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Thoughts on Banking and Finance

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Bangladesh Bank Training Academy
Mirpur-2, Dhaka-1216

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Editorial Note

BBTA Journal: Thoughts on Banking and Finance is a bi-annual flagship publication of Bangladesh Bank Training Academy (BBTA). This esteemed journal gathers analytical reports and research articles on financial, economic, banking, and socio-political issues of utmost importance. Scholars and academics from both home and abroad consider this journal as a prestigious platform to share and express their views and opinions.

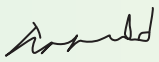
In this edition of Thoughts on Banking and Finance (Volume 10, Issue 1, January-June 2025), a total of six research papers are presented. The authors of these articles– university lecturers and professors, central bank officials –represent the most revered section of the intelligentsia. Each article is carefully selected after strict scrutiny and is tested through peer review method. I strongly believe that all these works are of very high standard and qualify for any local or international journals.

The papers in this journal depict both academic and professional integrity and excellence of the authors in examining critical socio-economic issues of the present time. The areas covered in the articles are wide ranging– monetary and exchange rate, external sector, inflation, unemployment, human development, and banking sector practices. The research findings and policy recommendations listed in the papers are very interesting and thought-provoking, and certainly call for attention on the part of the policy makers.

In brief, the first paper analyzes the complex interplay among monetary policy, inflation, broad money, exchange rates, and remittance in Bangladesh for the period 1978-2022. The second article examines the effect of imported capital goods on manufacturing exports in Bangladesh using time series data from fiscal year 1991 to fiscal year 2023. The third one establishes relationship between institutional quality, unemployment, and the dependency ratio on human development in Bangladesh for the period 1996-2022. The fourth paper presents a critical analysis of the volatility dynamics of food inflation in Bangladesh by applying econometric models. The fifth one explores the influence of the Real Effective Exchange Rate (REER) on Bangladesh's trade flows, explicitly focusing on nominal export earnings and import payments. Finally, the last article investigates whether green banking activity disclosure is relevant to stock prices of the firms by applying linear price model.

I express my gratitude to the authors for their hard work and commitment in the pursuit of knowledge and academic excellence. I would like to humbly acknowledge the invaluable guidance and directives received from Dr. Ahsan H. Mansur, Governor, Bangladesh Bank, who is also the Chairman of the Editorial Advisory Board of the journal. I also extend my thankfulness to all the members of the Editorial Advisory Board and Editorial Board for their suggestions and support in this regard. I wholeheartedly appreciate the contributions and sincere efforts made by the concerned officials of Research and Publications and Library Wing and the Department of Communications and Publications in this endeavor. Finally, I avow my profound indebtedness to Mr. Md. Hanif Miah, Executive Director, BBTA for his unwavering oversight and prudent leadership which remain as instrumental for the publication of this journal.

The articles in this issue address important financial and banking sector questions and deserve a sizeable niche in the academic and policy debates. I welcome comments and critiques from the valued readers regarding these papers in particular and for the betterment of the journal "Thoughts on Banking and Finance" as well.



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Monetary Policy and Exchange Rate Dynamics in the Context of Remittance Volatility: Evidence from Bangladesh

Md. Saddam Hossain[1]
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Abstract

The present study applies an ARDL model to examine the complex interplay among monetary policy, inflation, broad money supply, exchange rates and remittances in the context of Bangladesh. The investigation is grounded on yearly time series data covering the period from 1978 to 2022. The results of our unit root and cointegration analysis indicate that the variables under consideration demonstrate a mixture of integrated of order I(0) and integrated of order I(1) features. The study revealed that, in the short term, the effects of interest rates (IR) and inflation rates (IN) on remittances (REM) were shown to have a considerable influence on the flow of remittances. Conversely, exchange rates (EX) and broad money (BM) were deemed to be statistically insignificant. The Error Correction Mechanism (ECM) coefficient indicates a significant annual correction rate of around 26.45% for short-term aberrations from the long-run equilibrium in remittances. Surprisingly, the long-term association did not show any statistical significance in respect to exchange rates (EX). The findings highlight the crucial economic role of interest rates and inflation in influencing remittance flows, underscoring the need for balanced monetary policy and inflation control to harness remittances as a stabilizing force for Bangladesh's economy. The aforementioned findings provide significant insights for policymakers, emphasizing the importance of implementing a well-rounded monetary policy, effectively managing inflation and promoting financial inclusivity in order to maximize the positive impact of remittances on Bangladesh's economic stability and progress.

Keywords: ARDL, Monetary policy, Exchange Rate, Remittance, ECM, Bangladesh

JEL Classification: E52, F31, F24, C22, E41, E31

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1. Introduction

For many developing nations, remittances are a significant source of foreign exchange earnings. According to World Bank data, Bangladesh received approximately $21.5 billion in remittances in 2022, which accounted for approximately 5.2% of the country's GDP (WDI 2023). This made Bangladesh one of the leading recipients of remittances in South Asia. By increasing household income, stimulating consumption and investment and reducing deprivation, remittances can have a positive effect on economic growth. However, the volatile nature of these inflows poses challenges, as global labor market dynamics, economic crises, and geopolitical events can sharply impact remittance volumes. Such fluctuations threaten exchange rate stability and inflation, posing significant risks to Bangladesh's economic planning and stability (IOM UN Migration, 2022). An unexpected decline in remittances can result in a drop in foreign exchange reserves (Siddique et al., 2012).

Monetary policy can help mitigate the negative effects of volatility in remittances. The central bank can use monetary policy instruments to smooth out fluctuations in the exchange rate and inflation (Sultana, 2023). As an illustration, the central bank can surge interest rates to draw foreign capital and stabilise the exchange rate (Mandelman, 2011).
In an open economy like Bangladesh, where a large share of goods and services are traded globally, the exchange rate plays a vital role in economic stability and competitiveness. Changes in the exchange rate can have a significant effect on the competitiveness of Bangladesh's exports and the cost of imports, influencing the country's overall balance of payments and external trade position (Hosen, 2023). Changes in the exchange rate can also impact inflation dynamics because they affect the prices of imported goods and inflation expectations.

In the context of remittance volatility, the relationships between remittances, exchange rates and inflation are complex and multifaceted. When remittance inflows surge, they can result in an appreciation of the local currency, potentially harming the export sector's competitiveness and contributing to "Dutch disease" (Ball et al., 2010). An unexpected decline in remittances, on the other hand, can exert downward pressure on the exchange rate, potentially fueling inflationary pressures, particularly in an import-dependent economy like Bangladesh.

Given these dynamics, understanding how monetary policy interacts with exchange rate fluctuations in the context of volatile remittances is of the utmost importance for Bangladeshi policymakers. Through its influence on interest rates and money supply, monetary policy can affect exchange rates and, in turn, inflation dynamics. Effective monetary policy can mitigate the negative effects of volatility in remittances on exchange rates and inflation.

This study seeks to cast light on the complex relationship between Bangladesh's monetary policy, exchange rate dynamics, and remittance fluctuations. By analysing historical data, conducting empirical analysis, and assembling insights from pertinent literature, this study aims to provide policymakers with evidence-based recommendations for navigating the challenges and opportunities presented by remittance volatility in the context of exchange rate management.

The main objectives of this study are –

- To investigate whether a long-run equilibrium relationship exists between remittances, exchange rates and inflation rates in the context of Bangladesh.
- To analyze the short-term impacts and dynamics of monetary policy, exchange rate changes, and inflation on remittance flows within the Bangladeshi economy.

The paper is structured as follows: Section 1 introduces the issues; Section 2 presents the theoretical conundrum and empirical research review. The research methodology and analytical framework are outlined in Section 3. Section 4 of the paper describes data-driven results, and section 5 offers policy proposals with concluding remarks.

2.0 Theoretical Framework and Literature Review

2.1 Theoretical Framework

This section provides an overview of the key theoretical concepts that inform the research.

The Mundell-Fleming model is a seminal framework for analysing the interplay of monetary policy, exchange rates and capital flows. A central bank's monetary policy decisions, according to this concept, can affect currency exchange rates in an open economy. In particular, currency depreciation is associated with expansionary monetary policy, which is characterised by lower interest rates, and can alter the balance of trade. (Mundell, 1963); (Fleming, 1962). For this study's objective of analyzing short-term impacts of monetary policy on remittance flows and exchange rates, the Mundell-Fleming model provides insight into how changes in interest rates may cause immediate shifts in exchange rates, which, in turn, affect remittance inflows. Understanding these short-term effects is essential, as remittance inflows to Bangladesh respond not only to economic conditions in host countries but also to shifts in domestic currency value.

The Interest Rate Parity (IRP) theory states that a country's currency exchange rate should reflect a country's interest rate differential. If interest rates in one country are higher than in another, the value of that country's currency should rise to make up the difference. On the other hand, a decline in value is expected as interest rates fall. Capital flows and exchange rate fluctuations may be influenced by interest parity deviations, which may be indicative of arbitrage opportunities. For this study's objective of examining long-term impacts, the

IRP model helps to assess how sustained interest rate policies could influence the flow of remittances over time through their effect on exchange rates.

The influence of resource windfalls, like remittances, on an economy is the subject of the Dutch Disease hypothesis (Corden & Neary, 1982). There is evidence to suggest that remittances can cause a country's currency to appreciate and so reduce the competitiveness of exports that are not resources. Furthermore, it can cause economic imbalances by encouraging resources to relocate from the export sector to the non-tradable sector (resource movement impact) (Oomes & Kalcheva, 2007).

Together, these models form a comprehensive theoretical framework for investigating the complex relationship among remittances, exchange rates, inflation, and monetary policy in Bangladesh. The Mundell-Fleming and IRP models clarify the mechanisms through which monetary policy can impact remittance flows and exchange rates in both the short and long term, addressing the study's primary objectives. The Dutch Disease hypothesis highlights potential economic distortions arising from remittance inflows, providing a basis for assessing the broader implications of remittance volatility on inflation and economic balance. By integrating these theoretical perspectives, the study is well-positioned to offer policy recommendations that enhance the stability and effectiveness of Bangladesh's monetary policy in the context of remittance dynamics.

2.2 Selected Review of Literature

Monetary policy plays a pivotal role in the exchange rate dynamics and remittance flows in countries like Bangladesh, where remittances significantly contribute to economic stability. Abdullah et al. (2012) highlight the effects of monetary policy on inflation in Bangladesh, underscoring that monetary interventions, including interest rate adjustments, influence inflation dynamics and can indirectly impact remittance inflows. Kim (2019) further supports this by finding that remittance volatility in Bangladesh can be mitigated through supportive monetary policies. The study shows that a 1% increase in interest rates results in a 0.2% decline in the value of the Bangladeshi taka, thereby highlighting the relationship between interest rates, remittance flows, and exchange rates.

Islam et al. (2021) also examine the potential stabilizing effect of monetary policy on inflation in Bangladesh, asserting that a 1% increase in interest rates leads to a 0.01% reduction in inflation, which could enhance the real value of remittances. This is crucial for understanding how monetary policies in Bangladesh affect remittance value and, in turn, exchange rate dynamics.

Several studies focus on the relationship between exchange rates and remittances, with varying findings. Jahjah et al. (2003) suggest that an appreciation in the exchange rate can increase the value of remittances in local currency terms. However, the effect varies across countries and depends on contextual factors such as the income of remittance recipients.

This is corroborated by Razzaque et al. (2017), who explore the broader effects of exchange rates on economic growth in Bangladesh, establishing that exchange rate fluctuations can have significant implications for remittance inflows and economic stability.

Adenutsi and Ahortor (2008) conduct an empirical study on the Ghanaian economy and show that monetary aggregates, exchange rates, and interest rates positively influence remittance inflows, whereas domestic price levels have a negative impact. Their findings suggest that well-crafted monetary and exchange rate policies can encourage remittance inflows into Ghana. Similarly, Vu et al. (2019) explore how remittances interact with real exchange rates and the Dutch disease effect in Asian countries, highlighting that exchange rate volatility can alter remittance behavior, with implications for long-term economic growth.

Mandelman (2011) investigates the role of monetary policy in small open economies like the Philippines, where remittance volatility is a significant concern. His study indicates that a nominal fixed exchange rate regime can protect households from remittance fluctuations, while an adaptable floating regime may be more suitable when unexpected shocks occur. This research is particularly relevant to Bangladesh, where exchange rate fluctuations significantly affect remittance inflows and economic stability.

Ball et al. (2012) delve into the dynamics of exchange rate regimes and their effects on remittances, output, and inflation in non-tradable goods sectors. Their analysis suggests that under a fixed exchange rate system, remittances can lead to higher inflation for non-tradables and an increase in output for non-tradable goods, further complicating the impact of remittance flows on the economy.

In the case of Nigeria, Mbutor (2010) uses the vector autoregressive model to examine the impact of monetary policy on remittances, concluding that remittance flows are closely linked to the health of the domestic economy and exchange rate fluctuations. His findings are crucial for understanding how monetary policy can stabilize remittance flows in the face of economic instability.

Existing literature on the relationship between monetary policy, exchange rate dynamics, and remittance volatility has concentrated primarily on global or cross-country analyses, with limited attention paid to Bangladesh's particular circumstances. Many studies have explored what drives remittances and how they affect exchange rates and inflation. However, there is a clear lack of research focusing specifically on how these factors jointly interact in Bangladesh's economy. This study aims to address this deficiency by providing a comprehensive examination of how the country's monetary policy interacts with remittance fluctuations and their subsequent impact on exchange rate dynamics and inflation, thereby providing policymakers in Bangladesh with the knowledge they need to

effectively manage these crucial economic variables in the face of remittance-induced volatility.

3.0 Methodology of this Study

3.1 Source and Description of Data

In this study, we analyzed the dynamics of monetary policy and exchange rates in relation to remittance volatility using yearly time series data obtained from the World Bank Development Indicator (WDI) for the period spanning from 1978 to 2022. We used Personal remittances, received (current US$) or REM, Official exchange rate or EX, Lending interest rate (%) or IR Inflation, GDP deflator (annual %) or IN and broad money or BM to found out the dynamics. By transforming all variables into logarithmic form, it becomes possible to determine elasticities, which provides a more convenient means of explaining the model. The statistical software tool used for econometric analysis is EViews 9.0.

3.2 Methods

According to Nelson and Ploser (1982), the utilisation of time series data may lead to misleading results if unit root issues are present, hence hindering the achievement of our research objectives. Consequently, prior to conducting the autoregressive distributed lag (ARDL) analysis, it is necessary to assess the presence of unit root in order to ascertain the validity of the model. The Augmented Dickey-Fuller (ADF) test is widely employed as a method for identifying the presence of a unit root(Gujarati & Porter, 2009). There are several methods available for examining variable cointegration, with the ARDL bounds test being a widely utilised approach due to its ability to accommodate both I(0) and I(1) series. Given that our series comprises a combination of I(0) and I(1) components, the ARDL limits test is deemed suitable for our analysis.

3.3 Justification of the ARDL model

This article employs the Autoregressive Distributed Lag (ARDL) model to analyze both the short-term and long-term impacts of remittance volatility on exchange rates and inflation, offering a comprehensive view of these relationships. The ARDL model is particularly suited for this context, as it allows for analysis of mixed-order integrations and dynamic relationships, providing insights that are directly applicable to Bangladesh's economic conditions.

4.0 Results and Discussions

The ADF unit root test will be employed to assess the stationarity of variables, and the outcomes will be displayed in Table 1. Table 1 illustrates that the variables exhibit stationarity at the first difference, while they do not display stationarity at the level, except

for the inflation rate which is stationary at level I(0). This suggests that the variables possess a mixed nature of integration, combining orders I(1) and I(0).

Table 1: Results of Unit root test

	At Level					
		BM	EX	IN	IR	REM
With Constant	t-Statistic	-1.7657	-3.4462	-4.5449	-1.0097	-1.3251
	Prob.	***0.3922***	***0.0145***	***0.0007***	***0.7415***	***0.6094***
		n0	**	***	n0	n0
With Constant & Trend	t-Statistic	-0.7988	-1.9762	-4.5054	-1.5174	-2.8425
	Prob.	***0.9580***	***0.5978***	***0.0042***	***0.8080***	***0.1908***
		n0	n0	***	n0	n0
Without Constant & Trend	t-Statistic	2.5690	5.1848	-1.3112	-0.6022	2.5636
	Prob.	***0.9970***	***1.0000***	***0.1725***	***0.4507***	***0.9969***
		n0	n0	n0	n0	n0
	At First Difference					
		d(BM)	d(EX)	d(IN)	d(IR)	d(REM)
With Constant	t-Statistic	-5.1109	-4.1261	-9.8510	-3.9867	-4.7454
	Prob.	***0.0001***	***0.0023***	***0.0000***	***0.0034***	***0.0004***
		***	***	***	***	***
With Constant & Trend	t-Statistic	-5.3354	-6.3766	-9.7481	-4.5685	-4.8092
	Prob.	***0.0004***	***0.0000***	***0.0000***	***0.0036***	***0.0019***
		***	***	***	***	***
Without Constant & Trend	t-Statistic	-4.5452	-2.7693	-9.9552	-3.9832	-3.6690
	Prob.	***0.0000***	***0.0067***	***0.0000***	***0.0002***	***0.0005***
		***	***	***	***	***

Source: Authors' compilation using Eviews.

The ARDL bound test approach is employed in order to ascertain the presence of cointegration among the variables REM, IR, IN, BM, and EX within the specific context of Bangladesh. The F-statistic is utilised to assess the long-term cointegration by comparing it to the upper and lower bounds. The F-statistic obtained from the limits test in the table is 8.8819, significantly exceeding the 1% critical value of the upper bound (4.37) as determined by Pesaran et al. (2001). This result leads to the conclusion that the variables

REM, IR, IN, BM, and EX are cointegrated. Based on the findings of this study, it can be inferred that the variables examined exhibit cointegration and demonstrate long-term convergence.

Table 2: Results of ARDL Model

Dependent Variable: REM Selected Model: ARDL (1, 3, 1, 1, 3)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.*
REM(-1)	0.735451	0.066597	11.04326	0.0000
IR	-0.012360	0.260220	-0.047498	0.9625
IR(-1)	0.504392	0.417919	1.206915	0.2376
IR(-2)	-0.185176	0.432935	-0.427721	0.6721
IR(-3)	-0.799169	0.308493	-2.590555	0.0150
IN	-0.027581	0.021420	-1.287576	0.2084
IN(-1)	-0.036186	0.021387	-1.691955	0.1018
EX	1.608245	0.445592	3.609232	0.0012
EX(-1)	-1.480500	0.409912	-3.611755	0.0012
BM	0.081496	0.221505	0.367921	0.7157
BM(-1)	0.043940	0.313180	0.140301	0.8894
BM(-2)	0.133112	0.303293	0.438889	0.6641
BM(-3)	0.432355	0.218649	1.977394	0.0579
C	1.834127	0.485833	3.775219	0.0008
R^2 = 0.997530 Adj. R^2= 9.484780 F-Stat= 869.97				

Source: Authors' compilation using Eviews.

Table 3: ARDL Bounds Test

Significance	F- stat=8.8819	
	I(0)	I(1)
10%	2.2	3.09
5%	2.56	3.49
1%	3.29	4.37

In the short term, the variable IN is statistically significant at the 8% level(considering a 10% significance threshold), while EX demonstrates a high level of significance at 1%. However, the variables IR and BM do not demonstrate statistical significance. The statistically significant model reveals that the ECM (-1) exhibits a negative value, indicating a short-term deviation from the long-run equilibrium. This deviation, amounting to approximately 26.45%, is annually adjusted to restore the equilibrium. The process of correcting this deviation takes approximately 3.78 years.

Table 4: Short Run Model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(IR)	-0.012360	0.206147	-0.059957	0.9526
D(IR(-1))	0.984345	0.233693	4.212122	0.0002
D(IR(-2))	0.799169	0.258074	3.096664	0.0044
D(IN)	-0.027581	0.015441	-1.786222	0.0849
D(EX)	1.608245	0.224855	7.152354	0.0000
D(BM)	0.081496	0.168866	0.482608	0.6331
D(BM(-1))	-0.565467	0.191144	-2.958329	0.0062
D(BM(-2))	-0.432355	0.180268	-2.398397	0.0234
ECM(-1)	-0.264549	0.033381	-7.925136	0.0000

ECM = REM - (-1.8610*IR -0.2410*IN + 0.4829*EX + 2.6116*BM + 6.9330)

Given that REM, IR, IN, BM, and EX exhibit cointegration, it is possible to establish a long-term relationship between these variables. In this context, the variable REM is considered the dependent variable, while the variables IR, IN, BM, and EX are regarded as the explanatory variables. The long-term outcomes are presented in Table 5. The explanatory variable EX is shown to be statistically insignificant, but the variables IR and BM are highly significant at less than 1%, and IN is significant at 7%. The findings indicate that a 1% increase in the interest rate leads to a corresponding fall in remittance by 1.86%. In a similar vein, it can be shown that a 1% increase in the inflation rate leads to a corresponding fall in remittance by 0.24%. Furthermore, a 1% increase in broad money results in a subsequent increase in remittance by 2.61%.

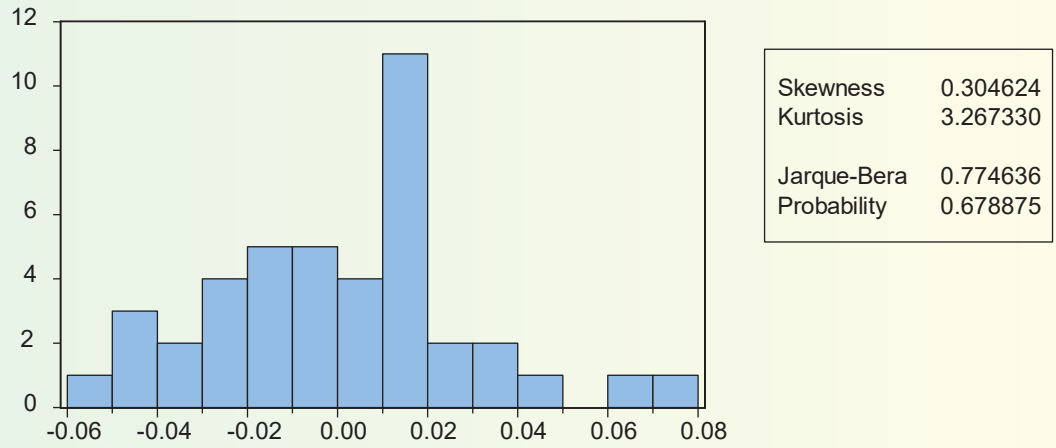
Table 5: Long Run elasticities

Variable	Coefficient	Std. Error	t-Statistic	Prob.
IR	-1.860953	0.421037	-4.419930	0.0001
IN	-0.241040	0.128772	-1.871841	0.0717
EX	0.482877	0.653011	0.739462	0.4658
BM	2.611631	0.597280	4.372543	0.0002
C	6.933044	0.653424	10.610335	0.0000

Source: Authors' compilation using Eviews.

Diagnostic Test

Diagnostic checks under the ARDL model include conducting normality, serial correlation, and stability tests, among other assessments. In the context of the normality test, it is commonly thought that if the p-value exceeds 5%, as observed in this example with a value of 67%, the null hypothesis is rejected. This implies that the residuals can be considered to follow a normal distribution. The normality plot depicted in Figure 1 was generated using the software Eviews.



The following tables present the outcomes of various diagnostic tests, indicating that the residuals do not exhibit serial correlation. Specifically, the null hypothesis of "no serial correlation" is not rejected at a significance level of 5%, which corresponds to a critical value of 33%. Additionally, it can be observed that the model is appropriately specified, as the null hypothesis of accurate specification is not rejected at a significance level of 5%,

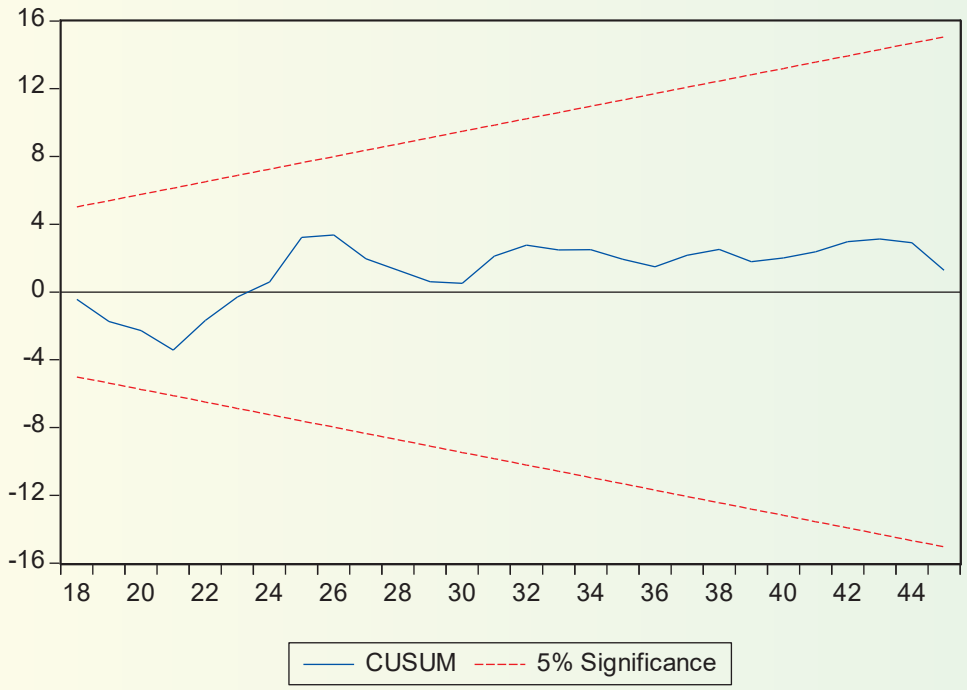
corresponding to a confidence level of 95%. However, the CUSUM square test demonstrates the presence of a structural break, as indicated by the concept of structural stability.

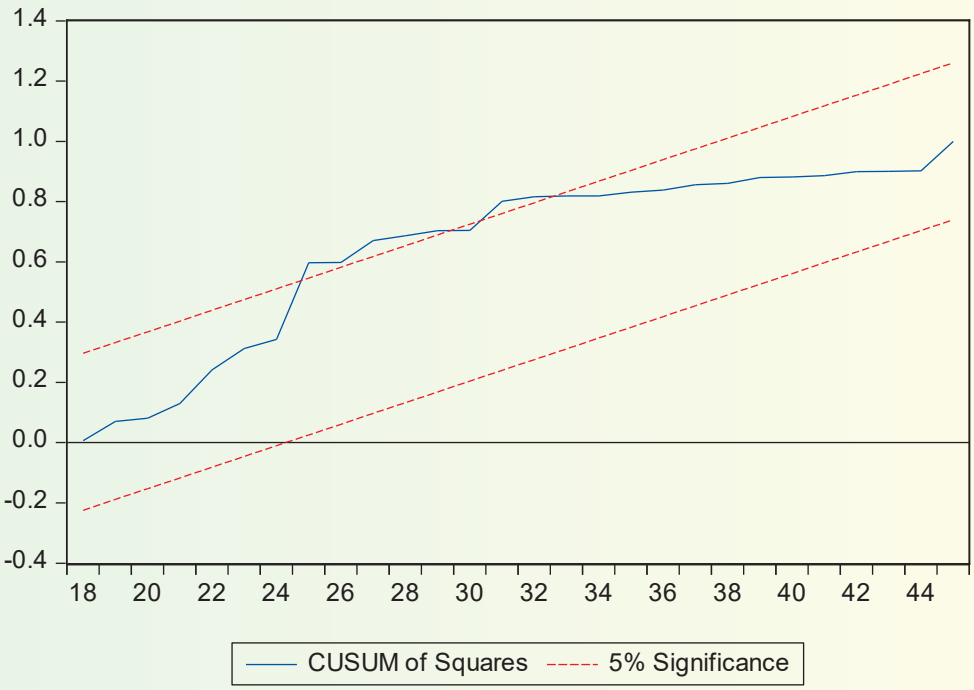
Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	1.149937	Prob. F(13,28)	0.3627
Obs*R-squared	14.61880	Prob. Chi-Square(13)	0.3318

Ramsey RESET Test

	Value	df	Probability
t-statistic	0.053817	27	0.9575
F-statistic	0.002896	(1, 27)	0.9575





The study's findings reveal several important economic factors influencing remittance flows in Bangladesh. First, there is a negative relationship between interest rates and remittances, suggesting that higher interest rates reduce remittance inflows. Economically, this may be because rising interest rates lead to an appreciation of the local currency, which lowers the value of remittances when converted into Bangladeshi Taka, thereby reducing purchasing power and potentially discouraging migrants from sending funds. Additionally, high inflation appears to negatively impact remittances, as it erodes the local currency's value, making remitted funds less effective in meeting household needs. Inflation may also signal economic instability, creating uncertainty among migrant workers about the financial viability of sending money home, prompting them to consider alternative investments elsewhere.

Another key finding is the positive association between an increased broad money supply and remittances, which may reflect greater financial inclusion and expanded access to banking services in Bangladesh. Improved banking access, especially in rural areas, encourages migrants to use formal channels for remittances, increasing overall inflows. Interestingly, while exchange rates are significant in the short term, they do not have a statistically significant impact on remittances in the long term. This suggests that remittances are driven more by social obligations than by economic fluctuations, with migrants prioritizing family support over minor changes in currency value. Additionally,

the Error Correction Mechanism (ECM) coefficient indicates that around 26.45% of short-term deviations from long-term equilibrium are corrected annually, reflecting the adaptive behavior of remittance flows and the resilience of Bangladesh's economy in adjusting to remittance-related shocks. This gradual correction also hints at effective monetary policies that help stabilize remittance inflows, ensuring their continued role in supporting the economy.

5.0 Conclusions and Policy Recommendations

In summary, our research has shed light on the complex interplay among monetary policy, inflation, broad money supply, exchange rates, and remittances in Bangladesh from 1978 to 2022, employing an ARDL model. The findings from the unit root and cointegration study indicate that the variables (REM, IR, IN, BM and EX) possess a combination of I(0) and I(1) features, suggesting that their integration orders are I(1) and I(0) respectively. Furthermore, the analysis of short-term dynamics reveals that variations in interest rates (IR) and inflation rates (IN) have a considerable impact on remittance flows, although exchange rates (EX) and broad money (BM) do not exert a substantial influence on remittances (REM). The ECM coefficient suggests that an estimated 26.45% of deviations from the long-term equilibrium in remittances are corrected annually, reflecting the stability and resilience of remittances in the face of economic fluctuations. Over the course of the study, it was seen that interest rates (IR), inflation rates (IN), and broad money (BM) have a significant influence on remittances (REM). The findings indicate that there is a negative relationship between rates of interest and remittances, with a 1% increase in interest rates leading to a 1.86% decrease in remittances. Similarly, inflation rates have a negative impact on remittances, as a 1% increase in inflation rates is associated with a 0.24% decrease in remittances. On the other hand, there is a positive correlation between broad money and remittances, where a 1% increase in broad money results in a 2.61% increase in remittances. Surprisingly, the long-term association did not show any statistical significance in respect to exchange rates (EX). A monetary strategy that is characterized by a relaxed approach, involving the reduction of interest rates, typically results in the devaluation of a country's currency. This devaluation, in turn, has significant consequences for the country's trade balance and its ability to compete in the international market. The aforementioned findings underscore the complex relationship between monetary issues and remittances within the context of Bangladesh, providing useful insights for both policymakers and researchers.

Policy Recommendations

Based on the study's empirical findings, several specific and actionable policy measures can be recommended to strengthen remittance inflows and ensure their sustained contribution to Bangladesh's economic stability and development:

1. **Adopt Remittance-Sensitive Interest Rate Policies:** Given the strong negative relationship between interest rates and remittance inflows, the Bangladesh Bank should consider adopting a remittance-sensitive monetary policy framework. While pursuing inflation targets and currency stability, interest rate adjustments should take into account their potential impact on remittances. Introducing targeted savings instruments for remittance recipients at favorable interest rates could also help channel remittance funds into productive investments.

2. **Strengthen Inflation Management Mechanisms:** Since high inflation discourages remittance inflows by reducing real income in the recipient country, the government should reinforce macroeconomic strategies aimed at controlling inflation. This includes prudent fiscal policies, targeted subsidies for essential commodities, and improved coordination between monetary and fiscal authorities to keep inflation expectations anchored, thereby preserving the value of remitted funds.

3. **Deepen Financial Inclusion through Technology and Infrastructure:** The positive effect of broad money on remittance inflows underscores the importance of financial access. Policymakers should prioritize the expansion of digital financial services, such as mobile money platforms and agent banking, especially in underserved rural areas. Public-private partnerships can be fostered to develop low-cost, user-friendly digital remittance platforms that connect migrant workers directly to formal banking channels.

4. **Ensure Exchange Rate Predictability and Manage Volatility:** Although the long-term effect of exchange rates was statistically insignificant, the short-term impact and general economic sentiment tied to exchange rate fluctuations must not be overlooked. The central bank should use a managed float system to prevent extreme volatility while ensuring competitiveness. Transparent communication of exchange rate policy and buffer-building through reserve accumulation can enhance migrant confidence.

5. **Facilitate and Incentivize Formal Remittance Transfers:** To reduce dependence on informal remittance channels (hundi), the government should implement incentives such as tax rebates, matching grants for remittance-linked savings, and reward schemes for frequent formal remitters. Simplifying documentation requirements, ensuring faster transaction processing, and reducing remittance charges in collaboration with service providers can further encourage the use of legal channels.

By aligning monetary, fiscal, and financial sector policies with the behavioral patterns of remittance flows, Bangladesh can not only safeguard this critical source of foreign exchange but also channel it more effectively into economic development and financial stability.

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Impact of Imported Capital Goods on Manufacturing Exports in Bangladesh

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Abstract

This study examines the effect of imported capital goods on manufacturing exports in Bangladesh using annual time series data from FY1991 to FY2023. The ARDL (auto-regressive distributed lag) bound test approaches were applied to investigate the symmetric relationship between manufacturing exports, imported capital goods, exchange rate, and trade openness. The results of the empirical analysis suggest that imported capital goods and trade openness have a positive influence on manufacturing exports. On the other hand, the econometric relationship gives the evidence that exchange rate depreciation has a negative impact on manufacturing exports. Finally, we recommend that the government should implement a comprehensive trade policy with a particular focus on the import policy for capital goods. This will help to improve the manufacturing export performance as a growth driver of the economy.

Keywords: Manufacturing Exports, Imported Capital Goods, Exchange Rate, Trade Openness

JEL Classification: C32, F13, F31, F41, O33

1. Introduction

The theory of import-led growth posits that by importing capital goods, a developing country can enhance its output and exports by leveraging technological advantages and innovative manufacturing techniques (Alfarajat & Masron, 2023). Our research investigates how the import of capital goods contributes to the expansion of manufacturing exports in Bangladesh. In developing nations, the industrial sector heavily relies on imported capital goods due to limited access to capital and technological

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advancements (Bekes & Harasztosi, 2020). Importing capital goods significantly benefits developing countries by transferring technology and enhancing manufacturing techniques from developed nations (Liao et al., 2023). International trade facilitates this benefit, enabling innovation in manufacturing that developing countries often lack due to resource limitations. However, there is a significant movement of capital from poorer to wealthier countries due to inadequate trade liberalization amidst global imbalances (Prasad et al., 2007). Production in developing countries has been hampered by a lack of capital goods resulting from flawed trade mechanisms, impeding their ability to export manufactured goods (Harrison & Rodriguez-Clare, 2010). Like other developing countries with limited technological resources, the importance of imported capital goods in manufacturing exports has become increasingly relevant in Bangladesh's policy discussions in recent years. This shift is largely due to the country's growing reliance on imported capital technologies for its economic development.

Bangladesh experienced significant development in manufacturing exports since 1980 following the economic liberalization. This economic growth was mainly driven by the increased ready-made garment (RMG) exports, and the economy started to experience export-led economic development (Swazan and Das, 2002). During the 1990s, liberalizing international trade resulted in the economy enjoying consistent output growth of approximately 6 percent over the past three decades (Robert & Wacker, 2023). Bangladesh faces a relative disadvantage in the production of capital goods due to limited resources and inadequate technological progress. As a result, the country heavily depends on imported capital goods to meet its demand for such commodities from foreign sources. Following the initiation of export-oriented economic growth, there has been a rise in the importation of capital goods to sustain the ability to export to international markets (Rahman et al., 2023).

In FY2023, the economy's overall exports amounted to approximately 56 billion US$, with RMG exports accounting for over 47 billion US$. The export growth rate was recorded at 6.28 percent, while the growth rate for RMG exports was 10.27 percent. The economy's import volume in FY2023 is approximately 69 billion US$. Capital goods imports accounted for around 24 billion US$. During FY2023, the proportion of total exports to GDP was 13.21 percent, while the proportion of total imports to GDP was 16.27 percent. Approximately 84 percent of the country's overall exports are accounted for RMG exports. The proportion of imported capital goods in the total import payments is 34.78 percent (BB, 2024). It can be assumed that imported capital goods, such as machinery and other equipment, positively influence a country's manufacturing production, exports, and economic development.

Since the last decade of the previous century, many economic reform projects have been introduced to enhance flexibility in international trade and expedite the achievement of exports and trade objectives. At that time, the World Bank provided support in initiating the

financial sector reform program (WB, 2016). In 2003, the foreign exchange policy was modified to introduce exchange rate flexibility due to the heavy reliance of the economy's manufacturing exports on imported commodities (IMF, 2023). The country's economic development has been facilitated by the importation of capital goods, which has allowed the transfer of knowledge and technology and improved manufacturing techniques. This has been further supported by the deployment of cheap labor in manufacturing that increases the country's exports. The sustained backing for export promotion has bolstered the economy's industrial production, while various incentives have facilitated the industrial output through imported capital goods. The country's rising manufacturing exports have contributed to its strong foundation. In 2008, the global economic crises had a relatively minimal impact on the country's financial and industrial sectors (Ali & Islam, 2010).

The Asian tiger countries, such as South Korea, Malaysia, Thailand, and Singapore, have successfully achieved industrial development and exports by importing capital goods (Bozkurt and Karakoy, 2022). Acquisition of technological know-how and development of human resources is facilitated by imported capital technology from developed countries (Weiss, 2005). In line with these countries' experiences, capital goods imported from abroad are crucial in driving the country's industrial development and boosting exports, contributing to overall economic growth. In adopting modern machinery and technological improvements, the economy depends on increased imports of capital goods. On the other hand, the economy has to prioritize developing its human resources to keep up with technological advancements. Undoubtedly, it could be realized that imports of capital goods could spur industrial growth and facilitate technology transfer and human resource development for an economy like Bangladesh. So far, there is limited research on the correlation between imported capital goods and manufacturing exports in Bangladesh.

The primary reason for conducting this study is that, after gaining independence, the nation has relied heavily on imported food and finished consumer products. The government has implemented export and financial liberalization policies to boost industrial production and started importing capital goods. Although the country's manufacturing sector benefits from low-cost labor, it gradually relies on imported capital goods to increase production. According to economic rationales stated in endogenous growth theory, relying solely on labor without technological capital is insufficient for production competitiveness. Technology plays a vital role in increasing labor productivity and, eventually, improving manufacturing exports. In this context, it has been recognized that the rising use of imported capital goods in export-oriented sectors depicts a connection between imported capital goods and manufacturing exports in Bangladesh. Since the country's economic progress is being driven by manufacturing export growth, manufacturing exports can be fostered through the increasing use of technological capital and better manufacturing techniques (Sultanuzzaman et al., 2019). This progress would also lead to the development of technological and human capital. In this regard, identifying the influence of imported capital goods on manufacturing export performance in Bangladesh is essential.

This study examines the long-term relationship between manufacturing exports and the importation of capital goods in understanding the role of technological advancements in industrial export growth. This study uses the import-oriented growth model strategies to examine the association among manufactured exports, imported capital goods, exchange rates, and trade openness. We utilize annual time-series data from FY1991 to FY2023 and apply the ARDL bound test approach to uncover symmetric connection among the metrics studied. Our study uses the dynamic multiplier effect to analyze how manufacturing exports respond to shocks from various variables, thereby stabilizing long-term relationships.

The remaining part of this work is organized as follows: Section 2 summarizes the existing literature to gain insights into the relationship between imported capital goods and exports, theoretically and empirically. Section 3 presents the data, variables, and techniques used in the empirical analysis. Section 4 shows the results of the econometric analysis. Finally, Section 5 provides concluding remarks and discusses policy implications.

2. Literature Review

2.1. Theoretical Underpinnings

Imported commodities have a vital role in transferring technology across nations and can contribute to long-term economic development, as proposed by endogenous growth theories and import-led growth theories. Imported capital and technology in international trade have significant potential to acquire foreign technological expertise, enhance domestic output, and facilitate engagement and integration between the home nation and its foreign partner (Ram, 1990; Grossman & Helpman, 1991). The advancement of technology in the production process primarily stems from the transfer of international capital from developed to developing nations. The level of technology cannot be internally generated in developing countries due to insufficient technological knowledge and investment (Todaro & Smith, 2009). Low-income nations can enhance production efficiency by incorporating advanced and innovative technology inputs from foreign capital and other goods. This is because industries in these countries cannot expand production just by collecting physical capital, as they experience declining returns. (Herrerias & Orts, 2013).

In low-income nations, the advanced technology inputs resulting from the research and innovation investment of the advanced country are comparatively more affordable than the alternatives created within the country. Therefore, these countries enhance their production and capital accumulation efficiency by utilizing sophisticated capital products imported from other countries (Lee, 1995). Importing capital goods enables countries to implement effective production processes through resource allocation that promotes optimal production (Coe et al., 2009). In addition, using new production processes and creating a

wide range of products can enhance domestic competition among industries in the economy, leading to enhanced worldwide competitiveness in production (Carbaugh, 2005). Output growth in an open economy is comparatively higher when utilizing imported capital goods than domestically manufactured commodities (Liao et al., 2023).

The efficient production of firms in the economy through imported goods incentivizes other firms to adopt technology that improves the export potential of the entire economy. This allows for acquiring innovative and technical knowledge from foreign equipment, increasing short-term production efficiency and long-term sustainable production capacity as the economy absorbs technological advancements (Mody & Yilmaz, 2002; Damijan et al., 2014). Advanced economies exhibit higher capital intensity while developing economies rely more on labor intensity (Setyari et al., 2016). Lower-income countries can enhance their productivity by importing capital goods primarily driven by technological innovations in developed countries (Mazumdar, 2001).

2.2. Empirical Evidence

Researchers from different countries have recently focused on the spread of technology through imports and examined the connection between imported capital goods and economic development and export performance. They have employed various growth theories and trade theories to study this link. Research is carried out to analyze the influence of exports, imports, remittances, and investments on the economic growth of various countries, particularly those in the developing world. Mazumder (2001) argues that 85% of the capital goods in less developed countries are sourced from advanced economies. This study demonstrates that imports have significantly impacted productivity change in developing economies, as evidenced by the panel econometric analysis conducted on a sample of developing countries. This study aligns with the findings of Lee's (1995) study, which utilized cross-country data. Thangavelu and Rajaguru (2004) conducted a study using data from India, Indonesia, Malaysia, Philippines, Singapore, and Taiwan. They discovered that importing capital goods promotes industrial output and economic growth. Similarly, Awokuse (2007, 2008) found the same conclusion in European transition economies and some South American countries, respectively.

Shi (1998) emphasizes the crucial role imported foreign technology has played in China’s industrialization since the 1950s. Similarly, Fan and Hu (2008) point out that introducing imported capital goods has significantly boosted productivity among Chinese firms. Furthermore, Herrerias and Orts (2011) provide evidence that the process of industrialization in China has been accelerated by technological advancements driven by these imported capital goods. Foreign technology and capital goods positively impact India’s manufacturing sector, driving economic growth (Hasan, 2002). Rijesh (2021) also finds that foreign capital goods boost production and exports. Furthermore, trade liberalization facilitates technology transfer through these imports. Likewise, Hye et al.

(2013) provide empirical evidence supporting the significant contribution of imported capital goods to the economic development of South Asian countries. Additionally, Panta et al. (2021) demonstrate that imports positively impact Nepal's short-term economic growth.

2.3. Evidence from Bangladesh

In the context of Bangladesh, the current literature offers limited evidence regarding the performance of imports and industrial exports. Nevertheless, other research has investigated the correlation between exports, imports, and economic growth. Moreover, these studies have produced inconsistent findings, with no conclusive evidence regarding the connection between imports and exports. Dawson (2006) examines the correlation between Bangladesh's exports, imports, and GDP. He analyzes data from 1973 to 2003 and discovers a negative connection between imports and GDP. Ahmed and Uddin (2009) examine the relationship between remittance, exports, imports, and GDP from 1976 to 2005. They find that imports positively correlate with GDP in the short term but have no meaningful association in the long term.

Hossain et al. (2009) analyze data from 1973 to 2009 to investigate the correlation between exports, imports, and economic growth. The study concludes that there is no significant connection between imports and economic growth. However, exports are positively associated with imports in the long and short run. Paul (2011) replicates these findings when analyzing the correlation between exports, imports, and economic growth using annual data from 1979 to 2010. This analysis demonstrates that exports have a positive and significant relationship with long-term economic growth, while imports do not have any discernible impact on economic growth. In their study, Wahab et al. (2017) analyze the correlation between the import of capital machinery and industrial output growth. They use annual data from 1980 to 2014 and discover a significant positive relationship between imported capital machinery and long-term output growth. However, they find that importing capital machinery does not contribute to industrial output growth in the short term. Using time series econometric techniques, Miyan and Biplob (2019) identify a positive relationship between exports, imports, and economic growth in Bangladesh. They also reveal a short-run linkage from exports to growth and from growth to imports. Conversely, the study by Selvanathan et al. (2020) demonstrates both export-led growth and growth-led export in Bangladesh. Additionally, it identifies some evidence of import-led growth and growth-led import in the Bangladesh economy. Similarly, Zayed et al. (2020) emphasize that exports and imports are important determinants of economic growth in Bangladesh, with exports directly influencing growth and imports having an indirect effect. Islam et al. (2022) highlight that, like many other least-developed countries (LDCs), export-led economic growth has no significant implications for the long-term period of the Bangladesh economy.

The research conducted in Bangladesh has yielded inconclusive findings about the correlation between imports and economic growth. Furthermore, no study has established a correlation between the importation of capital goods and the exportation of manufactured goods in the economy. All studies aimed to determine the symmetrical relationship by collectively examining the periods before and after the reforms. Imported capital goods facilitate the growth of manufacturing production and exports through technology diffusion, as described in the import-led growth theory or endogenous growth theory. Conducting research is crucial to analyze the correlation between imported capital goods and manufacturing exports following the era of reforms. It is essential to evaluate symmetric econometric method. Bangladesh lacks research regarding the impact of imported capital goods on manufacturing exports, specifically regarding technology transfer and technical production efficiency. No previous studies have addressed this research objective. The current study aims to fill this gap by analyzing the effects of imported capital goods on manufacturing exports using symmetric time series approach.

3. Methodology and Data

3.1. Model Specification

This paper presents a model that illustrates the direct relationship between the importation of capital goods and the promotion of exports in the manufacturing sector of import-dependent developing economies. The model suggests that by improving technology and providing adequate capital goods, exporting industries in these economies can experience growth in their export activities. This idea can be explained through the principles of endogenous growth theory and import-led growth theory.

In developing countries with abundant labor, there is an opportunity to expand a primary production framework focused on exports, positioning the country to leverage exports as a driver of economic growth. This framework depends on imported goods to enhance capital and technical efficiency. Additionally, various domestic and external factors, such as exchange rates and trade openness, also influence the export performance of these economies. We suggest specifying the model based on inputs and demand and supply factors. The export function can be defined based on import-oriented export growth in the following way (Awokuse, 2007).

$$EXP = f(ICG, ER, TO) \quad (1)$$

The expression above illustrates the correlation between manufacturing exports (EXP) and other explanatory factors, such as imported capital goods (ICG), exchange rate (ER), and trade openness (TO). This functional orientation can also be called import-oriented exports in developing countries that heavily depend on imported inputs in manufacturing. The econometric specification of the above model can be written in the following form.

$$lnEXP_t = \alpha_0 + \alpha_1 lnICG_t + \alpha_2 lnER_t + \alpha_3 TO_t + \varepsilon_t \quad (2)$$

Where lnEXP is the log of manufacturing exports volume (million US$), lnICG is the log of imported capital goods volume (million US$), lnER is the log of the nominal exchange rate (BDT/US$), TO is the trade openness measured by the trade to GDP ratio (%).

We design the model by considering manufacturing exports as an endogenous variable that responds to exogenous variables, such as imports of capital goods, as well as other control factors of internal and external variables, such as exchange rate and trade openness, as those factors could strongly influence demand and supply side phenomena in determining manufacturing exports. The specified econometric model focuses on the relationship between imported capital goods and manufacturing exports, where the parameters of all exogenous factors are assumed to take the expected positive signs.

3.2. Methods

Our study uses the auto-regressive distributed lag (ARDL) model to examine the cointegrating relationship among the variables in the specified econometric model. Our study intends to discover the symmetric connection between manufacturing exports and imported capital goods in Bangladesh. Initially, we examine whether the time series data exhibits any potential non-stationary issues by performing the unit root tests, including the Augmented Dickey-Fuller (ADF) test, Phillips-Perron (PP) test, and Zivot and Andrews test. In practice, to apply ARDL, variables must be integrated into different orders, which mean variables show the mixed order of integration where none of the variables would be stationary or integrated at more than order 2; if the variables are integrated into more than order 2, the ARDL produce ineffective results. The pretesting of stationarity is not mandatory for applying the ARDL in examining cointegration among variables. The ARDL approach suggested by Pesaran et al. (2000, 2001), can handle the cointegration among the variables when the variables show different orders of integration. These methods give a robust estimation in cointegration even for small observations, like smaller than 30 observations. As these models assume that there is no response from the endogenous variable to the exogenous variables at the level relationship, these approaches are free from the endogeneity problem of the exogenous variable (McNown et al., 2018). In the bounds test approach of ARDL model, the cointegrating relationship or long-run connection is confirmed if the estimated F-statistic value exceeds the upper critical bound at the statistically significant level. The long-run relationship and short-run dynamics with possible error correction are estimated once the cointegration relationship is established. After estimating the relationship among the variables, several diagnostic tests are conducted to check the robustness of both the ARDL model. Basically, the usual ARDL model can be written in the following form.

$$lnEXP_t = \alpha_0 + \sum_{i=0}^{p} \alpha_{1i} lnEXP_{t-i} + \sum_{i=0}^{q} \alpha_{2i} lnICG_{t-i} + \sum_{i=0}^{m} \alpha_{3i} lnER_{t-i} + \sum_{i=0}^{l} \alpha_{4i} TO_{t-i} + \varepsilon_t \quad (3)$$

The ARDL bound test model takes the long-run relationship suggested by Pesaran et al. (2001) and is applied in this study to examine the connection between manufacturing exports and imported capital goods, depicted as follows.

$$\Delta lnEXP_t = \alpha_0 + \sum_{i=1}^{p} \alpha_{1i} \Delta lnEXP_{t-i} + \sum_{i=0}^{q} \alpha_{2i} \Delta lnICG_{t-i} + \sum_{i=0}^{m} \alpha_{3i} \Delta lnER_{t-i} + \sum_{i=0}^{l} \alpha_{4i} \Delta TO_{t-i} + \beta_1 lnEXP_{t-1} + \beta_2 lnICG_{t-1} + \beta_3 lnER_{t-1} + \beta_4 TO_{t-1} + \varepsilon_t \quad (4)$$

In the above-stated equation, α_{1i}, α_{2i}, α_{3i}, α_{4i} are the coefficients of the short-term dynamic relationship and β_1, β_2, β_3, β_4 are the parameters of the long-term cointegrating relationship. The ARDL bound test approach justifies the null hypothesis of no cointegration among variables, that is $H_0 = \beta_1 = \beta_2 = \beta_3 = \beta_4 = 0$, If the estimated F test rejects the null hypothesis of no cointegration, it demonstrates the presence of a long-term relationship. After that, the appropriate lag lengths for the ARDL model are selected using the AIC (Akaike Information Criterion). In the existence of a long-term relationship, the short-run dynamics are calculated with the error correction mechanism, where the stability of the long-term connection is adjusted after the short-term shocks. The error correction model in the ARDL approach is depicted in the following form, as Pesaran et al. (2001) suggested.

$$\Delta lnEXP_t = \alpha_0 + \sum_{i=1}^{p} \alpha_{1i} \Delta lnEXP_{t-i} + \sum_{i=0}^{q} \alpha_{2i} \Delta lnICG_{t-i} + \sum_{i=0}^{m} \alpha_{3i} \Delta lnER_{t-i} + \sum_{i=0}^{l} \alpha_{4i} \Delta TO_{t-i} + \gamma ECT_{t-1} + \varepsilon_t \quad (5)$$

In the error correction mechanism, the coefficient of the ECT, γ reflects the dynamic adjustment to long-term stability from any short-term shocks. The short-term coefficients in the error correction mechanism are integrated by the adjusted error correction movement toward long-run equilibrium without losing any disequilibrium points in the long-term stability. The significant and negative value of the ECT coefficient validates the short-run causality through the significant values of the coefficients of the different regressors. The robustness of the ARDL bound test approach is then justified by using several diagnostic tests of the estimated residuals, like autocorrelation, normality, heteroscedasticity, model specification, and structural stability tests. Additionally, our analysis applies the dynamic ordinary least squares (DOLS) technique for model estimation to verify the robustness of the empirical relationship.

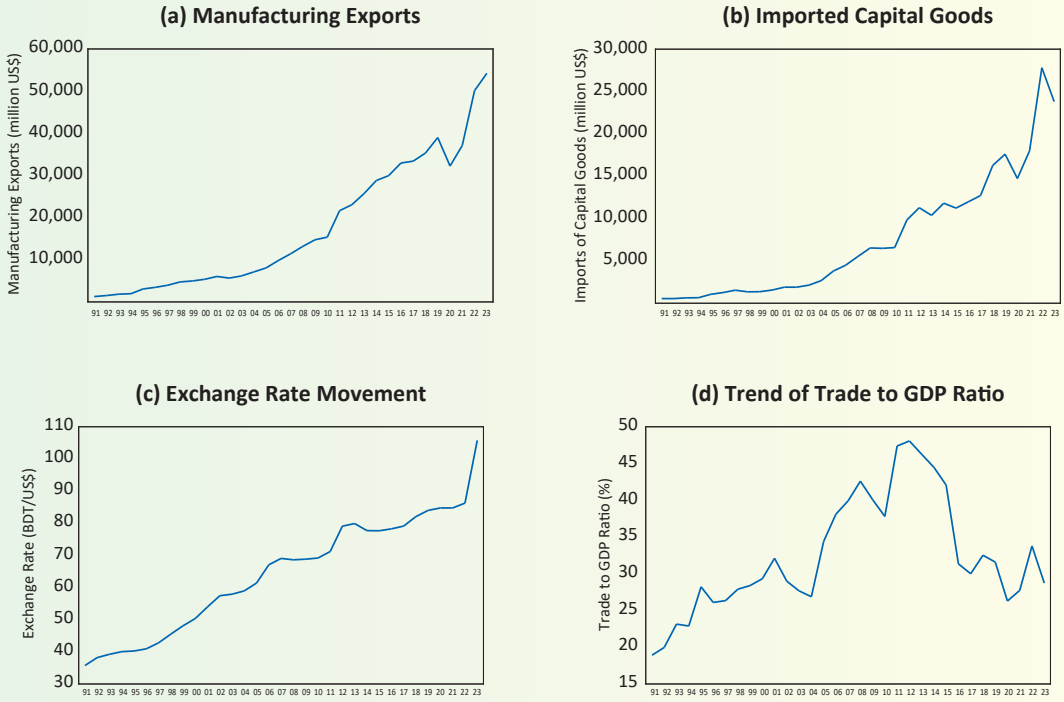
Lastly, the dynamic multiplier effects are estimated to diagnose the response of the endogenous variables from the different shocks of the regressors.

3.3. Data and Variables

This study utilizes the annual time series data from FY1991 to FY2023 to investigate the relationship between imported capital goods and manufacturing exports. The data for all indicators included in this analysis have been collected from the Bangladesh Bank database

(Bangladesh Bank Quarterly). The response variable, like manufacturing exports (EXP), is measured by the total volume of exports of manufacturing goods (million US$). In the regressors, the imported capital goods (ICG)are measured by the total volume of imports of the capital machinery and other capital goods (million US$), the exchange rate (ER) is measured by the nominal exchange rate (BDT/US$), and the trade openness (TO) is measured by the trade to GDP ratio (%).The historical movement or trend of the study variables is shown in the following Figure 1(a-d).

Figure 1. (a) Manufacturing Exports, (b) Imported Capital Goods, (c) Exchange Rate Movement, (d) Trend of Trade to GDP Ratio



Source: Author's estimation using E-views 10.

In examining the impact of imported capital goods on manufacturing exports, all the study variables like EXP, ICG, and ER are transformed into natural logarithms except for the TO, as expressed in the Trade to GDP ratio (%). The following Table 1 shows the summary statistics of the study variables. The statistical features of the study variables indicate that the mean and median values are reasonably close to each other for almost all the variables, while the mean of each variable lies between the maximum and minimum values with considerable standard deviation. The skewness and kurtosis values of the variables range

from -3 to +3. The Jarque-Bera (J-B) test reveals that all variables come from normal distribution as the probability of the J-B test value fails to reject the null hypothesis of the normality assumption.

Table 1. Descriptive Statistics

	lnEXP	lnICG	lnER	TO
Mean	9.2630	8.3343	4.1229	32.4215
Median	9.3366	8.6121	4.2283	29.9997
Maximum	10.902	10.2342	4.6623	48.1109
Minimum	7.0875	6.2304	3.5744	18.8898
Std. Dev.	1.1148	1.2287	0.2987	7.8965
Skewness	-0.2975	-0.2333	-0.3626	0.4701
Kurtosis	1.9382	1.7438	1.9197	2.3148
Jarque-Bera	2.0368	2.4690	2.3277	1.8610
Probability	0.3611	0.2909	0.3122	0.3943
Observations	33	33	33	33

Source: Author's estimation using E-views 10.

4. Empirical Results

4.1. Unit Root Test

Our study applies Augmented Dicky Fuller (ADF), Phillips-Perron (PP), and Zivot and Andrews unit root tests to identify the stationarity of the variables. The stationarity of variables has been checked at their level and at their first difference, and it has been illustrated in Table 2. The results from the ADF test and PP test show that the variables are integrated at order one. The results of the Zivot and Andrews test for examining the stationarity with any structural break are summarized in Table 3. All the variables show stationarity at their level. From the outcomes of the unit root tests, we find that variables are integrated at either level, I(0), or first difference, I(1), and none of the variables are integrated at order 2, I(2). Hence, our analysis can examine the long-term connection among the study variables by applying the ARDL framework.

Table 2. Unit Root Test (ADF and PP Tests)

	At Level			At First Difference	
Variables	ADF test p-value	PP test p-value	Variables	ADF test p-value	PP test p-value
lnEXP	0.3350	0.2523	lnEXP	0.0000	0.0000
lnICG	0.2553	0.0323	lnICG	0.0000	0.0007
lnER	0.8817	0.8905	lnER	0.0188	0.0000
TO	0.3055	0.2951	TO	0.0003	0.0003

Table 3. Structural break unit root test (Zivot and Andrews test)

Variables (At Level)	t-statistic	p-value	Break Period	Results
lnEXP	-4.9653	0.0852	2018	Stationary
lnICG	-2.3282	0.0111	2004	Stationary
lnER	-3.8384	0.0153	2013	Stationary
TO	-4.4402	0.0003	2016	Stationary

Source: Author's estimation using E-views 10.

4.2. ARDL Model Estimation

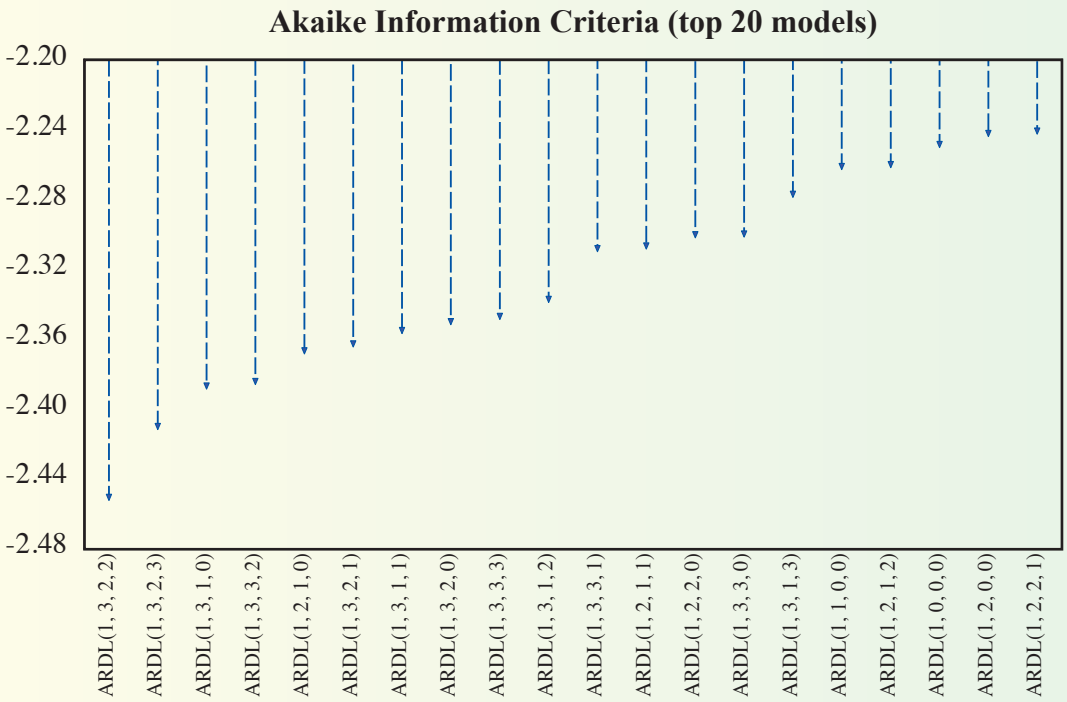
Our analysis applies the bound test method to investigate the long-term cointegration among the variables. The results of the F test using the bound test approach are incorporated in Table 4. The estimated value of the F-statistic exceeds the upper bound of the critical value at the 1% level, which means the long-term cointegrating relationship among the variables exists. Now, for selecting the appropriate lag length for the ARDL model, we use the AIC (Akaike Information Criterion),where the lowest value of AIC chooses the optimal combination of the optimal lag length of the variables from the different combinations of the 64 regressions. The results of the optimal lag length section for the ARDL model using AIC are depicted in Figure 2. The figure incorporates the least 20 combinations of the lag lengths of the different variables using AIC, where the lowest value of the AIC suggests that the lag structure of the specified model is ARDL (1,3,2,2).

Table 4. Results of the ARDL Bound Test

F-Bounds Test			Null Hypothesis: No levels relationship	
Test Statistic	Value	Signif.	I(0)	I(1)
F-statistic	5.6762	10%	2.37	3.20
		5%	2.79	3.67
		2.5%	3.15	4.08
		1%	3.65	4.66

Source: Author's estimation using E-views 10.

Figure 2. Optimal Lag Length Selection



Source: Author's estimation using E-views 10.

We apply OLS regression on the ARDL (1,3,2,2) model to estimate the long-run cointegration. The long-term relationship among the variables is demonstrated in Table 5, and the estimated cointegration shows that the long-run association among manufacturing exports, imported capital goods, exchange rate, and trade-to-GDP ratio are statistically significant. The parameters of the imported capital goods and trade to GDP ratio

demonstrate a positive association with manufacturing exports at 1% and 5% levels, while the parameter of exchange rate indicates a negative correlation with manufacturing exports at 10% level. In the long-term association, both imported capital goods and trade to GDP ratio positively influence manufacturing exports. An 1 percent increase in imported capital goods increases the manufacturing exports by 1.06 percent, whereas a 1 percent increase in trade openness measured by the trade to GDP ratio increases the manufacturing exports by 0.58 percent. The exchange rate negatively influences manufacturing exports over the long-term period. An 1 percent rise in the exchange rate causes the decline of manufacturing exports by 0.95 percent.

Table 5. Results of the Long-Term Relationship

Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnICG	1.0608	0.0864	12.276	0.0000
lnER	-0.9487	0.3706	-2.5594	0.0197
TO	0.0057	0.0031	1.8549	0.0801
C	4.2253	0.8053	5.2463	0.0001

Source: Author's estimation using E-views 10.

Now, the error correction mechanism has been applied to estimate the parameters of short-run relationships along with the parameter of the dynamic adjustment to long-run relationship from the short-run disequilibrium. Table 6 represents the estimated short-run coefficients along with the coefficient of the error correction term (ECT). The highly statistically significant and negative value of the ECT parameter demonstrates that the dynamic convergence process from the short-run disequilibrium to the long-run equilibrium connection is consistent. In comparison, 76 percent of the disequilibrium is adjusted to the long-term stability by a year from the short-run shocks of the explanatory variables. Moreover, the parameters of the short-run dynamic changes have statistical significance values that support the short-run association of the relationship among manufacturing exports, imported capital goods, exchange rate, and trade to GDP ratio to the long-run cointegration.

In dynamic relationships, the imported capital goods, exchange rate, and trade-to-GDP ratio significantly influence manufacturing exports in the short run.

Table 6. Short-Run Dynamics and Error Correction Estimates

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(lnICG)	0.6871	0.0780	8.8059	0.0000
D(lnICG(-1))	-0.2976	0.1063	-2.7979	0.0119
D(lnICG(-2))	-0.3454	0.1165	-2.9651	0.0083
D(lnER)	0.8417	0.3036	2.7720	0.0126
D(lnER(-1))	1.2148	0.4384	2.7710	0.0126
D(TO)	-0.0074	0.0039	-1.8796	0.0764
D(TO(-1))	-0.0098	0.0039	-2.5029	0.0222
ECT/CointEq(-1)*	-0.7693	0.1306	-5.8896	0.0000

Source: Author's estimation using E-views 10.

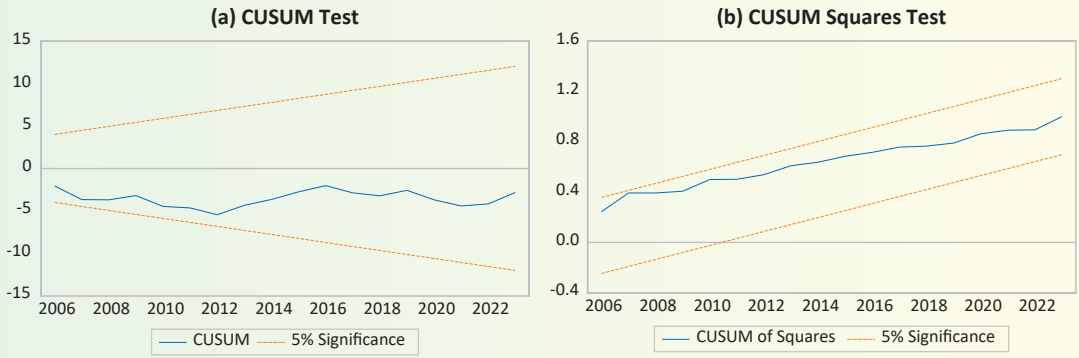
The robustness of the ARDL estimation has been checked through different diagnostic tests to examine the residuals' autocorrelation, normality, and heteroscedasticity assumptions. Moreover, the model specification and the structural stability have been examined to justify the validity of the ARDL estimation. The results of the different diagnostic tests, including the model specification test, are illustrated in Table 7. The Breusch-Godfrey serial correlation LM test demonstrates that the residuals are free from autocorrelation as the test statistic fails to reject the null hypothesis of serial correlation. The ARCH test confirms that the disturbances have no heteroscedasticity issue as it accepts the null hypothesis of homoscedasticity. The Jarque-Bera normality test illustrates that the residuals follow the normal distribution. The Ramsey RESET test demonstrates that the model has no specification error. The structural stability test of the ARDL model is depicted in Figure 3. The CUSUM test and CUSUM squares test show that the estimated value of recursive residuals is ranged within the boundary of a 5% significant level, and those tests reveal that the ARDL estimations are structurally stable and there are no issues for the structural break in the long-term relationship.

Table 7. Results of Diagnostic Tests

Test	Test Statistic	Prob.
Breusch-Godfrey Serial Correlation LM Test	F-statistic = 1.7749	0.1951
Jarque-Bera Normality Test	J-B = 1.0644	0.5872
ARCH Test for Heteroscedasticity	F-statistic = 0.4471	0.5094
Ramsey RESET Test	F-statistic = 0.1694	0.6857

Source: Author's estimation using E-views 10.

Figure 3. (a) CUSUM Test, (b) CUSUM Squares Test



Source: Author's estimation using E-views 10.

Our analysis includes an estimation of the empirical relationship using the DOLS method to verify the robustness of the ARDL estimation. The results from the DOLS estimation, as shown in Table 8, indicate a highly significant positive association between imported capital goods and manufacturing exports. Additionally, this estimation provides evidence of a negative relationship between the exchange rate and manufacturing exports. The findings from the DOLS estimation are largely consistent with those of the ARDL estimation, further establishing the robustness of the baseline estimation.

Table 8. Results of DOLS Estimation

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LnICG	0.9827	0.2063	4.7617	0.0002
LnER	-0.3607	0.6570	-0.5490	0.0815
TO	0.3698	0.9789	0.4024	0.1866
C	2.6987	1.1710	2.3046	0.0341

Source: Author's estimation using E-views 10.

Our empirical results of the relationship between manufacturing exports, imported capital goods, exchange rate, and trade openness using ARDL model reveal a positive influence of imported capital goods on manufacturing exports in the long run, while in the short-run, the relationship between manufacturing exports and imported capital goods are also consistent with the long-run cointegration. In the long run, the exchange rate negatively influences manufacturing exports. In the short run, the influence of the exchange rate on manufacturing exports is also consistent with the long-run connection. The trade openness measured by the trade-to-GDP ratio shows a positive impact on manufacturing exports in

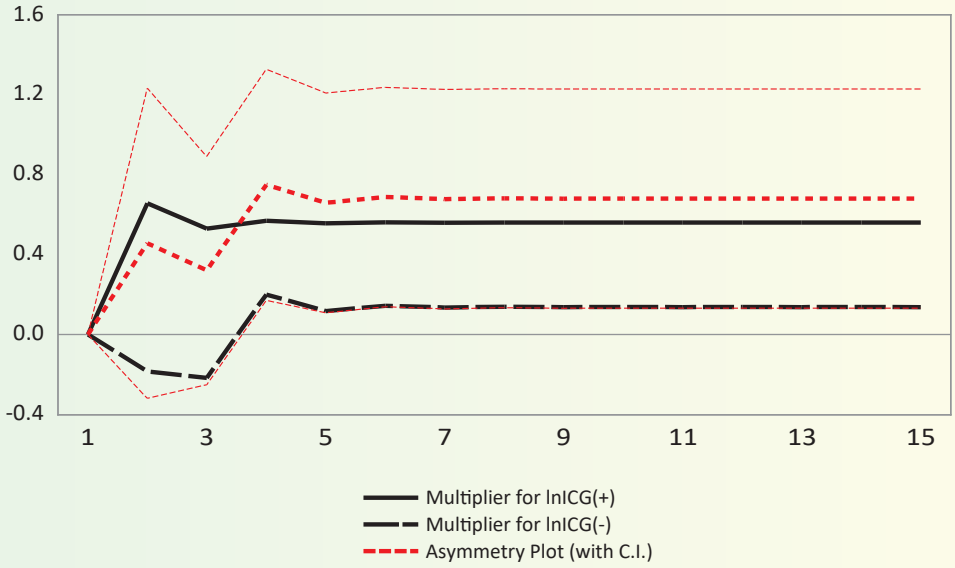
the long run as well as in the short run. The positive influence of the imported capital goods and trade-to-GDP ratio on manufacturing exports, as shown by the findings of our empirical analysis, is consistent with the outcome of the studies, such as Hasan (2002), Hye et al. (2013), Wahab et al. (2017), Panta et al. (2021) and Rijesh (2021). As long of the scarcity of empirical research on this ground in Bangladesh, we compare the results of our study with the outcome of the previous research (Hossain et al., 2009; Paul, 2011) that found a negative relationship between imports and economic growth in Bangladesh while exports and economic growth show the positive association. The results of our analysis are somewhat inconsistent with previous studies that found a negative relationship between imports and economic growth. Our study also indicates the negative relationship between exchange rate and manufacturing exports in the long run and in the short-run association, which is inconsistent with the economic theory that exchange rate depreciation has a favorable association with exports.

The dynamic multiplier effects of imported capital goods, exchange rate, and trade-to-GDP ratio on manufacturing exports are estimated and represented in Figures 6-8. Figure 6 illustrates that in the dynamic multiplier of imported capital goods on manufacturing exports, when imported capital goods rise, the manufacturing exports also rise. On the other hand, when imported capital goods decrease, manufacturing exports also decline. The fluctuation of the negative shock of imported capital goods to manufacturing exports is higher than the positive shocks. Furthermore, the representation also depicts that the positive and negative shocks of imported capital goods on manufacturing exports stabilized in around 5 years.

Figure 7 demonstrates the dynamic multiplier of the exchange rate to manufacturing exports. From this demonstration, we can see that negative shocks of exchange rate have a positive effect on manufacturing exports, whereas the positive shocks of exchange rate are negatively associated with manufacturing exports. The negative shocks are more prominent than the positive shocks, and the fluctuation of the negative shocks is higher than the positive shocks of the exchange rate to manufacturing exports. The stabilization of the negative and positive shocks of the exchange rate to manufacturing exports is around 5 years.

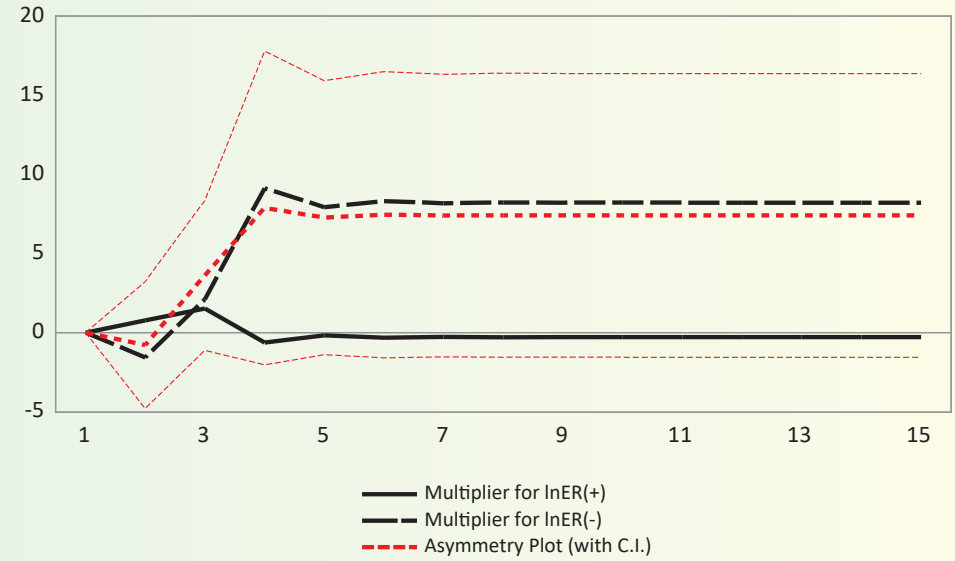
Figure 8 illustrates the dynamic multiplier of trade to GDP ratio on manufacturing exports. This illustration shows that when the trade-to-GDP ratio increases, the manufacturing exports also increase, and when the trade-to-GDP ratio decreases, the manufacturing exports also decline. The impact of positive shocks on manufacturing exports is higher than the negative shocks, whereas the fluctuation in positive shocks is also greater than the fluctuation in negative shocks of trade to GDP ratio on manufacturing exports. The graph also reveals that the positive shocks of trade to GDP ratio on manufacturing exports stabilized in around 8 years while the negative shocks stabilized a bit earlier, around 4 years.

Figure 6. The Dynamic Multiplier of Imported Capital Goods to Manufacturing Exports



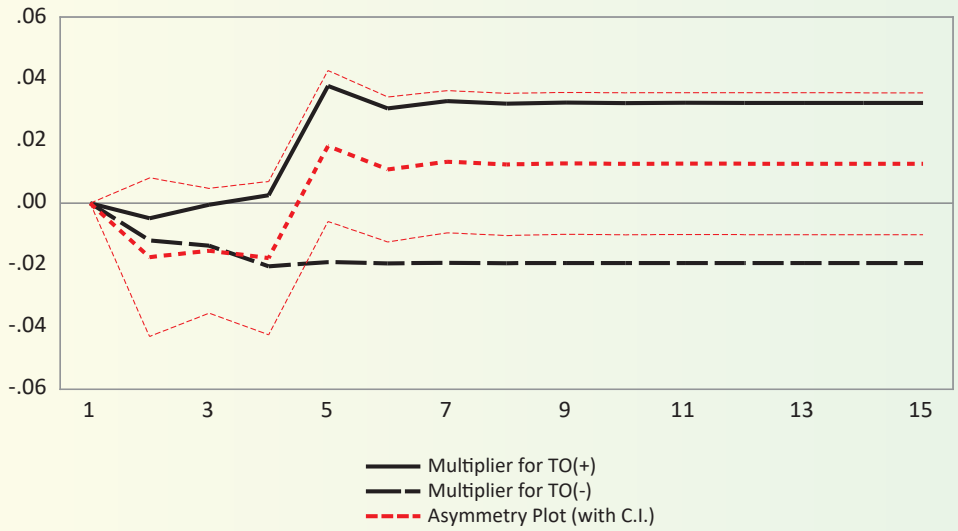
Source: Author's estimation using E-views 10.

Figure 7. The Dynamic Multiplier of the Exchange Rate to Manufacturing Exports



Source: Author's estimation using E-views 10.

Figure 8. The Dynamic Multiplier of Trade to GDP Ratio to Manufacturing Exports



Source: Author's estimation using E-views 10.

5. Conclusions and Policy Implications

This empirical study examines the symmetric linkage among the manufacturing exports, imported capital goods, exchange rate, and trade-to-GDP ratio in the context of Bangladesh's economy. The findings of the econometric analysis have supported the positive influence of imported capital goods and trade openness measured by the trade-to-GDP ratio on manufacturing exports. However, this study also reveals the negative impact of the exchange rate on manufacturing exports. The exchange rate depreciation negatively impacts manufacturing exports in Bangladesh, which is somewhat inconsistent with the economic theory. However, in Bangladesh, the depreciation of the nominal exchange rate is closely related to high inflation and fluctuation of interest rates (Chowdhury, 2022). The high inflation increases the input materials cost and labor cost, and the increasing interest rate also reduces investment in the private sector, which can hamper manufacturing exports. On the other hand, the rapid depreciation of the exchange rate has an adverse effect on the imported raw materials of the exporting sector, as the country's exports heavily rely on imported intermediate goods. That is why the exchange rate depreciation has adversely impacted the manufacturing exports in Bangladesh. This finding also creates room for investing in how exchange rates adversely impact manufacturing exports through high inflation and high interest rates in the context of Bangladesh.

Our study finds evidence that imported capital goods and trade openness are crucial to

expanding manufacturing exports in Bangladesh. In developing countries like Bangladesh, where limited capital technologies, including insufficient advanced manufacturing processes, technological capital adoption could have been achieved through imported capital goods from abroad. This provides the required technological transfer and support for human capital development; deploying the technological production equipment through imported capital goods has increased the manufacturing output and exports with the suitable combination of labor and technology in manufacturing. The liberalization of trade is crucial as it broadens the scope of exports and also widens the scope of imports of required materials, including capital machinery that is required for the manufacturing exports of the countries that have the comparative disadvantage of producing the capital technologies.

Although the manufacturing industries in Bangladesh are heavily labor-intensive, increasing production with export competitiveness, the manufacturing industry should properly adopt the technological capital mainly imported from abroad. The government, as well as policymakers, should think about the comprehensive import policies for capital goods that are required for increasing manufacturing exports. The proper policy measures should also be initiated for human capital development as the transferred technologies used in production from imported capital goods need a skilled workforce. So, investment in skilled workforce development is a prerequisite for increased export performance in manufacturing through imported capital goods. A weaker currency is typically seen as advantageous for exports. However, our analysis of Bangladesh indicates that currency depreciation negatively impacts export promotion. Therefore, policymakers should establish effective strategies to maintain exchange rate stability while appropriately managing inflation and interest rates.

However, this empirical study also has some limitations. In examining the connection between imported capital goods and manufacturing exports, this analysis has not considered macroeconomic variables like inflation, interest rate, and financial development directly to identify their impact on manufacturing exports in the long run causal effect. Considering these variables, further study could be conducted to more precisely explain the symmetric causal impact of imported capital goods on manufacturing exports. Moreover, our study utilizes time series data to reveal the connection among the variables on this issue; future studies could consider panel data to analyze the cross-country comparison for countries with similar economic structures along with Bangladesh. Further study by considering the different data with more explanatory factors and incorporating different methodologies could mitigate the research gap of the present study.

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Examining the Impact of Institutional Quality, Unemployment, and Dependency Ratio on Human Development in Bangladesh: An ARDL Time Series Evidence

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Abstract

This study examines the impact of institutional quality, unemployment, and the dependency ratio on human development in Bangladesh from 1996 to 2022. Using ARDL models, the findings reveal that both unemployment and the dependency ratio negatively affect the Human Development Index (HDI) in the long term. Institutional quality, measured by three different indicators, shows no significant impact on HDI in any model. In the short run, only one dependency ratio coefficient is significant, with a negative effect across all models. Granger causality tests indicate that causalities run from institutions to both HDI and the dependency ratio, while the dependency ratio Granger causes HDI in all models. One model uniquely shows that unemployment Granger causes institutional quality. Policy recommendations emphasize reducing unemployment and managing the dependency ratio to improve human development, alongside strengthening institutions to support these efforts.

Keywords: Human Development Index (HDI), Institutional Quality, Unemployment Rate, Dependency Ratio, ARDL Model

JEL Codes: O15, C32, P48

1. Introduction

In recent decades, Bangladesh has experienced important improvements in key human development indicators – evident from a steady increase in its Human Development Index (HDI) score from 0.441 to 0.67 between 1996 and 2022. Despite this progress, critical

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barriers persist: youth unemployment remains high at 11.9%, the age dependency ratio nears 50%, and institutional weaknesses—ranked 147th globally in governance efficacy (World Bank, 2023). Robust institutions are widely acknowledged as critical elements of sustainable progress, transparent governance, and equitable resource allocation (Acemoglu & Robinson, 2012; North, 1990). Concurrently, unemployment and high dependency ratios are associated with reduced access to education, healthcare, and intergenerational equity (Lee & Mason, 2009; Sen, 1999). Yet, studies on Bangladesh have predominantly prioritized GDP-centric frameworks.

None have systematically analyzed how institutional quality, along with unemployment and dependency ratios, shape human development outcomes in Bangladesh. This gap is critical because these factors collectively strain public resources, exacerbate inequality, and create feedback loops that perpetuate poverty. This study addresses this gap by employing the Autoregressive Distributed Lag (ARDL) time-series analysis to quantify the short and long run impacts of institutional quality, unemployment, and dependency ratios on Bangladesh's human development. The findings are intended to guide the development of focused policies, helping policymakers create cohesive strategies to tackle issues related to institutions, unemployment, and dependency.

The research aims to make a meaningful contribution by closely investigating how institutional quality, unemployment, and the dependency ratio together influence human development in Bangladesh, using data from 1996 to 2022. By employing the ARDL model along with bounds testing and diagnostic checks, this study sheds light on the complex interactions between these factors in both the short and long term. The study addresses the following key questions:

1. Does institutional quality affect human development in Bangladesh?
2. Is there a long-term relationship between human development, institutional quality, unemployment, and the dependency ratio?
3. What insights can be derived from the Granger causality analysis on these relationships?

By exploring these questions, this research not only fills a crucial gap in the literature but also offers valuable recommendations for policies aimed at enhancing human development in Bangladesh. The paper is organized as follows: Section 2 provides a review of the relevant literature, Section 3 outlines the data and methodology, Section 4 presents and discusses the results, Section 5 highlights the limitations and suggests directions for future research, and Section 6 concludes the paper.

2. Literature Review

Human development focuses on increasing people's freedoms and improving their well-being, which involves enhancing access to essential services like education, healthcare, and income. Sen (1999) emphasizes that human development is about enabling

individuals to lead meaningful lives by expanding their abilities, including access to knowledge, health, and opportunities for productive work. The United Nations Development Program (UNDP) introduced the HDI in 1990, to come up with a comprehensive measure of development beyond just quantitative economic growth. The HDI focuses on three aspects of a country's development: health (measured by life expectancy), education (measured by average and expected years of schooling), and living standards (measured by gross national income per capita). The index ranges from 0 to 1 with larger values reflecting higher levels of human development.

Institutions' role is pivotal as they create the necessary frameworks for veritable access to goods and services and resources driving human progress (De Muro & Tridico, 2008). Strong institutions are vital for ensuring economic stability, reducing inequality, and improving governance, which together help boost human capital and overall development (Acemoglu et al., 2014). Key components such as political systems, legal structures, and economic regulations significantly influence human development by shaping policies and creating an environment that encourages growth. Effective governance, marked by transparency, accountability, and respect for the law, attracts foreign direct investment, which contributes to economic growth and enhances living standards (Butkiewicz & Yanikkaya, 2006). On the other hand, weak institutions can lead to issues like corruption, greater inequality, and inadequate public services, all of which can stall human development (Seka, 2013). Research in various countries has consistently shown how crucial institutions are for fostering human development (Acemoglu et al., 2014; Ouedraogo et al., 2022; Rigobon & Rodrik, 2005).

North (1990) demonstrated the foundational influence of institutional frameworks on economic outcomes, noting their critical function in sustaining growth trajectories over extended periods. Sen (1999) contends that institutional structures that facilitate capability enhancement—such as ensuring equitable access to healthcare and educational resources—are indispensable for fostering individual and collective advancement. Acemoglu & Robinson (2012) expanded this discourse by contrasting participatory institutional frameworks, which drive positive socioeconomic transformations, with exploitative systems that perpetuate stagnation and inequality. Easterly (2001) cautions that temporary institutional interventions, such as anti-corruption initiatives, might generate preliminary improvements but lose momentum without enduring accountability mechanisms—a pattern evident in contexts like Bangladesh's ongoing challenges with administrative inefficacy (Khan, 2002).

Institutional inflexibility in managing demographic shifts, such as aging populations, can deepen disparities—a pressing issue for Bangladesh, where governance deficiencies hinder the conversion of economic expansion into tangible human development (World Bank, 2019). Asadullah et al. (2014) reveal that institutional quality gauged through governance indicators has not consistently translated into measurable progress in social development within Bangladesh. A cross-national study has identified persistent governance

shortcomings in both Bangladesh and India as key drivers of inequitable growth patterns that exclude marginalized populations(Abdullah-Al-Mamun & Akon, 2024). Shuaibu (2016) proposes that strategic enhancements in institutional frameworks and physical infrastructure act as catalysts for advancing human capital formation.

Unemployment harms human development by lowering income, increasing poverty, and restricting access to vital services such as healthcare and education. While the negative effects of unemployment are well established, their impact varies over time. In the short term, joblessness may lead individuals to seek opportunities in the informal sector or rely on temporary social support (Elder & Rosas, 2015). However, prolonged unemployment weakens human capital by reducing skills and creating intergenerational poverty (Blanchard & Summers, 1986; Sen, 1999). Research also highlights the adverse effects of unemployment in different contexts. Abamara et al. (2024) reported that unemployment significantly hinders human capital development in Nigeria. Bala et al. (2020) observed that rising unemployment slows economic growth in the country. Additionally, Tatli & Tasci (2021) found that higher female unemployment is linked to lower levels of human development.

The dependency ratio, which measures the number of economically inactive individuals (such as children and seniors) relative to the working-age population, plays a crucial role in shaping a nation's economic trajectory and societal well-being. Bloom & Williamson (1998) emphasized the economic advantages of a youthful population structure, where a reduced dependency ratio can enhance workforce productivity and spur growth. Conversely, in nations where this ratio remains elevated, economic resources become strained as a larger share must be allocated to support dependents. This dynamic restricts the allocation of funds toward essential sectors such as education and healthcare, hindering long-term human capital development and perpetuating cycles of limited opportunity.

Sofilda et al. (2015) showed that Indonesia's HDI suffered largely due to significant disparities between its Western and Eastern regions. This inequality stems from a centralized governance system that remained in place until 2001. Factors such as high unemployment rates and a large dependency ratio, combined with differences in spending on education and public services, contribute to this situation. Similarly, Sari (2022) looks into the factors affecting HDI in East Java and finds that both a high dependency ratio and rising unemployment have detrimental effects on HDI in the region. Additionally, Herianingrum et al. (2019) investigate how government spending and unemployment influence Indonesia's Islamic Human Development Index (IHDI) between 2010 and 2013. Their findings indicate that while unemployment negatively impacts the IHDI, the effect are not statistically significant, suggesting it may not have been a major factor during that time.

Singariya (2014) investigates the socioeconomic factors that affect the HDI across various Indian states, utilizing regression analysis and principal component analysis with

secondary data. The findings indicate that issues like poverty, child marriage, and infant mortality have a detrimental effect on HDI. On the other hand, positive influences on HDI include higher income levels, literacy rates, women's employment, urbanization, and improved access to essential services such as electricity and telecommunications. In a similar vein, Arisman (2018) examines the factors that impact HDI in ten ASEAN countries. Using a fixed effects model applied to panel data, the study concludes that population growth and per capita income are significant determinants of HDI, while unemployment appears to have minimal influence. These results suggest that although unemployment does not significantly affect HDI, it remains essential for governments to manage population growth and promote economic development to improve living standards.

The literature review clearly shows that, currently there exists a dearth of research with respect to analyzing the impacts of institutional quality on human development. This research aims to fill this gap by examining this link in the presence of unemployment and dependency. While previous studies have emphasized the crucial role of institutions in development, this research stands out by focusing specifically on Bangladesh.

3. Data and Methods

3.1 Data

Based on the review of the existing works, we define a simple model of human development within an ARDL framework where human development is explained by its lagged values, institutional quality, unemployment rate and the dependency ratio. Human development is measured by the HDI published by the UNDP. To measure institutional quality, three indexes are used. The first index, InQ1, is a composite index formed applying the principal component analysis to the six indicators of the Worldwide Governance Indicators (WGIs). The second index, InQ2, is an average of the six WGIs. We use this index following the argument that the average of the WGIs might be a better indicator (Alonso & Garcimartín, 2013).The third index, InQ3, is the Quality of Government index reported by the International Country Risk Guide (ICRG). For each measure of the institutional quality, we estimate a different model, thus giving us three models for the three indicators used. The information on unemployment rate (U) and the dependency ratio (D) come from the World Bank's World Development Indicators.

Table 1 presents the five summary statistics of the variables considered in the three forms of the model in this analysis. For example, during the study period, i.e., 1996-2022, Bangladesh had a mean HDI of 0.552 with a median of 0.541. The minimum and maximum values are 0.441 and 0.67 respectively. The standard deviation of the variable is 0.067. Statistics for the other variables can be interpreted in a similar fashion.

Table 1: Summary Statistics

Variable	Mean	Median	Std. Deviation	Minimum	Maximum
HDI	0.552	0.541	0.067	0.441	0.670
InQ1	0.000	0.419	1.583	-4.336	1.516
InQ2	-0.863	-0.856	0.126	-1.143	-0.617
InQ3	0.410	0.430	0.051	0.282	0.462
Unemployment	4.121	4.294	0.834	2.510	5.828
Dependency	60.742	61.962	8.686	47.088	76.064

Source: Author's own calculation using Stata 16

3.2 Methods

We start the analysis by performing unit root tests on the variables using three methods: the Augmented Dickey-Fuller (ADF) test, the Phillips-Perron (PP) test, and the modified Dickey-Fuller test (DF-GLS). These tests help determine whether any variables are integrated beyond the first order. After confirming the integration properties, we estimate the ARDL model, selecting the optimal lag order based on the Akaike Information Criterion (AIC). Following common practice in empirical research, all variables have been converted into their natural logarithmic forms.

As it incorporates lagged variables, the ARDL method can address issues such as omitted variable bias and autocorrelation, particularly when these problems arise due to the omission of lagged variables (Ghouse et al., 2018.; Muhammad & Abdullahi, 2020; Pesaran et al., 2001; Salahuddin et al., 2018). Unlike the Johansen and Engle-Granger models, the ARDL approach is better-suited for smaller samples and can handle variables with different levels of integration (Ghatak & Siddiki, 2001).

The empirical formulation of the ARDL models is given below, with p lags for the dependent variable and k lags for the independent variables. Since we use three indices of institutional quality, we have three equations—one for each index.

Model 1:

$$lnHDI_t = \beta_0 + \sum_{i=1}^{p} \beta_i \, lnHDI_{t-1} + \sum_{i=0}^{k} \gamma_i \, lnInQ_{1\,t-i} + \sum_{i=0}^{k} \delta_i \, lnU_{t-i} + \sum_{i=0}^{k} \rho_i \, lnD_{t-i} + \varepsilon_t \quad (1)$$

Model 1′:

$$lnHDI_t = \beta_0 + \sum_{i=1}^{p} \beta_i \, lnHDI_{t-1} + \sum_{i=0}^{k} \gamma_i \, lnInQ_{2\,t-i} + \sum_{i=0}^{k} \delta_i \, lnU_{t-i} + \sum_{i=0}^{k} \rho_i \, lnD_{t-i} + \varepsilon_t \quad (2)$$

Model 1″:

$$lnHDI_t = \beta_0 + \sum_{i=1}^{p} \beta_i \, lnHDI_{t-1} + \sum_{i=0}^{k} \gamma_i \, lnInQ_{3\,t-i} + \sum_{i=0}^{k} \delta_i \, lnU_{t-i} + \sum_{i=0}^{k} \rho_i \, lnD_{t-i} + \varepsilon_t \quad (3)$$

The ARDL bounds test is formulated as below (Pesaran et al., 2001):

Model 1:

$$\Delta \ln HDI_t = \beta_0 + \sum_{i=1}^{p} \beta_i \, \Delta \ln HDI_{t-i} + \sum_{i=0}^{k} \gamma_i \, \Delta lnInQ_{1\,t-i} + \sum_{i=0}^{k} \delta_i \, \Delta lnU_{t-i} + \sum_{i=0}^{k} \rho_i \, \Delta lnD_{t-i} + \lambda_1 lnHDI_{t-1} + \lambda_2 lnInQ_{1\,t-1} + \lambda_3 lnU_{t-1} + \lambda_4 lnD_{t-1} + \varepsilon_t \quad (4)$$

Model 1′:

$$\Delta \ln HDI_t = \beta_0 + \sum_{i=1}^{p} \beta_i \, \Delta \ln HDI_{t-i} + \sum_{i=0}^{k} \gamma_i \, \Delta lnInQ_{2\,t-i} + \sum_{i=0}^{k} \delta_i \, \Delta lnU_{t-i} + \sum_{i=0}^{k} \rho_i \, \Delta lnD_{t-i} + \lambda_1 lnHDI_{t-1} + \lambda_2 lnInQ_{2\,t-1} + \lambda_3 lnU_{t-1} + \lambda_4 lnD_{t-1} + \varepsilon_t \quad (5)$$

Models 1″:

$$\Delta \ln HDI_t = \beta_0 + \sum_{i=1}^{p} \beta_i \, \Delta \ln HDI_{t-i} + \sum_{i=0}^{k} \gamma_i \, \Delta lnInQ_{3\,t-i} + \sum_{i=0}^{k} \delta_i \, \Delta lnU_{t-i} + \sum_{i=0}^{k} \rho_i \, \Delta lnD_{t-i} + \lambda_1 lnHDI_{t-1} + \lambda_2 lnInQ_{3\,t-1} + \lambda_3 lnU_{t-1} + \lambda_4 lnD_{t-1} + \varepsilon_t \quad (6)$$

Δ is the first difference operator, t is the time index, i is the lag, and ε is the error term. The null hypothesis assumes that there is no co-integration, while the alternative hypothesis indicates that co-integration is present.

$$H_0: \lambda_1 = \lambda_2 = \lambda_3 = \lambda_4 = 0 \quad (7)$$

$$H_1: \lambda_1 \neq 0, \lambda_2 \neq 0, \lambda_3 \neq 0, \lambda_4 \neq 0 \quad (8)$$

To ensure the reliability of the results, we conduct several post-estimation diagnostic tests. For heteroscedasticity, we use the Breusch-Pagan test and the more general White's heteroscedasticity test. To detect autocorrelation, we apply the Breusch-Godfrey LM test and Durbin's alternative test. Residual normality is assessed using the Jarque-Bera test and the skewness-kurtosis test. The Ramsey RESET test is performed to check for omitted variable bias. Finally, both recursive and OLS-based CUSUM tests are used to evaluate the stability of the estimated parameters.

To identify causal relationships and as well as the direction of causality we also do the Granger causality test. Some argue that traditional causality tests like the Vector Error Correction Model (VECM) Granger causality and the Engle and Granger causality tests are restrictive and problematic in small samples (Sapnken et al., 2020). Toda & Yamamoto (1995) and Zapata & Rambaldi (1997) found that these methods can be sensitive to nuisance parameters, leading to unreliable results. Additionally, these tests often struggle

with correctly identifying the order of integration of the series (Mavrotas & Kelly, 2001). The Toda-Yamamoto (TY) procedure helps by augmenting a Vector Auto Regression (VAR) model with the highest order of integration from the series. This approach ensures that the Wald statistics have the necessary power and that there is no need to establish the order of integration before testing causality (Sapnken et al., 2020). The long-run causality test adjusts the lag order of the VAR by the highest order of integration, maintaining the standard asymptotic distribution of the Granger causality test statistics (Wolde-Rufael, 2010). This method makes sure the test statistics follow a chi-square distribution. It works even if the data series are non-stationary or have different orders of integration. Hence, following the work of Rahman & Kashem (2017) and Sapnken et al., (2020), we will assess Granger causality between the variables using an augmented VAR model with the Toda-Yamamoto method. When the null is rejected, the excluded variable Granger-causes the dependent variable. Non-rejection of the null indicates no Granger causality.

4. Results and Discussion

4.1 Results

In Table 2 we have a summary of the unit root tests. Following the unit root tests, lnHDI is I(0) following ADF and P-P tests whereas it is I(1) following DF-GLS. lnInQ1 is I(1) according to ADF and P-P tests and I (0) following DF-GLS. The same holds true for lnInQ2 and lnInQ3. All three tests identify lnU as I(1) while they all identify lnD as I(0). Hence all the variables are integrated of order 0 or 1 and none of them is integrated of an order higher than 1. This makes the data suitable for the application of the autoregressive distributed lag (ARDL) model.

Table 2: Unit root tests

	ADF		P-P		DF-GLS		I(?)
	Level	*First Diff.*	*Level*	*First Diff.*	*Level*	*First Diff.*	
lnHDI	-10.976***		-9.120***			-3.360***	I(0), I(1)
$lnInQ_1$		-4.087***		-5.995***	-16.521***		I(0), I(1)
$lnInQ_2$		-2.936**		-3.967***	-8.961***		I(0), I(1)
$lnInQ_3$		-3.264**		-3.296**	-3.785***		I(0), I(1)
lnU		-5.234***		-5.301***		-4.513***	I(1)
lnD	-17.577***		-10.823***		-5.488***		I(0)

Source: Author's own calculation using Stata 16

To determine the order of the ARDL model we consult the Akaike Information Criteria (AIC). Table 3 reports the various information criteria and the corresponding lag order that minimizes them. Based on the AIC, for three models with three distinct indicators of institutional quality, the orders of the models are: Model 1 (1 2 1 3), Model 1′(1 2 1 3), and Model 1″ (1 2 1 3).

Table 3: Determining the lag of the variables for the ARDL Model (1996-2022)

Variable	AIC	HQIC	SBIC
lnHDI	-7.25334(1)	-7.22851(1)	-7.1546(1)
$lnInQ_1$	0.88035(2)	0.917599(2)	0.99942(1)
$lnInQ_2$	-3.16905(2)	-3.1318(2)	-3.02094(2)
$lnInQ_3$	-2.28375(2)	-2.2465(2)	-2.13564(2)
lnU	-1.4918(1)	-1.46697(1)	-1.39306(1)
lnD	-10.06(3)	-10.0103(3)	-9.8625(3)

Source: Author's own calculation using Stata 16

As mentioned in the previous section, we estimate three models – each for one indicator of institutional quality employed. The results of the ARDL estimation are summarized in Table 4. Table 5 summarizes the ARDL bounds test. The various diagnostic tests conducted are reported in Table 6.

Table 4: ARDL Model Human Development = f (Institutions, unemployment dependency) Estimation Results

Y= lnHDI	Model 1 (1 2 1 3) 1996-2022	Model 1' (1 2 1 3) 1996-2022	Model 1" (1 2 1 3) 1996-2022
Variable	Long run		
lnInQ1	-0.0006(.002)		
lnInQ2		-0.0057(.010)	
lnInQ3			-0.006(.009)
lnU	-0.038**(.014)	-0.037**(.013)	-0.038**(.013)
lnD	-0.859***(.018)	-0.859***(.017)	-0.862***(.018)
		Short run	
Δ lnInQ1	-0.0009(.003)		
Δ lnInQ1(-1)	-0.0001(.003)		
Δ lnInQ2		-0.029(.018)	
Δ lnInQ2(-1)		0.013(.021)	

Δ lnInQ3			-0.0029(.014)
Δ lnInQ3(-1)			0.0048(.016)
Δ lnU	0.023(.014)	0.020(.015)	0.025(.0149)
Δ lnD	-1.503*(.836)	-1.371*(.709)	-1.737*(.838)
Δ lnD(-1)	2.137(1.527)	1.761(1.378)	2.384(1.466)
Δ lnD(-2)	0.763(.904)	0.996(.841)	0.817(.887)
Constant	3.857***(.780)	3.857(.808)	3.992***(.802)
ECT(-1)	-1.288***(.254)	-1.288***(.258)	-1.330***(.261)

Standard errors are presented in parentheses. ***, **, and * indicate significance at 1%, 5%, and 10% levels, respectively. Source: Author's own calculation using Stata 16

Model 1: Unemployment rate and dependency ratio – both affect HDI negatively and significantly in the long run. The impact of institutional quality, proxied by InQ1, is approximately zero. If we look at the short run dynamics; we see that again InQ1 fails to exert any important influence. The short run impact of unemployment is also insignificant. However, one of the short-term impacts of dependency ratio is significant at 10% with a negative sign. The ECT of -1.288 suggests that if deviated from the long run equilibrium, the model returns to equilibrium with a damped oscillation. Following the ARDL bounds test, all the variables in the model are cointegrated at 5%, i.e., they exhibit a long run relationship at 5% level of significance.

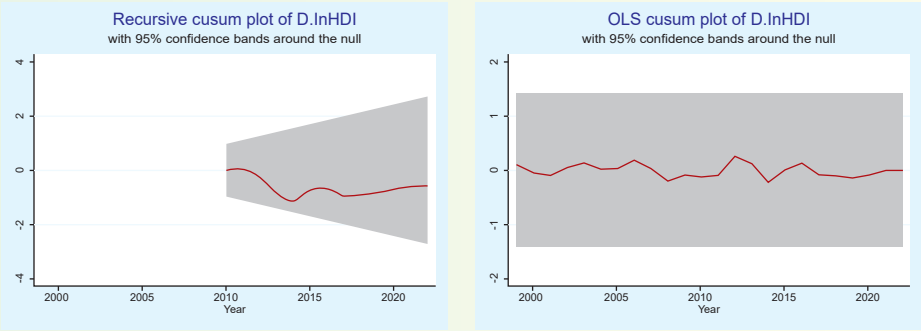


Figure 1: Recursive and OLS CUSUM Tests for Model 1 (Source: Author's calculation using Stata 16)

From Table 6 we see that 75.3% of the variation in human development is explained by this model. This reduces to 56.4% when adjusted for the degrees of freedom. Following both B-P and White's test, the residuals are normally distributed. The Ramsey RESET test shows that Model 1 does not suffer from omitted variable bias. BG LM test, Durbin's

alternative test and Durbin-Watson test – all confirm the absence of serial correlation. Both J-B and the skewness and kurtosis tests for normality assure that the residuals are normally distributed. Also, as illustrated in Figure 1, the estimated parameters exhibit stability.

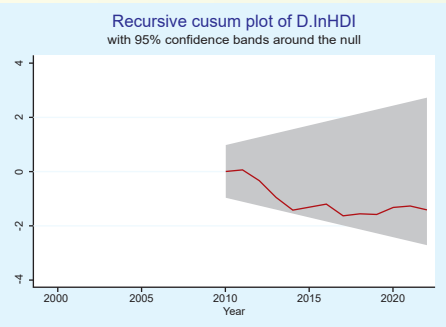
Table 7 reports results of the Granger causality Wald tests which is adjusted for the sample size. Model 1 has three unidirectional causalities running from institutions to HDI, institutions to dependency ratio and dependency to HDI.

Table 5: Pesaran, Shin, and Smith (2001) bounds test

H_0: no level relationship					
	Test statistic	**Value**	**p-value I(0)**	**p-value I(1)**	**Decision**
Model 1	F	6.757	0.008	0.028	Reject H_0 at 5%
	t	-5.055	0.001	0.010	
Model 1′	F	6.678	0.008	0.029	Reject H_0 at 5%
	t	-4.980	0.001	0.011	
Model 1″	F	6.703	0.008	0.029	Reject H_0 at 5%
	t	-5.093	0.001	0.009	

Kripfganz & Schneider (2020) critical values and approximate p-values.
Source: Author's own calculation using Stata 16

Model 1′: In the long run, institutional quality, represented by InQ_2, has no discernible impact on HDI. However, both unemployment rate and dependency ratio affect HDI negatively and significantly. In the short run, only one of the only one of the dependency coefficients is significant at 10% which is also negatively signed. The ECT suggests a damped oscillatory convergence towards long run equilibrium in case of a deviation. The bounds test confirms the existence of a LR relationship among the variables in Model 1′.



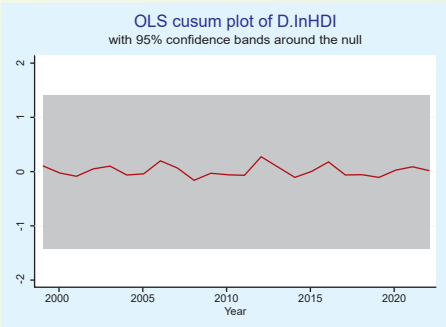


Figure 2: Recursive and OLS CUSUM Tests for Model 1′ (Source: Author's calculation using Stata 16)

The model's explanatory power is 79.20% which is 63.20% when adjusted for the degrees of freedom. Model 1′ does not suffer from heteroscedasticity, omitted variable bias, and non-normality. Though the B-G LM test suggests serial correlation, following the Durbin's alternative test, the residuals are not serially correlated. Recursive and OLS CUSUM tests, as displayed in Figure 2, the estimated parameters are stable.

As reported in Table 7, Model 1′ has four one-way causations – two running from institutions to HDI and dependency. The third one runs from dependency to HDI while the fourth one runs from unemployment to institutions.

Table 6: ARDL Diagnostics

	Model 1	Model 1′	Model 1″
R-squared	0.753	0.792	0.759
Adj R-squared	0.564	0.632	0.574
Breusch-Pagan / Cook-Weisberg test for Heteroscedasticity Ho: Constant variance	0.40 (0.526) Do not reject H_0	0.75 (0.385) Do not reject H_0	0.86 (0.354) Do not reject H_0
White's test Ho: homoskedasticity	24.00(0.403) Do not reject H_0	24.00(0.403) Do not reject H_0	24.00(0.403) Do not reject H_0
Ramsey RESET test Ho: model has no omitted variables	1.77 (0.216) Do not reject H_0	1.11 (0.389) Do not reject H_0	2.54 (0.115) Do not reject H_0
Breusch-Godfrey LM test Ho: no serial correlation	2.282 (0.130) Do not reject H_0	4.133(0.042) Reject H_0	3.052 (0.080) Do not reject H_0
Durbin's alternative test for autocorrelation Ho: no serial correlation	1.261 (0.261) Do not reject H_0	2.497 (0.114) Do not reject H_0	1.748 (0.186) Do not reject H_0
Jarque-Bera test Ho: normality	1.942 (.378) Do not reject H_0	2.774 (.249) Do not reject H_0	1.986 (.370) Do not reject H_0
Skewness-kurtosis tests for normality	2.54 (0.280) Do not reject H_0	4.25(0.119) Do not reject H_0	2.56 (0.277) Do not reject H_0

Source: Author's own calculation using Stata 16

Model 1″: Quality of institution, now represented by InQ3, has no important influence on HDI. Again, unemployment rate and dependency ratio have significant negative impacts on HDI in the long run. In the short run, none of the coefficients are significant except for one dependency coefficient which is negative and significant only at 10%. The ECT of -1.330 indicates that Model 1″ converges to long run equilibrium, once deviation experienced, in a damped oscillatory manner. Also, the ARDL bounds test show that the variables in the model are cointegrated at 5% level.

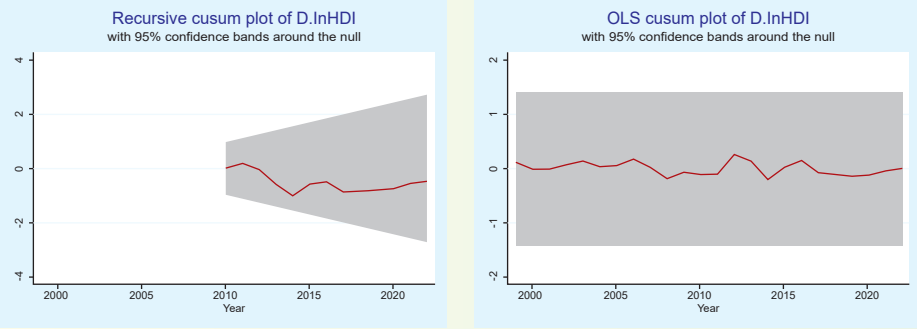


Figure 3: Recursive and OLS CUSUM Tests for Model 1″ (Source: Author's calculation using Stata 16)

Model 1″ explains 75.90% variations in HDI which becomes 57.4% when adjusted for degrees of freedom. According to the diagnostic tests, Model 1″ is free from heteroscedasticity, omitted variable bias, serial correlation and non-normality. The stability of the estimated parameters is confirmed by recursive and OLS CUSUM tests, presented in Figure 3.

Model 1″ is characterized by three unidirectional causalities, listed in Table 7. Institutions Granger causes HDI and dependency. Additionally, a unidirectional causality runs from dependency to HDI.

Table 7: Granger causality Wald tests

Model	Variables	F stat (p-value)	Direction of Causality
Model 1	$lnInQ_1 \rightarrow lnHDI$	$6.631^{**}(0.019)$	Institutions Granger cause human development
	$lnInQ_1 \rightarrow lnD$	$5.588^{**}(0.029)$	Institutions Granger cause dependency
	$lnD \rightarrow lnHDI$	$4.407^{**}(0.050)$	Dependency Granger causes Human development
Model 1′	$lnInQ_2 \rightarrow lnHDI$	$3.364^{*}(0.083)$	Institutions Granger cause human development
	$lnInQ_2 \rightarrow lnD$	$5.588^{**}(0.029)$	Institutions Granger cause dependency
	$lnD \rightarrow lnHDI$	$4.407^{**}(0.050)$	Dependency Granger causes Human development
	$lnU \rightarrow lnInQ_2$	$3.276^{*}(0.087)$	Unemployment Granger causes institutions
Model 1″	$lnInQ_3 \rightarrow lnHDI$	$11.725^{***}(0.003)$	Institutions Granger cause human development
	$lnInQ_3 \rightarrow lnD$	$7.650^{*}(0.012)$	Institutions Granger cause dependency
	$lnD \rightarrow lnHDI$	$16.211^{***}(0.0008)$	Dependency Granger causes Human development

p-values in parentheses. ***, **, and * indicate significance at 1%, 5%, and 10% levels, respectively.
Source: Author's own calculation using Stata 16

4.2 Comparison

When comparing the three models, all show consistent results: both the unemployment rate and dependency ratio have a significant and negative impact on HDI in the long term. Institutional quality, represented by InQ_1, InQ_2, or InQ_3, does not significantly influence HDI in any of the models.

In the short term, only one dependency ratio coefficient is significant at 10%, with a negative sign in each model. The ECT values in all models indicate that the system returns to long-term equilibrium after deviations, through a damped oscillation process. All models exhibit long run relationship among the variables as the null can be rejected at 5% level in all models.

Model 1 accounts for 75.3% of HDI variation, which adjusts to 56.4% after considering degrees of freedom. Model 1′ offers the highest explanatory power, capturing 79.2% of the

variation (63.2% adjusted). Model 1″ explains 75.9% (57.4% adjusted). Across all models, diagnostic tests confirm no issues with heteroscedasticity, serial correlation, omitted variables, or non-normality. Stability of parameter estimates is validated by recursive and OLS CUSUM tests in each model.

In all three models, we find Granger causalities running from institutional quality to both human development and dependency and from dependency to HDI. Additionally, in Model 1′ unemployment was found to Granger cause institutional quality.

4.3 Discussion

Table 8 summarizes the findings of the three models. According to the findings, the relationship between institutional quality and human development in Bangladesh is negative, in general, and insignificant. Hence, the overall evidence here is that of human development without governance during the 1996-2022 periods. As regards the short run positive impacts, in the short run, improvements in institutional quality can sometimes create optimism, bring investments, and ameliorate the delivery of public services, leading to immediate positive effects. Short run economic stimuli like foreign aid or policy reforms, can also support human development. But, in the long run, institutional inadequacies, bureaucratic incompetence, and structural limitations can undermine those initial gains, ultimately having a negative impact. If reforms are superficial, poorly executed, or driven by political motives, they can lead to ineffective resource distribution, declining quality of public services, and a reduced trust on the economic environment. Furthermore, issues such as improbity, policy inflexibility, and state volatility can slow down the process of human development. Also, changes in institutional quality often require an adjustment period. While early improvements may yield temporary dividends, continuous human development requires sustainable institutional strengthening and effective governance. Hence, longer term institutional challenges, economic inequalities, and inefficiencies can countervail the initial gains.

Table 8: Summary of Findings from Three Models on Institutions and HDI

Y=HDI		**Model 1 with InQ_1**	**Model 1′ with InQ_2**	**Model 1″ with InQ_3**
Variable		Sign & Significance	Sign & Significance	Sign & Significance
Institutional quality	LR	-	-	-
	SR	-,-	-,+	-,+
Unemployment	LR	-**	-**	-**
	SR	+	+	+
Dependency Ratio	LR	-***	-***	-***
	SR	-*	-*	-*

***, **, and * indicate significance at 1%, 5%, and 10% levels, respectively.

In the literature there are works that support such evidence. North (1990) argues that institutional improvements that work in the short run can become rigid in the long run which might obstruct human development. Khan (2002), in the context of Bangladesh, argues that anti-corruption measures work in the short run and they become less effective in the long run as the patronage network reemerges. Some argue that extractive institutions can generate such outcomes (Acemoglu & Robinson, 2012). Such outcome can also be generated by institutional reforms that are good on paper but lack sustainability (Pritchett & De Weijer, 2010).

In all three models, regardless of the index for institutional quality used, total unemployment rate has a significant negative impact in the long run while it has an insignificant positive impact in the short run. In the short run, unemployment can raise human development owing to government supports, training programs, social safety nets, and household initiatives. However, in the long run, unemployment reduces income security, limits access to essential services like health and education, and increases social inequality, ultimately hindering human development (Sen, 1999). According Blanchard and Summers, unemployment lowers productivity and human development in the long run (Blanchard & Summers, 1986). The findings are also consistent with the 2015 ILO report that suggests that short-term unemployment can marginally increase informal work or education enrollment while long-term unemployment causes lasting adverse impacts including lower lifetime earnings and poorer health (Elder & Rosas, 2015).

In all models, age dependency ratio negatively impacts human development in both the short and long term due to the economic burden of supporting a larger share of non-working individuals, such as children and the elderly. In the short run, resources are diverted from education and healthcare to support dependents, reducing household income and limiting investments in productive activities. Over time, this pressure intensifies, constraining savings, hindering human capital formation, and increasing costs for aging populations, such as healthcare and pensions. These factors slow economic growth, exacerbate intergenerational inequality, and restrict access to essential services. The findings are consistent with Lee's argument that with higher dependency ratios households save less and the government invests less in health and education which reduce human development (Lee, 2012).

4.4 Robustness

To evaluate the reliability of our conclusions regarding institutional quality's impact on human development, we utilize the methodological strength of using three indexes of institutional quality. Uniformity in outcomes across these different indexes reinforces the credibility of the results. The study demonstrates that institutional quality's influence on human development is similar irrespective of the indicator of institutional quality used, suggesting the observed relationship is not driven by measurement or methodological bias,

or the specific institutional index considered. For other variables, the impacts of unemployment and dependency ratio on human development are similar across models.

All models provide consistent evidence of a long-run relationship. Model 1' does not pass the B-G LM test for serial correlation. However, Durbin's alternative test indicates no evidence of serial correlation in Model 1'. All other diagnostic tests are satisfied by all models. Following the recursive and OLS CUSUM tests, the parameters in all models maintain stability over the entire estimation period, confirming that the relationships identified in the models are robust against structural changes or sudden disruptions in the data. Such parameter stability reinforces the reliability of the models in offering consistent and economically meaningful interpretations of the relationships under study.

5. Limitations and Future Research Directions

The research findings, though insightful, face constraints that require careful consideration.

a. A key limitation lies in the dependence on aggregate indicators to assess institutional quality, which risks oversimplifying Bangladesh's governance context. Also these indexes ignore the role of informal institutions.

b. The linear ARDL model cannot capture potential nonlinear dynamics in the model. Also, institutional improvements might have a threshold effect.

c. Though the models used in the study do not suffer from omitted variable bias, they exclude potentially important variables like education, health, various macroeconomic variables, external shocks and policy interventions.

d. The study is based on nationwide aggregated statistics and does not account for regional disparities.

e. The applicability of the study is confined to Bangladesh, limiting cross-national relevance.

f. The analysis is limited to the years 1996–2022, as the WGIs were introduced in 1996. Although the HDI extends back to 1990, substituting WGIs with alternative metrics to include earlier years (1990–1996) would yield a marginal six-year extension.

This study can lead to several potential directions for future research.

a. Future studies should focus on developing indicators that reflect Bangladesh's institutional landscape, rather than relying on broad composite indices. This includes incorporating measures of informal institutions to better understand their impact on development.

b. The Nonlinear Autoregressive Distributed Lag (NARDL) approach could help

capture the different effects of changes in institutions, unemployment, or dependency ratios. Additionally, threshold regression models could help identify specific levels of institutional performance beyond which human development accelerates.

c. Future research should include additional variables that are potentially relevant and external shocks like economic crises or policy changes.

d. Using regional data instead of national aggregates could reveal regional disparities in institutional quality and development, allowing for more targeted policy recommendations. Similarly, comparing Bangladesh with other countries facing similar challenges, could determine whether these findings are specific to Bangladesh or part of a broader trend.

6. Conclusions

6.1 Findings

The aim of the paper was to fill a research gap by analyzing the impact of institutional quality, unemployment rate and dependency ration on the human development of Bangladesh. Using data for the 1996-2022 periods, we conduct three unit root tests and proceed to estimate ARDL models followed by bounds test and diagnostic tests.

The findings from all three models are consistent. Both the unemployment rate and the dependency ratio have a strong, negative effect on HDI over the long term. However, institutional quality, represented by InQ_1, InQ_2, or InQ_3, does not have a significant impact on HDI in any of the models. There is evidence of long run relationship among the variables in all models. The ECTs indicate that after any short-term disruptions, the system gradually returns to its long-term balance through a process of damped oscillation. Across all models, institutions are found to Granger-cause both HDI and the dependency ratio, while the dependency ratio Granger-causes HDI.

6.2 Policy Implications

The findings and discussions of the study lead to several actionable policy implications.

a. Reducing unemployment rate to achieve better human development can be achieved through following ways-

i. Collaborating with industries to develop vocational and digital training programs aligned with job market needs.

ii. Providing tax incentives to businesses that employ long-term unemployed individuals, including women and displaced workers.

iii. Simplifying labor regulations to facilitate the transition of informal workers into the formal sector and support gig economy growth.

iv. Introducing unemployment benefits tied to mandatory skill enhancement programs.

b. Tackling the challenges associated with dependency ratio will also improve human development and following policies can help in this regard:

i. Enhancing female workforce participation through subsidized childcare, flexible work arrangements, and tax benefits for employers.

ii. Expanding pension schemes for informal sector workers and investing in universal early childhood education.

iii. Offering subsidized healthcare for the elderly and extend maternity benefits to support working parents.

iv. Strengthening family planning initiatives in regions with high fertility rates to manage demographic pressures.

c. Though Bangladesh experienced human development without governance, robust institutions can help achieve and sustain higher human development. Following policies can help in achieving that-

i. Incorporating transparency mechanisms, such as public audits, within development initiatives.

ii. Granting local governments financial autonomy and establish community-led monitoring systems.

iii. Creating independent regulatory bodies for education and healthcare while enhancing e-governance.

iv. Reforming the civil service by linking promotions to performance and minimizing political interference.

v. Promoting civic engagement through social audits and implementing progressive taxation to reduce wealth disparities.

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Exploring the Food Inflation Volatility in Bangladesh: An Econometric Study

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Abstract

This study examines the volatility dynamics of food inflation in Bangladesh using Generalized Autoregressive Conditional Heteroskedasticity (GARCH) and its variants (EGARCH, TGARCH, and IGARCH) to capture the influence of past shocks, volatility persistence, and asymmetric responses. The analysis utilizes Consumer Price Index (CPI) data for food and its subgroups. The findings reveal significant heterogeneity in volatility behavior across commodities. Overall, food price volatility shows both significant persistence and asymmetry, where negative shocks reduce volatility more than positive shocks. The results highlight the strong persistence of price volatility in many food subgroups and the asymmetric response of prices to shocks, where price increases lead to higher volatility compared to price decreases. This has important implications for policy, particularly for inflation management and food security, as volatility disproportionately affects lower-income households. The study suggests targeted interventions to stabilize prices and improve supply chain efficiency, alongside long-term strategies for sustainable agricultural practices. The findings contribute to the broader discourse on economic stability and food price dynamics in Bangladesh. The estimated volatility along with the threshold effect (if any) will help to confirm the active intervention by the authority in the food markets to prevent unusual food price hikes.

Keywords: Food Price Volatility, GARCH Models, Asymmetric Shocks

JEL Classification: C22, E31, Q18.

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Views expressed in the article are author's own, which do not necessarily reflect the views of the institution in which she works.

1. Introduction

Food inflation is a critical economic indicator that significantly impacts the livelihood and well-being of individuals, particularly in developing nations like Bangladesh. In Bangladesh, food inflation has emerged as a pressing concern with far-reaching consequences. The volatility of food prices in Bangladesh not only affects household budgets but also influences broader economic stability and social equity. Over recent decades, Bangladesh has experienced substantial economic growth and development, yet this progress has been accompanied by considerable fluctuations in food prices. These fluctuations are driven by a complex interplay of factors including agricultural productivity, global commodity prices, supply chain disruptions, and climatic conditions. The volatility of food inflation in Bangladesh is particularly concerning given the significant role that food expenditure plays in the average household budget, especially among lower-income families who spend a larger proportion of their income on food. So, understanding the extent and accurate measurement and analysis of food inflation volatility can provide crucial insights into economic conditions and inform effective policy-making. As food inflation in lower income countries is more volatile and higher than non-food inflation, this has received considerable research attention in Bangladesh. This research paper aims to provide a comprehensive assessment of food inflation volatility in Bangladesh by employing advanced statistical methods and economic models. The study analyses historical price data and seeks to uncover patterns and provide a nuanced understanding of food price dynamics by focusing on both short-term fluctuations and long-term trends. This research will contribute to the broader discourse on economic stability and food security in Bangladesh, offering valuable insights for policymakers, economists, and stakeholders dedicated to fostering a resilient and equitable economic environment.

2. Literature Review

Food price volatility has significant macroeconomic implications, especially in developing economies where food constitutes a large portion of the consumption basket. Studies have demonstrated that food price volatility is not only a result of supply and demand shocks but is also influenced by macroeconomic variables such as exchange rates, interest rates, and global economic conditions (Roache, 2010). This section provides a synthesis of the existing literature on food price volatility with a focus on key concepts on volatility measurement including macroeconomic factors, market-specific conditions, and policy interventions.

Iddrisu et al. (2019) discusses various statistical approaches for analyzing inflation volatility, including the Generalized Autoregressive Conditional Heteroskedasticity (GARCH) model and its variants. These models are commonly used to capture the time-varying nature of price volatility and are particularly relevant for studying food

inflation, given its susceptibility to external shocks and seasonal effects. A study by Sekhar et al. (2018) explores food inflation and volatility in India, identifying key contributors to inflation. This study reveals that food inflation and volatility have been persistent due to supply-side factors like production shortfalls, wage rates, and government policies such as minimum support prices. Crain and Lee (1996) found that more market-oriented government programs in the United States contributed to increased volatility in wheat and corn prices. On the other hand, some studies suggest that price supports and subsidies may help in stabilizing prices, but the evidence remains inconclusive (Yang, Haigh, & Leatham, 2001).

Several empirical studies have explored food inflation volatility in Bangladesh, revealing important insights into its causes and impacts. Ahmed, Muzib, and Hasan (2016) explored the relationship between inflation, inflation uncertainty, and relative price variability in Bangladesh. Their study used disaggregated CPI data from 2002 to 2013 and found that food inflation played a significant role in overall price instability. The research indicated that food inflation volatility often results from external shocks such as global commodity price fluctuations, domestic supply chain inefficiencies, and policy mismanagement. Islam et al. (2022) examined the effect of climate change on food security and food loss in Bangladesh. Their findings suggested that climate-induced agricultural disruptions, such as floods and droughts, contribute to food price volatility. The study found that food grain losses significantly increase inflationary pressures by reducing domestic supply, thereby increasing reliance on food imports. This underscores the necessity of climate-resilient agricultural policies to stabilize food prices.

Hossain, Mujeri, and Chowdhury (2013) analyzed the impact of inflation on different household groups in Bangladesh. Their study emphasized that food inflation disproportionately affects low-income households, as food expenses constitute a larger share of their total consumption. They also identified structural issues such as supply chain bottlenecks, inadequate storage facilities, and inefficient distribution networks as contributors to food price instability. Uddin and Anika (2023) explored how inflation affects economic access to food in Bangladesh. Their study highlighted that rising food prices reduce purchasing power, particularly among lower-income groups. Additionally, they identified factors such as international price shocks, currency depreciation, and market syndicates as significant drivers of food inflation. The study called for improved market regulation and targeted subsidies to protect vulnerable populations. Akter and Basher (2013) investigated the impacts of food price and income shocks on household food security in rural Bangladesh. Their study, using longitudinal survey data, found that the 2007–2009 food price crisis significantly worsened food insecurity. Poor households bore the immediate brunt of rising food prices, although over time, market adjustments and economic growth alleviated some adverse effects. This study highlights the cyclical nature of food price volatility and its differential impact across income groups.

As consistent with literature, we have used Generalized Autoregressive Heteroskedastic (GARCH) Process to capture the underlying volatility of food inflation. GARCH models not only allow the incorporation of the effects of the conditional mean into the system but also "accommodate the effects of the inflation shock on inflation volatility, and, in turn, the effects of inflation volatility on economic activity," (Elder, 2003). This model is useful for modeling the changes in volatility over time. It explains volatility as a function of the errors which are often called 'shocks'. While investigating the reverse causality between inflation and inflation volatility by using a large panel of developing and developed countries data over the period of 1965 to 2007, Kim & Lin (2012) estimated the inflation volatility. In the study they used a five-year rolling window standard deviation of inflation to measure inflation volatility. Sethi (2015) modeled the inflation volatility as the five-point moving average of coefficient of variation of inflation. This paper found that the coefficient of inflation volatility is negative and significant.

Despite the contributions of existing research, several gaps remain in the literature. There is a need for more granular studies that explore variations in food inflation volatility in Bangladesh. Additionally, incorporating newer econometric techniques and real-time data could enhance the understanding of volatility dynamics.

In this study we have used both the commodity groups and commodity subgroups to assess the underlying volatility. They have found that the commodities with higher income elasticity of demand and limited processing and storage facilities, have higher volatility. To the best of our knowledge, in Bangladesh there is no such study of estimating food inflation volatility with commodity subgroup level data. So, our study will add some important insights to the literature of food inflation volatility of Bangladesh in commodity level.

Eisenstat & Strachan (2016) conducted a study on the US quarterly CPI data over the period of 1947: q2 to 2013: q3 to measure the inflation volatility. They employed the change-point model to estimate the evolving persistence and level of volatility and found that as the prior expected duration increases, the model will switch regimes less often and increasingly approximate the time-invariant stationary model. This model was chosen because of its efficiency of capturing the low frequency behavior of stationary process while measuring US inflation volatility.

However, the introduction of Autoregressive Conditional Heteroskedasticity (ARCH) model by Engle in 1982 relaxed the assumption of constant variance of disturbances. He estimated the model with disturbances following an Autoregressive Heteroskedastic process rather than traditional econometric models based on UK inflation data which was concerned with the volatility of inflation. He found that UK inflation has significant ARCH effect with variances that increase substantially during the chaotic seventies.

After that many such volatility models using ARCH have been identified in the literature. Rizvi et al. (2014) investigated the inflation volatility in Asian perspective by exploiting

quarterly CPI data of 10 Asian countries. In this paper inflation volatility has been modeled as a time-varying process through different symmetric and asymmetric GARCH specifications. The results of this study suggest that a statistically significant asymmetry has been found in inflation volatility in all countries.

Banarjee (2017) undertakes an empirical exercise on monthly CPI over the sample period of 1958 to 2016 for 41 countries using the GARCH (1, 1) model to estimate the inflation volatility. Sek & Har (2012) applied a GARCH (1, 1) model to calculate inflation volatility of three Asian countries namely Korea, Philippines and Thailand. Zivko & Bosnjak (2017) analyzed Croatian CPI volatility pattern using ARCH model. Nyoni (2018) used an AR (1) - GARCH (1,1) model to estimate the volatility of inflation in Zimbabwe using annual time series data. While investigating the causality among inflation volatility, economic growth and monetary policy Hossain (2015) estimated the CPI inflation volatility using GARCH (1,1)-in-mean model. The empirical results suggest that inflation positively affects inflation volatility and inflation volatility raises inflation.

Neyapti (2000) shows that inflation significantly raised uncertainty. Evidence in Nas and Perry (2000) supports this finding, while the evidence on the effect of inflation uncertainty on the level of inflation is mixed and depends on the time period analyzed. They used the EGARCH technique for modeling inflation uncertainty. Javed et al. (2012) applied ARMA-GARCH model to estimate conditional volatility of inflation in Pakistan using monthly data over 1957:01 to 2007:12. Sekhar et al. (2018) analyze the food price volatility in India using ARCH family models.

3. Methodology

Volatility is a symptom of market disruption which cannot be measured directly. It is associated with unpredictability, uncertainty and is usually realized through time varying conditional variance. To capture this time varying conditional variances, we have employed Autoregressive Conditional Heteroskedastic (ARCH) class of models of volatility in each series of the food CPI group containing monthly data from 2013M08 to 2023M03 collected from Bangladesh Bureau of Statistics (BBS).

To reach an ARCH process at first, we applied Box-Jenkins methodology in order to come up with the adequate ARMA models for the conditional mean equations of each CPI food group. After that we tested the residuals from the mean equations for ARCH effects. Therefore, applying different specifications of ARCH class of models such as GARCH, TARCH, IGARCH, and EGARCH models under appropriate error distributions, we have measured the time varying conditional variances hence the time varying volatility.

ARCH/ GARCH Specifications

An autoregressive conditional heteroscedasticity (Engle, 1982) model considers the

variance of the current error term to be a function of the variances of the previous time period's error terms. ARCH relates the error variance to the square of a previous period's error. It can be described as follows:

$$h_t = a_0 + a_1\varepsilon_{t-1}^2 + b_1 a_1 \varepsilon_{t-2}^2 + b_1^2 a_1 \varepsilon_{t-3}^2 + \ldots$$

Where, $a_0 > 0,\ 0 \le a_1 < 1$

To capture the long lagged effects with fewer parameters, generalized ARCH model has been proposed by Bollerslev (1986) and Taylor (1986) independently. It tells us that the volatility changes with lagged shocks ε_{t-1}^2 but there is also momentum in the system working via h_{t-1}. A GARCH (1,1) model is as follows:

$$h_t = a_0 + a_1\varepsilon_{t-1}^2 + b_1 h_{t-1}$$

Often in GARCH $\widehat{a_1} + \widehat{b_1} \approx 1$. Motivated by the stylized fact, Engle and Bollerslev (1989) proposed the IGARCH process. An IGARCH (1, 1) process is as follows:

$$h_t = a_0 + a_1\varepsilon_{t-1}^2 + (1 - a_1)h_{t-1}$$

To allow asymmetric effect in the standard GARCH model, a TGARCH model has been proposed by Jagannathan & Runkle (1993) and Zakoian (1994) as follows:

$$h_t = a_0 + a_1\varepsilon_{t-1}^2 + \gamma d_{t-1}\varepsilon_{t-1}^2 + b_1 h_{t-1}$$

Where, the impact of good news is a_1 and bad news is $a_1 + \gamma$
Another variation is EGARCH model proposed by Nelson (1991) as described following:

$$\ln(h_t) = \delta + b_1 \ln(h_{t-1}) + a\left|\frac{e_{t-1}}{\sqrt{h_{t-1}}}\right| + \gamma\left(\frac{e_{t-1}}{\sqrt{h_{t-1}}}\right)$$

4. Results And Discussion

We have outlined the volatility of food inflation under Generalized Autoregressive Conditional Heteroskedastic (GARCH) framework. We considered the CPI of food along with food subgroups and estimated the volatility for each subgroup. We explored the sustained increases or decreases which are known as clustering and the asymmetry effects. Results indicate that the GARCH effects are strong for most of the CPI of food subgroups except Spices and Tobacco products. This suggests that the food price volatility in a period is impacted strongly by the volatility in previous periods. If the previous price volatility of a food subgroup is high then it can be concluded that the current price increase will be high for that food subgroups. Our findings support the Cukierman-Meltzer hypothesis which states that higher inflation volatility in the previous time increases inflation in the current time. We have found a stylized fact in food price movement is that volatility reacts asymmetrically to the good and bad news such as supply shortage, floods etc. which is evident from the significant threshold effects for most of the food subgroups. That is upward

movements are followed by higher volatility than downward movements. It implies that price increase lead to an increase in volatility. Price declines have the reverse effect though smaller in magnitudes. It is also evident that most of the food subgroups experienced large spikes in volatility during the COVID-19 period. There is an increase in volatility along with significant threshold effect during that period.

Volatility in Commodity Subgroups

The EGARCH model for the CPI food group indicates significant findings about volatility dynamics. The AR (1) term of 0.86 shows strong persistence in volatility, meaning past volatility predicts current volatility. The ARCH term of -0.39 is negative, suggesting that past shocks reduce current volatility, which is unusual as volatility typically increases with past shocks. The significant GARCH term of 0.776804 confirms strong persistence of volatility, showing that past volatility impacts future volatility. Lastly, the threshold term of -0.366031 is negative, indicating that downward market movements cause lower volatility compared to upward movements, which highlights unique characteristics of the food CPI. The volatility dynamics across commodity groups reveal varying patterns. For cereals, past shocks (ARCH) significantly impact future volatility, but persistence (GARCH) is weaker indicating high reactivity. Markets for cereals are highly reactive to sudden shocks or news, but these shocks do not have a long-lasting impact on future volatility. Edible oils & fats show strong volatility persistence with significant ARCH and GARCH terms, highlighting the presence of volatility clusters. When a shock occurs, its impact tends to cluster and persist over time, indicating a market where volatility does not quickly settle down. This suggests strong volatility clusters, common in markets with higher uncertainty. Pulses exhibit strong volatility persistence, with an asymmetric response where negative shocks reduce volatility more than positive shocks. If volatility is high for a prolonged period, the asymmetric response (negative shocks reducing volatility more than positive ones) implies that the market stabilizes faster after negative events. For Rice, past shocks (ARCH) matter, but persistence (GARCH) and asymmetry are insignificant. Shocks to volatility do occur, but they do not last long, and the market reacts symmetrically to both positive and negative shocks. This suggests a relatively stable market. Spices show significant immediate shocks (ARCH) but limited persistence (GARCH) and no asymmetry. The market reacts to shocks, but their impact fades quickly. This indicates a market where short-term volatility spikes occur but are not sustained over time. Milk & milk products display strong volatility persistence and asymmetry, where negative shocks reduce volatility more than positive shocks. This asymmetry reflects the market's tendency to respond differently to adverse and favorable conditions.

Table 1: Conditional Variance Results

Food Groups	ARCH term	GARCH term	Threshold term
Food	-0.391950 (0.0000)	0.776804 (0.0000)	-0.366031 (0.0000)
Food Subgroups			
Cereals	0.638365 (0.0000)	0.361635 (0.0006)	na.
Edible oils & fats	0.757758 (0.0000)	0.242242 (0.0000)	na.
Egg & meat	2.180793 (0.0000)	0.860961 (0.0000)	-0.426596 (0.1449)
Fish	2.902208 (0.0011)	0.838337 (0.0015)	-0.331462 (0.5907)
Fruits	0.494452 (0.0000)	0.505548 (0.0000)	na.
Pulses	-0.408127 (0.0000)	0.858572 (0.0000)	-0.404349 (0.0000)
Rice	0.710324 (0.0000)	0.267696 (0.0000)	-0.061722 (0.7648)
Spices	0.581739 (0.0001)	-0.011138 (0.9040)	na.
Other cereals	1.312757 (0.0000)	0.811384 (0.0000)	-0.259857 (0.0001)
Vegetables	1.568777 (0.0000)	0.516665 (0.0000)	-0.584962 (0.0000)
Milk & milk products	2.172941 (0.0000)	0.813009 (0.0000)	-0.761856 (0.0000)
Tobacco products	0.519040 (0.0386)	0.480960 (0.0553)	na.

*Values in the parentheses indicate p-value. na. Not Applicable.
Source: Author's calculation

Table 2: Variance Equation

Food Groups	ARCH term	GARCH term	Threshold term
Food	-0.391950 (0.0000)	0.776804 (0.0000)	-0.366031 (0.0000)
Food Subgroups			
Cereals	0.638365 (0.0000)	0.361635 (0.0006)	na.
Edible oils & fats	0.757758 (0.0000)	0.242242 (0.0000)	na.
Egg & meat	2.180793 (0.0000)	0.860961 (0.0000)	-0.426596 (0.1449)
Fish	2.902208 (0.0011)	0.838337 (0.0015)	-0.331462 (0.5907)
Fruits	0.494452 (0.0000)	0.505548 (0.0000)	na.
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Tobacco products	0.519040 (0.0386)	0.480960 (0.0553)	na.

*Values in the parentheses indicate p-value. na. Not Applicable.
Source: Author's calculation

5. Policy Implications and Conclusions

This study has provided an in-depth analysis of food inflation volatility in Bangladesh by utilizing advanced time-series models such as EGARCH, GARCH, IGARCH, and TGARCH across various food groups. The findings reveal significant volatility in key food categories. Overall food price volatility shows both significant persistence and asymmetry, where negative shocks reduce volatility more than positive shocks. Subgroups such as eggs & meat, fish, and milk & milk products exhibit strong volatility persistence alongside large

immediate shocks, including long-lasting market disruptions. In contrast, Cereals, Rice, and Spices are primarily influenced by immediate shocks with relatively limited persistence, suggesting more reactive but short-lived volatility. Asymmetric responses are observed in Pulses, Vegetables, and milk & milk products, where negative shocks stabilize volatility more effectively than positive ones. The results suggest critical policy implications, requiring commodity-specific policy interventions. For cereals like rice and wheat, prices react strongly to shocks but do not persist for long, indicating the need for strategic reserves, improved infrastructure, and early warning systems to stabilize prices. Edible oils & fats, characterized by strong volatility clustering, require diversified import sources, domestic oilseed cultivation, and tariff adjustments to smooth price fluctuations. Pulses, which exhibit persistent volatility with an asymmetric response, call for expanded local production, import hedging strategies, and government stockpiling to mitigate sharp price swings. Rice, though relatively stable, still benefits from seasonal buffer stocking, climate-resilient farming, and flexible trade policies to prevent shortages. Spices, highly reactive to shocks but without long-term volatility, require seasonal import planning, improved storage and transport facilities, and anti-hoarding regulations to curb price spikes. Milk & milk products, showing strong volatility persistence and asymmetry, need dairy farmer support, investment in cold storage, and price control mechanisms to ensure affordability. Broadly, a climate-resilient agriculture strategy, real-time price monitoring, flexible tariff policies, stronger public distribution systems, and strict market regulations are essential across all food commodities.

Overall, this research emphasizes the need for a multifaceted approach to managing food inflation volatility in Bangladesh, combining short-term stabilization measures with long-term agricultural policy reforms. Addressing the root causes of price instability will be crucial for ensuring food security, reducing inflationary pressures, and promoting economic stability in the country. Future research could also benefit from exploring the interactions between food inflation and other macroeconomic variables, such as employment and income distribution.

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Influence of Real Effective Exchange Rate on Nominal Export Earnings and Nominal Import Payments: Insights from Bangladesh

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Abstract

This study explores the influence of the Real Effective Exchange Rate (REER) on Bangladesh's trade flows, explicitly focusing on nominal export earnings and import payments. Using a decade of monthly data from July 2010 to March 2020, the research employs the Johansen cointegration and Vector Error Correction Model (VECM); the analysis reveals a significant long-term equilibrium relationship between REER and export earnings but not with import payments. REER appreciation enhances export competitiveness in the short and long run, while import payments remain unaffected due to import substitution policies. Diagnostic tests validate the model's reliability, confirming no serial correlation or heteroscedasticity. The findings emphasize stabilizing REER, adopting REER-led strategies, and promoting export-oriented policies to reduce the trade deficit. Policymakers should utilize REER adjustments to boost competitiveness and productivity. Future research could include variables like industrial production and GDP to understand Bangladesh's trade dynamics comprehensively.

Keywords: Real Effective Exchange Rate (REER), Trade Balance, Export Competitiveness, Import Substitution, Exchange Rate Policy

JEL Classification: F31, F14, E60

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1. Introduction

The Real Effective Exchange Rate (REER) is a crucial determinant of trade competitiveness, influencing export earnings, trade balance, and long-term economic growth. Unlike the Real Exchange Rate (RER), REER incorporates fluctuations in both nominal exchange rates (NER) and relative price levels across trading partners, making it a more comprehensive measure of external competitiveness (Santoya & Soutar, 2011). A higher REER indicates currency appreciation, potentially reducing export competitiveness, while a lower REER supports exports by making them more affordable to foreign buyers. Empirical studies on the REER-trade relationship yield mixed findings. Sattar & Shareef (2019) highlight that Bangladesh's exports remained sluggish between FY2012 and FY2017 due to a 45% REER appreciation, constraining competitiveness. Aziz (2012) finds that REER devaluation improves the trade balance, while Hassan et al. (2016) reveal a long-run negative impact of REER appreciation on real export earnings but no short-term effect. Conversely, Younus & Chowdhury (2014) report an insignificant relationship between REER and trade performance, emphasizing the complexity of this nexus.

Bangladesh's export sector is highly concentrated, with ready-made garments (RMG) accounting for 85.4% of total exports (World's Top Exports, 2021). Export prices are heavily influenced by exchange rate fluctuations, as evident from industry reports by the Bangladesh Garment Manufacturers and Exporters Association (BGMEA), which indicate that price competition with China, Vietnam, and India forces local exporters to accept lower rates to sustain business operations. Despite its dominance, Bangladesh's RMG sector adds less than 30%, relying heavily on imported raw materials (Hassan & Tufte, 2010).

While previous studies explore REER impacts on real exports, there is limited research on its effect on nominal export earnings and nominal import payments in Bangladesh. To bridge this gap, this study examines the influence of REER fluctuations on nominal trade flows using updated REER calculations (base year 2015-16), a broader currency basket (15 trading partners), and a sample period (2010:6–2020:3). The key objective is to assess how REER changes impact both nominal export earnings across sectors, particularly RMG, and nominal import payments.

2. Historical Evaluation of Bangladesh’s Exchange Rate Policy

Since gaining independence in 1971, Bangladesh has pursued export-oriented and import-substitution trade policies to strengthen its economic foundation. In the early years, the Bangladeshi Taka (BDT) was pegged to the British pound sterling, reflecting the country's efforts to stabilize its nascent economy. However, stringent foreign exchange controls were implemented to prevent capital flight and maintain external balance (Younus & Chowdhury, 2014). A secondary market emerged due to high foreign currency demand, causing significant BDT depreciation-37% in May 1975-and subsequent devaluation to

address balance of payment deficits.

In the late 1970s, market liberalization aimed to promote growth through export credit facilities, tariff reductions, and exchange rate convertibility (Aziz, 2012; BB Report, 1981). From 1972 to 2002, the BDT was undervalued about 130 times, with the USD replacing the pound sterling as the dominant trade currency. By 1985, the REER index guided exchange rate adjustments. On May 31, 2003, Bangladesh adopted a managed floating exchange rate system to enhance export competitiveness. The central bank reported notable REER appreciation, 17.29% from FY2012–FY2014 and 27.77% between FY2006–FY2014 (BB Annual Report, 2013–14).

Despite challenges, Bangladesh's exchange rate policies aim to sustain trade competitiveness, attract remittances, stabilize prices, and maintain external account viability (BB Financial Sector Review, 2006). Bangladesh Bank oversees these policies but requires coordination with the Ministry of Finance, reflecting limited central bank autonomy (Islam, 2003). Over time, these strategies have significantly shaped Bangladesh's trade balance and export and import trends.

3. Critical Review of Theoretical and Empirical Literature

The relationship between exchange rates and trade has been widely examined through two main theoretical perspectives: the elasticities approach (Robinson, 1947; Metzler, 1948) and the absorption approach (Alexander, 1952; Johnson, 1967). The elasticities approach suggests that currency depreciation enhances the trade balance if demand elasticities for exports and imports are sufficiently high. In contrast, the absorption approach argues that depreciation shifts expenditure toward domestic goods, improving the trade balance. Exchange rates are a crucial relative price in international trade, influencing export competitiveness and import affordability (Chinn, 2005; Dornbusch, 1976). However, the effects of exchange rate fluctuations differ across economies based on structural factors and policy frameworks (Hassan et al., 2016).

Empirical studies offer mixed evidence regarding the impact of exchange rates on trade. Some studies, such as Thapa (2002) and Andersson & Styf (2010), find that currency depreciation stimulates exports, while Abeysinghe & Yeok (1998) argue that high import content in exports can offset this effect. Similarly, Nabli & Marie-Ange (2002) and Alam (2010) report no significant impact of exchange rate overvaluation on export performance in Middle Eastern and North African countries and Bangladesh, respectively. Khan et al. (2019) note that Bangladesh's export basket, heavily reliant on import-dependent manufactured goods, is less responsive to exchange rate shifts.

The Real Exchange Rate (RER) is a key measure of trade competitiveness, as it reflects inflation-adjusted exchange rate movements. Research by Goldfajn & Valdes (1999) and Chinn (2000) highlights that RER misalignment can distort trade flows, with overvaluation

reducing export competitiveness and undervaluation boosting exports but raising import costs. Younus & Chowdhury (2014) find that RER significantly affects Bangladesh's exports, imports, and trade balance in the short and long run, while Alam (2010) reports no substantial link between RER and export earnings in Bangladesh.

The Real Effective Exchange Rate (REER), which adjusts the exchange rate for trade-weighted inflation differentials, provides a more comprehensive indicator of competitiveness. Studies by Fidan (2006) and Guechari (2012) suggest that REER influences trade more in the long run than in the short run. Hassan et al. (2016) find that REER appreciation negatively affects Bangladesh's exports over time, while Aziz (2012) shows that REER devaluation improves the trade balance. However, Younus & Chowdhury (2014) and Bahmani-Oskooee & Payesteh (1993) report no significant relationship between REER and the trade balance in Bangladesh.

The Marshall-Lerner condition states that currency depreciation improves the trade balance if the sum of export and import demand elasticities exceeds one. Andersson & Styf (2010) confirm this condition, showing that depreciation increases exports while reducing imports. However, Bhattarai & Armah (2005) and Perera (2009) find no substantial effect of exchange rate changes on the trade balance in Ghana and Sri Lanka, respectively. In Bangladesh, Ali & Kamal (2012) argue that currency appreciation makes exports more expensive and imports cheaper, worsening the trade balance.

Despite extensive research on REER, few studies have explored its effects on nominal export earnings and nominal import payments, particularly in Bangladesh. This study aims to fill this gap by analyzing the influence of REER fluctuations on these variables, using updated data (2010–2020) and a 15-country currency basket. The findings seek to provide policymakers with insights to enhance trade competitiveness and ensure macroeconomic stability.

4. Conceptual and Theoretical Framework

4.1 Dependent Variable: Export Earnings (XP)

Export earnings are crucial for economic growth in both developing and industrialized nations. While industrialized countries focus on high-value goods, developing economies leverage low-cost labor and export raw materials or primary products (Hasanov & Samadova, 2014). In developing economies, the demand for exports is influenced by external factors such as foreign income and relative export prices. This relationship can be expressed as:

$$XP_d = f(Y_f, P_x/P_m) \qquad (1)$$

The equation highlights that higher foreign income (Y_f) typically increases (XP_d) demand

for exports, while relative price changes (P_x/P_m) affect competitiveness in the global market.

4.2 Dependent Variable: Import Payments (IM)

Global trade patterns often favor imports due to lower production costs abroad, allowing consumers to access more affordable goods, especially when domestic production is less efficient. Import demand is shaped by factors such as relative prices and real income, and can be represented as:

$$IM_d = f(P_m/P_x, Y) \qquad (2)$$

This equation suggests that (P_m/P_x) higher relative import prices and increased (Y) income levels typically lead to higher (IM_d) import demand.

4.3 Independent Variable: REER

The REER is a crucial indicator of trade competitiveness, derived by adjusting the Nominal Effective Exchange Rate (NEER) for inflation differences among trading partners (Hossain & Ahmed, 2009). Unlike NEER, which tracks exchange rate fluctuations, REER reflects the real purchasing power of the domestic currency, making it a vital tool for central banks, including Bangladesh Bank, to assess currency competitiveness and monitor price-level changes across countries (Turner & Van'tdack, 1993). Formulas:

$$NEER=\prod_{i=1}^{n}(E_i)^{W_i} \qquad (3)$$

Where: $\prod$ is variables' product, E_i is Nominal exchange rate country i, w_i is weight of country i's trade in the overall trade balance and n *is* Number of trading partners

$$REER= (NEER)\frac{P_{base}}{P_{foreign}} \qquad (4)$$

Where, P_{base} is the price level of the domestic country and $P_{foreign}$ is Weighted average price level (CPI) of foreign countries.

4.3.1 Application in Bangladesh

Bangladesh Bank (BB) monitors the exchange rate using NEER and REER indices, computed daily and monthly against 15 major trading partners, including the Euro. A rise in the REER indicates home currency appreciation, which can hurt export competitiveness, while a decline signals currency devaluation, boosting export potential. BB also acknowledges that REER overvaluation negatively affects the trade balance by making exports more expensive and imports cheaper (Soutar & Santoya, 2011).

4.3.2 Bangladesh's Trade Context

In Bangladesh, NEER and REER trends reflect currency fluctuations. REER overvaluation

reduces competitiveness, whereas undervaluation may benefit exports. Other factors, such as labor productivity and national income, also impact competitiveness (Annual Report, 2019).

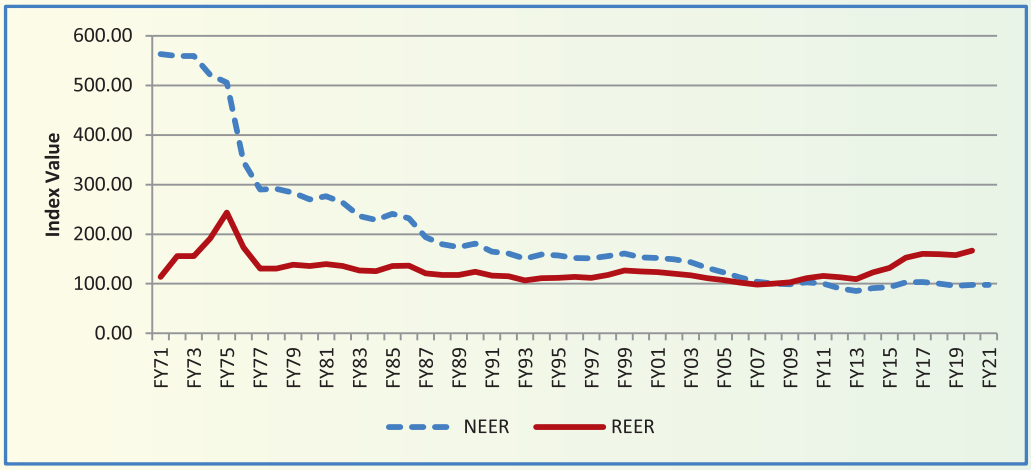
4.3.3 History of the REER Basket Group

The REER basket currently includes 15 currencies, with 10 currencies used since 2010. Prior to that, 8 currencies were included, and Hossain and Ahmed (2009) recommended simplifying the basket to four key currencies—Japanese Yen, US Dollar, Euro, and UK Pound Sterling—reflecting Bangladesh's dollar-dominated trade for easier monitoring by Bangladesh Bank (BB).

BB computes trade weights using data from Bangladesh's top 15 trading partners: Eurozone, China, India, UK, Japan, Singapore, Hong Kong, Canada, Australia, Korea, Malaysia, Turkey, Indonesia, Brazil, and the USA. According to BB's 2014 Policy Note, 10 major trading partners account for 80% of Bangladesh's global trade. Of these, 8 partners contribute about 60%, while Canada, Malaysia, and Korea account for roughly 12%.

This study uses BB's REER indices, calculated from NER and CPI data, based on the 15-currency basket. The trend of NEER and REER in Bangladesh from July 2010 to March 2020 is shown in the figure.

Figure 1: Yearly REER and NEER Data Trend (1972-2021) in Bangladesh



Source: Bruegel Database, 2021

When REER > 100, the Bangladeshi Taka (BDT) is "overvalued" and expected to depreciate. Conversely, when REER < 100, the BDT is "undervalued" and expected to appreciate.

4.3.4 Equations used by Bangladesh Bank

$$NEER = \frac{ERI_{BDT}}{\prod_{i=1}^{15}(ERI_{PC})^{wi}} \times 100 \quad (5)$$

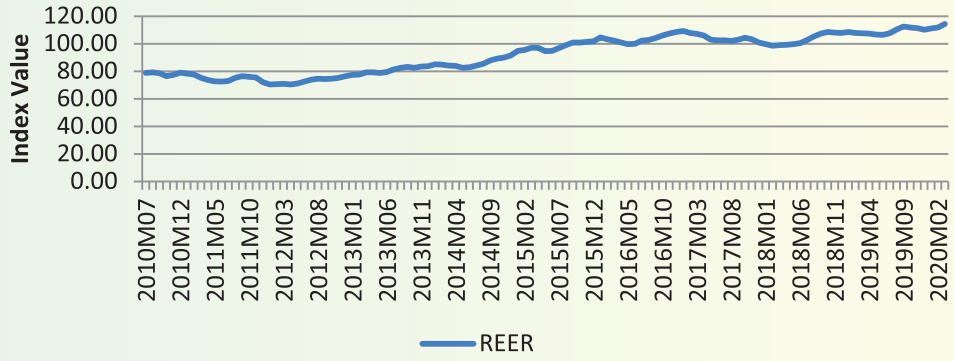
Where, $\sum_{i=1}^{15} w_1 = 1$ *and ERI=* $\frac{ER_c}{ER_b} \times 100$

Here, ER = bilateral NER (the value of BDT against USD), *c* = current, *b* = base period, while BD means Bangladesh (Annual Report, 2019).

$$REER = NEER \times \frac{CPI_{BD}}{\prod_{i=1}^{15}(CPI_{PC})^{wi}} \quad (6)$$

Where, *ERI is* bilateral nominal exchange rate index, *CPI* is consumer price index, *PC* is partner country, w_i is trade weight (partner country's share in Bangladesh's trade).

Figure 2: Monthly trend of REER from 2010:7-2020:3 of Bangladesh



Source: Monetary Policy Department, Bangladesh Bank, 2021

5. Methodology

This study employs an econometric approach to examine the short- and long-run relationship between the Real Effective Exchange Rate (REER) and nominal export earnings and nominal import payments in Bangladesh. The empirical analysis was conducted using EViews software, incorporating multiple statistical techniques to ensure robustness. Monthly data from July 2010 to March 2020 (base year: 2015-16) were sourced from the Monetary Policy Department of Bangladesh Bank and the Monthly Economic Trends reports. All variables were log-transformed and seasonally adjusted.

The analysis used the Unit Root Test for stationarity, the Johansen Cointegration Test for long-run relationships, and the Vector Error Correction Model (VECM) for short-run

dynamics. Diagnostic tests ensured model robustness. Since NEER and REER data are not publicly available, they were obtained from Bangladesh Bank under special permission. The study follows a CPI-based REER approach, using a 15-country currency basket, aligning with global methodologies (Chinn, 2005; Darvas, 2012). This methodological framework ensures a rigorous analysis of REER's impact on Bangladesh's nominal export earnings and import payments, contributing to the broader understanding of exchange rate policy implications.

5.1 Model Variables

The Johansen (1988) cointegration test is employed to examine the relationship between macroeconomic variables. The key variables are as follows:

ln_REER= log of REER
ln_NXP=log of Nominal Export Earnings
ln_NIM =log of Nominal Import Payments

5.2 Model Specification

The empirical model for exports and REER is specified as *NXP=f(REER)* and the empirical model for imports and REER is specified as *NIM=f(REER)*. Where, *NXP* = Nominal Exports Earning, NIM = Nominal Import Payments and *REER* = Real Effective Exchange Rate

Balassa (1978) and Tyler (1981) argued that exports of developing countries are largely supply-determined. Theory suggests that export demand is highly price elastic and driven by excess domestic supply. For small economies, exports are mainly influenced by demand and relative export prices. Thus, exports can be modeled as a decreasing function of the REER.

Transforming variables into logarithmic form to allow elasticity interpretation, the export regression model is expressed as:

$$ln\_NXP = \beta_o + \beta_1 ln\_REER + \in_t \qquad (7)$$

Where, β_o = Constant, β_1 = Coefficient of REER, and $\in_t$ = Residuals with zero mean and constant variance.

If β_1>1, exports are price-elastic; if β_1<1, exports are price-inelastic. A$\beta_1 = 0$ implies export insensitivity to REER. The log-log model is widely used in international trade analysis due to its statistical advantages, particularly in mitigating heteroskedasticity (Hossain, 2011). Transforming variables into logarithmic form enables the interpretation of coefficients as elasticities (Narayan, 2006). The regression model for REER and NIM is expressed as:

$$ln\_NIM = \beta_o + \beta_1 ln\_REER + \in_t \qquad (8)$$

Here, β_1 is the constant, β_1 is the REER coefficient, and $\in_t$ represents residuals with zero mean and constant variance.

Bangladesh's export sector depends significantly on imported machinery, making currency devaluation or overvaluation influential on domestic import prices and foreign export prices (ADB, 2007). An increase (decrease) in REER reflects an appreciation (depreciation) of the BDT, leading to cheaper imports and potentially higher demand for foreign goods. If $\beta_1 > 1$, imports are price-elastic, whereas if $\beta_1 < 1$, imports are price-inelastic (Hassan, 2016).

5.3 Empirical Results and Diagnostic Tests

5.3.1 Unit Root Test

This is essential for assessing the stationarity of time-series data, ensuring the validity of results and avoiding spurious findings (Alam, 2009). The tests of Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) are commonly used for checking stationarity. The ADF test, introduced by Dickey and Fuller (1979, 1981), is performed using the regression:

$$\Delta Y_t = \beta_1 Y_{t-1} + \alpha_i \Sigma \Delta Y_{t-i} + \varepsilon_t \qquad (9)$$

Where ε_t is a white noise error term and $\Delta Y_{t-1} = Y_{t-1} - Y_{t-2}$ represents the lagged difference. Hypothesis:

H_0: $\beta_1 = 0$ (unit root exists, non-stationary series)
H_1: $\beta_1 < 0$ (no unit root, stationary series)

Using the Schwarz Criterion (SC) and Akaike Info Criterion (AIC) with automatic lag selection in E-Views, the ADF test was performed.

Table 1: Augmented Dickey-Fuller Test

Variables	Level		First Difference		Order of Integration
	C	C & T	C	C & T	
ln_REER	-0.152 (0.940)	-2.522 (0.317)	-6.444 (0.000)*	-6.470 (0.000)*	I(1)
Ln_NIM	-1.766 (0.396)	-2.931 (0.158)	-13.378 (0.000)*	-13.367 (0.000)*	I(1)
ln_NXP	-2.054 (0.264)	-2.054 (0.042)	-14.619 (0.000)*	-14.650 (0.000)*	I(1)

Notes: *C= Intercept, T= trend. P values are in the parentheses. *Significant at 1% and 5% levels.*

The results show that all variables are non-stationary at the level but become stationary at first differences, classified as I(1). This justifies the use of cointegration analysis (Jongwanich, 2009) to explore long-run relationships. Given that all variables are integrated at order I(1), the Johansen (1988) cointegration method is employed to analyze their relationships.

5.4 Cointegration test

This is used to identify long-run relationships between groups of variables. In this study, cointegration is tested to determine whether a stable long-term relationship exists between the Real Effective Exchange Rate (REER) and nominal exports/imports, as the series are I(1) and non-stationary at levels.

5.4.1 Methods of Cointegration Testing

The cointegration test identifies long-run relationships between groups of variables. This study employs the Johansen (1988) and Johansen & Juselius (1990) tests, utilizing two key statistics: the Trace Statistic (λ_trace), which tests the null hypothesis that the number of cointegrating vectors is less than or equal to r, and the Maximum Eigenvalue Statistic (λ _max), which tests the null hypothesis that the number of cointegrating vectors is r against the alternative of $r + 1$. The null hypothesis (H_o) of no cointegration is rejected if the test statistics exceed the critical values at the 5% significance level. If the results differ, priority is given to λ_max (Asari et al., 2011). The test statistics are calculated as:

$$\lambda_{trace}(r) = -T \sum_{i-r+1}^{g} ln\,(1 - \hat{\lambda_i}) \qquad (10)$$

$$\lambda_{max}(r, r+1) = -T * ln(1 - \lambda_{r+1}) \qquad (11)$$

Where T represents the sample size, r denotes the number of cointegrating vectors and λ_i explains the eigenvalues. The results of both test statistics are summarized in Table 2:

Table 2: Cointegration Test Results of Johansen

Hypothesis	Trace Statistic	5% Critical Value	Conclusion	Max Eigenvalue Statistic	5% Critical Value	Conclusion
Model 1: ln_NXP & ln_REER						
r=0∗r = 0^*r=0∗	35.038	25.872	One cointegration relation	29.031	19.387	One cointegration relation
r≤1r \leq 1r≤1	6.007	12.518		6.007	12.518	
Model 2: ln_NIM & ln_REER						
r=0∗r = 0^*r=0∗	9.65	15.494	No cointegration relation	9.601	14.265	No cointegration relation
r≤1r \leq 1r≤1	0.049	3.841		0.049	3.841	

Notes: *r represents cointegrating relations and * denotes rejection of H_0 at 5%.*

In Model 1, both Trace and Max Eigenvalue tests indicate one cointegrating equation, confirming a long-term relationship between REER and export earnings in Bangladesh. The long-run equation is:

$$NXP = 1.04*REER+3.16\ (0.111) \qquad (12)$$

This indicates a 1% appreciation (depreciation) in REER results in a 1.04% decrease (increase) in nominal export earnings, consistent with economic theory.

In Model 2, both tests fail to reject H_0, indicating no evidence of a long-tern relationship between REER and import payments in Bangladesh. These findings confirm the significance of REER in influencing export earnings while showing no similar relationship with import payments. This highlights the asymmetrical effects of REER on different macroeconomic variables in Bangladesh.

5.5 Vector Error Correction Model (VECM)

The VECM is applied when cointegration exists among variables, offering insights into the speed of adjustment toward long-term equilibrium and avoiding spurious regression (Engle & Granger, 1987). It captures short-term dynamics while maintaining long-term equilibrium relationships (Hasan et al., 2015).

Since ln(*NXP*) and ln(*REER*) are cointegrated, the VECM is employed using the following form:

$$\Delta ln\_NXP = \beta_0 + \sum_{j=1}^{m} \beta_{1j} \Delta \ln\_REER_{t-j} + \alpha ECT_{t-1} + \varepsilon_t \qquad (13)$$

Where Δ denotes the first-difference operator, ε_t is the error term, and ECT_{t-1} represents the lagged error correction term.

Table 3: Vector Error Correction Estimates

Regressors	***D(ln_NEX)***	***D(ln_REER)***
Constant	-0.368 (0.114)	-0.027 (0.014)
D(*ln_NXP*(-1))	-0.75 (0.12)	-0.010 (0.014)
D(*ln_REER*(-1))	-0.219 (0.78)	0.48 (0.09)
ECT	-0.37* (0.113)	0.03 (0.014)
Adjusted R^2	0.604	0.206

Note: * significant at 5%, and standard errors in parentheses

The ECT for *D*(ln(*NXP*)) is -0.37, significant and negative, indicating 37% of disequilibrium is corrected monthly. This confirms a long-run relationship between REER and NXP.

In the short run, the WALD test shows causality, as the null hypothesis (C(5)= C(6)= C(7)=0) is rejected (p-value > 0.95). This implies REER appreciation (depreciation) increases (decreases) nominal export earnings in both the short and long run.

The model is well-fitted with an adjusted $R^2$of 62%, and the prob (F-statistics) is below 5%, confirming the model's validity.

The findings reinforce the importance of REER as a policy variable in managing Bangladesh's export competitiveness.

5.6 Diagnostic Tests of the Models

Diagnostic tests for the Error-Correction Model (ECM) assessed serial correlation, heteroskedasticity, and normality. The 1st model passed all tests: no serial correlation (p-value > 5%), no heteroskedasticity (p-value > 5%), and normally distributed residuals (p-value = 0.38). The 2nd model also showed no serial correlation and normal residuals but exhibited heteroskedasticity (p-value < 5%), requiring adjustments like variable transformation or robust standard errors. While the 1st model is statistically sound, the 2nd model needs corrections for reliable inferences.

6. Conclusions

This study examines the impact of the Real Effective Exchange Rate (REER) on Bangladesh's nominal export earnings and import payments, a crucial aspect of trade

competitiveness and economic sustainability. Using monthly data from July 2010 to March 2020 and employing Johansen cointegration, and VECM, the study finds:

1. *Long-run Relationship:* A significant long-run equilibrium exists between REER and nominal export earnings. The error correction term indicates a gradual but stable adjustment mechanism, confirming that REER fluctuations influence export earnings over time.
2. *No Direct Impact on Imports:* The study finds no significant relationship between REER and nominal import payments, suggesting that Bangladesh's import structure is influenced more by government policies (e.g., tariff measures, import substitution strategies) rather than exchange rate movements.

These findings have critical policy implications for Bangladesh's trade and exchange rate management:

1. *Maintaining a Competitive REER:* A moderate and stable appreciation of REER may benefit exporters by ensuring cost-competitiveness in global markets. However, excessive appreciation could erode export competitiveness, requiring careful monitoring and periodic adjustments in exchange rate policy. Simplify the REER basket by focusing on key currencies like USD, GBP, EUR, and JPY to ensure stability and competitiveness.
2. *Export-Oriented Industrialization:* Since export earnings respond to REER movements in the long run, policies should focus on modernizing industrial production, reducing input costs, and incentivizing high-value exports to sustain competitiveness.
3. *Managing Import Costs & Productivity:* While REER has no direct impact on imports, strategic tariff reductions on essential industrial inputs (e.g., machinery, raw materials) can enhance productivity, ensuring that import policies support long-term trade balance stability.
4. *Strategic Trade Expansion:* Diversifying export markets through trade agreements, trade facilitation measures, and foreign direct investment (FDI) incentives can reduce dependence on a few trading partners and mitigate external shocks.
5. *Workforce Development:* Address workforce challenges by ensuring fair wages, developing local expertise, and reducing dependency on foreign labor. Prevent talent and asset drain by creating local opportunities and incentivizing remittance contributions.

The results underscore the importance of a balanced exchange rate policy that supports export growth without causing excessive import cost pressures. Future policies should emphasize maintaining REER stability, fostering export diversification, and ensuring

sustainable trade practices to enhance Bangladesh's long-term trade performance. Strategic adjustments in tariff barriers, exchange rate policies, and workforce development are essential to address trade deficits and promote exports, ensuring Bangladesh remains competitive in the global market.

By addressing the gap in existing literature, this study provides valuable insights into the relationship between REER and nominal export earnings and import payments, offering a foundation for future research and policy development.

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The Value Relevance of Fundamental Accounting Data under the Adoption of Green Banking Disclosures: Evidence from Listed Bangladeshi Banks

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Abstract

The objective of the study is to recognize how stockholders adjust environmental information with fundamental accounting measures. This study investigates whether the disclosures regarding green banking activities is relevant to stock price of the firm by employing linear price model. The study applies regression analysis on a sample of 30 listed banks on Dhaka Stock Exchange. The analysis revealed that green banking disclosure has no direct impact on stock prices, but indirectly affects stock price through interaction with fundamental financial information, i.e. book value and earning per share. The estimates show that publications of green banking disclosures decrease the relevance of book value and increase the relevance of earning per share in determining firms share value.

Keywords: Environmental reporting, Green banking, Stock price, Value relevance, sustainability

JEL Classification: Q01, Q56, R53

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1. Introduction

The vulnerable state of world's environment and its impact on mankind has created new call for environmental disclosures. Corporate environmental disclosures are getting more attention due to increased government regulations and stakeholders scrutiny. Environmental disclosures can be described as an inclusive terms that communicate information about firms action that have direct and indirect impact on environment, hence positive and destructive consequence on environmental resource to the interested group. Bangladesh is an emerging economy with high growth potentials is facing various ecological challenges, like air pollution, water pollution, land erosion, loss of bio-diversity, unplanned urbanization, poor waste management, coastal erosion, natural disaster, deforestation which are now in alarming stage (Belal et al., 2015). In this vulnerable situation, environment friendly performance of business may be the most effective solution for preserving environment and natural resources. In addition to environment friendly banking activities (termed as green banking), banks poster environmental sustainability by modifying internal activities and business models. Such alteration and modification in operation lead to cost saving, energy saving, reduction in environmental pollution, improved efficiency, customer satisfaction, positive stakeholder perception and growth in revenue (Bose et al. 2021). As an social citizen banks also consider desire of different pressure groups and attempt to legitimize their impact on environment. In practical, the green banking activities are mostly voluntary and unregulated; hence disclosures of such performance are largely self- laudatory (Bose et al. 2021) as well as unstructured in format. The incentives of the banks to perform environmental activities and communicate these issues also have puzzling impression on firm financial performance suggested by Wu and Shen (2013). The study investigate whether green banking disclosures has any relevance to firm financial performance, with considering the moderating impact on accounting values. The philosophy of green banking lies on banks monetary or non-monetary contributions toward protecting and improving the environment (Belal et al. 2015). Thus green banking disclosures has become important for present and potential investors to evaluate risk and return associated with their investment (Masud et al. 2017).

Bangladesh (BD), already declared a middle income country, is emerging with high growth potential for further economic development (World Bank [WB], 2018). As a developing economy BD has exhilarated to develop its financial sectors to promote economic growth; last few decades banking industry achieved spectacular expansion. According to Masud et al. (2017) ''the banking sector has had a positive contribution to and influence on economic development of Bangladesh'' (p. 2). In 300 billion USD economies, banking sector comprises more than 80 percent of all financing activities. In 2018 total asset employed in banking sector is BDT 18,406 billion and bank deposit consist 41.05% of gross domestic product (GDP) in 2021 (World Bank [WB]).

Therefore, commercial banks are the key source of finance of steel, paper, cement, chemicals, fertilizers, power, textiles industries; which has substantial and harmful consequences on people, society and planet (Wendt, 2015), thus banks are related both directly and indirectly to environmental issues (Masud et al., 2017). Banks policies and performance are interrelated with greater stakeholder interest, since banking activities have deep implication in the protection and development of environment. Cohen et al. (2011) documented that in 2010 the US holds about $3.1 trillion asset identified as socially responsible investment (SRI) portfolios. This enhanced progress of SRI has pointed out to the sensitivity of market participants towards additional financial achievements related to environmental and social (Brammer et al., 2006). Thus, shareholders along with other stakeholders demand accurate information when making their resource allocation and business decision with banks. Recent financial crisis and different financial scandals by large firms have intensified the need to revise the implications of financial reporting in capital market along with non-financial information (Lipiec, 2016). These scandals have made the investors concerned about the process of adjusting the information into the valuations of their investment.

More information would provide more assurance about future financial prospect and lower the risk of the company, thus market participants can effectively measure the value of firms (Healy and Palepu, 2001). Bowerman and Sharman (2016) claimed that market value of stock efficiently estimated if investors correctly adjust environmental information with fundamental accounting information. Therefore, the practice of environmental reporting is especially relevant for stock market. The main target of value relevance studies is to check whether firm's fundamental accounting variables has any connection with market price movement (Utami, 2015). So the objective of the study is to gain knowledge on environmental disclosures by providing empirical support on whether the value relevance of financial statements (BVS, EPS) information of the commercial banks listed on the DSE has enhanced after the implementation of green banking guidelines of central bank.

The study is significant for emerging economy like Bangladesh and regulatory settings developed and monitored by central bank, Bangladesh Bank (BB). The study is particularly important for the country as Bangladesh has developed its own green banking regulation since February, 2011(BRPD Circular No.2). Besides this introduction of international and domestic guidelines, policies, provisions and their implications regarding environmental performance and disclosures have created new prospects for study. Another implication of the study is that the findings provide strong motive for investors to assess environmental disclosures. As the country is the worst victim of climate change, the findings influence policy makers to incorporate environmental issues more effectively when developing policies as well as motivate banks to follow environmental regulations strictly. Finally, the study contributes to new knowledge on the relevance of green disclosures in the stock market performance in the similar settings. Moreover, highlighting a single sector is useful

to control forces that are correlated with industry specific factors as well as facilitate better settings to make assumptions on value relevance.

The next section describes development of hypothesis on the basis of theoretical background and literature review. In section three, research design including model specification, sample selection and data collection are explained. Section Four contains primary statistical analysis and section five provides additional analysis for the purpose of checking robustness. And section six provides interpretation of statistical results and draws conclusions.

2. Literature Review

2.1. Theoretical Framework

The study include institutional theory, stakeholder theory and signaling theory for better understanding of emergence of environmental disclosures to the bank and stakeholders and its impact on relevance of accounting figures to the market valuation. Institutional theory is widely used to explain environmental disclosure, since is it is expected that firms respond to the national and international institutions and authority strategically to fulfill institutional guidelines and provide modern information to the stakeholders, when following social norms, rules, procedures and regulations. According to Bose et al. (2017) *"banks in Bangladesh incorporating green guideline by owing to institutional pressure of Bangladesh bank and disclosing green report to be more legitimate in society"* (p. 6). Stakeholder theory assumes that green disclosures explain the impact of organization action to the environment to the diverse group of people including investors, customers, debt holders, workers, media, government, environmental agencies, NGOs and others. Supporters of this theory claimed that banks provide environment related information due to stakeholders' pressure and aimed at enhancing reputation, raising more fund, advertising environmental innovation and green product, educating clients on efficient use of natural resources and environment friendly internal activities (Chen et al., 2015). Therefore, to manage the pressure of the multiple stakeholders banking companies provide more green disclosures, which are eventually, provide benefit to the banks itself. On the other side, signaling theory considers the situation of asymmetric information when explaining the emergence of environmental reporting. Considering signaling theory, financial and non-financial disclosures may results less information asymmetry among the stakeholders. Thus organizations activities associated with assets, opportunities, management and stakeholders can indicate superior firm performance. Therefore a company whose aim is to give a signal that they are good corporate, will disclose more than before because competitors may also have the same pressure to make disclosure. Therefore, banks that are highly concerned to environmental issues provide more voluntary disclosure (Clerkson et al., 2008), these send to positive signal to the current and potential investors and make firms more appealing to investors in share market.

2.2. Bangladesh Bank's Guidelines and Green Banking Disclosures

In 2011 Bangladesh Bank had taken initiative to implement sustainable financing in a comprehensive approach by circulating green banking guidelines (BRPD Circular No.04) for commercial banks in Bangladesh. According to Sustainable Finance Department (SFD) of Bangladesh Bank "The initiatives support to build a healthy, safe and developed society and environment to strengthen our economy," (Uddin, 2021). Commercial banks had to implemented the guidelines in 3 (three) phases (1st phase is within 31st December 2011, 2ndphase is within 31stDecember 2012, 3rd phase is within 31st December 2013) as per the direction of Bangladesh Bank from time to time. Bose et al. (2018) found that issuance of green banking guidelines by central bank positively influence green banking disclosure in Bangladesh and become a routine process for commercial banks. Haldar and Patwary (July 3, 2021, the Financial Express) asserted that, in recent year the situation is gradually improving, between 2018 and 2019, the number of Bangladeshi companies producing sustainability reports increased by 36 per cent, which is very encouraging. The green disclosure also increases in line with sustainability reporting. Masud et al. (2018) found level of environmental disclosures were satisfactory in listed banks regarding green policy, green product and corporate social responsibility expenditures. The study also revealed that banks ignore some important issues like information on environmental appreciation, waste management, climate change and global warming (Masul et al., 2018). Banking companies implement green banking philosophy through in house operation and external banking activities. Previous studies revealed that the banking sector mainly provides information regarding green finance, renewable energy, tree plantation, green product and marketing. Most of the banks highlight on the disclosures that are directly connected with revenue growth (online banking, ATMs, mobile banking)/launching new green product/green marketing) and positive image in the market (achievement of award, beautification, environmental awareness). Information regarding cost efficient activities such waste management, air, gas and water management and reduction of greenhouse emission has very little importance in sustainability reports. Besides, most of the disclosures are quantitative in natures, which may be only for compliance purpose. Despite of such major problems, sustainability practice and disclosures of commercial banks are satisfactorily increasing due to institutional pressure and monitoring of the central bank.

2.3. Value Relevance of Green Banking Disclosure and Development of Hypothesis

Based on the stakeholder and legitimacy theory, the firm responds to the public pressure by adopting environmental disclosures (Schadewitz and Nishkala, 2010). Prior studies also revealed that green banking and disclosures is favorable for the banks in long-term as adoption green regulation leads to cost efficiency, revenue growth and built strong positive market base (Porter, 1991; Bose et al. 2021). Transparency of the banks contribution to protect the environment will provide recognition and support from its stakeholders, so that banks run smoothly (Caesaria & Basuki, 2017). Previous studies highlighted the

perception that financial statements numbers need to justify the authentic financial position of business, exhibited in the market value of the firm; that is value relevance of accounting data (Francis and Schipper, 1999; Al-Akra and Ali, 2012)

Therefore, relevant information is that which influences the financial decision of users by helping them to assess backward and forward looking events. The possible impact of green banking disclosure on the relevance of accounting variables is also focused by a large number of academicians. Whether only financial statement can give full and fair view of the organization without considering the impacts of their operations on their external environment or not, till now unsolved (Eccles and Saltzman, 2011). Healy and palepu (1993) claimed non-financial information increase reliability of financial statements and contribute to the understanding the role of accounting figures in firm valuation. Clerkson et al. (2004) suggested that ecological activities are a forward looking method to enhance the information in the earning and book-value of share (BVS). Study of Klark and Villiers (2012) found that collective influence of sustainability disclosures and financial information explained market value better than individual focus on accounting variables in South African stock market. Konar and Cohen (2000); Clerkson et al. (2004); Hassel et al. (2005); Middleton (2015) revealed mixed findings in value relevance studies regarding environmental disclosures and recognize the limitations of studies due to different proxies, country and industry specific settings. Studies of Moneva and Cuellar (2009) documented environmental performance has significant positive coefficient on firm market value, whereas negative impact of environmental performance in Swedish market is found in the study of Hassel et al. (2005). Cormier and Magnan (2007) covered Canadian, French and German market for their value relevance study and only positive association found in Germany. Besides this, Carnevale et al. (2012) found no evidence of value relevance in banking sector in cross country study on Europe. In the context of Bangladesh Bose et al. (2021) found green banking has positive impact on firm valuation, proxy by Tobin's Q, but political connection negatively affect the relationship. The study highlighted the market performance and green banking relations directly, the study ignore the implication of green disclosures on accounting values like book value of equity and earning. In efficient market hypothesis rational investors adjust all information in their decision and valuation process. In under developed capital market most of the investors focus on accounting based performance of companies such as earnings, profit. Bangladesh investors are unconscious and have limited knowledge about firm's non-financial performance; they mainly focus on accounting values. In this point of view it is important to exert understanding on how investors adjust environmental disclosures with the accounting values such as BV and EPS, when determining or predicting market value of equity. Therefore, the purpose of the study is to investigate whether the green banking disclosures are useful to investors with accounting information. So, the study assumes the following hypothesis:

Hypothesis1 (H_1): Bangladesh bank's green banking disclosures have had effects on the value of summary accounting information of commercial banks.

3. Research Design: Model, Variables and Sample

The study investigates value relevance of fundamental accounting information after adoption of green banking. For this purpose, the study regress market value of equity with accounting information over three years before and after adoption of green banking. BB circulated green banking guideline in 2011. Hence, the analysis considers firms accounting information (EPS & BVS) of the year 2008 to 2013. The study coverall scheduled commercial banks of Bangladesh that listed in DSE since 2008. The study develops a linear price –level model which demonstrates the relation of firm market value of equity (stock price) with its book value of equity (BVS) and earning per share (EPS). The model is used by earlier studies of Baboukardos and Rimmel, (2016), Hassel et al. (2005) and Berthelot et al. (2012). Thus the primary linear price model is-

$SP_{(i+t)} = \alpha + \beta_1 BVS_{it} + \beta_2 EPS_{it} + \beta_3 YEAR\_D + €...(i)$

The study control firm level variables that have impact on equity value. Therefore,

$SP_{(i+t)} = \alpha + \beta_1 BVS_{it} + \beta_2 EPS_{it} + \beta_3 FSIZE_{it} + \beta_4 LEV_{it} + \beta_5 ROE_{it} + \beta_6 YEAR\_D + €...(ii).$

To measure the green banking disclosure impact on the relevance on the accounting information the study include dummy variable to capture the change due to the adoption of disclosure.

$SP_{(i+t)} = \alpha + \beta_1 BVS_{it} + \beta_2 EPS_{it} + \beta_3 GB\_D_{it} + \beta_4 (BVS_{it} \times GB\_D_{it}) + \beta_5 (EPSit \times GB\_D_{it}) + \beta_6 FSIZE_{it} + \beta_7 LE$

$Vit + \beta_8 ROE_{it} + \beta_9 YEAR\_D + €...(iii).$

Definition of Variables

Barth et al (2001), *"an accounting amount is defined as value relevant if it has predicted association with equity market values" (p. 79).* If coefficient of BVS and EPS in regression analysis are found to be significantly different than zero, then summary information are considered relevant.

In order to perform comparison, the study introduces a period binary variable GB_D, (for example, the value of GB_D equals 1 if GB disclosure exists; otherwise 0) to capture the mean of change in the relation between stock price and BVS and EPS after GB guidelines has been published. The most important thing is that the model (iii) accommodates the binary variable GB_D to interact with book value (BVS) and earning (EPS) to capture whether there is a logical difference in valuation of BVS and EPS between two different periods. In this case, significant positive coefficient indicates enhanced value relevance of accounting variables and significant negative coefficient indicates vice-versa.

Table-1

Acronym	Definition	Source	Empirical Support
SP	share price at the end of the year	Annual report (AR) and DSE library	Bachoo et al (2013), Baboukardos & Rimmel (2016);
BVS	book value of share at the beginning of the year	Annual report	
EPS	Income of per share	As above	Habib & Azim (2008); Baboukardos & Rimmel (2016); Middleton (2015)
FSIZE	Natural logarithm of total asset	Authors calculations based on AR	Bose et al (2017), Baboukardos & Rimmel (2016);
LEV	Ratio of total debt over total asset	Authors calculations based on AR	Jizi et al (2016); Uyar & Kilic (2012)
ROE	Return on Equity measure as the ratio of net income over total value of equity	As above	Kasbun et al. (2016); Baboukardos & Rimmel (2016) Uyar & Kilic (2012)
Year_D	Year dummy	Control year effect	

The study covers all the scheduled commercial banks of Bangladesh that listed in DSE since 2008. Table 2 present sample selection information, which tabulates balanced sample of 30 banks and all data are available for six years (30× 6=180 bank year observation). There is no case of missing data in the analysis.

Table-2

Number of banks listed in DSE	30
Year under the examination (2008-2013)*	6
Full bank year observation	**180**
observation with missing data	0
Final sample	**180**

*BB green banking disclosures had started functioning since 2011. The study has tried to compare the value relevance of summary accounting information between the disclosures from 2008 to 2010 and the disclosures from 2011 to 2013, considering the base year 2011.

4. Statistical Analysis

4.1. Descriptive Statistics

Descriptive statistics of the variables accommodated in the models are presented in Table 3. The mean (median) of stock price 76.212 (43.910) with a high standard deviation 102.611, indicates high fluctuation of equity price in market. Mean of book value (BVS) and earning of per share (EPS) 25.383 and 13.480, respectively. In case of control variables average of firm size, debt ratio and return on equity are 11.440, 0.920 and 0.246, respectively. The dummy variable GB_D has mean of 0 0.500.

Table-3

Variables	Mean	Std. Dev.	Median	Min	Max	P25	P75
PR	76.212	102.611	43.910	7.990	673.630	30.150	73.750
BVS	25.383	11.692	22.000	13.292	59.050	17.711	28.952
EPS	13.480	18.040	3.731	0.390	50.882	2.100	15.550
GB_D	0.500	0.510	1.000	0.000	1.000	0.000	1.000
FSIZE	11.440	0.650	11.460	10.070	12.990	11.063	11.870
LEV	0.920	0.040	0.911	0.860	1.030	0.890	0.930
ROE	0.246	0.743	0.170	-0.236	8.120	0.120	0.220

Table 4 provides Pearson correlation matrix for the key variables used in the study. The highest correlation coefficient between GB_D and Firm size is 0.570*** and Firm size and leverage -0.597***, therefore the analysis is free from multicollinearity (Gujrati, 1995). Besides that, the highest variation inflation factor (VIF) is found below 3(untabulated),

Table-4

Variable	PR	BVS	EPS	GB_D	FSIZE	LEV	ROE
PR	1.000						
BVS	0.536***	1.000					
EPS	0.412***	0.354***	1.000				
GB_D	-0.196***	-0.151**	0.564***	1.000			
FSIZE	-0.028	0.151**	-0.283***	0.570***	1.000	-0196***	-0.283***
LEV	0.093	-0.032	0.181**	-0.195***	-0.597***	1.000	
ROE	0.069	0.211***	-0.006	0.044	0.090	-0.059	1.000

4.2. Multi-variate Analysis

Table 5 tabulate OLS estimate of model (i), (ii) and (iii) accordingly with estimated coefficient and standard error for the balanced six year sample. The table shows that primary accounting information variables BVS has positive and highly significant coefficient with stock price for three models, 3.034, 3.042 and 8.229, respectively. This indicates that inclusion green banking disclosures increase relevance of BVS significantly in firm valuation in DSE during the year 2008-2013. EPS has positive relation with stock price and high significant coefficient in model (i) and (ii) (3.034 and 1.232, respectively), but insignificant in model (iii) in DSE during the year 2008-2013.

The main variable of interest, the coefficient of interaction variable BVS×GB_D is found negative (-5.532) at the 5% level of significance. In case of Earning, it is found that the EPS has positive and significant impact on stock price after the adoption of green banking disclosures, as the coefficient of interaction variables EPS×GB_D is positive (6.189) and strongly significant (at the 1% level). The value F-statistics is significant (20.176, 15.362 and 9.160, respectively. The explanatory power (R^2) of the variables 43.1%; 43.3% and 45.4%, respectively, indicates that inclusion of green banking disclosures variable increase explanatory power of the model (iii).

Table-5

$SP_{(i+t)=} \alpha + \beta_1 BVS_{it} + \beta_2 EPS_{it} + \beta_3 YEAR\_D + €\ldots(i)$

$SP_{(i+t)=} \alpha + \beta_1 BVS_{it} + \beta_2 EPS_{it} + \beta_3 FSIZE_{it} + \beta_4 LEV_{it} + \beta_5 ROE_{it} + \beta_6 YEAR\_D + €\ldots(ii).$

$SP_{(i+t)=} \alpha + \beta_1 BVS_{it} + \beta_2 EPS_{it} + \beta_3 GB\_D_{it} + \beta_4 (BVS_{it} \times GB\_D_{it}) + \beta_5 (EPS_{it} \times GB\_D_{it}) + \beta_6 FSIZE_{it} + \beta_7 LEV_{it} + \beta_8 ROE_{it} + \beta_9 YEAR\_D + €\ldots$ (iii).

	Column1		Column 2		Column3	
	model (i)		model (ii)		model (iii)	
Panel A: Coefficient Estimates	**Coef.**	**St.Err**	**Coef.**	**St.Err**	**Coef.**	**St.Err**
Constant	16.544	16.733	-119.087	171.716	-506.147	345.704
BVS	3.034***	0.318	3.042***	0.337	8.229***	1.911
EPS	1.271***	0.356	1.232***	0.363	0.158	0.528
FSIZE			1.637	8.274	18.223	16.637
LEV			127.89	127.556	347.25	239.414
ROE			-0.889	4.566	-5.431	8.258
GB_D					-136.4	85.922
BVS× GB_D					-5.532**	2.426
EPS×GB_D					6.189***	1.650
Panel B: Model Fit						
Year_D	Included		Included		Included	
R-squared	0.431		0.433		0.454	
F-test	20.176		15.362		9.160	
Observations	180		180		180	

All variables are defined in Table 1.*GB_D* is the dichotomous variable (0/1) for capturing adoption of green banking guidelines. *BVS×GB_D* and *EPS×GB_D* are the interacting variables to capture indirect effect of disclosure. White's (1980) heteroscedasticity-consistent standard error for all regression. Two – tailed p values are reported in the tables. ***, **, and * indicate level of significance at 1%, 5% and 10% respectively

5. Additional Analysis:

The study conducts a series of additional analysis to ensure robustness of findings.

5.1 Period Considerations:

The study compare the association of accounting information with market price before green banking disclosures against relevance of accounting information each of the first three years (2011, 2012 & 2013) after the adoption separately. Table-6 tabulated that the coefficient estimates of all variables in all three regressions are consistent with primary analysis. The coefficient of BVS is positive and strong at 1% level significance in all three specifications. The interaction variable BVS×GB_D showed significant negative association with stock price in all analysis consistently indicates that a decrease in value relevance of book value. EPS×GB_D provides positive association with market price and the association is significant in all the regressions indicates that significant increase in the relevance of earning.

Table -6

$SP_{(i+t)}=\alpha+\beta_1 BVS_{it}+\beta_2 EPS_{it}+\beta_3 GB\_D_{it}+\beta_4(BVS_{it}\times GB\_D_{it})+\beta_5(EPS_{it}\times GB\_D_{it})+\beta_6 FSIZE_i t+\beta_7 LEV_{it}+\beta_8 ROE_{it}+\beta_9 YEAR\_D+€$

	Pre and 2011 (1)		Pre and 2012 (2)		Pre and 2013 (3)	
Panel A: Coefficient estimates	**Coef.**	**St.Err**	**Coef.**	**St.Err**	**Coef.**	**St.Err**
Constant	-498.325	344.108	-369.307	332.901	-425.963	333.548
BVS	8.459***	1.878	8.528***	1.901	8.247***	1.897
EPS	.160***	.526	.193	.528	.18	.526
GB_D	-96.443**	30.622	-83.423***	29.641	-80.451***	29.185
BVS×GB_D	-5.841***	2.382	-5.853***	2.418	-5.511***	2.404
EPS×GB_D	6.065***	1.633	6.116***	1.651	6.273***	1.644
FSIZE	17.618	16.547	11.984	16.109	14.447	16.133
LEV	344.886	238.33	268.743	233.065	303.282	233.283
ROE	-4.901	8.187	-3.981	8.203	-5.061	8.228
Panel B: Model Fit						
Year_D	Included		Included		Included	
R-squared	0.452		0.447		0.451	
F-test	10.611		10.382		10.543	
Observation	120		120		120	

All the accounting variables are defined in Table 1. GB_D is the dichotomous variable (0/1) for capturing adoption of green banking guidelines. BVS×GB_D and EPS×GB_D is the interacting variables to capture indirect effect of disclosure. White's (1980) heteroscedasticity-consistent standard error for all regression. Two –tailed p values are reported in the tables. ***, **, and * indicate level of significance at 1%, 5% and 10% respectively.

5.2 Alternative Samples and Green Banking Disclosure Index:

In second additional test, the study covers post guidelines period for the purpose of investigating whether accounting summary information interact with green banking disclosure after 2011. The analysis cover a balanced sample from 2011-2019 including (9×30), 270 bank year observation. For the purpose of sensitivity the study include a variable which measure environmental performance, based on the green banking performance score calculated through developing index. Green banking disclosure index (GB_DI) is calculated based on the checklists including green baking guidelines of BB.

For disclosing an item the bank score 1, otherwise zero. The sum of scores divided by maximum score achieved by the banks is the environmental performance score of the bank. Table-7 presents the variable GB_DI, has no direct impact on stock price as the coefficient is insignificant, which consistent with primary findings in table-5. But the variable has an indirect impact by affecting the book value of shares (BVS×GB_DI) and earning (EPS×GB_DI). The coefficients of these interacting variables are similar to primary results (-0.143 and 3.703, respectively) and highly significant. The finding specifies the interaction between green banking disclosures and accounting information.

Table-7

$SP_{(i+t)}=\alpha+\beta_1 BVS_{it}+\beta_2 EPS_{it}+\beta_3 GB\_DI_{it}+\beta_4(GB\_DI_{it}\times BVS_{it})+\beta_5(GB\_DI_{it}\times EPS_{it})+\beta_6 FSIZE_{it}+\beta_7 LEV_{it}+\beta_8 ROE_{it}+\beta_9 YEAR\_D+€$

Panel A: Coefficient estimates	Coef.	St.Err.
Constant	144.286***	33.337
BVS	1.353***	0.243
EPS	0.114*	0.067
FSIZE	-4.32***	1.634
LEV	-85.404***	24.869
ROE	0.497	0.699
GB_DI	-12.568	10.966
BVS×GB_DI	-0.143**	0.454
EPS×GB_DI	3.703***	0.561
Panel B: Model Fit		
R2		0.847
F-test		77.031
Obsevation		270

All the accounting variables are defined in Table-1.GB_DI is the bank environmental disclosure score, the ratio of total unweighted score (0/1) firm achieved to maximum score. GB_DI×BVS and GB_DI×EPS is the interacting variables to capture indirect effect of disclosure. White's (1980) heteroscedasticity-consistent standard error for all regression .two – tailed p values is reported in the tables. ***, **, and * indicate level of significance at 1%, 5% and 10% respectively.

6. Discussion and Conclusions

The study is influenced by dearth research of value relevance of green banking disclosure in the context of Bangladesh. From the point of rational investors, especially when cost of reporting is bared by shareholders, it is important to find out whether firms green disclosures have relevance for valuation. The analysis found no direct impact on valuation, but a sharp decline in the value relevance of book value and significant increase of value

relevance of earning; this finding is robust across different period, sample and different models.

In regard to relevance of book value the findings can be explained that before disclosures investor consider environmental impact/ liabilities in their valuation of equity. After disclosure investors include environmental liabilities/ impact more reliably, a decline in BVS makes intuitive sense. (Baboukardos and Rimmel, 2016). Another point is that disclosure disclose not only current risk, but also provide how the banks manage risk and challenges in future (Earnest and Yong, 2013). Green banking disclosure enables investor to identify current and future risk more specifically, the decline of book value may be attributed to this risk disclosures (Baboukardos and Rimmel, 2016). The value relevance of earning can be explained that by relating accounting information with financial and non-financial information about its green banking disclosures, the value relevance of its earning is significantly increased, consistent with the argument of Cormier and Magnan,2007; Lourenco et al., 2014.

The study focused on the firm valuation after implementation of green banking guidelines for listed banks in DSE. The analysis suggests that value relevance of earning is highly positively significant after implementation of guidelines as well as banks with higher green banking performance shows higher positive relevance of EPS in valuation. On the other hand, relevance of BVS is strong and negative after implementation of BB green banking guidelines. So the primary findings are-first, environmental disclosure/ performance has indirect association with market valuation; stock price. Second, accounting summary information and non-accounting information has significant interaction. So, it is demonstrated that stock price is significantly influenced by the enactment of green banking guidelines as environmental disclosure has impact on accounting information.

The study also has some limitations. The study considers only single industry. The measurement of performance and development of index involve personal judgement of researcher. The performance is measured on the basis of regulatory setting in Bangladesh ,which may be vary among countries, so the findings may not be generalized for other economy.

Appendix: Items of Green Banking Disclosure Index in line with BB Green Banking Guidelines

1. Separate green banking reports in annual report
2. Corporate environmental policies
3. Bank's networking with agencies regarding environmental issues
4. Banks policies and technologies for ensuring efficient internal operation regarding natural resources like water, gas and electricity

5. Efficient use of energy through adoption of energy saving bulbs, solar energy
6. Financing in eco-friendly projects
7. Initiative to reduce wastage of paper and carbon emission through encouraging digitalization in internal communication by email, using double sided printing and recycling paper
8. Programs harmonious with environment such as undertaking beautification program, tree plantation
9. Initiative to reduce greenhouse gas emissions (online banking, ATMs, mobile banking)/ launching new green product/ green marketing
10. Information regarding climate change and establishment of climate change fund
11. Disclosure regarding actual amount of green financing and cost of various green activities
12. Disclosures of bank achievements in environment friendly activities or its contributions to environmental improvements and for excellence in environmental reporting practices
13. Internal training regarding green banking such as education program for employees.

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Thoughts on Banking and Finance

The BBTA Journal: Thoughts on Banking and Finance is a half-yearly, peer-reviewed publication of the Bangladesh Bank Training Academy (BBTA). We invite original empirical, methodological, policy, and theoretical papers, as well as contemporary and historical case studies, conference reports, and book reviews. Our focus is on topical issues in economics, banking, and finance. We also welcome diverse perspectives from scholars in other disciplines, including law, management studies, public policy, ethics, information science, environmental, and societal challenges, particularly concerning sustainable development and the future of Bangladesh and other developing countries.

Submission of Manuscripts

We welcome significant, original, and unpublished research works. Papers that are currently under review have been previously published or accepted for publication elsewhere will not be considered. All submissions undergo a blind peer-review process. Selection criteria are based on the accuracy and originality of ideas, clarity and significance of results, quality of presentation, and relevance to the journal's theme.

Instructions for Authors

Authors are requested to adhere to the following guidelines for manuscript submission:

Submission Criteria:

1. Articles should be double-spaced, typed on one side of A4 paper with generous margins, and generally not exceed 6000 words (including footnotes, tables, and graphs).
2. Each article must include an abstract of approximately 150 words.
3. Submit a hard copy in duplicate along with a soft copy in MS Word format.
4. A separate title page should be provided with the paper's title, authors' full names, affiliations, mailing address, telephone number, and email address of the corresponding author. Author details should not appear in the main text of the paper.
5. Submitted articles must not have been accepted for publication elsewhere.

6. Tables, graphs, and maps are permitted, provided their titles and sources are clearly mentioned.

7. Authors are expected to revise, shorten, or rephrase content as requested by the Editorial Board if an article is provisionally accepted.

8. Footnotes should be numbered consecutively and placed at the end of the article.

9. Articles not accepted for publication will not be returned.

Page Setup:

- Paper size: A4
- Margins: Top & bottom: 2 inches; Left & right: 1.5 inches
- Header & Footer: 1.6 inches
- Font: Times New Roman
- Font Sizes: Article Title: 16 (bold); Paragraph Caption: 12 (bold); General Text: 11; Abstract, Footnotes, and References: 10

Keywords and Classification Codes:

1. Include three (3) to five (5) keywords representing the article's main content after the abstract.

2. Provide three (3) standard JEL classification codes after the abstract.

Citation and References:

Each source cited in the paper must appear in your reference list; likewise, each entry in the reference list must be cited in your text.

1. ***Text citation:*** Cite sources in the text, typically in parentheses, using the author's last name, publication date, and page number if necessary.

2. ***Reference list:*** A complete list of references, following APA referencing format, should appear at the end of the paper. The year of publication should immediately follow the author's name in the reference list.

Book Review:

Reviews of new books on economics, central banking, commercial banking, finance, and recent economic developments are published upon request. Authors or publishers may send two copies of each book to the editor for review.

Honorarium:

A token honorarium of BDT 10,000.00 will be paid for each published article.

Contact:

Manuscripts, book reviews, and case studies should be submitted to:

Executive Editor

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About Bangladesh Bank Training Academy (BBTA)

Introduction

Bangladesh Bank Training Academy (BBTA) is a training wing of central bank of Bangladesh, Bangladesh Bank pursues tasks of capacity building and human capital development in order to prepare skilled human resources in central bank as well as for commercial banks. BBTA organizes different training courses, training workshops, conferences, seminars and other related activities on main topics of economics, banking and finance, financial sector development, human resources development and macroeconomic management. It was established in 1977.

BBTA's Mandate

The purpose of the Academy is to undertake training activities for enabling the officials of central bank and the banking sector to perform their jobs efficiently well-equipped with the latest knowledge of economic, financial and banking developments. To this end, BBTA extends its all-out efforts to facilitate training to personnel engaged in the financial sector. It also works to modernize its library and information center to collect, systematize and disseminate information in the financial arena. Recently, a plan has been adapted to reorganize BBTA library as a Knowledge Management Centre (KMC). This new role puts more weight on BBTA for knowledge creation and application. Since information is important to create new knowledge for educating staff and professionals, we hope that it would contribute to the creation of knowledge and disseminate knowledge for use by others.

BBTA's Strategic Objectives

Bangladesh Bank has adopted its 5-year Strategic Plan 2020-2024 and bestowed responsibilities upon BBTA (Strategic Goal # 7) to adopt all-out efforts to enhance professional excellence and grooming of the officers of Bangladesh Bank. To fulfill the target of the plan document, BBTA has been. employing its full capacity to provide need-based training to the officials both from central bank and commercial banks; continuously striving to diversify the contents of its courses in order to ensure their consistency with evolving training needs; facilitating the practical application aspects of knowledge of economics, banking and finance; and developing training as a scientific discipline.

In order to achieve the above mentioned strategic objectives, BBTA has introduced the following initiatives.

1. Building and enhancing training capacities of the trainers;

2. Improving quality, efficiency, impact and cost-effectiveness of training programs;
3. Linking training with real-world cases and experiences;
4. Building training partnership programs with the public and private sector domestic and overseas training institutions;
5. Building and maintaining the BBTA financial institutions information system,
6. Utilization of the Internet for dissemination of the Academy's biannual Journal
7. 'Thoughts on Banking and Finance';
8. Building a database on trainers and training institutions in the field of banking and finance; as well as
9. Facilitating the digitization of BBTA documents.

Organization

The Executive Director is the head of the academy. There are eleven wings to look after the administration, training and research programs of the academy.

Location

The academy is located at Mirpur-2, Dhaka-1216, Bangladesh.

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