase in defence spending will stimulate economic growth by 0.4948 per cent. These findings are consistent with line of literature such as Sezgin, (1997, 1999, 2000), Halicioglu, (2003, 2004) for Turkey, Narayan and Singh (2007) for the Fiji Islands, Wijeweera and Webb, (2009) for Sri Lanka, Atesoglu (2009) and Gupta et al. (2010) for US economy. Empirical analysis found that trade openness is positively and significantly linked with economic growth. A 0.3095 per cent economic growth is stimulated by 1 per cent increase in trade openness, all else same. Trade openness has a dominant role in raising economic growth in case of Portugal. The impact of capital on economic growth is positive and statistically significant at 5 per cent level of significance. All else the same, a 1 percent increase in economic growth is linked with a 0.1377 per cent increase in capital in Portuguese economy. This implies that capital is a stimulus for economic growth. The relationship between labour and economic growth

[4] Structural breaks are based on ZA unit root test.

is positive and it is significant at 1 per cent level. A 1 per cent increase in labour adds in economic growth by 0.1619 per cent, keeping other things constant.

Table-6: Long Run Analysis

Dependent Variable = $\ln Y_t$				
Variable	Coefficient	T-statistics	Coefficient	T-statistics
Constant	-4.0157***	-2.0415	36.5987***	1.8533
$\ln D_t$	0.4948**	2.4883	-16.2888**	-2.0473
$\ln D_t^2$	….	….	1.5589**	2.0776
$\ln TR_t$	0.3095*	5.8387	0.2472*	3.3995
$\ln K_t$	0.1377**	2.4737	0.1528*	3.1190
$\ln L_t$	0.1619*	2.8348	0.2802*	4.0084
R-Squared	0.9729		0.9752	
F-statistic	225.189*		229.642*	
Diagnostic Tests				
Test	F-statistic	Prob. Value	F-statistic	Prob. Value
$\chi^2 NORM$	0.3692	0.8301	0.4000	0.8201
$\chi^2 SERIAL$	1.8671	0.1352	1.7270	0.1676
$\chi^2 ARCH$	1.4341	0.2821	2.3809	0.1038
$\chi^2 WHITE$	1.5716	0.1960	1.7189	0.1123
$\chi^2 REMSAY$	0.5567	0.3899	0.1071	0.7463

Note: *, ** and *** denote the significant at 1%, 5% and 10% level respectively. $\chi^2 NORM$ is for normality test, $\chi^2 SERIAL$ for LM serial correlation test, $\chi^2 ARCH$ for autoregressive conditional heteroskedasticity, $\chi^2 WHITE$ for white heteroskedasticity and $\chi^2 REMSAY$ for Resay Reset test.

The monotonous impact of defense spending on economic growth is also investigated by including squared term of $\ln D_t$ i.e. $\ln D_t^2$. Our empirical evidence indicates U-shaped relationship between defense spending and economic growth. This implies that economic growth declines at initial stages of defense spending and after the threshold point economic growth is stimulated. The threshold point is 238 defense spending per capita

(Euro). Less than 238 defense spending per capita declines economic growth and economic growth is stimulated if defense spending is more than 238 defense spending per capita. These findings are in line of literature such as Pieroni (2009).

Table-7: Short Run Analysis

Dependent Variable = $\Delta \ln Y_t$			
Variable	Coefficient	T-statistics	Prob. value
Constant	0.0094*	3.9346	0.0007
$\Delta \ln D_t$	0.1966*	3.7296	0.0012
$\Delta \ln TR_t$	0.0901*	3.2127	0.0040
$\Delta \ln K_t$	0.1991*	6.9776	0.0000
$\Delta \ln L_t$	0.7694	1.0434	0.3081
ECM_{t-1}	-0.2311**	-2.7253	0.0124
R-Squared	0.9007		
F-statistic	39.929*		
D. W Test	1.6746		
Diagnostic Tests			
Test	F-statistic	Prob. value	
$\chi^2 NORM$	0.9235	0.6301	
$\chi^2 SERIAL$	0.6442	0.5355	
$\chi^2 ARCH$	0.2008	0.6578	
$\chi^2 WHITE$	1.2016	0.3552	
$\chi^2 REMSAY$	0.7705	0.3899	
Note: *, ** and *** denote the significant at 1%, 5% and 10% level respectively.			

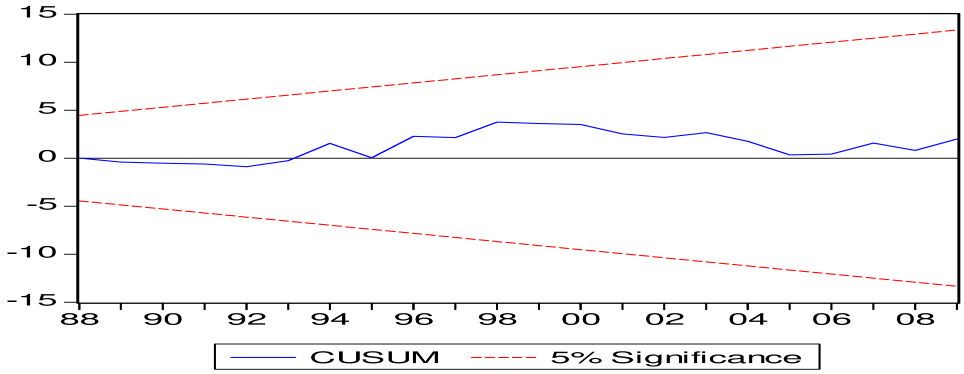
To examine the short run impact of independent variables including lagged error term, error correction model (ECM) is used. The results of the short run model are reported in Table-7. The coefficient of lagged error term i.e. ECM_{t-1} indicates the speed of adjustment from short run towards the long run equilibrium path with a negative sign. It is suggested by Bannerjee et al. (1998) that significance of the lagged error term further validates the established long run relationship between the variables. Our empirical exercise indicates that the coefficient of ECM_{t-1} is -0.2311 and significant at 1 per cent level of significance. It implies a 23.11 per cent of disequilibrium from the current year's shock seems to converge back to the long run equilibrium in the next year. The full convergence process will take more than 4 years to reach stable long run equilibrium path which is an indication of very fast and significant adjustment process for the Portuguese economy in any shock to the economic growth equation.

In the short run, the relationship between defence spending and economic growth is positive and it is significant. It is documented that a 1 percent increase in military spending will increase economic growth by 0.1996 per cent in short span of time. The relationship between trade openness and economic growth is positive and significant at 1 per cent significance level[5]. The results indicate that a 1 per cent rise in capital shows moderate effect on economic growth i.e. 0.1991 per cent. The impact of labour on economic growth is positive but it is insignificant.

For the short run model, diagnostic tests also indicate that there is no evidence of serial correlation and error term is normally distributed. The autoregressive conditional heteroskedasticity and white heteroskedasticity are not found. Finally, the short run model is well specified as confirmed by Ramsey RESET test. The stability of long run and short run estimates is checked by applying the cumulative sum (CUSUM) and the cumulative sum of squares ($CUSUM_{SQ}$) tests. The results of the CUSUM and $CUSUM_{SQ}$ reveal that both short run and long run estimates are stable and reliable.

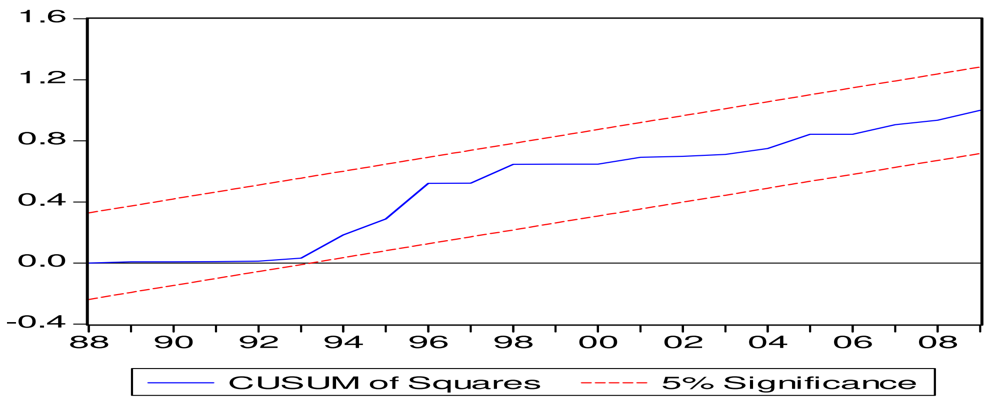
[5] The coefficient of long run for trade openness is higher than short run.

Figure-1: Plot of Cumulative Sum of Recursive Residuals



The straight lines represent critical bounds at 5% significance level

Figure-2: Plot of Cumulative Sum of Squares of Recursive Residuals



The straight lines represent critical bounds at 5% significance level

The VECM Granger Causality Analysis

The presence of cointegrating among the variables leads us to perform the Granger causality test to provide a clearer picture for policymakers to formulate defence and economic policies by understanding the direction of causality between defence spending and economic growth. It is reported that variables are cointegrated for long run relationship and this leads us to apply the VECM framework to detect direction of causality between the variables both for long-and-short runs. The results of the Granger causality test are reported in Table-8.

The causality relation can be divided into short-and-long runs causation as variables are cointegrated for long run relationship. The long run causality is indicated by the significance of coefficient of the one period lagged error-correction term ECT_{t-1} in equation (9) using t-test. The short run causality can be detected by the joint significance of LR test of the lagged explanatory variables in the equation. Our empirical results suggest that the ECT_{t-1} is having negative sign and it is statistically significant in all the VECM equations except in the growth VECM equation.

In the long run, economic growth Granger causes defence spending. Bidirectional causality is found between capital and military spending. There is a feedback hypothesis between labour and trade openness. Unidirectional causality is found running from the economic growth to capital, labour and trade openness. Trade openness and defence spending Granger cause each other. Feedback hypothesis also exist between capital and trade openness.

There is a bidirectional causal relationship exists between defence spending and economic growth in the short run. Capital and labor Granger cause economic growth while unidirectional causality is found running defence spending to capital. Feedback hypothesis are noted between capital and labour. Bidirectional causality exists between labour and trade openness and same conclusion is drawn for economic growth and trade openness.

Table-8: The VECM Granger Causality Analysis

Dependent Variable	Direction of Causality										
	Short Run					Long Run	Joint Long-and-Short Run Causality				
	$\Delta \ln Y_{t-1}$	$\Delta \ln D_{t-1}$	$\Delta \ln K_{t-1}$	$\Delta \ln L_{t-1}$	$\Delta \ln TR_{t-1}$	ECT_{t-1}	$\Delta \ln Y_{t-1}, ECT_{t-1}$	$\Delta \ln D_{t-1}, ECT_{t-1}$	$\Delta \ln K_{t-1}, ECT_{t-1}$	$\Delta \ln L_{t-1}, ECT_{t-1}$	$\Delta \ln TR_{t-1}, ECT_{t-1}$
$\Delta \ln Y_t$	….	3.7535** [0.0477]	30.9809* [0.0000]	1.9325** [0.1792]	10.8477* [0.0012]	….	….	….	….	….	….
$\Delta \ln D_t$	4.3973** [0.0289]	….	0.2453 [0.7852]	0.7615 [0.4822]	1.8664 [0.1850]	-0.3397** [-2.1128]	11.4715* [0.0002]	….	1.8359 [0.1789]	2.1554 [0.1213]	2.1839 [0.1278]
$\Delta \ln K_t$	0.6474 [0.5358]	4.8156** [0.0220]	….	7.9219* [0.0037]	5.2246** [0.0170]	-0.2525** [-2.4106]	2.1610 [0.1302]	5.6550* [0.0071]	….	5.5568* [0.078]	4.2435* [0.0207]
$\Delta \ln L_t$	1.7166 [0.2094]	0.7602 [0.4828]	3.7726** [0.0441]	….	4.2783** [0.0313]	-0.0564* [-13.8716]	100.2115* [0.0000]	64.6148* [0.000]	71.4235* [0.0000]	….	75.4239* [0.0000]
$\Delta \ln TR_t$	0.6165* [0.0075]	2.2906 [0.1316]	0.7227 [0.4998]	4.8634** [0.0214]	….	-0.1026* [-6.4400]	14.1329* [0.0001]	4.4703** [0.0173]	14.8899* [0.0001]	15.1083* [0.0000]	….

Note: *, ** and *** show significance at 1, 5 and 10 per cent levels respectively.

6. Conclusions and Policy Implications

The allocation of military spending for any economy like Portugal is one of the major policy issues which can direct the pace of economic growth. Therefore, the issue of military spending-growth nexus has been investigated using cross-section and time series data analysis across developed, developing and least developed economies by the researchers frequently. Various researchers applied supply-side to explore the nature of the relationship between defence spending and economic growth and produced mixed results. Using time series data set and the ARDL bounds testing approach to cointegration, relationship between military spending and economic growth in the case of Portugal has been investigated over the period of 1980-2009.

Our empirical exercise has confirmed cointegration between economic growth, military spending, trade openness, capital and labour. Moreover, results have indicated positive effects of military spending on economic growth for Portuguese economy. These findings are consistent with the existing literature such as Sezgin, (2001) for Turkey and Greece; Halicioglu, (2003, 2004) for Turkey; Yildirm et al. (2005) for OECD countries; Dunne and Nikolaidou (2005) for Portugal; Narayan and Singh (2007) for Fiji Island; Wijeweera and Webb, (2009) for Sri Lanka; Atesoglu (2009) and Gupta et al. (2010) for US; Wijewerra and Webb (2011) for South Asia and Tiwari and Shahbaz (2012) for India. These results are contradictory with Cappelen et al. (1984); Heo (1999); Atesoglu, (2002); Birdi and Dunne, (2002); Abu-Bader and Abu-Qarm (2003); Karagol and Palaz, (2004); Karagol (2006); Smith and Tuttle, (2008); Pieroni, (2009); d'Agostino et al. (2010) etc. Trade openness contributes to economic growth. Capital and labour are also important determinants of economic growth and add in economic growth significantly. The non-linear relationship between defence spending and economic growth is U-shaped in case of Portugal supporting view reported by Pieroni (2009).

The causality analysis unveils that unidirectional causality is found running economic growth to defence spending. The feedback effect exists between capital and military spending. Trade openness and labour Granger cause each other. Economic growth Granger causes capital, labour and trade openness. Trade openness Granger causes defence spending and vice versa. Bidirectional causality is also found between capital and trade openness.

This study has potential for inclusion of other variables to reexamine the relationship between defence spending and economic growth in the case of Portugal in the future. Although this is another area of research that goes beyond the scope of this paper, we hypothesize that the potential variables are savings, investment, corruption, inequality, education and health expenditures, external debt, political instability. In addition, undertaking institutional reforms and exploring investment opportunities can further boost economic growth in Portuguese. Quarterly or monthly data should be used to attain the more consistent results for comparing with the current data. This work raises some additional questions such as: 1) What are the underlying channels that dictate long-run causality between these variables for top military spending economics 2) What is the defence-GDP relationship in other advanced and emerging economies? These issues are, of course, intriguing, and thus left for future research. This would help the Portuguese government to formulate comprehensive defence and economic policy to sustain economic growth for the long run.

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