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# Impact of Public and Private Investment on GDP Growth in Bangladesh: Crowding-in or Out?

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## I. Introduction

GDP growth as well as the development of a country bank on its capability to invest and utilize its resources efficiently for aggregate production. Even, growth cannot be achieved with the lack of investment in adequate quantity and quality. Thus, GDP growth is the cause and outcome of investment (Bayraktar, 2003). The general assumption of economic theory reveals that both public and private investments have a pivotal role in boosting up GDP growth. Many studies strived to show that public and private investments have a dual impact on GDP growth, which may be positive or negative through crowding-in and crowding-out effects respectively (Saidjada and Jahan, 2016). Besides, in the short and long run, both public and private investment cause increase in production of a country to create employment opportunity, stimulate trade and finally, GDP growth to reach its optimality (Nwakoby and Bernard, 2016).

There are two distinct opinions prevailed in the analysis of economic theory, Keynesians and Neo-classical with rival views concerning the impact of public and private investment on GDP growth of a country. Keynesians opined that public investment is the tool of government that increases production of a country, which is included in aggregate demand resulting in increasing employment opportunities for the people. This aggregate demand has multiplier effects on output (Blinder, 2008). Keynesians also stated that private investment has a significant effect in the short and long run and it happens as public investment accelerates it through building infrastructure, providing energy and other capacity enhancing human resource development projects and initiatives (Mohsin and Manmohan, 1997). Neo-classical views stated that, as the public investment increases at the cost of private spending, it helps transform the private sector into the public sector. This sort of transfer of private investment impacts negatively on GDP growth and brings about crowding-out effect on private sector and the shift of public investment vice versa, which eventually makes the growth of economy sluggish (Sandler and Hartley, 1995). The modern views differ with that of Keynesian and Neo-classical views, pointing out that public investment as a government instrument has no multiplier effect to boost up growth, but actually, it has this kind of effect on GDP growth in a negative sense (Smaldone, 2006; Dunne, 2012; Musayev, 2013).

As a developing country of South Asia, Bangladesh witnessed several socio-economic and political perils, and natural calamities from its inception to present, which sometimes brought about quasi-stagnant situation in all sectors of the country in particular economic sector. Despite these all sorts of predicament, the country is still going forward maintaining its average GDP growth at more than 6 percent for almost a decade. Having this average growth continuance, Bangladesh has settled its dreams to reach the status of middle-income country by 2021 as set by the World Bank. The trajectory of development the country has achieved through the attention and initiative employed by both government and private entrepreneurs going through expenditures and investments in their variance of volumes and qualities. The series of schemes and projects taken by both the government and private sector have helped reach the trade at its apex thereby, achieving the rank of the 44th country regarding GDP growth across the world (World Bank, 2015).

The study is distinctive in myriad of ways as it has incorporated the ratio of the lagged value of GDP as the dependent variable, the lagged value of both the

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public and private investment as independent variables, and the terms of trade (TOT) as a control variable. To analyze the variables of the study, the ARDL Bounds Testing technique is used for regression. The study has used time series data collected from World Bank Development Indicators (WDI) and the globale-conomy.com over the year from 1980 to 2016—the period crucially marks out the more changing but stable economic situation the country witnesses regarding the degree of freedom in the policy-making domain. Previous studies barely covered this time and study technique along with the combination of relevant variables as used in the current study to investigate into the impact of public and private investment on GDP growth in Bangladesh. Also, Block Exogeneity Wald Test is employed to detect the existence of causal relationship from both the public and private investment to GDP growth.

The study is of five sections. Section I points out the introduction to the study. Section II underscores the literature review and the core findings of related studies. Section III outlines the methodology of the study including the data and model specification. Section IV represents the results attained, and lastly, section V makes the findings of the study concise, and it comes to an end with policy recommendations.

## II. Review of Literature

A good number of relevant literature elucidating the case of developing countries have been studied.

Empirical studies on the impact of public and private investment on GDP growth are quite widespread. Despite this, some researches followed by the empirical evidence of Aschauer (1989a, 1989b) and Munnell (1990) on the relationship between public investment and economic infrastructural development, and GDP growth are very noteworthy. All these studies found a statistically significant relationship of public investment with GDP growth. Studies conducted by Barro (1991); Barro and Sala-i-Martin (1992); Mankiw, Romer and Weil (1992) discovered that the aggregate investment (public and private) has a significant role on the long run growth and the convergence in real per capita incomes. Mohsin and Manmohan (1997) unmasked that public investment in infrastructure and the human capital formation may enhance the efficiency of private capital and be useful for GDP growth. They also found that some instruments of public investment may be complementary to private investment to spur GDP growth. The complementary may take place regarding public investment in infrastructure that increases the marginal productivity of private capital.

Karim, Rahaman, and Ali (2005) found that there exists significant impact of public and private investment on the GDP growth in Bangladesh. In another word, the marginal productivity of both public and private investments is differentiated in the context of Bangladesh. Further, the study showed that private investment plays a significant role in the growth process of the country. Rabnawas and Jafar (2015) conducted an empirical study that showed there is a positive relationship between GDP and public investment in the short run and increase in GDP causes a rapid increase in public investment in Pakistan. The study applied the Granger causality test that found the bi-causal relationship existed between public investment and GDP growth. The causality ran from GDP to public investment and equally, from public investment to GDP.

Mustafa, Kivilcim, and Aysit (2002) uncovered some evidence of the crowding-out effect of total government investment on private investment. Their study showed that there was no significant impact of public infrastructural investment on private investment in the long run. But the study found several complimentary between public and private investment over the short and medium run. The result of the study suggested that for the public investment, the chronic macroeconomic instability appears as an acute problem and has stopped, or even reversed, in the long run comple-mentaries. Majumder (2007), and Hasan and Salim (2011) investigated the crowding-out hypothesis in the case of Bangladesh. Employing the Johansen co-integration approach, Majumder (2007) found out the presence of a crowding-in effect in the long run for the period 1976-2006. On the other hand, Hasan and Salim (2011) showed a crowding-out impact of public investment in the short and long run for the period of 1981-2003 in Bangladesh. Saidjada and Jahan (2016) found that public investment negatively affects private investment both in the long run and short run. It also suggested that public investment crowded out the private investment. The study estimated a model with three different specifications in the ARDL bounds testing framework using real private investment, real public investment, real GDP, the real interest rate, and a dummy variable for liberalization.

It appears that very few studies have keenly covered the impact of public and private investment simultaneously on GDP growth and no study found has taken the terms of trade (TOT) as a control variable particularly in the context of Bangladesh. The inclusion of TOT as a control variable has significantly valued the study as Bangladesh penetrated into the spectrum of open market economy predominantly via trade liberalization in 1990. The existing study thus corresponds to a broad picture relating to the effect of public and private investment on GDP growth of Bangladesh regarding trade. Besides, there is the absence of such relevant as well as exclusive technique and variable specification in the previous studies. Instead, comprehensive and rigorous researches on this issue are essential to immaculately recognize the effect

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of public and private investment on GDP growth in Bangladesh.

## III. Methodology

*a) Variable and Model Specification*

In this study, Auto-Regressive Distributive Lag (ARDL) technique is used by choosing the best possible lag for all the variables. The dependent variable is GDP growth, and the independent variables are public investment and private investment, and the terms of trade (TOT) has taken as a control variable in the study.

The aggregate production function of Bangladesh economy may be defined as follows:

$$Y = \alpha f(k, l) \quad \text{(i)}$$

Where $\alpha$ = Technological Shift Parameter
k = Capital
l = Labor
f = Potential Aggregate Output

Bangladesh as a labor surplus country, it is also reasonable to assume that at the margin, the growth of labor force does not affect the aggregate output. In this regard, aggregate potential production function has been assumed as follows:

$$Y = \alpha f(k^g, k^p) \quad \text{(ii)}$$

$k^g$ = Public or Government's Capital Formation
$k^p$ = Private Capital Formation

Then, to test whether the public and private sectors' investment have differential impacts on growth, expressing equation (ii) in growth terms, we can have:

$$\frac{\Delta Y}{Y} = \left[\alpha \frac{\delta f}{\delta k^g}\right] \frac{\Delta k^g}{Y} + \left[\alpha \frac{\delta f}{\delta k^p}\right] \frac{\Delta k^p}{Y} + \frac{\Delta \alpha}{\alpha} \quad \text{(iii)}$$

It can be written for estimation purposes as follows:

$$\frac{\Delta Y}{Y(-1)} = \alpha_0 + \alpha_1 \frac{IG}{Y(-1)} + \alpha_2 \frac{IP}{Y(-1)} \quad \text{(iv)}$$

Where $\alpha_0 = \frac{\Delta \alpha}{\alpha}$

$$\alpha_1 = \alpha \frac{\delta f}{k^g}$$

$$\alpha_2 = \alpha \frac{\delta f}{k_p}$$

From the estimation, we can draw the growth model in the following way:

$$\Delta Y = \alpha_0 + \alpha_1 IG + \alpha_2 IP + \alpha_3 TOT + \mu_\tau \quad \text{(v)}$$

The constant term $\alpha_0$ is assumed to capture the growth in productivity as well as other left-out exogenous variables. $\alpha_1$ is the marginal productivity of public or government capital $(k^g)$ and $\alpha_2$ is the marginal productivity of private capital $(k^p)$. $\alpha_3$ is the coefficient of the terms of trade (TOT).

*b) Apriori Issues*

If the impacts of public and private investment are equal to GDP growth, this will imply that the relevant marginal productivity is the same, where $\alpha_1 = \alpha_2$. Besides, the higher impact of public investment than private investment on GDP growth leads us to expect that $\alpha_1 > \alpha_2$; contrarily, the higher impact of private investment makes us expect that $\alpha_2 > \alpha_1$.

Broadly, public investment causes crowding-out effect if the government utilizes scarce physical and financial resources that would shrink the private investment. Moreover, the financing of public sector investment through taxes, issuance of debt, or inflation would lower resources available to the private sector.

In contrast, public investment in infrastructure, energy and other capacity enhancing projects of human resources development are complementary to private investment, a situation popularly known as the crowding-in effect. Public goods/investment of this type can help increase the productivity of capital, demand for private output and savings. Therefore, $\alpha_2$ subsumes the effects of public investment and vice versa.

*c) Regression Technique and the Other Tests*

A. Augmented Dickey-Fuller (ADF) and Philips Perron (PP) unit root tests have been carried out to make sure the integration of variables, which are within their level and first difference form.[1] ADF test shows the following equation:

$$\Delta Y_t = \mu + \beta_t + \delta Y_{t-1} + \sum_{j=1}^{k} \alpha_j \ \Delta Y_{t-j} + \varepsilon_t \quad \text{(vi)}$$

Here, Δ is the difference operator; t represents time trend; $\varepsilon$ is the error term; $Y_t$ is the series, and k indicates the lag. Same null hypothesis and asymptotic distribution with ADF test are shared in PP test.

B. To check the presence of long run co-integration among the variables, Ordinary Least Squares (OLS) based Autoregressive Distributive Lag (ARDL Bounds Testing using Akaike Information Criteria has been used. The basis of ARDL regression model is shown below:

$$Y_t = \mu + \alpha_0 X_t + \alpha_1 X_{t-1} + \cdots + \alpha_p X_{t-q} + \beta_1 Y_{t-1} \cdots + \beta_k Y_{t-k} + \varepsilon_t \quad \text{(vii)}$$

The form of ARDL Regression model employed in this study is given below:

$$Y_t = \mu + \sum_{i=1}^{n=3} DY_t + \sum_{i=0}^{n=3} DIG_{t-i} + \sum_{i=0}^{n=3} DIP_{t-i} + \sum_{i=0}^{n=3} DTOT_{t-i} + Y_t + IG_{t-1} + IP_{t-1} + TOT_{t-1} + \varepsilon_t \quad \text{(viii)}$$

Here $\mu$ shows the intercept term, n and i represent the maximum and the minimum number of

[1] The null hypotheses of both the tests are the same that discloses that the concerned time series have a unit root or possesses a stochastic trend.



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lags respectively. And, the remaining variables are shown in the preceding interpretation section.

C. VAR Granger Causality/Block Exogeneity Wald Tests are done following the procedure introduced by Granger (1969, 1986) to know about the direction of causality between the dependent variable and the independent variables.

$$E_t = \alpha + \sum_{i=1}^{M} \beta_i Y_{t-i} + \sum_{j=1}^{N} \gamma_j E_{t-j} + \mu_t \quad \text{(ix)}$$

$$Y_t = \delta + \sum_{i=1}^{R} \mu_i E_{t-i} + \sum_{j=1}^{S} P_j Y_{t-j} + v_t \quad \text{(x)}$$

Here M, N, R, and S are usually determined based on lag selection criterion such as Akaike Information Criterion (AIC) where $\mu_t$ and $v_t$ are white noise error processes. Besides, residual variables and signs are described in the previous interpreting section.

D. To make sure the residuals free from error, Normality Test, Serial Correlation LM Test and Heteroskedasticity Test (Breusch-Pagan-Godfrey) are used. Besides, Recursive Estimations (CUSUM and CUSUM of Squares) are employed to understand whether the model is stable.

## IV. Results and Interpretations

*a) Unit Root Tests*

Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit-root tests are utilized in the study avoiding the non-stationary issue.

*Table 4.1:* Unit Root Test Results*

| Variables | ADF test Statistics | | | | PP test Statistics | | | | Order of Integration |
|---|---|---|---|---|---|---|---|---|---|
| | I(0) | | I(I) | | I(0) | | I(I) | | |
| | Constant | Constant & Trend | Constant | Constant & Trend | Constant | Constant & Trend | Constant | Constant & Trend | |
| LGDP | -5.17 ( 0.00) | -8.86 (0.00) | -14.89 (0.00) | -14.74 (0.00) | -5.40 (0.00) | -8.54 (0.00) | -21.91 (0.00) | -23.21 (0.00) | I(0) |
| LIGR | -3.57 (0.01) | -3.40 (0.06) | -8.31 (0.00) | -8.11 (0.00) | -3.62 (0.01) | -3.50 ( 0.05) | -8.08 (0.00) | -7.90 ( 0.00) | I(0) |
| LIPR | 0.2330 (0.9710) | -1.7338 (0.7152) | -5.1365 (0.0002) | -5.2933 ( 0.0007) | -0.04 ( 0.94) | -1.86 (0.65) | -5.29 (0.00) | -5.41 ( 0.00) | I(I) |
| TOT | -0.86 (0.78) | -3.09 (0.12) | -7.48 ( 0.00) | -7.37 (0.00) | -0.75 (0.81) | -2.97 ( 0.15) | -7.48 (0.00) | -7.37 (0.00) | I(I) |

**Results show adjusted t-stats with associated probabilities in parentheses.*

Results above (Table 4.1) show that all the variables have been integrated within their level and first difference form.

*b) ARDL Bound Testing Regression*

The ARDL model used in the study has taken one lagged value for GDP and private investment. No lagged value is considered for the public investment, and the lagged value of the terms of trade (TOT) is 3. Here in the regression, both the R-squared and adjusted R-squared values are 79% and 72% respectively, meaning that 72% change in GDP can be explained by using this model. As the F-statistic value is 0.00 and Durbin Watson stat is 2.24, indicating that this model is free from autocorrelation.

*c) ARDL Regression Output for the Long Run with Bounds Test*

*Table 4.2:* ARDL Long Run Form and Bounds Test

Level Equation

| Variables | | Std. Error | t-statistic | Prob. |
|---|---|---|---|---|
| IG | 0.982209 | 0.388092 | 2.530864 | 0.0183 |
| IP | 0.433821 | 0.176959 | 2.451533 | 0.0219 |
| TOT | -0.000496 | 0.000192 | -2.590132 | 0.0161 |
| @TREND | -0.003644 | 0.001551 | -2.350388 | 0.0273 |
| EC = GDP - (0.9822*LAG_IGR + 0.4338*LAG_IPR -0.0005*TOT -0.0036 *@TREND) | | | | |
| F-statistic | 9.65 | Level of Significance | I(0) | I(I) |
| | | 10% | 2.97 | 3.74 |
| | | 5% | 3.38 | 4.23 |
| | | 2.5% | 3.8 | 4.68 |
| | | 1% | 4.3 | 5.23 |

The 'Level Equation' output demonstrates the long run relationship between the dependent and independent variables. In this equation, public investment has a higher impact than private investment on GDP growth in the long run at 1% significance level as the coefficient of public investment is higher (0.982209). This long-run association of public and private investment with GDP growth is proven in economic theory in a way that these two types of

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investment have a differential impact on GDP growth (Mohsin and Manmohan, 1997). Here it is also traced that in the long run, the terms of trade (TOT) in Bangladesh is also highly associated with GDP growth at 1% significance level; but the coefficient is negative, indicating that the TOT of Bangladesh is in falling line following Prebisch-Singer Hypothesis.[2] The relevant F-statistic of 9.65 is higher than the upper bound value at 1% level of 5.23, leading to a co-integrating equation in the ARDL Error Correction (ECM) regression showing the short run coefficients and speed of adjustment in the long run.

*d) ARDL Regression Output for the Short Run with Coint Eq(-1)*

*Table 4.3:* ARDL Error Correction (ECM) Regression

| Variables | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | 0.053223 | 0.007046 | 7.553230 | 0.0000 |
| IP | 0.623884 | 0.152005 | 4.104370 | 0.0004 |
| D(TOT) | -0.000213 | 7.85E-05 | -2.715521 | 0.0121 |
| D(TOT(-1)) | 0.000195 | 8.00E-05 | 2.434167 | 0.0227 |
| D(TOT(-2)) | 0.000219 | 8.04E-05 | 2.720601 | 0.0119 |
| CointEq(-1)* | -0.811840 | 0.108189 | -7.503922 | 0.0000 |
| R-squared | | 0.739226 | | |
| Adjusted R-squared | | 0.692659 | | |
| Prob (F-statistic) | | 0.000000 | | |
| Durbin-Watson stat | | 2.248306 | | |

The 'ARDL Error Correction (ECM) Regression' output demonstrates the coefficients of the regressors in the short run. It shows that public investment has no impact on GDP growth in the short run.[3] The coefficient of private investment is (0.623884), indicating the significant impact of this variable on GDP growth in the short run. TOT is statistically significant, and it has an impact on the GDP growth in the short run. The current year's coefficient value of TOT is negative; but the 1st and 2nd lagged year's values are shown as positive, meaning that their added value will be positive. It indicates that TOT has a positive impact on GDP growth in the short run.

Beside this, ECM regression output narrates the speed of adjustment from the error correction term drawn from the Levels Equation (Table 4.2) with the combination of the regressors named CointEq (-1). In this model, this particular regressor shows the speed of adjustment to equilibrium in each period of the study. The coefficient of this variable needs to be negative with a probability value at or below 5% level while the original regressors are co-integrated. In this model, the value of the CointEq (-1) is -0.811840. So, it indicates that there exists co-integration between the dependent variable and the concern regressors in the model. The result of the model also shows that 81% disequilibrium is adjusted in the current period and it takes almost one year and four months for the economy to return equilibrium after any shock. As being the adjusted R-squared value (0.69) adequately high with the value of F-statistic probability at 0, it can be safely said that this model satisfies the goodness of fit.

*e) VAR Granger Causality Test Results*

This sub-section elucidates the result of VAR Granger Causality/Block Exogeneity Wald Tests of the different variables of the study. The summary of the results is shown in the following table:

*Table 4.4:* Relative Impact of Public and Private Investment on GDP growth regarding VAR Granger Causality/Block Exogeneity Wald Tests

| From | To | Chi-sq | Prob. | Result |
|---|---|---|---|---|
| IG ⟷ | Y ⟷ | 6.507 ⟷ | 0.038 ⟹ | Bidirectional |
| Y ⟷ | IG ⟷ | 6.256 ⟷ | 0.043 | |
| IP ⟶ | Y ⟶ | 16.777 ⟶ | 0.000 ⟶ | Unidirectional |
| IG ⟶ | IP ⟶ | 12.517 ⟶ | 0.001 ⟶ | Unidirectional |

[2] The Prebisch-Singer hypothesis coined by Raul Prebisch and Hans Singer is usually considered to be the proposition that the net barter terms of trade between primary products and manufacturing goods are subject to a long-run downward trend (Toye, 2003). It is eligible for Bangladesh as the coefficient of TOT is negative as per the Long Run Bounds test of the current study.

[3] Following the Neo-classical prediction, if public investment impacts significantly on GDP growth in the short run, there might be a crowding-out effect on the economy (Hasan and Salim, 2011). The public investment financed by domestic borrowing reduces the availability of funds for private investment. This situation leads to the higher interest rate, which, one at a time, shrinks private investment under the crowding-out effect. In the existing study, in the short run, public investment does not affect the GDP growth. It does not mean that public investment causes GDP growth. Regarding consumption, public/government expenditure has a higher impact in the short run on different public-oriented programs like social safety net program, wages and salaries and other consumption-related sectors in Bangladesh. The current study contrasts with that of Neo-classical prediction as found in the study of Hasan and Salim (2011); but espouses the crowding-in effect of public investment that accelerates the private investment as government investment is employed in public-concern schemes like infrastructures, energy, education, human resource development programs for achieving long-run output as prevailed within Keynesian framework (Saidjada and Jahan, 2016).



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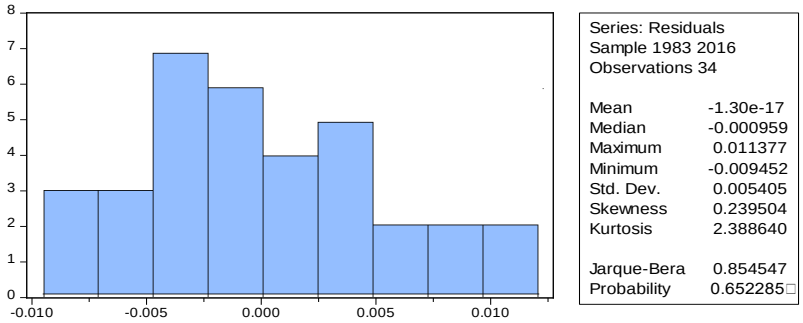
To analyze the causal relationship among the variables, the VAR Granger Causality/ Block Exogeneity Wald Tests is applied in the study shown in Table 4.4. The result reported shows that the relationship between public investment and GDP growth is bidirectional at 5% significant level. On the other hand, there exists unidirectional association from private investment to GDP growth and from public investment to private investment respectively at 1% significant level in which private investment causes GDP growth, and public investment causes the private investment. The existence of the effect of public investment thus brings about the crowding-in effect on private investment. The causality test of the study resembles the observations ordained in the study of Mohsin and Manmohan (1997).

*f) Residual Diagnostic Results*

*Table 4.5:* Summary of the Results of Residual Diagnostic Tests

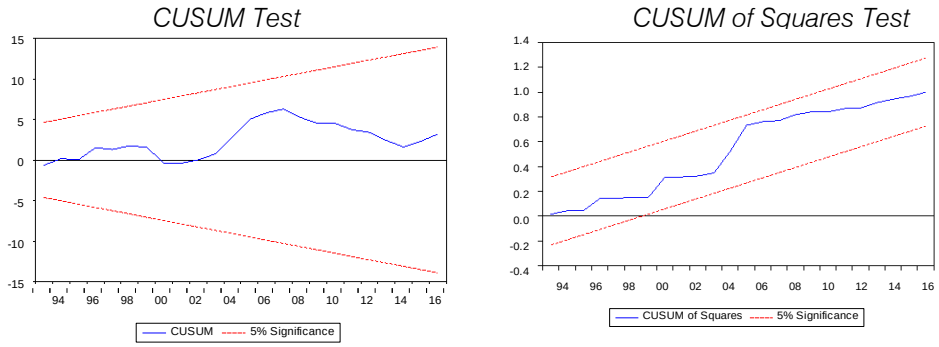
| | |
|---|---|
| *Breusch-Godfrey Serial Correlation LM Test* | |
| Prob. F (2,22) | 0.4285 |
| Prob. Chi-Square (2) | 0.2835 |
| *Heteroskedasticity Test: Breusch-Pagan-Godfrey* | |
| Prob. F (9,24) | 0.2749 |
| Prob. Chi-Square (9) | 0.2559 |
| Prob. Chi-Square (9) | 0.9173 |
| *Normality Test* | |
| Jarque-Bera | 0.854547 |
| Prob | 0.652285 |




The result shown above clarifies that there exists no serial correlation and heteroskedasticity, indicating that this model's residuals are normally distributed.

*g) Stability Diagnostic Results*

*Recursive Estimations*




*Graph 4.3:* Summary of the Stability Diagnostic Results

These two graphs (CUSUM and CUSUM of Squares) visualize that the drawn lines lie within the 5% critical line, making sure the stability of the model.



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## V. Findings, Conclusion and Policy Recommendations

*a) Findings*

The objective of this study is to investigate into the impact of public and private investment on GDP growth and identify the causal relationship between investment (public and private) and GDP growth of Bangladesh. To this end, the study analyzes the impact of public and private investment on GDP growth adopting the growth model of Production Function. The findings of the study conclude that there exists a significant impact of both the public and private investment on the GDP growth of Bangladesh in the long run (Table-4.2). Public investment has no effect on GDP growth in the short run, but the private investment has (Table-4.3). According to VAR Granger Causality/ Block Exogeneity Wald Tests, there exists a bidirectional relationship between public investment and GDP growth of Bangladesh and unidirectional association from private investment to GDP growth and public investment to private investment (Table-4.4). The impact of public investment on private investment shows that public investment crowds-in the private investment.

*b) Conclusion*

The study result shows that public investment has a significant impact on the GDP growth in the long run while private investment also has significant effect both in the short and long run. Apart from this, public investment has a significant impact on GDP growth of Bangladesh with their bidirectional association and private investment has a unidirectional relationship with GDP growth. Notably, public investment causes the private investment with unidirectional relation, meaning public investment crowds-in private investment. The study result is akin to that of Mohsin and Manmohan (1997) and contrasts with the study results found by Rabnawas and Jafar (2015) and Saidjada and Jahan (2016). It is caused due to the use of unique variables and the variance of times of the existing study. In recent years, the government of Bangladesh has been emphasizing public investment to attain higher GDP growth in the years to come. The current study findings may have significant implications in exploiting the potentials of private investment by way of public investment as it (public investment) crowds-in the private investment to be more effective in the growth process of Bangladesh.

*c) Policy Recommendations*

The policy recommendation is straightforward that may be associated with the facilitation of private investment. In this regard, the government may keep on increasing public investment. As public investment in Bangladesh crowds-in the private investment, increase in public investment is critical to moving to the next level of the country's growth.

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