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MACROECONOMIC DETERMINANTS OF FOREIGN DIRECT INVESTMENT: EVIDENCE OF BANGLADESH

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ABSTRACT

This study has examined the short-run, long-run, and granger causal relationship between total foreign direct investment (TFDI) and few selected macro variables, e.g., the nominal exchange rate (NER), trade openness (TRDOPN), wage rate index (WRI), gross fixed capital formation (GFCF), and industrial value added (IVA). This study has used 23 year's annual data (1996-2018) and the ARDL test has been applied for a short-run relationship, the Bound Cointegration test for a long-run relationship, and the Granger Causality test a causal relationship. In addition, short-run dynamics correction to converge towards a long-run equilibrium relationship has also been measured. This investigation reveals that TRDOPN, WRI, and GFCF have statistically significant short-run and long-run relationships with TFDI in Bangladesh during the sample period. A short run disequilibrium has been found to be corrected by 31.92 percent each year. On the other hand, except NER and GFCF, the other three macro variables, i.e., TRDOPN, WRI, and IVA, have a causal relationship with TFDI in a different form.

Keywords: Foreign Direct Investment, ADRL, Bound Test, Granger Causality

INTRODUCTION

Foreign Direct Investment (FDI) has grown rapidly as a major form of international capital transfer over the past decades. The improvement in the investment climate has been influenced by the careful recognition of the benefits of FDI. Foreign investment is an essential element for the country's economic integration and represents a key source to finance capital investment (Campos and Kinoshita, 2008). FDI is generally regarded as cash and non-cash inflow tool into the host countries from overseas investors. FDI projects typically involve transferring technology and managerial skills from the source country to the

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recipient country and providing greater access to the world market for the recipient country's exports. It is a kind of fund flow between the two countries in the form of inflow or outflow. One can benefit from their investments whereas another can exploit the opportunity to enhance productivity and find a better position through investments. The main role of Foreign Direct Investment (FDI) in economic growth is that it creates more benefits for the host countries rather than just full filling the short-term capital deficiency problem in that country (Borensztein et al., 1998). FDI supports economic growth by bringing in new technologies, creating employment opportunities, and enhancing the economy's productivity. It also leads to enhanced and effective management and organizational skills through the interaction of two cross-border expertise. Both theoretical and empirical studies have documented the positive impact of FDI on potential growth. Such effect materialize as FDI improves the transfer of technology and technical know-how, increases competition, and pushes more development of the firms (Dellis et al., 2017). In Bangladesh, the country's savings-investment gap had been mainly bridged by external financial and economic assistance. However, after the cold war era, the availability of foreign aid is decreasing gradually.

As a result, there is now widespread support for the need for FDI in Bangladesh. On the other hand, rapid industrialization is needed in Bangladesh to keep pace with development needs. The average annual FDI inflow in Bangladesh is significantly lower than comparable economies in the world. Over the past decade (2007 to 2017), inflows have averaged at 0.9% of GDP in Bangladesh compared with 3.0% in China, 5.5% in Ethiopia, 2.6% in The Philippines, 6.6% in Vietnam, 4.6% in Malaysia, and 2.1% in India. [1] So, it is very important to increase average annual FDI inflows for Bangladesh among comparable economies to cope with the world economic challenge. For increasing the FDI inflows, factors that significantly influence the FDI inflows need to be examined. However, few research studies have been carried out to identify those influential factors affecting FDI in Bangladesh. This paper attempts to incorporate few macroeconomic variables that exert significant statistical and economic stimulus with the FDI in Bangladesh.

This study is organized into seven sections. The first section presents the overall background of the study; the second section describes the objectives of this study; the third section discusses the basic concept of FDI and its related components; the fourth section presents the review of relevant literature; the fifth section describes the methodologies and tools used in this study; the sixth section presents the description of the research findings, and finally the seventh section presents the conclusion of this research.

[1] Bangladesh Bank Annual Report 2018

OBJECTIVES OF THE STUDY

Rapid industrialization is an imperative issue for Bangladesh to keep the pace of its growth and development. Allocational inefficiency of domestic savings and investment and low level of technology base hamper the expected industrialization process. Foreign aids and grants had been serving to bridge the gap. As a developing country, Bangladesh is graduating from being an aid-dependent economy into a trading economy; therefore, FDI is considered a critical stimulus to economic growth in this country (Rayhan, A. 2009). This study attempts to identify the macroeconomic factors that have a statistically short-run and long-run influence on FDI in Bangladesh. Here, the broad objective of this study is to examine the macro variables that exhibit strong statistical influence over the level of FDI in Bangladesh. More specific objectives include the following:

1. Estimating the short-run relationship between total FDI and all other selected macro variables.
2. Estimating the long-run relationship between total FDI and all other selected macro variables.
3. Computing the speed of disequilibrium adjustment to long-run relationship model.
4. Finally, identifying the Granger causal relationship between total FDI and the selected macro variables.

FOREIGN DIRECT INVESTMENT (FDI): COMPONENTS AND TRENDS

The term Foreign Direct Investment (FDI) refers to an investment that is made to acquire a lasting interest in an enterprise operating abroad, the investors' purpose being to have an effective voice in the management of the enterprise. In other words, FDI is an international financial flow to control or participate in the management of an enterprise in a foreign country. According to the survey report on Foreign Direct Investment (FDI) of Bangladesh Bank (July - December 2018), there are three different foreign direct investment components. These components are:

i. Equity Capital: Remittances received by the incorporated or unincorporated direct investment enterprises operating in Bangladesh on account of equity participation in those by the non-resident direct investors. Equity capital comprises Ordinary Shares, Revaluation & Capital Reserves, Share Money Deposits, and Other Reserves.

ii. Reinvested Earnings: It is the amount of profit retained for reinvestment.

iii. Intra-Company Loans: It refers to short or long-term borrowing and lending of funds between direct investors (parent enterprises) and affiliated enterprises. The traditional distinction between short and long-term maturity is based on the formal criterion of original maturity retained.

Figure 2.8 presents the trend of the percentage growth of three different components of FDI, i.e., equity capital, reinvested earnings, and intra-company loans during the period from 1996 to 2018. This graph clearly shows that the highest level of growth volatility is found in intra-company loans, and the lowest growth volatility is observed in retained earnings from 1996 to 2012. But after then the growing volatility of all the three FDI components is found less volatile and steady.

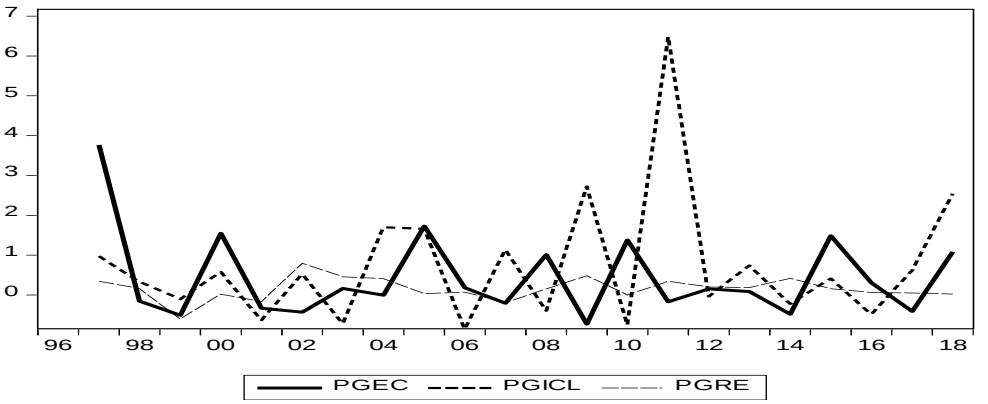

Figure 2.8: Percentage Growth of FDI inflows by Components (in a million US$)

On the other hand, Figure 2.9 presents the percentage growth of EPZ and Non-EPZ FDI from the period between 1996 and 2018. It is clearly visible that co-movement between these two-growth percentages is highly positively correlated and in different years, when FDI growth in EPZ area increases whereas FDI in Non-EPZ areas decreases. This different foreign investment behavior explains that when FDI in the EPZ area becomes possible, then investment in the Non-EPZ area got little response in foreign direct investment.

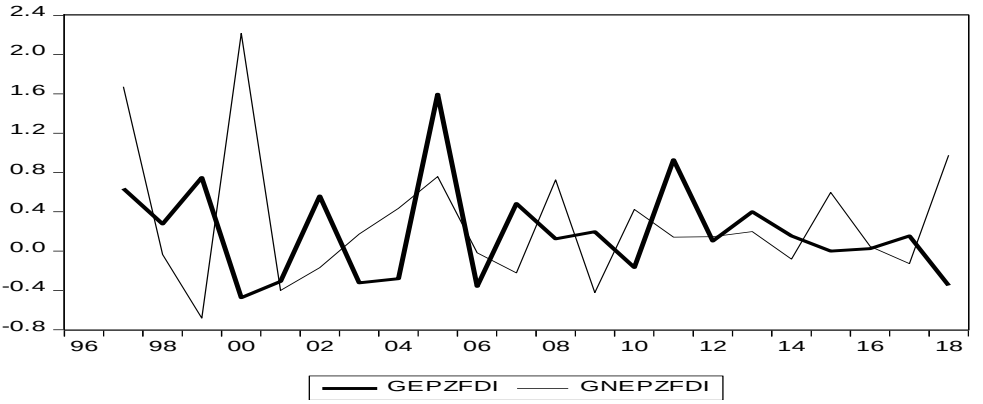

Figure 2.9: Percentage Growth of EPZ and NON-EPZ FDI (in a million US$)

REVIEW OF LITERATURE

Foreign Direct Investment (FDI) is considered an important economic development tool in any developing country (Aziz, Sarkar and Mahmud, 2014). If the investing country is wealthier than the host country, capital will flow to the host country (Zhao, 2003). It contributes to the growth of GDP, creates employment generation, technology transfer, human resource development, etc. It is also perceived that FDI can play a significant role in reducing the poverty of a developing country. A good number of research studies have carried out at the global and domestic levels to identify and determine the sensitive and influential factors of FDI in their respective economies. In the last 15 years, few research has already been done in the same or related areas in Bangladesh.

Rahman (2016) has attempted to identify the economic and social determinants of foreign direct investment (FDI) in Pakistan during the period 1984-2015. The author has used cointegration and error correction techniques to examine both the long-run and short-run impact of these determinants on FDI flow in Pakistan. Here, market size, the openness of the economy, inflation rate, and availability of natural resources have been used to develop the economic model. On the other hand, human capital, corruption, and bureaucratic red-tapism, political rights, and quality of life have been used to develop social models. The findings of this study reveal that both economic and social factors have a long-run impact on the flow of FDI in Pakistan. However, social factors are found more important than economic factors in attracting FDI in Pakistan.

Rayhan (2009) examined the importance of FDI in Bangladesh. It has been described that FDI is contributing to economic development as well as poverty reduction through initial macroeconomic stimulus and by raising total factor productivity and efficiency of the use of resources. Another attempt has also been

made to identify major prospects and problems of FDI in Bangladesh. Few obstacles to FDI in Bangladesh have been identified like poorly developed socio-economic and physical infrastructure, lack of skilled people, unreliable energy supply and corruption, etc.

Quader (2010) has examined the catalyst variables of FDI inflows in Bangladesh by applying extreme bounds analysis to the time series data from 1990-91 to 2005-06. The result of this study reveals that wage, trade openness, net export, GDP growth, and tax rate have a robust result. More specifically, the wage rate is negative, trade openness has positive, trade balance has positive, and the tax rate has a negative impact on the flow of foreign direct investment in Bangladesh. All these relationships are found to be significant at a 95 percent confidence level.

Aziz et al. (2014) have studied and examined various factors (i.e., market size, productivity indices of industrial labor, and trade balance) to identify their impact on FDI in Bangladesh. The cointegration test has been applied and found that market size and trade balance is positive and significant to FDI inflows in Bangladesh. Labor productivity has been found positive but statistically not significant to FDI inflows in Bangladesh.

Ferrer and Zermeno (2015) proved the relationship between China's foreign direct investment and gross domestic product from 1995 to 2012. Vector autoregressive model, Augmented Dickey-Fuller (ADF) test, and Johansen's Cointegration test has been applied. The result disclosed that FDI has a marginal impact on the economic growth of China.

Huq, Khan and Rahman (2016) have examined the contemporary FDI scenario of Bangladesh during the period 1996-2010. They stated that the scenario of FDI in Bangladesh is not satisfactory. The findings of this study suggested that FDI has a positive impact on export growth through its positive spillovers for South Asian countries. FDI inflows to South Asian countries are increasing and are mostly concentrated in manufacturing and services. Bangladesh could not attract a handsome flow of FDI, and the lion's share of FDI is being repatriated.

Seddeke and Rahman (2016) have evaluated the impact of the key factors on FDI in Bangladesh's point of view for the period between 2000 and 2015. This study has used a correlation matrix, stationary test, and multiple regression analysis. The result of this study indicated that trade openness and exchange rates are found to be key determinants of the FDI inflows in Bangladesh. On the other hand, GDP, interest rate, and inflation are found to be insignificant in attaining FDI inflows in Bangladesh. This study finally recommends that the government should focus on increasing transparency, reducing corruption, mobilizing domestic resources, controlling the inflation rate, stabilizing the exchange rate, and keeping the interest rate at a tolerable level so that more investment could be attracted.

Mahmood (2018) has examined the macroeconomic determinants of FDI inflows in Bangladesh from 1975 to 2015. Empirical results have been estimated using the ADRL technique using five macroeconomic variables (i.e., democracy,

GDP, inflation, interest rate, and trade openness). It has been found that democracy is positively affecting FDI in Bangladesh in the long run, but it is insignificant in the short run. GDP impact is positive to DFI both in the long and short run. The interest rate has a long-run positive relationship with FDI. Finally, trade openness has negative relation with FDI both in the long and short run.

Muraleethanran et al. (2018) observed determinants of FDI by applying time-series data from 1978 to 2015 in Sri Lanka. Inflation, GDP, interest rate, infrastructure, and international trade volume are used as explanatory variables. ADF test was applied to check the stationarity in the data, and an ordinary least square regression model was applied to know the relationship among variables. As per the result of this study, all attractive factors of FDI play a positive and significant role to crease FDI in Sri Lanka.

Rasheed (2019) have examined the macroeconomic factors affecting the FDI of 14 Asian countries over the period between 2003 and 2017. Here five independent macroeconomic variables (i.e., GDP, trade openness, labor cost, exchange rate, and corporate tax rate) have been used to develop fixed- effect as well as a random-effect OLS regression model of FDI. The study found that macroeconomic factors significantly affect the inflow of FDI in 7 Asian countries like China, Hong Kong, Indonesia, Jordan, Pakistan, Philippines, and Vietnam. Labor cost plays a significant role in deriving FDI in Hong Kong. The exchange rate gives the potential advantage and significantly impacts FDI in Pakistan, the Philippines, and Vietnam. While tax rate plays a significant role in boosting FDI inflow in the Philippine economy.

The literature review on the factors that significantly influence FDI summarized above is necessary to examine further for the developing economies like Bangladesh. In this study, the literature gap has been identified by incorporating the estimates of short-run, long-run, and causal factors that influence the FDI in Bangladesh.

METHODOLOGY OF THE STUDY

This research is an essential attempt to identify few macro-economic variables that have a strong statistical linkage with foreign direct investment (FDI) volume in Bangladesh. In this process, the dependent variable Total Foreign Direct Investment (TFDI) has been estimated by aggregating EPZ and Non-EPZ FDI for between 1996 and 2018 (total 23 years of observations). Other macro variables data like Nominal Exchange Rate (NER), Trade Openness (TRDOPN) which is measured by the sum of import and export values as a percentage of GDP, Gross Domestic Product (GDP), Wage Rate Index (WRI), Gross Fixed Capital Formation (GFCF), and Industrial Value Added (IDA) have been collected for the same

period. At first, descriptive statistics have been estimated to describe the behavior of the data series. Then each of the variable data has been tested for their stationarity through applying Augmented Dickey-Fuller (ADF) Test and Phillips-Parron (PP) Test. After then the short-run relationship between Total foreign direct investment and other selected macro variables has been tested by applying Autoregressive Distributed Lag (ARDL) test. In this case, optimal lag length has been estimated through VAR lag length selection criteria. On the other hand, the long-run relationship between the dependent variable and all other macro variables has been tested by using Bound Cointegration Test. Finally, Error Correction Model (ECM) has been used to examine the rate of speed of disequilibrium adjustment among the variables. In measuring both the short-run and long-run model, the Breusch-Godfrey Serial Correlation LM Test has been used to examine the presence of serial correlation in the error terms, the WALD test has been used to test the joint statistical significance of the regression coefficients, and the COSUM test has been used to examine the stability of the model.

ARDL Model Specification

ARDL is a least square regression containing lags of the dependent and explanatory variables. This model is usually denoted with the notation $ARDL\ (p, q_{1,} \ldots\ldots, q_k)$, where p is the number of lags of the dependent variable, $q_{1,}$ is the number of lags of the first explanatory variables, and q_k is the number of lags of the *k*-th explanatory variable.
The ADRL model can be written as:

$$y_t = \alpha + \sum_{i=1}^{p} \gamma_i y_{t-i} + \sum_{j=1}^{k} \sum_{i=0}^{q_j} X_{j,t-i} \beta_{i,j} + \epsilon_t$$

Some of the explanatory variables, $X_{j,}$ may have no lag terms in the model $(q_j = o)$. These variables are called static or fixed regressors. Explanatory variables with at least one lagged term called dynamic regressors.

To specify the ARDL model, we must determine how many lags of each variable should be included (i.e., specify $p\ and\ , q_{1,} \ldots\ldots, q_k$). Fortunately, simple model selection procedures are available for determining these lag lengths. Since and ARDL model can be estimated via least square regression, standard Akaike, Schwarz, and Hannan-Quinn information criteria may be used for model selection. Alternatively, one could employ adjusted R^2 from the various least square regressions.

Bounds Cointegration Test

Pesaran, Shin, and Smith (2001) have described a methodology for testing whether the ARDL model contains a level (or long run) relationship between the independent and the regressors. The following equation can represent the Bounds test procedure:

$$\Delta y_t = -\sum_{i=1}^{p-1} \gamma_i^* \Delta y_{t-i} + \sum_{j=1}^{k} \sum_{i=0}^{q_{j-1}} \Delta X_{j,t-i} \beta_{i,j,i^*} - \rho y_{t-1} - \alpha - \sum_{j=1}^{k} X_{j,t-1} \delta_j + \epsilon_t$$

The test for the existence of level relationships is then simply a test of

$$\rho = 0$$
$$\delta_1 = \delta_2 = \cdots = \delta_k = 0$$

Pesaran, Shin, and Smith provide critical values for the cases where all regressors are I(0) and the cases where all regressors are I(0) and have suggested using the critical values as bounds for more typical cases where the regressors are a mixture of I(0) and I(1).

Granger Causality Test

The causality relationships among the variables in this study are determined by using the methodology based on granger (1988). The Granger tests involve the estimation of the following equations.

$$X_t = \alpha_0 + \sum_{j=1}^{k} \alpha_{1s} X_{t-s} + \sum_{i=1}^{m} \alpha_{2i} Y_{t-m} + \varepsilon_{1t}$$

$$Y_t = \beta_0 + \sum_{j=1}^{n} \beta_{1j} Y_{t-j} + \sum_{h=1}^{p} \beta_{2h} X_{t-h} + \varepsilon_{2t}$$

Where ε_{1t} and ε_{2t} are assumed to be uncorrelated and E(ε_{1t} ε_{2t}) = 0 = E(ε_{2t} ε_{2s}) for all $s \neq t$.

These equations can be used to show the unidirectional causality between the stock price index and macroeconomic variables. lf the estimated coefficients α_{2i} statistically significant, i.e., $\alpha_{2i} \neq 0$, then Y Granger-causes X. Similarly, X is the "Cause Variable" for y if β_{2h} is statistically significant, i.e., $\beta_{2h} \neq 0$. lf both α_{2i} and β_{2h} are significant, it would provide evidence of a mutual Dependency between these two variables.

Finally, if both α_{2i} and β_{2h} are statistically not different from zero' then X and Y will be independent. According to this approach, a stock market is informationally inefficient if Y Granger-causes X (considering X represents the stock market variable and Y represents the macroeconomic variable). Mathematically $\alpha_{2i} \neq 0$, and $\beta_{2h} \neq 0$. The stock market will be informationally efficient if the direction of causality from lagged X value to current y value i.e.,

$\alpha_{2i} = 0$ and $\beta_{2h} \neq 0$. This means relationship between lagged stock prices and the current value of macroeconomic variable implies a stock market with a forward-looking propensity where changes in the macroeconomic variables are correctly anticipated.

ANALYSIS AND DISCUSSION

Table I presents the descriptive statistics of foreign direct investment (FDI) and different selected macroeconomic variables of Bangladesh during the period from 1996 to 2018. The mean value measures the average of the selected variables during the sample period. Here TFDI is $1072.3 million with a standard deviation of $841.0 million. The data distribution is positively skewed with a leptokurtic shape. NER average is Tk. 66.42 with a standard deviation of Tk. 12.5. This data set is negatively skewed with a platykurtic shape. TRDOPN measures the aggregate of total export and import as a percentage of GDP. This variable has an average of 42.6, with a standard deviation of 20.3. This data is positively skewed with a platykurtic distribution shape. GDP measures the gross domestic product in crore taka, which shows an average of Tk. 594,092. WRI is the wage rate index of Bangladesh that measures the trend and changes in the aggregate wages of the wage earners of the country in the case of low-paid skilled and unskilled labor. The base year of 2010-11 value has been converted back to the year 1996. Gross fixed capital formation (GFCF) in percent growth has been considered. Here the average growth is 8.6 with a standard deviation of 1.57. Finally, industrial value added (IVA), also used as a percent growth term, has an average growth of 8.0 with a standard deviation of 1.8.

Table I: *Descriptive Statistics of TFDI and Other Macroeconomic Variables*

	TFDI	**NER**	**TRDOPN**	**GDP**	**WRI**	**GFCF**	**IVA**
Mean	1073.3	66.42	42.6	594092.0	4961.0	8.6	8.0
Median	792.4	68.8	42.9	547437.0	3779.0	8.5	7.9
Maximum	3613.3	83.8	70.6	1105514.	10748.0	11.9	12.0
Minimum	231.6	42.7	15.8	296996.0	1900.0	5.36	5.2
Std. Dev.	841.0	12.5	20.3	240531.5	2866.9	1.57	1.8
Skewness	1.44	-0.38	0.06	0.60	0.72	-0.02	0.29
Kurtosis	4.7	1.0	1.39	2.26	2.14	2.49	2.2
Observations	23	23	23	23	23	23	23

Note: Author's own Calculations

Table II presents the results of the stationarity test by applying two different unit root tests, i.e., the Augmented Dickey-Fuller (ADF) test and Phillips-Parron (PP) test. This test is an essential step for qualifying variables for the application of the Autoregressive Distributed Lag (ARDL) model. Variables with the order of

integration zero and one (i.e., I (0) and I (1)) will be selected for the ARDL test. The above table presents the fact that both the dependent variable (i.e., TFDI) and all other independent variables (i.e., NER, TRDOPN, WRI, GFCF, IVA) have the order of integration within I (0) and I (1), which implies that these variables could be used in ARDL test for estimating the short-run relationship between TFDI and these selected macro variables. Another unavoidable step is to consider the optimal lag length for running the ARDL test. Different estimates of the optimal lag length have been presented in appendix Table-A which state that all the lag length selection model specifies lag of zero for running any subsequent tests.

Table II: *Test of Stationarity*

Variables	Augmented Dickey Fuller (ADF)Test				Phillips-Parron (PP)Test				Order of Integration	
	I(0)		I(1)		I(0)		I(1)			
	t-stat	Prob.	t-stat	Prob.	Adj. t stat	Prob.	Adj. t stat	Prob.	**ADF**	**PP**
TFDI	0.98	0.19	-6.50	0.03	-2.02	0.55	-3.07	0.13	I(1)	I(1)
NER	-2.77	0.22	-4.41	0.01	-1.78	0.68	-4.50	0.00	I(1)	I(1)
TRDOPN	-2.03	0.55	-4.09	0.02	-2.13	0.49	-4.09	0.02	I(1)	I(1)
WRI	-0.52	0.97	-3.29	0.04	-0.54	0.97	-3.11	0.03	I(1)	I(1)
GFCF	-7.39	0.00	-10.39	0.00	-7.54	0.00	-26.3	0.00	I(0)	I(0)
IVA	-4.12	0.01	-3.49	0.04	-2.02	0.55	-3.07	0.04	I(1)	I(1)

Note: Author's own calculations

Table: III presents the ARDL test (i.e., short-run relationship) estimates between TFDI and other selected macro variables. An appropriate lag length of 2 has been used in this ARDL (Appendix Table: A). Here the coefficient of WRI at level data is negatively related with the TFDI, and that is statistically significant. On the other hand, WRI at lag 1 has a significant positive relation with TFDI. IVA at lag 2 has been found significant at the same 5 percent level. GFCF has a significant sportive relation with TFDI at every lag. Finally, TRDOPN at lag 2 is found statistically significant at 1 percent level. Based on this evidence, it can be said that WRI and GFCF have a strong short-run influence on TFDI. In addition, both at lag 2, TRDOPN and IVA have a short-run influence on TFDI.

Table III: *ARDL (Short-run) Test Estimates between TFDI and other Macro Variables*

Dependent Variable: LOG(TFDI)
Dynamic regressors (2 lags, automatic): LOG(NER) LOG(TRDOPN) LOG(WRI) LOG(GFCF) LOG(IVA)
Fixed regressors: C
Selected Model: ARDL(2, 2, 2, 1, 2, 2)

Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.***
LOG(TFDI(-1))	-0.239292	0.158487	-1.509850	0.2056
LOG(TFDI(-2))	-0.879896	0.333664	-2.637073	**0.0578*****
LOG(NER)	-2.819890	2.358416	-1.195671	0.2979
LOG(NER(-1))	-5.018596	2.514156	-1.996136	0.1166
LOG(NER(-2))	3.691719	2.102701	1.755703	0.1540
LOG(TRDOPN)	-0.757964	0.489100	-1.549712	0.1961
LOG(TRDOPN(-1))	0.191772	0.412132	0.465317	0.6659
LOG(TRDOPN(-2))	3.022578	0.538188	5.616207	**0.0049***
LOG(WRI)	-12.75021	3.536512	-3.605307	**0.0227****
LOG(WRI(-1))	13.75815	3.689949	3.728547	**0.0203****
LOG(GFCF)	1.180695	0.319658	3.693618	**0.0210****
LOG(GFCF(-1))	2.320875	0.597361	3.885217	**0.0178****
LOG(GFCF(-2))	1.028601	0.305742	3.364275	**0.0282****
LOG(IVA)	-0.434263	0.609343	-0.712675	0.5154
LOG(IVA(-1))	-0.269458	0.351536	-0.766516	0.4861
LOG(IVA(-2))	1.557502	0.380526	4.093020	**0.0149****
C	4.373282	3.282522	1.332293	0.2536

Note: *, **, and ** indicates statistically significant at 1%, 5%, and 10% level.

After then the fitness of the ARDL model has been tested by applying different econometric tests. Appendix Table-B presents the Breusch-Godfrey Serial Correlation LM test, which usually measures the presence of serial correlation of the regression residuals estimated in the ARDL test. This test assumes under null hypotheses that no serial correlation existed in the regression residuals. The *p*-value of the F-statistics (i.e., 0.2860) fails to accept the null hypothesis, implying that serial correlation has not been found in the regression residuals at 5 percent significance level. Appendix Table-C presents the Wald test, which measures the joint statistical significance of the regression coefficients in the ARDL test. The *p*-value of the F-statistics (i.e., 0.0002) fails to accept the null hypothesis of no joint statistical significance of the regression coefficients, which means that regression coefficients are jointly statistically significant at 5 percent level. Finally, appendix Figure-A presents the CUSUM test, which is usually used to estimate the statistical stability of the model. Here the line indicating CUSUM is within the 5 percent

significant level, which indicates the model's stability. Overall, the ARDL model has been found statistically stable from the CUSUM test.

Table IV: *Bound Test estimates between TFDI and Other Macro variables.*

Null Hypothesis: No long-run relationships exist		
Test Statistic	Value	K
F-statistic	***15.09591***	5
Critical Value Bounds		
Significance	**I0 Bound**	**I1 Bound**
10%	2.08	3
5%	2.39	***3.38****
2.5%	2.7	3.73
1%	3.06	4.15

Note: * indicates statistically significant at 5 percent level.

Table: IV presents the ARDL bound test estimates between TFDI and other selected macro variables. This test assumes that no long-run relationship exists between TDFI and other selected macro variables. Here F-statistics (i.e., 15.09591) is greater than I (1) (i.e., 3.38) bound at 5 percent, which entails that the test fails to accept the null hypothesis of no cointegration or long-run relationship between TDFI and selected macro variables. Based on this test result, it can be concluded that there exists a cointegrating or long-run relationship between TDFI and selected macro variables at 5 percent level of significance.

Table V: *Cointegrating Test (Long Run) Estimates between TFDI and Other Macro Variables*

Dependent Variable: LOG(TFDI)				
Method: Least Squares				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
LOG(NER)	-1.956772	0.384651	-5.087135	**0.0070***
LOG(TRDOPN)	1.159117	0.190886	6.072300	**0.0037***
LOG(WRI)	0.475624	0.159732	2.977640	**0.0408****
LOG(GFCF)	2.137693	0.493515	4.331564	**0.0123****
LOG(IVA)	0.402881	0.343136	1.174114	0.3055
C	2.063660	1.511739	1.365090	0.2440

Note: * and ** indicates statistically significant at 5 and 10 percent levels, respectively.

Table: V presents the estimates of the long-run cointegrating (Pesaran, Shin, and Smith, 2001) relationship between TFDI and other macro variables. It is found that NER has a statistically significant negative relationship with TFDI. This result is consistent with Chen, K. *et al*. 2006; Kyereboah, A., and Agyire- F. 2008;

Saleem, H. *et al*. 2020. TRDOPN has a positive statistically significant coefficient with TFDI, which is consistent with Saini and Singhania. 2018 but not inconsistent with Adhikary B. 2012. WRI has a statistically significant positive relationship with TFDI, which is also consistent with Earle et al. 2013; Chakraborty, 2014 but a negative relationship has been found in Figini. et al. 2006; and Kato-Vidal. 2013. GFCF has found a statistically significant positive relationship with TFDI, contrary to Saleem, H. et al. 2020 and Krkoska L. 2001. Finally, IVA has an insignificant positive relationship with TFDI.

Later on, the Breusch-Godfrey Serial Correlation LM test (Appendix Table-D) has been applied for the presence of serial correlation in the long-run model. The *p*-value of the F-statistics (i.e., 0.2430) fails to reject the null hypothesis of no serial correlation in the long-run regression model. Wald test estimates for the long-run model have been presented in Appendix Table- E, which concludes that long-run regression coefficients are jointly statistically significant at 5 percent level. CUSUM test for the long-run model has been presented in Appendix Figure-B, which also specifies that the line indicating CUSUM moves in between 5 percent boundary. This evidence is indicative of the statistical stability of the long-run model.

Finally, Table: VI presents the Error Correction Model (ECM) between TFDI and other selected macro variables. Here error correction coefficient i.e., CoinEq (-1) is -0.319188 with *p*-value of the t-statistics of 0.0001. This error correction coefficient implies that the previous dynamic disequilibrium is corrected by 31.92 percent each year to converge towards equilibrium conditions.

Table VI: *Error Correction Model (ECM) between TFDI and Other Macro Variables*

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DLOG(TFDI(-1))	0.879896	0.121173	7.261504	0.0019
DLOG(NER)	-2.819890	0.631319	-4.466661	0.0111
DLOG(NER(-1))	-3.691719	0.481773	-7.662785	0.0016
DLOG(TRDOPN)	-0.757964	0.176716	-4.289157	0.0128
DLOG(TRDOPN(-1))	-3.022578	0.265074	-11.402757	0.0003
DLOG(WRI)	-12.750213	0.941831	-13537686	0.0002
DLOG(GFCF)	1.180695	0.093238	12.663240	0.0002
DLOG(GFCF(-1))	-1.028601	0.096565	-10.651861	0.0004
DLOG(IVA)	-0.434263	0.157194	-2.762599	0.0507
DLOG(IVA(-1))	-1.557502	0.148452	-10.491637	0.0005
CoinEq(-1)	**-0.319188**	**0.130383**	**-16.253568**	**0.0001***

Note: * indicates significance level at 1 percent.

Table: VII presents the pair-wise Granger causality test results between TFDI and all other selected macro variables. Based on the null hypothesis of no causal

relation between TFDI and other macro variables, the test evidence shows statistically significant bi-directional causality between trade openness and industrial value-added with TFDI. On the other hand, unidirectional causality has been found from the wage rate index to TFDI at 1 percent significance level. Surprisingly, nominal exchange rate and gross fixed capital formation have no causal relation with TFDI.

Table VII: *Test of Granger Causality between TFDI and Selected Macro Variables*

Direction of Causality			**Observations**	**F-Statistics**	**Prob.**
LOG(TFDI)	~	LOG(NER)	21	0.12601	0.8825
LOG(NER)	~	LOG(TFDI)		1.31054	0.2971
LOG(TFDI)	→	LOG(TRDOPN)	21	3.03473	0.0763***
LOG(TRDOPN)	→	LOG(TFDI)		2.89218	0.0847***
LOG(TFDI)	~	LOG(WRI)	21	0.16447	0.8498
LOG(WRI)	→	LOG(TFDI)		6.56127	0.0083*
LOG(TFDI)	~	LOG(GFCF)	21	1.24398	0.3147
LOG(GFCF)	~	LOG(TFDI)		0.52537	0.6012
LOG(TFDI)	→	LOG(IVA)	21	7.67292	0.0046*
LOG(IVA)	→	LOG(TFDI)		2.88091	0.0854***

Note: *, **, *** implies statistically significant at 1, 5, and 10 percent level.

Table: VIII presents the summary test evidence between TFDI and all other selected macro variables. Here, the coefficient of WRI at level data is negatively related to the TFDI, which is statistically significant. This is very likely because a low wage rate indicates insufficient capital resources in the production process, which reasonably attracts FDI in any least developed economy like Bangladesh. On the other hand, WRI at the 1st lag has a significant positive coefficient with TFDI. This could be due to increasing productivity also attracting more and more capital inflow from foreign countries. Gross fixed capital formation (GFCF) is very likely to attract FDI inflows but fails to show any causal relationship with TFDI in Bangladesh. Causal evidence between TFDI and GFCF has not been identified because it is true that FDI can be used to finance fixed capital formation; however, it can also be used to cover a deficit in the company or paying off a loan. In the short-run estimates, IVA has negative relation at lag 0 and lag 1 but has positive relation at lag 2. This means the inflow of TFDI fails to visualize the added value in industrial productivity in lag 0 and lag 1 data, but value addition is observed at lag 2. On the other hand, the long-run estimate generates a positive relationship between IVA and TFDI. Improving industrial productivity requires a substantial period, and that is why the logical positive relationship is observed in the long-range estimates. In addition, the favorable prospect of industrial

productivity is attracting FDI, and the inflow of FDI is causing the improvement in IVA.

Table VIII: *Summary Relationship between TFDI and Selected Macro Variables*

Variables	**Short-run Relationship with TFDI**	**Long-run Relationship with TFDI**	**Causal Relationship with TFDI**
Nominal Exchange Rate (NER)	Negative relation but not statistically significant	Negative relation and statistically significant	No causal relation
Trade Openness (TRDOPN)	Positive relation but not statistically significant at 2nd lag	Positive relation and statistically significant	Bi-directional causal relation
Wage Rate Index (WRI)	Negative relation with level data and positive relation at lag and 1st both are statistically significant	Positive relation and statistically significant	Statistically significant unidirectional causal relation from WRI to TFDI
Gross Fixed Capital Formation (GFCF)	Positive relation and statistically significant	Positive relation and statistically significant	No causal relation
Industrial Value Added (IVA)	Negative relation and statistically significant at 2nd lag	Positive relation but not statistically significant	Bi-directional causal relation

CONCLUSION

FDI of Bangladesh is undoubtedly an important limelight variable based on which the country's economic performance can be measured. This study is conducted to estimate the short-run, long-run, and causal relationship of one of the important performance variables of Bangladesh, i.e., FDI with respect to other macro variables of the same economy. Auto-regressive Distributed Lag (ARDL) test and Bound Cointegration test have been applied to estimate short-run and long-run relationship respectively between FDI of Bangladesh and selected macro variables. Finally, the pair-wise Granger Causality test has been applied to identify the causal relationship for the same variables. Based on all these test evidence, it has been revealed that each of the selected macro variables is statistically sensitive at a different level. Most importantly, nominal exchange rate, trade openness, wage rate index, and gross fixed capital formations are found statistically significant variables for explaining FDI fluctuations in Bangladesh. If long-range data can be

employed with additional macro variables, empirical evidence could be more reliable and feasible.

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APPENDIX

Table A: *VAR Lag length Criteria*

VAR Lag Order Selection Criteria
Endogenous variables: LOG(TFDI) LOG(NER) LOG(TRDOPN) LOG(WRI) LOG(GFCF) LOG(IVA)

Lag	LogL	LR	FPE	AIC	SC	HQ
0	60.22505	NA	2.30e-10	-5.164291	-4.865856	-5.099522
1	173.8970	151.5626	1.65e-13	-12.56162	-10.47257	-12.10824
2	**285.0469**	**84.68564***	**3.85e-16***	**-19.71875***	**-15.83910***	**-18.87677***

* 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

Table B: *Breusch-Godfrey Serial Correlation LM Test for ARDL Model*

F-statistic	2.496554	Prob. F(1,14)	0.2860
Obs*R-squared	14.99409	Prob. Chi-Square(1)	0.0006

Table C: *WALD Test for ARDL Model*

Null Hypothesis: C(2)=0, C(3)=0, C(4)=0, C(5)=0

Test Statistic	Value	df	Probability
F-statistic	10.34011	(5, 15)	0.0002
Chi-square	51.70057	5	0.0000

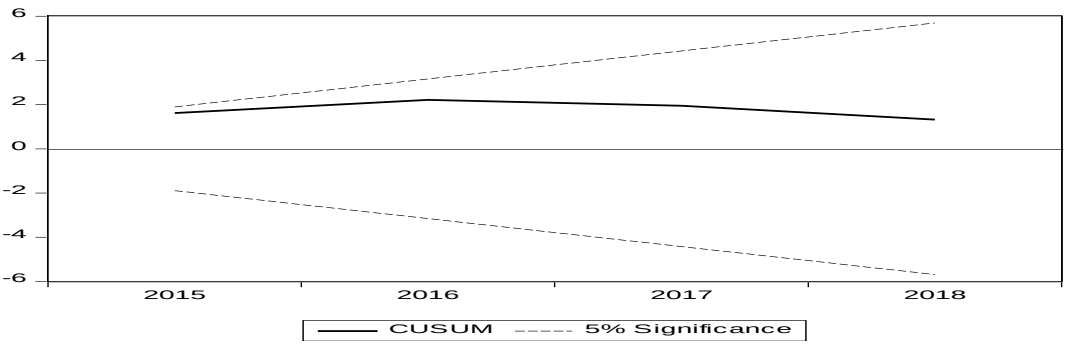

Figure A: *CUSUM test for ARDL Model Stability*

Table D: *Breusch-Godfrey Serial Correlation LM Test for Long Run Model*

F-statistic	1.469512	Prob. F(1,16)	0.2430
Obs*R-squared	1.934730	Prob. Chi-Square(1)	0.1642

Table E: *WALD Test for Long Run Model*

Null Hypothesis: C(2)=0, C(3)=0, C(4)=0, C(5)=0			
Test Statistic	Value	df	Probability
F-statistic	8.861744	(4, 17)	0.0005
Chi-square	35.44698	4	0.0000

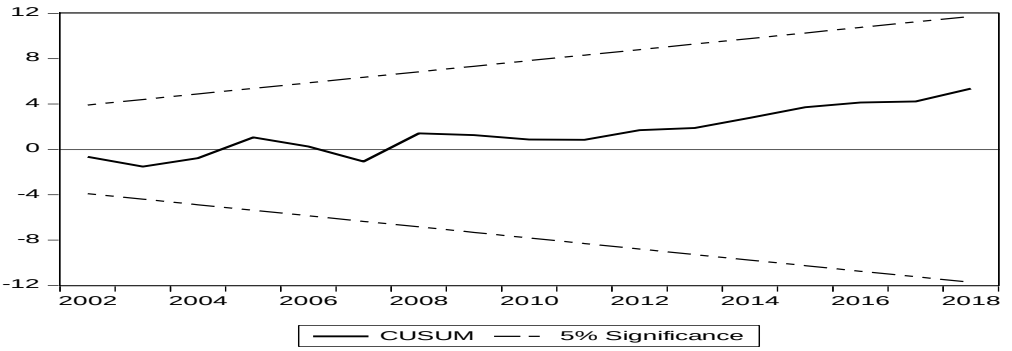

Figure B: *CUSUM Test for Long Run Model Stability*

Table F: *Breusch-Godfrey Serial Correlation LM Test for ECM*

F-statistic	1.469512	Prob. F(1,16)	0.2430
Obs*R-squared	1.934730	Prob. Chi-Square(1)	0.1642

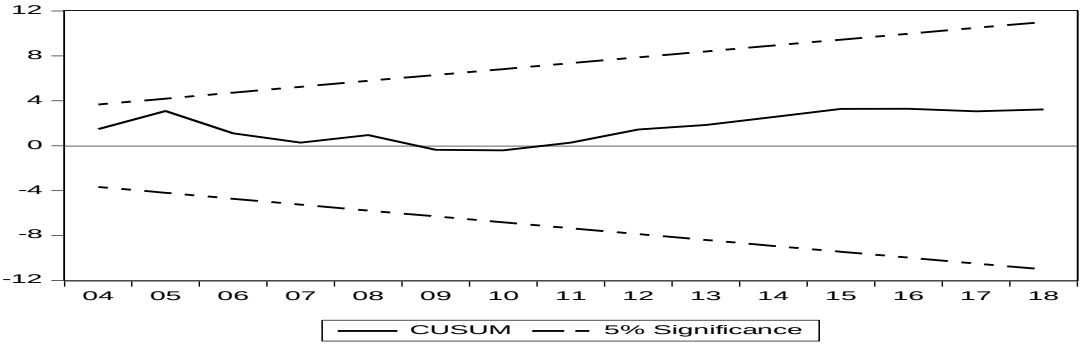

Figure C: CUSUM test for Long Run Model Stability