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Government Expenditure and Economic Growth in Bangladesh: An Econometric Analysis

Soma Bhattacharjee[1*] and Kazi Md. Nasir Uddin[2]

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ABSTRACT

Purpose: This paper aims to identify the impact of different components of government expenditure on the economic growth of Bangladesh to recommend an emphasis on that expenditure that can enhance the economic growth of Bangladesh.
Methodology: The methodology of the study is based on econometric analysis including the Augmented Dickey-Fuller (ADF) test, lag length criteria, co-integration test, VAR model estimation, pairwise Granger causality test, impulse response function, and variance decomposition analysis using data from Bangladesh Economic Review from 1994-1995 to 2016-17.
Findings: The study finds a unidirectional causality from economic growth to non-development expenditure and a bi-directional causality between economic growth and other expenditure. The results from the VAR model with lagged variables of economic growth only show the positive and significant effect, another expenditure has a negative significant impact but development and non-development expenditure show the positive insignificant impact of government spending on economic growth. Moreover, the impulse response function and the variance decomposition model also support the result that development expenditure has a positive influence on the economic growth of Bangladesh.
Limitations: Lack of previous research studies on the topic and limited access to data are major research limitations.
Practical Implications: The result of the study will be a useful source of information for the Bangladesh government for evolving strategies to rigorously monitor the implementation of her budgets to enhance growth in the economy.
Originality: This paper uses the VAR analysis to investigate the impact of government expenditure on economic growth in Bangladesh for the first time. This study further deepens the previous research and draws a more realistic conclusion.

1. Introduction

During recent years, there has been considerable interest among many scholars about the relationship between government expenditure and economic growth (Akpan, 2005; Al- Foul & Al- Khazali, 2003; Barro, 1990; Chang, 2002; Chang, Liu, & Caudill, 2004; Cheng & Lai, 1997; Ghali, 1997; Iyare & Lorde, 2004; Jiranyakul & Brahmasrene, 2007; Menyah & Wolde-Rufeal, 2013; Nurudeen & Usman, 2010; Rana, 2014; Verma & Arora, 2010; Wahab, 2004). There are two possible relationships between government expenditure and economic growth (Menyah & Wolde-Rufeal, 2013). Firstly, public expenditure is an inexorable outcome of economic growth and the level of economic growth affects the growth of government expenditure (Wagner, 1958). Secondly, the Keynesian hypothesis describes that government expenditure is intended to stimulate economic growth.

* Corresponding Author
[1] Associate Professor, Department of Economics, Jagannath University, Dhaka, Bangladesh, E-mail: soma450@yahoo.com
[2] Associate Professor, Department of Accounting & Information Systems, Jagannath University, Dhaka, Bangladesh. E-mail: nasiruddinkazi@gmail.com

According to Wagner's (1958) hypothesis, the public sector enlarges at a faster rate than income over time. The increase in government expenditure is needed because of three main reasons (Iyare & Lorde, 2004; Wahab, 2004; Menyah &Wolde-Rufeal, 2013). Firstly, with the industrialization of the country, the state's administrative and protective functions expand over time so that the market forces can operate properly. Secondly, different types of public services such as education, cultural activities, health services, and welfare expenditures are income elastic. This implies that the demand for these goods increases as income increases. Thirdly, private sectors do not want to invest in technological advancement; consequently, the government needs to increase expenditure on the sciences, technology, and various large-scale investment projects.

Bangladesh has been achieving good economic progress since the 1990s, which is mainly due to implementing a series of structural and economic reform measures. Economic performance, which is measured by Gross Domestic Product (GDP), has been showing an upward trend from the 1990s to date. In Bangladesh, the economic system has relocated as a market economy dominated by the private sector by the mid-1990s, from the public sector dominated the planned economy in the early 1970s. Nevertheless, whatever the form of economic system is prevailing in the country, the government will have to perform some functions to prevent the mess of the economy (Chowdhury & Sen, 1998).

The size of the national budget, as well as government expenditure of Bangladesh, has been increasing rapidly every year. Bangladesh aims to accelerate economic growth, reduce poverty, create higher employment opportunities, implement the 7th Five Year Plan, achieve the Sustainable Developments Goals (SDGs), and maintain Least Developed Countries (LDC) graduation criteria. To achieve all of those targets, the government needs a large amount of expenditure. Government expenditure is an integral part of fiscal management. Nonetheless, if the government expenditures fail to stimulate economic growth during the current period, it will not generate sufficient income to finance government expenditure in the next period (Bataineh, 2012).

The impact of government expenditure may vary depending on the component of government expenditures (Barro, 1990). For a better and meaningful analysis of the impact of government spending on economic growth, it is needed to clearly and properly segregate government expenditure into development expenditure, non-development expenditure, and other expenditures. For that reason, this study has decomposed total government spending into development expenditure, non-development expenditure, and other expenditures.

The general objective of this study is to examine the effect of government expenditure on the economic growth of Bangladesh. However, the specific objectives are to:

i) determine the impact of government development expenditure on the economic growth of Bangladesh;
ii) examine the impact of government non-development expenditure on the economic growth of Bangladesh; and
iii) investigate the impact of government expenditure on the economic growth of Bangladesh.

In the context of Bangladesh, there is hardly any study that measures the relationship between the government's decomposed expenditure and economic growth by using time series data. Hence, the purpose of this study is to fill this gap. To investigate the relationship between development expenditure, non-development expenditure, other expenditure, and the real GDP, this paper uses the vector autoregressive (VAR) analysis. In VAR analysis, the goal is not to estimate a parameter, but to gauge the interrelationship among the variables. For VAR analysis, the study uses the Augmented Dickey-Fuller (ADF) test, lag length criteria, co-integration test, VAR model estimation, pairwise Granger causality test, impulse response function, and variance decomposition analysis to analyze the relationship among government's development expenditure, non-development expenditure, other expenditure and the real GDP of Bangladesh.

For many countries, increasing government expenditure does not increase economic growth (Nurudeen & Usman, 2010). The result of the study would be a useful source of information for the Bangladesh government strategies to rigorously monitor the government expenditure to enhance growth in the economy. The government will focus on the specific component of the expenditure which will benefit the economy most.

The structure of the rest of the paper is as follows. Following the introduction section, an overview of the empirical literature of the study is discussed in section 2.This is followed by section 3 that presents the data sources and variable description and methodology used in the study. Section 4 presents the results and discussion. Finally, some concluding remarks are presented in section 5.

2. Literature Review

Economic growth is a key indicator to measure whether a country is growing more real output of goods and services or not. On the other hand, government expenditure is one of the instruments of fiscal policy. Last few years, numerous studies have examined the relationship between government expenditure and economic growth. Although in many countries budget deficit is a common phenomenon, there are wide ranges of variation in budget deficit across time and countries.

A considerable amount of literature has been published on Wagner's law to test the validity of the law, and also to find out the causal relationship between government expenditure and economic growth. Even though a large number of studies have been done to test the validity of Wagner's law, there appears to exist no consensus even for a single country. Whereas some studies show support for the law, others show little or no support for it.

Chang (2002) has studied five different versions of Wanger's law by using annual time series data for South Korea, Taiwan, Thailand, Japan, the USA, and the United Kingdom. This study has used the unit root test, co-integration test, and Granger causality test to find out a long-run relationship between income and government expenditure. This study has found a long-run relationship between income and government expenditure for five countries except for one country that is Thailand. These results are similar to those reported by Chang et al. (2004). Chang et al. (2004), have also examined five different versions of Wagner's law by using yearly time series data on South Korea, Taiwan, and Thailand, Australia, Canada, Japan, New Zealand, the USA, the United Kingdom, and South Africa. The authors have found unidirectional Granger causality running from income to government expenditure for South Korea, Taiwan, Japan, the United Kingdom, and the United States, supporting Wagner's proposition for those five countries. However, for Australia, Canada, New Zealand, South Africa, and Thailand, the study has found no causal relationship between income and government expenditure.

Ghali (1997) has used a time series analysis specifically to find out the causal relationship between government expenditure and economic growth in Saudi Arabia in the context of vector auto-regressions (VAR). For this reason, the author has examined the intertemporal interactions between per capita real GDP growth rate and the share of government expenditure in GDP. The result of the VAR analysis of this study has found no consistent evidence that changes in government expenditure could change the per capita output growth in Saudi Arabia.

Abu Al- Foul and Al- Khazali (2003) have used co-integration test and vector auto-regressions (VAR) analysis to find out the causal relationship between the economic growth and the growth in the government expenditures for the Jordanian economy. They have found that economic growth Granger causes the growth of government expenditure. In this study, the authors have found evidence that supported Wagner's law. To be specific, the study has shown a uni-directional relationship between economic growth and the growth in the government expenditures for the Jordanian economy.

Cheng and Lai (1997) have studied the causal relationship between public spending and economic growth in a tri-variate framework by using a VAR analysis of the South Korean economy. They have used unit root test, co-integration test, and diagnostic test. The study results have shown a bi-directional causality between government expenditures and economic growth for South Korea. Moreover, in this study, the author's findings support evidence for both Wagner's law that national income stimulates government expenditure and the Keynesian hypothesis that causality runs from government expenditure to national income.

Wahab (2004) has examined the relationship between government spending and economic growth by using yearly data for OECD countries. In this study, the author has used the Error correction model to find out the relationship between the variables. The findings of the research have shown that government spending rises less than proportionately with increasing economic growth and falls more than proportionately with decreasing economic growth. Here, for Wagner's Law, the study has found only partial support.

Akpan N.I. (2005) has done a study which is a part of a larger research about the effect of fiscal policy on economic growth in Nigeria. The specific aim of this study is to find out the consequence of government spending on economic growth in Nigeria by applying a disaggregated approach. To fulfill the aim of the study, the author has firstly determined the components of government expenditure and then applied the unit root test and the error correction model. The study has found no significant association between most components of government spending and economic growth in Nigeria.

To test Wanger's Law, Menyah and Wolde-Rufeal (2013) have examined the relationship between government expenditure and economic growth in Ethiopia. By using the bounds test approach to co-integration, the study has found a long-run relationship between government expenditure and GDP. The authors have found a unidirectional causality from GDP to government expenditure which supports Wagner's Law, whereas, they have found no evidence to support the Keynesian hypothesis for Ethiopia.

In the case of Bangladesh, Rana (2014) has studied the relationship between economic growth and government expenditure in Bangladesh. The author has used the unit root test, co-integration test, Vector error correction model, and Granger causality test to find out the nature of the relationship among the variables. This paper has found a significant relationship between the variables which also support Wagner's Law.

Verma and Arora (2010) have investigated the validity of Wagner's law in the Indian economy by using time series data from 1951 to 2008. In this study, for short-run dynamics, the empirical pieces of evidence have shown no relationship between economic growth and the size of the government expenditure. By using the Granger causality test, Jiranyakul & Brahmasrene (2007) have investigated the relationship between government spending and economic growth in Thailand. The results have found that these two economic variables are not co-integrated, although government spending has a positive impact on the economic growth of Thailand.

In the case of Nigeria, Nurudeen and Usman (2010) have shown that increasing government expenditure does not increase economic growth. In that paper, the authors have used a disaggregated analysis and they have found that the government's total capital expenditure, total recurrent expenditures, and government expenditure on education hurt economic growth. On the other hand, economic growth has increased when the government has increased expenditure on transport and communication, and health.

3. Methodology

3.1 Data Sources and Variable Description

Data have been collected on GDP, development expenditure, non-development expenditure, and other expenditure for the period 1994-95 to 2016-17. All the data are collected from various issues of the Bangladesh Economic Review (2005, 2015, 2017). Here, GDP is used as a proxy of economic growth, and the data are expressed in constant price.

The data is explained as follows:

LGDP = Log of gross domestic product;
LDEV_EXP = log of development expenditure;
LNDEV_EXP = log of non-development expenditure;
LOTHER_EXP = log of other expenditure.

This study mainly deals with the interrelationship among GDP, development expenditure, non-development expenditure, and other expenditures by the use of a VAR model to estimate the possible effect of changes in development expenditure, non-development expenditure, and other expenditures. This study uses an unrestricted VAR analysis to assess the effect of government expenditure on the economic growth of Bangladesh between 1994-95 and 2016-17. The econometric analysis of this study is done by using EViews software.

When the economic variables are non-stationary at the level and they are not co-integrated, then the correct approach is to take the first difference of the variables. If the economic variables become stationary at the first difference that is integrated of order 1 (I(1)) with no co-integration, then an unrestricted VAR can be estimated (Toda and Yamomoto, 1995; Holden 1995; Ibrahim, 2005). In VAR analysis, the goal is not to estimate a parameter, but to gauge the interrelationship among the variables. For that reason, an unrestricted VAR remains appropriate (Ibrahim, 2005).

3.2 Model Specification

3.2.1 Building the Vector Autoregressive Model (VAR)

This study generally deals with the causal relationship between government expenditure and the economic growth of Bangladesh by the use of a VAR model to estimate the possible effect of changes in government expenditure.

VAR models were developed by Christopher Sims (as cited in Sasikumar& Abdullah,2017). These models were developed to discover a better alternative to traditional dynamic simultaneous equation models to examine the dynamic interactions among the interrelated time series data. According to Sims and Todd (as cited in Sasikumar & Abdullah, 2017), VAR models are the multivariate extensions of the univariate AR models, which are applied to the multivariate case and forecast the values of a set of variables at any given point in time. Cooley and Leroy (as cited in Sasikumar & Abdullah, 2017) also explain that they are extensively used in forecasting and causality testing.

The basic *p*-lag the VAR model has the following form

$$y_t = c + A_1 y_{t-1} + A_2 y_{t-2} + \cdots \dots\dots\dots\dots\dots + A_p y_{t-p} + \varepsilon_t \quad t = 1, \dots\dots\dots ., T \tag{1}$$

Where $y_t = (y_{1t}, y_{2t}, \dots\dots\dots, y_{nt,})$ denote an $(n \times 1)$ vector of time series variables, Ai is $(n \times n)$ coefficient matrices, and εt is an $(n \times 1)$ unobservable zero-mean white noise vector process with the time-invariant covariance matrix.

An example of a bivariate VAR model is defined as

$$y_{1t} = c_1 + a_{11}^1 y_{1t-1} + a_{12}^1 y_{2t-1} + a_{11}^2 y_{1t-2} + a_{12}^2 y_{2t-2} + \varepsilon_{1t} \tag{2}$$

$$y_{2t} = c_2 + a_{21}^1 y_{1t-1} + a_{22}^1 y_{2t-1} + a_{21}^2 y_{1t-2} + a_{22}^2 y_{2t-2} + \varepsilon_{2t} \tag{3}$$

Where cov $(\varepsilon_{1t}, \varepsilon_{2s}) = \sigma_{12}$ for t = s; 0 other wise.

Here all variables functioned as endogenous variables; in each equation, there is an equal number of exogenous and lagged exogenous variables.

3.2.2 Tools for Testing Unit Root of Time Series

To test the presence of the unit root of a time series data, a variety of powerful tools can be used. To test the stationarity of data this study uses the Augmented Dickey-Fuller test. The test is administered for both level and differenced data using the model with intercept and model with intercept and trend (VAR Bangladesh).

3.2.3 Lag length Criteria

Before the formation of the VAR model, an essential initial step is the selection of the VAR lag order. The optimum lag order selection can be done by using the minimum information criterion, such as sequential modified LR test statistic, Final prediction error (FPE), Akaike information criterion (AIC), Schwarz information criterion (SCC), Hannan-Quinn information criterion (HQC).

3.2.4 CointegrationTest

A Co-integration test is used to detect the presence of a long-run relationship between variables. Different co-integration techniques can be used to determine the long-run relationship between time series data. Among these techniques, this study uses the Johansen cointegration technique. In the absence of cointegration, the VAR model can be used to determine the long-run relationship between variables (Gujarati, Porter, & Gunasekar, 2009).

3.2.5 Granger Causality Test

One of the important advantages of the VAR model is that this model can be used to accomplish the Granger causality test to determine the direction of causality among the variables. Granger causality test is a technique for examining the usefulness of one time series for forecasting another one. Suppose there are two variables *X* and *Y,* if variable *X* is found to help forecast another variable *Y,* then *X* is said to Granger-cause *Y*. To test the null hypothesis that *X* does not Granger-cause *Y,* the test statistic is given by

$$F = \frac{(RSSR - RSSUR)/m}{(RSSUR/(n - k)} \tag{4}$$

Where *RSSR* denotes the restricted sum of squares, *RSSUR* indicates the unrestricted residual sum of squares, *m* is the number of lagged *X* terms, and *k* denotes the number of parameters estimated in the unrestricted regression. Here the test statistic follows the *F*- distribution with m and (*n-k*) degrees of freedom (Sasikumar & Abdullah, 2017).

3.2.6 Impulse Response Functions and Variance Decompositions

Impulse response functions delivered by VAR models are used to identify the effect of change in one variable on all the other variables. It can also produce the time path of the dependent variables in the VAR model due to the shocks from all the explanatory variables. They exhibit the current and lagged effects overtime changes in error terms ($\varepsilon_{1t}, \varepsilon_{2t}, ..., \varepsilon_{kt}$) on the endogenous variables ($y_{1t}, y_{2t}, \dots \dots \dots, y_{kt},$). When the error term ε_{1t} has immediate effects and ($\varepsilon_{1t}, \varepsilon_{2t}, ..., \varepsilon_{kt}$) all have lagged effects on $y_{1t,}$ then it can be said that the VAR process of order "p" is stable.

The general form of any covariance stationary VAR (p) model has a Wold representation as follows:

$$y_t = \mu + a_t + \theta_1 a_{t-1} + \theta_2 a_{t-2} + \cdots \tag{5}$$

where θ sare the *n* x *n* matrices. To interpret the (*i, j*)-the lement $\theta^s{}_{ij}$, the element of the matrix θs as the impulse response is defined by : $\partial \varepsilon j,t\text{-}s$

$$\frac{\partial yi,t+s}{\partial \varepsilon j,t} = \frac{\partial yi,t}{\partial \varepsilon j,t\text{-}s} = \theta s \text{ ij}, \quad i,j = 1, 2, ..., n. \tag{6}$$

The condition for the variance of ε_t equal to Σ is a diagonal matrix. When Σ is diagonal, then it can be said that the elements of Σ and ε_t are uncorrelated.

With the supplements of the impulse response function analysis, the variance decomposition analysis is usually performed by VAR models (Ghatak, 1998). The variance decomposition is useful in evaluating how shocks reverberate through a system that is to assesses the pass-through of external shocks to each economic variable in the VAR model.

4. Result and Discussion

4.1 The Augmented Dickey-Fuller (ADF) Test

When a data set contains more than 20 years of observations then it is required to test the unit-roots for examining stationarity of the series (Chen, McCarl, & Schimmelpfennig, 2004). The Augmented Dickey-Fuller (ADF) test is done here and the results are presented in Table 1.

Table 1. Results of the ADF Test

Augmented Dickey-Fuller test results					
Variable	ADF Constant, Linear Trend		ADF with Constant (Intercept)		Integrated of order
	Level	1st Difference	Level	1st Difference	
LGDP	-0.368153 (-2.132508)	-1.054685 (-4.350630)*	-0.009517 (-0.193742)	-1.049113 (-4.463350)*	I (1)
LDEV_EXP	-0.080455 (-0.672511)	-1.584503 (-3.640555)**	0.071665 (2.443851)	-0.731960 (-3.373611)**	I (1)
LNDEV_EXP	-1.107134 (-4.730743)*	-1.497146 (-7.114094)*	-0.312713 (-1.914520)	-1.496914 (-7.317622)*	I (1)
LOTHER_EXP	-0.748392 (-3.359339)	-1.847856 (-5.288423)*	-0.355777 (-2.006539)	-1.824070 (-5.484472)*	I (1)

Source: Authors' Calculation

Note:LGDP, LDEV_EXP, LNDEV_EXP, and LOTHER_EXP represent log GDP, log development expenditure, log non-development expenditure and log other expenditure respectively.
* Represents significance at 1% level. ** Represents significance at 5% level.

The results of the ADF test (see table 1) shows that no time series are t stationary in variable levels except the variable LNDEV_EXP in the case of ADF constant with a linear trend. The first differencing of series removes the non - stationary components in all cases and the null hypothesis of non - stationary is rejected at a 5% significance level for all variables. On the other hand, ADF with constant (intercept) test shows that no time series are t stationary in variable levels but after taking the first difference of all the variables, the non - stationary components in all cases and the null hypothesis of non - stationary is rejected at 5% significance level for all variables. After all, it shows that all the variables are integrated of order one *I* (1), that is they generally become stationary only after taking their first difference before estimation (Gujarati et al., 2009). Therefore, all the relevant variables of the model are not stationary on their level but entire variables become stationary after the first difference that is all variables are I (1).

4.2 Lag length Criteria

Table 2. Lag length Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-56.49836	NA	0.004985	6.049836	6.248983	6.088712
1	9.002016	98.25057*	3.69e-05*	1.099798	2.095531*	1.294176
2	18.27378	10.19894	9.13e-05	1.772622	3.564940	2.122501
3	45.16830	18.82616	6.34e-05	0.683170*	3.272074	1.188551*

Source: Authors' Calculation

* indicates lag order selected by the criterion.
Note: LR: sequential modified LR test statistic (each test at 5% level), FPE: Final prediction error, AIC: Akaike information criterion, SC: Schwarz information criterion, HQ: Hannan-Quinn information criterion.

From Table 2, the values of different information criteria for the various lag lengths of VAR models are identified. The results show that most of the criteria like LR, FPE, and SC select the first lag as the optimal lag. On the other hand, the AIC and the HQ criteria select the third lag as the optimal lag. Though lag one is selected as the maximum lag by the maximum lag selection criterion, lag one is used for the estimation of the VAR model.

4.3 Johansen Test of Co-integration

Table 3. Johansen Co-integration Test

Unrestricted Cointegration Rank Test (Trace)				
Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.594983	34.81322	47.85613	0.4579
At most 1	0.379599	15.83284	29.79707	0.7240
At most 2	0.241371	5.807665	15.49471	0.7181
At most 3	0.000314	0.006588	3.841466	0.9347
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None	0.594983	18.98037	27.58434	0.4160
At most 1	0.379599	10.02518	21.13162	0.7423
At most 2	0.241371	5.801078	14.26460	0.6389
At most 3	0.000314	0.006588	3.841466	0.9347
Max-eigenvalue test indicates no cointegration at the 0.05 level				

Source: Authors' Calculation

Table 3 presents the trace and maximum eigenvalue statistics for the whole sample period. Based on the maximum eigenvalue and the trace tests, we conclude that there are no co-integration vectors in the full sample period. That is the co-integration test results accepted the null hypothesis of no co-integration by showing the existence of no co-integration among the variables. Here there is no long-run causality because the variables are not co-integrated. But there is short-run causality among the dependent and independent variables. When variables are not co-integrated, the VAR model can be used to investigate the long-run relationship between them (Dube & Ozkan, 2018).

4.4 The Vector Autoregressive (VAR) Model

Table 4. Model Estimation Results from VAR Model

	LGDP	LDEV_EXP	LNDEV_EXP	LOTHER_EXP
LGDP (-1)	0.893705	0.087195	0.456502	1.123407
SE	(0.12340)	(0.09004)	(0.55846)	(0.82505)
t-statistics	[7.24244]*	[0.96843]	[0.81743]	[1.36161]
LDEV_EXP (-1)	0.185549	1.005484	0.879406	0.259004
SE	(0.11458)	(0.08360)	(0.51855)	(0.76610)
t-statistics	[1.61937]	[12.0268]*	[1.69589]***	[0.33808]
LNDEV_EXP (-1)	0.019251	-0.011099	0.019188	-0.129132
SE	(0.05060)	(0.03692)	(0.22900)	(0.33832)
t-statistics	[0.38046]	[-0.30063]	[0.08379]	[-0.38168]
LOTHER_EXP (-1)	-0.088435	-6.86E-05	-0.100113	0.157884
SE	(0.03407)	(0.02486)	(0.15420)	(0.22781)
t-statistics	[-2.59547]*	[-0.00276]	[-0.64923]	[0.69304]
C	0.058016	-0.937341	-3.283274	-8.893463
SE	(0.66055)	(0.48197)	(2.98940)	(4.41649)
t-statistics	[0.08783]	[-1.94482]***	[-1.09831]	[-2.01369]**

Source: Authors' Calculation

Notes: Sample (adjusted): 1995-2016, included observations: 22 after adjustment; standard errors in () andt-statistics in *, **, *** indicate that the estimated coefficients are statistically significant at 1%, 5% and 10% level of significance respectively.

In table 4, let us consider the LGDP regression. Individually LGDP at lag 1 and LOTHER_EXP at lag 1 is statistically significant. Although LDEV_EXP and LNDEV_EXP are not statistically significant both of them have positive effects on LGDP. Moreover, here F value is so high that we cannot reject the hypothesis that collectively all the lagged terms are statistically significant.

4.5 Diagnostic Test Results

4.5.1 Heteroskedasticity Tests

Table 5. VAR Residual Heteroskedasticity Tests*

	Chi-sq	Df	Prob.
No Cross Terms	80.18530	80	0.4731

Source: Authors' Calculation

Note: * The null hypothesis is there is no heteroskedasticity in the data. No cross terms.

From Table 5, it can be seen that the estimated results are not affected by the heteroscedasticity problem and the calculated value of Chi-sq is 80.18530 with 80 df and the p-value is 47.31%, which is more than 5% that is statistically insignificant at 5% level of significance. As a result, we cannot reject the null hypothesis rather we can accept the null hypothesis that there is no heteroskedasticity in the data.

4.5.2 Serial Correlation LM Tests

Table 6. VAR Residual Serial Correlation LM Tests*

Lags	LM-Stat	Prob
1	10.36475	0.8469

Source: Authors' Calculation

Note: *Null Hypothesis: no serial correlation at lag order h

From Table 6, it can be seen that the estimated results are not affected by the serial correlation problem and the calculated value of LM-Stat is 10.36475 with 1 lag and the p-value is 84.69%, which is more than 5% that is statistically insignificant at 5% level of significance. As a result, we cannot reject the null hypothesis rather we can accept the null hypothesis that there is no serial correlation in the data.

4.5.3 Normality Tests

Table 7. VAR Residual Normality Tests [1] [2]

Component	Jarque-Bera	Df	Prob.
1	29.36126	2	0.0000
2	0.117986	2	0.9427
3	31.33394	2	0.0000
4	1.494544	2	0.4737
Joint	62.30773	8	0.0000

Source: Authors' Calculation

Note: [1] VAR residual normality tests [Cholesky (Lutkepohl)]. [2] Null Hypothesis: residuals are multivariate normal.

Table 7 shows that the p-value of joint normality tests for the residuals is lower than 5 percent, indicating that the null hypothesis that the residuals are multivariate normal cannot be accepted with a 5 percent level of significance. For many statistical estimation methods like VAR and SVAR models, fulfilling the normality condition is not a necessary condition. Therefore, nonconformities of the normality assumption might nonetheless specify that improvements to the model is possible (Rummel, 2015). According to Lütkepohl (1991), the asymptotic properties of the VAR parameter estimators do not depend on the normality assumption, as a result, we do not dismiss the study although the normality test indicates that the residuals are non-normal.

4.6 Pairwise Granger Causality Tests

Table 8. Pairwise Granger Causality Tests

Null Hypothesis:	Obs.	F-Statistic	Prob.
LDEV_EXP does not Granger Cause LGDP	22	1.62729	0.2175
LGDP does not Granger Cause LDEV_EXP		0.98109	0.3344
LNDEV_EXP does not Granger Cause LGDP	22	0.07319	0.7897
LGDP does not Granger Cause LNDEV_EXP		11.4106*	0.0032
LOTHER_EXP does not Granger Cause LGDP	22	5.08868*	0.0361
LGDP does not Granger Cause LOTHER_EXP		10.8564*	0.0038
LNDEV_EXP does not Granger Cause LDEV_EXP	22	0.00699	0.9342
LDEV_EXP does not Granger Cause LNDEV_EXP		15.1460*	0.0010
LOTHER_EXP does not Granger Cause LDEV_EXP	22	0.02574	0.8742
LDEV_EXP does not Granger Cause LOTHER_EXP		8.22288*	0.0099
LOTHER_EXP does not Granger Cause LNDEV_EXP	22	0.54170	0.4707
LNDEV_EXP does not Granger Cause LOTHER_EXP		2.63368	0.1211

Source: Authors' Calculation

Note: Lags: 1 and (*) marked that *F*- statistics are statistically significant at a 5% level of significance.

Table 8 shows the pairwise Granger causality test results. The test results show that there is a bivariate causal relationship among the variables marked as (*) by rejecting the null hypothesis of no Granger causality because the *F*- statistic is statistically significant. Now it is necessary to observe the impulse response functions.

4.7 Impulse Response Function

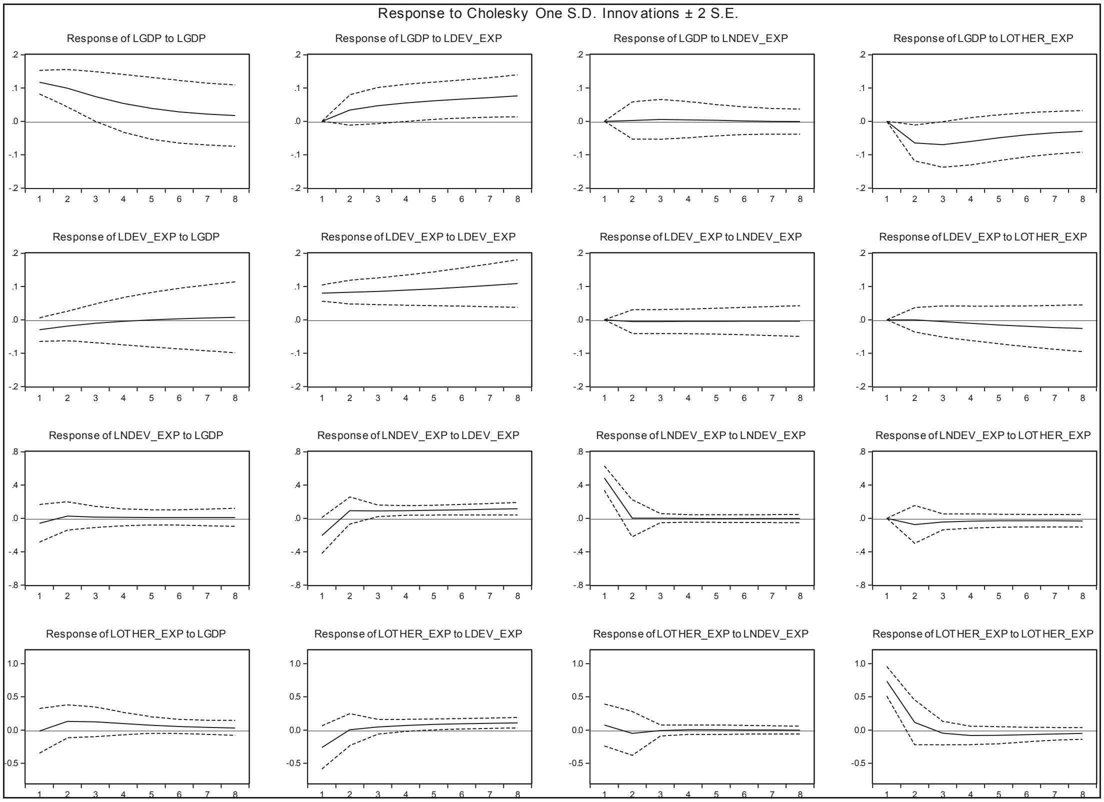

Figure 1. The Combined Graph of the Impulse Responses of the Estimated VAR Model. Source: Authors' Calculation.

In a conclusion, the VAR "Budget Implementation and Economic Growth" model can be considered representative to describe autoregressive connections between Government expenditure and economic growth of Bangladesh. Based on the model, we can identify sixteen impulse responses (illustrated in Figure 1), which evaluate the effect of a shock on variations in current or future values of the Government expenditure and GDP variables. Accumulated response to Chole sky one S.D. innovations ± 2 S.E.

Based on the chart analysis we can explain the following estimations:

I. A +1% shock in the development expenditure level (first-row second figure) in the current period has a positive effect on the GDP in future and shows a positive effect until the eighth period. On the other hand, +1% shock in the non-development expenditure level (first-row third figure) generates no effect on the GDP in all the eight years of the forecast. Moreover, one can notice that the same positive impact of other expenditure levels (first-row fourth figure) will lead to GDP contraction, therefore the relationship between the two variables will be negative.

II. A +1% shock in the GDP level (second-row first figure) will initially generate a negative impact on development expenditure, but gradually it becomes positive with the eight-year of the forecasting. On the other hand, the same shock in non-development expenditure will generate no effect on development expenditure (second-row third figure) but +1% shock in the other expenditure generates negative impact after three years on development expenditure (second-row fourth figure).

III. A +1% shock in the GDP level (third-row first figure) will initially generate a slightly negative impact on non-development expenditure, but very first it becomes zero with the eight-year of the forecasting. A +1% shock in the development expenditure level (third-row second figure) will initially generate a slightly negative impact on non-development expenditure, but very first it becomes positive with the eight-year of the forecasting. A +1% shock in the other expenditure level (third-row fourth figure) will initially generate a slightly negative impact on non-development expenditure, but after four years it becomes zero.

IV. A +1% shock in the GDP level (fourth-row first figure) will positively impact other expenditure, with the eight-year of the forecasting. A +1% shock in the development expenditure level (fourth-row second figure) will initially generate a slightly negative impact on other expenditure, but very first it becomes positive with the eight-year of the forecasting. A +1% shock in the non-development expenditure level (fourth-row third figure) will initially generate a positive impact than negative impact on other expenditure, but after two years it becomes zero.

4.8 Variance Decomposition

From variance decomposition values of the log of GDP that is shown in Table 9(a), 100-44.11% fluctuations can be explained by their fluctuations; 0-32.13%, 0-0.09%, and 0-23.67% fluctuations can be explained by the volatility of log of development expenditure, log of non-development expenditure and log of other prices, respectively. The above results show that all the influence variables have a positive influence on the log of GDP.

Similarly, from the variance decomposition values of log of development expenditure that are shown in Table 9(b), 88.14-95.16% fluctuations can be explained by the log of development expenditure fluctuations (own shock); 11.86-1.99%, 0-0.199%, and 0-2.65% fluctuations can be explained by the volatility of log of GDP, log of non-development expenditure and log of other expenditure, respectively. A shock in the log of development expenditure contributes to itself in the short-run and also in the long run.

Table 9 (a). Variance Decomposition of LGDP

Period	S.E.	LGDP	LDEV_EXP	LNDEV_EXP	LOTHER_EXP
1	0.117332	100.0000	0.000000	0.000000	0.000000
2	0.170397	81.40908	3.994229	0.022218	14.57447
3	0.204192	69.95583	8.102631	0.095403	21.84613
4	0.226509	62.51078	12.56220	0.122726	24.80430
5	0.242964	56.89669	17.33168	0.122453	25.64918
6	0.256775	52.17829	22.27257	0.112763	25.43637
7	0.269615	47.96992	27.24251	0.102317	24.68525
8	0.282334	44.11105	32.12940	0.094065	23.66548

Source: Authors' Calculation

Table 9 (b). Variance Decomposition of LDEV_EXP

Period	S.E.	LGDP	LDEV_EXP	LNDEV_EXP	LOTHER_EXP
1	0.085611	11.85702	88.14298	0.000000	0.000000
2	0.120910	8.352534	91.44800	0.199450	1.74E-05
3	0.148639	6.027681	93.60762	0.255416	0.109286
4	0.173732	4.473023	94.81594	0.262154	0.448881
5	0.197884	3.447913	95.34299	0.250533	0.958562
6	0.221812	2.769203	95.45946	0.233360	1.537981
7	0.245870	2.311298	95.35888	0.215765	2.114061
8	0.270274	1.993705	95.15900	0.199621	2.647676

Source: Authors' Calculation

Table 9 (c). Variance Decomposition of LNDEV_EXP

Period	S.E.	LGDP	LDEV_EXP	LNDEV_EXP	LOTHER_EXP
1	0.531003	1.204308	15.02147	83.77422	0.000000
2	0.544782	1.403524	17.17838	79.59083	1.827270
3	0.554034	1.444601	19.23700	76.95542	2.362986
4	0.562958	1.449520	21.39307	74.53562	2.621785
5	0.572337	1.440990	23.64731	72.11457	2.797134
6	0.582459	1.426110	25.99768	69.63248	2.943725
7	0.593473	1.407639	28.43708	67.07513	3.080148
8	0.605482	1.386876	30.95540	64.44432	3.213399

Source: Authors' Calculation

Table 9 (d). Variance Decomposition of LOTHER_EXP

Period	S.E.	LGDP	LDEV_EXP	LNDEV_EXP	LOTHER_EXP
1	0.784495	0.024325	11.08968	0.965399	87.92059
2	0.805206	2.620439	10.53235	1.311127	85.53609
3	0.817385	4.831614	10.57670	1.279147	83.31254
4	0.830339	6.081429	10.98380	1.241723	81.69305
5	0.841561	6.679127	11.69967	1.212287	80.40892
6	0.851223	6.929505	12.65358	1.186512	79.23040
7	0.860152	7.003820	13.79415	1.162300	78.03973
8	0.869008	6.986903	15.09043	1.138735	76.78393

Source: Authors' Calculation

Note: Cholesky Ordering: LGDP LDEV_EXP LNDEV_EXP LOTHER_EXP

In table 9 (c), the variance decomposition values of log of non-development expenditure shown that 83.77–64.44% fluctuations can be explained by the log of non-development expenditure fluctuations (own shock); 1.2 – 1.39 %, 15.02–30.96% and 0-3.21% fluctuations can be explained by the volatility of log of GDP, log of development expenditure and log of other expenditure, respectively. The above results show that a shock on the log of GDP, log of development expenditure, and log of other expenditure cannot contribute much to the log of non-development expenditure.

In table 9 (d), the variance decomposition values of log of other expenditure shown that 87.92–76.78% fluctuations can be explained by their expenditure fluctuations; 0.02–6.98%, 11.09-15.09%, and 0.97 – 1.14% fluctuations can be explained by the volatility of log of GDP, log of development expenditure and log of non-development expenditure, respectively. The above results show that a shock on the log of GDP, log of development expenditure, and log of non-development expenditure cannot contribute much to the log of other expenditure.

5. Conclusion

This paper analyzed the impact of government expenditure on the economic growth of Bangladesh using aggregate-level time series data. The results show that there is no co-integration between the components of government expenditures and economic growth. A unidirectional causality from economic growth to non-development expenditure and also a bi-directional causality between economic growth and other expenditure exist. Additionally, to find out the long-run relationship, the VAR model with lagged variables of economic growth show a positive and significant effect, other-expenditure has a negative significant impact but development and non-development expenditure show the positive insignificant impact of government spending on economic growth during the period of investigation. If the impulse response function shows a stronger and longer reaction of economic growth to a 'shock' in total development expenditure than 'shocks' in other variables, we would find support for the hypothesis that increasing the development expenditure leads to economic growth. According to this paper, it is concluded that only one influence variable that is the log of development expenditure has a positive influence on the economic growth of Bangladesh although the variable is statistically insignificant. Therefore, the Bangladesh government should increase its expenditure on the development sector to enhance the economic growth of the country.

The study leaves room for other researchers to include other developing countries as a sample of analysis. Cross-country comparison could also be done for getting a clear picture of any regions.

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