SBP Working Paper Series

No. 06 December, 2004

Defence Expenditure and Macroeconomic Stabilization: Causality Evidence from Pakistan

Mahmood-ul-Hasan Khan

STATE BANK OF PAKISTAN

SBP Working Paper Series

Editor: Riaz Riazuddin

The objective of the SBP Working Paper Series is to stimulate and generate discussions, on different aspects of macroeconomic issues, among the staff members of the State Bank of Pakistan. Papers published in this series are subject to intense internal review process. The views expressed in the paper are those of the author(s) and do not necessarily reflect those of the State Bank of Pakistan.

Price per Working Paper

Pakistan: Rs 50 (inclusive of postage)

Foreign: US$ 20 (inclusive of postage)

Purchase orders, accompanied with cheques/drafts drawn in favor of State Bank of Pakistan, should be sent to:

Chief Spokesperson
Corporate Services Department,
State Bank of Pakistan,
I.I. Chundrigar Road, P.O. Box No. 4456,
Karachi 74000. Pakistan

For all other correspondence:

Editor,
SBP Working Paper Series
Research Department,
State Bank of Pakistan,
I.I. Chundrigar Road, P.O. Box No. 4456,
Karachi 74000. Pakistan

Published by: Editor, SBP Working Paper Series, State Bank of Pakistan, I.I. Chundrigar Road, Karachi, Pakistan.

http://www.sbp.org.pk

Printed at the SBPBSC (Bank) – Printing Press, Karachi, Pakistan

Abstract
The objective of this study is to investigate the plausibility of using defence expenditure as a macroeconomic stabilization tool (referred as Military Keynesianism Hypothesis) in case of Pakistan. Johansen's co-integration techniques are used followed by the vector error correction modeling (VECM). Various parametric restrictions on VECM were tested to discern the Granger causal chains among defence spending, development expenditure, CPI and income. Using annual time series data from FY51 to FY03, we found a long-run relationship among the variables. The results tend to favor a long-run bi-directional causality among the variables. However, this temporal dependence does not hold in the short-run, as the lagged differences of defence expenditures do not significantly explain GDP and inflationary dynamics. These seemingly contrasting results for the short-run and long-run causality suggest that although MKH does not hold over the estimation period, long-run economic growth is not hurt by defence expenditure.

The author thanks Riaz Riazuddin, Omer Farooq Saqib, Syed Muhammad Tariq and Zulfiqar Hyder for their comments and useful suggestions. Views expressed in this working paper are those of the author and do not necessarily represent those of the State Bank of Pakistan. Comments and suggestions are welcome.

While the debate on the usefulness of government expenditure as a fiscal policy instrument to correct short-term fluctuations in economic activity has largely been resolved, the question of existence and direction of relationship between various components of expenditure and economic growth is far from settled. One of the most interesting and controversial result on the subject is that "countries with heavy defence burden generally had the most rapid rate of growth, and those with lowest defence burdens tend to show the lowest growth rates" (Benoit 1978, p. 271). These unexpected results provided a strong impetus for the research on the relationship between defence expenditure and economic growth. In the subsequent period the research on the subject was focused to investigate the validity of Benoit's findings. A number of options including the possibility of spurious relation, validity of results over differing study periods, use of different proxies for defence burden etc. were analyzed (Ram, 1995). However, the empirical evidence on the subject remained controversial largely on account of country specific factors. The major country specific factors include the role of military in non-military affairs, internal security needs, military budget in rival countries, and geopolitical position of the country (Looney 1998a).

Pakistan also attracted the attention of the researchers both within and outside the country due to its huge defence expenditure in an effort to maintain a credible level of deterrence, a vital geopolitical position in Afghan war, pursuance of nuclear capabilities, and a long outstanding dispute over territory of Kashmir with India (Henderson 1993, and Looney 1998a & b). In fact, large size of defence expenditure in overall budgetary outlay (in the presence of high budget deficits) remained a hot topic of debate among the domestic researchers as well (e,g, Tahir and Sajid 1999). However, the most interesting research on the subject was that of Looney (1998a) when the author analyzed the role of defence expenditure in macroeconomic stabilization. Surprisingly, the author concluded that there was an indication that Pakistan had been using its defence expenditures "as a stabilization tool, especially during the periods of relative peace with India" (Looney 1998a, p-610). The author further argued that defence expenditure seems to be controlled by economic environment instead of exogenous factors.

These surprising results in support of MKH especially in the presence of war driven changes in defence expenditure evident from stylized facts, together with the usefulness of analyzing the cost of defence expenditure in terms of reduction in development expenditure (reduction of investment in infrastructure) are catalyst to this study. Specifically, this study is focused to assess the possibility of any long/or short-term causal relation among defence spending, development expenditure, inflation and income by using multivariate Johansen co-integration techniques and error-correction modeling.

The organization of the paper is as follow: Section 2 reviews the empirical literature on the subject followed by a discussion of trends in defence and development expenditure of Pakistan in Sections 3, Section 4 explains the empirical methodology, Sections 5 presents the data and the results, and Section 6 concludes the paper. References and annexes are appended at the end.

2. Theoretical Underpinning and Review of Literature

As mentioned earlier that the use of government expenditure as a fiscal policy tool is well established, however the usefulness of defence expenditure as a tool of fiscal policy especially for developing countries is yet to be established. The opponents of defence expenditure generally argue on the basis of: (1) well-known crowding-out phenomenon (classical and neoclassical argument), i.e. increase in public spending substitutes public goods for private goods; (2) under the assumption of fixed government expenditure, high defence expenditure will undermine the government efforts to spend more on infrastructure, which is a prerequisite for economic growth; and (3) if higher defence expenditure is met through massive government borrowing (running budget deficit), this can exert an adverse pressure on credit market, which may result in interest rate hike and thus hamper private investment. As a result, defence spending may have an adverse impact on overall economic growth. Some researchers are also of the view that although defence spending is undertaken to achieve an important intrinsic objective of external defence, some feedback effects might still be present (Ram 1995).

In sharp contrast to above arguments, the advocates of Keynesian School of thought put forward the *Military Keynesianism Hypothesis (MKH)* parallel to the Keynesian effect of government spending on income. They argue that defence expenditure is a part of overall budgetary outlay and the government has considerable discretionary control over it, therefore defence expenditure has not only positive effects on economic growth but could also be used to stabilize the economy as a fiscal instrument (Looney, 1998a).[1] In other words, defence spending may be used to boost growth during the downturn period and vice versa.

Review of Literature

Impact analysis of defence expenditure on economic growth remained a live topic of empirical research since early 1970s. The real impetus came from Benoit (1973, 1978), suggesting that defence spending has a positive impact on economic growth. The empirical results based on a cross section of 44 less developed countries showed that "country with a heavy defence burden generally had the most rapid rate of growth, and those with the lowest defence burden tended to show the lowest growth rates".[2] Due to these unexpected results, the subsequent research was primarily focused to determine the robustness of these findings. Several possibilities of spurious correlation, variations over his

[1] " Several studies (Griffin, Wallace and Devine 1982, Treddenick 1985 and Looney 1991a) have found that positive link between defence expenditures and the economy are often a result of 'Military Keynesianism' effect" (Looney 1998a, p-600).
[2] For details, see Hartley and Sandler eds. (1995) Benoit (1978), page 271.

model, changes in estimation periods, use of different proxies for defence burden, etc., have been widely explored in the literature (see **Table 1**).

Table 1: List of selected studies of defence and growth

Reference	**Model/Sample/Period**	**Main conclusion**
Adams, Behrman and Boldin (1991)	Feder-type 3-sector model, LDC sample, 1974-1986	No effect of defence spending on growth
Alexander (1990)	Feder-type 4-sector model, 9 DCs, 1974-1985	No effect of defence spending on growth
Atesoglu and Mueller (1990)	Feder-type 2-sector model, USA, 1950-1965	Small positive and significant effect of defence spending on growth
Benoit (1973, 1978)	Traditional (ad hoc) models, 44 LDCs, 1950-1965	Positive and significant effect of defence spending on growth.
Biswas (1993)	Traditional and Feder-type 2-sector model, 74 LDCs, 1981-1989	Positive and significant effect of defence spending on growth.
Biswas and Ram (1986)	Traditional and Feder-type 2-sector model, 58 LDCs, 1960-1970 and 1970-1977	No significant effect of defence expenditures on growth
Chowdhury (1991)	Granger causality test, 55 LDCs, Time Series Data	No causality between military expenditure and growth in most countries
Deger (1986a,b)	Traditional (SEM 3-equations) model, 50 LDCs, 1965-1973	Positive growth effect of defence spending on growth, but negative indirect and total effect.
Faini, Annez and Taylor (1984)	Demand side traditional model, 69 countries, 1952-1970	A generally negative effect of defence spending on growth.
Frederiksen and Looney (1983)	Benoit's sample and model with breakup in sub-samples	Defence spending has a positive effect on growth in the group of 24 resource-abundant countries, but the effect is negative for the group of 9 resource-constrained countries.

Note: This table is adapted from "Handbook on Defence Economics" Table 1, page 255, which mentions 29 selected studies of defence-growth relations.

Over the years, defence spending of Pakistan also remained an important topic of research. The large size of defence expenditure in presence of high budget deficits, declining development expenditure and increasing debt services on account of exploding public debt focused the attention of domestic economists on the subject. These factors together with Pakistan's pursuit of nuclear capability, responses (although weak) to increased Indian defence expenditures and prevalence of considerable poverty attracted the attention of researchers outside the country.

Robet E. Looney, a professor of National Security Affairs at Naval Postgraduate School, USA has written frequently on Pakistan's defence spending. Looney (1998b) explored the pattern of causation between the foreign capital flows and defence expenditure of Pakistan. For this purpose, the author utilized annual time series data on the composition of public sector borrowing and defence expenditure from 1953 to 1991. The results suggest that: (1) feedback effect exists between the government expenditure and external borrowing;[3] (2) increase in government expenditure to GDP ratio has a strong impact on external borrowing, which acts as a weak constraint on expenditure to GDP ratio; (3) increases in defence expenditure growth rate are likely to reduce future external borrowing; and (4) increases in share of non-defence expenditure provides strong stimulus to higher external borrowing. The author further argued that a considerable demand for foreign exchange stemmed just form the objective acquiring external defence technology in the past.

In another study, Looney (1998a) tested the Military Keynesianism Hypothesis, i.e., use of defence spending for macroeconomic stabilization in Pakistan. To test the hypothesis, author used annual time series data of gross domestic product, GDP deflator (proxy for inflation), total government expenditure, military expenditure and non-military expenditure from 1960 to 1996. The results indicate the existence of long-run relationship for each of the major categories of the government expenditure with GDP and inflation. Furthermore, while overall government expenditure does not react to inflation, military expenditure declines with the increase in inflation. This means that defence expenditure appeared to be a counter-cyclical tool to offset inflation. However, its usefulness to offset real output fluctuations was meager compared with inflationary pressures.

Tahir and Sajid (1999) examined the issue of causality between defence spending and economic growth for less developed countries including Pakistan. They used quarterly decomposed series of real defence spending and real output from 1961:01 to 1997:04 for Pakistan.[4] The results suggest a feedback relationship in case of Pakistan, India and Iran; unidirectional causality from gross domestic output to defence spending for Guatemala and Venezuela; from defence spending to GDP for Turkey; and no relationship for Philippines, Ecuador and Sri Lanka. However, the simple causality results indicate the presence of bi-directional causality between defence spending and GDP.

While the above studies provide quite interesting results, at the same time they suffer from a number of technical weaknesses. First, Looney (1998a) used the standard Granger causality techniques, which imposed the restriction of single co-integration relations on the variables. In practice there may be more than one co-integrating vectors. Moreover, Looney's results for the use of defence spending as a macroeconomic stabilization tool suffer from an additional problem of degrees of freedom. To study any change in budgetary patterns, the author has used only 20 observations to estimate a model comprising of four variables with three lags. The estimation of a large number of parameters from just 20 observations can hardly be termed conclusive and, therefore, can not be used for policy purposes due to possible violation of stability condition of parameters. This is also evident from

[3] "Increases in government expenditure provided weak impetus to increased external borrowing. Whereby, increased external borrowing tends to place a constraint on future expenditures."

Looney's results for both sub samples, which substantially differ for both periods. Second, the study by Tahir and Sajid (1999) also uses Granger causality techniques, which imposed the strong a priori assumption of exogeniety. Furthermore, the study used a decomposed annual time series data into quarterly observations, which may entail errors.

The present study intends to contribute to the existing literature in three ways. First, the study uses the Johansen co-integration technique, which does not impose a priori restriction of exogenous variables and of single co-integration relation inherited in Granger causality approach used in earlier studies. Moreover, following recent developments in literature, the study conducts the causality tests in vector autoregressive (VAR)/vector error correction (VEC) models. Second, the study incorporates a whole section to analyze historical changes and the possible determining factors of defence spending in Pakistan. The study also takes into account development expenditure not only to understand underlying long-run/short-run relation, if any, with the defence expenditure, but also its dynamics with the gross domestic product. Third, we use the most recent annual time series data from 1951 to 2003.

3. Trends in Defence Expenditures

Pakistan's defence spending remained one of the largest components of total government expenditures since independence. Although sizeable variation in defence expenditure to GDP ratio has been witnessed over the past five decades and the ratio declined significantly toward the end of the 20th century, the absolute size of defence expenditure is considered still very high. The defence expenditure was 17.7 percent of the government's budgetary outlay for FY03.

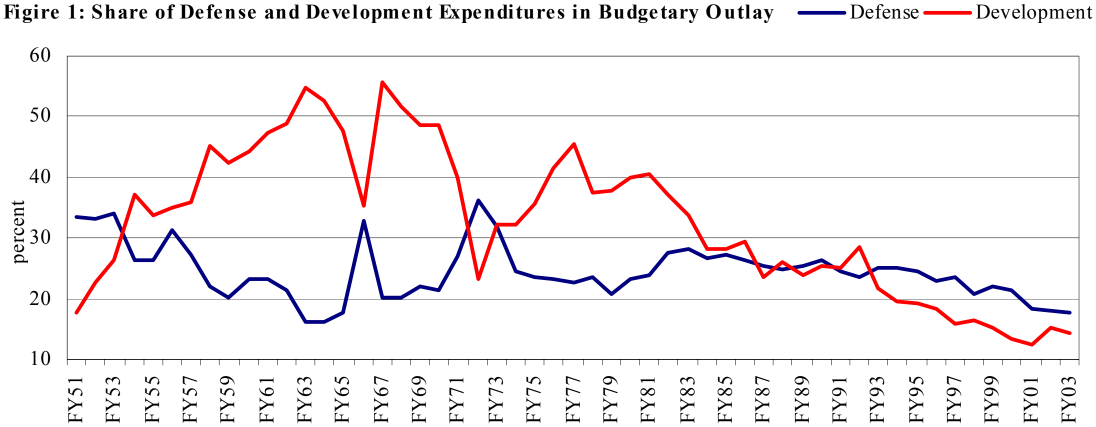
Specifically, the shares of defence and development expenditures in overall budgetary outlay were 33.5 percent and 17.7 percent respectively during FY51. This exceptionally high share of defence expenditures in early years of independence may be largely attributable to the government efforts to achieve a minimum level of deterrence, necessitated by the conflict on disputed territory of Kashmir and a war with India in 1948. After that, the share of defence expenditure in total expenditure saw a considerable decline with some fluctuations before spiking up again in FY66 on account of 1965 war with India (see **Figure 1**). In the post-1965 war era, the defence spending to the total expenditure ratio saw a sharp reversal in FY67. However, this decline proved short lived, as the ratio surged again in FY72 due to 1971 war before dipping down to pre-1965 war trend.

After FY72, the ratio gradually declined to 23.2 percent by FY80. However, the declining trend once again reversed in FY81 following the high tension in Afghanistan (Pakistan as a front line state).

[4] Quarterly data on Defence expenditures and real GDP were not available in case of Pakistan; therefore the authors

During first half of 1980s, the share of defence expenditure averaged 26.8 percent of total expenditure, indicating an increase of 4.1percentage points on average ratio for the second half of 1970s. The withdrawal of Russian forces from Afghanistan coupled with the prevalence of high fiscal deficits propelled government to revisit its defence spending. As a result, the decade of 1990s recorded considerable decline in the share of defence expenditure. The decline in second half of 1990s was more pronounced compared to the first half. Despite tensions on borders with Afghanistan (following the September 11) and India (due to incident of December 13), the share of defence expenditure continued to decline and averaged 18.7 percent for FY01-03. This recent declining trend amidst a few episodes of tension, is largely underpinned by the nuclear capabilities of Pakistan and neighboring India. The possession of nuclear weapons by both countries seems to be an important factor in minimizing the chances of war, even with the enlargement of traditional weapons.

Figire 1: Share of Defense and Development Expenditures in Budgetary Outlay

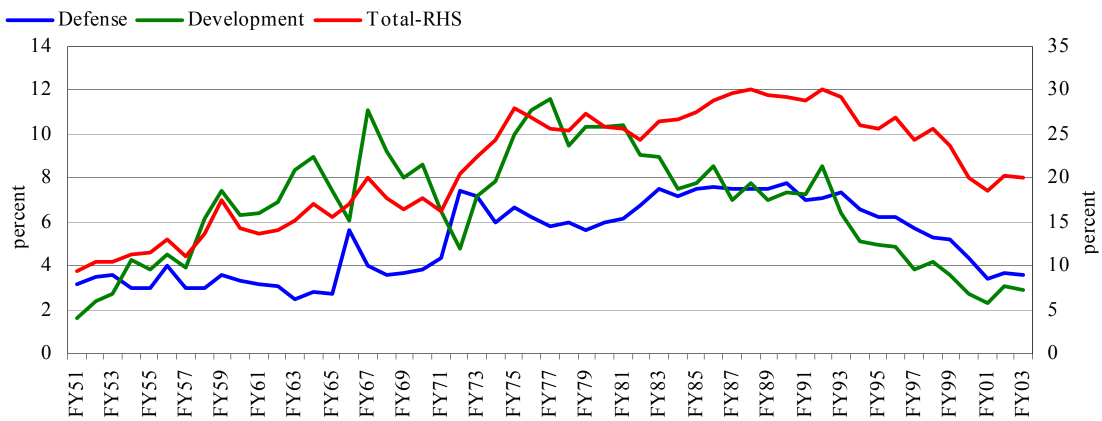


Another important point in **Figure 1** is the movement of development to total expenditure ratio and its relation with defence to total expenditure ratio. It is generally perceived that massive decline in development expenditure to GDP ratio over the past two decades is primarily on account of huge defence expenditure. However, the data do not lend credence to this view, as both defence and development expenditures are on decline since mid-1980s, not only in term of their ratios to total expenditures but also in terms of GDP. As evident from **Figure 2**, the decline in defence and development expenditures over the past one and half decades is largely attributable to the consolidation of public sector. Furthermore, the rise in defence expenditure generally accompanied the increase in overall expenditures, instead of decline in development expenditure. Specifically, there are only 7 years (out of 52 years) in which the increases in defence expenditure to GDP ratio does not accompany the increases in total expenditures to GDP ratio, but moves along with the declines in development expenditure to GDP ratio.

decomposed the annual series to obtain quarterly data. This may entail errors.

In sum, the above discussion suggests that war driven changes in defence expenditure in Pakistan hardly support the MKH and lend more credence to the view that the defence expenditure is used mainly for securing external defence and as such may not necessarily be used to counter down-turn cyclical movements in the economy. Furthermore, the negative relation between the defence and development expenditure does not seem to be hold. To be more precise, annual time series data on defence expenditure, development expenditure, consumer price index and GDP at current factor cost from FY50 to FY04 are used to analyze the presence of any causal relationship among these variables. The causal relationship is tested by using standard co-integration techniques and causality tests in VAR/VEC settings.

Figure 2: Trends in Expenditures to GDP ratios



4. Methodology: VAR/VECM and Causality Tests

The presence of any long-run relationship among defence expenditure, development expenditure, inflation and the income is tested with the help of Johansen co-integration technique, while the short-run dynamics are analyzed with the help of error correction model. This approach involves the following steps.

First, the relevant time series are tested for stationarity. A non-stationary time series Y_t is said to be integrated of order *d*, mathematically $Y_t \sim I(d)$, if it achieves stationarity after being differenced *d* times. The order of integration is determined by using the unit root tests. The most popular test to determine unit root in the series is Augmented Dickey Fuller (ADF).

Second, for co-integration analysis, optimal lag length of the system is determined with the help of an unrestricted VAR model.[5] The lag length should be high enough to ensure that the errors are approximately white noise.

[5]In VAR approach, each variable is treated as an endogenous variable in the system and is expressed as a linear combination of lagged values of itself and lagged values of all other variables in the group (see Johnston and Di-Nardo, 1997).

Third step is to test for co-integration using the optimal lag length determined in preferred VAR. The Johansen co-integration test states that if there are *k* endogenous variables, each of which has one unit root, there can be from zero to *k-1* linearly independent co-integrating relations.

Fourth step is to make a Vector Error Correction model (VECM) to study the short-run dynamics of the series. The VECM is a restricted form of VAR that incorporates co-integration restrictions. This specification restricts the behavior of co-integrating variables to converge to their long-run equilibrium. Furthermore, this specification allows for a wide range of short-term dynamics. The explicit functional form incorporating the Johansen (1988) co-integration restriction for two variables can be expressed as follow.

$$\Delta Y_t = \mu_y + \alpha_y ECT_{t-1} + \sum_{k=1}^{p} \beta_{yx,k} \Delta X_{t-k} + \sum_{k=1}^{p} \beta_{yy,k} \Delta Y_{t-k} + \varepsilon_{yt}$$

$$\Delta X_t = \mu_x + \alpha_x ECT_{t-1} + \sum_{k=1}^{p} \beta_{xx,k} \Delta X_{t-k} + \sum_{k=1}^{p} \beta_{xy,k} \Delta Y_{t-k} + \varepsilon_{xt}$$

In above equations, ECT_{t-1} is the error correction term lagged one period; $\beta_{ij,k}$ gauge the effect of *k*-th lagged value of variable *j* on the current value of variable *i*. The ε_{it} are the mutually un-correlated white noise residuals.

The increased use of VECM to study short-run dynamics of the variable without losing information on the long-run relationship has led to the modification of conventional causality tests. In fact, the presence of co-integration provides an additional channel for connecting variables in a Granger-causal chain. In a co-integrated system, since any deviation from the long-run equilibrium relationship between the levels must be corrected, therefore some or all the variables in the system must be Granger caused by the error correction term. Moreover, current change in Granger-caused variable in the system will partially be the outcome of its own adjustment towards long-term trend values of the other variables (see Granger 1988).[6]

In this backdrop, the Granger causality from variable *j* to variable *i* in the presence of co-integration is evaluated by testing the null hypothesis that $\beta_{ij,k}$ =0, and $\alpha_i = 0$ for all *k* in the equation, where *i* is the dependent variable. For this purpose, standard Wald test can be used. The two parts of the tests are also labeled as test of short-run and long-run Granger-(non) causality in the literature. For example, Masih and Masih (1996) state that the tests of lagged parameters ($\beta_{ij,k}$ =0) give the indications of "short-term" causal effect and significance of error correction term (α_i) indicates the "long-term" causal effect. Dufour and Renault (1998) also argue that one can distinguish between "short-run

[6]Moreover, if two variables are co-integrated, one possibility of standard Granger (1969) test -- no-causality in either direction -- is ruled out.

(non) causality" and "long-run (non) causality" on the basis of the indirect effects while analyzing the relationships between the series.

5. Data and Empirical Results

The primary data source for Pakistan's fiscal operations and output measures is the periodical Economic Survey. We used "50 Years of Pakistan in Statistics", a document published by Federal Bureau of Statistics (FBS) that contains most of the statistical tables published in various Economic Surveys from 1947-1997. Supplementary information is obtained from various issues of Economic Survey to complete the series from FY51 to FY03. All variables namely Gross Domestic Product (at current factor cost), Defence Expenditure, Development Expenditure are in nominal terms and expressed in natural log to make interpretation simple. To capture the dynamics of inflationary pressure, natural log of Consumer Price Index is introduced as a separate variable. Additionally, a dummy variable (one for FY66 and FY72, zero otherwise) is also used to capture the effect of wars with India.[7]

Time-series properties of log of GDP (LNY), log of defence expenditure (LDEF), log of development expenditure (LDEV) and log of Consumer Price Index (LCPI) are reported in **Table 3**. The ADF shows that all series are found to be non-stationary at levels and stationary at their first differences. These results are also confirmed with the help of correlogram at levels as well as at first differences.[8] Since all variables are integrated of the same order, i.e. *I(1)*, therefore one can expect that these series may be co-integrated as well.

Table 3: ADF Unit Root Test Result

Variable	Levels				First Deference			
	ADF	**Intercept**	**Trend**	**Lags**	**ADF**	**Intercept**	**Trend**	**Lags**
LNY	2.172	Yes	No	Zero	-5.565	Yes	No	Zero
LDEF	-0.025	Yes	No	Zero	-8.206	Yes	No	Zero
LDEV	-1.702	Yes	No	Zero	-7.963	Yes	No	Zero
LCPI	0.448	Yes	No	Zero	-3.707	Yes	No	Zero

* Indicates significant at 1 percent.

Note: Lag length is determined according to Schwarz Criterion

In second step, unrestricted Vector Autoregressive (VAR) model with two lags was selected on the basis of Schwarz Information Criterion (SIC) and the congruence properties of residuals from competing specifications with different lags. Detailed results of VAR estimation are reported in **Appendix Table A1**.

[7] All data series from FY51 to FY03 witnessed a structural break in FY72 due to separation of East Pakistan. Initially a dummy variable was introduced as an exogenous variable to capture this structural break; however, this turns out to be insignificant.

[8] The optimal lag length according to Schwarz Information Criterion (SIC) is zero, which implies that ADF test effectively become DF test.

To cheek the robustness of VAR specification, the statistical diagnostic tests were applied to the residual series obtained from the VAR estimation. As evident from **Table 4,** the ADF test showed that all residual series are stationary. This was also confirmed by inspecting correlogram of the residual series.

Table 4: Diagnostic Tests of Residuals obtained from VAR Model

	LNY	LDEF	LDEV	LCPI
R^2	0.998	0.996	0.989	0.999
ADF	-5.816	-8.923	-7.105	-4.515
Mackinnon Cr. Value at 1%	-3.568	-3.568	-3.568	-3.568
Q-Stat at lag 5	5.960	6.504	5.987	10.206
Probability	0.310	0.260	0.308	0.070
Jarque-Bera Statistics	47.113	0.836	0.164	41.132
Probability	0.000	0.658	0.921	0.000

Serial correlation in residuals was tested with the help of Ljung-Box statistic up to 5th order. The results indicate that while the possibility of serial correlation is remote in residuals of the series, the hypothesis of serial correlation is rejected with greater probability for LNY and LDEV as compared with other series. These diagnostic tests suggest that enough lag numbers were incorporated in the model. However, despite these results we cannot establish the normality of residuals, as Jarque-Bera test statistics exceeded the critical values for two of the four series. This violation is not surprising particularly in the presence of war effects and its fallouts in the data.[9]

In the next step, the rank of co-integrating vector at pre-selected lag length is determined with the help of Johansen (1988) maximum liklihood co-integration techniques. This test uses maximum eigenvalue values (λ_{max}) and trace statistics (λ_{Trac}). Both the λ_{max} and λ_{Trac} statistics indicate the presence of a single co-integrating vector at one percent level of significance (see **Table 5**). In simple words, the results indicate the presence of a long-run equilibrium relationship among income, defence expenditure, development expenditure and inflation. This evidence of co-integration has two important implications. First, it rules out one of the four possibilities of Granger non-causality and suggests a unique channel for Granger-causality to hold either uni-directional or bi-directional. Second, it also rules out the use of ordinary first-differenced VAR to model the dynamic relationship among these variables.

Table 5: Johansen Multiple Co-integration Test

No. of CEs	Trace	Max-Eigenval.	Critical Value
H_0: r = 0	68.48*	37.64*	54.46, 32.24
H_0: r ≤ 1	30.84	15.64	35.65, 25.52
H_0: r ≤ 2	15.20	14.52	20.04, 18.63
H_0: r ≤ 3	0.68	0.68	6.65, 6.65

Co-integration Equation

LRY = 2.92 – 1.44*LDEF + 1.39*LDEV + 2.23*LCPI

t-statistics (-3.86) (6.24) (4.61)

*denotes rejection of hypothesis at 1percent significance level

Note, r=0 means there is no co-integrating vector.

However, the presence of co-integration does not indicate the direction of Granger causality. For this purposes, we estimated VECM incorporating same assumptions related to deterministic trend in data

[9] One can argue that such unusual event can be modeled through dummy variables. However, introduction of large number of dummy variables may not be appropriate due to two reasons. First, co-integration techniques in fact investigate the underlying temporal relation between the series, therefore, the introduction of dummy variable will affect the temporal relation. Second, while the co-integrating relation will be sensitive to the inclusion/exclusion of exogenous variables, the

and co-integrating relation as was used in Johansen co-integration test. While the temporal causality results based on VECM are reported in **Table 6**, the original VECM estimates are reported in **Appendix Table A2**. The results indicate the presence of long-run Granger temporal causality among all the variables as the lagged error correction terms in all of the four equations are statistically significant. In simple words, the significance of error correction terms implies that each series in the system is adjusting towards the long-run equilibrium relation and the adjustment is initiated by the combination of all variables jointly. Specifically, a feedback relationship is evident among the income, defence expenditure, development expenditure and inflation.

Table 6: Results of Temporal -Causality Tests

	Independent Variables				
	ECT_{t-1}	∑ΔLNY	∑ΔLDEF	∑ΔLDEV	∑ΔLCPI
ΔLNY	-0.049*	7.62*	**4.26**	3.20	1.61
ΔLDEF	-0.128*	**1.47**	**0.71**	**1.42**	**1.34**
ΔLDEV	0.199*	1.40	**0.56**	3.79	0.89
ΔLCPI	0.034*	15.28*	**1.67**	0.29	11.51*

*indicates the level of significance at 1percent.
Figures in columns other than ECT_{t-1} represent the Wald test statistic.

To study the short-run Granger-causality, we evaluated zero restrictions on the lagged coefficients of the differenced variables by using Wald test statistic. The results indicate:

1. A separate test of zero restrictions on the coefficients of lagged differenced variables in equation for ΔLNY suggests that the changes in defence expenditure, development expenditure and inflation do not translate significantly to changes in the income in the short-run. In other words, there is no evidence of short-run causality from these variables towards income. Further analysis indicates that a test of simultaneous zero restrictions on all the coefficients of variables was rejected with 10 percent level of significance. This implies that combined effete of all the variables have some explanatory power to determine the changes in income. These results are in sharp contrast to the earlier findings of Looney (1998).
2. In the equations of defence expenditure, not only the zero restrictions on coefficients of individual variables were accepted, but we can not reject the null hypothesis of zero restrictions in case of a joint hypothesis. These results lend more credence to our earlier assertion that defence expenditure in Pakistan is largely driven by non-economic factors like strategic interests and efforts to maintain a minimum level of deterrence.
3. Like defence expenditure, we can not reject the null hypothesis of the zero restrictions on the co-efficient of income, defence expenditure and inflation in the equation of development expenditure. Both the acceptance of zero restrictions on the coefficients of lagged ΔLDEV in the equation of ΔLDEF and restrictions on the lagged coefficients of ΔLDEF in the equation of ΔLDEV dispels the general perception that the decline in development expenditure over time is attributable to increase in defence expenditure. A more plausible explanation may be

critical values for test statistics do not take into account the presence of exogenous variables. In this backdrop, the efforts should be made to minimize the use of dummy variables in such models.

the fact that increases in defence expenditure were generally financed by taking recourse to higher budget deficit.

4. There is strong evidence of short-run causality from income towards inflation, as the zero restrictions on the coefficient of income are rejected with a high level of statistical significance. However, no temporal causality was observed from defence and development expenditure towards inflation. These results are again not in agreement with the findings of the Looney (1998a) that defence expenditure declines with increases in inflation.

6. Conclusion and Policy Implications

The aim of this paper was to analyze the causal relationship, if any, among the defence expenditure, development expenditure, inflation and economic growth. To accomplish this, we used annual time series data from FY51 to FY03 and standard Johansen co-integration techniques in VAR/VECM setting. The results indicate the presence of a long-term relationship among the defence spending, development expenditure, inflation and GDP. The variables are connected in Granger-causal chains, however, short-run and long-run-chains differ with each other.

Although there is a long-run temporal causality relationship among the variables, defence expenditure can not be used for stabilization purposes due to absence of any significant temporal relation in the short-run. Furthermore, the evidence also suggests that defence expenditure can not be used to counter inflationary pressures in the short-run. Similarly, there is no significant short-run causal relationship between the defence expenditure and development expenditure. This undermines the popular perception that increases in defence expenditure are generally accompanied with the decline in development expenditure.

The above results suggest that not only popular perception that defence expenditure hurts economic growth does not seem to hold over the estimation period, but the Military Keynesian hypothesis also does not hold in case of Pakistan. However, one can still argue in terms of the opportunity cost of the defence expenditure. Nevertheless, one should not forget that defence expenditure is primarily used for securing external defence, which has an undisputed intrinsic value for any nation.

References

Andersson, B [1998], “On the Causality between Savings and Growth: Long- and Short-run Dynamics and Country Heterogeneity”, Working Paper, Uppsala University, Uppsala, Sweden.

Benoit, E., [1978], “Growth and Defence in Developing Countries”, Economic Development and Cultural Change, 26, pp. 271-280.

Dufour, J-Marie and E. Renault [1998], “Short-run and Long-run Causality in Time Series: Theory”, Econometrica, 66 (5), pp. 1099-1125.

Hartley, K. and T. Sandler, (eds) [1995], *Handbook of Defence Economics,* Volume 1, Elsevier Science B. V. Amsterdam, The Netherlands.

Johansen, S. [1988], “Statistical Analysis of Co-integration Vectors”, Journal of Economic Dynamics and Control, 12, pp. 231-254.

Johnston, Jack and J. DiNardo (eds) [1997], *Econometric Methods*, Fourth Edition, The McGraw-Hill Companies, Inc. New York.

Looney, E. Robert [1998a], “Defence Expenditure and Macroeconomic Stabilization in Pakistan: A test of the Military Keynesianism Hypothesis”, Rivista Internazionale Economiche e Commercialli (RISEC), Vlo. 45 (Sep.) pp. 599-613.

Looney, E. Robert [1998b], “Foreign Capital Flows and Defence Expenditures: Pattern of Causation and Constraint in Pakistan”, Canadian Journal of Development Studies, Vol. XIX (1), pp. 117-132. .

Masih, R. and Masih, A. M.M. [1996], “Macroeconomic Activity Dynamics and Granger causality: new evidence based on small developing economy based on a vector error-correction modeling analysis” Economic Modeling, 13, pp. 407-426.

Ram Rati [1995], “Defence Expenditure and Economic Growth” In Hartley, K., and T. Sandler, (eds). *Handbook of Defence Economics* Volume 1, Elsevier Science B. V. Amsterdam, The Netherlands.

Tahir, Rizwan and G. M. Sajid, [1999], “Defence Spending and Economic Growth in Less Developed Countries: Re-examining the Issue of Causality”, Government College Economic journal, 32 (1&2), pp 27-39.

Appendix Table A1: Results of Vector Auto regression Model

Variables	LNY	LDEF	LDEV	LCPI
LNY_{t-1}	0.994*	-0.182	0.599	0.251*
LNY_{t-2}	-0.136	-0.112	-0.562	-0.237*
$LDEF_{t-1}$	0.096	0.753*	0.322**	0.039
$LDEF_{t-2}$	-0.051	0.212	-0.033	0.063
$LDEV_{t-1}$	-0.007	0.071	0.425*	-0.022
$LDEV_{t-2}$	0.044	0.062	0.328*	-0.011
$LCPI_{t-1}$	-0.037	0.156	0.151	1.319*
$LVPI_{t-2}$	0.134	0.161	-0.418	-0.465*
Constant	0.651	1.429*	0.411	-0.170
DW	-0.229*	0.436*	-0.635*	0.009
Residual				
R-squared	0.998	0.996	0.989	0.999

Appendix Table A2: Results of Error Correction Model

Variables	ΔLNY	ΔLDEF	ΔLDEV	ΔLCPI
ECT_{t-1}	-0.049*	-0.128*	0.199*	0.034*
ΔLNY_{t-1}	0.160	0.029	0.425	0.260*
ΔLNY_{t-2}	-0.444*	-0.384	0.086	0.135
$\Delta LDEF_{t-1}$	0.141**	-0.120	0.085	-0.003
$\Delta LDEF_{t-2}$	0.116	-0.023	0.144	0.049
$\Delta LDEV_{t-1}$	-0.108**	-0.109	-0.300**	0.012
$\Delta LDEV_{t-2}$	0.017	0.069	-0.069	-0.011
$\Delta LCPI_{t-1}$	0.349	0.579	0.691	0.439*
$\Delta LCPI_{t-2}$	-0.055	-0.572	-0.621	0.009
Constant	0.110	0.146*	0.093	-0.009
DW	-0.286*	0.373*	-0.694*	0.005
Residual Tests				
R-squared	0.523	0.417	0.499	0.617
ADF	-7.206	-7.729	-5.758	-6.518
Critical Value	-3.563	-3.563	-3.563	-3.563
Q-Stat at Lag 5	2.359	2.871	5.628	3.050
Probability	0.798	0.720	0.344	0.692