ELK Asia Pacific Journal of Finance and Risk Management
ISSN (Print): 0976-7185; ISSN (Online): 2349-2325
www.elkjournals.com

Article # 4326/EAPJFRM (2015)
DOI: 10.16962/EAPJFRM/6_3_3
Volume 6 Issue 3, 35-49

Investigating the Causal Relationship between FDI and Economic Growth using Toda-Yamamoto Approach: Evidence from Bangladesh

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ABSTRACT

The aim of this paper is to investigate the direction of causality between FDI and economic growth in Bangladesh using annual data covering the period from 1972 to 2013 within a vector autoregressive (VAR) framework. The order of integration of the variables is initially determined using numerous unit root tests. The tests reveal that the maximum order of integration for the variables in the system is one. Applying a modified version of the Granger causality test due to Toda and Yamamoto, we found a strong evidence of a unidirectional causality running from FDI to GDP growth rate which points out the FDI-led growth in Bangladesh.

Keywords: FDI, Economic growth, Causality, Toda-Yamamoto approach.

Introduction

Foreign direct investment (FDI) is often considered as an important instrument for accelerating economic growth in the developing countries. The relationship between Foreign Direct Investment (FDI) and economic growth has long been a subject of great interest in the field of international development. FDI inflows contribute to economic growth through an increase in productivity by providing new investment, better technologies and managerial skills to the host countries. But, the impact of FDI on economic growth depends on the degree of capacity of the host country to use FDI efficiently (UNCTAD, 2008). FDI is considered as an important factor in accelerating economic success and wealth of a country as well as a door in creating jobs, facilitating economy, and creating more competitive environment and contributing productivity to the host country. As a result, FDI is included in the central economic policies of the developing countries. The significance of FDI is undeniable in host country because of the inability to make internal savings for local investments.

Foreign direct investment (FDI) is expected to benefit poor countries such as Bangladesh in different ways.

Firstly, it supplements domestic investment which is low due to lack of resources in these countries. Secondly, FDI is expected to generate employment, transfer, increase domestic competition and bring other positive externalities such as transfer of good practices. Bangladesh offers attractive investment opportunities to foreign investors and has adopted policies to attract FDI into the country. In fact, Bangladesh seems to offer one of the most liberal FDI regimes in South Asia (Khatun & Ahamad, 2013).

Foreign direct investment (FDI) in developing countries especially in Bangladesh takes a vibrant part of GDP acceleration and rapid economic growth. It helps the country in building up infrastructure, creating more employment, developing capacity, enhancing skills of the labor force of the host country through transferring technological knowledge and managerial capability, and helping in integrating domestic economy and the global economy. Various positive attributes of Bangladesh is now drawing the attention of the investors from both developed and developing countries. Bangladesh has been turning into the most generous FDI recipient country in South Asia because of the cheapest labor cost, tax holiday facilities etc. (Mottaleb, 2007).

(*Insert Table 1 here*)

(*Insert Figure 1 here*)

Bangladesh was experiencing an irregular trend of the inflow of FDI over the last twelve years. During the FY 2001-02 (Table I and Figure 1), FDI inflow was US$ 393.76 million which was reduced by 3.70 percent and reached to US$ 379.18 million in FY 2002-03. FDI inflow in FY 2003-04 was further reduced by 25.06 percent and reached to US$ 284.16 million. In FY 2004-05, FDI increased to US$ 803.78 million which is 182.86 percent higher than that of the previous fiscal year. In FY 2005-06, 2006-07, and 2007-08, the total FDI inflow was US$ 744.61 million, US$ 792.74 million, and US$ 768.69 million respectively showing nearly same amount of FDI inflows in these fiscal years. In the FY 2008-09, FDI increased to US$ 960.59 million which is 24.96 percent higher than that of the previous fiscal year (FY 2007-08). After that, the flows of FDI was reduced by 4.95 percent and reached to US$ 913.02 million in FY 2009-10. FDI inflow was further reduced to US$ 779.04 million in 2010-11 which is 14.67 percent

lower than that of the previous fiscal year. Then, Bangladesh witnessed a significant rise in the inflows of FDI in FY 2011-12 which was amounted to US$ 1194.88 million, an increase of 53.38 percent than that of the FY 2010-2011. Bangladesh received the highest inflows of FDI so far in its' history in the FY 2012-2013 which was amounted to US$ 1730.63 million, an increase of 44.84 percent than that of the FY 2011-2012. The inflow of FDI up to the first half of FY 2013-14 (up to December, 2013) was US$ 346.07 million. It can be said that during FY 2007-08 to FY 2012-13, the total inflows of FDI was US$ 6346.85 million with an average of US$ 1057.81 million per FY as compared to during FY 2001-02 to FY 2006-07, total inflows of FDI was US$ 3398.23 million with an average of US$ 566.37 million per FY.

(*Insert Figure 2 here*)

The trends in the share of FDI in GDP of Bangladesh are shown in Figure 2. After the year 1996, the share of FDI in GDP had shown an increasing trend up to the year 2000 (0.59%). After that, it had been falling up to the year 2002 (0.11%). Then, it began to rise upto the year 2005 (1.26%). After that, the percentage of FDI in GDP fluctuates between 0.7% and 1.15% upto the year 2013.

(*Insert Figure 3 here*)

The percentage of GDP growth of Bangladesh of different years has been displayed in figure 3. Between the years 1972 and 2013, Bangladesh had experienced negative growth rate of GDP only in the year of 1972 (-13.97%) and 1975 (-4.08%). Besides these, the country had enjoyed positive growth rate of GDP where the highest growth rate of GDP was 9.59% (1974) and the lowest growth rate of GDP was 0.819% (1980).

The remainder of the paper is organized as follows: Section 2 presents reviews of literature on the relationship between FDI and economic growth of different countries including Bangladesh. Section 3 presents the objectives of the study. Section 4 discusses in detail the Toda-Yamamoto approach to test for causality as well as data issues related to the empirical work. Section 5 presents the empirical results. Finally, Section 6 concludes the paper.

Literature Review

There have been carried out a considerable number of studies on FDI and economic growth of various countries using different samples, methodologies and

procedures. Khatun and Ahamad (2013) examined the causal relationship between foreign direct investment (FDI) in the energy and power sector and economic growth of Bangladesh by using data for the period 1972-2010. Using the Granger Causality test and Johansen Co-integration test, their results show that there are robust positive and unidirectional short-run causal relationships running from FDI to energy use and from energy use to GDP growth and also unidirectional causality running from per capita FDI to per capita GDP in the long run.

Frimpong and Oteng-Abayie (2006) explored the causal link between FDI and GDP growth for Ghana for the pre- and post-SAP (Structural Adjustment Program) period. Using the Toda-Yamamoto causality test and Johansen Co-integration analysis for Ghana over the period 1970-2002, their results show that there exists a long-term relationship between the variables for the whole sample period (1970-2002) and the post-SAP period (1984-2002) and there is the presence of one-way causality from FDI to GDP growth only for the post-SAP period (1984-2002).

Kundan and Qingliang (2010) indicate that FDI had a positive impact on economic growth in Nepal. Using the Granger Causality test, Unit Root test and Co-integration test with data for the period 1980-2006, their results show that there exists a long-term relationship between the variables and direction of causality runs from FDI to GDP growth rate.

Chowdhury and Mavrotas (2006) examined the causal relationship between FDI and economic growth by using the data covering the period 1969–2000 for three developing countries, namely Chile, Malaysia and Thailand. Using the Toda-Yamamoto causality test, their findings on the relationship between these two variables vary for three countries under study. For example, there is the presence of unidirectional causality running from real GDP to FDI (GDP driven FDI) in Chile, but there is strong evidence of bi-directional causality between FDI and real GDP for both Malaysia and Thailand.

Sethi and Sucharita (2010) examine the effect of FDI on economic growth in Bangladesh and India respectively by using the data for the period 1974-2009. Using the Ordinary Least Squares (OLS) model, the result indicates that FDI is positively correlated to the economic growth of Bangladesh but is negatively correlated to the

economic growth in India. Using the Granger-causality test, the results show that for both countries there is a unidirectional causality from GDP to FDI.

Athukorala (2003) examined the relationship between FDI and GDP in the context of Sri Lankan using time series data during 1959- 2002 time periods. He found that FDI inflows do not exert an independent influence on economic growth. And also the direction of causation is not towards from FDI to GDP growth but GDP growth to FDI. Political instability and disturbance, poor law and order situation and lack of infrastructural facilities were the main hindrance of less impact of FDI on economy, the study claimed.

Hossain and Hossain (2012) examined co-integration and the causal relationship between Foreign Direct Investment (FDI) and the economic output or Gross Domestic Product (GDP) both in the short and long run of Bangladesh, Pakistan and India over the period of 1972-2008. Their results suggest that there is no causality relationship between GDP and FDI for Bangladesh and one way or unidirectional relationship running from GDP to FDI in case of India and unidirectional causality running from FDI to GDP in case of Pakistan.

ESSO (2010) examined the relationship between FDI and economic growth in case of ten Sub-Saharan African countries using the time series data from 1970 to 2007. Using the bounds testing approach to cointegration and Toda-Yamamoto causality test, the results show that there is a positive long-run relationship between FDI and economic growth in Angola, Cote d'Ivoire, Kenya, Liberia, Senegal and South Africa. However, FDI significantly causes economic growth in Angola, Cote d'Ivoire and Kenya, while growth causes FDI in Liberia and South Africa.

Ozturk and Kalyoncu (2007) examined the causal relationship between FDI and economic growth of Turkey and Pakistan using annual data over the period of 1975-2004. Using the Engle-Granger cointegration test and Granger causality test, their results show that FDI and real GDP are cointegrated or there exists long-run equilibrium between GDP and FDI for both countries studied, and it is GDP that causes FDI (GDP driven FDI) in the case of Pakistan, while there is strong evidence of a bi-directional causality between the two variables for Turkey.

Meerza (2012) investigated empirically the causal relationship between export, foreign direct investment (FDI) and economic growth of Bangladesh for the period of 1973 to 2008. Using Johansen cointegration test and Granger causality test, the results show that there is a long run equilibrium relationship among the variables; economic growth of Bangladesh leads both FDI and export growth and there is a unidirectional causal relationship between FDI and export with direction from export to FDI.

Adi and Adimani (2014) explored the causal effect of FDI on economic growth of China by using time series data drawn from the primary, secondary and tertiary sectors of the economy over the period from 1995 to 2010. Using the Granger causality test, the results indicate that, utilized FDI do not cause economic growth in primary industry, FDI in secondary industry cause economic growth and economic growth cause FDI inflows in secondary industry, while economic growth cause FDI flow to tertiary industry of the economy.

The literature reviewed above pertaining to the causal nexus between foreign direct investment and economic growth in different countries is well established. Some studies show the presence of long run relationships between FDI and economic growth. Some studies show the bidirectional causality between the variables. Also, some studies show unidirectional causality with either direction. In this backdrop, the present study attempts to examine the causality between FDI and economic growth of Bangladesh by using Toda-Yamamoto (T-Y) test.

Objectives of the study

(1) To investigate the causal relationship between FDI and economic growth in Bangladesh by applying the Toda-Yamamoto (T-Y) test for causality

(2) To study the direction of causality between two variables which can overcome the problem associated with conventional Granger Causality test that produces invalid asymptotic critical values when causality tests are performed in the presence of nonstationary series or even cointegrated.

Data and empirical methodology

Data

The study employs annual data on the GDP growth (annual %) as a measure for economic growth and foreign direct investment (FDI) net inflows as percentage of GDP for Bangladesh over the period of 1972-2013. The data for the period has been chosen because it covers comprehensive data form just after independence of Bangladesh upto latest available data. The data are obtained from World Bank's World Development Indicators 2014 database.

Empirical Methodology

In this study, the Toda-Yamamoto procedure of Granger causality (Toda & Yamamoto, 1995) has been used. It requires the estimation of an augmented VAR irrespective of whether the time series is integrated or cointegrated. It fits a standard vector autoregressive (VAR) model in the levels of the variables (rather than the first differences, as the case with Granger causality tests) thereby minimizing the risks associated with the possibility of wrongly identifying the order of integration of the series (Mavrotas & Kelly, 2001). The procedure overcomes the problem of invalid asymptotic critical values when causality tests are performed in the presence of nonstationary series or even cointegrated.

In case of Toda-Yamamoto procedure, a Modified Wald (MWALD) test for restrictions on the parameters of the VAR (p) model has been employed where p is the optimal lag length of the VAR model. This test has an asymptotic chi-squared distribution with p degrees of freedom in the limit when a VAR [$p + d_{max}$] is estimated (where d_{max} is the maximal order of integration for the series in the system). Three stages are involved with implementing the procedure. The first stage is to test each of the time-series to determine the maximum order of integration d_{max} of the variables in the system by using tests, such as Augmented Dickey-Fuller (ADF) test (Dickey & Fuller, 1979), Phillips-Perron (PP) test (Phillips & Perron, 1988) and Kwiatkowski, Phillips, Schmidt and Shin (KPSS) test (Kwiatkowski, Phillips, Schmidt & Shin, 1992). The second stage includes the determination of the lag length (p). The lag length (p) is obtained in the process of the VAR in levels among the variables in the system by using different lag length criterion such as the LR test statistic, Akaike information criterion (AIC), Schwarz information criterion (SC), Final prediction error (FPE) and Hannan-Quinn (HQ) Information Criterion. In order to scrutinize the authenticity of the optimal lag length chosen by using LR test statistic, AIC, SC,

FPE and Hannan-Quinn (HQ) Information Criterion, the Lagrange Multiplier (LM) test on the residuals for serial independence has been applied. In third stage, the modified Wald procedure has been used to test the VAR (k) model for causality. The optimal lag length is equal to $k = (p + d_{max})$.

In the present study, the Toda and Yamamoto augmented Granger causality test has been obtained by estimating the following VAR model:

$$FDIP_t = \alpha_1 + \sum_{i=1}^{p+d_{max}} \beta_{1i} FDIP_{t-i} + \sum_{i=1}^{p+d_{max}} \lambda_{1i} GDPGR_{t-i} + \varepsilon_{1t} \quad (1)$$

$$GDPGR_t = \alpha_2 + \sum_{i=1}^{p+d_{max}} \beta_{2i} FDIP_{t-i} + \sum_{i=1}^{p+d_{max}} \lambda_{2i} GDPGR_{t-i} + \varepsilon_{2t} \quad (2)$$

Where, $FDIP_t$ = FDI net inflows as percentage of GDP at time t

$GDPGR_t$ = GDP growth (annual %) at time t

In equations (1) and (2), there is causality from gross domestic product (GDP) growth rate to FDI if null hypothesis H_o: $\lambda_{11} = \lambda_{12} = \ldots\ldots\ldots = \lambda_{1p} \neq 0$. Likewise, there is causality from FDI to gross domestic product (GDP) growth rate if null hypothesis H_o: $\beta_{21} = \beta_{22} = \ldots\ldots\ldots = \beta_{2p} \neq 0$.

Findings of the study

Initially, the properties of the time series have been examined to find out the presence of stationarity. This task is accomplished by using three most widely used tests i.e. ADF (Augmented Dickey- Fuller), PP (Phillips Perron) and KPSS unit root test.

(*Insert Table 2 here*)

The ADF unit root test (Table II) shows that variable such as FDIP is non-stationary at level but stationary at first differences, being integrated of order one, I(1). On the other hand, variable such as GDPGR is stationary at level, being integrated of order zero, I(0). Therefore, the maximum order of integration for the variables in the system under ADF unit root test is one, $d_{max}=1$.

(*Insert Table 3 here*)

The PP unit root test (Table III) shows that variable such as FDIP is non-stationary at level but stationary at first differences, being integrated of order one, I(1). On the other hand, variable such as GDPGR is stationary at level, being integrated of order zero, I(0).

Therefore, the maximum order of integration for the variables in the system under PP unit root test is one, $d_{max}=1$.

(*Insert Table 4 here*)

The KPSS unit root test (Table IV) shows that variable such as FDIP is non-stationary at level but stationary at first differences, being integrated of order one, I(1). On the other hand, variable such as GDPGR is stationary at level, being integrated of order zero, I(0). Therefore, the maximum order of integration for the variables in the system under KPSS unit root test is one, $d_{max}=1$.

In sum, several unit root tests (ADF, PP, KPSS) confirms that maximum order of integration for the variables in the system is one, $d_{max}=1$.

Next step in testing for causality is to investigate the optimum lag length (p) chosen by LR, AIC, FPE, SC and HQ. Table V reports the optimal lag length of one (p=1) as selected by AIC, FPE, SC and HQ.

(*Insert Table 5 here*)

Also, lag length chosen by AIC, FPE, SC and HQ criterion has been insured by running VAR Residual Serial Correlation Lagrange Multiplier (LM) test for testing the hypothesis of "no residual serial correlation".

(*Insert Table 6 here*)

In Table VI, the VAR Residual serial correlation LM test confirms that at the lag order of 1 there is no existence of residual serial correlation in the VAR model. At this level, the VAR is found to be dynamically stable.

Finally, the empirical results of Granger Causality test based on Toda and Yamamoto methodology is estimated through MWALD test and presented in Table VII. The estimates of MWALD test indicate that the test result follows the chi-square distribution with 1 degree of freedom in accordance with the appropriate lag length along with their associated probability.

To estimate the Toda and Yamamoto version of the Granger non-causality test for VAR(2), ($d_{max}=1$ and p=1), the following system equations has been estimated:

$$FDIP_t = \alpha_1 + \sum_{i=1}^{2} \beta_{1i} FDIP_{t-i} + \sum_{i=1}^{2} \lambda_{1i} GDPGR_{t-i} + \varepsilon_{1t} \quad (a)$$

$$GDPGR_t = \alpha_2 + \sum_{i=1}^{2} \beta_{2i} FDIP_{t-i} + \sum_{i=1}^{2} \lambda_{2i} GDPGR_{t-i} + \varepsilon_{2t} \quad (b)$$

Here, we have conducted the Toda and Yamamoto Granger causality test using a modified Wald (MWald) test to verify if the coefficients λ_{11} and β_{21} of the lagged variables are significantly different from zero in the respective equations *(a)* and *(b)*.

(*Insert Table 7 here*)

The results (in Table VII) show that we cannot reject the null hypothesis that GDP growth rate does not cause FDI at 5% level of significance in favor of alternative hypothesis that GDP growth rate does cause FDI. But, the null hypothesis that FDI does not cause GDP growth rate is rejected at 5% level of significance in favor of alternative hypothesis that FDI does cause GDP growth rate. Thus, we can conclude that there is unidirectional causality running from FDI to GDP growth rate (FDIP $\Rightarrow$ GDPGR). The empirical results are consistent with the findings of Khatun and Ahamad (2013), Frimpong and Oteng-Abayie (2006), Kundan and Qingliang (2010).

Conclusions

In the present study, we have investigated the nature and the direction of causality between FDI net inflows as percentage of GDP and GDP growth rate of Bangladesh by using annual data for the period of 1972-2013. A modified version of the Granger causality test proposed by Toda and Yamamoto (1995) is applied for testing the causality between the variables. The empirical results explore that there is unidirectional causality from FDI to GDP growth rate of Bangladesh for the mentioned time period which points out the evidence of FDI-led growth in Bangladesh. To enjoy the best benefits of FDI, policymakers have to focus on eradicating different obstacles such as political instability, poor infrastructure, lack of accountability, delay in decision making, inefficiency of human resources, widespread corruption, lack of good governance etc. A favorable business environment in Bangladesh may provide better incentive to attract more FDI inflows which may in turn benefit the country's overall economy.

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Table 1: Inflows of Foreign Direct Investment (FDI) in Bangladesh

Period (FY)	Amount (million US$)	Growth
2001-02	393.76	-
2002-03	379.18	(3.70%)
2003-04	284.16	(25.06%)
2004-05	803.78	182.86%
2005-06	744.61	(7.36%)
2006-07	792.74	6.46%
2007-08	768.69	(3.03%)
2008-09	960.59	24.96%
2009-10	913.02	(4.95%)
2010-11	779.04	(14.67%)
2011-12	1194.88	53.38%
2012-13	1730.63	44.84%
2013-14*	346.07	-

*up to December, 2013

Source: Bangladesh Bank, 2014

Table 2: ADF unit root test

Variables	ADF Test			
	Intercept		Trend and Intercept	
	Level	1st difference	Level	1st difference
FDIP	-0.871705	-6.425503**	-2.488119	-6.420956**
GDPGR	-6.645219**	-4.608858***	-12.58331**	-4.451072***

** and *** denote the rejection of null hypothesis that the time series is non-stationary with 5% and 10% significance levels respectively

Table 3: Phillips-Perron (PP) unit root test

Variables	PP Test			
	Intercept		Trend and Intercept	
	Level	1st difference	Level	1st difference
FDIP	-0.508379	-7.083745**	-2.453520	-7.866963**
GDPGR	-10.47402***	-34.96731**	-46.39681**	-38.56727**

** and *** denote the rejection of null hypothesis that the time series is non-stationary with 5% and 10% significance levels respectively

Table 4: KPSS unit root test

Variables	KPSS Test			
	Intercept		Trend and Intercept	
	Level	1st difference	Level	1st difference
FDIP	0.653528	0.251423**	0.210159	0.102882**
GDPGR	0.751783	0.251491**	0.055242**	0.112125***

** and *** denote the non-rejection/acceptance of null hypothesis that the time series is stationary with 5% and 10% significance levels respectively

Table 5: Lag Length Selection

Lag	LR	FPE	AIC	SC	HQ
0	NA	0.194366	4.037706	4.127492	4.068326
1	54.55641	**0.042353***	**2.513116***	**2.782474***	**2.604975***
2	1.465067	0.051121	2.697891	3.146820	2.850988
3	2.144529	0.060202	2.853758	3.482259	3.068095
4	6.334205	0.059950	2.835684	3.643757	3.111260
5	**11.60529***	0.046834	2.566400	3.554045	2.903215
6	2.146591	0.055330	2.699476	3.866692	3.097530
7	4.540570	0.057850	2.695792	4.042581	3.155086
8	4.484976	0.060129	2.667264	4.193625	3.187797

*indicates lag order selected by the criterion

Table 6: VAR Residual Serial Correlation LM Test

Lags	LM-Stat	Prob.
1	**9.426386**	**0.0513**
2	2.433743	0.6565
3	2.552573	0.6352
4	4.847720	0.3033
5	3.703969	0.4475
6	4.358764	0.3596
7	3.977533	0.4091
8	7.419539	0.1153
9	1.978474	0.7397
10	3.676862	0.4515
11	0.657665	0.9564
12	2.077204	0.7216

Table 7: Toda-Yamamoto Tests of Granger Causality

Null Hypothesis	χ^2 **value**	**p-values**	**Decision**
GDPGR does not Granger cause FDIP	0.136804	0.7115	cannot reject H_o
FDIP does not Granger cause GDPGR	5.063338	0.0244	**reject H_o***

* denotes rejection of null hypothesis at 5% level of significance

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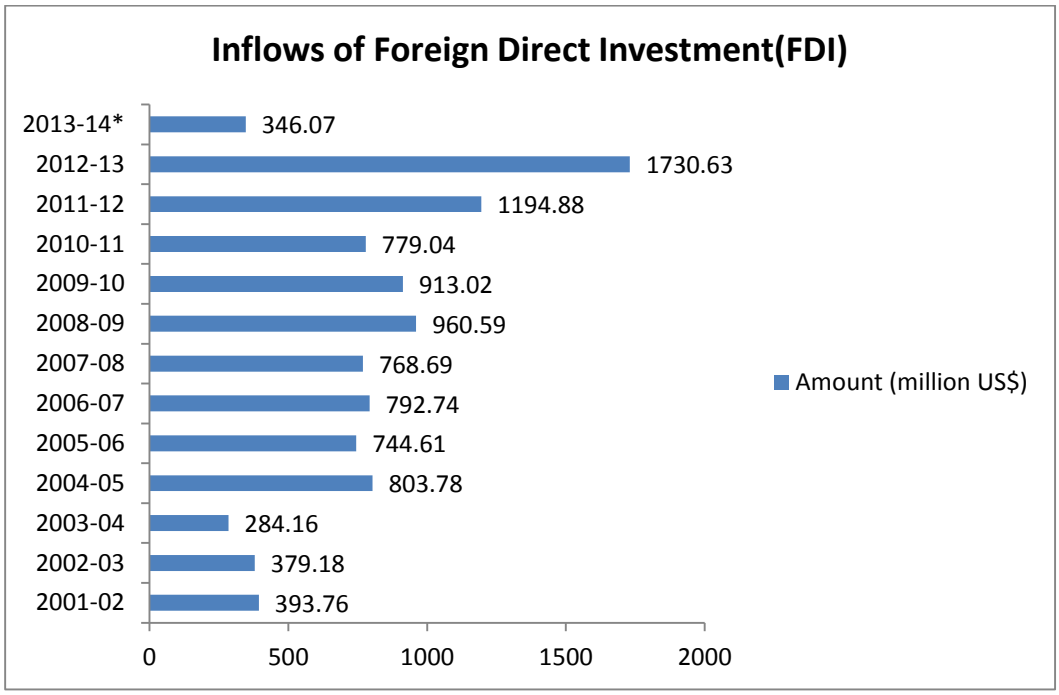
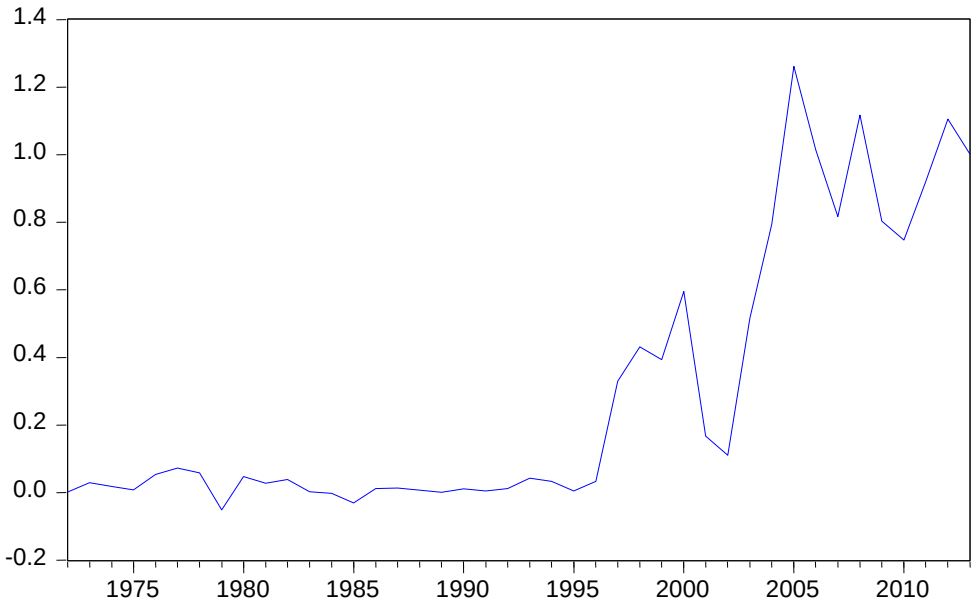


*up to December, 2013
Source: Bangladesh Bank, 2014

Fig 1: Inflows of Foreign Direct Investment (FDI) in Bangladesh



Source: World Development Indicators, 2014

Fig. 2: FDI net inflows in Bangladesh (% of GDP) (1972-2013)