Southeast Asian Journal of Economics Vol.11(1), April 2023: 123-158
Received: Apr 10 2022
Revision: Jun 9 2022
Accepted: Sep 12 2022

Nexus between Military Expenditure and Economic Growth in Bangladesh: A Vector Error Correction Model Approach

S.M. Nasir Uddin

Assistant Professor, Department of Economics, Bangabandhu Sheikh Mujibur Rahman Science and Technology University, Gopalganj-8100, Bangladesh.
Corresponding Author: S. M. Nasir Uddin (nasiruahmed789@gmail.com)

Anika Binte Shafiq

B.Sc. and M.Sc. in Economics, Department of Economics, Jahangirnagar University, Savar, Dhaka-1342, Bangladesh.

Abstract

Military expenditure is considered an influential factor in gross domestic product. This study investigates the relationship between military expenditure and gross domestic product in Bangladesh. Time series data, econometric techniques, and some robustness tests are used in this analysis. The results reveal that a 1% increase in military expenditure leads to a 0.74% increase in gross domestic products in the long run. A unidirectional causal relationship is identified, meaning that military expenditure causes economic growth. An external shock on military expenditure to gross domestic product and gross domestic product to itself have a positive effect, whereas an external shock on military expenditure to itself is decreasing, and gross domestic product is reacting to a shock of military expenditure that initially increases and then remains almost steady in the following years. Hence, military expenditures have a positive impact on economic growth in Bangladesh.

Keywords: military expenditure, economic growth, defense burden, gross domestic product, Bangladesh.

1. Introduction

Most countries have military forces, and it is an inevitable sector run by the government of those countries. Some developed countries have military expenditures more or less equivalent to their GDP, which is much more than the expenditures of less developed and developing countries. Some developing countries spend more money on the military sector than other important sectors in their economies. Hence, the military and defense industries play an important role in the economy.

Bangladesh is a developing country having a military strength ranked 46 out of 138 countries (Global Fire Power, 2020). When it comes to military expenditure, citizens want to know whether this vast public spending will have any impact on economic growth. This is a concern of all countries when the government must spend on several sectors, e.g., healthcare, education, social security, infrastructure, transportation, defense, agriculture subsidies, and so on. The impact of that spending can be seen through the health sector improving, the literacy rate increasing, changing infrastructure, and an increase in agricultural output. However, the impact of defense spending is not so visible to the public.

Studies that evaluate education and healthcare expenditures and agricultural subsidies on economic growth in Bangladesh are broadly available, while the study of the impact of defense expenditure on economic growth is not so available. Therefore, we have chosen to select this issue for our study. In this paper, we assess the relationship between military spending and GDP as a proxy of economic growth in Bangladesh.

Many related studies have been conducted on this subject. Qureshi and Khan (2017) determined the military expenditure and economic growth relationship in Pakistan. Klein (2004) examined the impacts of military expenditure on economic growth in Peru. Researchers have also identified different relationships and influences of military expenditure on economic growth. Narayan and Singh (2007) revealed that military expenditure accelerated Fiji's economy positively with both short-run and long-run positive influence on exports. Pradhan, Arvin, Norman, and Bhinder (2013) defined the relationship between defense expenditure and economic growth. In contrast, Smith and Tuttle (2008) concluded that they could not find enough evidence that military expenditure enhanced real aggregate output. Ram (1995) provided an inconclusive estimation of the effects of defense expenditure on economic growth.

No absolute statement on this issue was found in the economic literature related to Bangladesh. While the Keynesian school of thought suggests that military expenditure increases GDP or positively influences economic growth in developing countries, more military spending does not always means more GDP growth. Sometimes it can shrink private investment, leading to a decrease in GDP.

2. Theoretical background

Discussions about military expenditure in Bangladesh are not apparent. This study will discuss and examine the relationship between military expenditure and GDP, from which we can glean information on the necessity of military expenditure and subsequently infer future military and economic conditions in Bangladesh. Research or empirical analysis is rarely found in the context of Bangladesh. Therefore, we have attempted to analyze and explain this phenomenon.

Ali and Ather (2014) explained three ways in which military expenditure can cause economic growth, e.g., indirect effect (aggregate demand creation), distribution of resources, and creation of employment. More expenditure in the defense sector means more consumption of goods and services leading to increased aggregate demand. Additionally, increasing aggregate demand expands the economy and spurs economic growth. The distribution of resources is one prerequisite for economic growth. Many capital stocks, reserves, or resources may not be utilized in the economy. Investment in these resources in defense industries can lead to economic growth. Another influential way to affect economic growth is to create new employment in the defense industry. This supports the theories of military Keynesianism.

Antonakis (1997) traced a negative effect on economic growth by military expenditure in Greece. Military expenditure could affect the growth rate in several ways. The amount of money spent on military expenditure could be used on other industries to increase output growth. Here, we can explain the theoretical economy of two goods by the guns-and-butter curve to show the opportunity cost of producing guns. Azam (2020) investigated a strong negative impact of defense expenditure on output growth. High military expenditure could turn to stimulate an arms race among the countries that may see a slowing pace of economic growth. Less developed countries commonly face many crises, and their average growth rates are quite low. In less developed countries, military expenditure showed a negative effect on growth rate and reduced the speed of development (Deger & Smith, 1983). One study revealed that the positive effects of military expenditure on economic growth are found more in developed countries compared to less developed (Awaworyi & Yew, 2014). Feridun, Sawhney, and Shahbaz (2011) found a strong, positive unidirectional causal relationship running from military expenditure to economic growth. Heo and Ro (1998) found no significant relationship between defense expenditure and economic growth in South Korea, though they did identify, by considering its external effect, that defense expenditure suppresses economic growth in Taiwan.

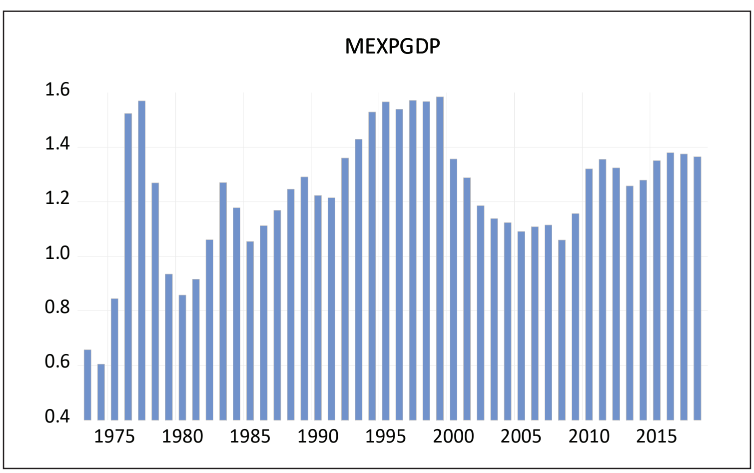
The economy of Bangladesh largely depends on agriculture, foreign remittance, and the ready-made garments sector. Factors such as government expenditure, investment, foreign direct investment, capital formation, technical innovation, population growth, net export, employment rate, the discovery of natural resources, and political status affect the economic growth of a country. We consider these factors as variables to evaluate how they affect economic growth in Bangladesh; meanwhile, we regard military expenditure and GDP as the variables of interest in our study. We use time series data collected from the World Bank's "World Development Indicator" database annual data from 1973 to 2018, the GDP time series data measured in US dollars, and military expenditure also measured in US current dollars. The time series data is converted to natural log form, and for the convenience of the analysis, are described below in Table 1.

Table 1: Variables description

Variables	Description
LNGDP	Natural log of Gross Domestic Product
LNMEX	Natural log of Military Expenditure

Bangladesh is one of the fastest-growing economies in the world, ranking seventh, with a rate of 7.3% real GDP annual growth. In 2018, the value of the GDP was $274,025,000,000 (current USD), and 1.3649% of its GDP was used for military expenditure. Figure 1 below shows military expenditure as a % of GDP.

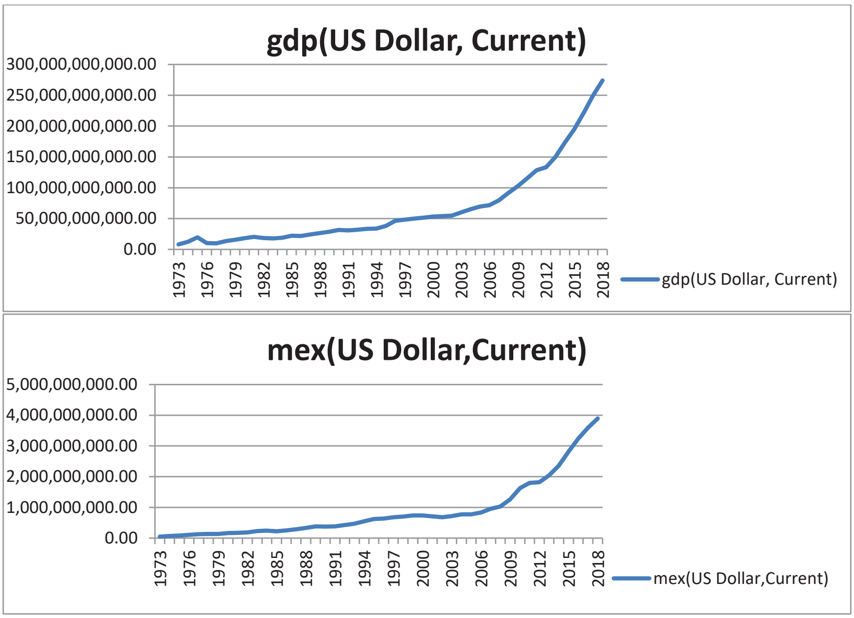
Figure 1. Military expenditure (% of GDP)



Source: Authors' calculations.

In Figure 1, we can see that the highest military expenditure was 1.58% in 1999 and the lowest military expenditure was recorded as 0.60% in 1974. After 1999, this expenditure dwindled up to 2010 and then began to upturn.

Figure 2. Plot of GDP and military expenditure in Bangladesh



Source: Authors' calculations.

In Figure 2, we can see the GDP and military expenditure flow in current USD from 1973 to 2018. In this figure, we see that both GDP and MEX are increasing positively with a similar trend and shape. This indicates the simple notion that GDP changes led to military expenditures changing as well as the changing of military expenditures leading to changes in GDP. In this study, we attempt to identify the relationship between our selected variables. The following analysis and results will provide a clearer understanding of the topic.

3. Literature Review

Empirical studies, such as Dunne and Vougas (1999) and Haseeb, Bakar, Azam, Hassan, and Hartani (2014), investigated the relationship between military expenditure and economic growth, and the results showed negative long-run relationships between defense expenditure and economic growth in Pakistan. Some major productive sectors may have deteriorated, and their findings suggested a reformulation of their policy. Dunne and Vougas (1999) also suggested that a negative impact existed between military spending and growth by analyzing the data from 1964 to 1996. They revealed that military burden had a decreasing growth effect and suggested that cutting defense expenditures could increase the growth and benefit the economy.

Anyanwu and Aiyedogbon (2011) used cointegration and the vector error correction model (VECM) and found that military expenditure has a positive relationship with economic growth in both the long run and short run. By analyzing variance decomposition, they identified a trivial impact of military expenditure on growth. Gupta, Kabundi, and Ziramba (2010) used the Factor Augmented Vector Autoregressive (VAR) model to examine the effect of positive defense expenditure shock on the growth rate of real GNP. Kollias, Manolas, and Paleologou (2004) and Raju and Ahmed (2019) used cointegration and the causality test to define the effect of military expenditure on economic growth. Odehnal and Neubauer (2012) differentiated four types of relationships by adopting the VAR, the VECM model, and the Granger causality test, showing a mutual link between the concerned variables, a relationship showing military expenditure having influence on economic growth, a link showing the influence of economic growth on the level of military expenditure, and non-existence of any relationship between anticipated variables. Dunne and Vougas (1999) found a negative relationship between military expenditure and economic growth in South Africa, but this was not seen through the standard techniques of analysis because much economic change has taken place in the recent past. The South African economy as a developing country had a high military burden with strong military forces. Umar and Bakar (2015) mentioned how the work of Benoit (1978) accelerated research on defense expenditure and economic growth linkage. Their findings are inconclusive as there were methodological variations, a versatile econometric model and techniques, a different economic culture in each country, different geographic locations, and varied data availability in various time periods. Other studies explored this context of economic growth and defense expenditure, such as measuring the influence of military expenditure and threats to growth in Nigeria (Umar & Bakar, 2015). The results show a significant long-run relationship exists between defense expenditure and the threat on economic growth in both short- and long-run conditions.

Ali and Ather (2014) employed the two stages least square (2SLS) method to measure the direct and indirect impact of defense burden on economic growth. The findings showed that defense expenditure, directly and indirectly, affected a slowdown of economic growth in Pakistan. Higher income inequality was found in Pakistan as military expenditure was being raised (Raza, Shahbaz, & Paramati, 2017). A good direction was found in Harris' (1988) work that military expenditure slowed economic growth by replacing the available resources in productive investments with military expenditure. The reduction in military spending could increase spending on health, education, and so on and might lead to economic growth. In the end, it was recommended that military expenditure be cut down in developing countries. Abdel-Khalek, Mazloum, and El Zeiny (2019) showed no causal relationship between military expenditure and economic growth in an estimated period in India. However, they gave the highest priority to military strategy and capacity because of regional provocation in South Asia. Indian military industries have earned a good reputation for the high number of military exports. The integration of public, private, and foreign direct investment in the military sector in India is considered a lucrative policy for Indian military manufacturing industries. Arshad, Syed, and Shabbir (2017) used the Augmented Solow Model for analyzing the relationship between military expenditure and economic growth and suggested that a country spends more on its defense purposes while engaged in conflicts. However, this might lead to cutting back on economic growth.

Khilji and Mahmood (1997) investigated the influences of military expenditure on economic growth and other relevant economic variables in Pakistan from 1972 to 1995. The defense burden and GDP growth were in a bi-directional causal relationship ensured by the Granger causality test. In this defense and development literature, they used four single equation models where results showed the defense burden was negatively related to GDP growth. In single equation estimations of the savings ratio and the defense burden, it was found that the saving ratio was affected by the defense ratio positively and negatively by the inflation rate. Haseeb et al. (2014) employed the ARDL model for the data period from 1980-2013 for empirical investigation of whether any relationship existed between military expenditure and economic growth in Pakistan. The result revealed negative long-run relationships. The ARDL approach was also used for analyzing the relationship between military expenditure and economic growth in Malaysia (Saudi et al., 2019).

Dimitraki and Ali (2015) utilized a long period of data from 1952 to 2010 to reexamine the relationship between military expenditure and economic growth in China. The analysis was mainly followed by the Barro style of growth model and used the Bertlett corrected trace test to ensure a better approximation of the rank of cointegration to the finite sample distribution. The results found a unidirectional long-run relationship between these variables.

Pieroni (2009) proceeded to a nonlinear framework considering a hypothesis of the nonlinear effect of military expenditure and economic growth. The study was an examination of the impact of military expenditure on economic growth associated with military and civilian components of government expenditure under the economic growth model with endogenous technology. After adding a proxy of re-allocative effects in the growth model of the equation, the findings indicated a negative relationship between military expenditure and growth in countries having a high level of military burden. Wijeweera and Webb (2009) investigated the relationship between military spending and economic growth in Sri Lanka. They employed a vector autoregressive technique to assess the impact of military expenditure on economic growth. Sri Lanka had experienced considerable economic growth even while increasing its military spending over the last three decades for the civil war. The VAR estimation approach showed that military expenditure had a negligible positive influence on real GDP. A 1% increase in nonmilitary expenditure increased the GDP by 1.6%, while military expenditure only increased the GDP by 0.05%. Maintaining peace rather than being involved in conflict was better for economic growth.

Smith and Tuttle (2008) found no proof of a positive stimulus relationship between defense spending and growth in real output; rather, defense spending led to aggregate income shocks. Another estimation concerning the effect of military spending on output and a dummy of all US military conflicts showed trade-offs between defense and non-defense government expenditure during wartime. Faini, Annez, and Taylor (1984) mentioned the basic Keynesian model of increased military expenditure leading to economic growth, saying that an economy having enough capacity for production increased military expenditure, leading to increased aggregate demand, or demand creation from any other sources pulling up the production, and resource utilization. However, an extension driven by Benoit (1978) for developing countries found that productivity shifted newly-formed military capital that would contribute to overall growth. Likewise, military training and knowledge could make soldiers more productive than civilians after their retirement. Military expenditure could reallocate resources that might turn to earn foreign exchange income by exporting military troops, logistics, arms, and military consultation.

Datta (2017) indicated that the impact of military expenditure on growth was the most debatable area of research among economists. The main issue was whether military expenditure assists or abates economic growth.

Government spending on goods and services, education, health, infrastructure, and defense were important issues in determining the output and employment in a country. On the contrary, military expenditure was not a direct investment in the productive sector and could not increase a nation's ability to produce more goods and services in the future. More public expenditure in the military sector traded off other investments and less investment in public goods like health, education, infrastructural development, and research and development, leading to negative GDP growth. Atesoglu and Mueller (1990) found cogent evidence of a positive relationship between defense spending and economic growth, but the influence of defense expenditure on economic growth was trivial compared to other expenditures. If the US government significantly cut defense expenditures, there would not be much change in economic growth.

Studies applying VECM techniques in the Dreger model, bi-directional causality between GDP and defense expenditure, and unidirectional causal relationship running from GDP to merchandise trade and gross domestic savings to merchandise trade were found. The impulse response function indicated that merchandise trade led to a positive response in one standard deviation shock in defense expenditure, while GDP responded negatively in one standard deviation shock in defense expenditure (Tiwari & Tiwari, 2010). Tahir (1995) used cointegration and the error correction model to examine the issue of a causal relationship between defense spending and economic growth for Pakistan and India. Ajmair, Hussain, Abbassi, and Gohar (2018) found a negative relationship between military expenditure and economic growth but a positive relationship between the number of military personnel and economic growth in Pakistan.

We have reviewed much literature in this context since very little literature exists on defense expenditure and economic growth in Bangladesh. In South Asia, Bangladesh is developing uninterruptedly in several sectors. Here, we attempt to describe the scenario of the military sector and economic growth in Bangladesh. Former researchers were concerned about this topic and used different methodologies, e.g., the ARDL method, VECM method, VAR analysis, and more. Researchers also used different geographic locations, different periods of data, and various types of economic variables to describe the economic intuitions about military expenditure and economic growth. This study has been carried out by using data covering 1973 to 2018. It will explain how military expenditure contributes to GDP and the relationship military expenditure has with GDP. This study will also provide some policies for the future researcher and the government of Bangladesh.

4. Methodology

In our study, we have examined the relationship between military expenditure and GDP in Bangladesh and conducted econometric and statistical tests. The necessity and rationale of these tests are described as follows:

The first initiative was to check whether both time series are stationary. The Augmented Dickey-Fuller test was employed to check the stationarity of the time series data. We applied the VAR model for determining the optimal lag length. For the cointegration analysis, we used the Johansen cointegration test (Johansen, 1988; Johansen & Juselius, 1990). The VECM was used for correcting the error from the short run to the long run. The Granger causality test was used to detect the causality between the variables. Lastly, for the robustness of the analysis, we utilized the serial correlation LM test, the normality test of Jarque-Bera, and the heteroscedasticity test. Impulse response function and variance decomposition methods were also applied for forecasting.

4.1 Unit Root Test

It is necessary to know the nature of time series data for econometric analysis. The nature of time series data determines which methodology, e.g., ARDL, VAR, or VECM models, will be applicable to this study. If the time series variables are integrated into an order of 0 and 1, the mix of I(0) and I(1), the model will be the ARDL model. If all the variables are I(1), the model will be the VECM model. The unit root test defines whether the time series data is stationary or not and explains how it is stationary around the integration of order.

The most popular and widely used stationarity test is the ADF, from which we will identify the order of integration when considering time series variables. The three variants of this test are as follows:

No constant and no trend.

$$\Delta Y_t = \gamma_1 Y_{t-1} + \sum_{i=1}^{m} \alpha_i \Delta Y_{t-i} + \mu_t \tag{1}$$

Constant and no trend.

$$\Delta Y_t = \gamma_0 + \gamma_1 Y_{t-1} + \sum_{i=1}^{m} \alpha_i \Delta Y_{t-i} + \mu_t \tag{2}$$

Constant and trend.

$$\Delta Y_t = \gamma_0 + \gamma_1 t + \gamma_2 Y_{t-1} + \sum_{i=1}^{m} \alpha_i \Delta Y_{t-i} + \mu_t \tag{3}$$

Where μ_t is a pure white noise error term, ΔY_t implies the first difference of the dependent variable, and the maximum lag m is determined by using information criteria. It is essential to determine which of the above equations will be used for checking the stationarity of the data. Initially, the graphical analysis will help us on this matter. If a drift and trend in the graphical analysis of data are found, we will use equation (3). If the graphical representation of data shows only drifts, we must follow equation (2). If both the drift and trend are not detected in the data, we will use equation (1).

In the ADF test, the null hypothesis is δ=0, and by comparing this coefficient value with the critical value, we can detect whether a time series is stationary or non-stationary or stationary in a different order (Dickey & Fuller, 1979). The findings say both time series variables, LNGDP and LNMEX, are stationary at the 1% and 5% level of significance, consecutively.

4.2 Johansen Cointegration Test

After the ADF test, we knew the order of integration of our time series data. We employed the VAR estimation to determine the optimal lag length for the cointegration test. The Johansen test was conducted to identify the cointegrating vector of our variables of interest. The two testing approaches of the Johansen cointegration method are the cointegration rank (trace) test and the maximum eigenvalue test.

Trace test equation.

$$\lambda_{trace(r)} = -T \sum_{i=r+1}^{h} ln(1 - \hat{\lambda}_i) \quad (4)$$

Maximum eigenvalue test.

$$\lambda_{\max\ (r,r+1)} = -Tln(1 - \hat{\lambda}_{r+1}) \quad (5)$$

Where r is the number of cointegrating vectors under the null hypothesis, T is the number of observations, and $\hat{\lambda}$ is the estimated matrix value. If the above two cases depict different results, the trace test is preferable (Al-exander, 2001).

The null hypothesis means no cointegrating equation exists, and the alternative hypothesis is that the null hypothesis is not true. From the above equations, we find the trace statistic and the maximum eigenvalue statistic. These statistics will be compared to the 5% critical value. If the trace statistic and maximum eigenvalue statistic are greater than the 5% critical value, we will reject the null hypothesis; otherwise, the null hypothesis is not rejected.

4.3 Vector Error Correction Model

If the Johansen cointegration test reveals a cointegrated relationship between the variables, we will move to the vector error correction model, and if they are not cointegrated, we will apply the simple VAR model. The vector error correction model represents the relationship between short-run and long-run dynamics, and the following equations are mentioned for the VECM:

$$\Delta LNGDP_t = \alpha_1 + \gamma_1 e_{t-1} + \sum_{i=1}^{p} \beta_i \Delta LNGDP_{t-i} + \sum_{i=1}^{q} \delta_i \Delta LNMEX_{t-i} + \varepsilon_{1t} \quad (6)$$

$$\Delta LNMEX_t = \alpha_1 + \gamma_1 e_{t-1} + \sum_{i=1}^{p} \beta_i \Delta LNMEX_{t-i} + \sum_{i=1}^{q} \delta_i \Delta LNGDP_{t-i} + \varepsilon_{2t} \quad (7)$$

4.4 Impulse Response Function and Forecast Error Variance Decomposition

The impulse response function depicts the response of an endogenous variable to the innovation or shock of other variables. It finds the present and future responses of an endogenous variable by one standard deviation shock. In our study, we used the impulse response function to explain how the estimated variables LNGDP and LNMEX are related to each other. We also used this method to examine how they respond when LNGDP is the independent variable and LNMEX is the dependent variable and vice versa. It also examines the results of the Granger causality analysis. The impulse response function is mostly used for testing causal analysis and policy effectiveness analysis. The impulse response function can be stated as the following equation:

$$Ɽ_i = \Theta_i B^{-1} \Phi^{\frac{1}{2}} \quad (8)$$

The variance decomposition of the forecast error explains the contribution of each variable produced by the shock of other variables. It reveals the percentage of impact on one variable by other variables. It also measures the fraction in a variable determined by the innovations of other variables. We have attempted to predict how the LNGDP is influenced by LNMEX and LNMEX is influenced by the LNGDP in the short run and long run. Variance decomposition of the forecast error bears a concern in this study that will assist us in making policy for the defense budget. The estimated result and its interpretation are explained in a later section.

4.5 Granger Causality Test

To know the direction of causality, we applied the Granger causality test proposed by Engle and Granger (1969). This test determines how much of a dependent variable is explained by past values of itself and lagged values of other independent variables (Simiyu, 2015).

$$LNGDP_t = a_0 + \sum_{i=1}^{p} \alpha_{1i} LNGDP_{t-i} + \sum_{i=1}^{q} \alpha_{2i} LNMEX_{t-i} + e1_t \tag{9}$$

$$LNMEX_t = a_0 + \sum_{i=1}^{p} \alpha_{1i} LNMEX_{t-i} + \sum_{i=1}^{q} \alpha_{2i} LNGDP_{t-i} + e2_t \tag{10}$$

Where, $e1_t$ and $e2_t$ are assumed to be uncorrelated. In equation (9), the null hypothesis is "LNMEX does not Granger Cause LNGDP", and "LNGDP does not Granger Cause LNMEX" is the null hypothesis in equation (10). The acceptance of the null hypothesis by comparing it to the *p*-value of the Granger causality test means there is no causal relationship between the estimated variables. If we reject the null hypothesis of the Granger causality test, this implies there are causal relationships between the estimated variables. The estimated results will be discussed in the discussion section.

5. Results discussion

In this section, we explain the estimated results. We initially discuss the descriptive statistics of the variables. Then, we discuss the other estimated results one by one. The descriptive statistics results table is given below.

Table 2: Descriptive statistics

Variables	Obs	Mean	Median	Std.Dev.	Min	Max
GDP	46	66165719807	42189116438	66215706468	8086725729	274039092455.306
MEX	46	878776132.9	629527000.4	959396091.8	48606800.13	3894695211

Source: Authors' calculations.

Table 2 displays the two variables, GDP and MEX, with 46 observations for both variables. We find the mean, median, and standard deviation with minimum and maximum values of the considered variables from the descriptive statistics results.

5.1 Unit Root test results

To examine whether the time series was stationary or not, we applied a series of unit root tests by changing its variations, e.g., level form, first difference form with intercept, with intercept and trend, and more. The estimated results are in Table 3.

Table 3: The results of the ADF

Variable	Test	t-statistic	Critical Value			Prob.*
Level(Intercept)			1%	5%	10%	
LNGDP	ADF	-0.240487	-3.584743	-2.928142	-2.602225	0.9254
LNMEX	ADF	0.591017	-3.605593	-2.936942	-2.606857	0.9877
Level (Trend and Intercept)						
LNGDP	ADF	-3.188571	-4.175640	-3.513075	-3.186854	0.0997***
LNMEX	ADF	-1.448510	-4.205004	-3.526609	-3.194611	0.8305
First Difference (Intercept)						
LNGDP	ADF	-7.020991	-3.588509	-2.929734	-2.603064	0.0000*
LNMEX	ADF	-2.795403	-3.605593	-2.936942	-2.606857	0.0679***
First Difference (Trend and Intercept)						
LNGDP	ADF	-7.048049	-4.180911	-3.515523	-3.188259	0.0000*
LNMEX	ADF	-4.067865	-4.186481	-3.518090	-3.189732	0.0135**

Note: *, **, and *** represent 1%, 5%, and 10% level of significance, respectively.
Source: Authors' calculations.

In Table 3, the ADF results show that LNGDP is stationary at a 1% significance level in the first difference, and LNMEX is stationary in the first difference with trend and intercept at the 5% significance level. Here, we can say that both time series are integrated to an order of 1 that is I(1).

5.2 Johansen Cointegration test results

Table 4: Unrestricted Cointegration Rank Test (Trace)

Maximum Rank	Eigenvalue	Trace Statistic	5% Critical Value
None *	0.250448	18.34786	15.49471
At most 1 *	0.147199	6.528403	3.841465

Note: Trace test indicates 2 cointegrating eqn(s) at the 0.05 level, and * denotes rejection of the hypothesis at the 0.05 level.

Source: Authors' calculations.

Table 4 represents the results of the cointegration trace test for the long-run relationships. In this procedure, the null hypothesis of no cointegration is rejected because the trace statistic 18.34786 is greater than the 5% Critical Value of 15.49471. Here, another null hypothesis is that at most one cointegrating vector is also rejected since the trace statistic 6.528403 is greater than the 5% Critical Value of 3.841465. Finally, we decided that the results indicated evidence of a long-run relationship between the considered variables.

Table 5: Normalized cointegrating coefficients

Cointegrating Equation(s)	Coint Eq1	SE	T-Statistic
LNGDP	1.000000		
LNMEX	-0.737752	(0.05390)	13.564972*

Note: *, **, and *** represent 1%, 5%, and 10% level of significance, respectively.

Source: Authors' calculations.

In Table 5, we find the long-run impact of military expenditure on GDP. The normalized cointegrating coefficient results reveal a positive long run relationship between military expenditure and economic growth. In the long-run, a 1% increase in military expenditure leads to a 0.73% increase in GDP, and it is statistically significant at the 1% level.

5.3 Short-run results of VECM model

The short-run model of VECM can be explained by Table 6, and the short-run coefficient results of the VECM are depicted below.

Table 6: Vector Error Correction for short-run model

Error Correction	D(LNGDP)	D(LNMEX)
CointEq1	-0.002537 (0.08873) [-0.02859]	0.236496 (0.10595) [2.23211]
D(LNGDP(-1))	0.244924 (0.09828) [2.49203]	-0.007198 (0.11735) [-0.06134]
D(LNGDP(-2))	-0.283657 (0.07684) [-3.69176]	0.003744 (0.09174) [0.04081]
D(LNGDP(-3))	-0.029670 (0.07487) [-0.39629]	0.005118 (0.08940) [0.05726]
D(LNMEX(-1))	0.505376 (0.12752) [3.96308]	0.441090 (0.15226) [2.89688]
D(LNMEX(-2))	-0.199604 (0.13511) [-1.47730]	-0.304635 (0.16133) [-1.88826]
D(LNMEX(-3))	0.222130 (0.11764) [1.88823]	0.230403 (0.14046) [1.64029]
C	0.015748 (0.00881) [1.78714]	0.022246 (0.01052) [2.11429]

Source: Authors' calculations.

When the dependent variable is LNGDP, the equation can be written as

$$\Delta LNGDP_t = -0.002537 ECT_{t-1} + 0.244924\, \Delta LNGDP_{t-1} - 0.283657 \Delta LNGDP_{t-2} - 0.029670\, \Delta LNGDP_{t-3} + 0.505376\, \Delta LNMEX_{t-1} - 0.199604\, \Delta LNMEX_{t-2} + 0.222130\, \Delta LNMEX_{t-3} + 0.015748. \quad (11)$$

When the dependent variable is LNMEX, the equation can be written as

$$\Delta LNMEX_t = 0.236496\, ECT_{t-1} - 0.007198\, \Delta LNGDP_{t-1} + 0.003744\, \Delta LNGDP_{t-2} + 0.005118\, \Delta LNGDP_{t-3} + 0.441090\, \Delta LNMEX_{t-1} - 0.304635\, \Delta LNMEX_{t-2} + 0.230403 \Delta LNMEX_{t-3} + 0.022246. \quad (12)$$

In equation (11), the coefficient of ECT_{t-1} is -0.002537, meaning that the previous period deviation from long-run equilibrium is corrected in the current period as an adjustment speed of 0.25%, and it is not statistically significant. For the one lag of LNGDP, the value of the coefficient is 0.244924, meaning that a 1% change in $\Delta LNGDPt_{-1}$ is associated with a 0.24% increase in LNGDP, and it is statistically significant. The value of the coefficient of $\Delta LNGDPt_{-2}$ is -0.283657, meaning that a 1% change in $\Delta LNGDPt_{-2}$ led to a decrease in LNGDP to 0.28%, and it is also statistically significant. The coefficient value of $\Delta LNMEXt_{-1}$ is 0.505376 and implies that a 1% change in $\Delta LNMEXt_{-1}$ led to an increase in ΔLNGDP to 0.5% having statistical significance. The remaining dependent lag variables are not mentioned here as they are not significant.

In equation (12), the coefficient of ECT_{t-1} is 0.236496 and implies that the previous period deviation from long-run equilibrium is corrected in the current period as an adjustment speed of 0.23%, and it is statistically significant. The coefficient value of $\Delta LNMEXt_{-1}$ is 0.441090, meaning that a 1% change in $\Delta LNMEXt_{-1}$ led to an increase of 0.44% of LNMEX, and it is also statistically significant.

5.4 Vector Error Correction Model test results

From the Johansen cointegration analysis, we learned that in our time series data, there was a long-run relationship between military expenditure and GDP. Hence, we estimated using the vector error correction model.

The error correction model represents disequilibrium in the previous period and will adjust gradually toward the new equilibrium (Engel & Granger, 1987). The VECM results are in Table 7.

Table 7: Vector Error Correction Estimates (Speed of adjustments) indicating long-run relationships

Cointegrating Equation(s)	Coint Eq1	SE	T-Statistic
LNGDP(-1)	1.000000		
LNMEX(-1)	-0.869060	(0.05122)	[-16.9674]
C	-3.049754		

Source: Authors' calculations.

The VECM results in Table 7 reveal the short-run and long-run relationships between military expenditure and GDP. The coefficient of error correction model describes the speed of adjustment at which the model is initially in disequilibrium and its return to equilibrium in the long run. The results predict that military expenditure requires 0.87% of error correction per year to obtain equilibrium, and it is convergent to equilibrium in nature.

6. Diagnostic tests

In any time series empirical analysis, diagnostic tests, e.g., serial correlation test, heteroscedasticity test, and normal distribution assumption, are mandatory to confirm that the estimated result is efficient. If the analysis does not pass these robustness tests, the prediction or forecasting will be biased and inefficient. Therefore, we used diagnostic tests to assure a well-estimated analysis.

6.1 VEC Residual Serial Correlation LM test results

In the time series literature, it is compulsory to test whether a serial correlation exists or not between the devised variables. The estimated results show the null hypothesis of "No serial correlation at lag h" cannot be rejected as the prob. values of all at lag h are high enough with a 5% significance value. Therefore, we can say that our estimated model is free from serial correlation problems.

Table 8: VEC Residual Serial Correlation LM test

VEC Residual Serial Correlation LM Tests						
Null hypothesis: No serial correlation at lag h						
Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	5.016146	4	0.2856	1.284593	(4, 62.0)	0.2858
2	7.914520	4	0.0948	2.074822	(4, 62.0)	0.0948
3	2.501457	4	0.6444	0.627819	(4, 62.0)	0.6445
4	1.687271	4	0.7930	0.420731	(4, 62.0)	0.7931
Result: No serial correlation						

Source: Authors' calculations.

6.2 VEC Residual Normality test results

In time series regressi on analysis, it was assumed that the residuals were normally distributed. In Table 9, the VEC Residual Normality Tests: Orthogonalization: Cholesky (Lutkepohl) results show that the probability value of component 1 and component 2 is higher than the 5% critical value; joint probability is also higher than the 5% critical value in the Jarque-Bera test of normality. Therefore, the results tell us that the vector error correction residuals are normally distributed. The skewness and kurtosis results also support the residuals of normality assumption.

Table 9: VEC Residual Normality Tests: Orthogonalization: Cholesky (Lutkepohl)

VEC Residual Normality Tests: Orthogonalization: Cholesky (Lutkepohl)				
Null Hypothesis: Residuals are multivariate normal				
Component	Skewness	Chi-sq	df	Prob.*
1	0.298023	0.621723	1	0.4304
2	0.017966	0.002259	1	0.9621
Joint		0.623982	2	0.7320
Component	Kurtosis	Chi-sq	df	Prob.
1	3.106239	0.019752	1	0.8882
2	2.639808	0.227041	1	0.6337
Joint		0.246793	2	0.8839
Component	Jarque-Bera	df	Prob.	
1	0.641474	2	0.7256	
2	0.229301	2	0.8917	
Joint	0.870775	4	0.9287	
Result: Residuals are normally distributed				

Source: Authors' calculations.

6.3 VEC Residual Heteroskedasticity Test (Levels and Squares) results

In Table 10, the joint test depicts the heteroscedasticity of our calculated model. The coefficient of Chi-sq is 42.12997, and the prob. value is 0.4653, which is much higher than 5%. It indicates that our model does not suffer from heteroscedasticity problems.

Table 10: VEC Residual Heteroskedasticity Tests (Levels and Squares)

Joint test:		
Chi-sq	df	Prob.
42.12997	42	0.4653
Result: No heteroscedasticity		

Source: Authors' calculations.

7. Granger Causality test results

We applied the Granger causality test (Granger, 1969), and the test results are given in Table 11. The null hypothesis "LNMEX does not Granger Cause LNGDP" is rejected since the *p*-value 0.0046 is lower than the 5% critical value, indicating that LNMEX Granger Causes LNGDP. Therefore, we can say there is a unidirectional causality running from LNMEX to LNGDP.

Table 11: Granger causality testy

Null Hypothesis:	Obs	F-Statistic	Prob.	Decision
LNMEX does not Granger Cause LNGDP	42	4.59824	0.0046*	Rejected
LNGDP does not Granger Cause LNMEX		1.74941	0.1627	Accepted

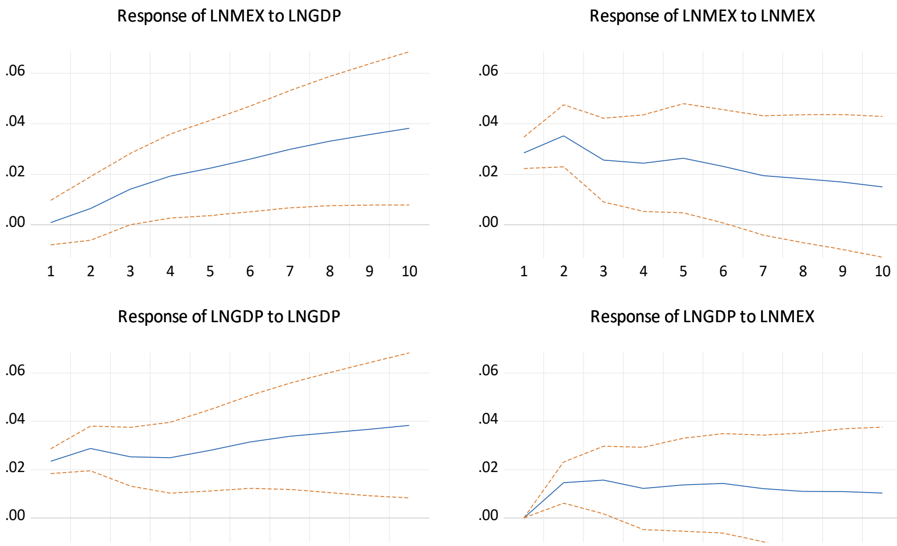
Note: *, **, and *** represent 1%, 5%, and 10% level of significance, respectively.

Source: Authors' calculations.

8. Impulse response function

The impulse response function focuses on the information from the Granger causality test. It explains the sign of the relationships between the calculated variables even if the external shock is permanent. It also reveals the responsiveness of a dependent variable led by an independent variable. This means when a dependent variable experiences a shock, it will return to equilibrium over time.

Figure 3: Impulse response functions for VAR model



Source: Authors' calculations.

The horizontal axis represents a shock in the VAR model over the next 10 time periods, and the vertical axis depicts the value of the response variables. The impulse response line lies in the 95% confidence interval in all cases. The upper two plots indicate the response of LNMEX to a one standard deviation shock to LNGDP and to LNMEX itself. The response of LNMEX is a gradual increase with LNGDP and is above the zero line. The response of LNMEX is a gradual decrease with LNMEX up to 10 time periods. The lower two plots depict the response of LNGDP to LNMEX and to LNGDP itself. The response of LNGDP is a gradual increase up to two time periods and then a decrease for the next two time periods; over the last five time periods is a gradual increase by its own shock. Finally, the response of LNGDP is a reaction to a shock of LNMEX with an initial increase and then over the following time periods remaining steady.

9. Variance Decomposition

Table 12 represents the variance decomposition for focus error variance for LNGDP. Here, we take 10 periods, meaning we look for 10 years in the future, where period 1 is treated as a short run, and period 10 is considered as a long run. In the short run, 100% of LNGDP on itself is explained by period 1, where the contribution of LNMEX is strongly exogenous, implying a very weak influence on predicting LNGDP in the future. In the long run, the influence of LNGDP on itself diminishes compared to the short run. On the other hand, LNMEX is strongly endogenous and implies a strong influence on the dependent variable in the long run.

Table 12: Variance Decomposition of LNGDP

Period	S.E.	LNGDP	LNMEX
1	0.023530	100.0000	0.000000
2	0.040476	87.59927	12.40073
3	0.051133	83.01405	16.98595
4	0.059083	83.20476	16.79524
5	0.067580	83.43896	16.56104
6	0.076562	84.03271	15.96729
7	0.085245	85.45061	14.54939
8	0.093605	86.91122	13.08878
9	0.101758	88.13458	11.86542
10	0.109750	89.25194	10.74806

Source: Authors' calculations.

In Table 13, LNGDP explains 0.102368% of the focus error variance in LNMEX and indicates a strong exogeneity, meaning that LNGDP has a weak influence in predicting LNMEX in the short run. On the contrary, LNMEX predicting itself by 99.89763% indicates a strongly endogenous relationship. In the long run, LNGDP reveals a strong endogenous influence with a 57.18131%

explanation of LNMEX and a 42.81869% influence on LNMEX by itself in the future or period 10.

Table 13: Variance Decomposition of LNMEX

Period	S.E.	LNGDP	LNMEX
1	0.028096	0.102368	99.89763
2	0.045117	2.119218	97.88078
3	0.053654	8.735347	91.26465
4	0.062098	16.93366	83.06634
5	0.071326	23.87394	76.12606
6	0.079775	31.09394	68.90606
7	0.087912	38.65991	61.34009
8	0.096268	45.59316	54.40684
9	0.104689	51.72093	48.27907
10	0.113076	57.18131	42.81869

Source: Authors' calculations.

10. Conclusion and policy recommendations

In a developing country like Bangladesh, military expenditure holds a large share of government expenditures every year. Here, we have examined the impact of military expenditure on GDP or economic conditions in Bangladesh. This study of macroeconomic variables is essential to economic development. Our study covered the time series data set on military expenditure and gross domestic product from 1973 to 2018. The ADF test was used to confirm whether the data sets were stationary or not, and the results showed the data set was stationary at the first order of integration, i.e., I (1). Using the Johansen Cointegration test, we found a long-run relationship exists between the variables of military expenditure and GDP. The long-run relationship between the calculated variables was positive and also statistically significant at the 1% level. This result indicates a 1% increase in LNMEX leads to a 0.74% increase in LNGDP. The VECM results depicted the short-run dynamics of long-run equilibrium, where a 0.87% error correction is required per year to reach equilibrium. The sign of the ECM coefficient was negative and statistically significant, implying the nature of convergence in equilibrium. We applied the Granger causality test with results showing a unidirectional causality running from LNMEX to LNGDP. The impulse response function depicted the response of LNGDP as reacting to a shock of LNMEX, increasing initially and then remaining almost steady in the following years. Our findings are supported by Anyanwu et al. (2011), Ismail (2017), Tiwari and Shahbaz (2013), Atesoglu and Mueller (1990), and Narayan et al. (2007) and opposed to Antonakis (1997), Heo and Ro (1998), Shahbaz et al. (2013), and Azam (2020).

There is an assumption that military expenditure in developing countries is unproductive. Sometimes people asked why the government is spending such a large share of its budget on defense purposes. This study speaks to many of these concerns. The study uncovers military expenditure having a positive impact on GDP. This sector should be expanded, and more investment is essential in the defense industry. The government should maintain the defense sector, free of corruption free, and ensure the quality of contemporary defense logistics. Bangladesh is located geographically in a very important place in Asia. Moreover, Bangladesh has won a maritime dispute with Myanmar. To maintain the sovereignty of its sea boundary, including its exclusive economic zone, military forces must be employed and expenditures increased, with a resulting increase in GDP. Technological and strategic changes could make this defense sector a strong military-based industry and competitive with the rest of the world. More investment in this sector will create sources of employment that could contribute to the GDP. They could even export defense logistics which would help expand the economy. We suggest that future studies include other variables, e.g., development index, vulnerability index, and number of military personnel, as well as number of military personnel in peacekeeping missions, in border areas with rivals, and so on. As the military sector becomes more proficient and accomplished, the government can use it for multifaceted development activity in the country. Therefore, in a nutshell, more government, private sector, or foreign investment in the defense industry has a positive prospect to create employment and increase exports, leading to an enhanced GDP or economic growth.

References

Abdel-Khalek, G., Mazloum, M. G., & Zeiny, M. R. M. E. (2019). Military expenditure and economic growth: The case of India. *Review of Economics and Political Science*, *5*(2), 116-135. https://doi.org/10.1108/REPS-03-2019-0025

Ajmair, M., Hussain, K., Abbasi, F. A., & Gohar, M. (2018). The impact of military expenditures on economic growth of Pakistan. *Applied Economics and Finance, 5*(2). DOI: 10.11114/aef.v5i2.2932

Alexander, C. (2001). Market models: A guide to financial data analysis. *John Wiley & Sons Limited,* DOI: 10.1093/jjfinec/nbg019

Ali, A., & Ather, M. (2014). Impact of defense expenditure on economic growth: Time series evidence from Pakistan. *Global Journal of Management and Business Research: B Economics and Commerce, 14*(9), https://journalofbusiness.org/index.php/GJMBR/article/view/1516

Antonakis, N. (1997). Military expenditure and economic growth in Greece, 1960-90. *Journal of Peace Research. 34*(1), 89-100.

Anyanwu, S., & Aiyedogbon, J. O. (2011). Defence expenditure and economic growth in Nigeria: A vector-error correction model (VECM) approach. *Asian Journal of Empirical Research*, *1*(2), 31- 40. http://www.aessweb.com/journals/December2011/5004/1123

Arshad, A., Syed, S. H., & Shabbir, G. (2017). Military expenditure and economic growth: A panel data analysis. *Forman Journal of Economic Studies, 13*, 161-175. DOI: 10.32368/FJES.20170008

Atesoglu, H. S., & Mueller, M. J. (1990). Defense spending and economic growth. *Defense Economics, 2*(1), 19–27. https://doi.org/10.1080/10430719008404675

Awaworyi, S., & Yew, S. L. (2014). The effect of military expenditure on growth: An empirical synthesis. (Discussion paper 25/14). VIC 3800, Monash University.

Azam, M. (2020). Does military spending stifle economic growth? The empirical evidence from non-OECD countries. *Heliyon.* https://doi.org/10.1016/j.heliyon.2020.e05853

Benoit, E. (1978). Growth and defense in developing countries. *Economic Development and Cultural Change, 26,* 271–280. http://dx.doi.org/10.1086/451015

Datta, K. (2017). Military expenditure and economic growth nexus in the post reform era of India. *Economic Affairs*, *62*(2), 283-287. DOI: 10.5958/0976-4666.2017.00010.9

Deger, S., & Smith, R. (1983). Military expenditure and growth in less developed countries. *The Journal of Conflict Resolution, 27*(2), 335-353.

Dickey, D. A., & Fuller, W. A. (1979). Distribution of the estimates for autoregressive time series with unit root. *Journal of the American Statistical Association, 74*(366), 427–431. DOI: 10.2307/2286348

Dimitraki, O., & Ali, F. M. (2015). The long run causal relationship between military expenditure and economic growth in China: Revisited. *Defence and Peace Economics*, *26*(3), 311–326. https://doi.org/10.1080/10242694.2013.810024

Dunne, P., & Vougas, D. (1999). Military spending and economic growth in South Africa. *Journal of Conflict Resolution*, *43*(4), 521-537. https://doi.org/10.1177/0022002799043004006

Engle, R. F., & Granger, C. W. J. (1987). Cointegration and error correction representation: Estimation and testing. *Econometrica, 55*(2), 251–276. DOI: 10.2307/1913236

Faini, R., Annez, P., & Taylor, T. (1984). Defence spending, economic structure and growth evidence among countries and overtime. *Economic Development and Cultural Change*, *32*, 487–498. DOI: 10.1086/451402

Feridun, M., Sawhney, B., & Shahbaz, M. (2011). The impact of military spending on economic growth: The case of North Cyprus. *Defence and Peace Economics, 22*(5), 555–562. https://doi.org/10.1080/10242694.2011.562370

Global Fire Power. (2020). Bangladesh Military Strength (2020). Retrieved from https://www.globalfirepower.com/country-military-strength-detail.asp?country_id=bangladesh

Granger, C. W. J. (1969). Investigating causal relations by econometric models and cross-spectral methods. *Econometrica, 37*(3), 424–438. https://doi.org/10.2307/1912791

Gupta, R., Kabundi, A., & Ziramba, E. (2010). The effect of defense spending on the US output: A factor augmented vector autoregression (FAVAR) approach. *Defence and Peace Economics, 21*(2),135–147. DOI: 10.1080/10242690903569056

Harris, G.T. (1988). Economic aspects of military expenditure in developing countries: A survey article. *Contemporary Southeast Asia, 10*(1), 82-102. https://www.jstor.org/stable/25797988

Haseeb, M. Bakar, N. A. A. Azam, M. Hasan, S., & Hartani, N. H. (2014). The macroeconomic impact of defense expenditure on economic growth of Pakistan: An econometric approach. *Asian Social Science*, *10*(4).

Heo, U., & Ro, K. H. (1998). Military expenditures and economic growth in South Korea and Taiwan. *International Interactions*, *24*(2), 171-186. https://doi.org/10.1080/03050629808434925

Ismail, S. (2017). Military expenditure and economic growth in South Asian countries: Empirical evidences. *International Journal of Economics and Financial Issues, 7*(3), 318-325. https://www.econjournals.com/index.php/ijefi/article/view/4391

Johansen, S. (1988). Statistical analysis of cointegration vectors. *Journal of Economic Dynamics and Control*, *12*(2-3), 231–254. DOI:10.1016/0165-1889(88)90041-3

Johansen, S., & Juselius, K. (1990). Maximum likelihood estimation and inference on cointegration with applications to demand for money. *Oxford Bulletin of Economics and Statistics, 52*, 169-210.

Khilji, N. M., & Mahmood, A. (1997). Military expenditures and economic growth in Pakistan. *The Pakistan Development Review, 36*(4) Part II(Winter), 791-808. https://pide.org.pk/pdf/PDR/997/Volume4/791-808.pdf

Klein, T. (2004). Military expenditure and economic growth: Peru 1970–1996. *Defence and Peace Economics*, *15*(3), 275–288. https://doi.org/10.1080/1024269032000035101

Kollias, C., Manolas, G., & Paleologou, S. M. (2004). Defence expenditure and economic growth in the European Union: A causality analysis. *Journal of Policy Modeling*, *26,* 553–569. DOI: 10.1016/j.jpolmod.2004.03.013

Narayan, P.K., & Singh, S. (2007). Modelling the relationship between defense spending and economic growth for the Fiji Islands. *Defence and Peace Economics, 18*(4), 391–401. DOI: 10.1080/10242690600807924

Odehnal, J., & Neubauer, J. (2012). Causal analysis of economic growth and military expenditure. Recent advances in energy, environment and economic development. *Conference paper*: https://www.researchgate.net/publication/266199794_Causal_Analysis_of_Economic_Growth_and_Military_Expenditure

Pieroni, L. (2009). Military expenditure and economic growth. *Defence and Peace Economics,* DOI: 10.1080/10242690701589876

Pradhan, R. P., Arvin, M. B., Norman, N. R., & Bhinder, H. K. (2013). Military expenditure and economic growth: Using causality, cointegration and missing variables. *Int. J. Computational Economics and Econometrics*, *3*(3/4), DOI: 10.1504/IJCEE.2013.058496

Qureshi, W., & Khan, N. P. (2017). Revisiting the relationship between military expenditure and economic growth in Pakistan. *Global Social Sciences Review (GSSR), 2*(1), 18 - 46. DOI: 10.31703/gssr.2017(II-I).02

Raju, M. H., & Ahmed, Z. (2019). Effect of military expenditure on economic growth: Evidences from India Pakistan and China using cointegration and causality analysis. *Asian Journal of German and European Studies, 4*(3), https://doi.org/10.1186/s40856-019-0040-6

Ram, R. (1995). Defense expenditure and economic growth. Chapter 10 in Handbook of defense economics, *1*, 251-274. https://doi.org/10.1016/S1574-0013(05)80012-2

Raza, S. A., Shahbaz, M., & Paramati, S. R. (2017). Dynamics of military expenditure and income inequality in Pakistan. *Soc Indic Res, 131*, 1035–1055. https://doi.org/10.1007/s11205-016-1284-7

Saudi, N. S. B. M., Ismail, A. B., Baker, R. B., Pinjaman, S. B., Abdullah, A. N. B., Rafiuddin, N. B. M., & Sulaiman, A. B. (2019). Military expenditure and economic growth empirical evidence from Malaysia. *International Journal of Recent Technology and Engineering (IJRTE)* 8(2S9), https://www.ijrte.org/wp-content/uploads/papers/v8i2S9/B10030982S919.pdf

Shahbaz , M., Afza, T., & Shabbir, M. S. (2013). Does defence spending impede economic growth cointegration and causality analysis for Pakistan. *Defence and Peace Economics, 24*(2), 105-120. https://doi.org/10.1080/10242694.2012.723159

Simiyu, C. N. (2015). Explaining the relationship between public expenditure economic growth in Kenya using vector error correction model (VECM). *International Journal of Economic Sciences, 4*(3). DOI: 10.20472/ES.2015.4.3.002

Smith, J. S., & Tuttle, M. H. (2008). Does defense spending really promote aggregate output in the United States? *Defence and Peace Economics*, *19*(6), 435-447. DOI: 10.1080/10242690701701950

Tahir, R. (1995). Defence spending and economic growth: Re-examining the issue of causality for Pakistan and India. *The Pakistan Development Review*, *34*(4), 1109–1117. DOI: 10.30541/v34i4IIIpp.1109-1117

Tiwari, A. K., & Shahbaz, M. (2013). Does defence spending stimulate economic growth in India? A revisit. *Defence and Peace Economics*, *24*(4), 371-395. https://doi.org/10.1080/10242694.2012.710814

Tiwari, A. K., & Tiwari, A. P. (2010). Defence expenditure and economic growth: Evidence from India. *Journal of Cambridge Studies*, *5*(2–3), 117–131. https://doi.org/10.17863/CAM.1363

Umar, M. A., & Bakar, A. S. A. (2015). Economic growth, defence expenditure and threats in Nigeria 1980-2013: Bound co-integration analysis. *International Business Management*, *9*, 784-790. DOI: 10.36478/ibm.2015.784.790

Wijeweera, A., & Webb, M. J. (2009). Military spending and economic growth in Sri Lanka: A time series analysis. *Defence and Peace Economics*, *20*(6), 499–508. https://doi.org/10.1080/10242690902868301

World Bank. (2020). World Development Indicator. Retrieved from https://databank.worldbank.org/source/world-development-indicators

Appendix: Abbreviations

1. GDP = Gross Domestic Product
2. MEX = military expenditure
3. ADF = Augmented Dickey-Fuller
4. VECM = Vector Error Correction Model
5. VAR = Vector Auto Regressive
6. IRF = Impulse Response Function
7. GFP = Global Fire Power
8. LDC = Least-Developed Country
9. RMG = Ready-Made Garment
10. US = United States
11. 2SLS = Two-Stage Least Squares
12. ARDL = Autoregressive-Distributed Lag
13. LNGDP = Natural log of Gross Domestic Product
14. LNMEX = Natural log of Military Expenditure
15. ECT = Error Correction Term