Journal of Economics and Sustainable Development
ISSN 2222-1700 (Paper) ISSN 2222-2855 (Online)
Vol.6, No.8, 2015

Foreign Direct Investment (FDI) and Gross Domestic Product (GDP) in Bangladesh: A Cointegration Analysis

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Abstract
This paper investigates the long-run relationship between GDP and FDI in Bangladesh for a period of 42 years ranges from 1972 to 2013 by using time series econometric technique. The empirical results show that there is a significant positive correlation between GDP and FDI. The results also show that FDI and GDP are cointegrated in the long-run. For the supplement of the results of cointegration analysis, this study also examine the causal relationships by using Granger causality test and find strong evidence for unidirectional causality running between GDP through FDI in the long run.
Keywords: FDI, GDP, Unit Root, Cointegration, Granger Causality

Introduction

FDI provides essential ingredients that are necessary for economic growth. By providing new production process, techniques, managerial skills and new varieties of capital goods, FDI promotes economic growth of the less developed countries (LDC). The transfer of new techniques and technology spill over from the subsidiaries of multinational to domestic firms and enhances economic growth. On the other hand, others found that FDI follow economic growth. Economic growth first provides necessary and conducive economic factors for FDI to play a positive role for economic development.

The economic literature has widely documented the significant impacts of FDI on economic growth. A number of studies have found that higher levels of FDI are associated with higher growth rates (e.g., De Mello, 1997; Borensztein *et al*., 1998; Choong *et al.*, 2005, 2010a), while some studies have found no significant relationship between FDI and economic growth (e.g., Aitken *et al*., 1997; Aitken and Harrison, 1999). These controversial findings have motivated many empirical investigations to study the different mechanisms that explain the linkage between FDI and growth, including human capital (Borensztein *et al*., 1998), public infrastructure (Barro, 1990), trade policy or exports (Balasubramanyam, *et al*., 1996), technological diffusion (Barro and Sala-i-Martin, 1997), and level of economic development and absorptive capacity (Hermes and Lensink, 2003; Alfaro *et al*., 2004; Choong *et al.*, 2010b, 2010c).

There is a wealth of evidence to suggest that a key aspect of economic development lies in the capacity of developing countries to acquire capital and scale the technological ladder. Developing countries can attempt capital formation on their own. But in an era of high capital mobility, foreign direct investment provides a stable and secure source of capital. FDI can help bridge the gap between savings and investment in capital-scarce economies. The role of FDI seems to be country based, and can be positive, negative, or insignificant, depending

on the economic, institutional, and technological conditions in the recipient economy (Li and Liu, 2005). FDI promotes growth: (1) FDI provides the financial resources needed by the host country, (2) FDI acts as a vehicle for the transfer of advanced manufacturing technologies from the DCs(Developed countries) to the LDCs(less Developed countries), (3) FDI increases competition in the host country's markets, (4) FDI helps the host countries improve their foreign exchange reserves (or balance-of payments position) by increasing exports, (5) FDI brings along with it the management know-how needed to run the facilities, (6) FDI enhances the training and employment opportunities for the people of the host country, (7) FDI reduces the burden of imports on the host countries through import substitution, (8) FDI acts as catalyst for increasing domestic savings and investment. In general, FDI provides ready access to the world markets and acts as a conduit for the host country to participate in the globalization process (Agrawal and Khan, 2011).

Though, FDI is seen as a vital factor in inducing growth rate, however, it will only lead to growth if its inflows are properly managed. During the last fifty years, FDI problem is one of the main challenges faced by the developing countries like Bangladesh. As a consequence, this paper examines the impact of FDI on economic growth of Bangladesh for the period of 1972-2013.

Literature Review

Borensztein *et al*. (1998) studied the effect of FDI on Economic Growth, using data on FDI flows from industrial countries to 69 developing countries from the period 1970 to 1990. The most important finding of this paper is that the effect of FDI on economic growth is dependent on the level of human capital available in the host economy. There is a strong positive interaction between FDI and the level of educational attainment (proxy for human capital). Notably, the same interaction is not significant in the case of domestic investment, possibly a reflection of differences of technological nature between FDI and domestic investment.

Carkovic and Levine (2002) assume FDI doesn't have an absolute and positive effect on economic growth. However, FDI in generating economic growth especially in particular environments, the magnitude depend on host country conditions which include a threshold level of human capital, income level, a well-functioning capital market and openness to global market. They use both panel and cross section data for 72 developing and developed countries for the time period of 1960-1995. Their result indicated for the both developing and developed economies FDI inflows do not exert a robust influence on economic growth.

Makki and Somwarn (2004) analyze the role of FDI and trade in economic growth of developing countries within the endogenous growth-theory framework. Using cross-section data relating to a sample of 66 developing counties from the period of 1971-2000, they show that there is a strong, positive interaction between FDI and trade toward advancing economic growth in developing countries. The paper suggests that lowering the inflation rate, tax burden, and government consumption would advance economic growth in developing countries and sound macroeconomic policies and institutional stability are necessary preconditions for FDI-driven growth to materialize.

Alfaro *et al*. (2004) analyzed the relationship between FDI and Economic Growth of 20-OECD and 51 non-OECD countries data between 1975 and 1995. Results showed that FDI alone plays an ambiguous role in contributing economic growth but the growth would be significant if the host country's financial market is well-developed (Wang and Wong, 2009). Moreover, they suggest that better local conditions not only attract foreign companies but also allow host economies to maximize the benefits of foreign investments.

Ljungwall (2007) examined the FDI and economic growth relationship of China. The study covers 28 provinces of China using data from 1986 to 2003. Applying the generalized method of moment's system, the study explores that the development of financial intermediation towards more market oriented financing is a factor in the link between FDI and Economic growth. The paper also provides the evidence that banking sector development spurs economic growth in China.

Thiam (2007) found limited evidence that FDI inflows contribute to higher total factor productivity growth. There was no evidence that FDI inflows lead to higher technical change but there was some evidence that FDI inflows lead to higher efficiency in some countries.

Türkcan *et al*. (2008) examined the endogenous relationship between foreign direct investment and economic growth for 23 OECD countries and 1975 – 2004 period of time. For this purpose a simultaneous equation system was established and an econometric estimation procedure was applied. The empirical results suggest that FDI positively affects economic growth rate and also economic growth rate positively affects FDI inflows. The paper explores that export growth rate is statistically significant determinant of FDI and economic growth. The results also indicate that economic growth stimulates growth rate of FDI inflows more than that the growth rate of FDI stimulates economic growth.

Vadlamannati and Tamazian (2009) examine the impact of FDI on economic output growth per worker using aggregate production function augmented with FDI inflows, economic policy reforms and institutional constraints covering 80 developing countries over the period 1980–2006. Using panel data and employ fixed random effects and GMM methods for estimation, the results highlight the importance of FDI, policy reforms

and institutional development for growth in developing economies and demonstrate that irrespective of reforms and institutions, an increase in FDI affects output growth positively.pe investigates.

Nanda (2009) suggests that Greenfield foreign investment is more beneficial to host countries as compared to the FDI that comes through the merger and acquisition route. The impact of FDI on growth performance seems to depend on the type of FDI rather than just the volume.

Kotrajaras (2010) examines the effect of FDI on the economic growth of 15 East Asian countries which are classified by their economic conditions, i.e. levels of human capital, investment on infrastructure, and trade openness for the analytical purpose. The panel cointegration analysis with endogenous growth model is used to observe the effect. The analysis is based on time series data from 1990-2009. The results show that FDI does not necessarily enhance economic growth. FDI had a positive effect on the economic growth only in the countries that have the appropriate economic conditions. East Asian countries including Thailand need to invest more on fundamental infrastructure and human capital, and increase their degree of trade openness in order to gain more from FDI.

Faruku *et al.* (211) use Cointegration VAR model to see relationship between FDI and GDP in Nigeria for a period from 1970 to 2004. They find that all variables are integrated of order 1. They identify the VAR (3) using AIC information criteria and the VECM (2) model with cointegration relation of exactly one. The results further indicate that there is a uni–directional causal relationship between GDP and FD. Having established the fact that foreign direct investment has positive impact on growth domestic product, government should strategize policies that would enhance foreign direct investment in Nigeria.

Abbas *et al.* (2011) investigate the impact of FDI on GDP of SAARC countries for a period of 2001-2010. They use change in GDP as dependent variable while FDI and inflation are as independent variables. The result reveals that the overall model is significant and they find a positive and significant relationship between GDP and FDI while the relationship between GDP and inflation is insignificant.

Aldehayyat & Alalaya (2012) found strong evidence of auto correlation in the association between FDI and Gross flows and trade is positive and significant at the 95% level for Jordan.

Choong,*et al.* (2011) examine the role of foreign direct investment (FDI) volatility as a source of variability in five major ASEAN economies. Using bounds testing approach, the results show that while FDI has positive and significant effect in all the ASEAN economies considered, its volatility retards long-run economic growth in Indonesia, Malaysia, the Philippines and Thailand except Singapore.

Ahmad *et al.* (2012) investigate the relationship between FDI and economic growth in Pakistan. GDP is used as the dependent variable while FDI, labor force and domestic capital are used as independent variables. The results show that there is a positive relation between FDI and GDP in short as well as long run. For the economic progress of Pakistan there is a need to invite foreign investors because FDI increases GDP.

Abdullahi *et al*. (2012) examines the role of FDI on economic growth, making a comparison between selected countries of Africa and Asia, utilizing data for 30 countries, 15 each from Africa and Asia for the period of 1990 to 2009. Using Hausman test, empirical results showed that FDI has positive relationship with GDP growth for both Africa and Asia and it also reported that one way causality for Africa but no such evidence for Asia. The authors suggested for more openness of the economies, more investment in infrastructure and more political commitment in the fight against corruption.

Chien and Zhang (2012) focus on problems related to FDI in the North Central Area and South Central Coast of Vietnam in the period from 2000 to 2010 and find a bidirectional relationship between FDI and GDP. Empirical results show that there is a strong bidirectional relationship between FDI and GDP in this area of Vietnam. They also find that there is no strong competition between provinces in attracting FDI, and provinces having better governance in economics attracted less registered FDI.

Carp (2012) emphasizes the impact of the FDI inflows on the economic growth by analyzing both theoretical and empirical researches. The results reveal that the impact capital flows on economic growth is significant and the main channels for the transmission are: financial markets, absorptive capacity, human capital and technological.

Hossain and Hossain (2012) examine co-integration and the causal relationship between FDI and GDP of Bangladesh, Pakistan and India for a period covering 1972-2008. The findings show that there is no co-integration between FDI and GDP in the both long and short run in Bangladesh and India. However, they find the co-integration between them in the both short and long run in Pakistan. The results also reveal that there is no causality relationship between GDP and FDI for Bangladesh and unidirectional relationship is found for Pakistan and India.

Alkhasawneh (2013) investigate the casual relationship between inflows of FDI and GDP per capita by taking data from Qatar for a period of 1970-2010. By using Johansen cointegration it is found that there is a long-run equilibrium relationship between FDI and GDP. It is also seen from the results that there is bidirectional causality between FDI and GDP in Qatar for the study period.

Nosheen (2013) investigates the impact of FDI on GDP for Pakistan. By using cointegration analysis, it

is found that there exists a long run relationship between GDP and FDI.

By reviewing existing literatures Shafi (2014) tries to give a conclusion on the relationship between FDI inflows and economic growth. The study gives contradictory conclusions regarding the growth effects of FDI. Researchers supporting the significant impact of FDI inflows GDP view FDI as a mechanism for economic growth. They think that FDI not only supplements capital but also stimulate growth by adopting foreign technology, technological spillovers, human capital (knowledge and skill) enhancement, and so on. The researchers having opposite opinion say that FDI may bring about crowding-out effect a country. They stink monopoly intentions of multi-national companies in making FDI in a country. They also argue that FDI brings destructive competition of foreign affiliates, external vulnerability and dependence.

Iqbal *et al.* (2014) seek to validate the relationship between FDI and GDP for a period between 1983 to 2012 by using Cobb-Douglas Production function. The variables used in the study are Gross Capital Formation (K), Labor (L), Health Expenditure (H), FDI and openness to trade in export oriented economy (OP*FDI). They find a positive relationship between FDI and GDP in Pakistan. It is also found that FDI impact may be situation and culture related. It is also concluded from the study that the extent of FDI economic benefits cannot be predicted.

From the above reviewed literature, we can summarize and identify three main ideas. First, FDI always has no independent effect. It depends on level of highly educated human capital. Second, FDI is more effective export oriented countries than import substituting. Third, result of its effect depends on FDI attracting sector. More technology intensive sectors get more spillover from FDI. So FDI spillover couldn't be always positive. It depends on countries' economic specific conditions. The present study is undertaken to see the scenario in a less developed country like Bangladesh.

Research Methodology

Annual data for GDP and net inflows of FDI in US dollar are used in this study. The study covers a period of 42 years ranges from 1972 to 2013. The data were collected from Board of Investment (BOI), Bangladesh Bank, Asian Development Bank, Key Indicators (KI), International Financial Statistics (IFS) and World Bank, World Development Indicators 2014 (WDI). Finally, the econometric software, namely Microfit 4.1 and Eviews 7.1 are used to complete the analysis of data.

In the time series literature, if the series are non-stationary or integrated of order one i.e. if the series are I(1) process, the regression results with variables at level will be spurious (Granger and Newbold, 1974; Phillips, 1986). Thus, we start with examining the time series properties of the series through the ADF stationarity tests. The results revealed that all the examined series are integrated of order one, I(1). These results are consistent with the notion that most of the macroeconomic variables are non-stationary at level, but become stationary after first differencing (Nelson and Plosser, 1982).

The Econometric Model

The model intends to establish the relationship between FDI and GDP of Bangladesh where it can be expressed in the following basic bivariate model.

$$G_t = \alpha + \beta F_t + \varepsilon_t \quad (1)$$

where, G_t is GDP and F_t is the net inflows of FDI and ε_t is error term. Logarithmic transformation of the above equation and inclusion of a trend variable would leave the basic equation as follows

$$LG_t = \alpha_0 + \alpha_1 t + \beta FE_t + \varepsilon_t \quad (2)$$

where, t is the trend variable. The standard Granger causality test (Granger, 1988) seeks to determine whether past values of a variable helps predict changes in another variable. In the context of this analysis the Granger method involves the estimation of the following equations:

$$LG_t = \beta_0 + \sum_{i=1}^{q} \beta_{1i} LG_{t-i} + \sum_{i=1}^{q} \beta_{2i} LF_{t-i} + \varepsilon_{1t} \quad (3)$$

$$LF_t = \varphi_0 + \sum_{i=1}^{r} \varphi i_{1i}\ LF_{t-i} + \sum_{i=1}^{r} \varphi_{2i}\ LG_{t-i} + \varepsilon_{2t} \quad (4)$$

where, LG_t and LF_t represent GDP and net inflows of FDI, respectively, ε_{1t} and ε_{2t} are uncorrelated stationary random process, and subscript t denotes the time period. Failing to reject $H_0 : \beta_{21} = \beta_{22} = ... = \beta_{2q} = 0$ implies that FDI does not Granger cause GDP. On the other hand, failing to reject $H_0 : \varphi_{21} = \varphi_{22} = ... = \varphi_{2r} = 0$ implies that GDP does not Granger cause FDI.

Empirical works based on time series data assume that the underlying time series is stationary. However, many studies have shown that majority of time series variables are nonstationary or integrated of order

1 (Engle and Granger, 1987). The time series properties of the data at hand are therefore studied in the outset. The above specification of the causality test assumes that the time series at hand are mean reverting process. However, it is highly likely that variables of this study are nonstationary. Formal tests will be carried out to find the time series properties of the variables. If the variables are I (1), Engle and Granger (1987) assert that causality must exist in, at least, one direction. The Granger causality test is then augmented with an error correction term (ECT) as shown below:

$$\Delta LG_t = \beta_0 + \sum_{i=1}^{q} \beta_{1i} \Delta LG_{t-i} + \sum_{i=1}^{q} \beta_{2i} \Delta LF_{t-i} + \alpha_1 Z_{t-1} + \varepsilon_{1t} \quad (5)$$

$$\Delta LF_t = \varphi_0 + \sum_{i=1}^{r} \varphi i_{1i}\ \Delta LF_{t-i} + \sum_{i=1}^{r} \varphi_{2i}\ \Delta LG_{t-i} + \lambda_1 Z_{t-1} + \varepsilon_{2t} \quad (6)$$

where Z_{t-1} is the ECT obtained from the long run cointegrating relationship between GDP and FDI. The above error correction model (ECM) implies that possible sources of causality are two: lagged dynamic regressors and lagged cointegrating vector. Accordingly, by equation (5), FDI Granger causes GDP, if the null of either $\sum_{i=1}^{q} \beta_{2i} = 0$ or $\alpha_1 = 0$ is rejected. On the other hand, by equation (6), GDP Granger causes FDI, if λ_1 is significant or $\sum_{i=1}^{r} \varphi_{2i}$ are jointly significant. GDP and FDI granger cause each other i.e. presence of bidirectional causality), if causality exists in both directions.

Empirical Findings

In this study annual data on FDI (F) and GDP (G) of Bangladesh in US dollar are used. Net inflows of FDI in US dollar are extracted from the BB, BBS, WB, ADB, KI, WDI and IFS. GDP in US dollar is also used at current market price and are extracted from BB, WB, ADB, KI, WDI and IFS. Data are used in original as well as in natural logarithms. To understand the tendency of economic activity, a primary analysis of the data is done. The following Table 1 shows the descriptive statistics of both variables in original and natural logarithmic form. From the Table 1 it is seen that average GDP and FDI are 39,400,000,000 and 192,000,000 US dollar respectively, whereas the GDP ranges from a maximum 116,000,000,000 to a minimum 6,290,000,000. On the other hand, the FDI ranges from a maximum 1,140,000,000 to a minimum -8,010,000. The average of LNGDP and LNFDI are 24.1551 and 15.54722 respectively.

Table 1: Descriptive Statistics

	GDP	FDI	LNGDP	LNFDI
Mean	39,400,000,000	192,000,000	24.1551	15.54722
Median	31,700,000,000	7,340,000	24.17986	15.80765
Maximum	116,000,000,000	1,140,000,000	25.47349	20.85246
Minimum	6,290,000,000	-8,010,000	22.56195	0.000000
Std. Dev.	28,000,000,000	330,000,000	0.72355	5.167815
Skewness	1	2	-0.14057	-1.914846
Kurtosis	4	4	2.424143	6.689766
Jarque-Bera	11	20	0.70153	47.13486
Probability	0	0	0.704149	0
Observations	42	42	42	42

The maximum values of LNGDP and LNFDI are 25.47349 and 20.85246 respectively and the minimum values for LNGDP and LNFDI are 22.56195 and 0 respectively. The following Table 2 represents the pair-wise correlation between GDP and FDI and Table 3 depicts the pair-wise correlation between LNGDP and LNFDI. The tables show there is a positive correlation between GDP and FDI at original value as well as natural logarithmic value and which is statistically significant at 1% level of significance.

Table 2: Correlation between FDI and GDP

	GDP	FDI
GDP	1	0.925***
FDI		1

*** Correlation is significant at the 1% level.

Table 3: Correlation between LNFDI and LNGDP

	LNGDP	LNFDI
LNGDP	1	0.518***
LNFDI		1

*** Correlation is significant at the 1% level.

The estimation procedure starts with testing the time series properties of GDP, FDI, LNGDP and

LNFDI. Table 4 (See in Appendices) shows the Correlogram GDP at level. It is seen from the table that Autocorrelation Coefficient (AC) and Partial autocorrelation coefficient (PAC) cross the boundary line. Moreover, in the case of AC at 1st to 7th lag crosses boundary lines. At 1st lag PAC crosses boundary line. Apart from that all the values of Box Pierce Ljung statistic (Q statistic) more than 25 and p value for hypothesis that all autocorrelation coefficient to this point are zero and it shows significant at 1 percent level. Therefore it indicates non stationary trend and it follows stochastic trend.

Table 5 (See in Appendices) depicts the Correlogram of GDP at 1st difference. The table shows that AC and PAC do not cross the boundary line except at lag 5. The p-value for all autocorrelation coefficients are more than 0.05 except at lag5 and lag6 and it shows insignificant at 1 percent level. That's why it indicates stationary trend due to 1st difference and it follows deterministic trend.

Table 6 (See in Appendices) shows the Correlogram of LNGDP at level. Table shows that AC crosses boundary lines at 1st to 6th lag. At 1st lag PAC crosses boundary line. Apart from 1st lag all the values of Box Pierce Ljung statistic (Q statistic) are more than 28 and p value for hypothesis for all autocorrelation coefficients to this point are zero and it shows significant at 1 percent level. That's why it indicates non stationary trend and it follows stochastic trend.

Table 7 (See in Appendices) shows the Correlogram of LNGDP at 1st difference. Table shows that AC crosses boundary lines at 1st, 4th and 5th lag. At 1st and 4th lag PAC crosses boundary line. Apart from 1st to 5th lag all the values of Box Pierce Ljung statistic (Q-statistic) are more than 22 and p value for hypothesis for most of the autocorrelation coefficients to this point are insignificant. That's why it indicates stationary trend and it follows deterministic trend.

Table 8 (See in Appendices) shows the Correlogram of FDI at level. It is seen from the table that AC crosses boundary lines at 1st to 7th lag and PAC crosses boundary line at 1st lag. Apart from 1st lag all the values of Box Pierce Ljung statistic (Q statistic) are more than 32.045 and p value for hypothesis that all autocorrelation coefficients to this point are zero and it shows significant at 1 percent level. That's why it indicates non stationary trend and it follows stochastic trend.

Table 9 (See in Appendices) shows the Correlogram of FDI at 1st difference. It is observed from the table that AC and PAC do not cross the boundary line. Apart from 1st lag all the values of Box Pierce Ljung statistic (Q statistic) are more than 1.87 and p value for hypothesis that most of AC is insignificant. That's why it indicates stationary trend and it follows deterministic trend.

Table 10 (See in Appendices) shows the Correlogram of LNFDI at level. It is seen from the table that AC crosses boundary lines at 1st, 5th and 6th lag and PAC crosses boundary line at 1st lag. Apart from 1st lag all the values of Box Pierce Ljung statistic (Q statistic) are more than 10 and p value for hypothesis of all autocorrelation coefficients to this point are zero and it shows significant at 1 percent level. That's why it indicates non stationary trend and it follows stochastic trend.

Table 11 (See in Appendices) shows the Correlogram of LNFDI at 1st difference. The table exhibits that AC and PAC do not cross the boundary line except 4th lag for PAC. Apart from 1st lag all the values of Box Pierce Ljung statistic (Q-statistic) are more than 2.5 and p-values for hypothesis of the most of autocorrelation coefficients are insignificant. That's why it indicates stationary trend and it follows deterministic trend.

In the 2nd step of testing the time series properties of the data the unit root test is done. The null hypothesis is that there is a unit root in the series which means that the time series data is non-stationary defining that there is a relation between time and data. The following Table 12 shows the results of unit root test by using Augmented Dickey-Fuller (ADF). For ADF, both with constant and constant and trend, one is unable to reject a null hypothesis at level but is able to reject the null hypothesis when 1st differenced series are used.

It is observed from the Table 12 that all the examined series are integrated of order one, I (1). These results are consistent with the notion that most of the macroeconomic variables are non-stationary at level, but become stationary after first differencing (Nelson and Plosser, 1982). For FDI, at level and first difference there is an existence of unit root for both at constant and constant and trend. For that reason logarithmic values of both series are used to test the unit root. It is seen from the table that when logarithmic values of FDI are used then it is become stationary at first difference for both constant and trend and constant.

Table 12: Unit root test of the variables

Variables	Augmented Dickey-Fuller (ADF) Test			Process	Test Critical Value		
	Statistics	p-values	Unit Root		At 1%	At 5%	At 10%
Test Equation: Intercept							
LGDP	2.60016	1.0000	Yes	I(1)	-3.62102	-2.94342	-2.61026
ΔGDP	-2.92325*	0.0528	No	I(0)	-3.63290	-2.94840	-2.61287
LLNGDP	1.54190	0.9989	Yes	I(1)	-3.75294	-2.99806	-2.63875
ΔLNGDP	-1.99815*	0.0863	No	I(0)	-3.63292	-2.94840	-2.61287
LFDI	6.53837	1.0000	Yes	I(1)	-3.63941	-2.95113	-2.61430
ΔFDI	-0.03195	0.9487	Yes	I(1)	-3.64634	-2.95402	-2.61582
LLNFDI	-0.83305	0.7974	Yes	I(1)	-3.62678	-2.94584	-2.61153
ΔLNFDI	-6.25550	0.0000	No	I(0)	-3.62678	-2.94584	-2.61153
Test Equation: Trend and Intercept							
LGDP	0.537206	0.9991	Yes	I(1)	-4.24364	-3.544284	-3.20469
ΔGDP	-5.02106***	0.0000	No	I(0)	-4.24364	-3.54428	-3.20472
LLNGDP	-2.11446	0.5101	Yes	I(1)	-4.44073	-3.632896	-3.25467
ΔLNGDP	-23.4143***	0.0000	No	I(0)	-4.49830	-3.658446	-3.26897
LFDI	5.07030	1.0000	Yes	I(1)	-4.25288	-3.54849	-3.20709
ΔFDI	-1.67683	0.7389	Yes	I(1)	-4.26274	-3.55297	-3.20964
LLNFDI	-4.38666	0.0064	No	I(0)	-4.21187	-3.52976	-3.19641
ΔLNFDI	-6.25223	0.0000	No	I(0)	-4.23497	-3.54033	-3.20245
Source	BB, WB, ADB, KI, WDI, IFS.						

Note: L stands for level, Δ denotes the first difference of the variable. The null hypothesis states that the variable has a unit root. P-values are used to decide the unit roots at the 1%, 5% and 10% significance level. The critical values and details of the tests are presented in Dickey and Fuller (1979, 1981). The AIC determines the lag length (P) in the ADF tests (see Stock and Watson 2007:561 for details). Test equation: trend and intercept. *,**, and *** denote rejection of null at 10%, 5%, and 1% level of significance.

Once it is established that variables are I (1), the next step is to test for existence of any co-integration relationship between GDP and FDI. To test the co-integration, the Johansen (1991) LR test is applied and results are showed in Table 13. The appropriate VAR lag length is selected using BIC.

Table 13: Cointegration test between GDP and FDI (Johansen Cointegration Test)
[VAR lag k = 2, [G,F]

Null	Eigen values	Trace Test		Max Eigen value Test	
		$\lambda - trace$	p–value	$\lambda - \max$	p–value
$r \leq 0$	0.31186	16.11266	0.0111	14.57676	0.0124
$r \leq 1$	0.03861	1.535901	0.2524	1.535901	0.2524

Since trace statistic is 16.11266 and p-value is 0.0111 which means that the statistics is significant at 5% level and we can reject the null hypothesis of no co-integration vector and accept the alternative of one co-integrating vector. Again trace statistic is 1.535901 and p-value is insignificant, so we cannot reject the null hypothesis of one co-integrating vector. Same thing is happened when λ-max test is used. Therefore we have to test co-integration between LNGDP and LNFDI.

Table 14: Co-integration Test between LNGDP and LNFDI (Johansen Co-integration Test)
VAR lag k = 2, [Y,X]

Null	Eigen values	Trace Test		Max Eigen value Test	
		$\lambda - trace$	*p*–value	$\lambda - \max$	*p*–value
$r \leq 0$	0.244418	15.74643	0.0128	10.93043	0.0563
$r \leq 1$	0.116167	4.81599	0.0335	4.81599	0.0335

Since trace statistic is 15.74643 and p-value is 0.0128 which means that the trace statistic is significant and we can reject the null hypothesis of no co-integration vector and accept the alternative of one co-integrating vector. Again trace statistic is 4.81599 and p-value is 0.0335 which means that the statistic is significant at 5% level and we can reject the null hypothesis of one co-integrating vector and accept the alternative hypothesis of more than one co-integrating vector. Same thing is happened when λ-max test is used. Both p-values for r=0 and r=1 are significant. The Eigen value tests based on stochastic matrix indicate existence of the co-integration relationship between GDP and FDI. Therefore, the Granger causality tests are to be modeled using ECM as explained in equations (5) and (6).

Table 15 summarizes the Granger Causality results between GDP and FDI of Bangladesh from 1972 to 2013. F-statistic and probability values are constructed under the null hypothesis of no causality.

Table 15: Granger causality test between GDP and FDI

Pairwise Granger Causality Tests			
Lags: 2			
Null Hypothesis:	Obs	F-Statistic	Probability
GDP does not Granger Cause FDI	40	2.96589	0.065
FDI does not Granger Cause GDP		2.71488	0.118

Here we can reject the null hypothesis of GDP does not Granger cause FDI because p-value are less than 0.10, therefore it can be concluded that GDP does Granger cause FDI. On the other hand, we cannot reject the null hypothesis of FDI does not Granger cause GDP because p-value is more than 0.10, hence it can be said that FDI does not cause GDP.

Table 16: Granger causality test between LNGDP and LNFDI

Pairwise Granger Causality Tests			
Lags: 2			
Null Hypothesis:	Obs	F-Statistic	Probability
LNGDP does not Granger Cause LNFDI	40	4.58109	0.0173
LNFDI does not Granger Cause LNGDP		0.21708	0.806

Table 16 summarizes the Granger Causality results between LNGDP and LNFDI of Bangladesh from 1972 to 2013. F-statistic and probability values are constructed under the null hypothesis of no causality. Here we can reject the null hypothesis of LNGDP does not Granger cause LNFDI at 5% level of significance. Therefore it can be said that LNGDP does cause LNFDI. On the other hand, it is also evident from the results that the null hypothesis of LNFDI does not Granger cause LNGDP cannot be rejected because the p-value is more than 0.10. Finally it can be concluded that there is a unidirectional causal relationship between the variables i.e. the one way causality runs through GDP to FDI.

Conclusion

The main objective of this paper is to examine empirically the relationship between GDP and FDI in Bangladesh with the latest time series econometric method. Time series econometric tools are used to examine the relationship between the variables. ADF test is used to see the stationarity of the data. Granger Causality Test and Johansen Co-integration are also used by taking care of stochastic properties of the variables to see the casual relationship between the variables. From the results of unit root test it is seen that GDP is integrated of order 1 in both original values and logarithmic values of the variables. But FDI is integrated of order one at logarithmic values. The empirical results show there is a unidirectional casual relationship between GDP and FDI which runs through GDP to FDI. By using natural logarithmic form of the variables it is also found that there is a long-term equilibrium relationship between GDP and FDI which runs through GDP to FDI. The Eigen value tests based on stochastic matrix indicate the existence of the co-integration relationship between GDP and FDI. The result of Granger's Causality test denotes that there is a unidirectional causality runs through GDP to FDI.

Bangladesh is a developing country with great potentials but the political situation is not so good to attract more FDI. But this is believed that FDI supplement the capital and it adopts foreign technology, technological spillovers, and human capital (knowledge and skill) enhancement and so on. As FDI inflows work as supplementary and complementary to domestic investment in a country, this study suggests a number of policy implications for Bangladesh for enjoying the advantages from FDI inflows. Bangladesh should try to establish a stable political situation. The country should develop policies that will encourage the inflow of FDI to the priority sectors. It should develop required capacities as a pre-requisite in terms of infrastructure, human capital base, financial markets, economic and political stability, market size, etc. The country should take actions to remove barriers and create favorable environment for attracting more inflows of FDI.

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Appendices

Table 4: Correlogram of GDP (Level)

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
. |****** |	. |****** |	1	0.780	0.780	25.011	0.000
. |***** |	. | . |	2	0.610	0.003	40.712	0.000
. |**** |	. | . |	3	0.487	0.027	51.016	0.000
. |*** |	. | . |	4	0.385	-0.010	57.643	0.000
. |** |	. | . |	5	0.307	0.009	61.997	0.000
. |** |	. | . |	6	0.248	0.006	64.919	0.000
. |** |	. | . |	7	0.198	-0.004	66.840	0.000
. |*. |	. | . |	8	0.169	0.028	68.283	0.000
. |*. |	. | . |	9	0.143	0.001	69.359	0.000
. |*. |	. | . |	10	0.120	-0.000	70.142	0.000
. |*. |	. | . |	11	0.098	-0.006	70.686	0.000
. |*. |	. | . |	12	0.079	-0.004	71.048	0.000
. | . |	. | . |	13	0.064	0.003	71.299	0.000
. | . |	. | . |	14	0.052	-0.002	71.468	0.000
. | . |	. | . |	15	0.040	-0.004	71.571	0.000
. | . |	. | . |	16	0.028	-0.007	71.625	0.000

Table 5: Correlogram of GDP (1st Difference)

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
. *| . |	. *| . |	1	-0.090	-0.090	0.3270	0.567
. |* . |	. |* . |	2	0.130	0.123	1.0288	0.598
. | . |	. | . |	3	0.033	0.056	1.0745	0.783
.**| . |	.**| . |	4	-0.274	-0.291	4.3659	0.359
. |*** |	. |*** |	5	0.406	0.393	11.782	0.038
. *| . |	. *| . |	6	-0.158	-0.084	12.947	0.044
. |* . |	. | . |	7	0.120	0.024	13.641	0.058
. | . |	. | . |	8	0.008	-0.051	13.644	0.092
. | . |	. |* . |	9	-0.048	0.193	13.764	0.131
. |**. |	. | . |	10	0.231	0.008	16.625	0.083
. *| . |	. | . |	11	-0.073	0.045	16.917	0.110
. |* . |	. | . |	12	0.105	-0.011	17.552	0.130
. | . |	. | . |	13	-0.035	0.042	17.625	0.172
. | . |	. | . |	14	0.002	0.006	17.626	0.224
. | . |	. | . |	15	0.064	-0.028	17.897	0.268
. | . |	. | . |	16	-0.008	0.049	17.902	0.330

Table 6: Correlogram of LNGDP (Level)

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
. |****** |	. |****** |	1	0.832	0.832	28.405	0.000
. |***** |	. | . |	2	0.681	-0.034	47.977	0.000
. |**** |	. | . |	3	0.572	0.049	62.191	0.000
. |*** |	. *| . |	4	0.455	-0.087	71.450	0.000
. |*** |	. | . |	5	0.355	-0.014	77.240	0.000
. |** |	. | . |	6	0.267	-0.033	80.632	0.000
. |*. |	. | . |	7	0.190	-0.023	82.402	0.000
. |*. |	. | . |	8	0.151	0.065	83.557	0.000
. |*. |	. | . |	9	0.114	-0.024	84.236	0.000
. |*. |	. | . |	10	0.080	-0.007	84.581	0.000
. | . |	. | . |	11	0.047	-0.038	84.704	0.000
. | . |	. | . |	12	0.019	-0.010	84.724	0.000
. | . |	. | . |	13	0.001	0.001	84.724	0.000
. | . |	. | . |	14	-0.013	-0.002	84.735	0.000
. | . |	. | . |	15	-0.022	0.004	84.768	0.000
. | . |	. | . |	16	-0.028	-0.002	84.821	0.000

Table 7 Correlogram of LNGDP (1st Difference)

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
***| . |	***| . |	1	-0.349	-0.349	4.8761	0.027
. | . |	. *| . |	2	0.029	-0.106	4.9101	0.086
. | . |	. | . |	3	0.047	0.025	5.0054	0.171
***| . |	***| . |	4	-0.353	-0.373	10.466	0.033
. |**** |	. |**. |	5	0.481	0.306	20.905	0.001
. *| . |	. | . |	6	-0.172	0.054	22.286	0.001
. | . |	. | . |	7	0.034	0.031	22.340	0.002
. | . |	. *| . |	8	-0.028	-0.146	22.381	0.004
. *| . |	. |* . |	9	-0.087	0.152	22.775	0.007
. |* . |	. | . |	10	0.147	-0.049	23.930	0.008
. *| . |	. | . |	11	-0.095	-0.038	24.435	0.011
. | . |	. | . |	12	0.043	-0.057	24.540	0.017
. | . |	. | . |	13	-0.052	0.045	24.702	0.025
. | . |	. *| . |	14	-0.044	-0.109	24.825	0.036
. | . |	. | . |	15	0.035	-0.057	24.905	0.051
. | . |	. | . |	16	-0.029	-0.010	24.961	0.071

Table 8: Correlogram of FDI (level)

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
. |****** |	. |****** |	1	0.853	0.853	32.045	0.000
. |***** |	. | . |	2	0.722	-0.018	55.614	0.000
. |***** |	. |* . |	3	0.636	0.092	74.403	0.000
. |**** |	. | . |	4	0.551	-0.037	88.879	0.000
. |*** |	. *| . |	5	0.445	-0.112	98.56	0.000
. |*** |	. | . |	6	0.378	0.072	105.74	0.000
. |** |	. *| . |	7	0.288	-0.143	110.04	0.000
. |* . |	. *| . |	8	0.164	-0.171	111.48	0.000
. | . |	. | . |	9	0.074	0.005	111.78	0.000
. | . |	. | . |	10	0.033	0.066	111.84	0.000
. | . |	. |* . |	11	0.034	0.174	111.91	0.000
. | . |	. | . |	12	0.02	-0.023	111.93	0.000
. | . |	. *| . |	13	-0.027	-0.155	111.98	0.000
. | . |	. | . |	14	-0.062	-0.002	112.23	0.000
. *| . |	. *| . |	15	-0.104	-0.104	112.95	0.000
. *| . |	. | . |	16	-0.137	-0.02	114.28	0.000

Table 9: Correlogram of FDI (1st Difference)

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
. *| . |	. *| . |	1	-0.185	-0.185	1.4722	0.225
. *| . |	. *| . |	2	-0.096	-0.134	1.8757	0.391
. |** |	. |** |	3	0.268	0.235	5.1372	0.162
**| . |	**| . |	4	-0.329	-0.275	10.196	0.037
. |* . |	. |* . |	5	0.199	0.19	12.096	0.033
. |* . |	. | . |	6	0.088	0.01	12.478	0.052
. | . |	. |** |	7	0.062	0.315	12.677	0.08
. |** |	. |* . |	8	0.284	0.199	16.915	0.031
. *| . |	. | . |	9	-0.185	0.003	18.771	0.027
. | . |	. *| . |	10	-0.041	-0.115	18.865	0.042
. | . |	. | . |	11	0.069	-0.016	19.142	0.059
. | . |	. | . |	12	-0.064	0.028	19.39	0.08
. | . |	. *| . |	13	0.021	-0.157	19.417	0.111
. | . |	. *| . |	14	0.025	-0.102	19.458	0.148
. | . |	. *| . |	15	-0.02	-0.133	19.484	0.193
. | . |	. | . |	16	-0.033	-0.036	19.558	0.241

Table 10: Correlogram of LNFDI (level)

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
. |*** |	. |*** |	1	0.481	0.481	10.196	0.001
. |** |	. | . |	2	0.215	-0.021	12.285	0.002
. |*. |	. |*. |	3	0.173	0.101	13.671	0.003
. |** |	. |*. |	4	0.238	0.157	16.372	0.003
. |*** |	. |** |	5	0.437	0.341	25.704	0.000
. |*** |	. |*. |	6	0.408	0.106	34.103	0.000
. |*. |	.*| . |	7	0.176	-0.119	35.708	0.000
. |*. |	. | . |	8	0.076	-0.039	36.02	0.000
. | . |	. | . |	9	0.07	-0.052	36.292	0.000
. |*. |	. | . |	10	0.119	-0.066	37.093	0.000
. |*. |	.*| . |	11	0.076	-0.167	37.435	0.000
. | . |	. | . |	12	0.062	0.034	37.671	0.000
. | . |	. | . |	13	-0.009	-0.03	37.675	0.000
.*| . |	.*| . |	14	-0.094	-0.104	38.253	0.000
.*| . |	.*| . |	15	-0.111	-0.077	39.094	0.001
.*| . |	. | . |	16	-0.089	0.018	39.652	0.001

Table 11: Correlogram of LNFDI (1st Difference)

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
**| . |	**| . |	1	-0.244	-0.244	2.5637	0.109
**| . |	**| . |	2	-0.223	-0.3	4.7574	0.093
.*| . |	**| . |	3	-0.108	-0.294	5.2837	0.152
.*| . |	***| . |	4	-0.131	-0.427	6.0868	0.193
. |** |	.*| . |	5	0.226	-0.175	8.5456	0.129
. |*. |	. | . |	6	0.202	0.056	10.559	0.103
.*| . |	.*| . |	7	-0.188	-0.111	12.353	0.09
. | . |	. | . |	8	-0.04	-0.022	12.437	0.133
. | . |	. | . |	9	-0.054	-0.026	12.597	0.182
. |*. |	. |*. |	10	0.096	0.097	13.111	0.218
. | . |	.*| . |	11	-0.038	-0.135	13.194	0.281
. | . |	.*| . |	12	0.004	-0.093	13.195	0.355
. | . |	. | . |	13	0.012	-0.033	13.204	0.432
. | . |	. | . |	14	-0.021	-0.062	13.232	0.508
. | . |	.*| . |	15	-0.039	-0.172	13.334	0.577
. | . |	.*| . |	16	0.033	-0.12	13.411	0.642

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