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The impact of foreign direct investment on the economy of Bangladesh: A time-series analysis

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Abstract. *This paper aims to discover the relationship between FDI and GDP in the context of Bangladesh. Using annual data of FDI, GDP, and export for the period of thirty-three years from 1986 to 2018, the paper finds that above three variables are non-stationary at level but stationary at first difference. No cointegration among three variables is found through the application of the cointegration test. The Granger-causality test reveals that there are no causalities among the variables except a causality running from FDI to GDP. The variance decomposition exhibits that the forecast error variance of GDP is mainly explained by itself and FDI. A negative relationship between FDI and GDP in the short-run is observed by the impulse response function. This finding indicates that the absorptive capacity of Bangladesh is not sufficient enough to avail the FDI for promoting economic growth. The paper renders some policy recommendations to ameliorate the absorptive capacity of Bangladesh to exploit the FDI.*

Keywords: gross domestic product, foreign direct investment, vector autoregressive, granger-causality test, variance decomposition, impulse response function.

JEL Classification: O11, R15.

1. Introduction

The economy of Bangladesh has been doing well for the last decade. Now, all macroeconomic variables are at their best but the population is growing disproportionately as compared to the recent economic success. According to the World Bank (WB) database, 1239.579 people lived per square kilometer in Bangladesh in 2018 that was approximately 34 times higher than the population density of the United States. Therefore, Bangladesh must find a way to boost its economy to meet the growing population's needs. Foreign Direct Investment (FDI) can be an agent to achieve the growth needed, but scholars have different views regarding the impact of FDI on Gross Domestic Product (GDP) growth. There are three main views about the impact of FDI on GDP growth. Some scholars argue that FDI has a positive impact on GDP growth, but some claim that FDI and GDP growth are negatively related. Other scholars found that the impact of FDI on GDP growth depends on the absorptive ability of the host economy.

The neoclassical theory indicates that the capital-scarce countries can achieve rapid growth by FDI inflow (Barro et al., 1992). Reza et al. (2018) argue that the investment insufficiency of LDCs can be adjusted by FDI from private and public sectors. Hussain and Haque (2016) share the same view. Kim and Seo (2003) claim that FDI improves human capital and technology of the host country. FDI also promotes GDP growth by improving technology and organizational form, providing spillovers to the enterprises of the recipient country, enhancing the human capital formation, transferring knowledge, making international trade integration and creating business more competitive (Haile et al., 2006; Borensztein et al., 1998, pp. 115-135; Tabassum et al., 2014, pp. 117-135; Al-Iriani, 2007; De Mello, 1999, pp. 133-151).

However, Singer (1975, pp. 43-57) claims that FDI inflow leaves some harmful effects on the host country that leads to uneven development in the world. The balance of payment (BOP) of the recipient country can also be at risk because of the expatriation of profits by the parent country (Kentor, 1998, pp. 1024-1046). Epstein and Braunstein (2002) argue that FDI is not an agent of growth rather it provides a detrimental effect on the GDP growth by crowding out the domestic investment. However, Sylwester (2005, pp. 289-300) contrarily claims that FDI is complementary to domestic investment.

Disagreeing with others, Balasubramanyam et al. (1996, pp. 92-105) and Bengoa et al. (2003, pp. 529-545) argue that the impact of FDI on GDP growth depends on the absorptive ability of the recipient country.

The effects of FDI on the GDP is ambiguous. FDI in some countries boosts economic growth by mitigating the resource gap, improving the human capital formation, enhancing the technologies of the recipient country, etc. However, it negatively affects some economies by expatriating the profits from the host country, increasing the import, and substituting the domestic investment. To check the effects of the FDI on the Bangladeshi economy, this paper attempts to empirically investigate the relationship between GDP and FDI. The findings of this paper will help the policymakers formulate policies that avail the FDI for hitting the growth target required to meet the demands of the increasing population of Bangladesh.

The sequence of the rest of this paper is as follows: Section 2 summarizes the previous theoretical and empirical studies related to the impacts of FDI on GDP growth. Section 3 sheds light on the methodology and specification of the model. Section 4 discusses the results. Finally, Section 5 concludes.

2. Literature review

This section comprises three parts. The first part summarizes the theoretical and empirical studies that found positive effects of FDI on an economy. The papers that found a negative relationship or no relationship between FDI and the GDP of an economy are recapitulated in the second part. The final part recaps the papers that concluded that the impact of FDI inflow on GDP growth depends on the absorptive ability of the economy.

Firstly, Modernization theory states that FDI leaves a positive effect on GDP by filling the resource gap, transferring knowledge, improving technologies and managerial skills, providing ideas, and supplying resources to build infrastructures in the host country (Firebaugh, 1992, pp. 105-130; De Mello, 1999, pp. 133-151; Romer, 1993, pp. 543-573; Mengistu et al., 2007).

Reza et al. (2018) tested the co-integration and Vector Error Correction Metrics (VECM) in their paper and found a positive relation between FDI inflow and GDP of Bangladesh in the short run and the long run. A VAR system including the error correction model was run using Chinese annual data from 1978 to 2003 to test causalities among FDI, domestic investment (DI), and GDP. The paper found that FDI complements DI and there is a single directional causality from FDI to GDP (Tang et al., 2008, pp. 1292-1309). Agosin and Mayer (2005, pp. 149-162) also found that FDI and DI are complementary to each other. A comparative study between India and China shows that FDI has positive effects on both countries, but the effects of FDI on the Chinese economy are more robust than the effects of FDI on the Indian economy (Agrawal et al., 2011). Baliamoune-Lutz (2004, pp. 49-57) argues that FDI positively influences GDP through enhancing exports. Zhang (2005, pp. 25-26) agreeing with Baliamoune (2004) claims that FDI leaves a positive effect on GDP growth by increasing the export volume of China.

Secondly, the dependency theory says that FDI negatively influences GDP growth through repatriation of profit from the host country (Brecher et al., 1977, pp. 317-322). This claim is backed by Dutt (1997, pp. 1925-1936). Rahman (2015, pp. 178-185) found a statistically insignificant positive correlation between FDI and the GDP of Bangladesh. The paper also found a positive correlation between FDI and inflation and a negative correlation between FDI and trade balance with a high level of statistical significance. A similar conclusion was drawn by Tabassum et al. (2014, pp. 117-135). Bornschier and Chase (1985) found that FDI causes crowding out of DI and creates a monopoly power for the firms of the parent country. This result is supported by Epstein and Braunstein (2002). Domestic capital is crowded out and even outflowed by FDI that affects the current account and foreign exchange account of the recipient country (Quazi, 2004, pp. 370-393; Eller et al., 2005). The intermediate goods and heavy machinery for foreign-financed companies are imported from the parent country that deteriorates the trade balance (TB) of the host country (Rahman, 2008).

Finally, Buckley et al. (2002, pp. 637-655) argue in favor of the third view that the absorptive ability of the economy is the deciding factor of the relationship between FDI inflow and GDP growth. They claim that the economic, political, and social conditions decide the impact of FDI on GDP. Toulaboe et al. (2009, pp. 155-169) in their comparative analysis of low-income and middle-income countries found that FDI is more effective for advanced countries than the least advanced countries. It means that FDI is more positively responsive to countries that have more absorptive capacity. FDI leaves a positive impact on GDP only if the host country has a fair amount of skilled labor force and developed technologies (Borensztein et al., 1998, pp. 115-135).

The existing literature shows that the FDI and GDP nexus is not categorical. From the theoretical end, the relationship between them depends on the different theories such as modernization theory or dependency theory. From the empirical perspective, it relies on the period of data taken, the variables for the model chosen, the countries investigated and the statistical techniques adopted.

3. Methodology and model specification

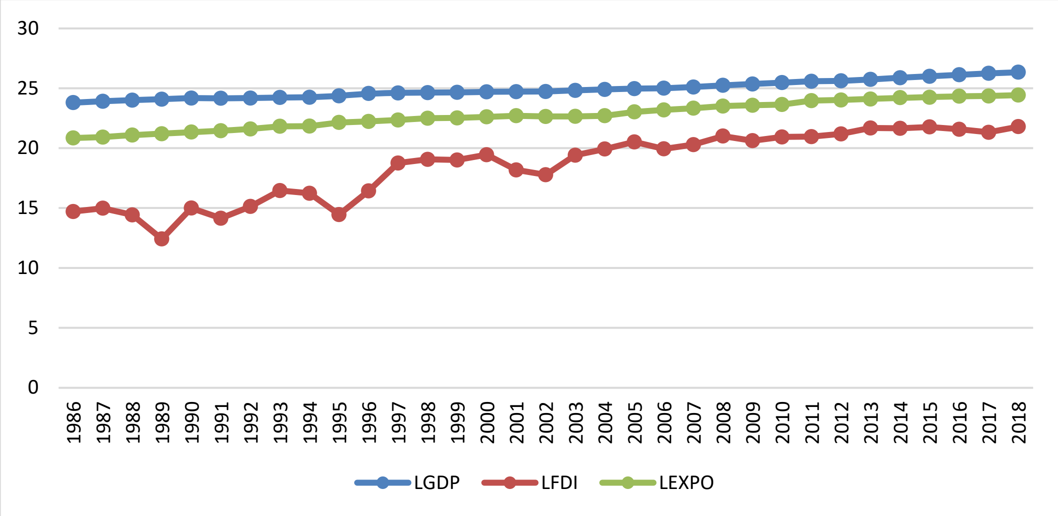
3.1. Methodology and data

Since this paper aims to find the dynamic relationship between FDI and GDP, quantitative data will be used to meet that end. As it is not possible to collect the primary data on the FDI, Export (EXPO), and GDP, this paper uses secondary annual data for the period of thirty-three years from 1986 to 2018. The data of the above three variables are collected from the World Development Indicator published by the World Bank (WB) and converted from Taka (Bangladeshi currency) to the US current dollar by adjusting the exchange rate of the respective year. Some other data are sourced from the Bangladesh Bank (BB) and World Bank (WB) to analyze some phenomena comparatively. Furthermore, the above variables are transformed into the natural logarithmic form. FDI contains negative values before 1986. These negative values do not allow the FDI to be transformed into the natural logarithmic form. Therefore, the period from 1986 to 2018 is selected for this study. Changing to logarithmic form has some benefits: one benefit is that it helps mitigate the heteroscedasticity problem (He et al., 2012, pp. 507-512), another is that it renders the skewed data less skewed, another is that it makes the interpretation easy, and the other is that it reduces the fluctuations in the data. All three variables are shown in the following figure to observe the nature of the data.

The graph shows that all three variables exhibit an upward trend. Though there are some fluctuations in the LFDI, the other two variables display approximately a smooth upward trend.

It is worth noting that the above three variables were used by Ozkan et al. (2018) in their study of the relationship of the Ethiopian economic growth to foreign direct investment and export.

Figure 1. *The natural logarithmic form of Gross Domestic Product (LGDP), Foreign Direct Investment (LFDI), and Export (LEXPO)*



3.2. Model specification

One should be cautious in specifying a model in the time-series framework because it may provide spurious results (Granger et al., 1974, pp. 557-561). This paper employs the appropriate model depending on the results of the unit root test to eliminate the possibility of a spurious result.

3.2.a. Unit root tests

A time series is said to be stationary if its variance and mean are constant in the course of time. And covariance between any two observations of a series relies on the time-gap between these two observations, not on the whole time series (Hill et al., 2018). The null and alternative hypotheses of the unit root test are as follows:

H_0: The series has a unit root (It means that the series is not stationary).

H_a: The series does not contain any unit root (It means that the series is stationary).

The criterion to accept or reject the null hypothesis is that if the absolute value of the test statistic is greater than the absolute value of the critical value, then the null hypothesis will be rejected. Otherwise, the null hypothesis cannot be rejected. There are few tools to test the stationarity of a time series such as the Dickey-Fuller (DF) test, Augmented Dickey-Fuller (ADF) test, Phillips-Perron (PP) test etc. DF test does guarantee that there is no serial correlation in the error term; however, the ADF test allows enough number of lag terms so that the time-series does not suffer from autocorrelation (Hill et al., 2018). Furthermore, the PP test provides a more reliable result than that of ADF when the time series has a structural break (Hussain et al., 2016). This paper uses only the ADF and PP tests to check the stationarity of the variables. Schwarz Information Criterion (SIC) with a maximum of 6 legs is used to select the optimum legs for the ADF test. And this paper explores the stationarity of the variables with drift and with drift and trend only. This is because the Figure 1 exhibits an upward trend in all three variables.

Table 1. *ADF and PP Tests at level*

Variables	ADF		PP	
	With drift	With drift and trend	With drift	With drift and trend
LGDP	[2.085484] (0.9998)	[-0.061910] (0.9934)	[1.806623] (0.9996)	[-0.333407] (0.9859)
LFDI	[-1.013992] (0.7352)	[-3.009513] (0.1458)	[-0.847769] (0.7915)	[-3.145150] (0.1135)
LEXPO	[-1.077220] (0.7125)	[-1.969027] (0.5954)	[-1.115132] (0.6975)	[-2.152240] (0.4986)

[ ] indicates the ADF and PP test statistics.
( ) represents the probability value.
***, **, and * mean significant at 1%, 5%, and 10% respectively.

Table 2. *ADF and PP Tests at first difference*

Variables	ADF		PP	
	With drift	With drift and trend	With drift	With drift and trend
LGDP	[-3.566114] ** (0.0126)	[-4.097555] ** (0.0002)	[-3.603009] ** (0.0115)	[-3.958606] ** (0.0212)
LFDI	[-5.569246] *** (0.0001)	[--6.388783] *** (0.0001)	[-8.665165] *** (0.0000)	[-9.201619] *** (0.0000)
LEXPO	[-5.893661] *** (0.0000)	[-6.020946] *** (0.0001)	[-5.884598] *** (0.0000)	[-6.007434] *** (0.0001)

[ ] indicates the ADF and PP test statistics.
( ) represents the probability value.
***, **, and * mean significant at 1%, 5%, and 10% respectively.

Table 1 indicates that all variables both with drift and with drift and trend are not stationary at 5% significance both in the ADF test and PP test.

Table 2 shows that the null hypothesis of unit root can be rejected at 5% significance by both the ADF and PP tests for all variables with drift and with drift and trend. This means that all variables are non-stationary at level but stationary at first difference.

Since all variables are stationary at the first difference (I(1)), the cointegration among the variables is checked as recommended by Hill et al. (2018). However, the optimal leg length should be selected before investigating the cointegration among the variables since the result of the cointegration test is sensitive to the leg length.

3.2.b. Optimal leg length selection

Table 3. *VAR lag order selection criteria*

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-68.33088	NA	0.020009	4.601992	4.740765	4.647229
1	52.25400	210.0511*	1.50e-05	-2.597032	-2.041940*	-2.416086*
2	61.89955	14.93505	1.47e-05*	-2.638681*	-1.667270	-2.322025

* indicates lag order selected by the criterion.
LR: sequential modified LR test statistic (each test at 5% level).
FPE: Final Prediction Error.
AIC: Akaike Information Criterion.
SC: Schwarz information Criterion.
HQ: Hannan-Quinn information criterion.

Though different leg length criteria show different optimal leg lengths, the leg length of 2 is selected as the optimal leg length according to the suggestion of the FPE and AIC. The optimal lag of '2' supports the suggestion given by Johansen and Juselius (1990, pp. 169-210). They argue that it is good not to choose more than two lags for the small sample size to find a compact result.

3.2.c. Cointegration test

Cointegration means that some non-stationary time-series that are away from the equilibrium can correspond in such a way that the forces of equilibrium work to assure that these series do not part too far away from the equilibrium (Nkoro et al., 2016, pp. 63-91). There are some tests to detect the cointegration among the time-series such as Engle and Granger (1987, pp. 251-276) test, the Bound test under the Autoregressive-Distributed Lag (ARDL) framework, Johansen Cointegration test, etc. Among these techniques to find cointegration, this paper employs the Johansen Cointegration test including the optimal leg of '2' as suggested by the FPE and AIC. Since this paper engages three variables, the Johansen Cointegration test creates three hypotheses. These hypotheses are as follows:

Hypothesis 1 (the first rank)

H_0: There is no cointegration equation.

H_a: There is at least one cointegration equation.

Hypothesis 2 (the second rank)

H_0: There is no more than one cointegration equation.

H_a: There are at least two cointegration equations.

Hypothesis 3 (the third rank)

H_0: There are no more than two cointegration equations.

H_a: There are at least three cointegration equations.

The criterion to accept or reject the null hypothesis is that if the Max-Eigen and Trace statistics are greater than the critical value, then the null hypothesis can be rejected. Otherwise, the null hypothesis cannot be rejected.

Table 4. *Johansen cointegration test*

Unrestricted Cointegration Rank Test (Trace)				
Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.483044	25.79744	29.79707	0.1349
At most 1	0.176458	6.003487	15.49471	0.6951
At most 2	0.005957	0.179253	3.841465	0.6720

Trace test indicates no cointegration at the 0.05 level.
* denotes rejection of the hypothesis at the 0.05 level.
**MacKinnon-Haug-Michelis (1999) p-values.

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None	0.483044	19.79395	21.13162	0.0761
At most 1	0.176458	5.824233	14.26460	0.6359
At most 2	0.005957	0.179253	3.841465	0.6720

Since the values of the Max-Eigen and Trace statistics in the first, second, and third ranks are not greater than their corresponding critical values, the null hypothesis of no cointegration cannot be rejected. This means that there is no cointegration equation at 5% significance. However, the Max-Eigenvalue test, in contrast to the result of the Trace statistic, shows that the null hypothesis (hypothesis-1) of no cointegration can be rejected at 10% significance. Serletis et al. (1997, pp. 44-57) recommend Trace statistic to consider when Trace statistic and Max-Eigenvalue statistic provide a contradictory result because Trace statistic takes all of the smallest Eigenvalues into account. Johansen and Juselius (1990, pp. 169-210) also advise prioritizing Trace statistic over the Max-Eigen statistic. Therefore, the conclusion of no cointegration is reached considering the suggestions of Serletis et al. (1997, pp. 44-57) and Johansen and Juselius (1990, pp. 169-210).

Since all variables have one order of integration (I(1)), and they are not cointegrated, this paper uses the Vector Autoregressive (VAR) model to check the dynamic relationship between the FDI and GDP. This paper adopts the Vector Autoregressive (VAR (p)) model as proposed by Lütkepohl (2005).

3.2.d. Developing the Vector Autoregressive (VAR (p)) model with ‘n’ dimension

$$Z_t = a + X_1 Z_{t-1} + \cdots + X_p Z_{t-p} + \omega_t.$$

Where the dimensions of Z_t, a, X, and ω_t vectors are [n × 1], [n × 1], [n × n], and [n × 1] respectively. ‘Z_t’ is the vector of endogenous variables, and ‘p’ is the number of legs. ‘a’ is the vector of intercepts. ‘X’ is the coefficient matrix. And ‘ω_t’ is the vector of white noise. It is worth noting that in the VAR system, there are no exogenous variables. All variables are considered endogenous variables.

A VAR (2) model is formulated from the VAR (p). ‘p’ is equal to ‘2’ since the optimal leg length is ‘2’ as suggested by the FPE and AIC. Since the optimal leg length is ‘2’, the dimension of the coefficient matrices changes from [n × n] to [n × pn].

$$\Delta LGDP_t = a_1 + \gamma_{11}\Delta LGDP_{t-1} + \gamma_{12}\Delta LGDP_{t-2} + \gamma_{13}\Delta LFDI_{t-1} + \gamma_{14}\Delta LFDI_{t-2} + \gamma_{15}\Delta LEXPO_{t-1} + \gamma_{16}\Delta LEXPO_{t-2} + \omega_{1t} \quad (1)$$

$$\Delta LFDI_t = a_2 + \gamma_{21}\Delta LGDP_{t-1} + \gamma_{22}\Delta LGDP_{t-2} + \gamma_{23}\Delta LFDI_{t-1} + \gamma_{24}\Delta LFDI_{t-2} + \gamma_{25}\Delta LEXPO_{t-1} + \gamma_{26}\Delta LEXPO_{t-2} + \omega_{2t} \quad (2)$$

$$\Delta LEXPO_t = a_3 + \gamma_{31}\Delta LGDP_{t-1} + \gamma_{32}\Delta LGDP_{t-2} + \gamma_{33}\Delta LFDI_{t-1} + \gamma_{34}\Delta LFDI_{t-2} + \gamma_{35}\Delta LEXPO_{t-1} + \gamma_{36}\Delta LEXPO_{t-2} + \omega_{3t} \quad (3)$$

Where $\Delta LGDP_t$, $\Delta LFDI_t$, and $\Delta LEXPO_t$ are the endogenous variables. a_1, a_2, and a_3 are the intercept terms. $\gamma_{3\times6}$ is the coefficient matrix. ω_{1t}, ω_{2t}, and ω_{3t} are the error terms. These three equations are regressed by using the Ordinary least Square (OLS) below.

4. Results and discussion

In this section, the equations (1), (2), and (3) are estimated, and some diagnostic tests are run to check the goodness of fit and stability of the model. The Impulse Response Function (IRF), Variance Decomposition (VD), and Granger Causality are determined to find the dynamic relationship between the FDI and GDP.

4.1. Vector Autoregressive (VAR) model

There is an ongoing debate among scholars whether the VAR model should be estimated at level (using non-stationary variables) or at the first difference (using stationary variables). The scholars who are in favor of using non-stationary variables argue that the IRF of non-stationary variables provides a good dynamic relationship among the variables. However, the scholars who are staunch supporters of using stationary variables claim that the non-stationary variables may render spurious results. This paper estimates the VAR by taking the first difference (using the stationary variables) as suggested by Hill et al. (2018).

Table 5. *Estimation of the Vector Autoregressive (VAR (2))*

	D(LGDP)	D(LFDI)	D(LEXPO)
D(LGDP(-1))	0.701689	3.204638	0.021085
	(0.21050)	(5.63202)	(0.52484)
	[3.33347]	[0.56900]	[0.04018]
D(LGDP(-2))	-0.223244	-2.221293	-0.018011
	(0.19267)	(5.15491)	(0.48037)
	[-1.15871]	[-0.43091]	[-0.03749]
D(LFDI(-1))	-0.024755	-0.217208	0.010530
	(0.00726)	(0.19423)	(0.01810)
	[-3.41016]	[-1.11831]	[0.58176]
D(LFDI(-2))	0.008850	-0.215904	0.011109
	(0.00940)	(0.25143)	(0.02343)
	[0.94173]	[-0.85870]	[0.47414]
D(LEXPO(-1))	-0.123520	-0.605429	-0.083311
	(0.08512)	(2.27752)	(0.21224)
	[-1.45108]	[-0.26583]	[-0.39254]
D(LEXPO(-2))	0.055882	2.343989	0.088549
	(0.08769)	(2.34623)	(0.21864)
	[0.63726]	[0.99904]	[0.40500]
C	0.051377	0.060916	0.105437
	(0.02094)	(0.56038)	(0.05222)
	[2.45298]	[0.10870]	[2.01906]
R-squared	0.505477	0.170383	0.036798
Adj. R-squared	0.376471	-0.046038	-0.214472
F-statistic	3.918240	0.787274	0.146448

Since the coefficient-wise explanation of the VAR model is discouraged, this paper investigates the FDI-growth nexus through the Granger Causality, VD, and IRF. Before doing this, the goodness of fit and stability of the model is checked through some diagnostic tests.

4.2. Diagnostic tests

4.2.a. Autocorrelation test

The non-existence of serial correlation in the residual defines the goodness of fit in the time-series analysis (Ozkan et al., 2018). The time series is said to be auto-correlated if the value of one residual can forecast the value of another residual (DINH, 2020, pp. 219-228). The autocorrelation in the residuals implies that some information is not considered in the model. This paper performs the Lagrange Multiplier (LM) test to check the autocorrelation of the residuals. An advantage of this test is that it includes more than one leg and. The null and alternative hypotheses are as follows:

H_0: There is no serial correlation in the residuals.

H_a: The residuals are serially correlated.

Table 6. *Lagrange Multiplier (LM) Test*

Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	12.38531	9	0.1924	1.456447	(9, 44.0)	0.1944
2	13.19058	9	0.1542	1.564954	(9, 44.0)	0.1560

The Lagrange Multiplier (LM) test cannot reject the null hypothesis of no serial correlation among the residuals, even at a 10 percent p-value. This means that the residuals are not serially correlated.

4.2.b. Heteroskedasticity test

Checking for the constant variance of the residuals is also essential to evaluate the goodness of a model. This paper uses the White Heteroskedasticity test to check the constant variance of the residuals. This test has two advantages over other tests: one is that it is not sensitive to the normality assumption of the residuals, and the other is that it is easy to perform (Gujarati et al., 2012). The null and alternative hypotheses are as follows:

H_0: Homoskedasticity.

H_a: Heteroskedastic.

Table 7. *VAR Residual Heteroskedasticity Tests (Levels and Squares)*

Joint test:		
Chi-sq	df	Prob.
72.84843	72	0.4499

The White heteroskedasticity test cannot reject the null hypothesis of homoskedasticity, even at a 10 percent p-value. It means that the residuals of the model are free from the heteroskedasticity problem.

4.2.c. Normality tests

There are some tests to check the normality of the residuals such as the normal probability plot (NPP), histogram of residuals, Jarque-Bera test, etc. The Jarque-Bera test has an advantage because it includes Skewness and Kurtosis. It also has a disadvantage because it is more appropriate for the large sample size. This paper runs the Jarque-Bera tests to check the normality of the residuals. The null and alternative hypotheses are as follows:

H_0: The residuals are multivariate normal.

H_a: The residuals are not multivariate normal.

Table 8. *VAR Residual Normality Tests*

Orthogonalization: Cholesky (Lutkepohl)				
Component	Skewness	Chi-sq	df	Prob.*
1	-0.053522	0.014323	1	0.9047
2	-0.356243	0.634545	1	0.4257
3	0.934878	4.369985	1	0.0366
Joint		5.018852	3	0.1704
Component	Kurtosis	Chi-sq	df	Prob.
1	2.299507	0.613363	1	0.4335
2	2.888562	0.015523	1	0.9008
3	3.317256	0.125814	1	0.7228
Joint		0.754700	3	0.8603
Component	Jarque-Bera	df	Prob.	
1	0.627686	2	0.7306	
2	0.650068	2	0.7225	
3	4.495799	2	0.1056	
Joint	5.773553	6	0.4490	

*Approximate p-values do not account for coefficient estimation.

The Table 8 reveals that the null hypothesis of the multivariate normality property of the residuals cannot be rejected, even at 10% significance. This denotes that the residuals are multivariate normal.

4.2.d. Stability test

The stability of the model is important for the IRF to be statistically credible. This paper performs the inverse roots of AR characteristic polynomial to check the stability of the model. If the Eigenvalues or all moduli lie within the unit circle, then the model is stable.

Figure 2. *The inverse roots of AR characteristic polynomial to test the stability of the model*

Inverse Roots of AR Characteristic Polynomial

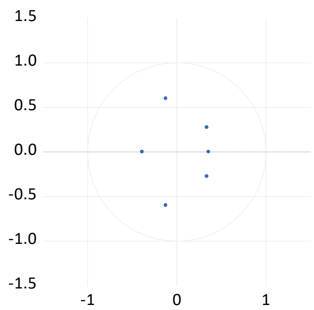


Figure 2 shows that each modulus is inside the unit circle meaning that the VAR model is stable. The stability of the VAR model implies that the IRF of this model is reliable.

4.3. Granger causality

This paper investigates the causalities among the variables through the VAR Granger Causality/Block Exogeneity Wald Tests. Granger states that the Granger-causality is running from one variable, let's say A, to another variable, let's say B if by using the past values of A, B can be predicted more accurately than forecasting B by only using its past values (Antwi et al., 2013, pp. 64-74). The null and alternative hypotheses are as follows:

H_0: There is no Granger-causality between the variables.

H_a: Granger-causality exists between the variables.

Table 9. *VAR Granger Causality/Block Exogeneity Wald Tests*

(a) Dependent variable: D(LGDP)			
Excluded	Chi-sq	df	Prob.
D(LFDI)	13.76396	2	0.0010
D(LEXPO)	2.568254	2	0.2769
All	15.64650	4	0.0035
(b) Dependent variable: D(LFDI)			
Excluded	Chi-sq	df	Prob.
D(LGDP)	0.337066	2	0.8449
D(LEXPO)	1.085289	2	0.5812
All	1.154015	4	0.8856
(c) Dependent variable: D(LEXPO)			
Excluded	Chi-sq	df	Prob.
D(LGDP)	0.001901	2	0.9991
D(LFDI)	0.492555	2	0.7817
All	0.586046	4	0.9646

Part (a) of Table 9 discloses that FDI Granger-causes the GDP at 1% significance. This implies that the past values of FDI contain information to predict the GDP. However, the null hypothesis, export does not Granger-cause the (GDP), cannot be rejected, even at 10% significance. This means that there is no causality running from export to GDP. The result of 'no causality running from export to GDP' does not align with the theoretical expectation.

In part (b) of Table 9, since the probability values of the individual and joint tests are higher than 0.10 or 10%, the null hypotheses cannot be rejected. This implies that GDP and export do not Granger-cause FDI.

Part (c) of Table 9 shows that there is no causality running from the GDP and FDI to the export sector.

This paper concludes that there is a one-way causality running from the FDI to the GDP.

4.4. Variance decomposition

Variance Decomposition (VD) dissects the total forecast error variance of a variable into portions that can be explained by its own shocks and the shocks of the other variables of the fitted VAR system (Hill et al., 2018). It checks the relative importance of the variables in the VAR system. The VD of FDI, GDP, and Export are explored below.

Table 10. *Variance decomposition*

(a) Variance Decomposition of D(LGDP):				
Period	S.E.	D(LGDP)	D(LFDI)	D(LEXPO)
1	0.040144	100.0000	0.000000	0.000000
2	0.055696	71.59921	23.81157	4.589220
3	0.056382	71.55258	23.96029	4.487136
4	0.056983	70.05848	24.83810	5.103417
5	0.056984	70.05653	24.83858	5.104895
6	0.057030	69.94873	24.91480	5.136467
7	0.057042	69.93190	24.93207	5.136036
8	0.057047	69.92005	24.94261	5.137339
9	0.057049	69.91513	24.94741	5.137459
10	0.057049	69.91441	24.94788	5.137707
(b) Variance Decomposition of D(LFDI):				
Period	S.E.	D(LGDP)	D(LFDI)	D(LEXPO)
1	1.074067	0.012357	99.98764	0.000000
2	1.106805	1.007395	98.71342	0.279187
3	1.156358	0.967851	95.61027	3.421877
4	1.171562	1.254645	95.34084	3.404514
5	1.174330	1.248859	95.28625	3.464890
6	1.177336	1.264365	95.25063	3.485004
7	1.177431	1.265959	95.23793	3.496112
8	1.177905	1.267099	95.23015	3.502752
9	1.177923	1.268008	95.22922	3.502772
10	1.177978	1.268023	95.22810	3.503873
(c) Variance Decomposition of D(LEXPO):				
Period	S.E.	D(LGDP)	D(LFDI)	D(LEXPO)
1	0.100090	6.633007	0.228279	93.13871
2	0.101011	6.526165	1.390797	92.08304
3	0.101762	6.546753	2.049472	91.40378
4	0.101875	6.538312	2.261196	91.20049
5	0.101909	6.534986	2.260414	91.20460
6	0.101937	6.535318	2.303533	91.16115
7	0.101937	6.535577	2.303939	91.16048
8	0.101940	6.535271	2.308255	91.15647
9	0.101940	6.535295	2.309061	91.15564
10	0.101941	6.535267	2.309363	91.15537

Cholesky Ordering: D(LGDP) D(LFDI) D(LEXPO).

In part (a) of Table 10, the VD of GDP gives a useful insight to achieve the objective of this paper; therefore, this paper emphasizes the VD of GDP. In the first period, 100% forecast error variance of GDP is explained by its own shocks. From the second to tenth period, approximately 70% of the forecast error variance of GDP is explained by its own innovations. In the first period, shocks of FDI and export do not explain the variation in the GDP. However, from the second to tenth period, approximately 25% forecast error variance is explained by the shocks of the FDI and approximately 5% by the shocks of the export. Thus, the variance decomposition of GDP implies that the GDP has relative importance over FDI and export in explaining its own variations. And FDI has relative importance over export in explaining the forecast error variance of GDP. This result is consistent with the Granger Causality test.

Part (b) indicates that the FDI dominates in explaining its own variations. It explains approximately 100% to 95% of its own variations throughout the ten periods. Approximately 1% and 4% of forecast error variance of FDI are explained by the GDP and export respectively in the long-run.

Part (c) denotes that the export dominates in explaining the forecast error variance of itself. It explains approximately 93% to 91% of its own variation throughout the ten periods. The GDP explains approximately 7% of the forecast error variance of export throughout the ten periods. And approximately 2% of variations are explained by the FDI.

From the VD analysis, this paper concludes that the GDP, FDI, and export are mainly sensitive to their own shocks. And GDP is more sensitive to the FDI shocks than to the export shocks as indicated by the Granger Causality.

4.5. Impulse response function

The Impulse Response Function (IRF) shows the responses of variables to a shock (one standard deviation shock or unit shock, etc.) to a variable under a particular time horizon. The Granger-causality and VD are not able to trace the direction in which way a variable influences another variable. The IRF analysis is essential to determine the direction of an impact. The null and alternative hypotheses of the IRF are as follows:

H_0: The effects of a shock of one variable on the other variables are not statistically significant.

H_a: The effects of a shock of one variable on the other variables are statistically significant.

The criterion to accept or reject the null hypothesis is that if the confidence bands (red dotted line) straddle the horizontal line (white line with zero coordinate in the vertical axis), the null hypothesis cannot be rejected. That means that after straddling the horizontal line, the IRF is not statistically significant (Farzanegan, 2014, pp. 247-269; Ewing et al., 2007, pp. 605-612).

Figure 3. *The responses of GDP, FDI, and export to one standard deviation shock of GDP*

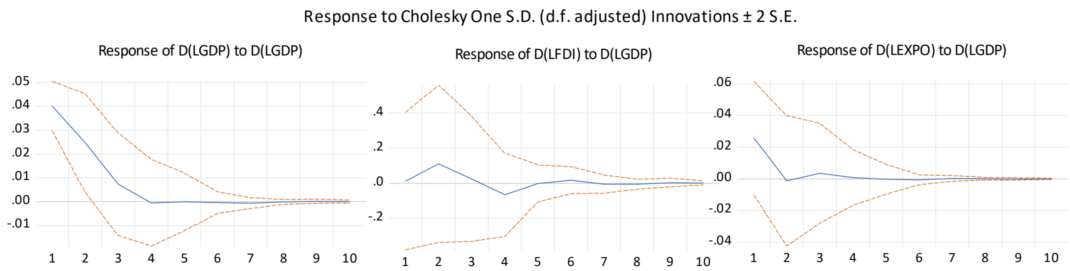


Figure 4. *The responses of GDP, FDI, and export to one standard deviation shock of export*

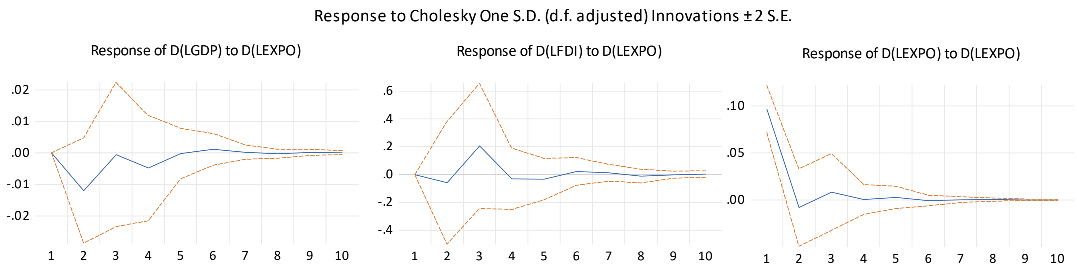
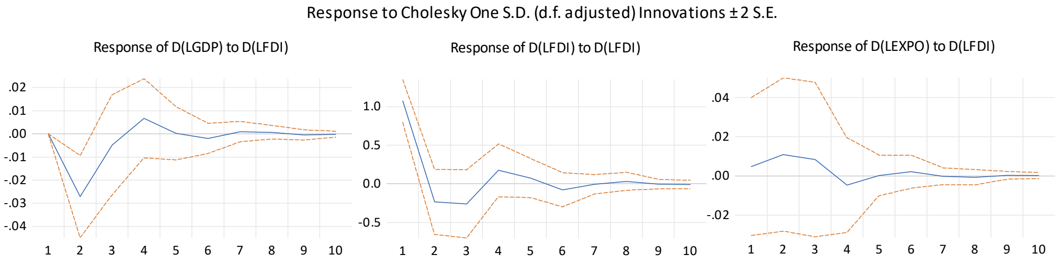


Figure 5. *The responses of GDP, FDI, and export to one standard deviation shock of FDI*



The vertical axis denotes the magnitude of the responses of a variable to a shock, and the horizontal axis represents the time. The blue line shows the IRF, and the red dotted line surrogates the confidence bands at 5% significance.

Figure 3 shows the responses of GDP, FDI, and export to one standard deviation shock of GDP. The response of GDP to its shock is positive and statistically significant until almost two periods. From period two, the IRF becomes statistically insignificant because it falls between the confidence bands. This finding is consistent with the VD. Since the IRFs of FDI and export to GDP straddle the confidence bands, both IRFs are not statistically significant.

Figure 4 reveals the responses of GDP, FDI, and export to export shock. The responses of GDP and FDI to the export shock are statistically insignificant. The result of a statistically insignificant relationship between GDP and export does not support the findings of Paul (2014). He found evidence of export-led growth both in the long-run and short-run in the context of Bangladesh. The response of export to its shock is positive and statistically significant until period one. The VD analysis supports this finding.

Figure 5 unearths the evidence of responses of GDP, FDI, and export to the FDI shock. Since the objective of this paper is to discover the link between GDP and FDI, Figure 5 is of main interest to this paper. The response of GDP to the FDI shock is negative and statistically significant until almost two periods. It means that there is a negative relationship between GDP and FDI in the short-run. Although this finding is not consistent with the result found by Reza et al. (2018), where they found a positive relationship between GDP and FDI in the short-run and long-run, it is consistent with the finding of Saqib et al. (2013, pp. 35-45).

The finding of the negative relationship between GDP and FDI is supported by both the Granger-causality and VD. The response of FDI to its shock is positive and statistically significant up to period one. This finding aligns with the VD analysis. The response of export to the FDI shock is statistically insignificant. This finding has an implication on the negative relationship between GDP and FDI. It implies that an insufficient amount of FDI is channeling to the export sector. Zhang (2005, pp. 25-26) argues that producing a large volume of exportable products using FDI accounts for the rapid growth in China. On the other hand, according to the Bangladesh Bank database, only 382.46 million FDI (US dollar) was invested in export processing zone (EPZ) areas in 2017 that was only 15.58

percent of the total FDI of Bangladesh. A higher amount of FDI in the Non-EPZ areas perhaps leads FDI to substitute DI. And that supplementary relationship provides an inverse relationship between GDP and FDI. Balasubramanyam et al. (1996, pp. 92-105) and Bengoa et al. (2003, pp. 529-545) claim that the relationship between FDI and GDP growth relies on the absorptive ability of the host country.

Therefore, it can be concluded that the absorptive ability of Bangladesh is insufficient enough to exploit the FDI. The authorities may consider the following suggestions to avail the FDI for ameliorating the absorptive ability of Bangladesh.

- The authorities should take initiatives to channel most of the FDI in the export sector so that the domestic investment is not crowded out.
- Relevant fiscal and monetary policies need to be adopted to improve the macroeconomic variables such as GDP, unemployment rate, inflation, etc.
- Trade policies should be formulated in such a way that the foreign investors can enjoy a comparative advantage in Bangladesh, and the native investors can profitably compete in the Bangladeshi markets.
- The authorities should make sure that the political condition of Bangladesh remains stable in the future as it is now.
- To attract more FDI inflow, infrastructures should be improved, and the rules and regulations regarding international trade in Bangladesh should be clear to understand and easy to follow. If the FDI is large enough, it may increase the absorptive ability of Bangladesh significantly.
- Human resources should be improved so that multinational companies can use Bangladeshi human resources. It will mitigate the unemployment problem and reduce the capital outflow.
- The banking system should be efficient so that Business in Bangladesh does not face any friction.

5. Conclusion

This paper attempts to discover the dynamic relationship between FDI and GDP. To achieve that objective, this paper employs thirty-three years of annual data (from 1986 to 2018) collected from the World Bank (WB). The ADF and PP tests are performed to test the stationarity of the three variables (Foreign Direct Investment, Gross Domestic Product, and export). Both tests reveal that the variables are non-stationary at level (I(0)) but stationary at first difference (I(1)).

Since all variables are stationary at the first difference (I(1)), this paper runs the Johansen Cointegration test after selecting the optimal leg length as suggested by the FPE and AIC. The Johansen Cointegration test shows that there is no cointegration among the variables. As there is no cointegration among the variables, this paper adopts the unrestricted Vector Autoregressive (VAR(2)) model as recommended by Hill et al. (2018). Some diagnostic tests are performed to check the goodness of fit of the model. The diagnostic tests indicate that there is no serial correlation in the residuals, and there is no heteroskedasticity problem. The tests also show that the residuals are normally distributed, and the model is stable.

The Granger-causality, VD, and IRF are explored to determine the relationship between GDP and FDI. The Granger-causality shows only one unidirectional causality running from FDI to GDP. The VD exhibits that the VD of GDP, FDI, and export are mainly explained by themselves. However, FDI has great importance in explaining the variation in the GDP. This finding is confirmed by the Granger-causality test. The Impulse Response Function confirms that the GDP, FDI, and export positively respond to their own shocks as suggested by the VD. The IRF also confirms a negative relationship between GDP and FDI in the short-run. This finding is supported by both the Granger-causality and VD. Moreover, the IRF indicates no statistically significant relationship between the GDP and export and the FDI and export.

The negative relationship between GDP and FDI implies that the absorptive ability of Bangladesh is not enough to take advantage of FDI for promoting economic growth.

The authority may consider the above suggestions to increase the absorptive capacity in order to reap benefits from FDI to meet the growth needed for the rapid-growing population.

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