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TIME - SERIES CO - INTEGRATION EVIDENCE OF THE FOREIGN DIRECT INVESTMENT AND ECONOMIC GROWTH IN BANGLADESH

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Abstract

This essay examines the relationship between Bangladesh's GDP and foreign capital inflow. Time series analysis from 1986 to 2020 is used to do this. The two variables can be deduced to have first-order integration (1) based on the study of stationarity, which suggests that a non-stationary series becomes stationary after just one cycle of differencing. Additionally, the study employs Johansen's co-integration procedure to ascertain a long-term link between the variables. At the significance level of 0.5, it can be deduced from the maximum Eigenvalue and trace test results that there are two integrating equations and four co-integrating equations. Long-term estimates of FDI show a statistically substantial and favourable impact on GDP, according to co-integration analysis. The logarithm of foreign direct investment (LNFDI) and gross domestic product (LNGDP) have a clear long-term correlation. An increase in LNFDI of one percent corresponds to an increase in LNGDP of 0.132 percent. The short-term correction of errors will show an intriguing increase in GDP that can be linked to the inflow of foreign direct investment (FDI). A one percent increase in the logarithm of nominal gross domestic product (LNGDP) corresponds to an annual growth of 0.003411 percent of LNGDP, assuming all other factors stay the same. Additionally, at the five percent significance level, it has been shown that the GDP has a statistically significant Granger causal effect. This suggests that historical GDP values can be used to predict present and future transactions.

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However, Granger causality analysis shows no causal relationship between FDI and GDP. Thus, the correlation between foreign capital inflows and Bangladesh's economic growth can be greatly enhanced by the current research.

Keywords: Dynamics, Foreign Capital, Inbound, Outbound, GDP.

INTRODUCTION

The total amount of capital that a nation obtains from outside sources is referred to as foreign capital inflows. According to Rahman (2011), the inflows can also take many different forms, such as grants, loans, export credit, technical assistance, foreign aid, and foreign direct investment. Foreign Direct Investment (FDI) will be the proxy employed in this study to gauge foreign capital inflows. Globally, foreign direct investment (FDI) has been increasing at a rate twice that of international commerce. A thorough examination of the impact on economic growth of the growing quantity of foreign direct investment (FDI) entering emerging countries is necessary. An increase in FDI inflows has a major effect on the performance and growth of home economies.

The benefits are directly caused by the additional resources, state-of-the-art technology, and skilled managerial skills made available by FDI. FDI therefore contributes significantly to economic growth. Foreign direct investment (FDI) is widely acknowledged as a policy that promotes economic development in a nation, according to Pradhan (2009). The issue is crucial for emerging countries because they may need help generating sufficient domestic funds to meet their investment demands. In his investigation, Chakraborty and Basu (2002) came to a similar conclusion. According to the study's findings, co-integration testing revealed a positive correlation between GDP and FDI, suggesting a long-term association between the two variables.

Due to a lack of foreign direct investment, Bangladesh confronts a paucity of job prospects despite having a sizable population with both partial and no advanced skills. This poses a significant obstacle to the nation's economic growth. According to Rahman (2011), compared to the previous ten years, this country's level of international trade has grown dramatically in recent years.

FDI is typically understood as a mechanism that encourages foreign nations to send both monetary and non-monetary assets into the recipient nations. It is also crucial to remember how important it is to have a big impact on the economic growth of developing nations.

According to Hossain and Hossain (2012), FDI's greatest contribution to economic growth is its capacity to offer host nations substantial benefits that go beyond a temporary fix for capital shortages. FDI is the phrase for a nation's investment in a company or firm in another nation. Strong economic circumstances tend to attract significant investments in open economies.

The findings of Appleyard (2010) indicate that foreign direct investments have the potential to boost technological spillover, improve competitiveness, and bolster the host economy's production capacities.

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LITERATURE REVIEW

Bangladesh was frequently characterised as a nation with widespread poverty in its early years of growth. But since then, it has grown to be a significant illustration of effective development. By moving from the least developed (LDC) category to the middle-income country group in 2021, the nation celebrated its 50th anniversary of independence. Bangladesh may maintain its pace toward becoming an upper-middle income nation by effectively implementing the necessary policies and promptly executing the necessary actions.

Global economic growth in 2020 has been negatively disrupted by the COVID-19 pandemic and its aftereffects. As a result, growth rates in all of Bangladesh's major economic sectors decreased. Bangladesh's GDP grew by 5.2 percent in the fiscal year 2020 compared to 8.2 percent in the fiscal year 2019, despite the country's recent robust economic growth (Bank, July 2019-June 2020).

One of the most important economic indicators that accurately reflects a nation's economic circumstances is foreign direct investment (FDI). FDI is widely acknowledged as one of the primary drivers of economic expansion and the preservation of macroeconomic stability in a nation (Saha & Kumar, 2012). Numerous scholarly viewpoints have addressed the connection between FDI and GDP. To ascertain the connection between foreign direct investment (FDI) and economic development in various nations, numerous studies have used a variety of research approaches. The study carried out in Tunisia has demonstrated that there is no statistically significant Granger causality in the short run between foreign direct investment (FDI) and economic development, economic growth and FDI, trade and economic growth, and economic growth and employment, as suggested by Belloumi (2014).

According to the study mentioned as (Arshad, 2012), import and export operations have a major impact on Pakistan's GDP, however foreign FDI has not been shown to have a significant long-term impact. The referenced source (Obiechina and Ukeje, 2013) has been successfully located. All the factors, except for FDI, are statistically significant and have an impact on GDP when examining Nigeria's short-run dynamic equilibrium model. The relationship between FDI and economic growth has a limited degree of exogeneity.

The study's findings have shown that certain factors have both one-way and two-way causal relationships, as well as a one-way causal relationship between economic growth and FDI.

Empirical evidence of cointegration, both in the short and long term, has been discovered in Pakistan. However, cointegration has not been seen in India or Bangladesh. The causal relationship has not been proven in the example of Bangladesh. Nonetheless, it must be acknowledged that Pakistan and India have a one-way connection. This remark implies that India's economic growth has been mostly fuelled by foreign direct investment (FDI). The study's findings indicate that, except for Malaysia, there is a two-way Granger causal relationship between GDP and economic progress. The current study will investigate the important connection between economic development and foreign direct investment

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(FDI). The results of the causality test demonstrate that local investment and the trade liberalisation progress in Bangladesh and Pakistan are significantly impacted by foreign direct investment (FDI). Additionally, the favourable trend of economic growth that these nations are experiencing is made possible in large part by FDI. FDI and human capital have a major impact on promoting economic growth in emerging nations, according to study by Li and Liu (2005). Based on the analysis, it can be observed that India's economic growth is driven by foreign direct investment, while Pakistan's economic growth is driven by its exports.

The GDP and FDI in Thailand have been shown to have a reciprocal causal relationship. However, as is the case with East Asian nations generally, no cause-and-effect relationship has been found between these variables in Malaysia.

A co-integration link between the nations chosen for their study was discovered by Narayana Moorthy, Perumal, and Rao (2008). In Brazil, Russia, and South Africa, a direct causal relationship between FDI and GDP can be shown. According to Seetanah and Khadaroo's (2007) research, there is a unidirectional Granger relationship between FDI and both China's and India's economic growth. The financial performance of Sub-Saharan African nations is significantly influenced by foreign direct investment. Furthermore, the existence of a positive association is supported by GMM panel estimate. However, FDI is less common than other kinds of investments.

Hossain and Hossain (2012) revealed that there is no co-integrated relationship between FDI and GDP. Moreover, they did not find any Granger causal relationship between FDI and economic openness, nor between FDI and GDP either in the short term or long term.

The study's findings suggest that FDI could promote economic expansion. The study did not find any independent impact of FDI inflows on economic growth, and the cause-and-effect relationship did not reveal any association between FDI and GDP growth. Athukorala (2003) discovered that GDP and FDI are causally related. FDI and GDP have a unidirectional relationship, according to Hossain and Hossain (2012). It is crucial to remember that there is a reciprocal relationship between GDP and exchange rates as well as between FDI and exchange rates. The phenomenon's hidden cause is the absence of a co-integration relationship between the variables. The authors of the study, Ozturk and Kalyoncu (2007), discovered proof of why foreign direct investment (FDI) boosts Pakistan's GDP. However, according to Ozturk and Kalyoncu (2007), a significant amount of data in the context of the scenario analysis in Turkey shows that the relationship between FDI and GDP is advantageous in both directions. Hussain and Haque (2016) highlight how important foreign investment is to Bangladesh's economic growth. This discrepancy in the stream's volume can be explained by the various economic strategies that each nation employs. Additionally, a strong correlation between FDI and GDP may be shown, indicating that FDI plays a critical role in the countries' economic development. According to Sandalcilar and Altiner (2012), no empirical evidence was available to support a causal relationship between FDI and GDP in Brazil, South Korea, Mexico and Peru. In contrast to the anticipated trend, a contradictory pattern has been noted in China regarding the correlation.

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The empirical data supports the cause-and-effect relationship between increase in FDI and the GDP growth, however not the other way around. Abbas, Akbar, Nasir, Ullah, and Naseem (2011) discovered a statistically negligible correlation between GDP and inflation, although they did find a positive and substantial association between GDP and FDI.

METHODOLOGY

The relationship between foreign capital influx and Bangladesh's GDP will be examined in this article, with a focus on both the immediate and long-term impacts. Bangladesh is the subject of a comprehensive data set that covers the years 1986 through 2020 and contains time series data. The study used two main variables: Bangladesh's GDP as the dependent variable and foreign direct investment as the independent variable. Additionally, a different logarithmic scale representation of these data was employed, called LGDP and LFDI.

The following is how the research's empirical analysis is carried out. In the first, the Jarque-Bra test is used to determine whether the distribution is normal. The next study uses a univariate approach to identify whether a unit root is present. The Augmented Dickey-Fuller (ADF) test, which is covered in the works of Dickey and Fuller (1979) and Fuller (2009), is used to do this. Additionally, the "Phillips-Perron (PP) test as defined by Phillips and Perron (1988)" is used. The ability to account for serial correlations by altering the t-statistics of lagged variable coefficients, as opposed to introducing lagged variables as differenced terms, gives the Phillips-Perron (PP) test a distinct advantage over the Augmented Dickey-Fuller (ADF) test.

The Unit Root test has been used to both the regression models with an intercept alone and the regression models with an intercept plus trend. This study employs the Error Correction Model (ECM) and cointegration approach to successfully capture the short- and long-term dynamics, as well as the rate of adjustment, related to the link between GDP and FDI in Bangladesh once the variable stationarity has been verified. A goodness-of-fit test called the Jarque–Bera (JB) test determines whether the skewness and kurtosis of sample data match a normal distribution. ** A unit root test indicates whether the time series data is steady.

Johansen's 1988 study indicates that in a significant portion of macro-econometric time series analysis, the Error Correction Model (ECM) technique has emerged as a preferred method for evaluating and verifying the linkages among non-stationary data.

The current study utilizes an empirical Error Correction Model (ECM) based on the following subsequent regression equation:

$$\Delta LNGDP_t = \delta_1 + ECT_{t-1}(\, LGDP_{t-1} - \gamma_0 - \gamma_1 LNFDI_{t-1} - \gamma_2 LNCPI_{t-1} - \gamma_3 LNER_{t-1} - \gamma_4 LNEXP_{t-1} - \gamma_5 LNIMP_{t-1} - \gamma_6 REMI_{t-1}) + \sum \delta_{11}(i)\Delta LNGDP_{t-1} + \sum \delta_{12}(i)\Delta LNFDI_{t-1} + \sum \delta_{13}(i)\Delta LNCPI_{t-1} + \sum \delta_{14}(i)\Delta LNER_{t-1} + \sum \delta_{15}(i)\Delta LNEXP_{t-1} + \sum \delta_{16}(i)\Delta LNIMP_{t-1} + \sum \delta_{17}(i)\Delta REMI_{t-1} + \vartheta_{tn} + \ldots..$$

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$i = 1,2, \cdots \cdots \cdots \cdots m,$ is the optimal lag lanth, Δ is the difference operator and ECT_{t-1} is error correction term.

Following the verification of variable stationarity, the present study employs the Error Correction Model (ECM) and cointegration method to examine the short-run and long-run dynamics and the rate of adjustment, between GDP and FDI in Bangladesh.

Once the estimation of the ECM has been done, the coefficient of swiftness of adjustment is obtained, which is used to rectify any disequilibrium that may be present in the system. The above coefficient denotes the rate, at which the state of disequilibrium is adjusted and shifts towards the long-term equilibrium. It is imperative to note that the ECM coefficient is short-term coefficients and can be applied to explain the fluctuations in GDP that occur because of alterations in all the independent variables studied over a limited period.

The value of the parameter λ in the lagged error correction term (et-1) of this specification is significant in its ability to determine the long-run relationship between the variables being investigated in addition to how the system will change to the long-run equilibrium. The lag length of the variables was determined (in particular, lag 1) based on the final prediction error (FPE) criterion that was first proposed by Akaike in 1969. The aim of applying this strategy was to address the issue of over parameterization or under parameterization which can lead to incomplete and wasteful calculations. To realize the creation of sustainable equilibrium relation between variables, it is essential that the parameter of the error correction term should exhibit a negative value and has a statistical significance which is proved by the corresponding t-value.

RESULT ANALYSIS

The descriptive statistics of the variables studied in this research have been presented in Table 1.

Jarque Berra statistics were used to test the normality of the distribution of individual variables. The results indicate non-sufficient evidence to disapprove of the null hypotheses of normal distribution. This fact is an indication that the series follows a normal distribution. Moreover, one can notice that the values of the kurtosis of each variable are less than the critical value of 3, which means that the distribution is inclined to the normal distribution.

In addition, the series has a relatively small standard deviation relative to the mean implying that the data values are closely clustered around the mean. The size of the range of deviation which is the difference between the maximum and the minimum of each variable is considered acceptable in comparison with the mean. These data contribute to the normalcy of distribution which is established in the study.

Concisely, the descriptive statistics support the assumption of normal distribution of the variables in study. This is justified by the fact that the Jarque-Bra test was not rejected

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and there existed an appropriate range of deviation. This will ensure the consistency of the assumption of normalcy of the variables under investigation.

Table 1: Descriptive statistics

Statistics	LNGDP	LNFDI	LNCPI	LNER	LNEXP	LNIMP	LNREMI
Mean	25.06964	-1.788944	22.51536	23.01236	3.981189	4.139222	1.641620
Median	25.01530	-0.807524	22.25346	22.70094	4.058510	4.039955	1.703888
Maximum	25.99188	0.551249	24.11771	24.55138	4.424442	5.136764	2.393704
Minimum	24.32733	-7.057022	20.64093	21.50244	3.414670	3.189653	0.939087
Std. Dev.	0.504030	2.202054	1.245435	1.069527	0.333912	0.579124	0.475328
Skewness	0.217352	-0.759125	-0.047293	0.026527	-0.279054	0.182078	0.081561
Kurtosis	1.841493	2.218925	1.480262	1.410799	1.665067	1.858972	1.512259
Jarque-Bera	2.105269	4.008348	3.188004	3.476513	2.878608	1.972513	3.079978
Probability	0.349017	0.134772	0.203111	0.175827	0.237093	0.372970	0.214383
Sum	827.2980	-59.03515	743.0067	759.4079	131.3793	136.5943	54.17347
Sum Sq. Dev.	8.129484	155.1694	49.63543	36.60445	3.567916	10.73231	7.229961
Observations	33	33	33	33	33	33	33

Table 2 depicts the correlation table, which demonstrates a statistically significant positive correlation between the different economic indicators, such as GDP, FDI, exports, imports, nominal exchange rates, CPI, and remittances. The findings indicate that a given change in one variable will most probably be met by a consistent change in the other variables, which implies that the two variables are highly dependent and have economic connections. The significance of considering the different variables together in economic analysis and decision making is emphasized.

Table 2: Correlation matrix

Variable(s)	LNGDP	LNFDIP	LNEXP	LNIMP	LNER	LNCPI	LNREMI
LNGDP	1.000000						

LNFDIP	0.857811	1.000000					
	0.0000	-----					
LNEXP	0.978316	0.893822	1.000000				
	0.0000	0.0000	-----				
LNIMP	0.973959	0.877166	0.995958	1.000000			
	0.0000	0.0000	0.0000	-----			
LNER	0.971736	0.911424	0.985267	0.972819	1.000000		
	0.0000	0.0000	0.0000	0.0000	-----		
LNCPI	0.998229	0.854037	0.978210	0.972542	0.970243	1.000000	
	0.0000	0.0000	0.0000	0.0000	0.0000	-----	
LNREMIP	0.832801	0.867894	0.910943	0.905878	0.904198	0.829633	1.000000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-----

Before estimating equations, it is significant to conduct unit root tests, i.e. the ADF and the so-called Phillip-Perron tests, to estimate the stationarity of variables. As Table 3 (A and B) shows, the results of the tests show that all variables utilized in the analysis have unit roots at the first level. The results of the analysis show that most economic indicators including GDP, FDI, imports, exports, nominal exchange rates, CPI, and remittances have

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non-stationary nature in their original form. This has been supported by the fact that neither ADF test nor the Phillips-Perron test at any level of significance shows any statistical significance.

It can be noted however that the variables show stationarity after a first-order differencing process. This means that the order of integration of all variables is one and is usually denoted as I (1). The main distinction involves the elimination of the unit root and the conversion of the variables into stationary series, therefore, making them easier to analyze with an econometric model.

The additional evidence of the stationarity of the variables at the first difference is the use of the Phillips Perron test statistics. This observation confirms that the variables are integrated to equal extent hence showing that there is the possibility of cointegration among them. Cointegration is the long-term equilibrium relations that are involved between nonstationary variables. The Vector Error Correction Model (VECM) is a suitable model that can be used to analyze these correlations because it can identify both the short-term dynamics and the long-term relationships.

In short, the results of the unit root tests indicate that the variables GDP, FDI, imports, exports, nominal exchange rates, CPI, and remittances are non-stationary at the first level, however, when the first difference is taken, the variables become stationary. This implies that the variables discussed are combined in first order (I (1)). The initial difference of variable stationarity is one of the main premises to conduct further analysis, including the possibility of cointegration between the variables. This could be used to offer valuable information regarding the long-term associations and dynamics of people.

Table 3(A): Results of stationary test using ADF Test

Variables	Level		1st Difference		
	Statistics	P-Value	Statistics	P-Value	Remarks
LNGDP	-0.516551	0.9772	-4.734489	0.0034	I(1)
LNFDI	-0.127964	0.9915	-6.675760	0.0001	I(1)
LNEXP	-1.181175	0.8976	-4.449326	0.0068	I(1)
LNIMP	-2.477180	0.3362	-4.559432	0.0052	I(1)
LNER	-0.970384	0.9343	-4.643677	0.0044	I(1)
LNCPI	-0.976345	0.9334	-4.301420	0.0096	I(1)
LNREMI	-2.105564	0.5180	-4.366354	0.0402	I(1)

Table 3(B): Results of stationary test Using PP Test

Variables	Level		1st Difference		
	Statistics	P-Value	Statistics	P-Value	Remarks
LNGDP	-0.353970	0.9851	-4.706443	0.0036	I(1)
LNFDI	-2.820832	0.2006	-8.732981	0.0000	I(1)
LNEXP	-1.547423	0.7912	-4.453767	0.0067	I(1)
LNIMP	-1.994354	0.5822	-4.513140	0.0058	I(1)
LNER	-0.884479	0.9457	-6.233312	0.0001	I(1)
LNCPI	-1.257200	0.8805	-4.307595	0.0095	I(1)
LNREMI	-0.645941	0.9688	-4.768415	0.0031	I(1)

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To determine the optional lag length for the multivariate cointegration analysis using the Johansen-Juselius test, several selection criteria were employed, including the Akaike Information Criterion (AIC), Schwarz Bayesian Criterion (SBC), Hannan-Quinn Criterion (HQ). As presented in Table 4, the results indicate that all the applied criteria selected for the test had a maximum lag length of 1.

Common model selection criteria used include Akaike Information Criterion (AIC), Schwarz Bayesian Criterion (SBC), and HannanQuinn Criterion (HQ), and they attempt to find the best trade-off between the quality of fit of the model and its complexity. These criteria aim at achieving an ideal level of trade-off between the explanatory power of the model and overfitting. Using the three criteria, it can be concluded that a model that has fewer lags is preferred because all the three criteria indicate the maximum lag of 1.

It is also noted that the SBC and LR criteria were used, but the results obtained using the criteria were not presented. The statement of the user about the highest latency of 1 in the other criteria would indicate that the other criteria would have also had a bias toward choosing a lag of 1.

It is important to note that the calculation of the lag time is done using a statistical parameter and thus can be different when it comes to a given dataset and analysis being performed. The issue of the right lag length is a critical consideration because it has significant impact on the accuracy and reliability of the study of cointegration. The lag selection criteria continually reveal that lag of 1 is always reported, which means that the lag of 1 is the optimal one in the multivariate Johansen-Juselius cointegration test in the current analysis.

Table 4: The Lag Selection Criteria Results

Lag	LogL	LR	FPE	AIC	SC	HQ
0	114.7164	NA	2.26e-12	-6.949444	-6.625640	-6.843892
1	359.6405	363.4358*	7.97e-18*	-19.58971*	-16.99928*	-18.74529*
2	404.9845	46.80669	1.72e-17	-19.35384	-14.49678	-17.77056
* Indicates lag order selected by the criterion						
LR: Sequential modified LR test statistics (each test at 5% level) FPE: Final prediction error AIC: Akaike Information Criterion SC: Schwarz criterion HQ: Hannan-Quinn criterion						

The Johansen cointegration test was employed in this study to examine whether a cointegration relationship exists among the variables. The above procedure is considered more beneficial than the Engle-Granger methodology because it has the capability of determining the rank or number of cointegrating relationships. Conversely, the Engle-Granger method presupposes that there is only one cointegrating equation regardless of the number of the series involved.

The findings of the cointegration analysis are reported in Table 5, depicted in parts A and B. The outcomes support that both the trace statistic and the maximum eigenvalue statistic reject the null hypothesis of no cointegration at the 5% significance level. Hence,

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the results confirm the presence of a long-run cointegrating relationship among the variables.

Considering the outcomes of the trace test, it may be said that there are four cointegrating equations available. According to the analysis done, it has been found to have two cointegrating equations based on the maximum Eigen value test which is found to be statistically significant at a level of significance of 0.05. Therefore, the outcomes confirm a long-term equilibrium association among the variables.

Identification of the cointegration between the variables is of scholarly significance because it implies that the variables do not manifest long-term divergence. On the contrary, one can say that these entities are interrelated through stable interactions, and, therefore, suggest a state of sustainable equilibrium. This research can be of great use in determining the dynamics and interactions of the variables under study.

Table 5: Results of Johansen Maximum Likelihood Method

Table 5(A): Unrestricted Co-integration Rank Test (Trace) Results

Null Hypothesis	Eigenvalue	Trace Statistic	5% Critical Value	P-Value
R = 0	0.800213	170.7195	125.6154	0.0000
R ≤ 1	0.753326	120.7939	95.75366	0.0003
R ≤ 2	0.605508	77.40366	69.81889	0.0109
R ≤ 3	0.548271	48.56879	47.85613	0.0428
R* ≤ 4	0.369776	23.93395	29.79707	0.2032
R* ≤ 5	0.260997	9.621879	15.49471	0.3110
R* ≤ 6	0.007898	0.245823	3.841466	0.6200
R ≤ 7	0.800213	170.7195	125.6154	0.0000

Table 5(B): Unrestricted Co-integration Rank Test (Maximum Eigenvalue) Results

Null Hypothesis	Eigenvalue	Trace Statistic	5% Critical Value	P-Value
R = 0	0.800213	49.92557	46.23142	0.0193
R ≤ 1	0.753326	43.39026	40.07757	0.0204
R* ≤ 2	0.605508	28.83488	33.87687	0.1776
R* ≤ 3	0.548271	24.63483	27.58434	0.1140
R* ≤ 4	0.369776	14.31207	21.13162	0.3400
R* ≤ 5	0.260997	9.376056	14.26460	0.2562
R* ≤ 6	0.007898	0.245823	3.841466	0.6200
Note: (*) denotes accepted hypothesis at 5% level and R = Number of Co-integration				

The estimated long-run co-integrating equation linking FDI, measured by LNFDI, and GDP, represented by LNGDP are reported in Table 6. Based on the estimation outcomes, FDI exhibits a positive relation with GDP in the long run; however, the relationship is not statistically significant.

The long-run relationship coefficient of LNFDI is recorded to be 0.1322 with an equal t-ratio of 7.2752 indicating the degree of significance is significant. The coefficient presented above is the change which is expected in the logarithm of LNGDP in case of 1 percent increase in the logarithm of LNFDI, other things being constant.

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In the case under consideration, the positive coefficient is associated with the expected trend, which implies that the impact of FDI on GDP is positive. The results of the research show that the relationship between the continuous growth of 1 percent in LNFDI and the similar growth of 0.1322 percent in LNGDP over a long period of time is positive.

The t-ratio 7.2752 is very significant, which provides an additional argument in favor of the validity and reliability of the estimate. The t-ratio value shows that the coefficient is statistically significant, which increases the validity of the determined correlation between FDI and GDP

Table 6: Normalized Co-integration Coefficients

Variables	Coefficients	Standard Errors	T-Statistics
LNGDP	1.000000		
LNFDI	0.132221	(0.04573)	[2.89140]
LNEXP	-2.341334	(0.71974)	[-3.25305]
LNIMP	0.241828	(0.55190)	[0.43817]
LNER	-4.006026	(0.95601)	[-4.19036]
LNCPI	2.286866	(0.57182)	[3.99927]
LNREMI	2.826659	(0.39006)	[7.24670]
C	24.74024		

The Granger causality, cointegration, and unit root test results demonstrate that the variables are non-stationary and integrated at the same level, indicating the presence of cointegration. The need was seen to be crucial for the study's use of the Error Correction Model (ECM). A long-run equilibrium relationship between variables is inferred when they are cointegrated but non-stationary. Therefore, it was decided that the error correction model (ECM) was crucial for assessing how responsive the variables were to the long-term equilibrium dislocations. Table 7 displays the ECM estimation findings, indicating the confirmation of a long-term equilibrium relationship between the variables. The error correction term (ECT) is present at the lag (t-1) according to the calculated parameter of -0.016851. The theoretical presumptions that indicate that the variables will eventually tend to approach their equilibrium connection are consistent with the negative value of the ECT coefficient.

In addition to long-term relationship studies, short-term dynamics can be studied using the ECM. The results show that, in the short term, FDI has a statistically significant and favourable impact on Bangladesh's GDP. After the study was completed, it was determined that, with all other variables maintained constant, a 1% increase in the logarithm of LNFDI would result in a future growth in the logarithm of LNGDP of 0.003411%.

The findings provide useful insight into the relationship between these two variables and highlight the importance of FDI in short-term GDP volatility. Policymakers and scholars studying the relationship between FDI and GDP in Bangladesh might gain valuable insights from the analysis of the economic complexity matrix (ECM), which provides a thorough understanding of short-term changes necessary to achieve the long-term equilibrium.

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Table 7: Results of ECM

Test	Coefficient	Standard Error	T-Statistics	P-Value
C	0.061174	0.01548	3.95172	0.0007
ECT_{t-1}	-0.016851	0.00551	-3.06008	0.0057
D(LNFDIP(-1))	0.003411	0.001789	-1.906989	0.0697
D(LNEXP(-1))	-0.023719	0.028913	0.820342	0.4208
D(LNIMP(-1))	0.014651	0.021721	-0.674491	0.5070
D(LNER(-1))	0.064308	0.094873	-0.677825	0.5049
D(LNCPI(-1))	0.058181	0.064240	-0.905686	0.3749
D(LNREMIP(-1))	0.002292	0.029955	-0.076510	0.9397
R-squared	0.587055	Mean dependent var		0.052501
Adjusted R-squared	0.436893	S.D. dependent var		0.012337
S.E. of regression	0.009258	Akaike info criterion		-6.288985
Sum squared resid	0.001886	Schwarz criterion		-5.872666
Log likelihood	106.4793	Hannan-Quinn criter.		-6.153275
F-statistic	3.909476	Durbin-Watson stat		2.070647
Prob(F-statistic)	0.005244			
D(LNGDP)=C(1)*(LNGDP(-1)+ 0.003411*LNFDIP(-1)- 0.023719*LNEXP(-1)+ 0.014651*LNIMP(-1) - 0.064308*LNER(-1) + 0.058181*LNCPI(-1) +0.002292*LNREMIP(-1) -0.016851) + C(2)*D(LNGDP(-1)) + C(3)*D(LNFDIP(-1)) + C(4)*D(LNEXP(-1)) + C(5)*D(LNIMP(-1)) + C(6)*D(LNER(-1)) + C(7)*D(LNCPI(-1)) + C(8)*D(LNREMIP(-1)) + C(9)				

As shown in Table 8, the results indicate that there is insufficient evidence to support a causal effect of FDI on GDP. However, the findings reveal that GDP has a statistically significant causal influence on FDI at the 5% significance level. The existing results indicate the presence of a one-directional causal relationship between the variables. The results of the research claim that GDP and FDI have a causal relationship, implying that variations in GDP cause and determine variations in FDI. Conversely, FDI does not have a comparable impact on GDP. A significant value of 5% indicates high level of statistical confidence of the observed cause and effect relationship between GDP and FDI. The outcome mentioned above highlights the importance of GDP as an essential variable in the attraction or impact of FDI inflows in the framework of the considered environment.

The unidirectional causal relationship must be admitted to being imperative, but the non-relevance or irrelevancy of FDI to GDP growth is not implied. The implication of this statement is that the changes in GDP can more significantly stimulate the inflows of FDI, but FDI can be influenced by other policies or factors.

Table 8: Pairwise Granger Causality Tests

Direction of Casuality:	Obs	F-Statistic	Prob.	Interpretation
LNFDI-LNGDP	32	0.24163	0.6267	No Causality
LNGDP-LNFDI	32	6.86832	0.0138	Significant Causality
LNEXP -LNGDP	32	0.12480	0.7264	No Causality
LNGDP -LNEXP	32	0.00874	0.9262	No Causality
LNIMP -LNGDP	32	0.12188	0.7295	No Causality
LNGDP -LNIMP	32	1.69666	0.2030	No Causality

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LNER -LNGDP	32	0.04118	0.8406	No Causality
LNGDP -LNER	32	1.3E-05	0.9971	No Causality
LNCPI -LNGDP	32	0.50544	0.4828	No Causality
LNGDP -LNCPI	32	7.55958	0.0102	Significant Causality
LNREMI -LNGDP	32	1.01946	0.3210	No Causality
LNGDP -LNREMI	32	0.92610	0.3438	No Causality
LNEXP -LNFDI	32	7.42333	0.0108	Significant Causality
LNFDI -LNEXP	32	0.62505	0.4356	No Causality
LNIMP -LNFDI	32	5.58624	0.0250	Significant Causality
LNFDI -LNIMP	32	0.45746	0.5042	No Causality
LNER -LNFDI	32	11.8677	0.0018	Significant Causality
LNFDI -LNER	32	0.41307	0.5255	No Causality
LNCPI -LNFDI	32	7.43539	0.0107	Significant Causality
LNFDI -LNCPI	32	0.10584	0.7473	No Causality
LNREMI -LNFDI	32	2.52263	0.1231	No Causality
LNFDI -LNREMI	32	0.27952	0.6010	No Causality
LNIMP -LNEXP	32	0.16771	0.6852	No Causality
LNEXP -LNIMP	32	2.99757	0.0940	Weak Casualty
LNER -LNEXP	32	4.53255	0.0419	No Causality
LNEXP -LNER	32	0.00620	0.9378	No Causality
LNCPI -LNEXP	32	0.06015	0.8080	No Causality
LNEXP -LNCPI	32	6.10448	0.0196	Significant Causality
LNREMI -LNEXP	32	2.20489	0.1484	No Causality
LNEXP -LNREMI	32	0.15389	0.6977	No Causality
LNER -LNIMP	32	4.94521	0.0341	Significant Causality
LNIMP -LNER	32	0.08222	0.7764	No Causality
LNCPI -LNIMP	32	0.80633	0.3766	No Causality
LNIMP -LNCPI	32	7.78975	0.0092	Significant Causality
LNREMI -LNIMP	32	2.07905	0.1600	No Causality
LNIMP -LNREMI	32	0.33897	0.5649	No Causality
LNCPI -LNER	32	0.10458	0.7487	No Causality
LNER -LNCPI	32	0.48286	0.4927	No Causality
LNREMI -LNER	32	0.80521	0.3769	No Causality
LNER -LNREMI	32	0.10705	0.7459	No Causality
LNREMI -LNCPI	32	7.85864	0.0089	Significant Causality
LNCPI -LNREMI	32	1.16255	0.2898	No Causality

The analysis of variance breakdown gives helpful information on the extent to which each of the variables in the autoregressive model is contributing to the variability of the dependent variable, in this case, exports. It is beneficial to know how much the contribution of each independent variable to the variability of exports would be.

The results of the variance decomposition analysis of exports is presented in Table 9. The results indicate that there is a high correlation between the fluctuation of GDP and the explanation of export changes during the decade. At the initial phases, the changes in the levels of exports can be attributed to internal factors to a significant extent, which implies a high level of independence. This means that the changes in exports are mostly influenced by their historical trends.

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In the long run, GDP is less effective in determining exports though it is another major determinant. During the second year, one can note that the variations in the GDP account for about 92% of the variations in the exports. FDI also starts taking a role and it adds approximately 4 percent to the noted change in exports. Subsequent years show that the FDI has a rising share of the changes in exports and remains an interesting factor. The current discussion brings out the dynamics that have been experienced between GDP, FDI, and exports over the years. Though initially the GDP will majorly explain the fluctuation in exports, further in the years FDI will have a greater influence. This implies that FDI is gaining more powers in the determination of the performance of exports implying the increasing role of foreign investment in export-driven activities.

Table 9: Variance Decomposition of LNGDP

Period	S.E.	LNGDP	LNFDI	LNEXP	LNIMP	LNER	LNCPI	LNREMI
1	0.008905	100.0000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
2	0.017371	92.80343	4.256001	0.111027	0.006955	0.288665	0.027629	2.506289
3	0.025928	90.89920	4.700501	0.076748	0.011833	0.297003	0.170730	3.843981
4	0.034798	89.60665	5.055196	0.166140	0.007995	0.261140	0.450694	4.452183
5	0.043749	88.44151	5.431180	0.259713	0.005132	0.227003	0.667201	4.968263
6	0.052552	87.52904	5.747884	0.362495	0.003710	0.204653	0.833192	5.319027
7	0.061112	86.79444	6.021341	0.458133	0.003211	0.190138	0.952931	5.579803
8	0.069373	86.20563	6.249429	0.544554	0.003146	0.180704	1.040620	5.775914
9	0.077316	85.72938	6.438712	0.620528	0.003293	0.174361	1.106331	5.927399
10	0.084940	85.34036	6.595842	0.686475	0.003532	0.169935	1.156889	6.046970

CONCLUSION AND POLICY RECOMMENDATION

In summary, the results of this study offer empirical proof that the GDP of Bangladesh and the inflow of foreign capital, particularly FDI, are significantly correlated. The findings show that FDI has both a short-term and long-term positive and statistically significant effect on GDP.

The long-term cointegration analysis's findings demonstrate that FDI is crucial as a catalyst for economic growth since it helps to maintain a stable and durable relationship with GDP. This demonstrates the potential advantages of increasing foreign investment in Bangladesh.

The empirical findings of the error correction model (ECM) research indicate that FDI has a short-term, statistically significant, and favourable impact on GDP. This suggests that short-term increases in GDP are positively connected with the growth in FDI inflows, demonstrating the significant role that foreign investment plays in driving an economy.

The variance decomposition analysis's findings indicate a clear trend toward FDI's growing contribution to GDP over time. This demonstrates the significance of implementing laws and policies that can draw in and promote foreign investment in Bangladesh. Policymakers should prioritise establishing trade and foreign exchange policies that boost export industry competitiveness, fostering an environment that is conducive to foreign direct investment, and fostering a favourable business environment.

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Consolidating regulations, offering incentives to foreign investors, building infrastructure, allocating funds for human capital development, and fortifying institutional structures are some of the strategies that the government must prioritise to accomplish these objectives. These attempts are expected to contribute significantly towards the sustainable economic growth in Bangladesh through enhancing the competitiveness among the export industries and create a more favourable environment for investment.

Overall, the study's findings have significant policy ramifications for decision-makers and indicate that encouraging foreign direct investment may be one of the best ways to advance Bangladesh's economic growth. Bangladesh can boost economic activity, attract more foreign investment, and eventually achieve long-term sustainable growth by implementing the suggested policy measures.

References

1) Abbas, Q., Akbar, S., Nasir, A. S., Ullah, H. A., & Naseem, M. A. (2011). Impact of foreign direct investment on gross domestic products. Global Journal of Management and Business Research, 11(8), 35-40.

2) Akaike, H. (1969). Power spectrum estimation through autoregressive model fitting. Annals of the institute of Statistical Mathematics, 21(1), 407-419.

3) Appleyard, D. R. (2010). International economics: New York: McGraw-Hill/Irwin.

4) Arshad, M. (2012). Impact of foreign direct investment on trade and economic growth of Pakistan: A co-integration analysis. Int. J. Eco. Res, 3(4), 42-75.

5) Athukorala, P. (2003). The impact of foreign direct investment for economic growth: A case study in Sri Lanka. Paper presented at the 9th International Conference on Sri Lanka Studies.

6) Bank, B. (July 2019-June 2020). Annual Report https://www.bb.org.bd/pub/annual/anreport/ar1920/index1920.php.

7) Belloumi, M. (2014). The relationship between trade, FDI and economic growth in Tunisia: An application of the autoregressive distributed lag model. Economic Systems, 38(2), 269-287.

8) Chakraborty, C., & Basu, P. (2002). Foreign direct investment and growth in India: A cointegration approach. Applied economics, 34(9), 1061-1073.

9) Dickey, D. A., & Fuller, W. A. (1979). Distribution of the estimators for autoregressive time series with a unit root. Journal of the American statistical Association, 74(366a), 427-431.

10) Fuller, W. A. (2009). Introduction to statistical time series: John Wiley & Sons.

11) Hossain, A., & Hossain, M. K. (2012). Empirical relationship between foreign direct investment and economic output in South Asian countries: A study on Bangladesh, Pakistan and India. International Business Research, 5(1), 9-21.

12) Hussain, M. E., & Haque, M. (2016). Foreign direct investment, trade, and economic growth: An empirical analysis of Bangladesh. Economies, 4(2), 7.

13) Li, X., & Liu, X. (2005). Foreign direct investment and economic growth: an increasingly endogenous relationship. World development, 33(3), 393-407.

14) Narayanamoorthy, V., Perumal, S., & Rao, K. (2008). Causal relationship between foreign direct investment and growth: Evidence from BRICS countries.

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15) Obiechina, M., & Ukeje, E. (2013). Economic growth, capital flows, foreign exchange rate, export and trade openness in Nigeria. International Journal of Economics and Management Sciences, 2(9), 1-13.

16) Ozturk, I., & Kalyoncu, H. (2007). Foreign direct investment and growth: An empiricial investigation based on cross-country comparison.

17) Phillips, P. C., & Perron, P. (1988). Testing for a unit root in time series regression. Biometrika, 75(2), 335-346.

18) Pradhan, R. P. (2009). The FDI-led-growth hypothesis in ASEAN-5 countries: Evidence from cointegrated panel analysis. International Journal of Business and Management, 4(12), 153-164.

19) Rahman, M. Z. (2011). An empirical study on the relationship between foreign investment and international trade in Bangladesh. International Journal of Financial Research, 2(2), 33-39.

20) Saha, D., & Kumar, A. (2012). Scenario of the foreign direct investment (FDI) in Bangladesh: An evaluation. IOSR Journal of Business and Management, 5(6), 19-26.

21) Sandalcilar, A. R., & Altiner, A. (2012). Foreign direct investment and gross domestic product: An application on ECO Region (1995-2011). International Journal of Business and Social Science, 3(22), 189-198.

22) Seetanah, B., & Khadaroo, A. (2007). Foreign direct investment and growth: new evidences from Sub-Saharan African countries. University of Mauritius, 27.