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Abstract: This study revisits the relationship between defence spending and economic growth using Keynesian model in Pakistan by applying ARDL bounds testing approach to cointegration for long run and error correction method for short span of time. Empirical evidence suggests a stable cointegration relationship between defence spending and economic growth. An increase in defence spending retards the pace of economic growth confirming the validation of Keynesian hypothesis in the country. Current economic growth is positively linked with economic growth in previous period while rise in non-military expenditures boosts economic growth. Interest rate is inversely associated with economic growth. Finally, unidirectional causality running from military spending to economic growth is found.

Keyword: Defence Spending, Economic Growth, Cointegration, Causality, Pakistan

JEL Codes: C12, O16

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I. Introduction

The study revisits the impact of defence spending on economic growth using augmented Keynesian model in long-and-short runs in case of Pakistan. Existing literature highlights two main channels through which defence spending affects economic growth. On the one hand, in Keynesian view, an increase in military spending increases the aggregate demand by stimulating output, employment and hence economic growth. Additionally, an increase in human capital due to military spending through education and technological guidance seems to have positive spill-over effects and increases the expenditures on research and development activities for civilians. On the other hand, neoclassical model argues that an increase in military spending means shift of resources away from private sector resulting in reduced private spending. This seems to crowd-out both public and private sector investments which declines economic growth (Sandler and Hartley, 1995). The public sector uses resources inefficiently while private firms are relatively more concerned about the cost of production. Gupta et al. (2004) have empirically validated that low military expenditures are associated with high economic growth through increased capital formation.

Studies focusing on high and low income countries have shown that higher military spending is associated with low investment, employment and hence with low rate of economic growth [Smith, (1977); Boretsky, (1975); Sivard, (1977); Atesoglu (2002), Ocal and Brauer (2007) and Smith and Tuttle (2008)]. In contrast, positive effect of defence spending on economic growth was also found by Benoit (1973); Halicioglu (2003, 2004); Wijeweera and Webb (2009) and Atesoglu, (2009) etc. Therefore, it can be concluded that empirical investigations regarding impact of defence expenditures on economic growth are mixed and is the main motivation for researcher to examine the effect of military spending on economic in context of country case study using time series data in case of Pakistan.

The current study is a valuable contribution to existing literature for four main reasons. Firstly, the study reinvestigates the impact of military spending on economic growth both for long run and short run using Keynesian model over the period of 1972-2009. Secondly, ARDL bounds testing approach is applied to examine cointegration among variables which is not used in the existing literature on military spending and economic growth in case of Pakistan. Thirdly, the study uses Ng-Perron (2001) unit root test which provides reliable and consistent results as compared to the other traditional unit root tests such as ADF, P-P and DF-GLS. Finally, VECM ganger causality is employed to detect the direction of causality between defence spending and economic growth.

The rest of study is organised as following: section-II contains the review of literature on relationship between defence spending and economic growth. Modelling framework and data is explained in section-III while section-IV explains the estimation strategy. The empirical evidence on relationship between defence spending and economic growth is discussed in section-V and conclusions and policy implications are drawn in final section.

II. Literature Review

The dawn of 1970s is marked with great attention of researchers to examine the impact of defence spending on economic growth. Benoit (1973, 1978) focused on this particular issue in his landmark studies and later on, many researchers investigated the relationship between defence spending and economic growth and provided mixed evidence[1].

Aligned with the Keynesian theory, some researches concluded that defence expenditures stimulate economic growth by raising aggregate demand. These positive externalities may enhance economic output and hence economic growth [see for example, Kennedy, (1974); Whynes, (1979); Fredericksen and Looney, (1982); Stewart, (1991); Ward et al. (1991); Dunne et al. (2001) and Yildirim et al. (2005)]. Based on above theoretical and empirical evidence, it may be argued that a rise in military expenditures may be effective to improve the infrastructure, stimulate aggregate demand and to enhance the production level. Military spending further trains labour force by military skills to increase employment and absorb advanced technology to be used in production process, resulting in an increase in aggregate output which stimulates economic growth (MacNair et al. 1995).

The relationship between defence spending and economic growth was initially investigated by Benoit, (1973, 1978) and positive impact of military expenditures on economic growth through positive spill-over effects was validated. Later on, Kennedy (1974); Deger, (1986); Kollias, (1995); Sezgin, (1997, 1999, 2000) also investigated the effect of defence spending on economic growth and provided a support for empirical findings by Benoit (1973, 1978). The relationship between military spending and economic growth in case of Turkey and Greece has been examined by Sezgin, (2001) using time series approach. Their results showed positive effect of defence spending on economic growth not only in the long run but also for the short span of time. In the case of Turkey, Özsoy (2000) found no relationship between defence spending and economic growth. But, Halicioglu, (2003, 2004) used simple model of Atesoglu (2002) to examine the effect of military spending on aggregate output. The findings showed positive impact of military expenditures on aggregate output for Turkish economy.

Yildirm et al. (2005) explored the relationship between military spending and economic growth for OECD countries using dynamic panel data approach and indicated that an increase in military spending stimulates aggregate output. In case of Fiji Island, Narayan and Singh (2007) investigated the association between military spending and economic growth by including exports as a new variable in production function to examine the impact of military spending on economic growth within multivariate framework. They reported positive effect of defence spending on economic growth through exports-enhancing affect[2]. Wijeweera and Webb, (2009) employed VAR analysis on four variables including real output, military spending, non-military expenditures and real interest rate for the Sri Lankan economy[3]. They also reported that military spending affects economic growth positively. Their results revealed that although a 1 percent increase in defence spending leads to 0.05 percent increase in economic growth. Whenever, economic growth is increased by 1.6 percent due to 1 percent increase in non-military spending. Atesoglu (2009) showed positive effect of military spending on aggregate output by using augmented Keynesian model and latter on, Gupta et al. (2010) confirmed the findings by Atesoglu (2009) using Factor Augmented Vector Autoregressive (FAVAR) model for US economy and concluded that shock of real military spending has positive impact on aggregate output.

Literature also provides empirical evidence about the negative impact of military spending on economic growth [Deger and Smith, (1983); Fredericksen and Looney, (1983); Faini et al. (1984) and, Birdi and Dunne, (2002)] both for cross-section and time series data sets. For instance, in poor African economies, Lim (1983) found negative effect of military spending on economic growth. Cappelen et al. (1984) examined the effect of military expenditures on economic growth including manufacturing output and investment spending in OECD countries. They found positive association between military expenditures and manufacturing sector output while investment expenditures are inversely linked with military spending while overall military expenditures seem to affect economic growth inversely with significance for three sub-groups. Similarly, Starr et al. (1984) pointed out an indirect channel affecting economic growth negatively by increasing military expenditures and concluded that inflation rises due to an increase in military expenditures and increased inflation retards economic growth.

Atesoglu, (2002) investigated the role of military spending on the performance of national economy for the case of United States following the models developed by Romer, (2000) and Taylor, (2000). The empirical evidence revealed that reduction in military expenditures will improve the performance of US economy. For South African economy, Birdi and Dunne, (2002) investigated the impact of military spending on economic growth using model developed by Feder-Ram. Their findings indicated an inverse association between military spending and economic performance for short span of time with significant feed back effect. Karagol and Palaz, (2004) re-examined the association between defence spending and economic growth for Turkish economy using Johansen multivariate approach and confirmed cointegration between the variables. They reported that an increase in military spending slows down the rate of economic growth[4]. For Peru's economy, Klein (2004) conducted a study to investigate the influence of rising defence expenditures on economic growth and found inverse impact of military expenditures on the pace of economic growth. In 2006, Karagol (2006) explored the link between economic growth, defence spending and external debt in Turkey and reported that a rise in military spending is having inverse effect on economic growth by reducing possibilities of investment.

In case of United States, Smith and Tuttle, (2008) probed the relationship between military spending and economic growth based on Atesoglu, (2002) model and found the absence of positive impact of military spending on economic growth. Results indicated that military spending is inversely associated with aggregate output. Similarly, Tang (2008) examined the impact of military spending on economic growth in the context of Malaysian economy. The evidence by bounds testing approach indicated the negative effect of military spending on economic growth. In European case[5], Mylonidis (2008) estimated regressions by using Barro's (1991) growth models between military spending and economic growth by including population growth and government expenditures on education as other determinants of growth. The empirical evidence revealed negative impact of military spending and population growth while positive effect of investment and education on economic growth.

Most recently, Pieroni, (2009) examined the relationship between military spending and economic growth using cross-country data set. He noted that a rise in defence spending is retarding economic growth. Furthermore, Pieroni argued that relationship between military spending and economic growth may be non-linear and provided different results as compared to traditional approaches. Finally, Abu-Qarn (2010) revisited the relation between military spending and economic growth for Israeli-Arab conflict and concluded that high defence spending impedes the pace of economic growth[6].

In case of Pakistan, Tahir (1995) scrutinized the direction of causal relationship between military spending and economic growth for Pakistan and India using VECM granger causality in bivariate system. The results showed that military spending and economic growth granger caused each other in both the countries and same inference was drawn by Khilji and Mahmood (1995). Moreover, Khilji and Mahmood (1995) found negative impact of defence spending on economic growth using three-equation model. Khan (2004) investigated the Military Keynesianism Hypothesis (MKH) and reported bidirectional causality between both the variables. Further, Khan concluded that Military Keynesianism Hypothesis does not hold true in case of Pakistan. The findings by Khan (2004) may be biased due to occurrence of structural break in time series data as East Pakistan got independence and Bangladesh came into being in 1971.

III. Modelling Framework and Data

The development of empirical model to examine the relationship between military spending and economic growth started by Feder (1983) dividing economy into export and non-export sectors and latter on, Feder (1983) model was also used by Ram (1986, 1995), Biswas and Ram (1986) to investigate the effect of military spending on economic growth for 58 less developed economies. Ward et al. (1991) and Yildrin et al. (2005) also used Feder (1983) model to examine the impact of military spending on aggregate output for OECD countries.

Following Romer (2000) and Taylor (2000), Atesoglu (2002) used his own derived macroeconomic model by replacing IS-LM and AD-AS models to examine the association between military spending and economic growth[7] as given below:

$$Y_t = C_t + I_t + X_t + GE_t + ME_t \ldots\ldots (1)$$

Where Y is real GDP or aggregate output, C is consumption in real terms, I is real investment, GE is real government expenditures on non-military sectors, X indicates real net exports of an economy or balance of trade. ME represents real military spending of an economy[8]. These variables are termed as exogenous variables and written as follows:

$C_t = \beta + \delta(Y_t - T_t)$ ……. (2)

$T_t = \alpha + \lambda Y_t$ ……. (3)

$I_t = \varphi - iR_t$ ……. (4)

$X_t = a - bY_t - fR_t)$ ……. (5)

Where real taxes and real interest rate are denoted by T_t and R_t respectively. The present study follows Halicioglu, (2004) approach and real interest rate is considered as an exogenous variable[9]. Following above discussion, the empirical equation is modelled as[10]:

$GDP_t = \lambda_1 + \lambda_2 ME_t + \lambda_3 GE_t + \lambda_4 IR_t + \varepsilon_t$ ……. (6)

$\lambda_1 = [(\beta - \delta\alpha + \varphi + a)/(1 - \beta(1 - \lambda) + b)]$, $\lambda_2 = \lambda_3 = 1/[1 - \beta(1 - \lambda) + b)]$,

$\lambda_4 = (-i - f)/[(1 - \beta(1 - \lambda) + b)]$ and $\lambda_2, \lambda_3 > 0$, $\lambda_4 < 0$.

Where GDP is real GDP proxy for economic growth, ME denotes real military expenditures, GE shows real government non-military expenditures while IR represents real interest rate. 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 Shahbaz, 2010).

The data on real GDP, real military and real government non-military expenditure has been obtained from GOP (2008-09) [11]. The statistical bulletin of SBP[12] (2008-09) is used to collect the data on real interest rate. The study covers the period from 1972 to 2009.

IV. Estimation Strategy

Ng-Perron test is applied for unit root problem while ARDL bounds testing approach is used to examine the cointegration between the running variables in the model.

Ng-Perron Test

Recently developed Ng-Perron (2001) unit root test has been utilized to investigate the order of integration of the variables (*Theoretical formation of Ng-Perron is based on Joseph and Sinha, 2007*). The Ng-Perron unit test has good size and explanatory power than Augmented Dickey-Fuller (ADF), Phillips and Perron (P-P). This test is particularly suitable for small sample data sets. Ng-Perron unit root test contains four unit root tests including Phillips-Perron (1988) Z_a *and* Z_t, Bhargava (1986) R_1 and ERS optimal point tests. These tests are based on GLS de-trend data Δy_t. First, let us define

$$k = \sum_{t-2}^{T} (y_{t-1}^{d})^2 / T^2$$

The four statistics are listed below.

$$MZ_{\alpha}^{d} = (T^{1} y_{T}^{d})^2 - f_0) / 2k$$
$$MZ_{t}^{d} = MZ_{\alpha} \times MSB$$
$$MSB^{d} = (k / f_0)^{1/2}$$

$$MP_{T}^{d} = (\bar{c}^2 k - \bar{c} T^{1})(y^{d} T)^2 / f_0 \; if \; x_t = \{1\}$$

and $MP_{T}^{d} = (\bar{c}^2 k + (1-\bar{c}) T^{1})(y^{d} T)^2 / f_0 \; if \; x_t = \{1,t\}$ where $\bar{c} = -7$ if $x_t = \{1\}$ and $\bar{c} = -13.5$ if $x_t = \{1,t\}$

ARDL Bounds Testing Approach for Cointegration

Moreover, we have employed the autoregressive distributed lag model or ARDL bounds testing approach to cointegration developed by Pesaran et al. (2001) as the most appropriate specification to carry out cointegration analysis among the economic growth, defence spending, government non-military expenditures and real interest rate. The bounds testing approach to cointegration has numerous advantages over traditional techniques of cointegration. The main merit lies in the fact that it can be applied irrespective of whether the variables are integrated of order *I(0)* or integrated of order *I(1)*. Fortunately, ARDL bounds approach to cointegration is free of any problem faced by traditional techniques in the economic literature. Another merit is that, it has better properties for small sample data set. Moreover, a dynamic error correction model (ECM) can be derived from the ARDL model through a simple linear transformation (Banerrjee and Newman, 1993). The error correction model integrates the short-run dynamics with the long-run equilibrium without losing information about long-run. The ARDL bounds testing approach to cointegration involves estimating the unrestricted error correction method (UECM) of the ARDL model as follows:

$$\Delta \ln GDP = \alpha_{\circ} + \alpha_T T + \alpha_{GDP} \ln GDP_{t-1} + \alpha_{ME} \ln ME_{t-1} + \alpha_{GE} \ln GE_{t-1} + \alpha_{IR} \ln IR_{t-1} + \sum_{i=1}^{p} \alpha_i \Delta \ln GDP_{t-i} + \sum_{j=0}^{q} \alpha_j \Delta \ln ME_{t-j} + \sum_{l=0}^{m} \alpha_k \Delta \ln GE_{t-l} + \sum_{n=0}^{n} \alpha_l \Delta \ln IR_{t-n} + \mu_i \quad \dots (7)$$

$$\Delta \ln ME = \beta_{\circ} + \beta_T T + \beta_{GDP} \ln GDP_{t-1} + \beta_{ME} \ln ME_{t-1} + \beta_{GE} \ln GE_{t-1} + \beta_{IR} \ln IR_{t-1} + \sum_{i=1}^{p} \beta_i \Delta \ln ME_{t-i} + \sum_{j=0}^{q} \beta_j \Delta \ln GDP_{t-j} + \sum_{l=0}^{m} \beta_k \Delta \ln GE_{t-l} + \sum_{n=0}^{n} \beta_l \Delta \ln IR_{t-n} + \mu_i \quad \dots (8)$$

$$\Delta \ln GE = \phi_{\circ} + \phi_T T + \phi_{GDP} \ln GDP_{t-1} + \phi_{ME} \ln ME_{t-1} + \phi_{GE} \ln GE_{t-1} + \phi_{IR} \ln IR_{t-1} + \sum_{i=1}^{p} \phi_i \Delta \ln GE_{t-i} + \sum_{j=0}^{q} \phi_j \Delta \ln ME_{t-j} + \sum_{l=0}^{m} \phi_k \Delta \ln GDP_{t-l} + \sum_{n=0}^{n} \phi_l \Delta \ln IR_{t-n} + \mu_i \quad \dots (9)$$

$$\Delta \ln IR = \varphi_{\circ} + \varphi_T T + \varphi_{GDP} \ln GDP_{t-1} + \varphi_{ME} \ln ME_{t-1} + \varphi_{GE} \ln GE_{t-1} + \varphi_{IR} \ln IR_{t-1} + \sum_{i=1}^{p} \varphi_i \Delta \ln IR_{t-i} + \sum_{j=0}^{q} \varphi_j \Delta \ln ME_{t-j} + \sum_{l=0}^{m} \varphi_k \Delta \ln GE_{t-l} + \sum_{n=0}^{n} \varphi_l \Delta \ln GDP_{t-n} + \mu_i \quad \dots (10)$$

Where $\alpha_{\circ}$, $\beta_{\circ}$, $\phi_{\circ}, \varphi_{\circ}$ and α_T, β_T, ϕ_T, φ_T are the drift components and time trends, and μ_i is assumed to be white noise error processes. The optimal lag structure of the first differenced regression is selected by Akaike Information Criteria (AIC) to ensure that serial correlation does not exist. Pesaran et al. (2001) tabulated two critical bounds (upper and lower critical bounds) to take the decision about the existence of long-run relationship among the running variables. The null hypotheses of no cointegration in equations 7-10 are $H_{\circ} : \alpha_{GDP} = \alpha_{ME} = \alpha_{GE} = \alpha_{IR} = 0$, $H_{\circ} : \beta_{GDP} = \beta_{ME} = \beta_{GE} = \beta_{IR} = 0$, $H_{\circ} : \phi_{GDP} = \phi_{ME} = \phi_{GE} = \phi_{IR} = 0$ and $H_{\circ} : \varphi_{GDP} = \varphi_{ME} = \varphi_{GE} = \varphi_{IR} = 0$ against alternate hypotheses of cointegration which is $H_1 : \alpha_{GDP} \neq \alpha_{ME} \neq \alpha_{GE} \neq \alpha_{IR} \neq 0$, $H_1 : \beta_{GDP} \neq \beta_{ME} \neq \beta_{GE} \neq \beta_{IR} \neq 0$, $H_1 : \phi_{GDP} \neq \phi_{ME} \neq \phi_{GE} \neq \phi_{IR} \neq 0$ and $H_1 : \varphi_{GDP} \neq \varphi_{ME} \neq \varphi_{GE} \neq \varphi_{IR} \neq 0$. Next step is to compare the calculated F-statistic with LCB (lower critical bound) and UCB (upper critical bound) tabulated by Pesaran et al. (2001). There is cointegration among the variables if calculated value of F-statistic is more than upper critical bound (UCB). If lower critical bound (LCB) is more than computed F-statistic then hypothesis of no cointegration may be accepted. Finally, if calculated F-statistic is between lower and upper critical bounds then decision about cointegration is inconclusive.

To establish the goodness of fit of the ARDL model, the diagnostic and the stability tests have also been conducted. The diagnostic test examines the serial correlation, functional form, normality of error term and heteroscedisticity associated with the model. The stability test is checked by applying the cumulative sum of recursive residuals (**CUSUM**) and the cumulative sum of squares of recursive residuals (**CUSUM$_{\mathbf{SQ}}$**).

Next step is to detect the direction of causal relationship between economic growth, military spending, government non-military expenditures and real interest by applying standard Granger causality test augmented with a lagged error-correction term. The Granger representation theorem suggests that there will be Granger causality in at least from one direction if there exists cointegration relationship among the variables provided that the variables are integrated of order one or I(1). Engle-Granger (1987) cautioned that if the Granger causality test is conducted at first difference through vector auto regression (VAR) method then it will be misleading in the presence of cointegration. Therefore, the inclusion of an additional variable to the VAR method such as the error correction term would help us to capture the long-run relationship. To this end, error correction term is involved in the augmented version of Granger causality test and it is formulated in a bi-variate *p*th order vector error-correction model (VECM) which is as follows:

$$\Delta \ln GDP = \alpha_{\circ 1} + \sum_{i=1}^{l} \alpha_{11} \Delta \ln GDP_{t-i} + \sum_{j=1}^{m} \alpha_{22} \Delta \ln ME_{t-j} + \sum_{k=1}^{n} \alpha_{33} \Delta \ln GE_{t-k} + \sum_{r=1}^{o} \alpha_{44} \Delta \ln IR_{t-r} + \eta_1 ECM_{t-1} + \mu_{1i} \quad \ldots (11)$$

$$\Delta \ln ME = \beta_{\circ 1} + \sum_{i=1}^{l} \beta_{11} \Delta \ln ME_{t-i} + \sum_{j=1}^{m} \beta_{22} \Delta \ln GDP_{t-j} + \sum_{k=1}^{n} \beta_{33} \Delta \ln GE_{t-k} + \sum_{r=1}^{o} \beta_{44} \Delta \ln IR_{t-r} + \eta_2 ECM_{t-1} + \mu_{2i} \quad \ldots (12)$$

$$\Delta \ln GE = \phi_{\circ 1} + \sum_{i=1}^{l} \phi_{11} \Delta \ln GE_{t-i} + \sum_{j=1}^{m} \phi_{22} \Delta \ln GDP_{t-j} + \sum_{k=1}^{n} \phi_{33} \Delta \ln ME_{t-k} + \sum_{r=1}^{o} \phi_{44} \Delta \ln IR_{t-r} + \eta_3 ECM_{t-1} + \mu_{3i} \quad \ldots (13)$$

$$\Delta \ln IR = \varphi_{\circ 1} + \sum_{i=1}^{l} \varphi_{11} \Delta \ln IR_{t-i} + \sum_{j=1}^{m} \varphi_{22} \Delta \ln GDP_{t-j} + \sum_{k=1}^{n} \varphi_{33} \Delta \ln ME_{t-k} + \sum_{r=1}^{o} \varphi_{44} \Delta \ln GEK_{t-r} + \eta_4 ECM_{t-1} + \mu_{4i} \quad \ldots (14)$$

Where Δ is the difference operator; ECM_{t-1} is the lagged error-correction term derived from the long-run cointegrating relationship; and $\mu_{1i}, \mu_{2i}, \mu_{3i}$ and μ_{4i} are serially independent random errors with mean zero and finite covariance matrix. The presence of a significant relationship in first differences of the variables provides evidence on the direction of the short-run causation while a significant *t*-statistic pertaining to the error correction term (*ECM*) proposes the presence of significant long-run causation. However, it should be kept in mind that the results of the statistical testing can only be interpreted in a predictive rather than in the deterministic sense. In other words, the causality has to be interpreted in the Granger sense.

V. Empirical Estimation

The main objective of paper is to re-investigate the impact of military expenditures on economic growth and direction of causality between military spending and economic growth in the case of Pakistan. A number of cointegration approaches such as Engle and Granger (1987), Johansen (1991, 1992) and Johansen and Juselius (1990), Stock and Watson (1993) and, Phillips and Moon (1999, 2001) are available to examine cointegration between the variables[13]. The prerequisite of these tests for cointegration is that all variables in the model must have same order of integration[14]. ARDL bounds testing approach to cointegration is more advanced and flexible as compared to other traditional cointegration approaches. The autoregressive ditributive lag model can be applicable whether variables are integrated at I(0) or I(1) or I(1) / I(0). İt shows that there is no need to find out the order of integration of variables to apply ARDL bounds testing. However, it is pointed out by Ouattara (2004) that there is a need to have informtaion about order of integration of the variables. The main assumption of ARDL model is that variables are inetgrated at I(1) or I(0) and no variable sholud be stationary beyond that integrating orders. İf any variable is integrated at I(2) then the whole computation of F-statistic for cointegartion becomes invalid. Therefore, in order to apply ARDL bounds testing approach to cointegration, it is necessary to have information about the order of integration of the variables.

Traditional unit root tests such as ADF (Dicky and Fuller, 1979), P-P (Philip and Perron, 1988) and DF-GLS (Elliot et al. 1996) are used to find out integrating order of the variables. But, conventional unit root tests seem to over-reject the null hypothesis when it is true and vice versa. To overcome this problem, we used Ng-Perron (2001) unit root test. This test is more powerful and reliable for small data set as compared to other traditional unit root tests and produces consistent results. The results of unit root test are reported in Table-1.

Table-1: Unit Root Estimation

Ng-Perron at Level with Intercept and Trend				
Variables	MZa	MZt	MSB	MPT
$\ln GDP_t$	-4.20307	-1.3811	0.3285	20.9802
$\ln ME_t$	-3.2154	-1.2052	0.3748	26.9661
$\ln GE_t$	-5.8527	-1.7090	0.2920	15.5669
$\ln IR_t$	-8.7644	-2.0398	0.2327	10.5843
Ng-Perron at 1st Difference with Intercept and Trend				
$\Delta \ln GDP_t$	-24.1666*	-3.4679	0.1435	3.8189
$\Delta \ln ME_t$	-30.8187 *	-3.8964	0.1264	3.1208
$\Delta \ln GE_t$	-17.1881***	-2.9202	0.1699	5.3696
$\Delta \ln IR_t$	-27.9289*	-3.7181	0.1331	3.3713

Note: *, ** and *** denote significance at the 1%, 5% and 10% levels respectively.

The empirical evidence shows that all the variables have unit root problem at level. At 1st difference, GDP, ME, GE and IR are found to be stationary. This shows that variables in the model are having unique order of integration. In such circumstances, we can apply ARDL bounds testing approach to cointegration to examine long run relationship between the variables of interest in the model. Before proceeding to two steps ARDL procedure, it is necessary to select appropriate lag length of variables and akaike information criteria (AIC) is used to select lag length. It is reported that computation of F-statistic seems to be sensitive with lag order of variables in the model (see Feridun and Shahbaz, 2010). The VAR results show that lag order 2 is appropriate[15]. The number of total regressions generated by following ARDL methodology is $(4+1)^2 = 25$ in estimated equation-7. Table-2 reveals the results of F-statistic for cointegration. The empirical evidence indicates two cointegration vectors when ME and GE are dependent variables i.e. $F_{ME_t}(ME_t / GDP_t, GE_t, IR_t)$ and $F_{GE_t}(GE_t / GDP_t, ME_t, IR_t)$. For both equations calculated F-statistics are 5.278 and 5.191 and greater than upper critical bound (5.039) at 10 percent level of significance.

Table-2: Cointegration Test: ARDL Bounds Test

Estimated Model	*F*-Statistics	Lag
$F_{GDP_t}(GDP_t / ME_t, GE_t, IR_t)$	3.165	2
$F_{ME_t}(ME_t / GDP_t, GE_t, IR_t)$	5.278***	2
$F_{GE_t}(GE_t / GDP_t, ME_t, IR_t)$	5.191***	2
$F_{IR_t}(IR_t / GDP_t, ME_t, GE_t)$	2.113	2

Estimated Model	R^2	Adjusted- R^2	F-Statistics	Durban Watson
$F_{GDP_t}(GDP_t / ME_t, GE_t, IR_t)$	0.79820	0.55317	3.257**	2.283
$F_{ME_t}(ME_t / GDP_t, GE_t, IR_t)$	0.71432	0.36742	2.059***	2.376
$F_{GE_t}(GE_t / GDP_t, ME_t, IR_t)$	0.80145	0.56035	3.324**	1.915
$F_{IR_t}(IR_t / GDP_t, ME_t, GE_t)$	0.65814	0.27070	1.698	2.149

Note: ** and *** denotes significance at the 5% and 10% level comparing with critical bounds generated by Turner (2006).

The existence of cointegrating vectors confirms the long run relationship between GDP, ME, GE and IR i.e. real GDP, real military spending, government non-military expenditures and interest rate over the period of 1972-2009. The existence of long run relationship among the variables helps us to find out partial effects of military spending, government non-military expenditures and real interest rate on economic growth in case of Pakistan. Empirical evidence reported in Table-3 indicates that current economic growth is positively affected by economic growth in previous period. It is concluded that a 1 percent increase in economic growth in current period will raise economic growth by 0.8895 percent in future. The relationship between defence spending and economic growth is negative and significant at 5 percent. It implies that a 1 percent increase in defence spending will decline economic growth by 0.4515 percent. At this point, we can compare our results with Khilji and Mahmood (1997) who reported inverse impact of military spending on economic growth.

Table-3: Long Run Elasticities

Dependent Variable = $\ln GDP_t$			
Variable	Coefficient	Std. Error	T-Statistic
Constant	0.7188	0.4765	1.5084
$\ln GDP_{t-1}$	0.8895	0.0270	32.9158*
$\ln ME_t$	-0.4515	0.1912	-2.3607**
$\ln GE_t$	0.1298	0.0220	5.8988*
$\ln IR_t$	-0.0418	0.0114	-3.3677*
R-Squared = 0.9888 Adjusted R-Squared = 0.9873 S.E. of Regression = 0.0311 Akaike info Criterion = -3.9688 Schwarz Criterion = -3.7466 Log Likelihood = 74.4542 F-Statistic = 662.8248 Prob(F-statistic) = 0.0000 Durbin-Watson = 1.4876			
Diagnostic Tests	**Statistics**		
J-B Normality test	2.0692		
Breusch-Godfrey LM test	[1] 1.8188, [2] 2.0671		
ARCH LM test	[1] 0.1932, [2] 0.3322		
White Heteroscedisticity	0.9561		
Ramsey RESET	2.9494***		
CUSUM	Stable**		
CUSUMsq	Stable**		

Note: * and ** denote significance at the 1% and 5% levels respectively.

The coefficient estimates are much different due to different time spans used in the studies. However, our empirical evidence is consistent with the findings by Atesoglu (2002) for USA, Karagol and Palaz, (2004) for Turkey, Smith and Tuttle, (2008) for USA and Keller et al. (2009) for OECD countries who found inverse relationship between defence spending and economic growth. The impact of government non-military spending on economic growth is positive and it is statistically significant at 1 percent level of significance. It is found that a 5 percent increase in non-military expenditures by government raises economic growth by 0.649 percent. The findings are consistent with existing defence economics literature including Atesoglu (2002) for United States, Halicioglu, (2004) for Turkish economy, Yildirm et al. (2005) for Middle Eastern countries, Tang (2008) for Malaysia and, Wijeweera and Webb, (2009) for Sri Lanka. Finally, real interest rate is inversely correlated with economic growth. It is documented that a 1 percent increase in real interest rate is linked with 0.0418 percent decline in economic growth. These findings are consistent with the empirical results of Atesoglu (2002), Halicioglu, (2004) and, Wijeweera and Webb, (2009).

The lower portion of Table-3 reflects that long run model passes all diagnostic tests against serial correlation, autoregressive conditional heteroscedisticity, non-normality of residual term, white heteroscedisticity and misspecification of model. The long run estimates are stable because diagrams of CUSUM and $CUSUM_{SQ}$ are lying between critical bounds. To examine the short run impact of independent variables including lagged error term ECM version of OLS is used. The results of short run model are reported in Table-4. The coefficient of lagged error term or ECM_{t-1} indicates the speed of adjustment from short span of time towards long run equilibrium path is significantly negative. It is suggested by Bannerjee et al. (1998) that significance of lagged error term further validates the established long run relationship among the variables. Our empirical exercise indicates that coefficient of ECM_{t-1} is -0.6057 and significant at 5 percent. It implies a 60.57 percent of disequilibrium from the current year's shock seems to converge back to the long run equilibrium in the next year.

Table-4: Short Run Elasticities

Dependent Variable = $\Delta \ln GDP_t$			
Variable	Coefficient	Std. Error	T-Statistic
Constant	-0.0010	0.0058	-0.1815
$\Delta \ln GDP_{t-1}$	0.7954	0.1454	5.4671*
$\Delta \ln ME_t$	-0.2147	0.7151	-0.3002
$\Delta \ln GE_t$	0.0550	0.0256	2.1512**
$\Delta \ln IR_t$	-0.0406	0.0146	-2.7739*
ECM_{t-1}	-0.6057	0.2333	-2.5959**
R-Squared = 0.5358 Adjusted R-Squared = 0.4529 S.E. of Regression = 0.0275 Akaike info Criterion = -4.1840 Schwarz Criterion = -3.9146 Log Likelihood = 77.1285 F-Statistic = 6.4639 Prob(F-statistic) = 0.0004 Durbin-Watson = 2.1083			
Diagnostic Tests		**Statistics**	
J-B Normality test		0.9678	
Breusch-Godfrey LM test		[1] 0.8106, [2] 1.7890	
ARCH LM test		[1] 0.9308, [2] 0.4728	
White Heteroscedisticity		1.1003	
Ramsey RESET		1.6688	
CUSUM		Stable**	
CUSUMsq		Stable**	

Note: * and ** denote significance at the 1% and 5% levels respectively.

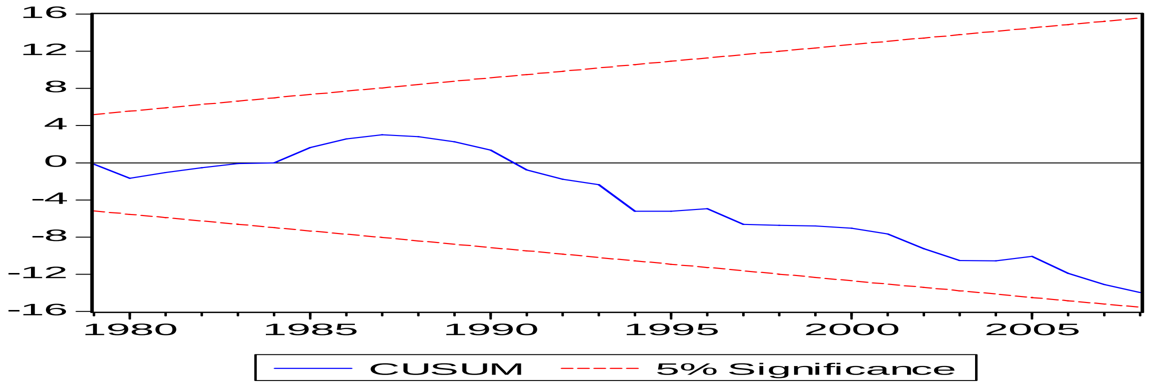
In the short run, economic growth is affected positively by 0.7954 percent in future by 1 percent rise in economic growth in current period. The relationship between defence spending and economic growth is negative but it is insignificant. It is documented that a 1 percent increase in military spending will lower economic growth by 0.2147 percent in short span of time but it is statistically insignificant. There is positive association between government non-military expenditures and economic growth. The results indicate that a 1 percent rise in government non-military spending shows very minimal effect on economic growth i.e. 0.0550 percent. Finally, link between real interest rate and economic growth is negative and significant at 1 percent significance level. The coefficients of long run and short run for real interest rate are more or less the same.

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 heteroscedisticity and white heteroscedisticity are not found. Finally, 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 CUSUM and $CUSUM_{SQ}$ reveal that both short run and long run estimates are stable and reliable.

Long run model

Figure 1

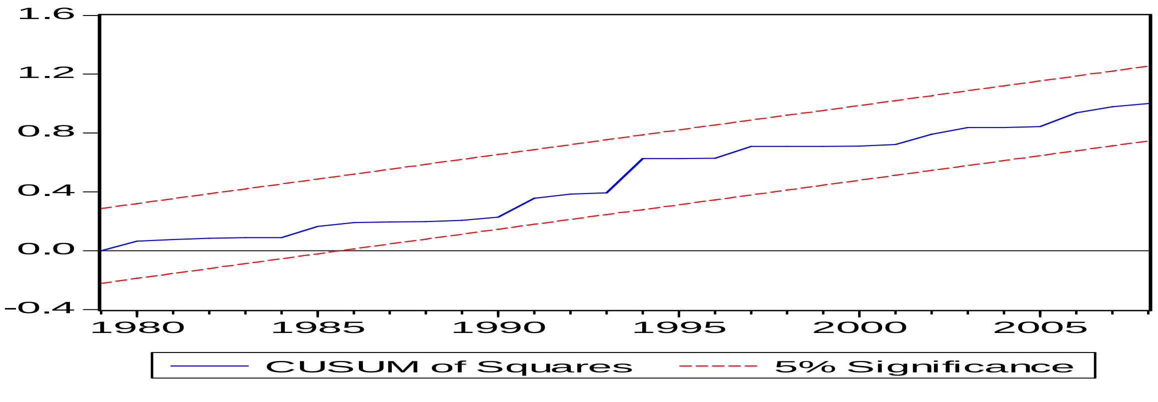
Plot of Cumulative Sum of Recursive Residuals



The straight lines represent critical bounds at 5% significance level.

Figure 2

Plot of Cumulative Sum of Squares of Recursive Residuals

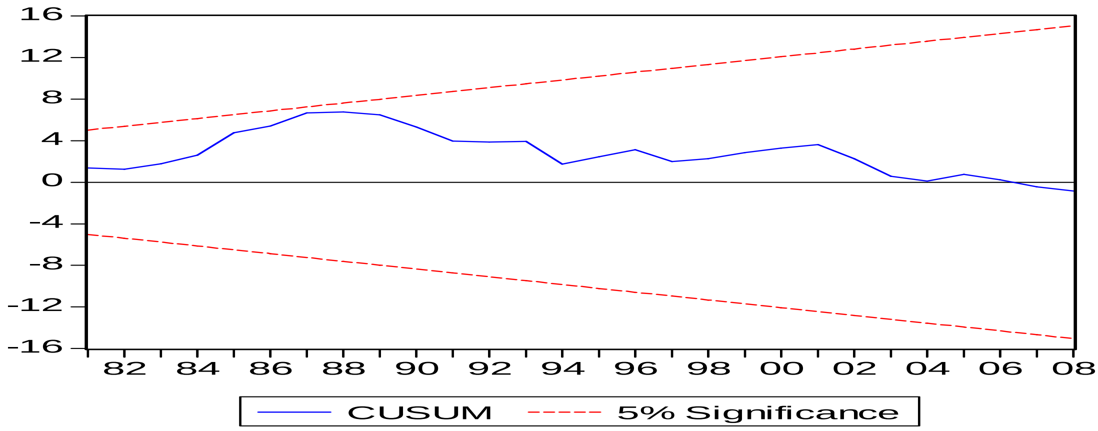


The straight lines represent critical bounds at 5% significance level.

Short run model

Figure 3

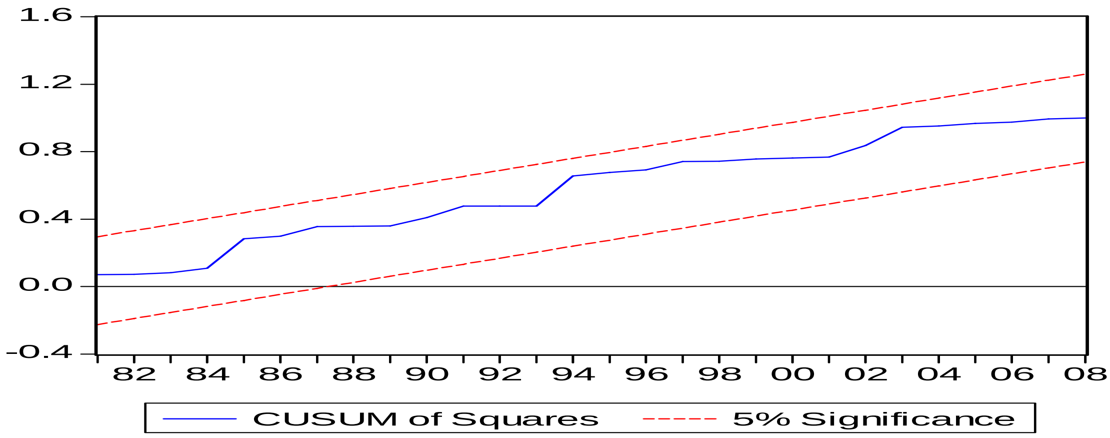
Plot of Cumulative Sum of Recursive Residuals



The straight lines represent critical bounds at 5% significance level.

Figure 4

Plot of Cumulative Sum of Squares of Recursive Residuals



The straight lines represent critical bounds at 5% significance level.

The VECM and Direction of Causality between Defence Spending and Economic Growth

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 VECM framework to detect direction of causality between the variables both for short- and short-runs. The results of Granger causality test are reported in Table-5.

Table-5: The Results of Granger Causality

Dependent variable	Type of Granger causality								
	Short-run				Long-run	Joint (short- and long-run)			
	$\Delta \ln GDP_t$	$\Delta \ln ME_t$	$\Delta \ln GE_t$	$\Delta \ln IR_t$	ECT_{t-1}	$\Delta \ln GDP_t, ECT_{t-1}$	$\Delta \ln ME_t, ECT_{t-1}$	$\Delta \ln GE_t, ECT_{t-1}$	$\Delta \ln IR_t, ECT_{t-1}$
	F-statistics [p-values]				[t-statistics]	F-statistics [p-values]			
$\Delta \ln GDP_t$	–	2.7751*** [0.0816]	0.5497 [0.5839]	3.5256** [0.0448]	–0.04757** [-2.0951]	–	5.0604*** [0.0071]	2.2172 [0.1110]	3.2058*** [0.0403]
$\Delta \ln ME_t$	1.7899 [0.1877]	–	0.8173 0.4530]	0.5634 [0.5763]	-0.0543 [-1.0155]	2.1834 [0.1151]	–	1.1099 [0.3637]	0.8882 [0.4607]
$\Delta \ln GE_t$	0.0767 [0.9263]	3.0751*** [0.640]	–	5.3668** [0.0115]	-0.3752* [-2.7935]	2.7262*** [0.0654]	7.6500* [0.0000]	–	6.2417* [0.0026]
$\Delta \ln IR_t$	3.2052** [0.0577]	0.7267 [0.4934]	0.0540 [0.9447]	–	-0.4838*** [-1.8536]	4.6518** [0.0102]	3.3255** [0.0358]	4.5179** [0.0107]	–

Note: The asterisks ***, ** and * denote the significant at the 1, 5 and 10 per cent levels, respectively.

The causality relation can be divided into short- and long-run causation as variables are cointegrated. The long run causality is indicated by the significance of coefficient of the one period lagged error-correction term ECT_{t-1} in equations (11) to (14) 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 statistically significance in all VECM equations except in equation-12. The results show unidirectional causal relationship running from military spending to economic growth in short run as well in long run over the period of 1972-2009. It is concluded on the basis of our empirical exercise that rise in defence expenditures will inversely granger cause economic growth. These findings are contradictory to those of Tahir (1995), Khilji and Mahmood (1997) and, Khan (2004) for Pakistan who reported bidirectional causality between the variables which may be biased and inconsistent due to different data span used in the studies. However, our empirical evidence is consistent with the existing defence economic literature such as Abu-Bader and Abu-Qarm (2003) for Egypt, Israel and Syria; Karagol and Palaz, (2004) and Özsoy (2008) for Turkey; Tang (2008) for Malaysia and Smith and Tuttle, (2008) for United States.

Bidirectional causal relationship is found between economic growth and government non-military spending in long run. Our findings corroborate with the view by Abu-Bader and Abu-Qarm (2003) who reported that a rise in government non-military spending will stimulate the pace of economic growth and in turn, government allocates more resources to productive and efficient ventures to sustain the rate of economic growth. There is also bidirectional causal relation between economic growth and interest rate. It can be inferred on the basis of our findings that a rise in interest rate will granger cause economic growth inversely through investment-declining effect while economic growth inversely granger causes interest rate through real money balances enhancing-effect. The unidirectional causality is reported to be running from interest rate and defence spending to government non-military expenditures in short- and long-runs. This shows that an increase in interest rate will increase the rate of inflation that makes government non-military spending less efficient and expensive. The causality running from defence spending to government non-defence spending lends the support for popular perception that a rise in defence expenditures is generally accompanied with the decline in development expenditures. Finally, there is unidirectional causality is found running from defence spending and government non-military expenditures to interest rate in long run. Overall, our results report that military spending granger causes economic growth which indicates that high military spending is retarding economic growth both for short- and long-runs.

VI. Conclusions and Policy Implications

The allocation of military and non-military expenditures for developing economies 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 approaches including classical, neoclassical and Keynesian were used to explore the nature of relationship between defence spending and economic growth and produced mixed results. Using time series data set and ARDL bounds testing approach to cointegration, relationship between military spending and economic growth in the case of Pakistan has been re-investigated over the period of 1972-2009.

The empirical exercise has confirmed cointegration between economic growth, military spending, government spending and interest rate. Moreover, results have indicated negative effect of military spending on economic growth for Pakistan's economy. These findings are consistent with the existing literature such as Khilji and Mahmood, (1997); Atesoglu, (2002); Karagol and Palaz, (2004); Smith and Tuttle, (2008); Tang, (2008) and Keller et al. (2009). The estimated coefficient of government non-military spending is showing positive impact on economic growth supporting the views of Halicioglu, (2004); Yildirm et al. (2005) and Wijeweera and Webb, (2009). The inverse relationship is also witnessed between real interest rate and economic growth and is consistent with findings of Halicioglu, (2004). Finally, unidirectional causal relationship running from military spending to economic growth has been found.

In the background of our empirical investigation, it can be highlighted that both Pakistan and India are strategically important nuclear states, and their cordial mutual relationship is important for the South East Asian region as well as the global economy and peace. Therefore, it is highly appropriated if both the governments initiate bilateral talks to develop mutual confidence and harmony to fight against terrorism and poverty. The population size and population growth rate of both the countries do not permit them to invest such a huge chunk of their annual budgets on their military spending. It is strategically important for them to start dialogue to reach at a consensus for peace and prosperity by reducing their military size and expenditures. This may result in reducing the arms race between Pakistan and India which will shift resources to developmental projects and stimulate the pace of economic growth.

In the context of policy implications for Pakistan, defence expenditures are escalating due to the mutiny and unrest as a consequence of terrorism, violence and carnage. Terrorism is instigated and noticed in tribal areas like FATA and others areas in Pakistan where per capita income appears to be very low. It can be highlighted that the terrorism in these areas may be due to low expenditure on the basic needs of health, education and infrastructure. Therefore, the Government of Pakistan should initiate development projects in the areas with low per capita income, scarcity of resources, penury, and abject poverty by reducing military spending. Employment generating activities should be supported and emphasis should be placed on schooling, edification and civilization. Currently, industries are established in Sind, especially in Karachi, and Punjab such as Gujranwala, Sailkot, Faisalabad and Wazirabad. Government of Pakistan should pay special attention to establish industries in less developed areas like FATA and other tribal areas to increase employment opportunities for the people of that area which will help to enhance their living standards. It will be possible by cutting down the defence spending and shift these resources to production ventures to sustain economic growth, reduce poverty and decline income inequality in the country.

We used Keynesian approach to examine the impact of military spending on economic growth using time series for Pakistan and this approach has its own limitations indicated by Dunne et al. (2005). The study can be extended for future research by including net exports, capital, labour (Dunne et al. 2005) and, natural resources and technology (Dunne and Uye, 2009) for more efficient and consistent results following endogenous growth model. Agostino et al. (2010) pointed out that modified endogenous growth model may provide more help in investigating the effect of military spending on economic growth by including the above mentioned variables.

Footnotes

1. For example see Choudhury, (1991); DaKurah et al. (2001); Atesoglu, (2002); Abu-Bader and Abu-Qarm, (2003); Cuaresma and Reitschuler, (2003); Halicioglu, (2004); Yildirim et al. (2005); Bas, (2005); and Kollias et al. (2007).
2. Military spending increases exports and exports lead the rate of ecnomic growth.
3. Lee and Chen (2007) also concluded that defence spending stimulate economic growth in OECD and Non-OECD countries.
4. Keller et al. (2009) pointed out very good issue on military draft and economic growth for OECD countries. They concluded that military draft is associated with high recruitment of their army personals. The large size of military draft means high resources are required to meet their demands. This indicates the distortions of both human and physical capital in an economy. This big draft of military will lower aggregate demand and hence lower the output level. This channel indicates negative impact of military draft on economic performance in OECD countries.
5. Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, the Netherlands, Portugal, Spain, Sweden and the UK.
6. Inverse impact of defence spending on economic growth is for Jordan, Syria and Arab while positive effect is found for Egypt.
7. Atesoglu (2002) extended new macroeconomic model by including military expenditures.
8. Formation of empirical model is totally based on Halicioglu, (2004).
9. For more details see (Atesoglu, 2002 and Halicioglu, 2004)
10. Atesoglu, (2002) has used many other additional equations to explain impact of military expenditures on aggregate output for the case of United States with the help of new macroeconomic model but ignored the effect of real interest on aggregate output (Halicioglu, 2004).

11. Government of Pakistan
12. State Bank of Pakistan
13. Engle–Granger's approach seems to produce less satisfactory when one cointegrating vector is present in multivariate case (Seddighi et al. 2000).
14. There are several factors that cause structural changes such as change in economic policies, financial or economic crisis, and institutional change in their structure.
15. The VAR lag length selection results are not reported but available upon request from authors.

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