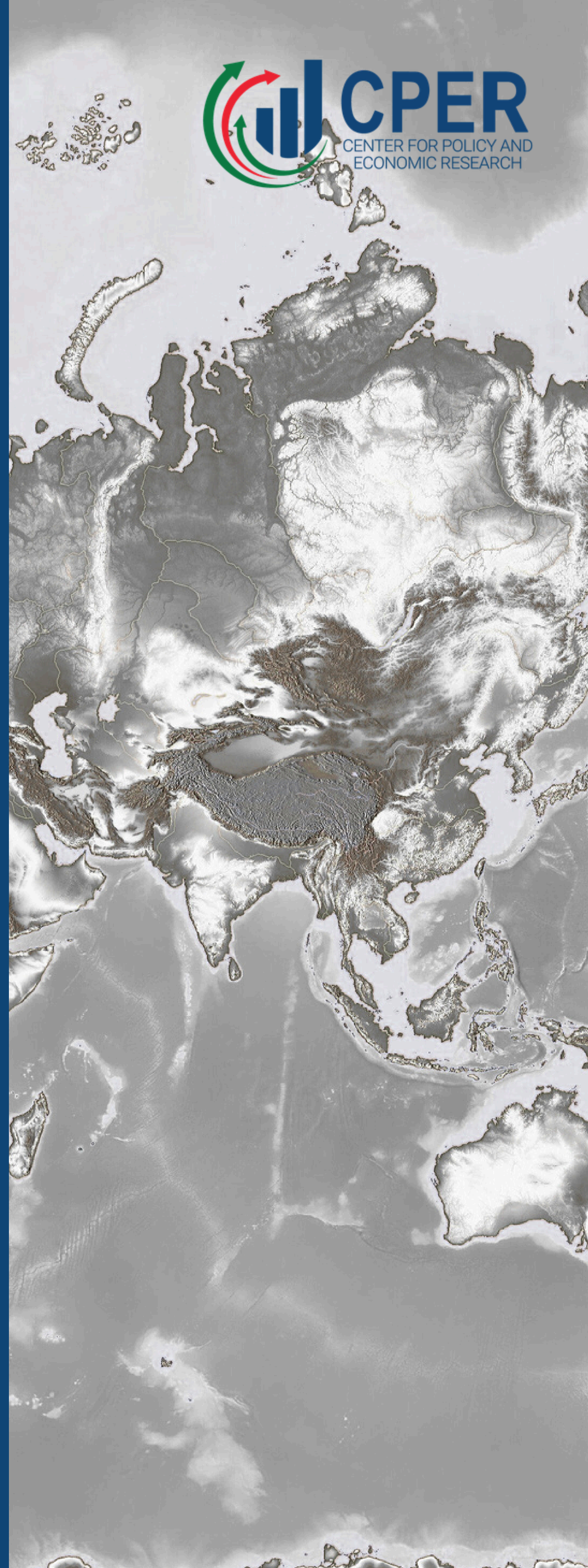

Working Paper 08

The Role of Export and Foreign Direct Investment in the Economic Growth of Bangladesh

A Time Series Analysis

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Abstract

Purpose - This study examines the long-run and short-run relationships among foreign direct investment (FDI), exports, and economic growth in Bangladesh. It also considers the role of structural changes and external shocks—such as the COVID-19 pandemic and the Russia–Ukraine conflict—in shaping these relationships, with the aim of providing policy-relevant insights for sustainable economic development.

Design/methodology/approach - The analysis employs annual time-series data from 1986 to 2022. The Autoregressive Distributed Lag (ARDL) bounds testing approach is applied to investigate cointegration among the variables, allowing for mixed orders of integration. To capture potential regime shifts, the study incorporates a structural break identified through the Gregory–Hansen cointegration test. The error correction model (ECM) is used to estimate both short-run dynamics and long-run equilibrium relationships, supported by standard diagnostic and stability tests.

Findings - The results confirm the existence of a stable long-run cointegrating relationship among FDI, exports, and economic growth. Exports are found to have a positive and statistically significant effect on economic growth in both the short and long run, supporting the export-led growth hypothesis in Bangladesh. In contrast, FDI exhibits a positive but statistically insignificant impact, suggesting that its growth-enhancing effects may depend on complementary factors such as institutional quality and infrastructure. The analysis also identifies a structural break around 2015, coinciding with Bangladesh's transition to lower-middle-income status and improved macroeconomic performance. Furthermore, global disruptions, including the COVID-19 pandemic and geopolitical tensions, are shown to have indirectly influenced FDI inflows and export performance.

Research limitations - This study is limited by its focus on a small set of variables and the use of aggregate data, which may overlook sector-specific dynamics. Additionally, while the analysis establishes long-run associations, it does not fully explore causal relationships. Future research could incorporate additional variables—such as remittances, human capital, and financial development—and apply advanced econometric techniques to provide deeper insights.

Originality/value - This study contributes to the existing literature by jointly examining FDI, exports, and economic growth in Bangladesh within an ARDL framework that incorporates structural breaks. By integrating recent global shocks into the analysis, it offers a timely and context-specific understanding of growth dynamics in a developing economy. The findings provide practical insights for policymakers seeking to promote export-led growth while enhancing FDI's effectiveness in supporting long-term economic development.

Keywords: Export, FDI, Economic Growth, ARDL, Bangladesh

Table of Contents

List of Tables and Figures

The Role of Export and Foreign Direct Investment in the Economic Growth of Bangladesh: A Time Series Analysis

1. Introduction

Since gaining independence in 1971, Bangladesh has made a concentrated attempt to achieve long-term, sustainable economic development, transitioning from a post-war agrarian society to an increasingly industrial and service-oriented economy (M. E. Hussain & Haque, 2016; Mamun & Kabir, 2023a; Salma et al., 2023). This transformation led the country to achieve sustained GDP growth rates exceeding 6% in recent decades, reaching lower-middle-income status in 2015, and it is currently on a non-negotiable path to graduate from the United Nations' list of Least Developed Countries (LDC) by 2026 (Hussain & Haque, 2016; Mamun et al., 2024; Mamun & Kabir, 2023a; Salma et al., 2023; Tazin, 2023; World Bank, 2025). Looking ahead, the government aims to reach upper-middle-income status by 2031 and become an emerging nation by 2041, goals that require robust milestones to reduce poverty and build a skilled workforce (Golder et al., 2023).

In the context of globalization, Foreign Direct Investment (FDI) and exports are widely regarded as the primary engines of economic growth in emerging economies such as Bangladesh (Goh et al., 2017; M. E. Hussain & Haque, 2016; Zobair & Uddin, 2019). For a capital-scarce nation with limited domestic savings, FDI serves as a critical vehicle for technology transfer, human capital development, and the improvement of host country institutions (Dinh et al., 2019; Sarker & Khan, 2020a; Tabassum & Ahmed, 2014; Ullah et al., 2022). Simultaneously, the export sector—predominantly driven by the success of the Ready-Made Garment (RMG) industry, which accounts for over 84% of total exports, have maintained an average annual growth rate of 11% since 2001—has become a vital pillar, providing necessary foreign exchange and contributing significantly to industrialization (Akter et al., 2024, 2024; Mamun & Kabir, 2023a; Tazin, 2023). Understanding the dynamic interplay between these determinants is essential now, as the global economic landscape has been severely disrupted by the COVID-19 pandemic and the Russia-Ukraine conflict, causing Bangladesh's exports to plummet by 10.6% in 2020 and slowing the recovery of FDI inflows (Mamun & Kabir, 2023a). Moreover, after the July 2024 Revolution, the unstable political situation also disrupted FDI inflows in Bangladesh. Now, the conflict between Israel and Palestine in Gaza has been newly added, including ongoing tensions among Iran, the USA, and Israel, which will also force a slowdown in exports and FDI inflows (CPA, 2025; Gjevori, 2025).

The theoretical discourse on economic development often positions Foreign Direct Investment (FDI) and exports as the primary "engines of growth" for emerging economies (Bal et al., 2019; Goh et al., 2017; Tabassum & Ahmed, 2014). In the context of Bangladesh, a substantial body of empirical literature supports the export-led growth (ELG) hypothesis. Researchers such as Begum and Shamsuddin (1998) and Mamun and Nath (2005) have demonstrated that export expansion—particularly the transition from traditional goods such as jute to manufactured products such as ready-made garments (RMG)—has a significant positive impact on total factor productivity and long-run GDP growth. Mamun and Kabir (2023) also found the export has a significant positive impact on long-run GDP growth. Similarly, the role of FDI is often highlighted as a vital catalyst for technology transfer and human capital development; Tabassum and Ahmed (2014) and Hussain and Haque (2016) identified a strong long-term linkage between FDI inflows and economic output. According to Zardoub and Sboui (2021), FDI plays a fundamental role in the economic development of African countries.

However, the consensus is far from universal, as empirical findings remain highly contrasting and inconclusive (Bal et al., 2019; Mamun & Kabir, 2023a; Sarker & Khan, 2020a). Several studies, including Ahmed and Uddin (2009)Ahmed and Uddin (2009) and Afsana et al. (2023), report that exports and remittances do not have a direct, significant impact on GDP in certain frameworks. Furthermore, the impact of FDI is a subject of intense debate. While many claim it fosters growth, other scholars, such as Tabassum and Ahmed (2014) and Rahman (2015), found FDI to be statistically insignificant or even negatively correlated with growth in the Bangladeshi context. These negative outcomes are frequently attributed to systemic bottlenecks such as inadequate infrastructure, power and gas shortages, and bureaucratic complexities (Sutradhar, 2020). Additionally, the direction of causality remains disputed, with recent evidence suggesting a unidirectional relationship running from GDP to FDI, implying that a steady growth rate is what attracts foreign investment rather than vice versa.

A critical gap in the existing literature stems from the fact that most previous studies have examined exports and FDI independently or in narrow frameworks, often failing to account for their joint or synergistic impact on the macroeconomy. Furthermore, there is a notable scarcity of research that incorporates the profound economic disruptions caused by recent global shocks. Most existing time-series analyses utilize historical datasets that conclude before the COVID-19 pandemic and the Russia-Ukraine conflict, failing to capture how these events disrupted global trade flows, heightened investor risk perceptions, and caused volatility in commodity markets.

However, the primary objective of this study is to conduct a rigorous empirical investigation into the long-term relationship between Foreign Direct Investment (FDI), exports, and economic growth in Bangladesh, with particular consideration for recent structural shifts. To fulfill these objectives, the study addresses the following critical research questions:

1. What is the nature and magnitude of the long-term relationship between FDI, exports, and economic growth in Bangladesh?
2. How have FDI inflows and export performance influenced the economic development of the nation over the selected time series?
3. What are the specific effects of the COVID-19 pandemic and the Russia-Ukraine conflict on the stability of these growth engines?
4. What strategic policy measures can the government implement to maximize the benefits of trade and investment in a volatile global market?

Based on neoclassical and endogenous growth theories, this study tests the hypothesis that exports and FDI have a positive, statistically significant impact on Bangladesh's economic growth in both the short and long run.

The geographical scope of this research is centered exclusively on Bangladesh, a South Asian nation serving as a critical test case for outward-oriented growth strategies. Temporally, this study utilizes annual time-series data spanning from 1986 to 2022, a period characterized by major phases of trade liberalization, the rapid expansion of the industrial sector, and recent profound disruptions. The significance of this study is paramount as Bangladesh prepares for its scheduled LDC graduation in 2026, which necessitates a rigorous re-evaluation of export competitiveness and reliance on FDI. Furthermore, the study provides practical insights for policymakers aiming to achieve upper-middle-income status by 2031, a goal that requires substantial investment in productive infrastructure. From a policy perspective, this research addresses critical systemic bottlenecks, including power and gas shortages and bureaucratic complexities that have hindered the nation's ability to attract FDI. Finally, the significance of this work is enhanced by its focus on the resilience of Bangladesh's growth model in the face of recent global shocks, offering evidence-based strategies to navigate a volatile global landscape.

This research makes several significant contributions to the body of knowledge on Bangladesh's macroeconomy. First, it addresses a critical gap in the literature by providing an updated empirical analysis that incorporates the most recent economic data (up to 2022), thereby capturing the structural shifts caused by the COVID-19 pandemic and the Russia-Ukraine conflict. Methodologically, this study enhances the field by employing advanced time-series techniques, such as the ARDL bounds testing approach and Vector Error Correction Models (VECM), which account for structural breaks and the potential mixed orders of integration among variables. By examining exports and FDI within a unified framework, this research also uncovers their joint impact on growth, a dimension often overlooked by studies analyzing these variables in isolation. From a policy perspective, the findings provide evidence-based recommendations to help policymakers navigate the impending loss of preferential trade benefits and design strategies for long-term sustainable economic development.

The remainder of this study is organized as follows. Section II outlines the data sources, variable definitions, and methodological framework, explaining the application of advanced econometric techniques. Section III presents and interprets the empirical results and discussion, including unit root tests, cointegration analysis, and diagnostic checks. Finally, Section IV concludes the article by summarizing the key findings and providing strategic policy recommendations designed to support Bangladesh's sustainable economic future.

2. Data and Methodology

2.1 Data and Variables

Given the availability of data, this study uses 36 annual observations from 1986 to 2022. The data were obtained from the World Bank database (https://data.worldbank.org/country/BD, accessed on 15 March 2025). The dataset includes three key variables: net inflows of foreign direct investment (FDI) as a percentage of GDP, exports of goods and services as a percentage of GDP, and GDP growth (annual percentage).

Table 1 presents the summary statistics for the selected variables. The results indicate that the average GDP growth rate in Bangladesh between 1986 and 2022 was 5.423%. Another important variable in this study is the exports of goods and services. On average, exports accounted for 12.508% of GDP during the study period, substantially higher than the average FDI net inflow, at 0.552% of GDP. The graphical trends of these variables are presented in Figure 1.

Table 1. Summary Statistics

Variable	Observations	Unit	Mean	SD
GDP	36	Annual %	5.423	1.351
FDI	36	% of GDP	0.552	0.505
Export	36	% of GDP	12.508	4.265

Figure 1 illustrates the upward trend in the natural logarithm of the data, including possible structural breaks. To better understand these breaks, Figure 1c is particularly important because GDP is the dependent variable in this study. The GDP plot suggests structural breaks across years, as reflected by noticeable fluctuations, including sharp rises and declines. However, the presence of structural breaks may complicate conventional unit root tests. To address this issue, this study employs the cointegration test with regime shifts developed by Gregory and Hansen's (1996), which accounts for structural breaks in the analysis. The test evaluates the null hypothesis of no cointegration at the breakpoint against the alternative hypothesis of cointegration. Specifically, this study applies three models proposed by Gregory and Hansen's (1996): the level shift model, the trend model, and the regime shift model.

Table 2 presents the estimated results of the Gregory–Hansen test for cointegration with regime shifts. The first model (Table 2a), which allows a break in the constant, indicates that the Z_t statistic rejects the null hypothesis of no cointegration because it falls within the rejection region. This result indicates cointegration with a structural break occurring in 2015. Similarly, the second model (Table 2b), which allows for a break in both the constant and the trend, also shows that the Z_t statistic rejects the null hypothesis. This finding confirms cointegration with a structural break in 2015. Finally, the third model (Table 2c), which allows for a break in both the constant and slope (regime shift), indicates that the Z_t statistic rejects the null hypothesis of no cointegration at the 2015 breakpoint. This suggests that the linear combination of the variables is long-run stable despite a structural break. Such a break may reflect changes in macroeconomic conditions or government policy adjustments (Mamun & Kabir, 2023b). Furthermore, the ADF statistics across all three models provide consistent results, supporting the rejection of the null hypothesis of no cointegration with a structural break. Based on these findings, the year 2015 is identified as the structural break point in the cointegrating relationship. Accordingly, a dummy variable is constructed, taking the value of 1 from 2015 onward and 0 for all preceding years. To incorporate this structural break into the empirical model, three dummy variables are included in the analysis. First, a dummy variable for the break is generated (Dummy 2015). Then, interaction terms are created by multiplying the break dummy by each explanatory variable in the model, such as the interaction between the break dummy and lnFDI and the interaction between the break dummy and lnexports (Gregory & Hansen, 1996).

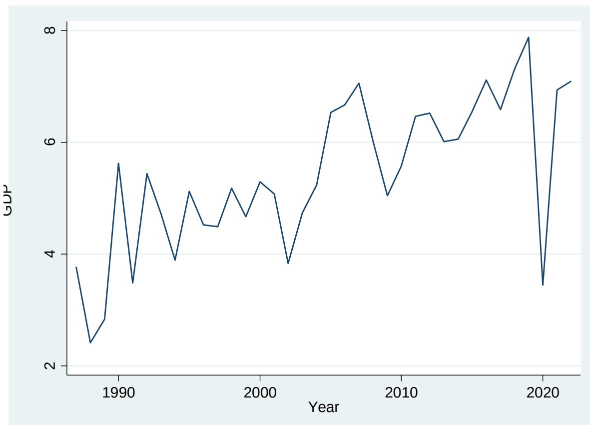

Figure 1a: GDP growth

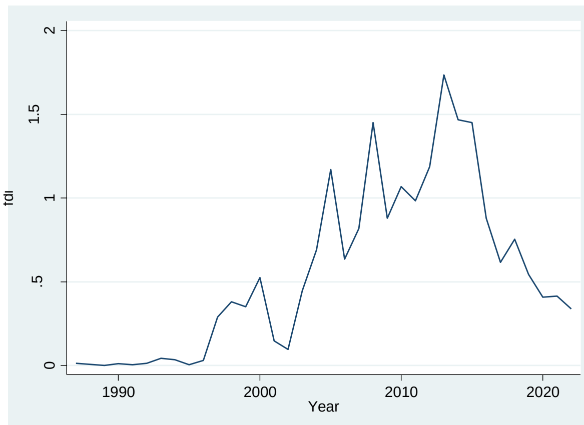

Figure 1b: FDI (% of GDP)

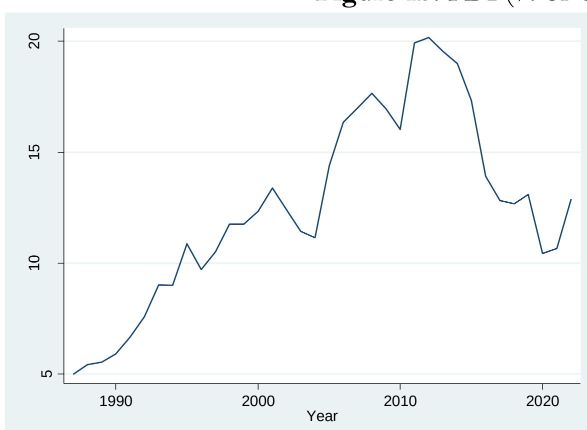

Figure 1e: Export of goods and services (% of GDP)

Figure 1. GDP growth, FDI, and exports in Bangladesh from 1986 to 2022

2.2 Model and Methodology

2.2.1 Model Specification

The primary objective of this study is to examine the effects of external (foreign direct investment) and internal (exports) determinants on economic growth in Bangladesh. The empirical analysis is based on 37 annual observations covering the period from 1986 to 2022. Subject to data availability, three variables are included in the analysis: foreign direct investment (FDI) net inflows as a percentage of GDP, exports of goods and services as a percentage of GDP, and GDP growth (annual percentage). For the econometric analysis, the following model is specified:

$$lnGDP_t = \alpha_0 + \beta_1 lnFDI_t + \beta_2 lnEXP_t + \beta_3 D2015_t + \beta_4 IBDlnFDI_t + \beta_5 IBDlnEXP_t + e_t \quad (1)$$

Table 2. Gregory-Hansen test for Cointegration with Regime Shifts
Table 2a: Break in the constant

Testing Procedure	Test Statistic	Breakpoint	Date	Asymptotic Critical Values		
				1%	5%	10%
ADF	-6.82	30	2015	-5.44	-4.92	-4.69
Z_t	-6.92	30	2015	-5.44	-4.92	-4.69
Z_α	-42.22	30	2015	-57.01	-46.98	-42.49

Note: The level shift equation, including the error term, can be written $Y_t = \alpha_1 + \alpha_2\gamma_{t\sigma} + \beta^T X_t + e_t$, where Y is GDP Growth, X is the FDI and Export, t is time subscript ($t = 1, 2, \dots, n$), σ is the break date, and $\gamma_{t\sigma}$is a dummy variable ($\gamma_{t\sigma} = 0 \; if \; t \leq \sigma \; and \; \gamma_{t\sigma} = 1 \; if \; t > \sigma$). Similarly, α_1 represents the intercept before the shift, and α_2 represents the change in the intercept at the time of the shift. Finally, the slope coefficients β are held constant, and e_t is $I(0)$.

Table 2b: Break in the constant and trend

Testing Procedure	Test Statistic	Breakpoint	Date	Asymptotic Critical Values		
				1%	5%	10%
ADF	-6.90	30	2015	-5.80	-5.29	-5.03
Z_t	-6.99	30	2015	-5.80	-5.29	-5.03
Z_α	-42.88	30	2015	-64.77	-53.92	-48.94

Note: The level shift with the trend, also known as a break in the constant and trend equation, including the error term, can be written $Y_t = \alpha_1 + \alpha_2\gamma_{t\sigma} + \mu t + \beta^T X_t + e_t$, $t = 1,2, \dots, n$, where μt indicates a trend.

Table 2c: Break in the constant and slope

Testing Procedure	Test Statistic	Breakpoint	Date	Asymptotic Critical Values		
				1%	5%	10%
ADF	-6.98	30	2015	-5.97	-5.50	-5.23
Z_t	-7.08	30	2015	-5.97	-5.50	-5.23
Z_α	-42.99	30	2015	-68.21	-58.33	-52.85

Note: The regime shift, also known as a break in the constant and slope equation, including the error term, can be written $Y_t = \alpha_1 + \alpha_2\gamma_{t\sigma} + \beta_1^T \beta^T X_t + \beta_2^T \beta^T X_t \gamma_{t\sigma} + e_t$, where, $\alpha_1$and α_2 represents the level shift model, β_1 denotes the cointegrating slope coefficients before the regime shift, β_2 denotes the change in the slope coefficients.

Equation (1) specifies the relationship between economic growth and its key determinants in Bangladesh while accounting for a potential structural break. In this model, $lnGDP_t$ represents the natural logarithm of gross domestic product (GDP) at time t, which is used as the dependent variable. The logarithmic transformation helps stabilize variance, reduce potential heteroskedasticity, and allows the estimated coefficients to be interpreted as elasticities. The variable $lnFDI_t$ denotes the natural logarithm of foreign direct investment (FDI) net inflows as a percentage of GDP, which serves as an external determinant of economic growth. Similarly, $lnEXP_t$ represents the natural logarithm of exports of goods and services as a percentage of GDP, capturing the internal determinant that may contribute to economic performance through trade expansion. The term $D2015_t$ is a dummy variable introduced to capture the structural break identified in 2015. The dummy variable takes the value of 0 for the years before 2015 and 1 for 2015 and subsequent years. This variable accounts for potential changes in the economic relationship after the structural break. The interaction terms $IBDlnFDI_t$ and $IBDlnEXP_t$ represent the interaction between the structural break dummy and the explanatory variables. Specifically, $IBDlnFDI_t$ captures the interaction between $D2015_t$ and $lnFDI_t$, while $IBDlnEXP_t$ represents the interaction between $D2015_t$ and $lnEXP_t$. These interaction terms allow the model to examine whether the effects of FDI and exports on GDP changed after the structural break in 2015. Finally, α_0 represents the intercept term, β_1 to β_5 denote the slope coefficients measuring the impact of each explanatory variable on GDP, and e_t is the stochastic error term that captures other factors affecting economic growth that are not included in the model.

2.2.2 Estimation Methodology

Time-series data require careful handling before empirical analysis; therefore, selecting an appropriate estimation method is essential. Time-series variables are often non-stationary and may contain unit roots. Consequently, it is necessary to determine the order of integration for each series and address any potential non-stationarity. Ignoring unit root or stationarity problems may lead to spurious regression results. According to Gujarati et al. (2012), time-series data should be stationary to avoid biased or inconsistent coefficient estimates. When time-series variables are non-stationary, it is recommended to apply cointegration techniques or transform the data to account for their orders of integration. Alternatively, differenced series can be used in the analysis instead of the original data to ensure stationarity (Tahir et al., 2015). Before conducting stationarity tests, it is also important to determine the optimal lag length. An inappropriate number of lags may reduce the accuracy of model estimation and forecasting. To identify the optimal lag structure, this study employs three commonly used information criteria: the Hannan–Quinn Information Criterion (HQIC), Akaike Information Criterion (AIC), and Schwarz Bayesian Information Criterion (SBIC) (Lütkepohl, 2013a).[2] To examine the presence of unit roots and potential non-stationarity in the variables, this study applies three widely used unit root tests: the Augmented Dickey–Fuller (ADF), Phillips–Perron (PP), and Kwiatkowski–Phillips–Schmidt–Shin (KPSS) tests.[3]

Numerous time-series econometric techniques are used to analyze long-run relationships among variables. These include Fully Modified Ordinary Least Squares (FMOLS), the LSE–Hendry General-to-Specific (GETS) approach, the Johansen Maximum Likelihood (JML) method, the Engle–Granger (EG) cointegration approach, the Johansen multivariate cointegration test, and the Autoregressive Distributed Lag (ARDL) procedure (Tahir et al., 2015). Among these methods, the ARDL cointegration approach developed by Pesaran, Shin, and Smith (2001) has gained considerable attention in empirical research. The ARDL method is considered effective because it can accommodate variables integrated of different orders, provided that none are integrated of order two, $I(2)$. In addition, the ARDL approach helps address potential endogeneity issues and performs well with both small and large sample sizes (Pesaran et al., 2001; Tahir et al., 2015). On the other hand, Shrestha and Bhatta (2018) argue that if all selected variables are stationary at level, conventional methods such as Ordinary Least Squares (OLS) or Vector Autoregression (VAR) can be applied. However, if all variables are non-stationary and integrated at the same order, the Johansen cointegration test is more appropriate than OLS or VAR models. In cases where the variables are integrated at mixed orders, that is, some are stationary at level and others at first difference, the ARDL approach provides a suitable framework for analysis. Therefore, given the possibility that the variables in this study may be integrated at different orders, the ARDL bounds testing approach is employed to examine the existence of a long-run relationship among the variables.

2.2.3 Cointegration Testing and ARDL Estimation Procedure

The ARDL approach to cointegration follows a step-by-step procedure. Pesaran, Shin, and Smith developed the bounds F-test approach for cointegration, also known as the ARDL approach, in 2001 (Pesaran et al., 2001).

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[2] The formulas for AIC, SBIC, and HQIC, as provided in Lütkepohl (2013), are: $AIC = -2\left(\frac{LL}{T}\right) + \frac{2t_p}{T}$; $SBIC = -2\left(\frac{LL}{T}\right) + \frac{\ln(T)}{T} t_p$; $and\ HQIC = -2\left(\frac{LL}{T}\right) + \frac{2ln\{\ln(T)\}}{T}\ t_p$

[3] The equations for these tests, including the error term *(e_t)*, are as follows: $ADF\colon \Delta y_t = \mu + \sigma y_{t-1} + \sum_{i=1}^{k} \beta_i \Delta y_{t-i} + e_t$; $PP\colon \Delta y_t = \sigma y_{t-1} + \beta_i R_{t-i} + e_t$; $and\ KPSS\colon Y_t = X_t + e_t$

The first step in this study is to examine the presence of long-run cointegration by rewriting equation (1) as an unrestricted error correction model (UECM) in the ARDL framework, as shown below:

$$\Delta GDP_t = \alpha_0 + \beta_1(GDP)_{t-1} + \beta_2(FDI)_{t-1} + \beta_3(EXP)_{t-1} + \beta_4(D2015)_{t-1} + \beta_5(IBDFDI)_{t-1} + \beta_6(IBDEXP)_{t-1} + \sum_{i=1}^{n}\beta_7\Delta(GDP)_{t-1} + \sum_{i=1}^{n}\beta_8\Delta(FDI)_{t-1} + \sum_{i=1}^{n}\beta_9\Delta(EXP)_{t-1} + \sum_{i=1}^{n}\beta_{10}\Delta(D2015)_{t-1} + \sum_{i=1}^{n}\beta_{11}\Delta(IBDFDI)_{t-1} + \sum_{i=1}^{n}\beta_{12}\Delta(IBDEXP)_{t-1} + e_t \quad (2)$$

where (Δ) is the difference operator, indicating short-run dynamics, while the coefficients of the lagged variables represent long-run relationships. This study will test the null hypothesis of no long-run relationship ($H_0\colon \beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = \beta_6 = 0$) against the alternative hypothesis of the existence of a long-run relationship ($H_1\colon \beta_1 \neq \beta_2 \neq \beta_3 \neq \beta_4 \neq \beta_5 \neq \beta_6 \neq 0$). If the null hypothesis is rejected, it indicates the establishment of a long-run cointegrating relationship; otherwise, the null hypothesis is accepted. The coefficients capture the short-run dynamics $\beta_7, \beta_8, \beta_9, \beta_{10}, \beta_{11}$, and β_{12}.

In 2001, Pesaran, Shin, and Smith developed the bounds testing approach for cointegration, which provides both lower-bound and upper-bound critical values for the F-test. The bounds testing procedure imposes restrictions on the long-run coefficients using the Wald test, which produces a Wald F-statistic. This statistic is then compared with the lower- and upper-bound critical values to determine the presence of a long-run relationship among the variables (Pesaran et al., 2001). The bounds testing procedure yields three possible outcomes. First, if the calculated Wald F-statistic exceeds the upper bound critical value $I(1)$, the null hypothesis of no cointegration is rejected, indicating the existence of a long-run relationship among the variables. In this case, the long-run coefficients and the error correction model (ECM) can be estimated. Second, if the calculated Wald F-statistic is lower than the lower bound critical value $I(0)$, the null hypothesis cannot be rejected, implying that no cointegration or long-run relationship exists among the variables. In this situation, only the short-run autoregressive distributed lag (ARDL) model can be estimated.

However, if the F-statistic lies between the lower bound $I(0)$ and the upper bound $I(1)$ critical values, the result is considered inconclusive. Narayan (2017) later recalculated the critical values for the ARDL bounds test for small sample sizes (30-80 observations). He argued that the critical values provided by Pesaran et al. (2001) were derived for large sample sizes and may produce misleading results when applied to small samples. Since the present study uses 37 annual observations, the critical values proposed by Narayan (2005) are more appropriate for the analysis. Nevertheless, this study considers both sets of critical values—those reported by Pesaran et al. (2001) and those provided by Narayan (2017)—to compare the outcomes. Accordingly, the calculated Wald F-statistic is evaluated against both critical value sets to determine the presence of cointegration. After establishing the existence of a long-run relationship, the next step is to estimate both the short-run and long-run dynamics using the ARDL model. According to Duasa (2007), the ARDL approach allows for the selection of different optimal lag structures for the variables in the model. The long-run coefficients can be derived from the estimated unrestricted ARDL model by dividing the coefficients of the explanatory variables by the negative value of the coefficient of the lagged dependent variable (Khatun & Ahamad, 2012). Accordingly, the long-run coefficients for FDI and exports, including the dummy variables, are calculated as follows:

$$\left(\frac{\beta_2}{\beta_1}\right) - 1, \left(\frac{\beta_3}{\beta_1}\right) - 1, \left(\frac{\beta_4}{\beta_1}\right) - 1, \left(\frac{\beta_5}{\beta_1}\right) - 1, \left(\frac{\beta_6}{\beta_1}\right) - 1, \text{ respectively.}$$

Finally, the short-run error correction model is estimated, where the short-run dynamics identify and verify the robustness of the long-run coefficients. The error correction model is specified based on equation (2):

$$\Delta GDP_t = \alpha_0 + \sum_{i=1}^{n} \beta_7 \Delta(GDP)_{t-1} + \sum_{i=1}^{n} \beta_8 \Delta(FDI)_{t-1} + \sum_{i=1}^{n} \beta_9 \Delta(EXP)_{t-1} + \sum_{i=1}^{n} \beta_{10} \Delta(D2015)_{t-1} + \sum_{i=1}^{n} \beta_{11} \Delta(IBDFDI)_{t-1} + \sum_{i=1}^{n} \beta_{12} \Delta(IBDEXP)_{t-1} + (ECM)_{t-1} + e_t \quad (3)$$

Where ECM represents the error correction term derived from the long-run estimates in equation (2), the error correction term is expected to have a significant and adverse relationship with the dependent variable, indicating adjustment back to equilibrium.

3. Results and Discussion

3.1 Lag Length Selection

The selection of an appropriate lag length is a crucial preliminary step in time-series analysis, particularly for stationarity testing and model estimation. Choosing too many lags may reduce estimation efficiency and increase forecasting errors, whereas too few lags may omit important dynamic information (Stock & Watson, 2006). Therefore, determining the optimal lag structure is essential for estimating the ARDL model, conducting the bounds cointegration test, and specifying the error correction model (ECM).

In practice, lag selection may be guided by theoretical considerations, prior empirical evidence, and the researcher's judgment. However, information criteria are widely used to determine the optimal lag length more objectively. In this study, three commonly used information criteria are applied: the Schwarz Bayesian Information Criterion (SBIC), the Akaike Information Criterion (AIC), and the Hannan–Quinn Information Criterion (HQIC).

When all three criteria suggest the same lag length, the choice is straightforward. However, discrepancies may arise. In such cases, the SBIC is generally preferred for small samples and for annual or quarterly data due to its tendency to select more parsimonious models. In contrast, the AIC is often more suitable for higher-frequency data (e.g., monthly), whereas the HQIC performs better for large samples, particularly for quarterly data with more than 120 observations (Kilian & Ivanov, 2001).

A common rule of thumb for selecting the maximum lag is as follows: 1–2 lags for annual data, 1–8 lags for quarterly data, and 6, 12, or 24 lags for monthly data. Given that this study uses 37 annual observations, the SBIC is considered appropriate, with a maximum lag length of two.

To determine the optimal lag length, an unrestricted vector autoregression (VAR) model is estimated. Table 3 reports the lag-order selection statistics, including the Final Prediction Error (FPE), AIC, HQIC, and SBIC, for lag orders up to two. The results indicate that most criteria (FPE, AIC, and HQIC) suggest an optimal lag length of one, while SBIC also supports this selection based on model parsimony.

Table 3. Obtain lag-order selection statistics (obtain optimal lag for each variable)

Lag	LL	LR	p-Value	FPE	AIC	HQIC	SBIC
0	-149.961	NA	NA	1.25489	8.74063	8.78665	8.87394
1	-105.051	89.82*	0.000	0.161702*	6.68862*	6.8727*	7.22188*
2	-97.1487	15.804	0.071	0.174491	6.75136	7.0735	7.68456

Note: LL: Log Likelihood, LR: Likelihood Ratio, FPE: Final Prediction Error, AIC: Akaike Information Criterion, HQIC: Hannan and Quinn Information Criterion, SBIC: Schwartz's Bayesian Information Criterion. *Optimal Lag Length: Significant at 5% or Lower Level.

3.2 Stationarity Test

3.2.1 Graphically Test for Stationarity

This study presents time-series plots of the logarithmic values of three variables: GDP growth, foreign direct investment (FDI), and exports. The graphical analysis indicates that the series exhibits noticeable trends over time, suggesting that the variables are non-stationary at their levels (see Figure 2). After applying the first-difference transformation, the series appears to fluctuate around a constant mean, indicating that they become stationary (see Figure 3).

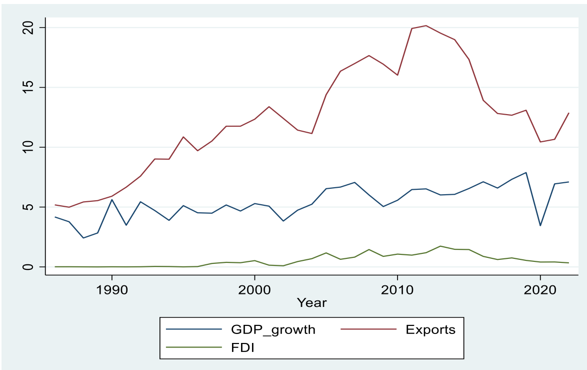

Figure 2. Time Series plot of variables at the level

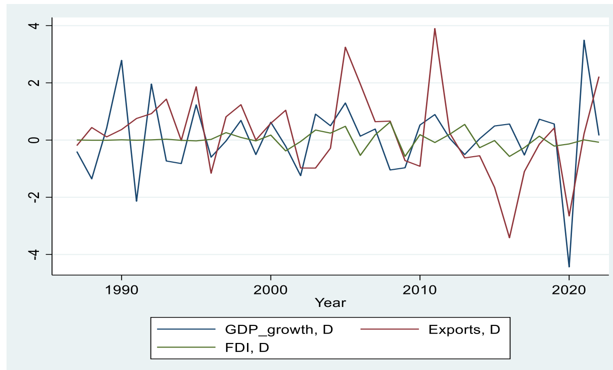

Figure 3. Time Series plot of the first difference

3.2.2 Unit Root Test for Stationarity

To examine the stationarity properties of the time-series data, unit root tests are conducted for GDP growth, FDI, exports, and the dummy variables. The tests are performed at both levels and in first differences, including specifications with an intercept and with both an intercept and a trend. Three widely used unit root testing approaches are applied: the Augmented Dickey–Fuller (ADF), Phillips–Perron (PP), and Kwiatkowski–Phillips–Schmidt–Shin (KPSS) tests.

The ADF test results (Table 4) indicate that most variables are non-stationary at levels. However, after first differencing, all variables become stationary at conventional significance levels. When a deterministic trend is included, GDP growth appears to be stationary at the 5% level, while the remaining variables remain non-stationary at levels but become stationary after first differencing. The ADF test is based on the null hypothesis that a variable has a unit root (i.e., is non-stationary) and tests against the alternative of stationarity. Rejection of the null hypothesis occurs when the absolute value of the test statistic exceeds the corresponding critical value.

The Phillips–Perron (PP) test results (Table 5) support the ADF test findings. Specifically, all variables are non-stationary at levels under the intercept specification, although GDP growth is trend-stationary at the 5% level when a trend is included. After first differencing, all variables become stationary at the 5% significance level. The PP test also assumes the null hypothesis of a unit root, and rejection implies stationarity.

The KPSS test (Table 6), which complements the ADF and PP tests, provides further evidence on stationarity. Unlike ADF and PP, the KPSS test assumes stationarity as the null hypothesis and non-stationarity as the alternative. The results indicate that most variables are non-stationary at levels, as the test statistics exceed the critical values. However, after first differencing, the test statistics fall below the critical values, confirming that the variables become stationary.

Overall, the results from the ADF, PP, and KPSS tests are consistent and indicate that the variables are integrated of order one, $I(1)$, except for GDP growth, which shows some evidence of trend stationarity at the level. Therefore, the variables are suitable for further cointegration analysis.

Table 4. Augmented Dicky Fuller (ADF) test results

Variable	Intercept				Trend and Intercept			
	Level		First Difference		Level		First Difference	
	t-stat	p-value	t-stat	p-value	t-stat	p-value	t-stat	p-value
GDP Growth	-2.171	0.2169	-7.156	0.0000	-4.637	0.0009	-7.151	0.0000
FDI	-1.561	0.5033	-4.882	0.0000	-1.238	0.9025	-5.030	0.0002
Export	-1.907	0.3290	-3.838	0.0025	-1.480	0.8360	-4.123	0.0058
Dummy 2015	-0.457	0.9001	-4.123	0.0009	-1.630	0.7805	-4.259	0.0036
Dummy FDI	-2.047	0.2665	-5.808	0.0000	-2.799	0.1974	-5.715	0.0000
Dummy Export	-0.854	0.8026	-4.875	0.0000	-1.991	0.6064	-4.933	0.0003

Table 5. Phillips-Perron (PP) test results

Variable	Intercept				Trend and Intercept			
	Level		First Difference		Level		First Difference	
	t-stat	p-value	t-stat	p-value	t-stat	p-value	t-stat	p-value
GDP Growth	-3.164	0.0221	-9.849	0.0000	-6.033	0.0000	-9.688	0.0000
FDI	-1.717	0.4223	-6.944	0.0000	-1.623	0.7834	-7.008	0.0000
Export	-1.713	0.4245	-4.569	0.0001	-1.126	0.9246	-4.732	0.0006
Dummy 2015	-0.485	0.8950	-5.916	0.0000	-1.682	0.7587	-6.009	0.0000
Dummy FDI	-2.562	0.1010	-7.724	0.0000	-3.391	0.0526	-7.603	0.0000
Dummy Export	-1.063	0.7296	-6.942	0.0000	-2.270	0.4506	-6.954	0.0000

Table 6. KPSS test results

Variable	LM Statistics KPSS Test			
	Intercept		Trend and Intercept	
	Critical Value at 10% = 0.347, 5% = 0.463, 2.5% = 0.574, 1% = 0.739		Critical Value at 10% = 0.119, 5% = 0.146, 2.5% = 0.176, 1% = 0.216	
	Level	First Difference	Level	First Difference
GDP	1.380	0.0265	**0.0513**	0.0262
FDI	1.140	0.1560	0.2410	0.0808
Export	1.200	0.2460	0.3270	0.0684
Dummy 2015	1.120	0.1780	0.3440	0.0498
Dummy FDI	0.869	0.0418	0.1820	0.0403
Dummy Export	1.100	0.1130	0.3050	0.0381

3.3 ARDL Model Estimation

This stage involves estimating the ARDL model using the optimal lag length of one. Based on the Schwarz Bayesian Information Criterion (SBIC), the ARDL (1, 0, 1, 1, 0, 0) specification is selected, incorporating a structural break dummy for 2015 (see Table 7). The model also includes interaction terms between the break dummy and the key explanatory variables, namely FDI and exports, to capture potential structural changes in their effects on economic growth.

The selected ARDL model indicates that GDP growth is influenced by its own lagged value (t_{-1}). Exports and the break dummy are included with one lag, while FDI and the interaction terms (dummy–FDI and dummy–exports) enter the model contemporaneously (i.e., at t). These lag structures reflect the dynamic relationships among the variables.

The inclusion of the structural break dummy allows the model to capture shifts in economic conditions. The estimated coefficient of the break dummy is negative and statistically significant, suggesting that the structural change in 2015 is associated with a temporary decline in economic growth of approximately 9.32%. However, the positive and significant coefficient of the lagged dummy indicates a partial recovery in the subsequent period.

Furthermore, the estimated ARDL (1, 0, 1, 1, 0, 0) model serves as the basis for subsequent analysis, including the bounds cointegration test, estimation of long-run and short-run coefficients, the error correction term (speed of adjustment), and various diagnostic tests.

Table 7. ARDL Model Estimation

Variable	ARDL Estimation
Lagged GDP	-0.2540
	(0.1474)
FDI	0.4098
	(0.5352)
Export	0.5024***
	(0.1101)
Lagged Export	-0.3130**
	(0.1050)
Dummy 2015	-9.3225*
	(4.0774)
Lagged Dummy 2015	4.6903**
	(1.5871)
Dummy 2015 FDI	1.0938
	(2.2107)
Dummy 2015 Export	0.5088
	(0.3178)
Constant	3.6463***
	(0.6572)
N	36
R-squared	0.7853
Adjusted R-squared	0.7217
Root MSE	0.7125

Note: Standard Errors in Parentheses
* p<0.05, ** p<0.01, and *** p<0.001

3.4 ARDL Bounds Test for Cointegration

Based on the error correction representation, this study employs the ARDL bounds testing approach to examine the existence of a cointegrating (long-run) relationship among the variables (Pesaran et al., 2001). The bounds test is based on the joint F-statistic, whose asymptotic distribution is non-standard under the null hypothesis. The null hypothesis (H_0) assumes no cointegration (i.e., no long-run relationship), while the alternative hypothesis (H_1) indicates the presence of cointegration.

The bounds testing procedure provides two sets of critical values: the lower bound $I(0)$, which assumes that all variables are stationary at level, and the upper bound $I(1)$, where all variables are integrated of order one. The test involves estimating the ARDL model using ordinary least squares (OLS) and assessing the joint significance of the lagged level variables.

The decision rule is as follows: if the computed F-statistic exceeds the upper bound critical value, the null hypothesis of no cointegration is rejected; if it falls below the lower bound critical value, the null hypothesis cannot be rejected; and if it lies between the two bounds, the result is inconclusive (Belloumi, 2014).

The results of the ARDL bounds test are presented in Table 8. The calculated F-statistic is 13.883, which exceeds the upper bound critical value of 4.68 at the 1% significance level (with the lower bound value at 3.41). This indicates that the null hypothesis of no cointegration is rejected at the 1% significance level. Therefore, a stable long-run relationship exists among the variables (Narayan, 2005b). Consequently, the findings confirm the presence of a unique cointegrating relationship among the variables when normalized on economic growth. This implies that foreign direct investment (FDI) and exports are significantly associated with GDP growth in Bangladesh in the long run.

Table 8. ARDL Bound Test for Cointegration

Significance Level	Critical Value		Calculated F Statistic
	Lower Band $I(0)$	**Upper Band $I(1)$**	
1%	3.41	4.68	
2.5%	2.96	4.18	13.883
5%	2.62	3.79	
10%	2.26	3.35	

Note: *The Variables Lag Length (1 0 1 1 0 0)

* H_0 is accepted if F<critical value for $I(0)$ regressors (Lower band); and rejected if F>critical value for $I(1)$ regressors (Upper band)

3.5 ARDL and ECM Results

The results of the bounds test confirm the existence of a long-run cointegrating relationship among the selected variables. Therefore, the ARDL error correction model (ECM) is employed to estimate both the long-run and short-run dynamics between the dependent variable (GDP growth) and the explanatory variables (FDI and exports).

The long-run estimates presented in Table 9 indicate that exports have a positive and statistically significant effect on economic growth in Bangladesh. The estimated coefficient suggests that a 1% increase in exports leads to approximately a 0.151% increase in GDP growth, holding other factors constant.

In contrast, foreign direct investment (FDI) exhibits a positive but statistically insignificant relationship with economic growth in the long run. The estimated coefficient implies that a 1% increase in FDI is associated with a 0.3268% increase in GDP growth; however, this effect is not statistically significant. This finding may reflect structural factors in the Bangladeshi economy or the exclusion of other relevant variables, such as remittances, that may interact with FDI to influence growth (Mamun & Kabir, 2023c). Previous studies, including Hussain and Haque (2016), Adhikary (2010), and Sarker and Khan (2020), report similar findings, whereas Hye and Islam (2013) find contrasting evidence.

The results provide strong evidence of a positive relationship between exports and economic growth. The export coefficient is statistically significant at the 1% level, reinforcing the importance of export-led growth in Bangladesh. Consistent with these findings, earlier studies such as Begum and Shamsuddin (1998) and Mamun and Nath (2005) also report that increased exports significantly contribute to economic development.

Regarding structural breaks, the Gregory–Hansen cointegration test identifies a breakpoint in 2015, which is incorporated into the model through a dummy variable. The coefficient on the break dummy (Dummy 2015) is negative but statistically insignificant in the long run, suggesting that the structural break has no persistent effect on economic growth. Similarly, the interaction terms for FDI and exports (Dummy 2015 × FDI and Dummy 2015 × Export) are positive but not statistically significant, indicating that the structural break does not significantly alter the long-run effects of these variables.

Table 9 also reports the error correction term (ECT), represented by the lagged dependent variable. The coefficient of the ECT is negative and statistically significant at the 1% level (−1.254), confirming the existence of a stable long-run relationship. The magnitude of the coefficient suggests a rapid adjustment process, whereby approximately 125.4% of the previous period's disequilibrium is corrected within the current period. Although the adjustment speed exceeds unity, this may indicate an overshooting adjustment toward equilibrium.

In the short run, the results show that exports have a positive and statistically significant impact on economic growth at the 1% level. In contrast, the structural break dummy (Dummy 2015) has a negative and statistically significant effect, indicating that the structural change in 2015 adversely affected short-term GDP growth.

Table 9. Long-run estimates and error correction result (Predictand: GDP)

Variable	Estimated Coefficient
Long-run Estimates	
FDI	0.3268
	(0.4302)
Export	0.1510**
	(0.4956)
Dummy 2015	-3.6939
	(2.5348)
Dummy 2015 FDI	0.8723
	(1.7827)
Dummy 2015 Export	0.4058
	(0.2486)
Adjustment	
Lagged GDP	-1.2540***
	(0.1474)
Short-run Estimates	
Export	0.3130**
	(0.1049)
Dummy 2015	-4.6903**
	(1.5871)
Constant	3.6463**
	(0.6572)
N	36
R-squared	0.7849
Adjusted R-squared	0.7212
Root MSE	0.7125

Note: Standard Errors in Parentheses
* p<0.05, ** p<0.01, and *** p<0.001

3.6 Diagnostic Tests Results

The final step involves assessing the goodness-of-fit and reliability of the ARDL error correction model. To this end, a series of diagnostic tests is followed by stability tests. Table 10 presents the results of the diagnostic tests, which confirm that the estimated ARDL model is free from major econometric problems. The Durbin–Watson statistic (2.172) suggests the absence of first-order autocorrelation. Consistent with this, the Breusch–Godfrey test indicates no evidence of higher-order serial correlation. Furthermore, the White test for heteroscedasticity is statistically insignificant at the 5% level, implying that the variance of the residuals is constant. The Jarque–Bera test confirms that the residuals are normally distributed, while the Ramsey RESET test provides no evidence of model misspecification or omitted variable bias. Overall, these results suggest that the estimated ARDL model is statistically robust and reliable for inference.

Table 10. The result of the diagnostic test

Specification	Statistic	p-Value	Conclusion
Durbin-Watson statistic (Autocorrelation)	2.172	-	No autocorrelation
Breusch-Godfrey statistic (Autocorrelation)	0.785	0.3756	No higher-order autocorrelation
Heteroscedasticity	26.040	0.2498	No heteroscedasticity
Ramsey RESET test	1.520	0.2342	No omitted variables
Jarque-Bera normality test	0.5609	0.7555	No omitted variables

Note: Significant at 5% level and the d-statistic used for Durbin-Watson.

3.7 Stability Checking

The stability of the estimated model is assessed using the cumulative sum (CUSUM) and cumulative sum of squares (CUSUMSQ) tests. The plots of the CUSUM and CUSUMSQ statistics are presented in Figures 4 and 5, respectively. The graphical results indicate that both the CUSUM and CUSUMSQ lines remain within the critical bounds at the 5% significance level. This suggests that the model parameters are stable over the sample period and that no structural instability is present. Therefore, the estimated ARDL model is stable and reliable for inference.

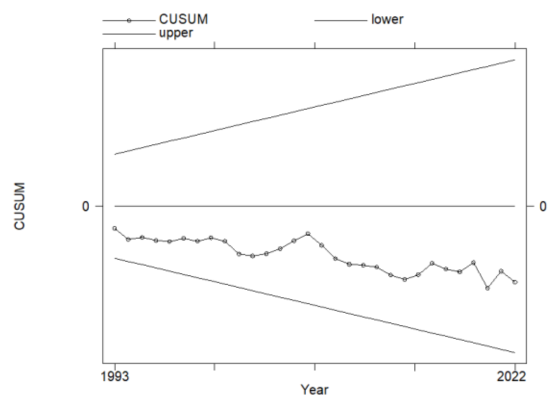

Figure 4. CUSUM Test

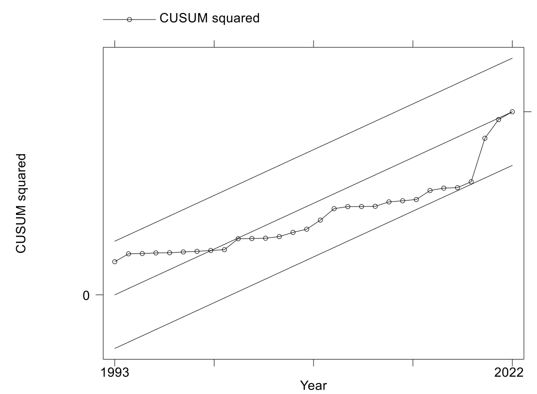

Figure 5. CUSUM Square Test

4. Conclusion and Policy Recommendation

This study investigates the long-run and short-run relationships among foreign direct investment (FDI), exports, and economic growth in Bangladesh using annual data from 1986 to 2022. Employing the Autoregressive Distributed Lag (ARDL) bounds testing approach with a structural break, the results confirm the existence of a stable long-run cointegrating relationship among the variables. The empirical findings reveal that exports have a positive and statistically significant impact on economic growth in both the short and long run, supporting the export-led growth hypothesis in the context of Bangladesh. In contrast, FDI exhibits a positive but statistically insignificant effect on economic growth, suggesting that its contribution may depend on complementary structural and institutional factors. The analysis also identifies a structural break around 2015, which coincides with Bangladesh's transition to lower-middle-income status and notable improvements in macroeconomic performance.

The findings of this study offer important implications for policymakers and contribute to the empirical literature on growth dynamics in developing economies. The strong role of exports highlights the importance of export-oriented policies, industrial diversification, and global market integration as key drivers of sustainable economic growth. Although FDI shows an insignificant effect, it remains a critical component of long-term development. Policymakers should therefore focus on improving the investment climate by enhancing institutional quality, ensuring political stability, reducing regulatory barriers, and investing in infrastructure. Strengthening human capital and technological capabilities is also essential to maximize the potential benefits of FDI. Additionally, the identification of a structural break emphasizes the importance of adaptive and responsive macroeconomic policies in managing economic transitions and external shocks.

Despite its contributions, this study has several limitations. First, it focuses on a limited set of variables—FDI and exports—without incorporating other important determinants of economic growth such as remittances, human capital, financial development, and institutional quality. Second, the study primarily examines long-run associations and does not fully explore causal relationships among the variables. Third, the use of aggregate data may mask sector-specific dynamics, particularly in the case of FDI.

Future research could extend this study by incorporating additional macroeconomic and institutional variables to provide a more comprehensive understanding of growth dynamics in Bangladesh. Applying advanced econometric techniques, such as Granger causality tests or structural vector autoregression (SVAR), could help establish causal relationships among the variables. Moreover, sectoral analysis of FDI and exports may offer deeper insights into their differential impacts on economic growth. Future studies could also examine the role of political stability, governance quality, and technological advancement in shaping the effectiveness of FDI and export performance. Expanding the analysis to a comparative or panel framework across similar developing countries may further enrich the findings.

Finally, this study underscores the critical role of exports as a key driver of economic growth in Bangladesh, while highlighting the conditional and limited impact of FDI in the absence of supportive structural factors. Achieving sustained and inclusive economic growth will require a balanced policy approach that promotes export diversification, strengthens the investment climate, and enhances institutional capacity. Such efforts are essential for ensuring long-term economic resilience and advancing Bangladesh's development trajectory.

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