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Cointegration Analysis of the Economic Growth, Military Expenditure, and External Debt: Evidence from Pakistan

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Abstract
This paper attempts to examine the relationship between real military spending (RME), level of economic activity (RGNP), and real external debt (RED) by using a Johansen multivariate cointegration framework. The analysis is carried out using time series data over 1980-2008 The study investigates the long-run effects and short-run dynamics of the effect of rise in RGNP and RME on RED Pakistan. The quantitative evidence shows that external debt is more elastic with respect to military expenditure in the long run, whereas, there has been insignificant effect in the short-run. In the long-run, 1.00% increase in military expenditure leads to an increase in external debt by almost 3.96%. On the other hand, 1.00% increases in economic growth decreases external debt by 2.13%. In the short run, 1.00% increase in economic growth reduces external debt by 2.90%. The results presented in this study reinforce the importance to government, academic, and policy makers.
Keywords: military expenditure, external debt, national income, cointegration, impulse response function, Pakistan.

Introduction

The relationship between military expenditure-economic growth and external debt- economic growth has been the focus of many studies. Mostly the impact of military expenditure and external debt on economic growth is debated. However, the impact of economic growth and military expenditure on external debt has received less attention in the literature.

Military expenditure can be expected to have a positive effect on external debt through three channels. First, military expenditure is a budget item that needs to be financed. If taxation is not sufficient to finance military expenditure, a budget deficit will ensue. If the means to finance deficits domestically is limited, budget deficits may create a need for foreign borrowing and thus debt accumulation. Second, a component of military expenditure may be allocated to arms imports, which will require foreign exchange. If the country lacks foreign exchange, it will need to borrow externally, contributing to external debt (see Dunne et al, 2004,). Third, indigenous arms production may generate demand for foreign exchange in the form of high-tech imported intermediate inputs and machinery (Gunluk-Senesen, 2004).

In countries with large military expenditure, the role of military spending in contributing to external debt is important because of the potential adverse economic effects of external debt. While foreign borrowing need not harm economic growth, excessive foreign debt accumulation can cause deterioration in the terms of trade, an overvaluation of the domestic currency and slower economic growth. Since the seminal contribution by Benoit (1973, 1978) several studies have examined the effect of military expenditure on economic growth including Deger and Sen, (1995), Ram (1995), Dunne (1996) and Dunne et al (2005). The empirical evidence of the military expenditure-economic growth nexus varies across countries and time and is sensitive to the theoretical framework. Conceptually military expenditure could have a positive or negative effect on economic growth. On the one hand, military expenditure could have a positive effect on economic growth through Keynesian-type aggregate demand stimulation and the creation of positive externalities from human capital and infrastructure. Studies which have found that military expenditure has a positive effect on economic growth include Mueller & Atesoglu (1993), MacNair *et al.* (1995), Chlestos & Kollias (1995), Dunne et al (2001) and Yildirim & Sezgin (2002). Equally military spending may have a negative effect on economic growth through reducing the availability of public funds for spending in the supposedly more productive civilian sector and creating inflationary pressures. Deger (1986) found negative relationship between military expenditure and growth in the less developed countries

(LDCs), citing that defense expenditure takes resources away from productive investments and fails to mobilize and create additional savings. Studies which have found that military expenditure retards economic growth include Antonakis (1997), Heo (1998), Dunne & Mohammed (1995), Linden (1992) and Dunne et al (2002). Yildirim et al (2006) examined the issue of arms race between India and Pakistan and its relation to each country's economic growth. They found that there is a unidirectional causal relationship between military expenditure of India and Pakistan. Abu-Bader and Abu-Qarn (2003) found negative effect between military burden and economic growth in Egypt, Israel and Syria. They also found that civilian expenditure caused positive economic growth in Israel and Syria. In a study carried out by Dunne et al (2003) no evidence was found that military burden had any impact on the evolution of debt in Argentina and Brazil, but some evidence that military burden tended to increase debt in Chile.

Hartley and Sandler (1990) and Hatler (1991) opines that in specialist defense firms, the government dominates and determines the firm's culture and that culture tends to be one of dependence on the government rather than an enterprise culture responsive to changing market demands. It is not unknown for defense contractors in non-competitive markets to be criticized for high costs, cost escalation, delays, unsatisfactory equipment performance, waste and excessive profits. In addition, Sandler and Hartley (1995) provide an extensive survey of the field of defense economics and the study of defense and peace issues with the application of economic analysis and methods. These works point out that Military Expenditure are associated with a variety of factors: a) The level of GNP, b) The level of relative defense price (if available), c) the aggregate military expenditure of other allies (if any) and finally d) the threat perception (i.e military spending of the enemy). Other factors are associated with public opinion, international events and inter-service rivalries. Kennedy (1989) in his book "the rise and fall of the great powers: economic change and military conflict from 1500-2000) describes how the past 500 years shows that nations which became great powers had to decline as their growth rate slowed and their spending on defense continued to increase and explains how this can be eased or worsened by clever or short-sighted policy decisions. Winter (1975) in his book "war and economic development" describes about wars, or collective violence which came in many forms and sizes. The widespread devastation and global reach of the second world war to the limited and confined actions of many insurgency campaigns. However, local the consequences of wars, they invariably have a major effect on the lives of those individuals and institutions they touch.

McNeil (1982) in his book “the pursuit of power: technology, armed force, and society since A.D. 1000” argued that commercial transformation of world society in the eleventh century caused military activity to respond increasingly to market forces as well as to the commands of rulers. McNeill emphasizes the power of market forces and the incredibly stimulating effect the early markets of Western Europe had on technological development. By the time he wrote "Pursuit of Power," McNeill had come to see the return of command innovation where technological change is driven by the direction and investment of sprawling state bureaucracies, much as the feudal lords of Medieval Europe controlled military technology. Barber and Harrison (2000) in his book “The Soviet Defense-Industry Complex from Stalin to Khrushchev” argue that the notion of a military-industrial complex does not adequately describe the conditions of Soviet society, because the relations among defense enterprises, the military, and the government were fundamentally different from the corresponding relations in capitalist countries. Civilian enterprises often took pains to avoid having to accept military production and the problems it often entailed. Hence, although the military and security organs play an important role in this study, the authors' focus is on the defense-industry complex - the enterprises and design bureaus that produced military goods.

In this paper an analysis has been carried out to find a statistical relationship between military expenditure, economic growth and external debt in Pakistan using secondary data from 1980 to 2009. This paper does not include all dimensions and factors of the military expenditure-growth problems but limited to the following variables:

● Military Expenditures: According to UN report (1977), military capability as the ability to apply organized military force against an external military threat or an external armed enemy. However, the scope and content of military expenditures varies significantly according to the objective sought.

● Economic Growth: There are two opposing views regarding the trade-off between military spending and economic growth. The first one believes in the positive trade-off between military spending and economic growth. Higher aggregate demand generated by military expenditure leads to the creation of employment opportunities and the construction of infrastructure (Benoit, 1973; Brumm, 1997; Melman, 1988). The second view i.e. defense expenditure diverts resources away from productive activities and leave adverse impact on economic growth (Lim, 1983; Klein, 2004).

● External Debt: According to Brzoska (1983) and Looney and Frederiksen (1986) suggest that borrowing to finance military expenditure will have a negative effect on a country's growth rate if it faces constraints on international borrowing. Consistent with the 'guns butter trade-off', the rationale is that arms purchased with scarce foreign exchange reduces resources available for importing intermediate and investment goods that promote sustainable long-run economic growth (Looney, 1989; Dunne, Perlo-Freeman & Soydan, 2004).

In the light of above discussion, the more specific objectives are:

i. To estimate whether there is a long-run relationship between real military expenditure, real income, and real external debt in Pakistan.

ii. To estimate the long-run and short-run effects of real military spending and real income on real external debt in Pakistan.

A Johansen's methodology is used to (a) test for cointegration, (b) estimate the long-run parameters, and (c) examine the short-run dynamics. Impulse Response Function (IRF) and Variance Decomposition techniques are used for forecasting. The study used a sophisticated econometric technique with additional tests of forecasting framework to examine the effect of military expenditure on external debt over a 10 year period.

This paper is organized in five sections. Section 2 shows a brief overview of economic growth, military expenditure, and external debt in Pakistan. Section 3 provides data source and methodological framework. The empirical results are presented in Section 4, while the final section concludes the study.

Overview of economic growth, military expenditure and external debt in Pakistan

Economic Growth: Pakistan's economy has gone through a various stages of decline and high economic growth over the first six decades (1960 - 2010) which provides an interesting case study. A view of economic growth during the first six decades as mentioned in the following Table 1.

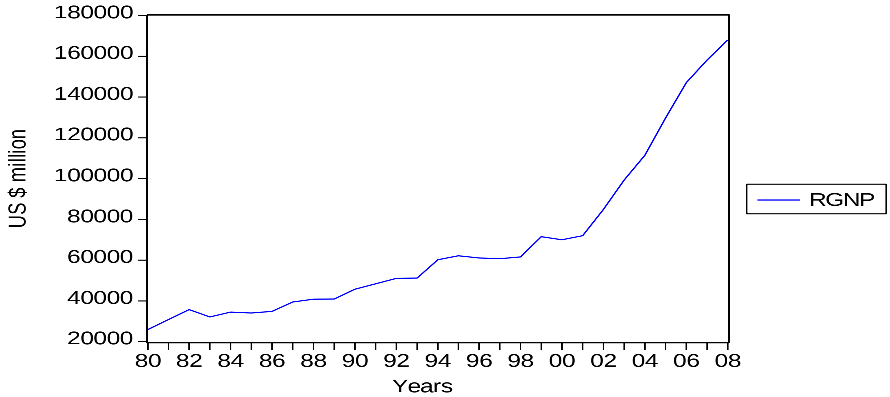
Table 1: Economic Growth during First Five Decades

Decades/Year	Economic Growth (%)
1960s	6.8
1970s	4.8
1980s	6.5
1990s	4.6
2000s*	4.8

Source: Khan (2002), Chaudhri (2003) and Bhatti (2001)
* Economic Survey of Pakistan (2009-10).

Despite the various efforts, Pakistan failed to achieve a sustainable growth. "The unsustainable economic growth has been blamed mainly on the high inflation rate, a mounting fiscal deficit, increasing foreign debt and debt servicing, weak foreign demand for Pakistani products, low level of physical and human capital, unfavorable weather, political instability, and, among other factors, a deteriorating law and order situation in the country"(Iqbal and Zahid, 1998). The following figure 1 shows a clear picture of real GNP from 1980-2008.

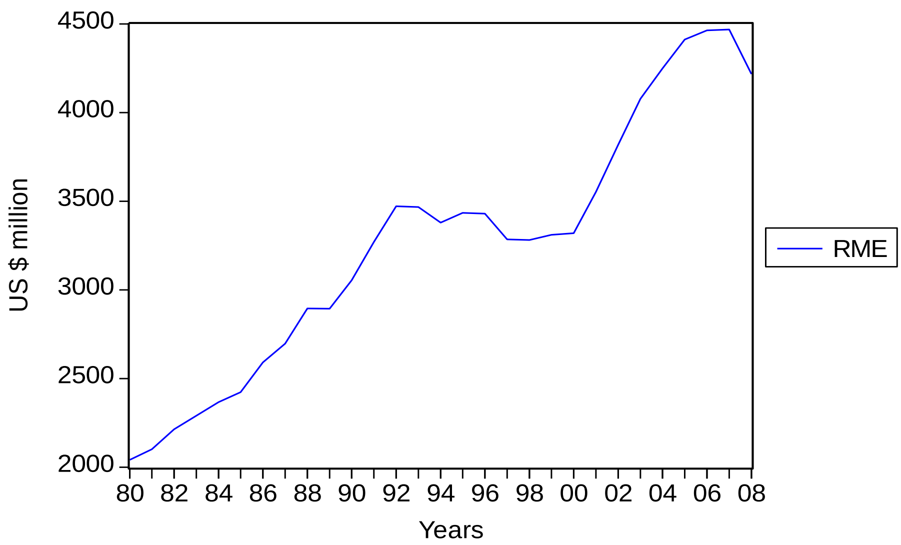
Figure 1: Trend analysis of real GNP (1980-2008)



Source: Economic Survey of Pakistan (2009-2010)

Military Expenditure: The share of current expenditure out of total expenditures has declined from 88% in 1999-2000 to 81.4% in 2007-08, mainly because of an enormous fall in interest related expenditure. In absolute terms, current expenditure stood at Rs. 1858 billion in 2007-08 and is budgeted at Rs. 2066 billion for 2008-09. Defense, the second largest component of the current expenditure, remained stagnant at around 3.89 % of GNP during the last six years (2003-2008). Real military expenditures for period of 1980-2008 gives a clear picture as shown in Figure 2 below:

Figure 2: Trend analysis of real military expenditure (RME)

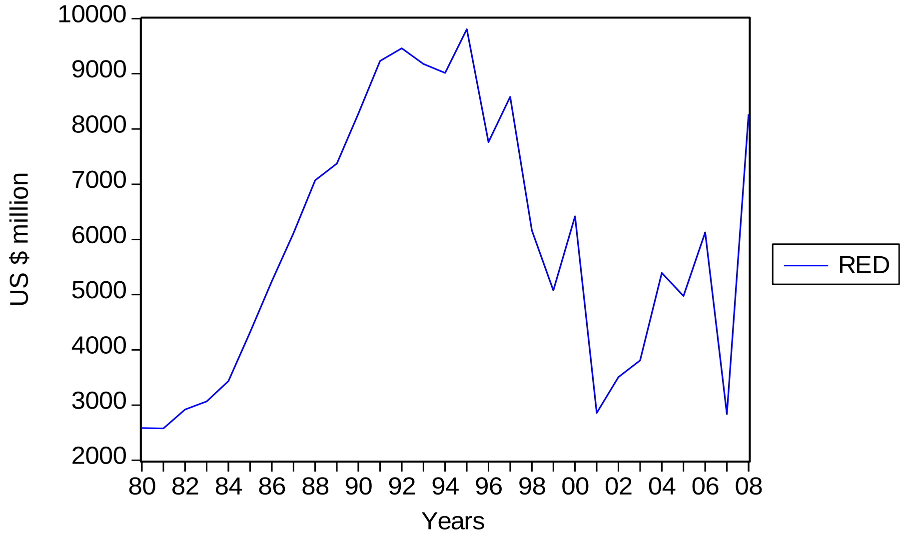


Source: SIPRI (2009).

External Debt: In the decade of the 1980s, Pakistan's debt stock more than doubled from US $ 11.4 billion in 1980-1981 to US $ 22.35 billion in 1989-1990. In terms of its share of GDP, the debt stock increased from around 40 per cent to 56 per cent of the GDP during the same time period. During the 1990s, the debt stock increased from US $ 25 billion to US $ 34 billion and the debt stock-GDP ratio increased to 61 per cent in 1998-99 (Sayeed and Rashid, 2003).

Pakistan has experienced serious debt problems in the 1980s and accordingly deterioration in the macroeconomic environment, leading to deceleration in investment rate and economic growth and the associated rise in the incidence of poverty. In real terms, External Debt Liabilities (EDL) increased from US $ 5136 million to $ 7314 million between 2000 and 2008. During the same period, EDL as a percentage of GNP decreased by 9.0% to 4.9%. However, the last two years (2008 and 2009) have seen an increase in the rate of growth of EDL, as external debt and liabilities have been increasing not only in absolute terms, but also as a percentage of some major economic indicators. This shift in momentum shown in figure 3 which highlighted the crucial role played by current account deficit and exchange rate stability on a country's debt burden (Economic Survey, 2008-09).

Figure 3: Trend analysis of real external debt (RED)



Source: Economic Survey of Pakistan (2009-2010)

In 1980, defense expenditure together with debt servicing have accounted for around 80% of current expenditure (Looney, 1995).

Data and methodology

The data of military expenditures are taken from the Stockholm International Peace Research Institute (SIPRI, 2009) and the data of GNP and external debt were taken from Economic Survey of Pakistan (2009-10) for the period of 1980-2009. Defense expenditure data for

Pakistan is available from 1980 onwards. Due to this limitation, we have used the limited data of thirty years. All of the dependent and explanatory variables were deflated by the consumer price index (CPI), whereby the year 2000 was treated as the base year (2000 = 100). Furthermore, all of the series were transformed into log form. Log transformation can reduce the problem of heteroscedasticity because it compresses the scale in which the variables are measured, thereby reducing a tenfold difference between two values to a twofold difference (Gujarati, 2003). In this research, a recent technique, the Johansen's co-integration technique, is employed to find a long-run relationship between the variables.

Conceptual Framework

The study used the Production Function (PF) analytical framework to estimate the external debt attributable to economic growth and military expenditure. A production function describes the transformation of the factors of production (inputs) into outputs with its existing technology. Formally, the effect of economic growth and military expenditures on external debt can be expressed as follows:

$$ED = f\,(GNP, ME) \qquad \text{(i)}$$

where: GNP is the real Gross National Product, ME is the military expenditure and ED is the external debt.

Equation (i) shows the effect of ME on ED, holding the effect of GNP. If military spending increases, it put up the burden on the developing economies like Pakistan in the form of borrowing external debt. In other words, if the state cuts the military budget, a lot of firms go bankrupt, the unemployment rate increases and the GNP decreases. The coefficient for ME variable would be expected to assume a negative sign. The effects of the explanatory variables on the dependent variable (GDP) are unlikely to be linear; thus, in this study we shall estimate Cobb-Douglas production function of the following form:

$$ED = aGNP^{\beta 1} ME^{\beta 2} e \qquad \text{(ii)}$$

Taking the logarithms of both sides of equation (ii), we obtain the following log-log (or double-log, log-linear or constant elasticity model):

$$\log(ED) = \log(a) + \beta_1 \log(GNP) + \beta_2 \log(ME) + e \qquad \text{(iii)}$$

where: log is the natural log (i.e. log to the base e, where e equals 2.718); a is the intercept term (i.e. the debt, if all the explanatory variables included in the model were equal to zero); ß's are the coefficients of elasticity, which can take any value between 0 (perfectly inelastic) to ∞ (perfectly/infinitely elastic); and e is a random (stochastic) error term capturing all factors that affect external debt but are not taken into account explicitly in the model.

Econometric Framework

Econometric model: Comparable to all other techniques, that utilize time series data, it is essential to distinguish that unless the diagnostic tools used account for the dynamics of the link within a sequential 'causal' framework, the intricacy of the interrelationships involved may not be fully confined. For this rationale, there is a condition for utilizing the advances in time-series version. The study follows the frame work of Smyth and Narayan (2009). The following model is estimated:

$$DLn(RED) = C + \alpha_O DLn(RGNP) + \alpha_1 DLn(RME) + \alpha_2 Ln(RED(-1)) + \alpha_3 Ln(RGNP(-1)) + \alpha_4 Ln(RME(-1)) + \varepsilon \ldots\ldots (1)$$

where

Ln	=	Natural Logarithm
RED	=	Real External Debt (US$ in millions)
RGNP	=	Real Gross National Product (US$ in millions)
RME	=	Real Military Expenditure (US$ in millions)
(-1)	=	First lag value
D	=	First Difference
ε	=	Error Term

Estimation of equation (1) with sample data will provide fairly accurate long-run external debt, economic growth, and military expenditure elasticity's. Augmenting lagged terms will add formation to the dynamics. The following sequential procedures are adopted as part of methodology used.

Univariate test: In order to confirm the degree, these series split univariate integration properties; we execute unit root stationarity tests. The DF (Dickey & Fuller, 1979 and 1981) and the non-parametric Phillips-Perron (PP) type tests developed by Phillips & Perron (1988) are suitable testing procedures, both based on the null hypothesis that a unit root exists in the autoregressive representation of the time series. The Phillips-Perron statistics are shown to perform badly over small samples.

Setting the appropriate lag length of the model: The most common procedure in choosing the optimal lag length is to estimate a VAR model including all our variables in non-differenced data. This VAR model should be estimated for a large number of lags, then reducing down by re-estimating the model for one lag less until we reach zero lags. In each of these models we inspect the values of AIC and the SBC criteria. The model that minimizes the AIC and the SBC is selected as the one with the optimal lag length.

Choosing the appropriate model regarding the deterministic components in the multivariate system:

In general five distinct models can be considered. Although the first and the fifth model are not that realistic and they are also implausible in terms of economic theory, therefore, the problem reduces to a choice of one of the three remaining models (model 2, 3 and 4).

Model 1: No intercept or trend in CE or VAR.
Model 2: Intercept (no trend) in CE, no intercept or trend in VAR.
Model 3: Intercept in CE and VAR, no trends in CE and VAR.
Model 4: Intercept in CE and VAR, linear trend in CE, no trend in VAR.
Model 5: Intercept and quadratic trend in the CE intercept and linear trend in VAR.

Determining the ranks of Π or the number of cointegrating vectors: For the intention of investigating the long-run relationship among the variables, they must be co-integrated. In the multivariate case, if the I(1) variables are linked by more than one co-integrating vector, the Engle-Granger (1987) procedure is not applicable. The test for co-integration used here is the likelihood ratio put forward by Johansen and Juselius (1990), indicating that the maximum likelihood method is more appropriate in a multivariate system. Therefore, this method is used in this study to identify the number of co-integrated vectors in the model. The Johansen and Juselius method has been developed in part by the literature available in the field and reduced rank regression, and the co-integrating vector 'r' is defined by Johansen as the maximum Eigen-value and trace test. There is 'r' or more co-integrating vectors. Johansen and Juselius (1990) propose that the multivariate co-integration methodology can be defined as:

$$\text{Ln}\ (\text{RED}_{t)} = \text{Ln}\ (\text{RGNP, RME}) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

which is a vector of $P = 2$ elements. Considering the following autoregressive representation:

$$RED_t = \pi_\circ + \sum_{T=1}^{K} \pi_i RED_{t-1} + \mu_t$$

Johansen's method involves the estimation of the above equation by the maximum likelihood technique, and the testing of the hypothesis H$_o$; $(\pi = \Psi\xi)$ of 'r' co-integrating relationships, where 'r' is the rank or the matrix $\pi(0 \angle r \angle \text{P}), \Psi$ is the matrix of weights with which the variable enters co-integrating relationships and ξ is the matrix of co-integrating vectors. The null hypothesis of non-cointegration among variables is rejected when the estimated likelihood test statistic $\phi_i \{= -n \sum_{t=r+1}^{p} \ln(1 - \hat{\lambda}_i\}$ exceeds its critical value. Given estimates of the Eigen-value $(\hat{\lambda}_i)$ the Eigen-vector (ξ_i) and the weights (Ψ_i), we can find out whether or not the variables in the vector (RED_t) are co-integrated in one or more long-run relationships among the dependent variables.

If the time series are integrated at first difference, then one could run regressions in their first differences. However, by taking first differences, we drop the long-run correlation that is stored in the data. This means that one needs to use variables in levels as well. Error

Correction Model (ECM) incorporates variables both in their levels and first differences. ECM depicts the short-run disequilibrium as well as the long-run equilibrium adjustments between variables. ECM term having negative sign and value between "0 to 1" specifies convergence of the model towards long run equilibrium.

Impulse Responses: A shock to the *i-th* variable not only directly affects the *i-th* variable but is also transmitted to all of the other endogenous variables through the dynamic (lag) structure of the VAR. An impulse response function traces the effect of a one-time shock to one of the innovations on current and future values of the endogenous variables (EViews 5 User's Guide, 2010).

Variance Decomposition: While impulse response functions trace the effects of a shock to one endogenous variable on to the other variables in the VAR, variance decomposition separates the variation in an endogenous variable into the component shocks to the VAR. Thus, the variance decomposition provides information about the relative importance of each random innovation in affecting the variables in the VAR (EViews 5 User's Guide, 2010).

Results and discussion

The preliminary step in this analysis is to establish the degree of integration of each variable. To get reliable results for equation 1, the implicit assumption is that the variables in equation 1 are *I(1)* and co-integrated. We test for the existence of a unit root in the level and the first difference of each variable in our sample using the Augmented Dickey Fuller (ADF) and Phillips-Perron (PP) test. Both ADF and PP test statistics check the stationarity of series. The results in Table 2 reveal that all other variables are non-stationary in their level data. However, stationarity is found in the first differencing level of the variables i.e., Real External Debt (RED), Real Economic Growth (RGNP) and Real Military Expenditure (RME).

Now the issue of finding the appropriate lag length is very important because we want to have Gaussian error terms. The most common procedure in choosing the optimal lag length is to estimate a VAR model including all three variables in levels (non-differenced data). The study tested for the existence of long-run relationships. As the study use annual data, the maximum number of lags was set equal to 1 showing in Table 3.

Table 2: Unit Root Estimation

Augmented Dickey-Fuller (ADF) Test				
Level			**First Difference**	
Variables	Constant	Constant and Trend	Constant	Constant and Trend
RED	-1.924 (1)	-2.103 (1)	-7.254* (0)	-7.325* (0)
RGNP	4.539 (0)	1.446 (0)	-2.380 (0)	-3.661** (0)
RME	4.479 (0)	1.456 (0)	-3.911* (0)	-3.803* (0)
Phillips-Perron (PP) Test				
Level			**First Difference**	
Variables	Constant	Constant and Trend	Constant	Constant and Trend
RED	-1.724 (2)	-1.862 (2)	-7.109* (2)	-7.200* (2)
RGNP	4.136 (1)	1.195 (1)	-2.239 (2)	-3.604** (2)
RME	4.021 (1)	1.299 (1)	-2.241 (2)	-3.587**(2)

Note: Mackinnon et al (1999) one-sided p-values. * Significant at 1%; ** significant at 5% level respectively. Bracket shows lag length for ADF test and Bandwidth for PP test.

Table 3: VAR Lag Order Selection Criteria

Lag	Log L	LR	FPE	AIC	SC	HQ
0	-606.2541	NA	2.25e+18	50.77118	50.91843	50.81024
1	-586.3903	33.10631*	9.19e+17*	49.86586*	50.45489*	50.02213*
2	-577.5178	12.56944	9.69e+17	49.87648	50.90728	50.14995
3	-569.8079	8.994889	1.20e+18	49.98399	51.45656	50.37466
4	-560.9003	8.165301	1.52e+18	49.99169	51.90603	50.49956

* indicates lag order selected by the criterion

LR: sequence modified LR test statistic (each test at 5% level)

FPE: Final prediction error

AIC: Akaike Information criterion

SC: Schwarz information criterion

HQ: Hannan-Quinn information criterion

The relationship between dependent variable (Real External Debt) and the independent variables (Real Military Expenditure and Real GNP) is observed using the multivariate cointegration methodology proposed by Johansen (1988) and Johansen & Juselius (1990). The Johansen's Cointegration Test designates at least one co-integrating vector. Thus, long run relationship is maintained by the data generating method. Using Johansen and Juselius (1990) multivariate cointegration tests the study finds that a statistically significant relationship exists between independent variables on external debt (RED). The following cointegrating vector has been determined in Table 4, 5 and 6 respectively.

Table 4: Cointegration Test Results (Model 2)

HO	H1	TEST STATISTIC	0.05 CRITICAL VALUES
λ trace		Λ TRACE	
r=0*	r>0	37.68516	35.19275
r≤1	r>1	18.24465	20.26185
r≤2	r>2	6.24124	9.16454

Model 2: Intercept (no trend) in CE, no intercept or trend in VAR

This study starts with the null hypothesis of no co-integration *(r=0)* among the variables. It is found that the trace statistic of 37.68 exceeds the 95 per cent critical value (35.19) of the **λ** trace statistic. It is possible to reject the null hypothesis *(r=0)* of no co-integration vector in favor of the general alternative $r > 0$. The null hypotheses of $r > 1, r > 2$ cannot be rejected at 5 per cent level of confidence. Consequently, we conclude that there is 1 co-integration relationships involving the variables log (RED), log (RGNP) and log (RME). Now we take model 3 to check the cointegration vector.

Table 5: Cointegration Test Results (Model 3)

HO	H1	TEST STATISTIC	0.05 CRITICAL VALUES
λ trace		Λ TRACE	
r=0*	r>0	45.51222	29.79707
r≤1*	r>1	22.15526	15.49471
r≤2*	r>2	10.96425	3.841466

Model 3: Intercept in CE and VAR, no trends in CE and VAR

In Table 5, we starts with the null hypothesis of no co-integration *(r=0)* among the variables. It is found that the trace statistic of 45.51 exceeds the 95 per cent critical value (29.79) of the **λ** trace statistic. It is possible to reject the null hypothesis *(r=0)* of no co-integration vector in favor of the general alternative $r > 0$. The null hypotheses of $r > 1, r > 2$ are also rejected at 5 per cent level of significance. Consequently, we conclude that there are 3 co-integration relationships involving the variables log (RED), log (RGNP) and log (RME). Similarly, we bring model 4 for further investigation for cointegration vector.

Table 6: Cointegration Test Results (Model 4)

HO	H1	TEST STATISTIC	0.05 CRITICAL VALUES
λ trace		Λ TRACE	
r=0*	r>0	46.3454	42.91525
r≤1	r>1	18.3510	25.87211
r≤2	r>2	7.1581	12.51798

Model 4: Intercept in CE and VAR, linear trend in CE, no trend in VAR

Table 6 indicates that there is only one cointegrating vector as the trace statistic of 46.34 exceeds the 95 per cent critical value (42.91) of the **λ** trace statistic. It is possible to reject the null hypothesis *(r=0)* of no co-integration vector in favor of the general alternative $r > 0$. The null hypotheses of $r > 1, r > 2$ cannot be rejected at 5 per cent level of confidence. Consequently, we conclude that there is an only 1 co-integration relationship involving the variables log (RED), log (RGNP) and log (RME). In the next step, we combined the trace statistics for all three models together in order to choose which model is appropriate. The results are shown in Table 7.

Table 7: The Pantula Principle Test

R	n-r	model 2	model 3	model 4
0	3	37.68516*	29.79707*	46.3454*
1	2	18.24465	15.49471*	18.3510
2	1	6.24124	3.841466*	7.1581

From the above results it is shown that model 3 is appropriate because there are greater numbers of cointegrating vectors as compared to other models results. In order to check the stability of the long-run relationship between the log (RED) and their independent variables, we assess the Error Correction Model in Table 8 (a) and 8 (b) respectively.

Table 8 a): Empirical Results of the Error Correction Model

Dependent Variable: D Log (RED)

Variables	Short-run and Long-run elasticity's (p-value)
C	-8.369 (0.152)
D Log (RGNP)	-2.902* (0.001)
D Log (RME)	-1.734 (0.315)
Log(RED(-1))	-0.936* (0.000)
Log(RGNP(-1))	-2.139* (0.004)
Log(RME(-1))	3.963* (0.000)
ECM	-0.681 (0.000)

(*) shows significant probability values at 5 % level of C.I

These consequences bring to light some features for inferences regarding the external debt in Pakistan over the sample period. In the short run, a 1% increase in national income reduces external debt by 2.902%, while military expenditures found to be insignificant over this time period. Growth and military expenditure, as a component of the long-term cointegrating relationship through the lagged error-correction term jointly influence external debt over the long term. In the long-run, GNP decreases external debt almost 2.139%, whereas, military expenditures increases external debt by 9.963%. It indicates that the impact of military expenditures in increasing external debt is a somewhat greater than that of economic growth in reducing external debts of Pakistan. This result clearly supports the conventional view which suggests that a rise in RME affects RED positively, while the effect of a rise in RGNP is negative. The results are in consistent with the previous work of Karagol (2005) and Karagol and Turhan (2008) in which they find the positive impact of military expenditures on external debt in case of Turkey. The results are quit similar with the Panel data work of Dunne et al (2004) and Smyth & Narayan (2009). Further, Winter (1975) and McNeil (1982) provide selective information regarding military expenditures are inversely associated with the economic development across history. The error-correction term is significant with an adjustment coefficient of -0.681, indicating that external debt adjusts to its long-run equilibrium level with 68.1% of the adjustment taking place within the first year. The sign of the ECT coefficient also specifies that changes in the external debt adjust in an opposite direction to the previous period's deviation from equilibrium. Diagnostic tests are presented in Table 8 (b).

Table 8 (b): Diagnostic Statistics

Statistics test	
SSR	1.412
R-squared	0.817
Adjusted R-squared	0.654
Durbin-Watson stat	1.967
F-statistic	5.021*
Serial Correction	
LM 1	0.512
Functional form	
RESET	0.121
Heteroscedasticity test	
White Test	1.871
ARCH	2.721
Normality test	
Jarque – Bera (JB-test)	0.812

Note: *SSR refers to the sum of squared residuals. LM(I) tests for the null of 1st order serial correlation amongst the residuals; Het: a test based on regression of squared residuals on a constant and squares of the fitted values; ARCH: a test for first-order autoregressive conditional Heteroscedasticity effects; RESET: Ramsey's Regression Specification Error/'-test with (m, n) degrees of freedom; and the Jarque-Bera X2(2) LM test for normality of residuals. * indicate significance at the 5% levels.*

The empirical results, given in Table 8 (b), appear to be very good in terms of the usual diagnostic statistics. The value of R^2 adjusted indicates that 65.4% variation in dependent variable has been explained by variations in independent variables. F value is higher than its critical value suggesting a good overall significance of the estimated model. Therefore, fitness of the model is acceptable empirically. The Durbin Watson Test is almost equal to 2, therefore, there has no such problem of serial correlation in the model. The model also seems to be robust to various departures from standard regression assumptions in terms of residual correlation, Heteroscedasticity, Autoregressive Conditional Heteroscedasticity (ARCH), misspecification of functional form, or non-normality of residuals. This result tends to suggest that the impact of any structural change over the entire sample period does not appear to be significant at least in terms of model stability. Stability tests suggest that the estimated model is stable over the sample period.

Detecting Granger causality is restricted to within sample tests which are useful in describing the plausible Granger exogeneity or endogeneity of the dependent variable in the sample period but are unable to deduce the degree of exogeneity of the variables beyond the sample period. To examine this issue, we consider the generalized impulse response functions. Figure 4 presents the impulse response functions. The figures plot the response of the log (RED) to shocks in log (RGNP) and log (RME).

Figure 4: Impulse Response of log (RED) to One-standard Deviation Shocks in Log (RGNP) and Log (RME)

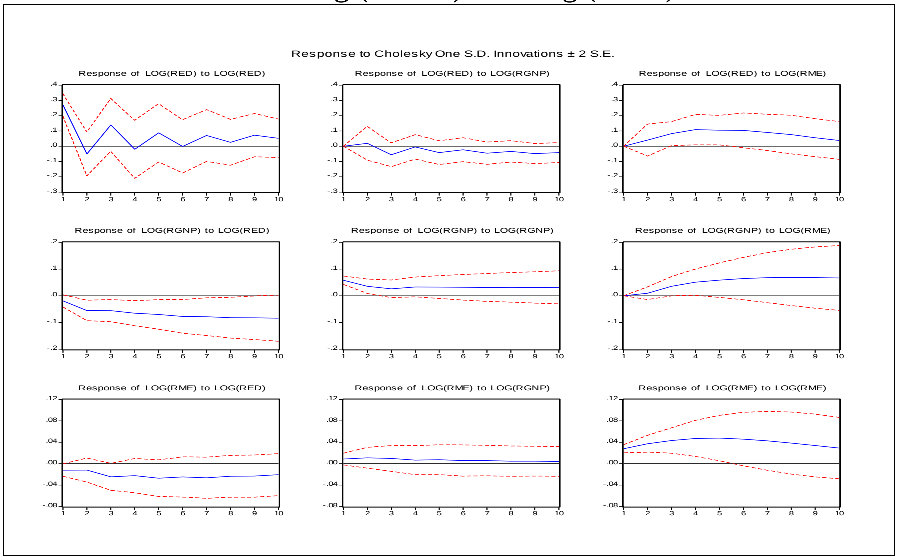
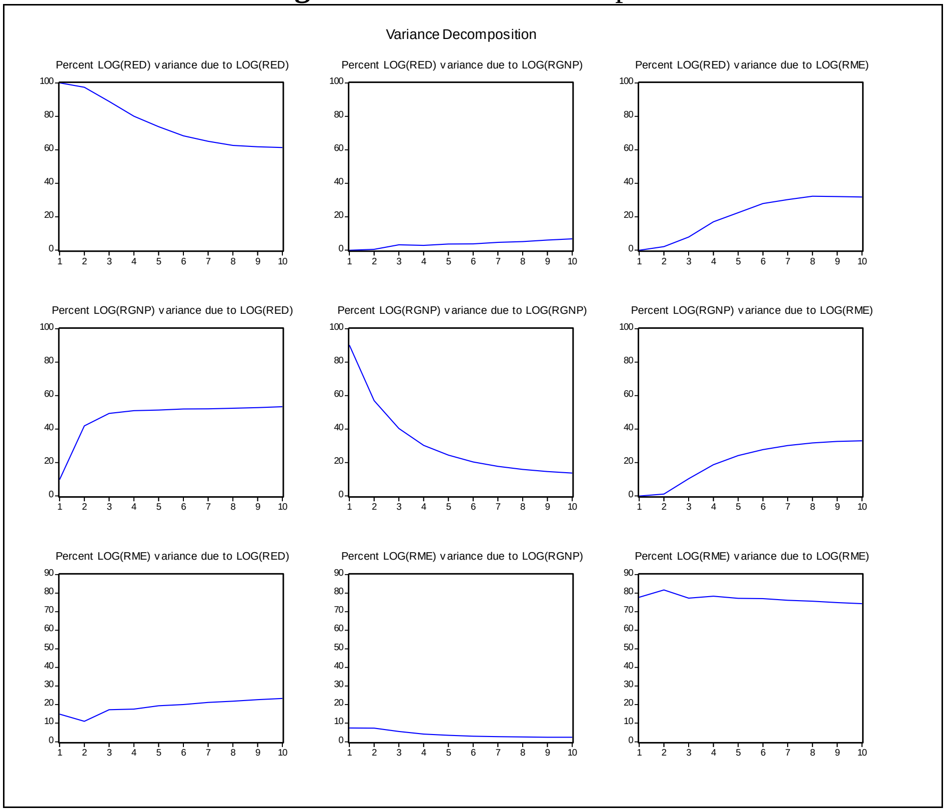


Figure 4 plots the response of log (RED) to shocks in log (RGNP) and log (RME). A shock in external debt has a negative effect on economic growth while positive effect on military expenditures over the 10 years. A shock to economic growth has a negative effect on external debt while a positive impact on military expenditure during subsequent years. Similarly, the response of military expenditure to shocks in external debt has negative effect, while a positive effect has been observed on economic growth over a ten year period (see, appendix, Table 7).

Figure 5: Variance Decomposition



Variance Decomposition: The variance decomposition results are summarized in figure 5 over a 10-year period. The variance decomposition analysis indicates that external debt is the exogenous variable. A high proportion of its shock is explained by the own innovations compared to the contributions of own shocks to innovations for economic growth and military expenditure variables. At the end of 10 years, the forecast error variance for external debt explained by their own innovations is 43.6%, while the forecast error variance for economic growth and military expenditure explained by their own innovations are 30.0% and 14.6% respectively (see, appendix, Table 8).

Conclusion

This paper has estimated the impact of economic growth and military expenditure on external debt in the context of Pakistan using time series data from 1980-2008 by employing Johansen Cointegration approach. Defense expenditure data for Pakistan is available from 1980 onwards. Due to this limitation, we have used the limited data of twenty-nine years. The result reveals that there is strong positive relationship between military expenditure and external debt while strong negative relationship between economic growth and external debts in the long runs. As shown in results, in long run, 1.0% increase in military expenditure leads to an increase in external debt by 3.96%. On the other hand 1.0% increases in economic growth decreases external debt by 2.13% respectively. In the short run, a 1% increase in national income reduces external debt by 2.90%.

The error-correction term is significant with an adjustment coefficient of -0.681, indicating that external debt adjusts to its long-run equilibrium level with 68.1% within the first year. The results of impulse response function indicates that a shock in external debt has a negative effect on economic growth while positive effect on military expenditures over the 10 years. Consistent with the results of the decomposition of variance results, a large proportion of the variance in external debt is explained by its own innovations.

The overall conclusion is that military expenditure increases external debt in relation with economic growth by almost 4% in Pakistan. If military expenditure is reduced by 1.0%, it will reduce external debt by 3.96%, and the same time it will increase income which helps the economy to pay off their external debt.

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APPENDIX

Table 7: Impulse Response Generalize One SD

Response of DLOG (RED)

Period	DLOG(RED)	DLOG(RGNP)	DLOG(RME)
1	0.270435	0.000000	0.000000
2	-0.050349	0.019227	0.040322
3	0.139723	-0.055403	0.082586
4	-0.019906	-0.004418	0.108603
5	0.087786	-0.041726	0.105277
6	-0.000915	-0.022738	0.103979
7	0.070342	-0.045619	0.090275
8	0.025531	-0.033708	0.076112
9	0.072394	-0.047919	0.055876
10	0.051812	-0.041859	0.037580

Response of DLOG (RGNP)

Period	DLOG(RED)	DLOG(RGNP)	DLOG(RME)
1	-0.012149	0.008572	0.027786
2	-0.011972	0.010921	0.037212
3	-0.024659	0.009689	0.043296
4	-0.022448	0.006577	0.047155
5	-0.027271	0.007284	0.047873
6	-0.024859	0.005806	0.045826
7	-0.026395	0.005669	0.042631
8	-0.023578	0.004689	0.038417

9	-0.023263	0.004663	0.033831
10	-0.020627	0.004097	0.029059

Response of DLOG (RME)

Period	DLOG(RED)	DLOG(RGNP)	DLOG(RME)
1	-0.012149	0.008572	0.027786
2	-0.011972	0.010921	0.037212
3	-0.024659	0.009689	0.043296
4	-0.022448	0.006577	0.047155
5	-0.027271	0.007284	0.047873
6	-0.024859	0.005806	0.045826
7	-0.026395	0.005669	0.042631
8	-0.023578	0.004689	0.038417
9	-0.023263	0.004663	0.033831
10	-0.020627	0.004097	**0.029059**

Table 8: Variance Decomposition
[DLOG (RED)]

Period	S.E.	DLOG(RED)	DLOG(RGNP)	DLOG(RME)
1	0.270435	100.0000	0.000000	0.000000
2	0.278685	97.43059	0.475993	2.093416
3	0.327228	88.90011	3.211882	7.888013
4	0.345382	80.13242	2.899477	16.96810
5	0.373924	73.87760	3.718957	22.40345
6	0.388779	68.34055	3.782252	27.87719
7	0.407833	65.07880	4.688300	30.23290
8	0.417024	62.61665	5.137288	32.24606
9	0.429614	61.83991	6.084698	32.07539
10	**0.436368**	61.35019	6.817984	31.83182

DLOG (RGNP)

Period	S.E.	DLOG(RED)	DLOG(RGNP)	DLOG(RME)
1	0.061260	9.819640	90.18036	0.000000
2	0.090232	41.91446	56.98815	1.097391
3	0.114837	49.38189	40.32278	10.29534
4	0.145350	50.98091	30.29927	18.71982
5	0.174580	51.36920	24.46631	24.16449
6	0.203835	51.96542	20.36225	27.67232
7	0.230711	52.08955	17.70727	30.20318
8	0.256186	52.44415	15.87726	31.67859

9	0.279282	52.80885	14.60660	32.58455
10	**0.300710**	53.32208	13.69088	32.98704

DLOG (RME)

Period	S.E.	DLOG(RED)	DLOG(RGNP)	DLOG(RME)
1	0.031514	14.86092	7.399546	77.73953
2	0.051385	11.01773	7.300008	81.68226
3	0.072229	17.23230	5.494187	77.27352
4	0.089375	17.56350	4.129947	78.30655
5	0.105244	19.38036	3.457406	77.16223
6	0.117593	19.99290	3.013159	76.99395
7	0.127962	21.13879	2.740870	76.12034
8	0.135750	21.79962	2.554706	75.64568
9	0.141900	22.63873	2.446059	74.91521
10	**0.146363**	23.26517	2.377500	74.35733