




## NEXUS AMONG FOREIGN EXCHANGE RESERVE, REMITTANCE AND TRADE OPENNESS: AN EMPIRICAL INVESTIGATION IN THE CASE OF BANGLADESHI ECONOMY

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### ABSTRACT

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This study has explored the nexus among foreign exchange reserve, remittance, exchange rate, and trade balance in Bangladesh for the period of 1986 to 2019. By employing the Autoregressive Distributed Lag (ARDL) bound test approach, a long-run equilibrium relationship among the variables has been found. The study has shown a statistically significant positive impact of remittance inflow and trade balance on foreign exchange reserves in the long run. If remittance inflow increases by 1 percent, then the foreign exchange reserve would increase by 0.43 percent, and if trade openness rises by 1 percent, then the foreign exchange reserve would rise by 1.22 percent. Granger causality test has revealed the presence of unidirectional causality from the remittance inflow to foreign exchange reserve and remittance inflow to exchange rate. Bidirectional causality has observed between trade openness and exchange rate; however, no causal relationship exists between reserve and trade openness. Based on the findings, this study has endorsed several policy directions that Bangladesh can take to excel in the 21st century and cope with post-pandemic challenges.

**Contribution/Originality:** This study is one of the very few studies which have investigated the foreign reserve dynamics in the context of Bangladesh and the first one to explore the nexus among foreign reserve, remittance, and trade openness by employing the ARDL approach.

### 1. INTRODUCTION

Foreign exchange reserve (FER) plays a pivotal role in reducing external debt risks and mitigating the adverse shocks of an unanticipated waning of capital inflow or capital flight (Yongzhong & Freeman, 2013). Usually, countries hold foreign exchange reserves to maintain exchange rate stability and safeguard other economic activities (Kashif, Sridharan, & Thiyagarajan, 2017). A sizeable foreign exchange reserve bolsters a country's competency to carry out various projects and aid to promote economic development. It also assists in designing and evaluating the current and future macro policies to achieve trade balance (Arize & Malindretos, 2012). Empirical studies have also suggested that the increase in foreign exchange reserves can also promote investment and

economic growth (Fukuda & Kon, 2012; Kashif, Singh, Thiyagarajan, & Maheshwari, 2020; Krušković & Maričić, 2015).

Bangladesh has experienced phenomenal progress in achieving the continuous acceleration of growth over the last four decades, and the remarkable expansion of growth is primarily propelled by RMG (readymade garments) exports and remittances (Bourguignon & Raihan, 2020). Remittance sent home by migrant workers is one of the main pillars of Bangladesh's economy, contributing 6.1 percent of GDP in 2019 (World Development Indicator, 2020a). According to the World Bank (2020) statistics, steady remittance inflows have driven Bangladesh to become the world's 8<sup>th</sup> largest remittance-recipient economy (Figure 1). The inflow of foreign remittances enables the central bank's accretion of foreign reserves and lower the country's external debt burden and current account deficit (Gherbovet, 2014).

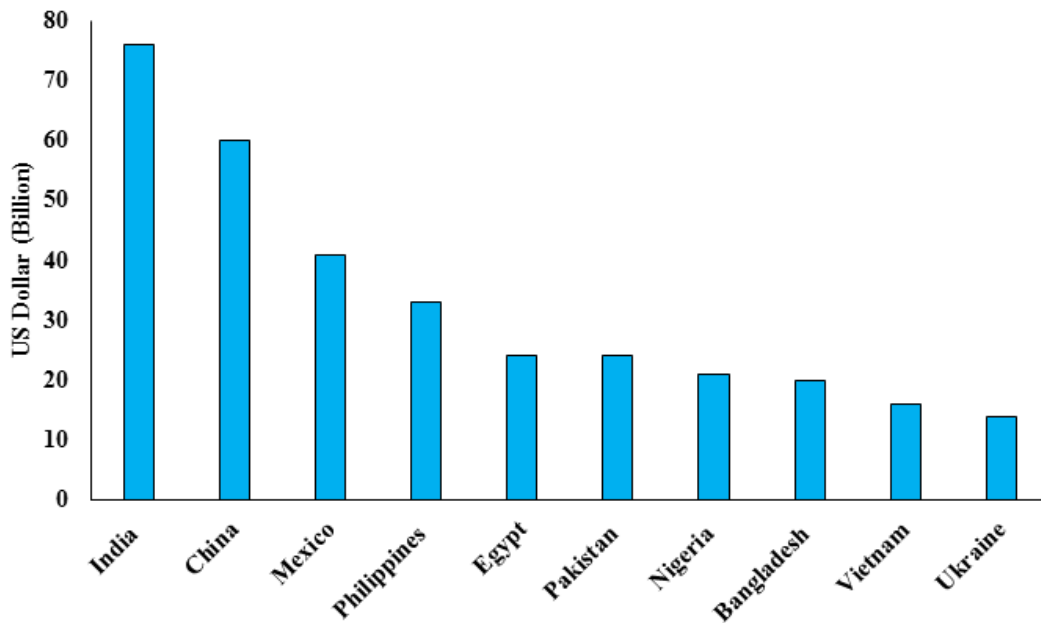


Figure-1. Top Remittance Recipients in the World in 2020.

Source: World Bank (2020).

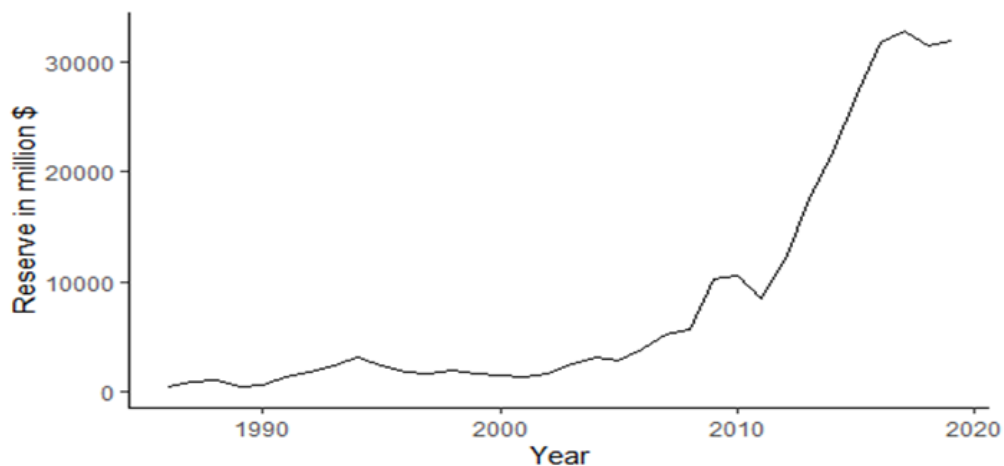


Figure-2. Trend in Foreign Exchange Reserve in Bangladesh.

Source: World Development Indicator (2020b).

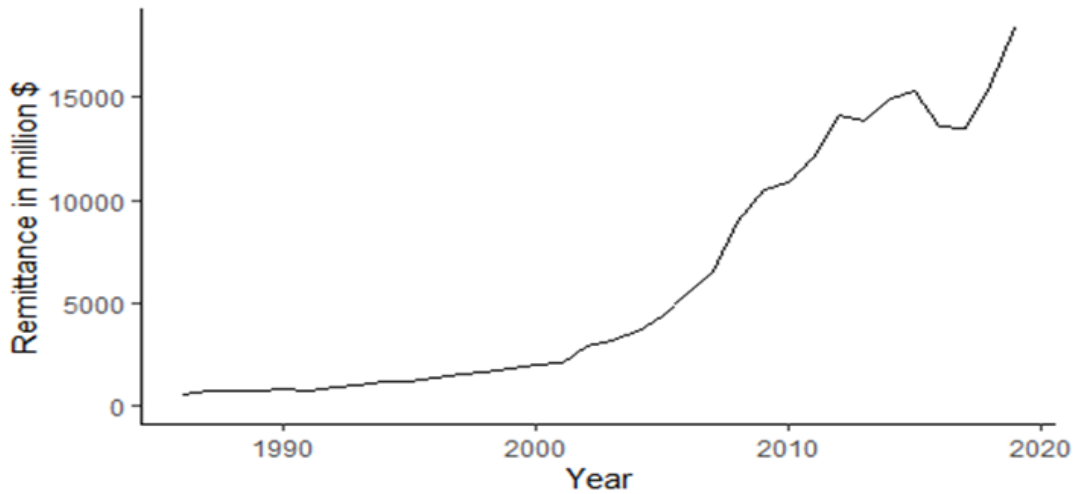


Figure-3. Trend in Remittance Inflow in Bangladesh.

Source: World Development Indicator (2020c).

Despite being a net importing country with a large trade deficit, Bangladesh has been piling up huge reserves in the past few years. In Bangladesh, the foreign exchange reserve has been accumulated since 2010 (Figure 2). Current account and financial account balance improvement due to the rise in export and remittance inflows (Figure-3), low imports and low-cost foreign financing facilities have substantially contributed to accumulate foreign exchange reserve in Bangladesh (Sultana, 2017). Even in this current pandemic situation, remittance inflow and foreign exchange reserve in Bangladesh have maintained an upward trend [Figures 4 and 5]. In the first half of the fiscal year 2021, Bangladesh has observed around 37 percent growth in remittance inflow the previous year (Bangladesh Bank, 2020b). The government's two percent cash incentive on inward remittances, central bank's initiatives of easing the money transfer process, and gradual depreciation of the local currency against the dollar have facilitated boosting the remittance inflow Bangladesh (Bangladesh Bank, 2020a). The upward trend in remittance inflows, positive export, and negative import growth has helped reach a record foreign exchange reserve of USD 43.17 billion at the end of December 2020 (Bangladesh Bank, 2020b, 2020c).

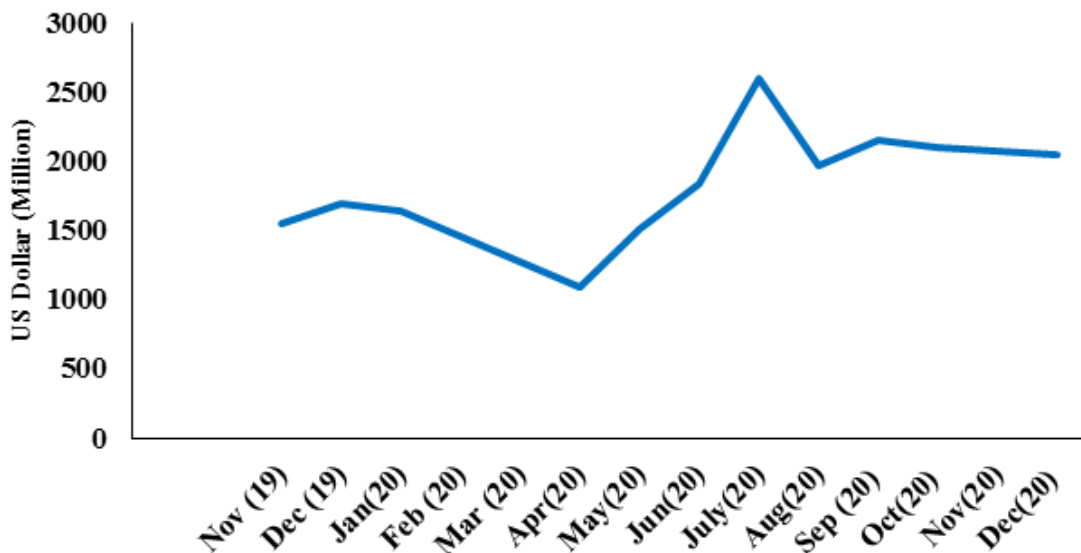


Figure-4. Remittance Inflow in Bangladesh amid the Pandemic Situation.

Source: Statistics Department (2020a).

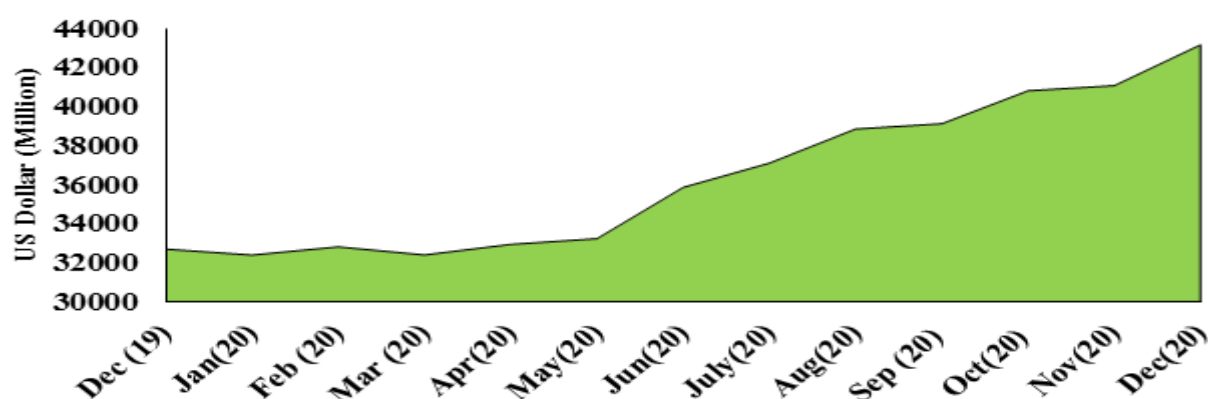


Figure-5. Foreign Reserve in Bangladesh amid the Pandemic Situation.

Source: Statistics Department (2020b).

Several studies have been conducted to explore the determinants of foreign exchange reserve (Aizenman & Marion, 2003; Gantt, 2010; Kashif et al., 2017; Narayan & Smyth, 2006). From these studies, the determinants of foreign exchange reserve can be broadly categorized into five topics: economic size, current account vulnerability, capital account vulnerability, exchange rate flexibility and the opportunity cost of holding reserve (Aizenman & Marion, 2003; Batten, 1982; Frenkel, 1974; Obstfeld, Shambaugh, & Taylor, 2009). Recently, many studies have explored the relationship of foreign exchange reserve with some macroeconomic determinants such as trade balance, money supply, exchange rate, foreign direct investment, inflation, remittance (Cheung & Ito, 2009; Delatte & Fouquau, 2011; Gantt, 2010; Kashif et al., 2017; Narayan & Smyth, 2006; Osigwe & Uzonwanne, 2015; Ume & Ndubuaku, 2019).

To our knowledge, except (Chowdhury, Uddin, & Islam, 2014), no previous study has been conducted to explore the long-run relationship between the foreign exchange reserve and other macroeconomic determinants. Following Pesaran, Shin, and Smith (2001), we employ the Autoregressive distributed lag (ARDL) bound test approach to explore the dynamics among foreign exchange reserve, remittance inflow, trade balance, and exchange rate in the context of Bangladesh. ARDL method has advantages over other conventional cointegration methods as it can simultaneously estimate short-term and long-term relationships irrespective of the integrated order of the variables (Pesaran et al., 2001).

The rest of the paper is organized as follows. Brief literature reviews are presented in Section 2. Section 3 discusses the methodology, model, and result of the analysis. Finally, conclusions and policy implications are presented in Section 4.

## 2. LITERATURE REVIEW

In his seminal work, Frenkel (1974) has studied the determinants of foreign exchange reserve in the developed and less developed countries. The study has found a positive relationship of reserve holdings with the variability of international receipts and payments, the volume of imports, and the foreign trade sector's relative size. By considering the sample of seven countries (Denmark, France, West Germany, Japan, Netherlands, Norway, and Sweden), Batten (1982) has performed the empirical study to determine the demand for foreign exchange reserves. He has identified four determinants of foreign exchange reserve holding: international payments and receipts variability, global transaction size, opportunity cost, and marginal propensity to import. Aizenman and Marion (2003) have compared the demand for foreign exchange reserves in the Far East countries with the developing economies. This paper has revealed the reserve accumulation due to multiple factors as volatility of international transactions, political issues, corruption, and exchange rate mechanism.

Arize, Malindretos, and Grivoyannis (2004) have used the Johansen cointegration technique to explore the long-run relationship among imports, income, relative prices of import, and foreign exchange reserves in Pakistan. A long-run stable relationship has been found in this study. Narayan and Smyth (2006) have employed the ARDL

bound test approach to testing the linkage between real exchange rate, foreign exchange reserves, and the real interest rate discrepancy between China and the United States. They have revealed the long-run cointegrating relationship among the variables and the real effective exchange rate has a statistically significant positive impact on foreign exchange reserve. Moreover, the short-run non-monotonic relationship has been found among the variables. [Cheung and Ito \(2009\)](#) have used the data for more than 100 countries to examine foreign exchange reserves' factors empirically. The study has categorized the factors into four groups: macro variables, financial variables, institutional variables, and dummy variables to capture individual features of the economies. They have shown that foreign exchange reserve and their factors significantly vary between developed and developing countries and not stable over time. [Gantt \(2010\)](#) has applied the panel data econometric method to explore foreign exchange reserves as a combination of trade variables (export and import), monetary aggregates (M2), and features of the exchange rate policy.

[Delatte and Fouquau \(2011\)](#) have utilized the Panel Smooth Transition Regression (PSTR) model to check the dynamics of the emerging economies' international reserves holdings. They have revealed the presence of a nonlinear nature in the foreign exchange reserve demand. They have also shown a significant positive impact of money supply (M2) and export to reserve holding. [Yasir, Shehzad, Ahmed, Sehrish, and Saleem \(2012\)](#) have empirically tested the linkage among foreign exchange reserves, foreign direct investment, and nominal exchange rate by using the Johansen cointegration technique and found the long-run relationship among the variables. They have revealed that the nominal exchange rate significantly impacts foreign exchange reserves from the vector error correction mechanism. In contrast, foreign direct investment (FDI) has an insignificant effect on foreign exchange reserves.

Many studies have also investigated the linkage between foreign exchange reserve and other macroeconomic determining factors. In Nigeria, [Osigwe and Uzonwanne \(2015\)](#) have examined the cointegrating relationship among foreign exchange reserve, exchange rate, and FDI utilizing the Johansen cointegration technique and revealed the long-run relationship among the variables. Unidirectional causality from exchange rate to foreign reserve has also found from the Granger Causality test. [Ume and Ndubuaku \(2019\)](#) have also found a long-run relationship between the foreign reserve and the real exchange rate in Nigeria by using the ARDL bound test approach. [Kashif et al. \(2017\)](#) have used the Johansen cointegration procedure to study the relationship among foreign exchange reserve, trade openness, and economic growth and revealed the long-run equilibrium relationship among the variables. The error correction mechanism has shown the negative relationship between trade openness and foreign exchange reserve, while the economic growth variable has exhibited a positive relationship with reserve. Using the panel data of 19 Asia Cooperation Dialogue member countries, [Ali, Khan, and Khan \(2018\)](#) have investigated the dynamics of total reserves, financial development index, improved sanitation, renewable energy, trade openness, and tourism. From the Kao cointegration test, the variables have shown the presence of a long-run relationship among them. In the context of Bangladesh, by using the yearly time series data from 1972-2011, [Chowdhury et al. \(2014\)](#) have explored the long-run relationship between foreign exchange reserve and some selected determinants of the reserve (exchange rate, remittance, home interest rate, broad money, unit price index of export and import, and per capita GDP) by employing the Engle and Granger cointegration technique and have found the existence of long-run relationship among the variables. No previous study has been conducted in Bangladesh's perspective to explore foreign reserve dynamics using the bound test approach. Our current study will surely fill this gap.

### 3. DATA AND METHODOLOGY

#### 3.1. Description of the Data

The data of reserve, remittance, and trade openness are collected from world development indicators by the World Bank. The exchange rate is taken from the Bangladesh bank. All these series have the period of 1986 to

2019. 1986 is chosen for the starting year because of the adaptation of extended structural adjustment policy by the government of Bangladesh facilitated by the IMF and World Bank (Rahman, 1992). Here, remittance indicates the personal remittance that is received in a year in the current US dollar. Reserve shows the foreign exchange reserve in the current US dollar minus gold. Trade openness is calculated as the percent of trade to GDP. The exchange rate shows the local currency unit (taka) per US dollar. We have taken the logarithmic form of all the variables, and these are shown in Figure 6. From this figure, we can see that variables have an intercept but do not follow any discernable trend.

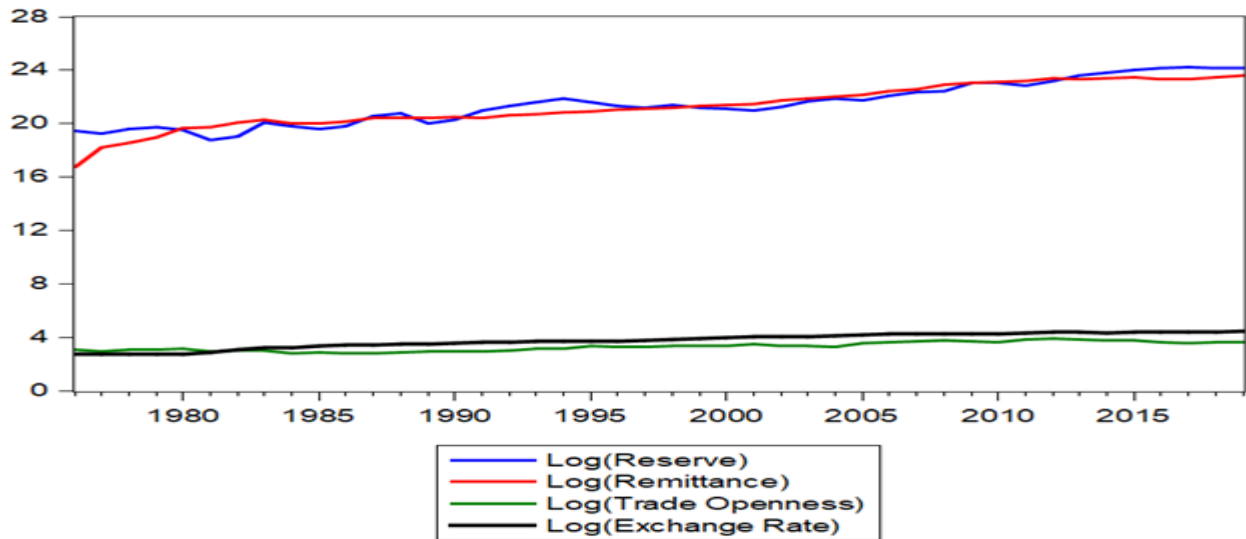


Figure-6. Logarithmic form of reserve, remittance, trade openness and exchange rate.

Source: World Development Indicator (2020b); World Development Indicator (2020c); World Development Indicators (2020d); World Development Indicator (2020e).

### 3.2 Model

First, we adopt the cointegration test to check if there is any long-run relation among these variables. Our proposed model follows from Pesaran, Shin, and Smith (1999) and Pesaran et al. (2001).

$$Res_t = \beta_0 + \sum_{i=1}^p \beta_i Res_{t-i} + \sum_{j=0}^{q_1} \alpha_j Rem_{t-j} + \sum_{j=0}^{q_2} \gamma_j Tra_{t-j} + \sum_{j=0}^{q_3} \lambda_j Exc_{t-j} + \epsilon_t \quad (1)$$

Where in Equation 1  $Res_{t-i}$  represents reserve,  $Rem_{t-j}$  is the remittance,  $Tra_{t-j}$  stands for the trade openness,  $Exc_{t-j}$  is for the exchange rate and lastly  $\epsilon_t$  stands for the white noise error. If there exists a long-term relationship among these variables, then this model must be cointegrated. We estimate the model mentioned above using the ARDL bounds test by Pesaran et al. (1999). However, to employ the bound test, all the variables must be I (0) or I (1). Therefore, we have checked the stationarity of all the variables and can confirm from the appendix, Table 1, that no variable is I (2). From this table, we can observe that reserve and trade openness are stationary at first difference whether remittance is stationary at level and exchange rate is inconclusive at the level, however stationary at first difference. This combination of I (0) and I (1) necessitates the use of ARDL bounds testing.

We can employ case-3 of Conditional Error Correction Model (CECM) <sup>1</sup> proposed by Pesaran et al. (2001), which includes an unrestricted constant, but no trend seen in Figure 6.

<sup>1</sup>Pesaran et al. (2001) proposed 5 models for CECM; which are categorized according to restricted, and unrestricted constant, and trend.

$$\Delta Res_t = \beta_0 + \sum_{i=1}^p \beta_i \Delta Res_{t-i} + \sum_{j=0}^{q_1} \alpha_j \Delta Rem_{t-j} + \sum_{j=0}^{q_2} \gamma_j \Delta Tra_{t-j} + \sum_{j=0}^{q_3} \lambda_j \Delta Exc_{t-j} + \theta_0 Res_{t-1} + \theta_1 Rem_{t-1} + \theta_2 Tra_{t-1} + \theta_3 Exc_{t-1} + \epsilon_t \tag{2}$$

Here, in Equation 2\_ we will perform an F-test presented by Pesaran et al. (2001) with the null hypothesis of  $\theta_0 = \theta_1 = \theta_2 = \theta_3 = 0$  which would imply there is no long term relationship. However, if we can reject this null hypothesis, we can be sure of a long-run relationship. The critical values for the test have two bounds: lower bound and upper bound. If the test statistic is more than the upper bound, then we reject the null hypothesis.

As there is no previous economic theory on the number of lags for remittance and reserve, we have considered a maximum of 5 lags for each of the regressor variables and ran 1080 regression models to find out the optimal combination according to Schwarz information criterion (SIC).<sup>2</sup> The optimal combination that minimizes SIC is ARDL (4,4,1,5) (Figure 7).

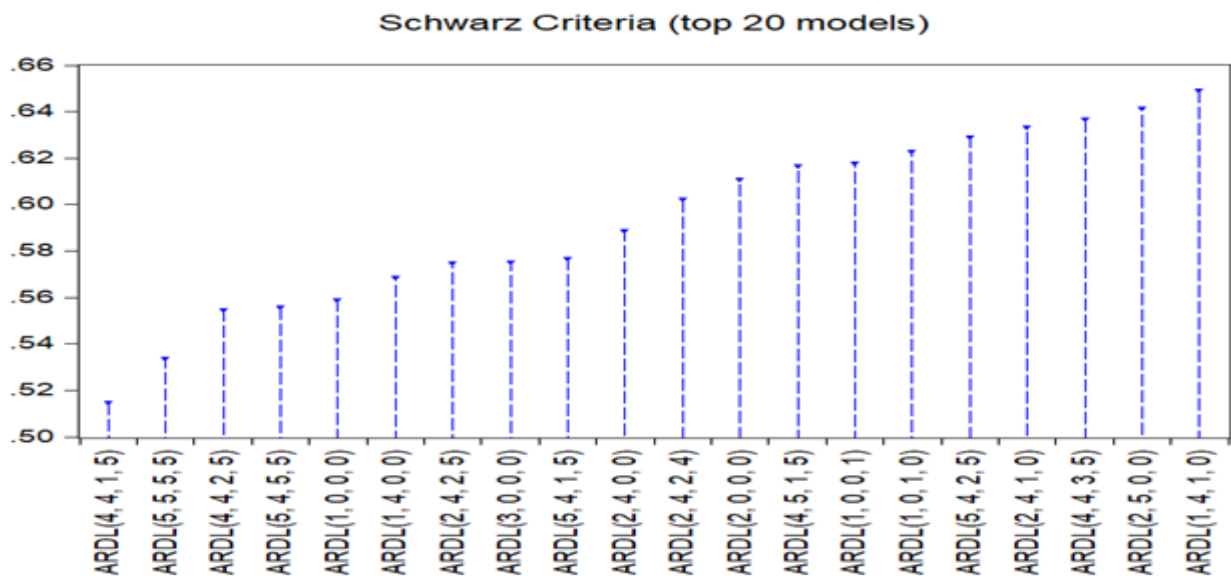


Figure-7. Model Selection according to Schwarz information criterion.

After that, we will use different diagnostic tests such as the LM test for serial correlation' where the null hypothesis is that there is no autocorrelation in this model's errors. We will also test the Breusch-Pagan-Godfrey test for heteroscedasticity, where the null hypothesis states that these variables are homoscedastic. Finally, we will test the stability of the model using the CUSUM and CUSUM square test. Finally, the Granger causality test will reveal whether there is any causality among these variables and if there is any, then the direction of the causality.

#### 4. EMPIRICAL FINDINGS

From Table 1, we can find that F-statistic for the bounds test is larger than the upper bound even at 1% significance level. This conclusively proves that there is a cointegrating relationship among these variables in the long run.

<sup>2</sup> Schwarz information criterion (SIC) is used instead of Akaike Information Criterion (AIC) because SIC gives more consistent model selector.



Table-1. Results of the ARDL bounds test.

F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Significance level	I(0)	I(1)
F-statistic	6.640763	10%	2.72	3.77
		5%	3.23	4.35
		2.5%	3.69	4.89
		1%	4.29	5.61

Next, the results of the CECM model of Equation 2 are shown in Table 2. We can see the long-run effects of remittance, trade openness, and exchange rate from this result, shown in the lower part of Table 2. If remittance inflow increases by 1 percent, then the foreign exchange reserve would increase by 0.43 percent, and if trade openness rises by 1 percent, then the foreign exchange reserve would increase by 1.22 percent. Both of these coefficients are statistically significant at a 5 percent significance level. However, the coefficient of the exchange rate is not significant. Lastly, the error correction coefficient is -0.91, which implies that if there is disequilibrium, then this model would correct itself by 91 percent in a year.

Table-2. Conditional error correction regression.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	7.851715	2.478086	3.168459	0.0060
Reserve (-1)*	-0.907139	0.177215	-5.118847	0.0001
Remittance (-1)	0.389953	0.182596	2.135600	0.0485
Trade Openness (-1)	1.113495	0.500318	2.225575	0.0408
Exchange rate (-1)	0.191951	0.585979	0.327574	0.7475
D(Reserve-1))	0.823129	0.189292	4.348459	0.0005
D(Reserve-2))	0.314485	0.180943	1.738039	0.1014
D(Reserve(-3))	0.434995	0.151181	2.877322	0.0109
D(Remittance)	0.418561	0.455652	0.918597	0.3719
D(Remittance(-1))	0.022904	0.519869	0.044058	0.9654
D(Remittance(-2))	-2.549314	0.537442	-4.743425	0.0002
D(Remittance(-3))	-1.894103	0.605030	-3.130593	0.0065
D(Trade Openness)	-0.192244	0.606818	-0.316806	0.7555
D(Exchange Rate)	-2.740458	1.823869	-1.502553	0.1524
D(Exchange Rate(-1))	-6.359643	1.854268	-3.429732	0.0034
D(Exchange Rate(-2))	-2.592939	1.775584	-1.460330	0.1636
D(Exchange Rate(-3))	-4.262876	1.389247	-3.068479	0.0073
D(Exchange rate(-4))	-3.421123	1.206803	-2.834864	0.0119
Long-run effects				
Remittance	0.429871	0.192777	2.229890	0.0404
Trade Openness	1.227481	0.483212	2.540253	0.0218
Exchange Rate	0.211601	0.641782	0.329708	0.7459
Error correction coefficient				
CointEq(-1)	-0.907139	0.161517	-5.616371	0.00000

We will now test this model for autocorrelation and heteroscedasticity. The results of these two tests are given in Table 3. For LM serial correlation test, we can see that the null hypothesis cannot be rejected at a 5 percent level. That means this model is free from autocorrelation in the errors. Also, in the Breusch-Pagan-Godfrey test, we cannot reject the null hypothesis at the 5 percent level. Therefore, these variables are homoscedastic, and there is no problem with heteroscedasticity.

Table-3. Serial-Correlation and Heteroscedasticity test.

Breusch-Godfrey Serial Correlation LM Test:			
F-statistic	0.922381	Prob. F(2,14)	0.4204
Heteroskedasticity Test: Breusch-Pagan-Godfrey			
F-statistic	0.986777	Prob. F(17,16)	0.5126



Figure 8(a) and 8(b) of the CUSUM test and CUSUM square test show that this model is stable over time as these lines are within 5% significance level bound.

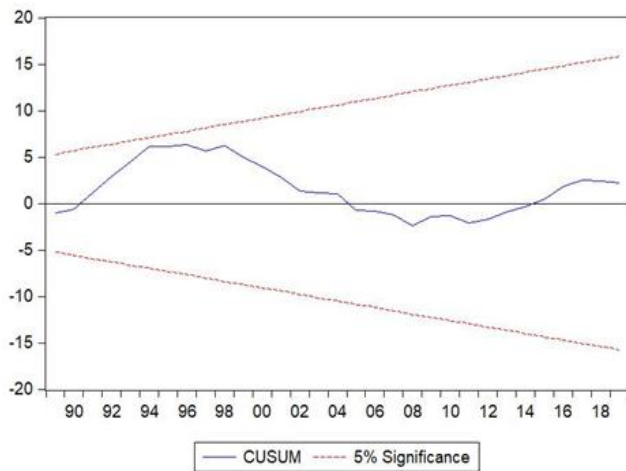


Figure-8 (a). CUSUM test.

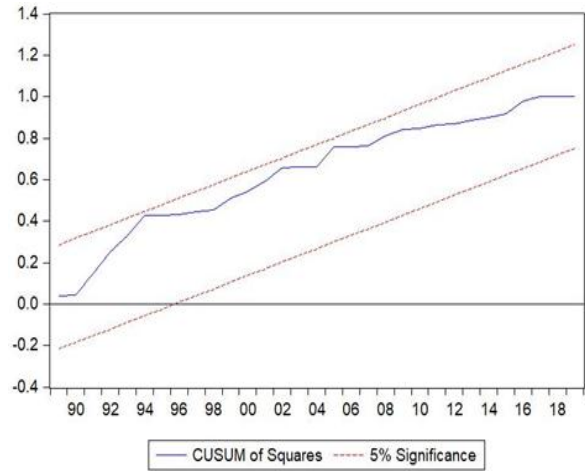


Figure-8 (b). CUSUM square test.

The next step is to test the Granger causality among these variables. Table 4 shows that there is a unidirectional causality between reserve and remittance, running from remittance to reserve. As remittance add to the foreign exchange account and increase the reserve, this relationship is expected. We can see that there is no causality between reserve and trade openness, which is unexpected but can be explained by an insignificant difference between export and import. We also get that reserve Grange causes exchange rate; however, we have previously seen in Table 2 that there is no long-term relationship between the exchange rate and reserve; therefore, this result is not robust. Table 4 also shows that remittance causes exchange rate change, which can be explained by remittance, which will create a surplus of foreign reserves, which then changes the exchange rate. Lastly, trade openness and exchange rate have bi-directional causality. If trade changes relative to the GDP would impact the exchange rate, the exchange rate also affects the trade.

Table-4. Granger causality test.

Null Hypothesis:	F-Statistic	Prob.
LREM does not Granger Cause LRES	3.63457	0.0117
LRES does not Granger Cause LREM	3.40122	0.1590
LTRA does not Granger Cause LRES	0.34175	0.8831
LRES does not Granger Cause LTRA	0.92005	0.4826
LEXC does not Granger Cause LRES	1.73264	0.1598
LRES does not Granger Cause LEXC	3.72136	0.0104
LTRA does not Granger Cause LREM	0.63842	0.6722
LREM does not Granger Cause LTRA	3.65943	0.0113
LEXC does not Granger Cause LREM	1.35907	0.2694
LREM does not Granger Cause LEXC	3.51456	0.0137
LEXC does not Granger Cause LTRA	3.70152	0.0107
LTRA does not Granger Cause LEXC	3.01031	0.0268

## 5. CONCLUSION AND POLICY RECOMMENDATIONS

We explore the long-run relationship among foreign exchange reserve, remittance inflow, trade balance, and exchange rate in Bangladesh and find a long-run stable relationship among the variables. We show a significant positive impact of remittance inflow and trade balance on foreign exchange reserves in the long run. The exchange rate also positively impacts foreign exchange reserve though the coefficient is not statistically significant. The causality test has also shown unidirectional causality from the remittance inflow to foreign exchange reserve. So, remittance inflow has a crucial role in attaining growth in foreign exchange reserves. The study has found no causal

relationship between foreign exchange reserve and trade openness. The study has also found the unidirectional causality from remittance inflow to the exchange rate. Lastly, trade openness and exchange rate have bi-directional causality.

Since it is evident from the paper that remittance inflow has a steady impact on foreign exchange reserves in the long-run, the government should further synchronize the policies to ensure the inflow of remittance for sustaining the future economic securities. It is also worth noting that remittance inflow is also crucial for attaining the SDGs (Sustainable Development Goals) in Bangladesh. In this pandemic situation, many countries may experience a decline in trend and the size of employment, especially in the middle east countries, and it is expected to pose a serious challenge to the migrant workers since the majority of the migrant workers are working in the Gulf Co-operation Countries (GCC) countries. So, diversification of the labour market and providing necessary support to the migrant workers must maintain the stable remittance inflow in Bangladesh.

Moreover, Bangladesh's historically negative trade balance and the high concentration of the export basket in the RMG sector would be significant challenges in the coming days of the pandemic situation. So, diversification of export commodities is necessary to tackle the post-pandemic difficulties. Bangladesh government may also concentrate on its accretion of excess foreign exchange reserve as it has both advantages and disadvantages. Accumulation of extra reserve than the optimal level has high costs (fiscal and monetary) and posed a considerable pressure to the central bank authority in formulating monetary policy (Islam, 2010). So, Bangladesh's government should reevaluate the optimal foreign exchange reserve accretion in Bangladesh and take adequate measurements on this issue.

Since Bangladesh has achieved its independence in 1971 and has adopted liberalization policies in the 1980s, this study's sample size is relatively small, which is one of the main drawbacks of this paper. One avenue of extending this paper is to examine the determinants of foreign exchange reserve for the South Asian countries in the panel framework.

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## APPENDIX

**Table-1. Stationary Test for the variables.**

Variables	ADF (P-value)	PPERRON (P-value)	Conclusion
Reserve (Level form)	0.9831	0.9933	Not Stationary
Reserve (First difference)	0.0000	0.0000	Stationary
Remittance (Level form)	0.0019	0.0221	Stationary
Trade Openness (Level form)	0.8040	0.8181	Not Stationary
Trade Openness (First difference)	0.0000	0.0000	Stationary
Exchange Rate (Level form)	0.0386	0.2979	Inconclusive
Exchange Rate (First difference)	0.0027	0.0042	Stationary

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