Impact of Macroeconomic Variables on Foreign Direct Investment of Bangladesh

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Abstract

The main purpose of the study is to explore the impact of macroeconomic variables, such as GDP growth rate (GDPGR), inflation rate (INF), the real exchange rate (RER), and balance of trade (BOT) on foreign direct investment the FDI in Bangladesh. Data has been gathered from the World Bank's data indicators for the years 1987-2022. Our result shows that there is a significant and positive correlation between the macro variables and FDI. Additionally, the macro variables are co-integrated and have both short-run and long-run relations with FDI. We also observe that there are unidirectional relations of GDP growth and real exchange rate with foreign direct investment. On the contrary, there is a non-directional causality between the balance of trade and FDI along with inflation and FDI. Thus, for attracting foreign investors, the government of Bangladesh and economic policymakers should focus on and critically analyze macroeconomic aspects that highly influence the FDI in Bangladesh.

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1. Introduction

Foreign nations easily look for nations with a strong history in the economic and social sectors when making long-term investments that profit from maximizing profits. Foreign direct investment is crucial for the long-term growth of the global economy because it generates new capital, transfers technologies, boosts competition and creates jobs. One crucial element in the development of emerging nations is direct investment. Homogeneous capital flows are frequently intended to increase a nation's profitability. Diverse forms of foreign direct investment exist. International businesses make investments in their home countries and contribute money for the construction of new facilities, structures, machines, etc. The purpose of capital investment is to increase the operational level and replace old or inefficient assets. The goal of direct investment from the host nation is to boost the revenue and output of businesses from the nation of origin. According to recent data from Bangladesh Bank, the foreign direct investment (FDI) of Bangladesh in 2022 was \$1.36 billion which declined by 10.26% from the previous (2020). And after 2018, the FDI of Bangladesh is continuously decreasing. Thus in 2018, the FDI of BD was \$2.42 billion which is higher than the current year's FDI of Bangladesh. And one country's FDI is highly influenced by various macroeconomic factors. The flow of foreign direct investment (FDI) which is significantly impacted by macroeconomic factors, is the most crucial component in promoting economic progress or distress in any nation. Direct investment is regarded as a crucial tool for economic growth, particularly in developing nations. The developing economies of the home country can benefit from FDI if it is directed in the appropriate direction. It has shown to be the most flexible foundation of outside resources for a growing nation like Bangladesh. As the primary force behind the economy as a whole and emerging markets, foreign direct investment (FDI) is monitored and disputed. The influence of foreign direct investment on macroeconomic performance is the subject of numerous research.

Additionally, changes in the money supply and demand as well as long-term resources like foreign direct investment affect how much the value of export and import flows move. Like as Exchange rates play a significant role in determining global trade. Inflation rates, GDP, and currency rates are further determinants of the marginality of foreign direct investment. Interest rates are a common macroeconomic indicator, and their stability or volatility reflects a country's macroeconomic position. FDI has a positive or negative association with the economic growth of a nation depending on changes, rises, or decreases in macroeconomic variables. The connection between macroeconomic variables and FDI is well understood and this study should pay attention to it. In this study, several macroeconomic factors to see how they impacted FDI will be highly used. Gross Domestic Product (GDP), Real Exchange Rate (RER), Inflation (INF) and Interest Rate (INT), Gross National Income (GNI), and Unemployment Rate are the macroeconomic indicators that will be looked at in this study.

This study's main objective is to evaluate the impact of these macroeconomic variables on FDI in Bangladesh as well as Bangladesh's economic expansion. To do this, a historical and statistical examination of the relationship between the trends of FDI inflow and specific macroeconomic variables 'impact on FDI is conducted.

The objective of the study is to clarify this gap regarding the empirical data from Bangladesh. Thus, the following hypotheses were investigated in this study:

H1: There is a significant positive relationship between FDI and GDP growth rate in Bangladesh.
H2: There is a strong negative relationship between FDI and the inflation rate (INF) in Bangladesh
H3: There is a significant negative relationship between FDI and foreign exchange rate in Bangladesh.
H4: There is a strong positive relationship between FDI and BOT in Bangladesh

We consider that our research contributes to the current literature, as no one has yet made any research on the effect of balance of trade on FDI in the context of Bangladesh as well as has not shown the impact of macro variables on FDI after Covid-19 due to during pandemic years' data were not used in the previous studies.

2. Literature Review

According to Rogaczewski (2020), the International Monetary Fund (IMF) defines FDI as investments that are made with the intention of acquiring a long-term stake in businesses that are not part of the investor's own economy. The IMF also classifies an investment as FDI if the investor maintains a partial ownership share of at least 10% and exercises a sizable amount of management control. Whereas according to Abel et al. (2018), an enterprise that is located in one economy and in which an investor located in another economy acquires, directly or indirectly, 10% or above of its voting power, or the equivalent of an unincorporated enterprise is known as foreign direct investment enterprise. An investor's ability to effectively participate in the management of the company is generally accepted to require ownership of at least 10% of the voting power of the company.

According to Shrestha and Bhatta (2018), researchers need to check whether the chosen variables are stationary or non-stationary for choosing the right statistical tests which may provide the best hypothetical results. Hence when the variables are stationary at the level, it is better to choose the OLS method for measuring key relations between independent and dependent variables. But If the variables are stationary at 1st difference or used mixed variables, Johansen co-integration and ARDL models are highly effective in measuring long-run and short-run relations between independent and dependent variables. Thus for con-integrated relations, the error correction model (ECM) and the Causality Test are highly suitable for determining the overall impact of each independent variable on the dependent variable. According to this article, for ensuring the same flow of used variable values, logical data transformation (Log) has provided greater significance in statistical hypothesis testing. And based on Rahman (2015), in terms of trade deficits or negative values, logical transformation with clear rationale and caution may ensure higher transparency and clarity in research findings due to negative values or trade deficits also representing a significant flow of goods or amount of money.

According to Casson and Silva (2013), the ability of a democracy to draw FDI was more dependent on economic factors. Empirical studies revealed that secondary education and per capita income had a favourable impact on foreign direct investment. Additionally, the balance of payments deficits, rising wages, and inflation all hurt foreign direct investment. Foreign direct investment has decreased as a result of rising inflation rates, rising wage expenses, and deficits in the balance of payments in emerging nations. According to Serem (2022), the effect of inflation, real interest rate, real exchange rate and development expenditure highly changed the foreign direct investment of Kenya. And in this study, the data between 2002 and 2013 was used for running a regression model and correlation analysis to analyze the hypothesis. And the study's key findings show the real interest rate, inflation, and real exchange rate all had negative effects on FDI, while there was a positive correlation between development spending and FDI.

According to Hossain (2016), Pakistan's ability to attract foreign direct investment is significantly influenced by the growth rates of Pakistan's GDP, exports, imports, and balance of payments. To evaluate the study's main hypothesis, hierarchical multiple linear regression was employed. And this study was conducted for depth analysis of the impact of moderate political stability on the relationship between macroeconomic trade-offs, variables of the business climate, and FDI inflows in the future study. According to Mahmoodi and Mahmoodi (2016), dictatorship and the instability of democracy are major factors in the dramatic changes in currency rates which have a negative influence on FDI inflows into Pakistan. High manufacturing costs and high inflation are the results of exchange rate volatility. Consequently, foreign investors are hesitant to make investments in Pakistan. According to Alfaro and Charlton (2007), since 1999, Nigeria has seen an upsurge in FDI thanks to democratic governance and generally tranquil processes. The government should permit additional currency depreciation since it will lower the dollar value of some struggling domestic industries and draw more foreign investment in the form of mergers or acquisitions.

According to Rahaman and Chakraborty (2015), this empirical study primarily focused on Bangladesh and examines the causal relationship between foreign direct investment (FDI) and gross domestic product (GDP). According to the study's findings, Bangladesh needs to improve its infrastructure, train its

workforce, address its lack of power and electricity generation, create an investment-friendly macroeconomic environment, and maintain political stability in order to significantly increase the amount of foreign investment it receives. And for evaluating the existence and nature of the influence of FDI on Bangladesh's GDP from a developing country's perspective, the Granger causality test was conducted. Thus this model was developed to ensure the presence of a uni-directional causal relationship that goes from foreign direct investment to GDP and a co-integration test to confirm the existence of a long-run equilibrium relationship. Hence according to Quader (2009), macroeconomic determinates positively influenced the FDI. Additionally, it is discovered that two-year delayed FDI values and changes in the level of domestic investment have a significant positive impact on economic growth. By using extreme bounds analysis to the time series data from 1990 – 1991 to 2005 – 2006, the spark variables of FDI inflows in Bangladesh are investigated in this research. Here ordinary least square regression model was used to conduct the analysis and for hypothesis testing.

According to Kh and Rehman (2017), there is a very substantial correlation between unemployment and FDI inflows; if unemployment rises by 1%, FDI will rise by 32%. The average tax rate is positively correlated but not significantly so. During the study period, there was no significant correlation between FDI and inflation. Only multiple regression was run for hypothesis testing as well as showing a negative relationship between FDI and unemployment rate. According to Diouf and Hai (2017), FDI in DCs and LDCs is substantially different in terms of its character, volume, and impact. They discovered that the underlying variables that affect where FDI activity occurs in different nations differ systematically between LDCs and DCs; the impact of FDI on economic growth is only supported for LDCs in the aggregate data, not for DCs; and FDI is much more likely to crowd in domestic investment for LDCs than DCs.

According to Gaikwad (2013), this issue for 23 developing countries and found that cheap labour was a major source of FDI. They also discovered that growing urbanization promoted the attraction of foreign direct investment. Thus, they conclude that elements such as supply and demand, which can raise firm profitability, are crucial in encouraging FDI. And also demonstrated a positive relationship between the GDP and FDI of the Indian economy. Descriptive statistics, Visual graph, Cobb – Douglas production function and ARDL method were used to achieve the paper's goal and effectively measure the short-run and long-run relationship. According to Mostafa (2020), the long-term effects of inflation on FDI were significantly negative, whereas the short-term effects were negligible as well as the dependent and independent variables had a sustainable relationship. The findings also demonstrated a strong long-term and short-term positive relation between exchange rate and FDI That implied, a decline in the value of the Bangladeshi Taka relative to the US Dollar encouraged FDI inflows to Bangladesh. Conducting the objectives of the study, time series data on dependent and independent variables were collected from various secondary sources covering the period 1980 to 2017. To define the purpose, the study employed different econometric techniques such as the Augmented Dickey-Fuller (ADF) test, Johansen Co-Integration Test, and Vector Error Correction Model (VECM) (Tamizharasan, 2018).

According to Okafor (2012), real gross domestic product, interest rate, and real exchange rate are key determinants of foreign direct investment in Nigeria. And its analysis suggested that these domestic macroeconomic variables are critical to FDI inflow. Additionally, the proper improvement of the macroeconomic environment encourages the flow and benefits of foreign direct investment in developing countries like Nigeria. In this study, an empirical analysis was practised for measuring the relationship of key domestic macroeconomic variables on Foreign Direct Investment in Nigeria by conducting ordinary least square estimation techniques. Hence unit root test, cointegration test etc. were conducted for completing the whole analysis.

According to Apergis et al. (2007), FDI can positively contribute to economic growth in developing countries as well as FDI can meet the need for capital formation in developing countries through capital investment, which can boost economic growth. And that concept is supported by Morrissey (2012) who suggested that the resource gap in many developing countries can be filled in part by foreign investment. For instance, by boosting capital formation, FDI has facilitated an economic expansion in South and East

Asia. Thus according to Bielikova and Paliderova (2017), physical infrastructure like industries and roads can be built with the help of foreign investment. The host country's capacity to absorb investment will rise as a result of improved physical infrastructure, potentially bringing in more FDI.

3. Research Methodology

The study's methodology is entirely quantitative. The study has only used numerical data and different empirical analyses are used to estimate the degree of the defendant's relationship to the independent factors. And for completing this quantitative research, raw data of the considering dependent and independent variables are used. An all-encompassing strategy for conducting research is known as a research strategy. And in this research, the impact of macroeconomic variables on foreign direct investment in the context of Bangladesh is analyzed numerically. And for conducting the research, a detailed descriptive and analytical design is to be applied to the proper findings of the study. This study has been made by using secondary data that has been gathered from national and international data indicators. All data have been reported and analyzed as time series because the values used in the study have to be periodically recorded numbers. From 1987 to 2022, an annual value for each variable was utilized to conduct the study. The data has been used for the study's analysis ranged from 1987 to 2022. The data for Bangladesh's Gross Domestic Product Growth Rate (GDP), Inflation Rate (INF), Real Exchange Rate (RER), and Balance of Trade (BOT) has been collected from the World Bank's data indicators, Bangladesh Bank, Microtrends.net (www.macrotrends.net) etc.

In developing this model, data collection, recording, and analysis have been done in a methodical and objective manner. To determine the outcome of the hypotheses, it has attempted to identify the problems while avoiding the distorting effect of personal bias. After choosing and evaluating a course of action, the secondary data is to be analyzed. Whenever a population database is too large, a sample size of the population with standard characteristics can be established. And the sample size will be sufficient in amount to reflect the true scenario of the research as well as to complete the numeric analysis, the last 36 years' data will be used. Thus the most practicable sampling approach in this circumstance as well as for this quantitative analysis, probability sampling i.e. cluster sampling is to be used. For our analysis, one independent variable and four dependent variables are to be considered to define the proper findings as well as evaluate the data. Hence due to data differentiation in values (both percentage and millions of dollars' values), logical transformations (log format) are used. Thus balance of trade shows trade deficits which are imputed as negative values but conceptually trade deficits also represent a flow of goods or an amount of money. Thus its logical transformation is used for conducting the research based on Rahman (2015). We consider Foreign Direct Investment (FDI) as a dependent variable and Domestic Product Growth Rate (GDPGR), Balance of Trade (BOT), Inflation Rate (INF), and Real Exchange Rate (RER) as independent variables. This study has carried out a statistical analysis approach to determine the outcome of the research. As the study has used numeric data for statistical analysis, for testing the hypothesis, statistical analysis has to be appropriate for the study. Thus as following the base article "Shrestha and Bhatta (2018)", Unit Root Test (Augmented Dickey-Fuller Test), Johansen Co-integration tests, ARDL models, Granger Causality test etc. are used. Hence several alternative tests for data and model's variability and effectiveness, Heteroskedasticity test, Normality test, and Multicollinearity test are also enrolled. Hence ordinary least-square method is also run as an alternative test for measuring the relationship between independent and dependent variables. And based on Arun and Kumar (2017), those analyses were to be effective for analyzing the remaining data set.

3.1 Unit Root-Augmented Dickey-Fuller Test

To avoid erroneous regression, we first look into the characteristics of the time series data we are working with to see if the variables are stationary or nonstationary in nature. Unit root testing for stationarity is done using the Augmented Dickey-Fuller Test (ADF). In your time series analysis, unit roots may produce unexpected findings. Serial correlation can be used in conjunction with the Augmented Dickey-Fuller test. Compared to the Dickey-Fuller test, the ADF test is more potent and capable of handling more complicated

models. However, because it has a rather high Type I error rate, like the majority of unit root tests, it should be used with caution. The ADF test is the same as the Dickey-Fuller test in the testing procedure, but we consider the AR (p) equation:

$$y_t = \alpha + \gamma t + \sum_{i=1}^{p} \beta_i \, y_{t-i} + \varepsilon_t$$

$$\Delta y_t = \mu + \gamma t + \alpha \, y_{t-1} \sum_{i=1}^{p} \beta_i \, \Delta y_{t-i} + \varepsilon_t$$

Where $\lambda 0$ is a constant term, n for the lagged difference term, $\lambda 2t$ represents the trend, $\Delta Y_t = Y_t - Y_{t-1}$ and εt is a pure white-nose term.

3.2 The Auto Regressive Distributed Lag model (ARDL)

ARDL model is the common econometric model which is highly used by researchers for measuring the short and long-run relationship between dependent and independent variables. The Auto Regressive Distributed Lag model is highly effective in time series data as well as when researchers follow the mixed variables to find the study's objectives. Thus where the used variables are integrated into several roles like the used variables have different levels of stationary, this model is developed for handling the mixing variables. I (0) and I (1) which indicate respectively integrated of order at level (0) and integrated of order at 1st differences (1) that are allowed in this model for designing the same regression framework.

$$y_t = c_0 + \sum_{k=1}^{p} \beta_k \, y_{t-k} + \sum_{j=0}^{l} \alpha_{j+1} x_{t-j} + \mu_t$$

And ARDL model is highly used in mixed variables and also for the OLS model and bound testing by which the long-run relationship among variables is effectively measured. And for measuring the impact i.e. relationship of macroeconomic variables on FDI in the context of Bangladesh, the ARDL model is used for this empirical research.

3.3 Heteroscedasticity test

Although heteroscedasticity is a challenging word to say, it need not be a challenging idea to comprehend. Heteroscedasticity, to put it simply, is the situation where a variable's variability is unequal throughout the range of values of a second variable that predicts it. Based on their observations, a line was predicted in the linear regression. A heteroscedasticity mistake occurs when the observations do not belong to the same group or category.

3.4 Johansen Co-integration test

For determining the relationship between independent and dependent variables, the Johansen co-integration test is quite useful. Moreover, the co-integrating relationship between macro variables and FDI was determined by the Johansen co-integration test. Also, this study aids in determining whether or not the used variables have a co-integration relationship.

3.5 Granger Causality Test

Granger causality is a statistical method for figuring out whether one time series causes another to be predicted. According to Granger causation (1969) is:

A variable Y is causal for another variable X if understanding its history helps predict the state of X in the future more than understanding its history alone. So, we can identify that considering Y as a predictor if X gets improvement, we can consider Y as Granger Cause for X. Hence in the Ganger Causality test the relationship between two variables is considered as unidirectional, bidirectional, and neither bilateral nor unilateral. Thus bidirectional means when both variables significantly influence one another. And in unidirectional casualty, one variable influence another but another variable does not have causality with another. Thus in bilateral causality, both independent and dependent variables do not have causality and significant relation with each other. Thus there is no direction between the two variables. Only for statistically stationary time series, we can apply the Granger Casualty test. The equation of the Granger Causality test is shown below:

$$Y_t = \sum_{i=1}^{n} \alpha_i\, Y_{t-i} + \sum_{j=1}^{n} \beta_j X_{t-j} + \mu_{1t}$$

$$X_t = \sum_{i=1}^{n} \lambda_i\, Y_{t-i} + \sum_{j=1}^{n} \sigma_j X_{t-j} + \mu_{2t}$$

The first equation implies that the current Y_t is prepared based on its past values as well as that of X_t and vice versa. Unidirectional causality from X_t and Y_t Is indicated if the estimated coefficient on the lagged X_t is statistically different from zero as a group (i.e., $\Sigma\beta j \neq 0$) and the set of estimated coefficients on the lagged Y_t is not statistically different from zero if ($\Sigma i \lambda \neq 0$). The converse is also the case for unidirectional causality from Y_t to X_t. Feedback or bilateral causality exists when the sets of X_t and Y_t coefficients are statistically different from zero in both above regressions.

3.6 Regression Analysis

According to Khan and Rehman (2017), to measure the significant relationship between dependent and independent variables in any numeric analysis, the OLS method is highly effective and for determining the impact of macroeconomic variables on FDI, the OLS method has provided effective outputs. And by supporting this article, the OLS method is also used to determine the objectives of the study. The fundamental framework for the time series data is defined according to the following regression model:

$$Y_{it} = a + bx + \mu_{it}$$

Where Yit is the dependent variable, a is the coefficient or intercept term, b is the coefficient, x is the given observations or samples, and the unit is the residual. And for OLS, the above tests like correlation test, normality test, heteroscedasticity test, cook's test as well as interquartile range tests are conducted in this study.

4. Analysis & Findings

4.1 Descriptive Statistics

Table 1: Summary Statistics; using the observations 1987 – 2022

	LFDI	*LGDPGR*	*LINF*	*LRER*	*LBOT*
Mean	5.2737	1.6562	1.7568	4.0501	8.9902
Standard Error	0.3424	0.0463	0.0682	0.0563	0.0000
Standard Deviation	2.0544	0.2776	0.4094	0.3380	0.0002
Sample Variance	4.2206	0.0771	0.1676	0.1142	0.0000
Kurtosis	-0.0393	0.5922	1.0785	-1.2216	19.7472
Skewness	-1.0565	-0.9199	-1.0411	-0.4217	-4.0099
Range	7.5644	1.1823	1.7365	1.0866	0.0010
Minimum	-0.1054	0.8822	0.6967	3.4324	8.9893
Maximum	7.4590	2.0646	2.4332	4.5190	8.9903
Sum	189.8535	59.6220	63.2438	145.8046	323.6460
Count	36	36	36	36	36

(note: dependent variable: foreign direct investment (FDI); independent variables: GDP growth rate (GDPGR), inflation rate (INF), real exchange rate (RER), balance of trade (BOT))

Table 1 shows the summary of descriptive statistics of the used macroeconomic variables for the study. And these statistics are developed for measuring the entire descriptions of the used data for the study's statistical model as well as active to screen the following data for any suspicious figure.

Mean and Standard deviation: The statistical mean refers to the average that is used to derive the central tendency of the data in the observation. It is determined by adding all the data points in a population and dividing the total by the number of points. The resultant figure is referred to as the average or mean. We can see what many of the variables signify from the table above. All of them are positive variables. For example, the mean of the log of real exchange rate is positive (4.05). And that means the average value of RER's observation is almost 4.05 which used data has deviated from its mean to the extent of 0.11 times. Thus concerning the following macroeconomic variables, LFDI has the highest percentage of standard deviation and it has also the second-highest mean value (5.27). Thus standard deviation is used for measuring the dispersion of the data (how data is spread out). It demonstrates the variance between the observations and the sample mean. Again the standard deviation of FDI is 2.05 which indicates the changes of the data from its mean. Thus log of GDPGR has an average of 1.66 as well as its following data has deviated to the extent of 0.28 times from its mean value. Hence during the same study period, the mean value of LINF is 1.76 which data has changed over 0.41 times from its mean. Additionally, the mean value of LBOT in the belonging period is 8.99 which data has spread out by 0.02%.

Maximum and Minimum value: Maximum and minimum value shows the highest and lowest values of the given observations. Based on Table 1, the LFDI of Bangladesh expound a moderate disparity among multiple years with a minimum of -0.1054 and a maximum of 7.46 Additionally for the same period, LGDPGR has shown a minimum of .8822% and a maximum of 2.06. Hence the economic growth as highly peroxided by the natural growth of LRER with a minimum value of 3.43 and a maximum value of 4.52. Thus the minimum and maximum values of LBOT during the same period are respectively 8.98 and 8.99. And these values are recorded for LINF at almost 0.69 and 2.43.

Skewness: The value of skewness is used to measure the degree of asymmetry of the series. If the skew is 0 it means the distribution is symmetric around its mean and it's called normal skewness. If the skew is positive (or greater than 0) it shows the long right tail distribution. A negative value shows the long left. Tail distribution of the observation. Here LGDPGR has a 0.59 long right tail because 0.59> 0 (positive skewness) and the log of FDI has a long-left tail (negative skewness) because -1.06< 0

Kurtosis: The calculated value of Kurtosis is used to measure the peak or flatness of the distribution of the series. In a normal distribution, the result of kurtosis is 3 and it is called mesocratic. If the kurtosis is (greater than 3) positive, it is called leptokurtic and the distribution curve is peaked. If the kurtosis is negative or less than 3 it is called platykurtic and the distribution curve is flattered. For example, in the above table log of the real exchange rate's kurtosis is -1.22 < 3 so it is platykurtic.

4.2 Augmented Dickey-Fuller test

Table 2 shows the unit root test results of all used macroeconomic indicators in the context of Bangladesh. And it is important that the used macroeconomic variables must be stationary as well as if the variable is not stationary, it is assumed that deterministic trends are included in these variables. And for checking whether the time series data are stationary or non-stationary, an Augmented Dickey-Fuller (ADF) unit root test has been applied to choose the variable.

Table 2: Unit Root- Augmented Dickey-Fuller test; using the observations 1987 – 2022

Variables		*At Level*	*1st Difference*
LFDI	P value	0.0087*	0.0000*
	t-Statistics	-2.812716	-6.369978
LGDPGR	P value	0.0013*	0.0000*
	t-Statistics	-3.507352	-7.483938
LBOT	P value	0.1566***	0.0067*
	t-Statistics	-1.449520	-2.900590
LINF	P value	0.0003*	0.0000*
	t-Statistics	-3.997446	-7.137270
LRER	P value	0.1062***	0.0001*
	t-Statistics	-1.661047	-4.302691

(note: dependent variable: foreign direct investment (FDI), independent variables: GDP growth rate (GDPGR), inflation rate (INF), real exchange rate (RER), balance of trade (BOT) included with lags for autocorrelation in the time series; first difference of time series denotes the co-efficient of 1 for figuring out the differencing of time series; H_0 = series has unit root; H_1 = series has trend stationary *MacKinnon critical values for rejection of null hypothesis; *, ** & ***indicates statistically significant at 1%, 5% and 10% significance level respectively; at P values is less than 0.05 at 95% confidence level the null hypothesis is rejected i.e. stationary at level)

   In the above table, the level of stationary is shown by the Augmented Dickey-Fuller (ADF) unit root test. Here foreign direct investment, GDP growth rate, inflation rate etc. are stationary at Level as well as real exchange rate and balance of trade are stationary at 1st difference.

Based on Prakash and Kumar (2017), LFDI, LGDP, LINF, LRER etc. all are stationary after the first differences I (1) and highly integrated of order one, I (1). And all these variables are not stationary at level as well as it has clarified that it is necessary for the data to be stationary to avoid deterministic trends. Thus according to Nwagu (2023), to ignore erroneous regression results, it is needed that all variables are stationary at level but all variables like GDP, FDI EXR etc. are stationary at 1st difference I (1) and only INF is stationary at level. And in this case, ARDL models are highly effective in measuring the relationship between independent and dependent variables.

According to Islam, and Sahajalal (2019), for testing each variable's level of stationary, FDI and RER are stationary at 1st difference as well as GDP is stationary at the level. And the rejection of the null hypothesis against the alternative hypothesis indicates that all the time series variables are stationary and integrated in the order of zero and one.

4.3 ARDL Models

   For measuring the short-run co-integration between independent variables and dependent variables, ARDL models are highly used. And ARDL model suggests that the log-dependent variable is significantly affected by log-independent variables in the short run. And based on Nwagu (2023), all variables are co-integrated in a mixed order of I (1) and I (0) as well as it has also clarified that all used variables like LFDI, LGDP, LINF, LRER etc. are co-integrated are both short-run and also long-run. And that indicates there is a co-integrated connection between FDI and the rest of the independent variables. Thus based on Table 3, all independent variables have a co-integrated connection with FDI.

Table 3:Short Run co-integration (ARDL model); using the observations 1987 – 2022

Dependent Variable: FDI				
Dynamic regressors (1 lag, automatic): LOG GDPGR, LOG BOT, LOG INF, LOG RER				
Fixed regressors: C				
Selected Model: ARDL				
Variable	Coefficient	Std. Error	t-Statistic	Probability*
LFDI(-1)	0.580	0.170	3.415	0.002*
LGDPGR	1.519	0.788	1.926	0.044**
LINF	-0.154	0.397	-0.387	0.701***
LBOT	931.024	963.671	0.966	0.342***
LRER	1.333	1.251	1.0657	0.049**
C	-8375.754	8665.511	-0.9665	0.141***
Adjusted R-squared	**0.840568**			
Prob(F-statistic)	**0.000000***			

(note: dependent variable: foreign direct investment (FDI); independent variables: GDP growth rate (GDPGR), inflation rate (INF), real exchange rate (RER), balance of trade (BOT) included with lags; independent variables' lagged values (LGDPGR, LINF, LBOT, LRER) denote the significant relationship with dependent variable's lagged value (LFDI); *, ** & ***indicates statistically significant at 1%, 5% and 10% level respectively; **(*) denotes statistically significant at 95% confidence level)

Hence according to Appendix 1.4, the variance of residual is homoscedasticity. Thus the P value is greater than 0.05 (0.05<0.2654) which indicates heteroskedasticity is not present and there is a homoscedasticity nature. Thus according to Arun and Kumar (2017), when the P value is higher than 0.05 at the significance level, the null hypothesis is accepted which indicates heteroskedasticity is not present. And the result shows that the observations are from the same group or stayed in the same category. Hence according to Appendix 1.6, the data are normally distributed. Thus the Jarque P value is higher than 0.05 which indicates the null hypothesis is rejected as well as the normal distribution of the used data.

Again if the data are non-stationary at level or used mixed variables Granger Causality test is also effective in showing relations. Thus based on Kwoba and Kibati (2016), the independent variables have both positive and negative correlations with the dependent variables as well as FDI is highly correlated with GDPG, INF, RER etc. and there has no multicollinearity problem along the correlation value has stayed between 0.8 to 0.8. thus based on Appendix 1.5, there is no multicollinearity problem among the used variables.

4.4 Johansen Co-integration test

Johansen's co-integration test is highly effective for measuring the relationship between independent and dependent variables. And by Johansen's co-integration test, the co-integrating relationship between macro variables and FDI. And this analysis helps to identify whether there exists a co-integration relationship between used variables or not. It helps to find more than one co-integration relationship between the used time series data. According to Ugonna & John (2022), when all variables are stationary at 1st difference, the Johansen co-integration test has provided the best relationship between independent and dependent variables. And this model highly shows the long-run study relations between variables as well as it has shown that FDI and GDP along with other macro variables have a long-run relationship in the context of the Nigerian economy.

Table 4: Johansen co-integration test of FDI and macro-variables; using the observations 1987 – 2022

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.616414	78.89383	76.97277	0.0354
At most 1	0.424260	46.31531	54.07904	0.2046
At most 2	0.303426	27.54393	35.19275	0.2623
At most 3	0.269643	15.25015	20.26184	0.2124
At most 4	0.125683	4.566626	9.164546	0.3343

(note: Trace test indicates 1 co-integrating eqn. (s) at level 0.05 level *denotes rejection of the hypothesis at the level 0.05 level ** Mackinnon-Hauq-Michelis (1999) P values)

In order to accept the co-integrating relationship between variables, the Trace and Max-Eigen Statistics value might be higher than the critical value at a 10% significance level as well as the P value is lower than 5% (0.03). Thus there has existed a co-integrating relationship between variables. And the result is supported by Prakash and Kumar (2017). According to Arun and Kumar (2017), the Trace test indicates 1 co-integrating eqn. at a 5% significant level, the null hypothesis is rejected. Thus the conducting co-integration test shows that the variables are co-integrated with FDI at a 5% significance level due Trace test indicating 1 co-integrating equation at that significance level.

4.5 Granger Causality Test

Granger causality test is a particular statistical hypothesis test to determine whether one-time series data is useful in predicting another as well as it is also used to measure the unidirectional relationship. Granger causality test results have shown the unidirectional relationship between the log of gross domestic product growth and FDI, the log of the balance of trade and FDI, the log of the inflation rate and FDI, and the log of real exchange rate and FDI. According to Tripathi, and Bhandari (2015), when both pairs show a significant result, it indicates a bi-directional causality relationship between independent and dependent variables.

Table 5: Granger Causality Test of FDI and Macroeconomic Indicators(Lags 1); using the observations 1987 – 2022

Null Hypothesis:	Obs.	F-Statistic	Prob.
LGDPGR does not Granger Cause LFDI	35	1.13447	0.2948***
FDI does not Granger Cause GDPGR		6.37374	0.0167**
LRER does not Granger Cause LFDI	35	3.41350	0.0074*
LFDI does not Granger Cause LRER		0.33872	0.5646***
LINF does not Granger Cause LFDI	35	0.04831	0.8274***
LFDI does not Granger Cause LINF		1.95079	0.1721***
LBOT does not Granger Cause LFDI	35	0.00045	0.9833***
LFDI does not Granger Cause LBOT		0.01216	0.9129***

(note: H_0 =variables have no co-integration; H_1 = variables have co-integration; * (**) denotes rejection of null hypothesis at 5% (1%) significance level at 95% confidence level; *** denotes the acceptance of alternative hypothesis: no co-integration)

Pairwise Causality test; LGDPGR and LFDI: According to Table 5, there is a unidirectional relationship between GDPGR and FDI, as well as the null hypothesis, is rejected due to the P value is not significant (0.05<0.29). So GDPGR does not Granger cause on FDI. Hence there is a significant relationship between FDI and GDPGR. According to Rahaman and Chakraborty (2015), when a pairwise test indicates one significant and one insignificant relationship on each side of the independent and dependent variable, the relationship is unidirectional. However, according to Prakash and Kumar (2017), GDP growth does not Ganger to cause FDI as well as FDI does not Ganger cause GDP growth and there is a non-directional relationship between them. Hence according to Amoah et al., (2015), FDI has long-run relations with FDI and its result is also consistent with the existing result of the study. However, the result is different from Meftah and Nassour (2019) who found there is no casualty between GDPG and FDI.

Pairwise Causality test; LRER and LFDI: Based on Table 5, the real exchange rate significantly affects foreign direct investment. Here null hypothesis is rejected due to the P value is lower than 5% but there is a unidirectional relationship between RER and FDI. According to Tripathi and Bhandari (2015), when the P value is lower than 0.05 at the level, there is a significant relationship as well as a causality relationship. Hence, there is a unidirectional relation between LRER and FDI and the result is similar to Kosteletou and Liargovas (2000), and Phillips and Ahmadi-Esfahasi (2008) which find the causality runs from the LRER to LFDI. And the result is different with Meftah and Nassour (2019).

Pairwise Causality test; LBOT and LFDI: Considering Table 5, the P value is not significant, and the null hypothesis is accepted. Balance of trade is much more likely to attract foreign direct investment inflows but fails to show any significant relationship with FDI in Bangladesh. According to Jordaan, and Eita (2007), when both pairs have not shown insignificant results i.e. P value is higher than 0.05, there has shown a non-directional or unilateral relationship between both variables. And there is a non-directional

relationship between BOT and FDI. And this result is highly similar to Varamini and Kalash (2010) whose study clarified that there are no long-run relations or ganger causes between the balance of trade and foreign direct investment. This result is dissimilar to Hobbs et al. (2021) which finds there is a significant impact on trade balance as well as there shows a unidirectional relation between trade balance and FDI.

Pairwise Causality test; LINF and LFDI: According to Chowdhury et al. (2019), the P value is not significant and the null hypothesis is accepted which indicates LINF does not have Granger cause to LFDI. And the converse is true as the P value (0.1721) is not significant which indicates LFDI does not Ganger cause LINF. And based on Arun and Kumar (2017), due to the present both significant and insignificant levels, there is a unidirectional relationship between INF and FDI. And this result is supported by Meftah and Nassour (2019) and Alshamsi et al., (2015) as well as based on their research outcomes, there is no effect of inflation on FDI. However, the result of Mason & Vracheva (2017) is not consistent with the existing results and there is a positive relation between INF and FDI.

4.6 Ordinary Least Square Method

According to Okafor (2012), the correlation test, normality test, heteroskedasticity test, cook's test as well as interquartile range are used as assumptions of the OLS method of analysis. And in this study, those tests are conducted for use as assumptions of OLS.

Table 6: Assumptions of the OLS model

Test	Remark
VIF (Multicollinearity)	<10
Shapiro-Wilk W Test (Normality)	0.5386***
Breusch-Pagan-Godfrey (Heteroskedasticity)	0.5602***
Interquartile range	Yes**
Cook's Test (Fitness)	Yes**

(note: VIF (Multicollinearity) >10> denotes the level of Multicollinearity in the model; H_0 = the data follows normal distribution; H_1 = the data doesn't follow normal distribution; ** (***) denotes statistically significant and insignificant level at 5% significance level Shapiro-Wilk W Test (Normality); *** denotes statistically insignificant (no significant evidence of Heteroskedasticity) at 5% level; having significance (**) in interquartile range and the model's fitness)

Based on Mostafa (2020), if the variance inflation factor (VIF) is more than 10 Multicollinearity problem prevails in this model. Based on table 7, the value of all the variables is less than 10 so there is no evidence of excessive collinearity. Thus the p-value of this analysis is 0.997042 which is more than 0.05. And that result implies residuals are normally distributed. And considering the assumptions result of Islam and Sahajalal (2019), the assumptions of the ordinary least square testing can be valid for this research.

Table 7: Ordinary Least Square Method; using the observations 1987 – 2022

Variables	t-ratio	p-value	Significant or not significant
C	-2.279317	0.0297**	The significant level of 5%
BOT	2.279317	0.0298**	The significant level of 5%
GDPGR	1.289171	0.2069***	Not significant
INF	0.666097	0.5103***	Not significant
RER	6.426933	0.0000*	The significant level of 5%
R-square	0.785313		
Adjusted R-square	0.757611		
Prob.(F-statistic)	0.000000*		

(note: independent variables: balance of trade (BOT), GDP growth rate (GDPGR), inflation rate (INF), real exchange rate (RER) denote the predictor variables for explanation the dependent variable: foreign direct investment (FDI); Intercept (C) denotes the expected value of dependent variable (FDI) in terms of constant (remain 0) independent variables; R-square denotes the variance proportion in the dependent variable (FDI) explained by independent variable; **p>0.05, ***p<0.05 at 95% confidence level; *(**) denotes statistically significant level at 5%)

4.7 Impact of GDP growth rate on FDI
The following regression equation is found,

$Y_1 = 1.1595 + 1.2891X$

Here Y_1 = FDI and X = GDP growth rate

Variables	Coefficient	t-ratio	p-value
GDPGR	1.1595	1.2891	0.2069***

(note: ***denotes the insignificance at 95% confidence level)

According to the OLS analyzed table, the GDP growth rate is not significant due to the P value being higher than 0.05 (0.2069 > 0.05) as well as the coefficient is also positive (1.15958). And the test is not significant and there is no linear relationship between FDI and GDP growth rate in this model. According to Khan and Rehman (2017), the positive correlation of the coefficient shows that the independent variable has a high degree of correlation with the dependent variable and based on this research, GDP growth positively influences foreign direct investment. Based on the research of Rogaczewski (2020), the GDP growth rate negatively impacts FDI in the context of Germany as well as it is a significant influence on the country's FDI. Hence based on the opinion of Rahman (2015), there is a linear relation and positive impact of GDP growth on foreign direct investment.

4.8 Impact of the balance of trade on FDI
The following regression equation is found,

$Y_2 = 2284.6947 + 2.2793X$

Here Y_2 = FDI and X = Balance of trade

Variables	Coefficient	t-ratio	p-value
BOT	2284.6947	2.2793	0.0297**

(note: **denotes the data pass the significance test at 95% confidence level)

Based on the table, BOT is significant because the P value is lower than 0.05 which is 0.0297 as well as has a positive coefficient which implies there is a positive relationship between BOT and FDI. According to Rahman (2015), the balance of trade does not significantly impact foreign direct investment as well as has a negative relationship between the independent variable and dependent variable. And the above result is supported by this article. Thus the above result implies that BOT has a significant positive impact on FDI. Whereas, based on the research of Okafor (2012), the balance of trade significantly influences the foreign direct investment in Nigeria as well as has a negative impact on the country's FDI. Hence the result is similar to Kabi (2021) who finds that balance of trade has a significant positive impact on FDI.

4.9 Impact of inflation rate on FDI

The following regression equation is found,

$Y_3 = 0.28290 + 0.66609X$

Here Y_3 = FDI and X = Inflation rate

Variables	Coefficient	t-ratio	p-value
INF	0.28290	0.66609	0.51027***

(note: ***denotes the insignificance at 95% confidence level)

According to Table 7, the INF rate is not significant because the P value is higher than 0.05 which is 0.51027 as well as the coefficient is positive (0.66609). However, according to Rahman (2015), there is a positive significant relationship between FDI and inflation rate as well as IFR highly influences foreign direct inflow. Hence based on Mostafa (2020), if the inflation rate increases by 1%, then foreign direct investment in the economy also increases by 1%. And he showed in his study that the inflation rate has a significant and positive relationship with FDI in Bangladesh. Thus considering the above table, if the INF of Bangladesh is increased by 1% then the FDI of the country may also be increased by 4.37% as well as the inflation rate has a high degree of positive correlation with FDI. Whereas according to Khan and Rehman (2017), the inflation rate is insignificantly influenced the foreign direct investment as well as a negative correlation between INF and FDI. Additionally, its coefficients table shows that if 1 unit of Inflation increases the FDI will decrease by 0.10 units and has shown no significant relationship.

4.10 Impact of real exchange rate on FDI

The following regression equation is found,

$Y_4 = 4.80402 + 6.42693X$

Here Y_4 = FDI and X = Real exchange rate

Variables	Coefficient	t-ratio	p-value
RER	4.80402	6.42693	3.663E-07*

(note: *denotes the significance level at 95% confidence level)

The real exchange rate is significant because the p-value is less than 0.05 which is 0.0000' and the coefficient is 4.80402 that means if the real exchange rate is increased by 0.01 then the foreign direct investment will be increased by 6.42693. So, the Exchange rate has a positive impact on FDI. According to Islam and Sahajalal (2019), RER positively and significantly influence the foreign direct investment of Bangladesh and in this research, the data from 1976 to 2018 were used and the findings indicated that RER as an independent variable has a high degree of positive correlation with dependent variable i.e. FDI. Thus considering the above table, RER has a significant relationship with FDI and also a positive correlation to FDI. Based on the research of Gaikwad (2013), the real exchange rate of India negatively influences the country's FDI as well as has an insignificant relationship between these two variables. And the above

outcome is also supported by Khan and Rehman (2017) which also show that there is a linear relationship between RER and FDI.

From the above Ordinary Least Square model, Gross Domestic Product Growth Rate (GDPGR), Real Exchange Rate (RER), Inflation rate (INF) and Balance of Trade (BOT) data explained a 78.53% change in Foreign Direct Investment (FDI). And the most important thing is, that the P value of the overall model is 5.7895E-10 which is less than 0.05. So the decision is the Null hypothesis is rejected and the alternative hypothesis is accepted. So, there is a significant linear relationship between the independent and dependent variables in this model. Thus according to Chowdhury et al. (2019), R square implies variability and a high degree of correlation with the dependent variable in terms of independent variables. And according to Rahman (2015), macroeconomic variables like GDP growth rate, and inflation are positive and the balance of trade has a negative impact on FDI. And based on Khan and Rehman (2017), inflation has a negative and the exchange rate has a positive significant impact on FDI. However, the overall conclusion is those macroeconomic variables have a linear significant impact on foreign direct investment.

4.11 Findings

In this study, it is tried to assess the relationship between various macroeconomic factors and foreign direct investment in the context of Bangladesh using the annual data from 1987 to 2022. Thus the major findings of the above analyses are like:

➢ The ADF unit root test clarified that LFDI, LGDPGR, LINF are stationary at level I (0) but LRER and LBOT are stationary at 1st difference I (1). And for mixed variables Johansen Co-integration test and ARDL models are highly developed to measure the short-run relationship as well as Granger Causality test is also developed for long-run relations among variables. And in the case of the Johansen co-integration test, macro-variables and FDI are co-integrated as well as the used data are also normally distributed. Hence there is a short-run equilibrium relationship between the dependent and independent variables.

➢ Thus Heteroskedasticity test shows whether the observations are from the same category or not as well as whether sample data ranges are equal or unequal. And in this analysis, the sample data ranges are equal and from the same category. Thus the Ganger Causality test implies that there has existed a unidirectional relationship between LGDPGR and LFDI and also between LRER and LFDI but there as a non-directional relationship between LBOT and LFDI as well as LINF and LFDI. And these results are supported and different from multiple researchers which are also defined.

➢ Thus in the case of mixed variables Granger Causality test is highly developed but OLS also provides significant results to measure the impact of independent variables on the dependent variable. Hence the empirical results of the OLS method, log of trade balance and log of real exchange rate statistically significantly with LFDI whereas LGDP growth rate and LINF do not have any significant impact on LFDI. Thus there is a positive relationship between LFDI and both LBOT and LRER but has negative relationship with LINF and LGDP growth. However, the overall P value is significant which implies that macroeconomic variables significantly impact on log of FDI as well as those variables highly influence the LFDI. And the used independent variables have a high degree of positive correlation with the dependent variable. Thus LFDI of Bangladesh is significantly influenced by several macroeconomic variables like GDP growth, inflation rate, real exchange rate and balance of trade.

5. Conclusion & Recommendations

After the independence of Bangladesh, its economy has become stronger as well as the country has achieved millennium development goals along with sustainable development goals. Thus the increasing level of foreign direct investment ensures a better economy. For the economic development of Bangladesh, FDI is essential due to FDI supplies crucial finance towards the country by improving the level of national income. Additionally, a high level of income per capita attracts more investors to invest in our country. The government of Bangladesh has taken multiple initiatives and supporting activities to promote the investment climate through industrialization and privatization. Hence in most cases, weak infrastructure as compared to other countries as well as political instability highly distract the taking initiatives. Thus Bangladesh needs to be very concerned about the global economic situation and keep track of the global economic competition by generating an effective investment environment for foreign investment. Thus the administrative system must be reformed by ensuring appropriate and effective measures. Hence the bureaucracy needs to be recognized and also eliminated. Due to cheap labour costs, the availability of workers as well as the growing economy of Bangladesh, foreign investors highly focus on the country and enter its market. Hence macroeconomic variables highly influence foreign direct investment. Based on OLS analysis, the trade balances and real exchange rates significantly affect foreign direct investment. Hence according to the ARDL model, Co-integration tests and also Granger Causality test, there is a significant short-run and long-run relationship among the variables. Thus Granger Causality test implies that there are unidirectional relations between GDP growth and real exchange rate with foreign direct investment. On the contrary, there is a non-directional causality between the balance of trade and FDI along with inflation and FDI. Foreign direct investment in Bangladesh is highly influenced by the macroeconomic variables.

In this research, only four macroeconomic variables are used as independent variables which don't dignify the overall impact of macroeconomic variables on FDI in Bangladesh. Thus for further studies, more macroeconomic variables will be used to identify the overall macroeconomic impact on FDI. Thus the balance of trade of Bangladesh has continuously shown a negative percentage over the period due to the country's imports are always higher than exports. Hence, the negative value may create conflicts and also show insignificant results in several statistical models. However, it may be better to use the imports and exports portion as macro factors individually instead of the balance of trade for further research. And the researchers may avoid the negative values problem which may smooth their model's significance. Hence unemployment rate, interest rate, poverty rate, tariff rate etc. will be used as macroeconomic indicators as well as to show their impact on FDI. Thus in further studies, the range of data will be expanded by taking the monthly data of each variable. Thus in this study, time series data is considered but in further studies, cross-sectional data will be effective to find out the findings of the objectives. Thus further studies on this research phenomenon by reducing the limitations of this study are highly encouraged.

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