FDI, Trade Openness, Capital Formation, and Economic Growth in Bangladesh: A Linkage Analysis

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Abstract

This paper examines the linkage between FDI, trade openness, capital formation, and economic growth rates in Bangladesh over a period 1986 to 2008 using time series analysis. All variables are found stationary at first differencing both at constant and constant plus trend level under the ADF and PP stationary tests. The Johansen-Juselius procedure is applied to test the cointegrating relation between variables followed by a vector error correction model. The empirical results trace a strong long-run equilibrium relationship between GDP growth rates and the explanatory variables with unidirectional casual flows. The volume of FDI and level of capital formation are found to have significant positive effect on changes in real GDP. The degree of trade openness unleashes negative but diminishing influence on GDP growth rates. We conclude that Bangladesh should formulate FDI-led polices and ensure higher degree of capital formation to enhance her economic growth rates at large.

Keywords: FDI, Capital formation, Trade openness, GDP growth, VECM and Bangladesh

1. Introduction

Theoretically, the linkage between foreign direct investment (FDI), trade openness, capital formation, and economic growth tends to be positive. A number of reasons can be outlined in favor of this assertion. First, the neoclassical and endogenous growth theories underline that FDI promotes economic growth in a capital scarce economy by increasing volume as well as efficiency of physical investment (Romer 1986, Lucas 1988, Grosman & Helpman 1991, Baro & Salai-I-Martin 1995). In other words, FDI supplies long-term capital with new technologies, managerial know-how and marketing capabilities which, in turn, augment economic growth by creating employments, increasing managerial skills, diffusing technologies and fostering innovations (Asiedu 2002). FDI can also facilitate 'agglomeration economies' through industry clustering and networking, and lowering costs for all producers in the market (Krugman 1991). Pugel (2007) reports that FDI increases technological spillover benefits, widens the scope of international competition and strengthens the supply side capabilities of a host country for producing and selling goods and services, which lead to higher economic growth.

Second, the degree of trade openness is likely to influence the flows of international capital in terms of risk-return relationship. In fact, no one feels interested in committing long-term investment in a country that imposes tariff and non-tariff barriers on investment and creates problem in repatriating capitals as well as profits. The level of trade openness also indicates the degree of comparative advantage of a country in undertaking investment. This view basically rests on the 'transaction cost theory' (Coase 1937, Williamson 1975) that postulates a low transaction cost environment generates financial incentives (higher return on investment) for both the domestic and foreign players in supplying large irreversible investment like FDI. Moreover, the endogenous growth theories stress that a more open trade policy framework promotes allocative efficiency of investment by reorienting factors of production to sectors that have comparative advantages in trade; thereby augmenting economic growth (Solow 1956, Balasubramanyam et al. 1996). Edwards (1992) also points out that a country with a higher degree of economic openness can grow faster by absorbing new technologies at a faster rate than a country with a lower degree of openness.

Third, the level of capital formation is likely to influence FDI and economic growth as well. Neo-classical growth model postulates that developing economies that have a lower initial level of capital stock tend to have higher marginal rate of returns (productivity) and growth rates if adequate capital stock is injected. In other words, in a capital shortage economy, the marginal productivity of investment is increased in the short-run when additional capital is injected in the form of long-term investment like FDI, and this increased productivity

influences economic growth in the long-run. The new endogenous growth theories further postulate that the increased efficiency of investment brought by FDI provides a comparative advantage to the capital scarce economies to catch-up or to converge with the richer economies in the long-run (Romer 1986). Finally, FDI channels much needed capital for investment and provides support to capital formation; trade openness facilitates the flows of international capital and redirects factor endowments to more productive sectors; a high level of capital formation ensures needed finance for the industries growth and development; and all of them jointly promote economic growth at large. From this perspective, the linkage between FDI, trade openness, and economic growth ought to be positive. Not only this, this nexus should be co-integrated in the long-run. *However, a question arises whether this nexus works equally for all developing countries, particularly in Bangladesh.*

Bangladesh, in fact, opened her economy in the late 1980s to reap the benefits of FDI in order to accelerate economic growth. The government set up Board of Investment (BOI) in 1989 to promote and facilitate private investment both from domestic and overseas sources. The government also lifted restrictions on capital and profit repatriation gradually and opened up almost all industrial sectors for foreigners to invest either independently or jointly with the local partners. Further, the government introduced various financial and non-financial incentives like tax exemptions for power generations, import duty exemptions for export processing industries, tax holiday schemes for undertaking investment in priority sectors and low development areas, zero duty rate for the import of capital machinery and spare parts for 100 percent export oriented industries, almost no restrictions on the entry and exit mode, and reduction of bureaucratic hassles in getting faster approvals of foreign projects. Together with all these incentives followed by a low labor cost structure, Bangladesh has been an attractive destination for FDI in the South Asian region since the late 1980s.

Figure 1 (in appendix) illustrates the flows of FDI (as a percentage of GDP), degree of trade openness, level of capital formation over GDP, and GDP growth rate in Bangladesh for a period 1986 to 2008. Figure 1 portrays that Bangladesh has significantly opened her economy during the previous two decades from 17.57% in 1986 to 49.09% in 2008 in order to encourage cross- border transactions. Likewise, the gross capital formation as a percentage of GDP increased consistently from 16.70% in 1986 to 24.08% in 2008. However, FDI inflow as a percentage of GDP provides a heterogenic trend that mainly increased from 1995 (0.24%), but dropped in 1999(0.69%), reached a peak in 2005 (1.46%) and leveled off 1.39% in 2008. Similarly, with respect to GDP growth rates, the country exhibits a heterogenic trend that varies between 2.15% to 6.62% over the period 1986-2008. *This creates an interest for us to investigate empirically the long-term equilibrium relationship among FDI, Trade openness, capital formation and GDP growth rates in Bangladesh with a view to assisting policy making institutions*. We like to note that there exists a growing body of literature that examines individually the FDI, openness and capital led growth hypothesis in a cross-country analysis, however, a few studies has examined economic growth led FDI, trade openness and capital formation jointly in a single study either in the context of cross countries or an individual country.

Thus, the study contributes to the existing FDI, economic and finance literature in the following ways. First, the study deals with one of the emerging economies in South Asia that practices democracy and market oriented policies to enhance economic growth. Second, a country specific study removes the country specific problem and skepticism about the robustness of economic results that are often linked with cross-section and panel analysis. Third, the study utilizes annual time series data from 1986 to 2008 which covers recent data as well as a period of extensive economic and financial liberalization measures undertaken by the government to attract FDI. Fourth, it investigates the linkage between FDI, trade openness, capital formation, and economic growth which is rarely studied in the context of Bangladesh. Finally, the study employs a new estimation technique like Vector Autoregressive (VAR) approach to examine whether the linkage between variables is long-term, unidirectional or bi-directional. We like to note that the data point covers 23 observations for this study which may raise small sample bias in long-run growth analysis. However, we used here yearly observation which is considered effective when it covers more than two decades.

The remainder of the paper is organized as follows: Section 2 provides theoretical underpinnings and surveys the related literature of the linkage between FDI, trade openness, capital formation, and economic growth. Section 3 describes our data and statistical model. Section 4 reports the empirical results, and finally, section 5 concludes with some policy remarks.

2. Theoretical underpinnings and survey of related literature

The neoclassical and endogenous growth models can be considered as a theoretical foundation for FDI led economic growth hypothesis of a country. The neoclassical growth theories assume that FDI can channel required funds to the productive sectors of a capital shortage economy which, in turn, help increase the economic

growth rate by increasing the marginal productivity of capital. In other words, the neoclassical perspective is based on a basic principle in economics that outlines economic growth demands capital investment in the form of long-term commitment (Adams 2009). The neoclassical economists also view FDI as more reliable and less volatile sources of capital for the developing economies that can augment economic growth (Blomstorm et al. 1994, Borenzstein et al. 1995, Balasubramanyam et al. 1996, Lipsey 1999, Moosa 2002, Moosa & Cardak 2006). On the other hand, the endogenous growth theories state that the long-run growth of a country is not only influenced by the volume of physical investment but also depends on the efficiency of utilizing investment. Therefore, endogenous growth model focuses on incorporating organizational, managerial, technical and human skills, innovation and technological progress, and accumulation of knowledge endogenously in the growth theories that are often brought by FDI (Romer 1986, Lucas 1988, Mankiw et al. 1992, Pugel 2007). Precisely, in the endogenous growth model, the long-run economic growth is viewed as a function of technological progress deriving from technology transfers and knowledge spillovers (Grossman and Helpman 1991, Romer 1994, Nair –Reichert and Weinhold 2001). A growing body of empirical literature also supports this FDI led endogenous growth hypothesis. For example, Saint-Paul (1992) and Obstfeld (1994) argue that a higher volume of cross-border transaction increases the productivity of capital by diversifying the risk of investment. Not only that, a greater risk diversification further encourages domestic investment in innovation activities that, in turn, influences economic growth in the long-run. This is also revealed by a study of the United Nations Conference on Trade and Development (UNCTAD) in 1992 that examines the FDI led growth hypothesis in developing economies. The study unearths that FDI creates a positive effect on employment, human skills and international trade, beside the economic growth rates, for China and Taiwan. By the same token, Acemoglu and Zilibotti (1997) explain that greater openness in international transactions helps direct financial flows from capital-abundant towards capital-scarce countries. Such a movement of capital flows helps in accelerating the convergence process - a system to catch the developed economies by the developing economies - of a developing country. Zhang (2001) reports that FDI tends to promote economic growth in the Asian economies than in Latin Americas. He further argues that FDI is likely to influence economic growth when a host country adopts liberalized trade policies, improves education and maintains macroeconomic stability. McLean & Shrestha (2002) also report that FDI exerts significant influence on economic growth in developing economies than in the developed economies. They document that in developing economies, a 1 per cent increase in FDI can increase GDP per capita growth rates by approximately 0.5 percentage point on an average (Adhikary & Mengistu 2008). Recently, Nath (2009) reports that economic growth calls for investing sufficient capital where FDI plays a two-fold function: (1) contributes to capital accumulation and (2) increases the total productivity of investment.

Despite this positive link between FDI and economic growth, empirical evidence also reveals negative association between them. This view goes to the dependency theorists who argue that dependence on foreign investment tends to create a negative impact on economic growth and income distribution. The underlying assumption behind the dependency theory is that an economy controlled by foreigners does not develop organically rather grows in a disarticulated manner (Amin 1974). This happens because of the multiplier effect which shows that the demand elasticity between two sectors is less than unitary, thereby directing to stagnant growth rates in the developing countries (Adams 2009). The dependency theories also argue that foreign gigantic players may create negative effect on the growth and development of domestic firms' of a host country in the long-run as they have large volume of capital, superior technologies, higher market access, advanced marketing networks and better managerial and human relation skills (Marksun & Venables 1997, Agosin & Mayer 2000, Kumar & Pradhan 2002). This situation could be even dismal for the limited capital young growing firms as they may be unable to compete with the Multinational Corporations (MNCs). Further, this imbalanced competition may possibly lead to the extinction of such small local firms. In this tune, Bornschier & Chase–Dunn (1985) claim that FDI tends to create a monopoly industrial structure which may lead to 'underutilization of productive forces'. The dependency theories further argue that FDI can have an adverse impact on employment, income distribution, national sovereignty and autonomy of a country (Musila and Sigue 2006). FDI can also influence negatively the balance-of-payment position of a country if the inputs of production need to be imported (Musila and Sigue 2006). Moreover, financial stability of a country may reduce by shrinking foreign exchange reserves when profits and capitals are repatriated. Thus, dependency theories argue that FDI is not an aid to the development rather it undermines the process of development (Razin et al. 1999). This confounding theoretical and empirical evidence on FDI and economic growth leads us to conclude that FDI is country specific, and can be positive, negative or insignificant, depending on the economic, technological and institutional conditions of a host country.

With respect to the link between trade openness and economic growth, the endogenous growth theory (Romer 1986, Lucas 1988), transaction cost theory (Coase 1937, Williamson 1981) and international product life cycle

theory (Vernon 1966) can be put into place. According to the endogenous growth theory, a more open trade regime allows a country to reorient factors of production in sectors that have comparative advantages. As factor endowments are better utilized due to trade openness, the endogenous theory also underlines that a higher equilibrium growth rate can be achieved in the long-run through increasing specialization and lowering cost of inputs (Romer 1989). Solow (1957) reports that trade openness can create a room for technological progress and efficiency in allocating inputs by eliminating protection for import substitution industries which, in turn, influences economic growth. Grossman & Helpman (1991), and Barro & Sala-I-Martin (1995) mention that a country with a higher degree of openness has a greater ability to absorb technological developments generated in the leading nations, and this absorption capability leads them to grow more rapidly than a country with a lower degree of openness. However, Edwards (1998) argues that the equilibrium rate of growth in the poorer countries does not solely depend on openness rather on its initial stock of knowledge and the cost of imitations. Edwards (1998) also argues that if the imitation cost of innovation in the poorer countries becomes lower than the cost of innovation in technologically advanced economies, the poorer countries will grow faster than the advanced one, and there will be a tendency towards convergence. This hypothesis basically complements the transaction cost theory that postulates market for intermediary products are usually imperfect, and firms, as an economic agent, need to incur certain costs to complete a transaction. Importantly, this transaction cost can be minimized when markets are integrated both at the national and international levels through greater openness, or in particular, through free trade. In addition, a reduction in the transaction cost provides opportunity for the developing economies to gain larger access to the international markets, and this helps them to increase foreign exchange reserves through increasing exports. Clearly, a higher degree of openness reduces transaction cost of investment and influences economic growth by increasing investment and exports. This hypothesis can also be extended to the international product life cycle theory proposed by Vernon in 1966. According to the product life cycle theory, a high-income elastic product is usually used as a symbol of fashion and prestige by the upper class people of a developing economy. This product becomes a middle class product when it enjoys economies of scale. As products become standardized, firms tend to relocate their production in less capital intensive and low transaction cost economies with a view to exporting them to richer countries. In other words, the product life cycle theory explains that, other things being equal, the faster the rate of innovation in advanced economies, the higher the scope of growth via imitation for laggard economies. Precisely, the higher the technology flows from the leader to the follower via trade openness (international trade), *ceteris paribus*, the faster the diffusion process is likely to be (Baumol et al. 1994). Obviously, a faster rate of technology absorptions and diffusions helps accumulate technical and human skills that ultimately contribute to growth in the long-run. To this end, World Bank (1993) studies 51 countries over a period 1960-89 and concludes that economic openness has a statistically positive impact on the total factor productivity (TFP) growth. World Bank (2001) in its global development finance edition also reports the importance of absorptive capacities for the success of FDI in Malaysia and Taiwan. Likewise, Acemoglu & Zilibotti (1997) explain that the economically backward countries can accelerate convergence process to catch richer economies by opening up their capital markets as capital usually moves from capital-abundant towards capital-scarce economies. In effect, economic growth rates are enhanced in the long-run.

However, counter arguments of the positive link between trade openness and economic growth can also be found in empirical literature. For instance, Rodrik (1992) reports that economic openness may bring macroeconomic instability by increasing inflation, depreciating exchange rates and inviting balance of payment crisis. Similarly, Levine & Renelt (1992), and Andriamananjara & Nash (1997) report that a high degree of trade openness may increase inflation and lower the real exchange rates which may create negative impact on domestic investment. In other words, a liberalized trade regime may lead to a greater exchange rate depreciation which may reduce aggregate supply of inputs by increasing prices of the imported inputs used in the production. As a result, the volume of domestic output tends to be decreased. By the same token, Krugman (1994) argues that the effect of openness on economic growth could be, at best, very tenuous, and at worst, doubtful. The argument in this case is that the degree of trade openness, particularly the magnitude of tariff and non-tariff barriers, only can affect the volume of trade, not necessarily the link between exports, imports, and economic growth. However, we would like to note that these conflicting findings basically rest on different measurement of trade openness used by researchers in a cross-country analysis. A country specific data analysis thus deserves attention to capture the impact of specific problems and policies of a particular country in order to enrich our FDI literature with new evidence.

Although empirical literature does not have consensus in tracing the link between trade openness and the economic growth, a more conclusive views is found with respect to the capital accumulation and economic growth. Both the classical and neo-classical growth model postulates that capital is nucleus to economic growth.

Simply, if there is no capital, there is no investment and no growth. The rationale to this argument is that capital accumulation helps expand productive capacity of different economic sectors by increasing number of firms. When a number of firms engage into production or business activities, internal resources of a country are better utilized through increasing competition and efficiency. As a result, the productivity of factor endowments is increased and a low production cost can be achieved through greater economies of scale as well as standardization of products. Precisely, capital accumulation helps increase investment, investment creates employment through expanding production bases, additional employment generates higher savings which provide confidence in undertaking larger investment, and this chain effect ultimately influences economic returns positively. In tune with this, the proponents of endogenous growth theories argue that FDI can play a substantial role in building capital formation by increasing funds and supplying of needed technology and skills, which, in general, promote economic growth. In empirical analysis, Kormendi & Meguire (1985), Barro (1991), Levine and Renalt (1992) conclude that the rate of physical capital formation influences the rate of a country's economic growth. In contrast, Kendrick (1993) notes that the formation of capital alone does not lead to economic prosperity, rather the efficiency in allocating capital from less productive to more productive sectors influences economic growth. Blomstorm et al. (1996) also note a one way causal relationship between fixed investment and economic growth. They conclude that changes in capital formation rates do not have any significant influence on future growth rates. On the other hand, Ghali & Al-Mutawa (1999) apply time series analysis on G-7 countries and report that the causality between fixed investment (capital formation) and economic growth is country specific and may run in both directions.

In summary, the empirical literature on the linkage between FDI, trade openness, capital formation, and economic growth does not provide a consensus with its theoretical relationship as many authors document positive relationship between them while others do not trace it, or at best, report very week relationship. These wide differences basically result from authors' perspectives, sample selection, methodologies and analytical tools applied in their study (Chakrabarti 2001). Besides, the country specific characteristics with respect to the economical, technological, infrastructural and institutional developments indeed matter a lot to gauze empirical relationship. The present study thus extends a country specific analysis to add knowledge in our empirical literature.

3. Data descriptions and empirical designs

In this paper, we seek to trace the relationship between FDI, trade openness, capital formation, and economic growth in the context of Bangladesh over a period 1986-2008. In doing so, we consider changes in real GDP as an indicator of economic growth. FDI is standardized by GDP to remove the problem associated with absolute measurement. Trade openness is measured by export and import over GDP following Gries et al. (2009) and Yanikkaya (2003). Capital formation is expressed as a percentage of gross fixed capital formation over GDP. This measure is also adopted by Ghali & Al-Mutawa (1999), Levine & Renelt (1992), and Barro (1991). Data have been gleaned from World Development Indicators published by World Bank.

As part of the empirical design, our base estimating equation in log-linear form is specified as follows:

$$\ln Y_t = \alpha + \beta \ln FDIG_t + \Psi \ln GFCG_t + \Omega \ln TGDP_t + \varepsilon_t \quad \text{----------(1)}$$

Where, Y = changes in real GDP, FDIG = foreign direct investment as a percentage of GDP, GFCG = gross fixed capital formation over GDP, and TGDP = trade over GDP. There are two reasons why variables are converted into natural logs. First, the coefficients of the cointegrating vector can be interpreted as long-term elasticities if the variables are in logs. Second, if the variables are in logs, the first difference can be interpreted as growth rates. The expected signs of the parameters are: $\alpha>0$, $\beta>0$, $\Psi>0$ and $\Omega>0$. The error-term (ε) is assumed to be independently and identically distributed. The subscript (t) indexes time.

For execution of the empirical design, we proceed as follows. First, the nature of the data distribution is examined by using the standard descriptive statistics (mean, median, standard deviation, skewness and kurtosis). Normality of data distribution is also ascertained by invoking the Jarque–Bera test. Second, the time series property of each variable is investigated under a univariate analysis by implementing the ADF (Augmented Dickey- Fuller) test for the unit root (nonstationarity) (following Dickey and Fuller 1981, Fuller 1996). Likewise, the PP (Phillips-Perron) test is also implemented (following Phillips 1986, Phillips & Perron 1988, Perron 1989). Third, if these tests confirm stationarity in time series data of each variable, equation (1) is estimated appropriately by the Ordinary Least Square (OLS) method. Otherwise, its application leads to misleading inferences in the presence of spurious correlation (Granger & Newbold 1974). These tests are conducted with and without a deterministic trend (t) for each of the series. The general form of ADF test is estimated by the following regression:

$$\Delta Yt = \alpha_0 + \alpha_1 Y_{t-1} + \sum_{i=1}^{n} \alpha \ \Delta Y_i + \varepsilon_t \quad \text{----------(2)}$$

$$\Delta Yt = \alpha_0 + \alpha_1 Y_{t-1} + \sum_{i=1}^{n} \alpha \ \Delta Y_i + \delta_t + \varepsilon_t \quad \text{----------(3)}$$

Where, Y is a time series, t is a linear time trend, Δ is first difference operator, α_0 is a constant, n is the optimum number of lags in the dependent variable and ε is a random error term. The Philip-Perron (PP) equation is thus:

$$\Delta Yt = \alpha_0 + \alpha_1 Y_{t-1} + \varepsilon_t \quad \text{----------(4)}$$

Fourth, in the event of the nonstationarity of each variable, the cointegrating relationship among variables (tendency for variables to move together in the long-run) is studied by the Johansen-Juselius procedure (Johansen 1988, Johansen-Juselius 1992, 1999) to overcome the associated problem of spurious correlation and misleading inferences. The basic idea behind cointegration is that if two or more series move together in the long-run, even though the series themselves are trended, the difference between them is stationary, and it is possible to regard these series to have a long-run equilibrium relationship. For cointegration, however, all the variables must be in the same order of integration or depiction of I(d) behavior. To implement, the Vector Autoregressive (VAR) approach is invoked as outlined in Granger (1988).The appropriate lag-length (p) is selected with the aid of the FPE (Final Prediction Error) criterion (Akaike 1969) to ensure that errors are white noise. This helps overcome the problem of over/under parameterization that may induce bias and inefficiency in the estimates. The analysis commences with a congruent statistical system of unrestricted reduced forms as follows:

$$Y_t = \alpha + \sum_{i=1}^{p} \Pi \ Y_{t-i} + \xi_t; \qquad \xi_t \sim IN\ (0, \Omega),\ i=1, 2, 3, \text{----T}\ \text{----------(5)}$$

Where, Y_t is an (n × 1) vector of I (1) and /or 1(0) variables, and α is an (n × 1) vector of constraints. Letting $\Delta Y_t = Y_t - Y_{t-1}$, a convenient reparameterization of equation (5) is placed below:

$$\Delta Y_t = \alpha + \sum_{i=1}^{p-1} \Gamma \Delta Y_{t-i} + \Pi\, Y_{t-i} + \xi_t \quad \text{----------(6)}$$

Since ξ_t is stationary, the rank, r, of the long–run matrix Π determines how many linear combinations of Y_t are stationary. If r = n, all Y_t's are stationary, while r = 0 so that Π =0, ΔY_t is stationary, as are all linear combinations if $Y_t \sim I(1)$. For 0<1<n, there exist r cointegrating vectors meaning r stationary linear combinations of Y_t. If this is the case, $\Pi = \alpha \beta'$, where both α and β are n × r matrices. The cointegrating vectors of β are the error-correction mechanisms in the system, while α contains the adjustment parameters. The cointegrating rank, r, can be formally tested with maximum eigenvalue test (λ_{max}) and the trace test (λ_{trace}). These are computed as follows:

$$\lambda_{max} = -T \ln(1 - \hat{\lambda}_{r+1}) \quad \text{----------(7)}$$

Where, the appropriate null is r = g cointegrating vectors with (g = 0,1,2,3,---) against the alternative that r ≤g+1.

$$\lambda_{trace} = -T \sum_{i=r+1}^{n} \ln (1 - \hat{\lambda}_i) \quad \text{----------(8)}$$

Where, the null is r =g against the more general alternative r ≤1.

In the Johansen-Juselius procedure, λ_{max} and λ_{trace} tests are conducted. For any conflict between these tests, the final selection lies with the discretion of the researchers in view of their trade offs for bias, efficiency and sample size.

Finally, on the evidence of cointegrating relationship, a vector error-correction model (VECM) is estimated to model the long-run causality and short-term dynamics. The purpose of VECM model is to indicate the speed of adjustment from the short-run equilibrium to the long-run equilibrium state. The greater the coefficient of the parameter, the higher is the speed of adjustment of the model from the short-run to the long-run. Considering our base equation (1), The VECM model is specified as follows:

$$\Delta \ln Y_t = \alpha + \lambda e_{t-1} + \sum_{i=1}^{n} bi\ \Delta \ln Y_{t-i} + \sum_{i=1}^{n} ci\ \Delta \ln FDIG_{t-i} + \sum_{i=1}^{n} di\ \Delta \ln GFCG_{t-i} + \sum_{i=1}^{n} ei\ \Delta \ln TGDP_{t-i} + \varepsilon_t \quad \text{----------(9)}$$

In this specification, the variables are cointegrated if the parameter (λ) of the error correction term is negative and statistically significant in terms of its associated-t value. This indicates unidirectional long-run causal flows from changes in FDI, capital formation and openness to real GDP changes in Bangladesh as well as long-run convergence. Changes in FDI, capital formation and trade openness Granger cause the changes in economic growth rates when c_i's, d_i's and ei's are significant in terms of the F- test (Bahmani & Payesteh, 1993). In case of λ being positive and statistically significant, still there exists a long-run causality but with a divergence.

Besides, impulse response analysis is performed in this study by giving a shock of one standard deviation (± 2 S.E. innovations) to FDI, capital formation and trade openness to visualize the duration of their effects on the

GDP growth rates of Bangladesh. In the end, a variance decomposition analysis is conducted to gain additional insights.

4. Empirical Results and Main Findings

According to our empirical design outlined in section four, we document the following results:

4.1 Descriptive Statistics

The variables under study are found to be normally distributed (appendix, table 1). The mean-to-median ratio of each variable is approximately one. The standard deviation is also low compared to the mean, showing a small coefficient of variation. The range of variation between maximum and minimum is also reasonable. The numeric of skewness of each variable is low and is mildly negatively skewed. The figure for kurtosis in each variable, except the LnGDPG, is below 3 which confirms near normality. The Jarque-Bera test statistics also accept the null hypothesis of normal distribution of each variable, except the LnGDPG, with varying probabilities. However, the histogram normality test supports normality of the distribution within 10% level (Jarque-Bera 4.8541 with associated P-value 0.08829). The Breusch–Pagan-Godfrey test reveals homoskedasticity (Obs*R-squared 5.04122 with associated P-value 0.1688) of the distribution. Likewise, Breusch–Godfrey serial correlation test reveals no autocorrelation among the variables (Obs*R-squared 1.5931 with associated P-value 0.4509). Thus, the normality of the distribution is ensured in the study.

4.2 Stationarity results

All the variables under ADF and PP tests (except LnY that is found stationary at constant and trend) are found nonstationary in levels (appendix, table 2&3). This is ensured by comparing the calculated ADF and PP statistics at the 1 per cent and 5 per cent significance levels with their respective critical values. As a result, all the variables have been differenced once to check their stationarity. At first differencing, the calculated ADF and PP tests statistics clearly reject the null hypothesis of unit root both at the 1 per cent and 5 per cent significance levels when compared with their corresponding critical values. Clearly, the ADF and PP tests decisively confirm stationarity of each variable at first differencing under both constant and constant plus trend level, and depict the same order of integration, i.e. I (1) behavior. Consequently, the Johansen-Juselius procedure is implemented as outlined in equation (5) to detect the cointegrating relationship among variables.

4.3 Co-integration results

Table 4 (in appendix) presents the result of Johansen co-integration test both at the trace and maximum eigenvalue levels. Accordingly, both the trace and maximum eigenvalue statistics detect one cointegrating relationship at the 5% level ((panel 4(a) and 4(b)). In other words, these tests indicate the presence of a long-run equilibrium relationship among variables. As a result, the vector error correction model (9) is estimated.

4.4 Vector error correction model (VECM)

The vector error correction model confirms a long-run equilibrium relationship among the variables where a unidirectional long-term causal flow runs from changes in FDI, capital formation and trade openness to the GDP growth rates of Bangladesh (appendix, Table 5). This is revealed by the estimated coefficient (λ) of the error correction term ($e^{\wedge}_{t-1}$) which is negative, as expected and statistically significant in terms of its associated t-value. The changes in lagged FDI and capital formation have positive significant effects on real GDP growth. However, trade openness exerts significant negative, but diminishing effect on the economic growth rates. This is revealed from the negative sum of the coefficients of subsequent lagged trade openness values. The reason behind the negative relationship between trade openness and economic growth rates is probably due to high imports and depreciating exchange rates of Bangladesh which has created negative trade balance position in almost all the years covered in the study. The numeric of adjusted R^2 at 0.8244 shows a very high explanatory power of the model. The F statistics at 10.915 suggest that a moderate interactive feedback effect exists within the system. The significance of F statistics further indicates Granger causality among variables. The optimum number of lags is determined by the AIC criterion, as stated earlier.

4.5 Impulse response and variance decomposition

Figure 2 (in appendix) reports impulse responses. It shows how a one-time positive shock of one standard deviation (± 2 S. E. innovations) to the FDI, capital formation and trade openness endures on the economic growth rates of Bangladesh. A cursory examination of Figure 2 (a) in appendix shows that the impulse response of trade openness on GDP growth rates is positive and mildly increases as time passes on. Likewise, figure 2(b) in appendix reveals that the initial positive shock given to the capital formation raises economic growth rates from the second year and peaks at approximately 0.25% somewhere between the sixth and seventh years.

Thereafter, it declines but remains positive. Figure 2(c), however, unearths positive but diminishing influence on changes in real GDP over time. Overall, the impulse response function traces positive influence of the response variables on the GDP growth rates of Bangladesh.

The variance decomposition outputs are reported in table 6 (appendix). We document that the variance of GDP growth rates is always caused by 100 per cent by itself in the first year. In the second year, the GDP growth variance is decomposed into its own variance (64.48%) followed by FDI (22.84%) and level of capital formation (12.66%). However, in subsequent years, the share of GDP growth rates remains constant to approximately 56% followed by the volume of FDI and degree of capital accumulation (26% and 12% respectively). On the other hand, the share of trade openness in explaining the variation of real GDP increases gradually from the second year, and remains constant to 7% from the fifth year onwards. In summary, the volatility of GDP growth rates is mainly caused by its own variation, as it always accounts for major portion (above 50%) of the fluctuations.

5. Concluding remarks

This study investigates the linkage between FDI, trade openness, capital formation, and economic growth rates empirically in the context of Bangladesh by analyzing time series data for a period 1986-2008. Based on the evidence from the trace (λ_{trace}) and maximum eigenvalue (λ_{max}) statistics, the study reveals a strong long-run equilibrium relationship among the variables. A strong unidirectional long-term causal flow is evidenced stemming from changes in FDI, trade openness and capital formation to the economic growth rates of Bangladesh. The significance of lagged response variables followed by F statistics further indicates joint significance of the explanatory variables to cause Granger causality in the system. Precisely, the volume of FDI and level of capital formation reveal significant positive effects on changes in real GDP. This result approves our theoretical linkage between them, and favors international finance and neoclassical growth theories. The results also support the study of Kormendi & Meguire (1985), Barro (1991), Levine & Renalt (1992) that report positive influence between the rate of physical capital formation and the rate of a country's economic growth. In contrast, trade openness shows significant negative, but diminishing effect on the rates of economic growth. This result contradicts our theoretical positive relationship hypothesis between them, but supports the study of Levine and Renelt (1992), and Krugman (1994) that trace insignificant or negative relationship. In Bangladesh, the negative association between the trade openness and economic growth rates perhaps due to the exchange rate depreciation, large volume of imported materials and negative trade balance position. The impulse response function reveals a mild positive influence of the response variables on the GDP growth rates of Bangladesh. Finally, the variance decomposition analysis unearths that the variation in the GDP growth rates is predominantly feed on its own variance followed by the volume of inward FDI and the level of capital formation as well. Trade openness, however, provides less importance, as compared to FDI and degree of capital formation, in changing GDP growth rates. The policy implications of this study are relatively simple. The volume of international capital and the magnitude of capital formation, in general, being the robust determinants of economic growth, it is expected that the government of Bangladesh should provide more emphasis of the above factors to increase its economic growth. Side by side, the government should formulate export led fiscal and monetary policies to increase its exports as well as rates of GDP growth.

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Appendix

Table 1. Descriptive Statistics

	LNGDPG	LNFDIG	LNGFCG	LNTGDP
Mean	1.559156	4.108411	3.008771	3.336558
Median	1.617234	5.733730	3.031238	3.401585
Maximum	1.891505	6.990533	3.204802	3.893677
Minimum	0.769739	-1.386294	2.773604	2.849156
Std. Dev.	0.282751	2.676347	0.157778	0.332852
Skewness	-1.289908	-0.579275	-0.153181	-0.043030
Kurtosis	4.284243	1.777516	1.397786	1.743775
Jarque-Bera	7.958695	2.718509	2.550074	1.519446
Probability	0.018698	0.256852	0.279421	0.467796

Table 2. ADF unit root test for stationarity

	Level		First Difference	
	Constant	Constant and Trend	Constant	Constant and Trend
LnY	-1.79788	-4.96125***	-7.07823***	-6.87831***
LnFDI	-0.93837	-1.9294	-5.88046***	-5.73292***
LnGFCG	-2.12551	-0.125224	-3.82921***	-4.06575**
LnTGDP	0.03210	-2.55446	-5.45606***	-5.31637***

Table 3. PP unit root test for stationarity

	Level		First Difference	
	Constant	Constant and Trend	Constant	Constant and Trend
LnY	-2.47665	-5.13399**	-15.8572***	-15.1582***
LnFDI	-0.83553	-1.95249	-5.86517***	-5.72174***
LnGCFG	-0.53433	-1.67153	-3.80658***	-4.0657**
LnTGDP	0.185644	-2.57981	-5.46239***	-5.32052***

Note: The Mackinnon (1996) critical values are -3.699871 and -2.976263 at 1 per cent and 5 per cent levels of significance, respectively. *** indicates significance at the 1% level while ** at the 5% level.

Table 4. Johansen Multivariate Co-integration Test

Panel: 4(a)

Hypothesized No. of CE(s)	Eigen Value	Trace Statistic	5 Percent Critical Value	P- Value
None*	0.817067	57.08819	47.85613	0.0054
At most 1	0.525830	21.41690	29.79707	0.3322
At most 2	0.202818	5.746936	15.49471	0.7252
*denotes rejection of the hypothesis at the 5% level				
Trace test indicates one cointegrating equation at the 5% level.				

Panel: 4(b)

Hypothesized No. of CE(s)	Eigen Value	Max-Eigen Statistic	5 Percent Critical Value	P- Value
None*	0.817067	35.67129	27.58434	0.0037
At most 1	0.525830	15.66996	21.13162	0.2447
At most 2	0.202818	4.760118	14.26460	0.7718
*denotes rejection of the hypothesis at the 5% level				
Max-eigenvalue test indicates one cointegrating equation at the 5% level.				

Table 5. Estimates of VECM

Variable	Coefficient	Std. Error	t-statistic	Prob.
C	-0.150284	0.068198	-2.203632	0.0334
$e^{\wedge}_{t-1}$	-0.182232	0.038935	-4.680459	0.0000
ΔLnY(-1)	-0.867117	0.262642	-3.301520	0.0020
ΔLnY(-2)	-0.495819	0.158338	-3.131394	0.0032
ΔLnFDIG(-1)	0.198331	0.091388	2.170219	0.0360
ΔLnFDIG(-2)	0.129342	0.052035	2.485652	0.0172
ΔLnGFCG(-1)	15.89569	3.657879	4.345603	0.0001
ΔLnGFCG(-2)	6.026766	2.553032	2.360630	0.0232
ΔLnTGDP(-1)	-3.861557	0.886831	-4.354331	0.0001
ΔLnTGDP(-2)	-2.502552	0.732334	-3.417226	0.0015
R-squared	0.907609	Mean dependent var		0.052822
Adjusted R-squared	0.824456	S.D. dependent var		0.272519
S.E. of regression	0.114180	Akaike AIC		-1.19523
Sum squared resid	0.130370	Schwarz SC		-0.69736
Log likelihood	21.95230	F-statistic		10.9150
Durbin-Watson stat	1.812184	Prob (F statistic)		0.01447

Table 6. Estimates of variance decomposition of GDP growth rates

Period	S.E.	LnGDPG	LnFDIG	LnGFCG	LnTGDP
1	0.155968	100.0000	0.000000	0.000000	0.000000
2	0.194226	64.48479	22.84152	12.66434	0.009343
3	0.209479	55.66875	26.11899	12.96792	5.244346
4	0.212282	55.75105	25.64782	12.62782	5.973311
5	0.215623	55.24734	24.89778	12.47488	7.380003
6	0.218325	55.08025	24.99665	12.35383	7.569264
7	0.221545	55.17349	25.11277	12.04392	7.669815
8	0.224446	55.61204	25.01953	11.78260	7.585828
9	0.226923	56.05718	24.91642	11.59775	7.428651
10	0.229185	56.32750	24.74352	11.44226	7.486719

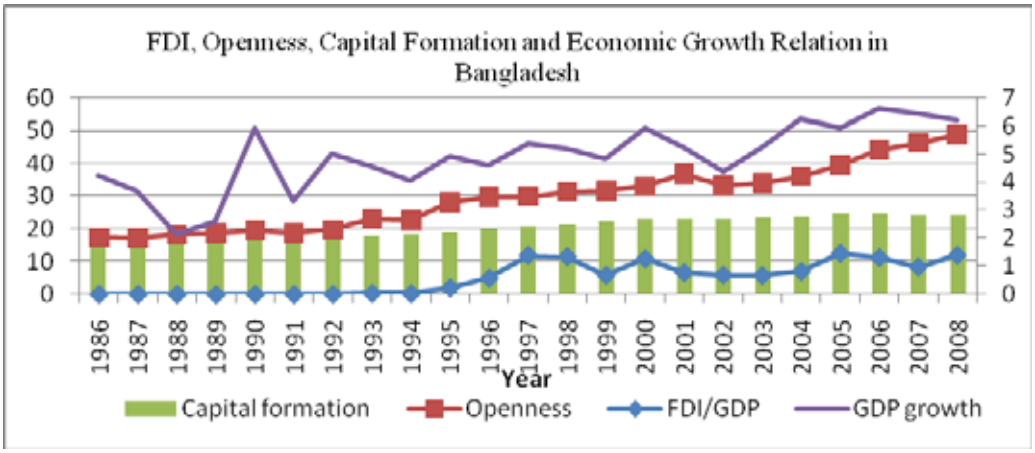

Figure 1. FDI over GDP, trade openness, Gross capital formation over GDP and GDP growth rate in Bangladesh (1986 -2008)

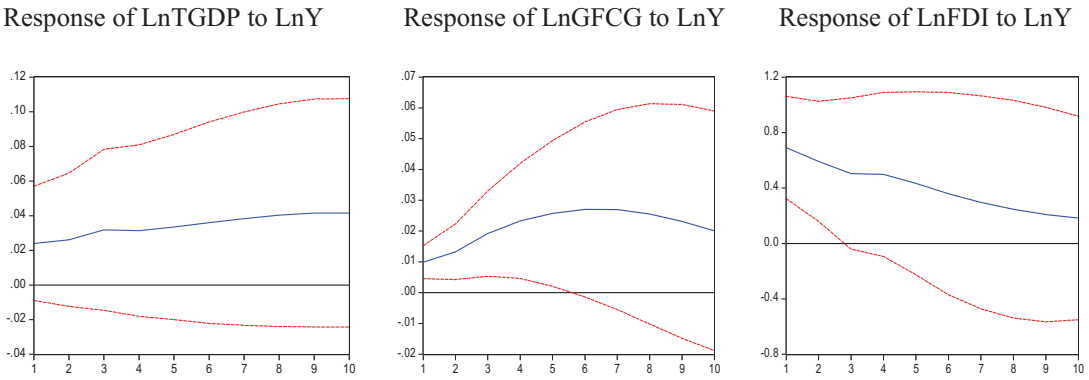

Figure 2. Response to Cholesky one SD (± 2 S.E. innovations)

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