DOES INDIAN ECONOMIC GROWTH AFFECT BANGLADESH? AN APPLICATION OF AUTO REGRESSIVE DISTRIBUTED LAG

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A B S T R A C T

Growth spillover on neighboring country has been studied recently but not enough empirical literature to support this. More importantly, how regional power like India can affect its next-door neighbor Pakistan, Bangladesh, Nepal, Bhutan and Sri Lanka. Using Bangladesh as a case study, this study employs an error correction model derived from standard time series technique called "Auto Regressive Distributed Lag" (ARDL) proposed by Pesaran-Shin-Smith (2001). Our study has applied a time series data over the period 1975–2014. This study extends existing literature by focusing on growth spillover effect on neighboring country. By using the ARDL technique, the findings indicate that there is a long-term relationship between Indian growth and growth of Bangladesh. It can be argued that Indian growth effects on growth of Bangladesh and it is found statistically significant. A number of policy recommendations have been proposed in order to further strengthen the relationship between these two countries.

Keywords: ARDL, Bangladesh, Growth Spillover, India.

INTRODUCTION

Bangladesh is a developing country surrounded by India. Basically, in the West, North, and East side and in the Southwest side by Myanmar. It is a market-based mixed economy and is listed as one of the Next Eleven emerging markets. The per capita income of Bangladesh is US$1,314 in 2015 that rise from 1190 in 2014. Bangladesh enjoys the third-largest economy in South Asia following India and Pakistan and has the second highest foreign exchange reserves after India. The Bangladeshi diaspora living abroad contributed US$15.31 billion in remittances in 2015. Specially, it's (Bangladesh) economy directly or indirectly depend on the three main sectors such as service sector (52.7%), industry sector (28.61%) and agricultural sector (18.64%) (Bangladesh Economic Review report, 2014-2015).

A number of researchers, on behalf of the positive theoretical effect of growth spillover on neighboring countries, for example, Al-Mawali (2015), Ding and

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Masha (2012), Roberts et al. (2009), Pradhan (2008), and Behar (2008) Found that the spillover effect has impact on one country by another country. On the contrary, the other researchers such as, John P. D et al. (2015), Arora et al. (2011), found there is a negative impact of spillover on one country by another country which effect on over situation of the country. Nerveless, some of the researchers like Arora et al. (2011), Pradhan (2008) said the positive and negative effect of the spillover (we discussed details in theoretical underpinnings). Still there is disagreement among researchers on for and against the spillover effect. And so, we are going to the following data or empirical study. For empirical studies, a good number of researchers such as, Gurara and Ncube (2013), Adler and Sosa (2012), Roberts and Deichman (2009), Drummond and Ramirez (2009) and Arora et al. (2005), provided empirical evidence and statistical significance which has positive effect of spillover on one country by another country. However, some researchers have found statistically negative spill overaffect on a neighbouring country. Among the researchers, Khan (2016, cited in Piccio, 2015), (IMF report 2014e), and Adler and Sosa

(2012). They found a negative empirical relation in spillover effect. Spillover effect happens throughout numbers of key transmission channels, like trade, financial flow, trade openness, geographical proximity and so on. We have discussed details in empirical underpinnings. Empirical study is also unresolved and conflicting views among the researchers.

What is the issue? What is the topic for research? What is my research? Now, we got a chance to go through the unresolved issue for my study by solving gap in both literatures theoretically and empirically. We want to make humble efforts for the issue "India's growth spillover effect on neighboring country (Bangladesh)" by pursuing methodology. Finally, it may give useful implications for policy makers and practitioners.

By applying advanced time series econometric technique, ARDL which is better than conventional regression (OLS estimation) because it has the limitation of it assume long run theoretical relation of the variables and make assumption of causality among the variables. The study finds that there is economic co-integration between Bangladesh and India. In other words, Bangladesh growth trajectory follows Indian growth trajectory and it is statistically significant. In addition to geographical proximity, the three main reasons are economic, political and policy interconnectedness between these two countries. Whereas, an economic reason implies increasing bilateral trade, infrastructures, import, foreign direct investment and so on.

The rest of the paper is organized as follows. Section 2 will be theoretical underpinning. Section 3. Empirical underpinnings both are followed by methodology in section 4. Conclusion and policy implication will be drawn at the last section.

THEORETICAL UNDERPINNINGS

Existing literature shows that economic growth of foreign countries has the spillover affect on its neighboring countries. FG or example, Pradhan (2008), Ding and Masha (2012), Khan (2016) focused on the spillover effects of Indian economic growth South Asian countries. Whereas, according to Roberts et al. (2009), Al-Mawali (2015) there is significant academic evidence which suggest growth in one country tends to have a positive impact on growth in neighboring countries. Behar said (2008) Asia and the Americas have big neighborhood effects with each other. Compared with Pradhan (2008), by using different variables, namely, real GDP per capital, demographics (age

dependenceratio), physical capital (gross domestic investment), human capital (secondary school enrollment ratio), trade openness (trade as a percent of GDP), size of government (government expenditure as a percent of GDP) and macroeconomic stability(inflation) and found that all the variables have the effect on other countries.

On the one hand, with the incremental sophistication of the in-house innovation and technological activities of Indian parent companies and large scale acquisition of foreign technologies, it makes the assumption of intermediate technologies weak. There is no direct impact of transferred technologies to local parties but only through potential spillover channels. It is unlikely that Indian organizations are spending on developing region for doing R&D and performing substantial export activities. On the other hand, due to the Indian multinationals in primary sector, labor-intensive industries and also in knowledge-based sectors, their presence may play a catalytic role for developing technology-intensive industries in hosting countries.

Moreover, it is likely that the growth spillovers of India are transmitted through a combination of direct and indirect key transmission channels in different counties. The introducing technology from India and human capital development might be the reasons which lead to the increase in productivity and efficiency of South Asian Counties. The achievements of India in the post-reform era may also improve business confidence in the region which eventually positively affected the growth of South Asian Countries.

Furthermore, compared with other regional economic powerhouses, the level of India growth spillover is lower. Evidence from Southern African region suggested that enhanced real and financial flows could provide a stronger basis for integration, improving the benefit of growth through the trade and financial channels. Ahmed and Ghani (2007, cited in, Ahmed, 2006) stated that the growth of India has had a decisive impact on the overall regional growth. When India has led the way, other South Asian countries including Bangladesh and Pakistan have also shown significant development in economic growth. In this paper, it also pointed out that the gas trade in Bangladesh is constrained by the inadequate infrastructure and political misconceptions in that region.

In addition, according to the Al-Mawali (2015), there is a common view among economists that Saudi Arabia is an

engine of the GCC growth and this is on the basis of the connected channel of trade, investment, financial linkage, more size, political, religious statue. Spillover explains part of the phenomenon that economies grow faster than might be expected on the basis of labor and capital input growth. Arora and Vamvakidis (2011) stated that, China's growth could influence other countries' growth through a number of channels. First, China's imports of commodities, processing inputs and, increasingly, final products have a direct positive impact on the exports and GDP of trading partner countries. And also mentioned that shocks to the growth of china effect immediately on the other countries.

Based on the above mentioned theoretical underpinnings, the lead-lag relationship between Indian's economic growth spillover effects on growth of Bangladesh has been tested on the following variables, focus variables are, growth of India (GIN) and growth of Bangladesh (GDP) and control variables are foreign direct investment (FDI), life expectancy (LE), inflation (INF), all the variables expect to positively impact on the dependent variable except inflation.

On the other hand, Behar (2008) also fund that, Europe and Africa have small or no neighborhood effects but large regional effects. Specifically, Pradhan (2008) studied the overall and regional trends in Indian direct investment flows into developing region from 1960s and found both negative and positive impact on the hosting developing countries. Dunne and Tian (2015) implies there is a negative impact of all spillover channels like trade, capital, technology, recourse allocation, and labor on the neighbouring countries in Africa. According to Arora and Vamvakidis (2011) said that, conversely, China's exports of goods to other countries have direct negative effects on those countries' net exports.

Actually, it is difficult to find out theoretical literature rather than empirical literature review due to the most of the researcher's discuses on the basis of the data or empirical analysis instead of economic interpretation. And so, it is very rare to find paper on it.

From the above theoretical underpinnings, we come to a conclusion that, the previous study is inconclusive that means, there is still debate on the issue or research question. That is why, we would like to make a humble attempt and very much interested in going through the following data answers or empirical literature review to improve the existing study and resolve the gap on the issue.

EMPIRICAL LITERATURE REVIEW
The empirical evidence documents increasing growth spillover effect from the emerging economies to low income countries. Study found that, a 1% point increase in India's growth is associated with a 0.37% point increase for South Asian countries. A 1% point increase in China's growth is correlated with an average of 0.5% point increase in the growth of the rest of the world. Arora and Vamvakidis (2005) found in his study by using panel data for the period 1960–1999 for 101 industrial and developing economies suggests that a 1 percentage point increase in economic growth among a country's trading partners (keeping all else equal) is correlated with an increase in domestic growth of as much as 0.8 percentage points. Ding and Masha (2012) applied panel growth regressions and tested the extent to which growth in the region has been associated with developments in India from 1961 to 2009. The results suggested that the growth of India has impact on the overall growth of South Asia only after 1995.

The study found that, by using a Vector Auto Regression method with considering global demand, international financial conditions, commodity prices, Brazil's real GDP, and domestic GDP to disentangle the spillover effects from Brazil to the rest of the region from 1990 to 2011, Adler and Sosa (2012) found that the trade linkage between Brazil are significant for the Southern Cone countries. Results also show that Brazil has strong effects on the Southern Cone countries especially Mercosur's members. They further analyzed that the spillover effects can be divided into two types through the impact on the output of Brazil. One is the transmission of Brazil-specific shocks; the other is the amplification of global shocks. In addition, their findings suggested that the depreciations of currency in Brazil may not have significant impact on output of its key trading partners.

Spillover effect also exist in African countries, by developing a global vector autoregressive model (GVAR), Gurara and Ncube (2013) study the global growth spillover effects on Africa. Their results imply that the economic growth from both Euro zone and BRICs have significant impact on African economics.

Roberts and Deichman (2009) analyzed the relation between spillover and geographical neighborhood and found significant heterogeneity in growth spillovers, which are strong between OECD countries and essentially absent among Sub-Saharan African countries.

Drummond and Ramirez (2009), using dynamic panel regressions for sub-Saharan African countries relating their real growth of GDP to world growth in trade weighted by partner countries, found that African countries are considerably affected by the decrease of external demand for their exports, the decline in commodity price and term of trade, and tighter Önancial conditions abroad.

On the other hand, Dabla-Norris et al. (2012) showed that growth shocks coming from the external sector have increased in low income countries (LIC) due to the expanding linkages between low-income countries and emerging market leaders. Khan & Ding (2016) used a Bayesian structural vector autoregression model, he found that the spillovers from a 1 percent negative growth shock in India result in a 0.6 percentage points decline in Bangladesh, 1 percentage point decline in U.S. GDP is associated with a 0.12 percent fall below baseline in India's GDP (IMF report 2014e). Moreover, 1 percentage point decline in GDP growth in G-7 countries causes growth in India to fall by 1.7 percentage points. Adler and Sosa (2012) found that the trade linkage between Brazil is not significance rather than Southern Cone countries (Argentina, Bolivia, Chile, Paraguay, and Uruguay) but it is weak for others in that region and also result shows that However, for the rest of South America, the influence is not strong. Actually, net export of Bangladesh is negative because it exports less rather than its import more from the trading partner from 1975 till now. Among the trading partner India and china are the main trading partner of Bangladesh. Since export is less and import is more from India, this is also the one indication of having impact on the growth of the GDP of Bangladesh which is one channel of growth spillover effect.

Above studies indicate that the existing of spillovers effects on its neighboring countries. In the following section, it will focus on what are the factors that would result in the spillovers effects.

Economic growth of the same region: South Asia has developed unprecedented since the 1990s. Among South Asian countries, Indian economy growth has decisive impact on the overall regional growth. When India has led the way, other South Asian countries, for example, Bangladesh and Pakistan have also achieved considerable improvements in economic growth (Ahmed & Ghani, 2007 cited in, Ahmed, 2006). Specifically, from 1980 to 2000, India and Bangladesh increased their GDP growth rates to the rates they had sustained in the two decades prior to 1980 (Ahmed & Ghani, 2007).

Trade and openness: export and import ratios rose in the South Asia countries between 1990 and 2004 due to the declining of trade barriers for example, South Asia Agreement on Regional Cooperation (SAFTA). In India, exports/GDP ratio rose from 7.1 to 19 per cent and Import/GDP ratio from 8.6 to 22.5 per cent. Likewise, in Bangladesh, exports rose from 6.1 per cent of the GDP in 1990 to 15.5 per cent in 2004 while imports rose from 13.5 to 20.8 per cent over the same period. However, whether SAFTA which is supposed to promote trade among South Asian counties, will really be benefiting people in the region by increasing their income depends on whether the SAFTA will be predominantly trade creating or trade diverting. For example, when India imported duty-free goods, and this leads the more efficient Indian cement industry to outcompete the less efficient Bangladesh cement industry, there is trade creation.

Inflation: inflation effects on economic growth, employment, income distribution and wealth as well as social and political conditions of a country (Namazi, and Salehi, 2010; Fischer, 1993). Iqbal and Nawaz (2010) found that the inflation in Pakistan from 1961- 2008, below the first threshold (6 percent) has positive but insignificant effect on economic growth; inflation rate between two threshold levels (from 6 percent and 11 percent) affects economic growth negatively and significantly; high inflation rate above threshold level (11 percent), the marginal impact of additional inflation on economic growth diminishes but it is still negative and significant (Namazi and Salehi, 2008).

Financial depth: in terms of the relationship between financial development and economic growth, there has been a debate in literature since the 19th century (Odhiambo, 2008). In recent studies, Cecchetti and Kharroubi (2012) found that financial sector size has an inverted U-shaped effect on productivity growth by using 50 advanced and emerging market economies from 1980 to 2009. Specifically, there comes a point where further enlargement of the financial system can reduce real growth. They also found that financial sector growth is a grad on productivity growth, which implied that big and fast-growing financial sectors can be very costly for the rest of the economy. Their results are similarly with Law and Singh (2014)'s, who applied the

dynamic panel threshold approach including 87 developed and developing countries from 1980-2010. Law and Singh (2014) found that a threshold effect exists in the finance-growth relationship.

Life expectancy (proxy of human development): The impact of life expectancy on economic growth and health care determinant has been well established at the individual level. There are multiple channels through which life expectancy affects economic growth. Firstly, healthier individuals increase their incomes by being more productive, physically more energetic and mentally more robust. A second mechanism for improved economic development is through increased saving. As people live longer, they will tend to invest more in their retirement. Thirdly, the improved health status of people can lead to increased economic growth through increased education levels. The healthier people tend to invest more in their skills development in order to earn higher wages than the less healthy people. In addition, a healthier child can attend school, learn more and have higher cognition than the non-healthier one.

Therefore, based on previous studies, this paper chooses economic growth at home and board, foreign direct investment (FDI), inflation, financial depth along with life expectancy, M2 (money supply to client), export as factors of Growth spillovers effects.

On the basis the above empirical literature review and we found that there is also the same problem or debate because different researchers said different things so this also not very systematic, not very conclusive. That means debate, not clear the issue yet. There is still problem. This problem may be due to the technical approach, unavailability of data, country specific problem, and economic policy related problem.

Why have we chosen the issue? Based on the studied paper, there are three motivations to choose this topic. Firstly, it is related to unresolved debate or they become inconclusive in existing literature. Secondly, it is from economic reasons. Economic reasons mean that, trade, financial flow, remittance, large import, human capital development, political interference as well as geographical proximity (common language- few states, joint venture, credits arrangement and similarity in the consumption pattern) would affect the economic growth of a country. Thirdly, there is direct link between two countries in civilization, culture, social as well as economical, which is the key transmission channel for Indian's growth spillover effect on Bangladesh.

Bangladesh draw the attention of foreigner for making investment by giving several incentives like, tax holiday, accelerated depreciation, concessionary duty on the imported capital machinery. This is because Bangladesh has a dream that it will be the middle-income county by 2021 (this is the vision of the Government gained). Therefore, this paper aims to make explore the growth spillover effect of India on Bangladesh by the following methodology.

METHODOLOGY AND DATA ANALYSIS
Auto-Regressive Distributive Lag (ARDL)

The research question can be done by the conventional regression analysis that will give the result of the relationship of depend and independent variables only. The main difference between conventional regression and time series technique is that regression assumes both long-run theoretical relationship among the variables and assumes which variable is exogenous and which variable is endogenous. But we did not get the answers of the following question in addressing my issue 1. Does regression express lead-lag relationship among the variables? 2. Does it give the direction of the causality? 3. Does it express the cointegression of the variables or theoretical relationship or trend effect of the variables? 4. Does it express which variables should give more emphasize? 5. Does it give the strategic solution to the practitioner that which one needs to focus first for decision making? Due to the above debates or problems we choose the time series analysis techniques. What regression cannot do we are doing that by applying time series analysis. in regression just we assume the theory, we say that right hand side variables effect the left-hand side variables, but we did not test X1, X2, X3......there is the difference with the regression and the time series techniques. But it better to test theoretical relationship which is called cointegretion.

Generally, ARDL approach is employed in economic empirical work to determine the relationship among the variables. This model has some advantages over other cointegration approaches.

Firstly, this technique is relatively more robust in small or finite samples consisting of 30 to 80 observations. In our study, it only has 40 observations from 1975 to 2014. Thus, for this paper, ARDL appears to be an appropriate technique (Afzal et al., 2013). Secondly, ARDL can be applied irrespective of whether regressors are of I (0) or I (1) or mutually integrated with a perquisite that none of the explanatory variables is of I

(2) or higher order (Afzal et al., 2013: 25). In this study, because of the conflicting results in unit root test between ADF and PP tests, it rejects to use Long Run Structure Modelling which requires all tested variables must have long run relationship (Garratt et al., 2006: 6). As ARDL does not require that variables are stationary, it will be more suitable for this paper to apply this technique compared with other conintegration approaches. Thirdly, ARDL pertains general-to-specific modelling framework by taking sufficient number of lags to capture the data generating process[i]. It estimates $(p+1)^k$ number of regressions to get an optimal lag length for each variable, where p is the maximum lag to be used, and k is the number of variables in the equation. The model is selected based on the different criteria, for example, SBC, AIC, RBC and HQC (Afzal et al., 2013).

Fourthly, conventional cointegration methods face the problems of endogeneity while ARDL can differentiate between dependent and explanatory variables and eradicate the issues which might be due to the presence of autocorrelation and endogeneity. Moreover, ARDL permits the conintegration relationship to be estimated by Ordinary Least Squares (OLS) once the lag order of the model is identified. Furthermore, Error Correction Model (ECM) can also be included in ARDL approach (Sezgin & Yildirim, 2003 cited in Afzal et al., 2013). In regression analysis, one often obtains a very high R^2 even though there is no meaningful relationship between the two variables. This situation exemplifies the issue of regression whose nature will be explored shortly (Gujarati, 2009: 737). However, ECM allows drawing outcome for long-term relationships whereas other cointegration techniques do not have such kinds of inferences. Thus, ECM, which can be conducted within the processes of ARDL approach, combines the short-run adjustments with long-run equilibrium without losing long-term information (Afzal et al., 2013: 25).

Therefore, these above advantages of ARDL justify the application of ARDL approach in the present study to analyze the relationship among the variables.

It is well documented that most economic time series are non-stationary in their original 'level' form. If the variables are non-stationary, the conventional statistical tests (such as R2, t, etc.) are not valid. If the variables are non-stationary but cointegrated, the ordinary regression without the error-correction term(s) derived from the cointegrating equation is mis-specified. However, if the

GDP = ∫ (GIN, FDI.1, LE, INF)

variables are non-stationary but not cointegrated, then an ordinary regression with 'differenced' variables (which will be stationary) can be estimated but the conclusions drawn from such an analysis will be valid only for the short run and no conclusions can be made about the long run i.e., theoretical relationship among the variables since the theory has typically nothing to say about the short run relationship. This is because the 'differenced' time series variables have no information about the long run relationship between the trend components of the original series since these have, by definition, been removed. The long run co-movement between the variables cannot be captured by differenced variables.

Therefore, on the one hand, when the variables taken are 'non-stationary' at their original 'level' forms, the conventional statistical tests are not valid because the variances of these variables are changing, and the relationship estimated will be 'spurious'. On the other hand, when the variables taken are turned 'stationary' by 'first-differencing', the long-term information contained in the trend element in each variable has been, by definition, removed and the relationship estimated gives only the short run relationship between the variables and the regression does not test any theoretical relationship

Data and model

Our study applies the Autoregressive Distributed Lag model (ARDL) analysis (also known as the Bounds testing procedure) *Pesaran-Shin-Smith (2001)* by using five variables derived from the previous studies and according to our research objective. These variables have divided them into two categories. Since our focus is on the India's growth spillover effect on the growth of Bangladesh, so growth of the two countries, growth of Bangladesh (GDP per capita constant dollar), growth of India (GIN) are our focus variables, and, other three variables likely, foreign direct investment (FDI.1), Life expectancy (LE), and macroeconomic stability inflation (INF) are the control variables. Over this study uses these variables for the lead lag analysis. We transformed all the variables (except the inflation rates) are into logarithms to achieve stationary in variance. All the level forms of the variables were transformed into the logarithm scale but that was not necessary for the inflation rate variable, which was originally in % form. Theoretical model specifications are given following.

Whereas,

GDP = Growth of the Bangladesh (GDP per capita constant dollar),

GIN = Growth of India,

FDI.1 = Foreign Direct Investment,

LE = Life Expectancy (proxy of human development),

INF = Inflation.

The ARDL model specifications of the functional relationship among the five variables can be estimated below,

$$DGDP_t = a_0 + \sum_{i=1}^{k} b_1 DGDP_{t-i} + \sum_{i=0}^{k} b_2 DGIN_{t-i} + \sum_{i=0}^{k} b_3 DFDI.1_{t-i} + \sum_{i=0}^{k} b_4 DLE_{t-i} + \sum_{i=0}^{k} b_5 DINF_{t-i}$$

$$+b_6 LGDP_{t-1} + b_7 LGIN_{t-1} + b_8 LFDI.1_{t-1} + b_9 LLE_{t-1} + b_{10} INF_{t-1} + \mu_t$$

In general, ARDL bounds testing procedure includes two major stages. At the first stage, it tests the existence of a long-run relationship among the variables. This is done by constructing an unrestricted error correction model (UECM) with each variable in turn as a dependent variable and then testing whether the 'lagged levels of the variables' in each of the error correction equations are statistically significant. The second stage will forecast the long run coefficients (after selecting the optimum order of the variables through AIC or SBC criteria) and then estimates the associated error correction model.

Specially, ARDL bounds testing procedure permit us to take into consideration I (0) and I (1) variables together. The null hypothesis of the non-existence of a long-run relationship is denoted by $F_{LGDP}(LGDP|LGIN, LFDI.1, LLE, INF,)$ is H0 = b6= b7 =b8 =b9 =b10 =0). Similarly, I compute the F-statistics when the other variables in Eq. (2) are used as dependent variables and denote them with

$$F_{LGIN}(LGIN|LGDP, LFDI.1, LLE, INF), F_{FDI.1}(LFDI.1|LGDP, LGIN, LLE, INF),$$

$$F_{LLE}(LLE|LGDP, LGIN, LFDI.1, INF), \text{ and } F_{INF}(INF|LGDP, LGIN, LFDI.1, LLE),$$

and while the null hypothesis means there is no cointegration, against the alternative hypothesis of there is cointegration. H_1: b6 ≠ b7 ≠ b8≠ b9≠ b10 ≠ 0. In equation, k is lag criteria.

The calculated F-statistics are derived from Wald test are compared with Pesaran et al. (2001)'s critical values. If calculated F-statistics falls below the Pesaran et al. (2001)'s lower critical values, it is accepted that there is not relationship between time series. If calculated F-statistics is among Pesaran et al. (2001)'s lower and higher critical values, it is avoided to make certain commitment and referred to other cointegration tests. If

calculated F-statistics is upper than bound critical values, it is accepted that there is relationship between time series. In other words, the null hypothesis is rejected.

After estimating the existence of long run relationship between variables the second step is selecting optimal lag length by using of standard criteria such as Swartz Bayesian (SBC) or Akaike Information (AIC). After that long run and short run coefficients could be predicted. ARDL long run form (not model) is exhibited in equation below:

$$LGDP_t = a_0 + \sum_{i=1}^{k} b_1 LGDP_{t-i} + \sum_{i=0}^{k} b_2 LGIN_{t-i} + \sum_{i=0}^{k} b_3 LFDI.1_{t-i} + \sum_{i=0}^{k} b_4 LLE_{t-i} + \sum_{i=0}^{k} b_5 INF_{t-i} + \mu_t$$

Error correction **term or form but not model** is used in the ARDL short run model. The short run dynamic model can be presented as follows:

$$DGDP_t = a_0 + \sum_{i=1}^{k} b_1 DGDP_{t-i} + \sum_{i=0}^{k} b_2 DGIN_{t-i} + \sum_{i=0}^{k} b_3 DFDI.1_{t-i} + \sum_{i=0}^{k} b_4 DLE_{t-i} + \sum_{i=0}^{k} b_5 DINF_{t-i} + ECT_{t-i}$$

Where, ECT is lagged error correction term.

The hypothesis that we will be testing is the null of 'non-existence of the long-run relationship' defined by

$$H_0: b_1 = b_2 = b_3 = b_4 = b_5 = b_6 = 0$$

Against, existence of a long-run relationship.

$$H_1: b_1 \neq b_2 \neq b_3 \neq b_4 \neq b_5 \neq b_6 \neq 0$$

We begin our empirical testing by determining the stationarity of the variables used. In order to proceed

with the testing of cointegration later, ideally, variables should be I (1), in that in their original level form, they are non-stationary and in their first differenced form, they are stationary. The differenced form for each variable used is created by taking the difference of their log forms. For example, DGDP = LGDP – LGDPt–1. We then conducted the Augmented Dickey-Fuller (ADF), Philip-Perron (PP) and Kwiatkowski–Phillips–Schmidt–Shin (KPSS) test. The table below summarizes the results. We cannot say that our result is 100% accurate because there may be data problems.

The study's empirical analysis uses annual data from 1975 to 2014. A total of 40 observations were obtained. We could not include 2015, 2016 and 2017 in our study due to the unavailability of data. Bangladesh has been taken as an area of the study. Required data has been collected from difference sources like, World Bank, Global Economy, and Bangladesh Bureau of Statistics.

INTERPRETATION OF ESTIMATED RESULTS

Stationarity Test

A stationary series has a mean (to which it tends to return), a finite variance, shocks are transitory, autocorrelation coefficients die out as the number of lags grows, whereas a non-stationary series has an infinite variance (it grows over time), shocks are permanent (on the series) and its autocorrelations tend to be unity. If the series is 'stationary', the demand-side short run policies are more effective but if the series is 'non-stationary', the supply-side policies are more likely to be effective in the long run.

Table 1. Unit Root Test[ii].

Variables	ADF			PP			KPSS		
Level form	T-test	CV	Decision	T-test	CV	Decision	T-test	CV	Decision
LGPD	.71691	-3.5468	NS	1.9427	-3.5279	NS	.14507	.18528	S
LGIN	-.72593	-3.5468	NS	-1.1658	-3.5279	NS	.15006	.18528	S
LLE	3.4234	-3.5468	NS	-5.6675	-3.5279	S	.15767	.18528	S
LFDI.1	-3.8019	-3.5468	S	-2.5197	-3.5279	NS	.12534	.18528	S
INF	-4.6993	-3.5468	S	-16.5074	-3.5279	S	.16137	.18528	S
Differenced form									
DGPD	-2.4075	-2.9528	NS	-5.0758	-2.9400	S	.37850	.37674	NS
DGIN	-4.2778	-2.9528	S	-5.8095	-2.9400	S	.42414	.37674	NS
DLE	.67740	-2.9528	S	-4.2508	-2.9400	S	.44668	.37674	NS
DFDI.1	-6.7312	-2.9528	S	-8.2476	-2.9400	S	.12660	.18528	S
DINF	-9.1119	-2.9528	S	-30.6938	-2.9400	S	.34130	.37674	S

Notes: ADF; Augmented Dickey-Fuller, PP; Phillips-Perron, KPSS; Kwiatkowski–Phillips–Schmidt–Shin, CV; Critical value, NS; Non-stationary, S; Stationary.

Moreover, before determining which co-integration method (between VAR and ARDL) should be used in this study, unit root tests are necessary steps to see whether the variables are *I* (1), namely all variables should be non-stationary at level form but stationary at first difference form.

Table-1 shows that result varies from one test to another test. If we analyze the results of unit root tests of all variables in the level and differenced form. In level form, we observe that life expectancy (LE), foreign direct investment (FDI.1) inflation (INF) show different result from ADF and PP tests however; KPSS shows all variables are stationary. Whereas, in differenced form,

growth of Bangladesh is NS in ADF test, in KPSS, DFDI.1 and DINF are stationary and in PP test all the variables are stationary. It is more than evident that the results are not consistent across various tests. Therefore, variables are using for this analysis are I (0) or I (1). (Appendix in details)

As the results of unit root test are not consistent among the tests, we decided to use ARDL technique to test the long run relationship or trends among the variables. Before proceeding with the test of cointegration, we try to determine the order of the vector auto regression (VAR), that is, the number of lags to be used.

Determination of Lags

In VAR model, lag order selection is a necessary step before conducting cointegration. However, in ARDL it is not. Even we had done this test, the result might be biased because VAR requires that regressor must be I (0) and I (1) at the first step, only if this condition is fulfilled, we can go for the lag order selection. The order of lags would tell policy makers that how long the variables would come back to equilibrium.

Table 2. VAR order selection.

		Selection Criteria	
		AIC	SBC
Optimal order of the VAR	4	4	1
Optimal order of the VAR	3	3	1

According to the table-2, there are conflicts between recommendation of AIC and SBC. This can interpret as inherent nature of time series data of our study.

After robustness test, result shows that AIC gives 3 and SBC gives 1 which is provided by Adjusted LR test. However, the results of these two tests are conflicting. When this study proceeds with maximum order (4), it had problem in impulse response in the latter stages. But taking lower order (1) shows no problem (appendix). In order to precede the research, this paper chose 1 lag order.

Cointegration Test[iii]

An evidence of cointegration implies that the relationship among the variables is not spurious, i.e. there is a theoretical relationship among the variables and that they are in equilibrium in the long run.

Table 3. Engle – Granger (E-G) Test.

T-statistics	Critical value
-2.7568	-4.8026

Table-3 shows that the absolute form of *T*- statistics (-2.758) in is less than the absolute form of Critical vale (-4.8026). Thus, we cannot reject the null which means the residuals are non-stationary. Statistically, the above result indicates that the chosen variables, in some combination, lead to a non-stationary error term. Non-stationary indicates that there is no cointegration or long-term relationship among variables.

There initial result is not intuitively appealing. Thus, this paper decided to go for Johansen cointegration test.

Johansen Cointegration Test

As depicted in the Table-4 below, the maximal Eigenvalue, Trace, SBC and HQC indicate that the maximum eigenvalue and trace are four cointegrating vectors whereas according to AIC, SBC, and HQC there are 5 cointegrating vectors.

Table 4. Johansen Cointegration[iv].

Criteria	Number of co-integrating vectors
Maximal Eigenvalue	4
Trace	4
AIC	5
SBC	5
HQC	5

The statistics refer to Johansen's log-likelihood maximal Eigenvalue and trace test statistics based on cointegration with unrestricted intercepts and restricted trends in the VAR. These results conflict each other, it also conflict with Engle – Granger. As these approaches have many limitations that are taken care by ARDL. For that we decided to go for ARDL approach for testing cointegration among variables.

Table 5. F-Statistics for Testing the Existence of Long-Run Relationship (Variable Addition Test)[v].

Dependent Variables	F-Statistics	Critical value lower (95%)	Critical value upper (95%)
DGDP	6.0398*	2.850	4.049
DGIN	2.0682	2.850	4.049
DFDI.1	3.4512	2.850	4.049
DLE	1.1032	2.850	4.049
DINF	4.0925*	2.850	4.049

Table-5, shows the calculated F-statistics for DGDP (Growth of Bangladesh) is 6.0398, which is higher than the upper bound critical value 4.049 at the 5% significance level. This implies that the null hypothesis of no cointegrating long-run relationship can be rejected since F-statistics>Critical value. These results reveal that a long-run relationship exists between the macroeconomic variables and growth of India, growth of Bangladesh. This by itself is a significant finding in view of the fact that the long run relationship between the variables is demonstrated here avoiding the pre-test biases involved in the unit root tests and cointegration tests required in the standard cointegration procedure. The evidence of long run relationship rules out the possibility of any spurious relationship existing between the variables. In other words, there is a theoretical relationship existing between the variables. Next, the ECM"s representation for the ARDL model is selected

AIC Criterion. Table provides the estimates of the ARDL long-run coefficient for the model.

At this stage, we run the ARDL test to confirm the short-term and long-term relationship, study long-run coefficients and error-correction model to identify which variables are endogenous and which are exogenous.

ARDL Bound test

At this stage we run ARDL test to examine the short-term and long-term relationships among variables and identify endogenous and exogenous variables. The non-hypothesis of non intergratoin among the variables can be rejected if *F*-Statistics is higher than the upper bound. If F-Statistics is below than the lower bound, we cannot reject that there is no long relationship between dependent variable and explanatory variables. If the *F*-Statistics falls in between, the implication is inconclusive. The results are given in table 6.

Table 6. ARDL Bound test for existence of a level relationship[vi].

Dependent Variables	F-Statistics	Critical value lower (95%)	Critical value upper (95%)
LGDP	12.9063*	3.539	4.667
LGIN	2.0579	3.539	4.667
LFDI.1	3.5782	3.539	4.667
LLE	78.8338*	3.539	4.667
INF	4.0443	3.539	4.667

From the above table-6, it shows that when real GDP per capita constant dollar is the dependent variable, the calculated F-statistic *F*LGDP (LGDP|LGIN, LFDI.1, LLE, INF) = 12.9063 is greater than the upper bound of the critical value obtained from Pesaran et al. (2001), indicating there is compelling evidence for cointegration between growth and its determinant in Bangladesh for the study period. These results reveal that a long-run level relationship exists among growth other variables and

they are co-integrated. This by itself is a significant finding in view of the fact that the long run relationship between the variables is demonstrated here avoiding the pre-test biases involved in the unit root tests and cointegration tests required in the standard cointegration procedure. The evidence of long run relationship rules out the possibility of any spurious relationship existing between the variables. In other words, there is a theoretical relationship existing between them.

Table 7. Results of Estimated Long-Run Coefficients using the ARDL Approach

Depend variables	GDP (Growth per capita constant dollar)
LGIN	0.89901 (.000) **
LFDI.1	0.0040659 (.037) *
LLE	-1.3857 (.000) **
INF	0.7945 (.229)
Intercept	6.0676 (.000)
Chi-square SC	0.34335 [.558]
Chi-square FF	5.3736 [.020]
Chi-square N	14.1614 [.001]
Chi-square Het	1.8680 [.172]

Notes: [1] Note: * and ** denotes significant at 5 percent and 1 percent level, figure in the first bracket () and third bracket [] denotes P-value.

Table-7 provides the estimates of the ARDL long-run coefficient of this study. The estimated long run coefficients of the long run relationship show that GIN, FDI.1, and LE have significant effects on the real GDP per capita constant dollar in Bangladesh. The coefficient of India's growth is statistically significant at 1 percent level (since p<0.01) that implies that 1% increase in the Indian GDP, Bangladesh GDP would increase by 0.8990%, the coefficient of foreign direct investment is 0.0041 that statistically significant at p<0.01, indicating that 1% change in FDI.1, growth would change by 0.0041%. Accordingly, the coefficient of the life expectancy is -1.3857% that is negatively significant. If 1% changes in LE, growth would decrease by 1.38%. The reasons behind this significance are that, Bangladesh and India have bilateral trade agreement; Bangladesh import 15% goods and services from India, investment by India in garment sector as well as political relation influence the growth of Bangladesh. Currently foreign direct investment in Bangladesh is 1.44% of GDP in 2014 that is higher than 2013 (1.27%) and 2012(1.19%). So,

this is an incremental flow in FDI in Bangladesh by foreigner. This is due to the incentives (tax holiday, accelerated depreciation, concessive duty on imported capital machinery as well as availability of low cost labour) given by the government. Finally, life expectancy that is supposed to have positive effect on GDP theoretically, but we found it here significant but negative effect on GDP. The reason is, life expectancy theoretically said that healthy people are more save more for retirement or for future, energetic, investment more, more productive that lead to the GDP. Since average life age of people of Bangladesh is 60-61 years that less save, restively less investment and unhealthy, it effects negatively to GDP. Inflation is not statistically significant at all which shows that inflation does not affect the growth of Bangladesh.

Error correction model of ARDL[vii]

Error correction model indicates which one exogenous and which one endogenous among the variables and this is shown in the following table.

Table 8. F-test for estimated long-run coefficients.

Variables	Coefficient	Standard error	P-value	Implication
ecm (-1) DGDP	-.40218	.090711	[.000] *	Endogenous
ecm (-1) DGIN	-.55973	.22112	[.016]	Exogenous
ecm (-1) DFDI.1	-.59548	.14551	[.000] *	Endogenous
ecm (-1) DLE	-.13868	.0095284	[.000] *	Endogenous
ecm (-1) DINF	-1.2512	.077541	[.000] *	Endogenous

Note: * denotes significant at 1 percent level.

As stated earlier, cointegration tells that there is a long run relationship between the variables. However, there could be a short-run deviation from the long-run equilibrium. Cointegration does not unfold the process of short-run adjustment to bring about the long-run equilibrium. For understanding that adjustment process we need to go to the error-correction model. The p value of the error-correction coefficient indicates whether the deviation from equilibrium (represented by the error-correction term) has a significant feedback effect or not on the dependent variable.

According to the above table-8, the coefficient of Indian growth is 0.55973, since P>0.01, we fail to reject null hypothesis (Ho) and so it becomes the exogenous variable. On the other hand, remaining variables are endogenous due to fail to accept null hypothesis and this

are statistically significance, since P<0.01. Why Indian's growth is exogenous? There are several economic reasons behind this. Firstly, trade between two countries. Secondly, investment in Bangladesh (FDI) under the act "The treaty on bilateral investment and protection", since Bangladesh has 160 million people which able to provide labour at lower cost, it motivates India as well as other countries to invest in Bangladesh. Thirdly, India is the 2nd largest county for Bangladesh for import goods and services. Fourthly, geographical proximity between two countries. Fifthly political relationship between two countries, this are the main reasons behind the exogenity.

Why are we going to the following stage? In this stage, we will find which variables are exogenous and which variables are endogenous. Now, we want to study which

variable is the relative or the most exogenous and which is the weakest endogenous. So, we are going to the following step to see that situation.

Variance Decomposition (VDC)

Although the error correction model tends to indicate the endogeneity/erogeneity of a variable this study has to apply the variance decomposition technique to discern the relative degree of endogeneity or exogeneity of the variables. The relative exogeneity or endogeneity of a variable can be determined by the proportion of the variance explained by its own past. The variable that is explained mostly by its own shocks (and not by others) is deemed to be the most exogenous of all. We started out applying generalized VDCs because that is better than the orthogonalized and obtained the following results.

What is the difference between error correction model and variance decomposition? The main difference is that error correction model shows us which one is exogenous, and which one is the endogenous but VDC will show us which one is relative exogenous, and which one is the relative endogenous.

Table 9. Generalized VDC.

VARIABLES	HORIZON	DGDP	DGIN	DFDI.1	DLE	DINF	RANKING
DGDP	3	55.43%	33.01%	0.45%	3.24%	7.87%	5
DGIN	3	12.10%	67.09%	0.36%	3.16%	17.29%	4
DFDI.1	3	2.69%	1.61%	93.10%	1.81%	0.79%	1
DLE	3	10.61%	3.51%	3.96%	79.83%	2.09%	2
DINF	3	2.44%	16.36%	6.84%	3.71%	70.65%	3
	HORIZON	DGDP	DGIN	DFDI.1	DLE	DINF	
DGDP	5	55.21%	32.86%	0.48%	3.63%	7.83%	5
DGIN	5	12.17%	66.71%	0.40%	3.54%	17.18%	4
DFDI.1	5	2.69%	1.61%	93.09%	1.82%	0.79%	1
DLE	5	11.45%	4.19%	4.13%	78.33%	1.90%	2
DINF	5	2.45%	16.35%	6.85%	3.79%	70.56%	3
	HORIZON	DGDP	DGIN	DFDI.1	DLE	DINF	
DGDP	10	55.07%	32.78%	0.50%	3.85%	7.80%	5
DGIN	10	12.18%	66.51%	0.42%	3.76%	17.13%	4
DFDI.1	10	2.69%	1.61%	93.08%	1.83%	0.79%	1
DLE	10	11.86%	4.49%	4.21%	77.63%	1.81%	2
DINF	10	2.46%	16.35%	6.85%	3.83%	70.51%	3

From the table-9, it dispatches that in the 3-year time horizon, foreign direct investment (FDI.1) is the most exogenous and growth is the most endogenous. In the 5- and 10-years' time horizon, both are the in same situation respectively. One more interesting thing is that, growth of Bangladesh it depends on of its own past by 55.43% and remaining majority part almost 33.01% depend on growth of India. In remaining two times horizon is same. This is our expectation that positive with our research question.

In this stage, we found relative exogenity/endogenity of the variables. But we want to see the graphical presentation of the variables when shock one specific variable and what is effect on other variables with the same result. For this reason, we are going to the following stage.

Impulse Response (IR) and analysis result.

Impulse response (IR) analysis is based on VAR model. It is not necessary step for ARDL method. ARDL does not need to fulfil a series is I (0) and I (1), while VAR requires this precondition to carry out all other steps. Therefore, in ARDL model, even we conducted IR test, the result would also face biased issue.

But for the advantages of IR analysis, it provides policy makers with additional information that which variable is the most exogenous and relative exogeneity/endogeneity. Therefore, policy makers would shock on one variable which is the most exogenous to achieve the economic target.

Moreover, the impulse response functions (IRFs)

essentially produce the same information as the VDCs, except that they can be presented in graphical form. If any specific one variable was shocked, we will see the immediate effect on others. This paper will only shock two focusing variables-the growth of India and the growth of Bangladesh - since these two variables will directly answer the research question. The reasons to choose generalized impulse response instead of orthogonalized IR is: (i) Generalized impulse response does not depend on the order of lag; (ii) it does not assume when one variable is shocked another variable is switched off.

Generalised Impulse Responses to one SE shock in the equation for DGIN
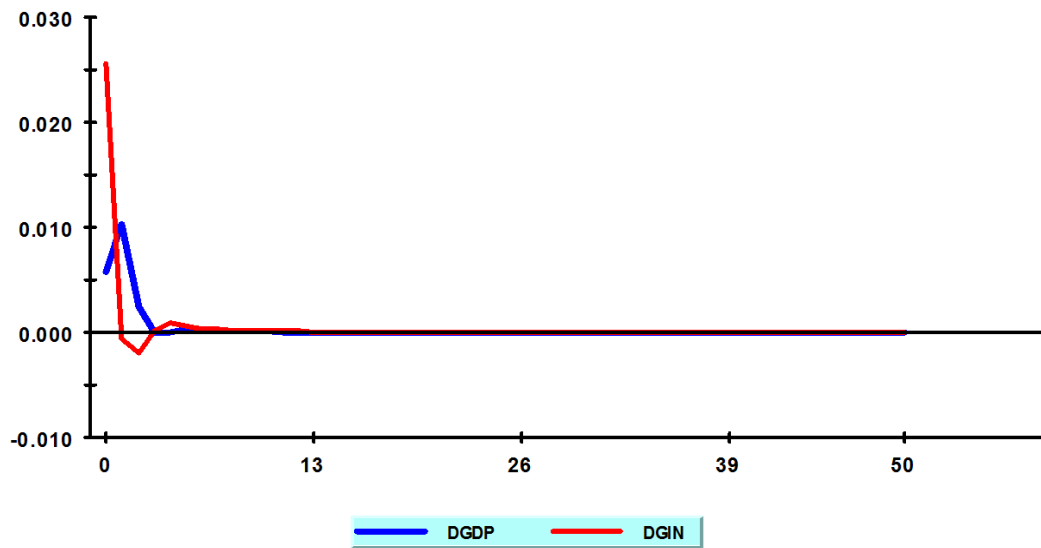

Figure 1a. India's growth shock and impact on growth of Bangladesh.

Source: This figure shows the authors' own Estimation.

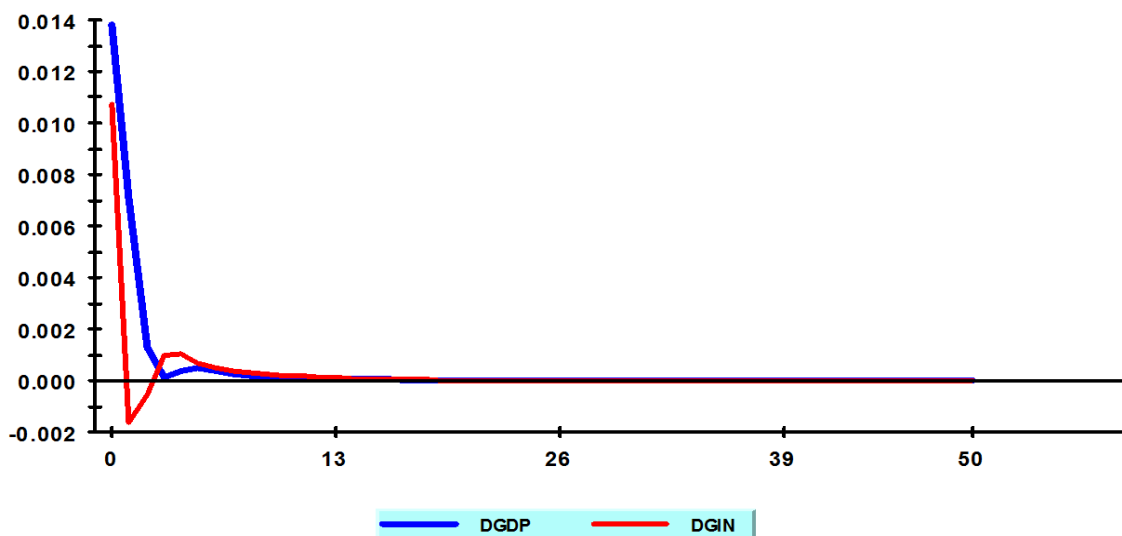**Generalised Impulse Responses to one SE shock in the equation for DGDP**

Figure 1b: Growth of Bangladesh is shocked and impact on growth of India.

Source: This figure shows the authors' own Estimation.

In figure-1a, it presents the generalized responses of dependent variable to shocks on independent variable. When we shocked the growth of the India and see the immediate effect on the growth of Bangladesh. We see the instant movement of growth of the Bangladesh but after certain period of time both are going to the equilibrium. There is an economic reason behind that; a large portion of the investment in Bangladesh are coming from India in different form as well as India is one of the largest trade partners of Bangladesh.

In addition, in figure 1b, we see, when GDP of Bangladesh is shocked there is no significant effect on the Indian's growth both are in a parallel situation. The reason behind this, Bangladesh is a small economy than India and so it can't affect as much as India effect on Bangladesh.

Finally, this is the most important that getting the direction of the long run relationship in variables until VECM. But after the VECM until impulse response will show the lead lag of the variables and this is the most important symptom for the policy makers. Because he or she will able to know which one most exogenous and which one is the most endogenous. In our research question, it easy to say growth of India has significant effect on the growth of the Bangladesh. So, it is the task of the policy maker is to give emphasis on it.

LIMITATION OF THE STUDY

We do have plausible limitations on our study on the basis of the following stages

Limitation on the Measurements

Normally, in empirical studies, the measurement of different variables might be conducted by various software or techniques. But in this paper, it only uses one software/technique because it mainly depends on the availability of data. There may be still some problems due to the upcoming adjustment that will be solved in future by other researchers with standard technical or updated approach.

Limitation on the Interpretation of Result

Interpretation can be done in two ways, theoretically and empirically. Theoretical interpretation indicates the economical interpretation or economical examination of the variables. Empirical interpretation is the explanation on the basis of the statistical significance. We have discussed the result whatever this study found through software. Thus, this paper interpreted the results based on the report given by the software. However, due to data issue, the interpretation may not be 100% correct. For example, suppose one variable theoretically or economically positively affects another variable but this variable is not statistically significant in our study. In this situation, there exist conflicts between literature or theory and the empirical result got by this study. In this case, this paper chose not to describe anything regarding this variable. This is because there may have data issue.

Data Limitation and Time Constraint

Apart from the above limitations, this study also faces other two more limitations, namely, data limitation and time constrain. On the one hand, we could not take recent year 2015 and 2016 due to the unavailability of data. In addition, we only have four months, this time period is not enough for the author of this study to making a research paper.

CONCLUDING REMARKS AND POLICY SUGGESTIONS OR IMPLICATION

This study has provided a quantitative assessment on India's economic growth effect on the economic growth of Bangladesh. The research question is: Does growth spillover effect on neighboring country? we made an attempt to explore the research question by applying a standard time series technique called 'Auto-Regressive Distributed Lag' (ARDL) (Pesaran et al., 2001) which has taken care of a major limitation of the conventional cointegrating tests in that they suffer from the pre-test biases involved in the unit roots and cointegration. The samples selected in this paper are from 1975 to 2014 with a total observation 40. We focus on the economic growth of Bangladesh by considering the effect of the growth of India, foreign direct investment, life Expectancy and inflation. Results tend to show that Indian growth trajectory affects economic growth of Bangladesh even after controlling for key macro variables. This could be due to trade openness, financial flow, bilateral trade contract between the two countries and indirect political interference in economic policy measures.

It is found in the study that; all variables are co-integrated in the long run. This confirms that the relationship is not spurious and exist strong long run theoretical relationship. Based on empirical findings, it can be argued that Indian economic growth does affect Bangladesh's growth significantly even after controlling for other key variables and it is positive.

This study provides some important policy implications.

Firstly, Policy makers should give more emphasis and continue on the bilateral trade contract with India and establish infrastructural development project with India like corridor for seven sisters. Secondly, they should maintain good political relation with India as well as well as political stability inside the country as well. Finally, for the future empirical research which focuses the effect of the growth of one country on neighboring country, it might be helpful for them to extend the analytical framework used in this study to other developing countries by applying advanced econometric techniques.

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[i] Data Generating Process (DGP): suppose we want to speculate on the shape of some curves beyond the sample period, for example, in this study, 2015 to 2016. We can do that if we know the statistical mechanism, or the data generating process (Gujarati & Porter, 2009: 738).

[ii] Null hypothesis (H0) = Non-stationary and alternative hypothesis (H1) = Stationary. Therefore, if the $P<0.05$ Then fail to accept the null hypothesis (Ho) on the other the $P>0.05$, Fail to reject the null hypothesis (Ho). In the level form variables should be non –stationary and in differenced form variables should be stationary but in case of KPSS it will be inversed.

[iii] Null-hypothesis (Ho) = No cointegration, alternative hypothesis (H1) = Cointegration. Therefore, if the $P<0.05$, fail to accept the null hypothesis (Ho) on the other hand, if the $P>0.05$, Fail to reject the null hypothesis (Ho).

[iv] In the case of Maximal Eigenvalue and Trace, the test statistic for null of $r = 0$ is greater than the 95% critical value whereas for other null hypotheses, statistic is less than the critical values. For AIC, SBC and HQC, the number of cointegrating vectors is obtained by locating the highest numbers.

[v] The critical values are taken from Pesaran et al. (2001), unrestricted intercept and no trend with five repressors. * denote rejecting the null at 5% level.

[vi] The critical values are taken from Pesaran et al. (2001), unrestricted intercept and trend with five regressors. * denote rejecting the null at 5% level.

[vii] Null hypothesis (Ho) = variable is exogenous or leader or independent or stronger, alternative hypothesis (H1) = Variable is endogenous or follower or dependent or weaker.. Therefore, if the $P<0.05$ Then fail to accept the null hypothesis (Ho) on the other hand, if the $P>0.05$, Fail to reject the null hypothesis (Ho). More over before the written variable above table, there should be no delta. If we put delta before that variable it becomes short term and we are not testing the theory part. And so, for the sake of testing theory we can't put delta. No equality sign (=) also.