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INTEREST RATE AND INFLATION DYNAMICS ON EXCHANGE RATE MOVEMENT IN BANGLADESH: AN EMPIRICAL INVESTIGATION USING ARDL APPROACH

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Abstract

This paper investigates the impact of inflation and interest rates on exchange rate fluctuations in Bangladesh using the ARDL approach. The study establishes a stable and significant long-term relationship between Interest Rate (IR), Inflation (INF) and Exchange Rate (ER) in Bangladesh from 1980 to 2021. The results indicate that lending interest rates have a positive effect on Bangladeshi currency appreciation against the US dollar, while inflation has a positive but insignificant impact on the exchange rate. In the short term, the interest rate also has a significant and positive effect on the exchange rate, while inflation does not. The study recommends an efficient management of interest rates and inflation in Bangladesh to keep balance in the exchange rate. The paper emphasizes the sensitivity of the country's economic growth to changes in the exchange rate and exposes the remittance and export sector to greater vulnerability. These findings contribute significantly to the current literature on the link between interest rate, inflation, and exchange rate in developing countries like Bangladesh

Introduction: Understanding the relationship between exchange rate, inflation, and interest rates is essential for policymakers to maintain economic stability in developing countries like Bangladesh. Recently, the country has shown remarkable progress in terms of economic growth, and its remittance and export sectors play crucial roles in driving the economy forward. Nonetheless, the country's economy's exposure to changes in the exchange rate can have significant implications for its long-term growth prospects. This study explores the nexus between interest rates, inflation, and the nominal exchange rate in Bangladesh using the ARDL approach from 1980 to 2021. The study's significance lies in its comprehensive exploration of the relationship between these variables, and its results contribute to policymakers' understanding of the link between macroeconomic variables and exchange rate volatility. The central question this study seeks to answer is whether interest rates and inflation matter in determining the nominal exchange rate in Bangladesh. Therefore, the research aims to provide empirical evidence to policymakers on how interest rates and inflation affect exchange rate stability. The Keynesian view argues that an increase in nominal interest rates leads to an increase in real interest rates, which, in turn, attracts

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foreign capital and appreciates the domestic currency. On the other hand, the monetarist perspective posits that an increase in money supply leads to inflation, which ultimately leads to a depreciation of the domestic currency. This study contributes to the existing literature by exploring whether interest rate and inflation can be crucial factors in creating instability in the nominal exchange rate in developing countries like Bangladesh.

1.1. Exchange Rate, Interest Rate and Inflation Nexus in Bangladesh

The transition of Bangladesh's economy since(to) independence was not smooth. Since then, the country has faced several economic policy shifts. For example, it adopted socialism shortly after the independence and thereby nationalized all its SOEs. The socialistic mode of production, however, did not bring success to the economic growth for which the country had to enter into the privatization-led free-market economy in the early 1980s. The statistics show that the economy was not performing well, even in the realm of a privatization-based free-market economy. The economy was facing several challenges ranging from low GDP growth to ensuring food security. The key macroeconomic variables such as interest rate, inflation and exchange rate showed volatility as the monetary aggregates were not steady. This might be due to the persistent lower export growth, high import cost, low remittance inflow, poor foreign direct investment and high payment of external debt interest.

Table 1. Trend of exchange rate, lending interest rate and consumer price index in Bangladesh.

Year	Exchange Rate	Interest Rate	Consumer price Index
1980	15.45	11.33	17.92
1985	27.99	12	27.80
1990	34.57	16	49.85
1995	40.28	14	63.73
2000	52.14	12.75	80.22
2005	64.33	10.62	102.69
2010	69.65	12.22	163.52
2015	77.95	11.71	227.39
2020	84.87	8.3	282.685
2021	85.08	7.3	298.395

Source: 1) World Development Indicators (WDI), World Bank, 2). World Economic Outlook 2020 (WEO), IMF.

From the statistics depicted in Table 1, the BDT had been continuing to have depreciated since the 1980s. From 1983 onwards, the country experienced 89 adjustments in exchange rate. Among which 83 were observed downwards and the remaining were upward (Islam, 2002). On occasion, the government had intentionally kept its currency value lower against the USD aiming to boost its export sector. The practice of an adjustable peg system had made it easier for the government to keep the currency value favorable to international trade. Despite this, during the 1980s and 1990s, the nominal exchange rate of Bangladesh was being further depreciated. The domestic interest rate and inflation were volatile and at the same time, the export earnings and remittances were not strong enough to prevent BDT from being further depreciated. However, in early 2000, the booming export sector and remittance earnings along with the stability in macroeconomic aggregates have provided Bangladesh with some economic strength to adopt a floating exchange rate system.

The statistics as displayed in Table 1 show that the nominal exchange rate of Bangladesh was not steady, even in the realm of floating exchange rate. After 2005, the rate of depreciation of BDT was not less comparing to the previous decades. So why did the exchange rate of BDT depreciate while the country had better export earnings and remittance inflow? The volatility in the interest rate and inflation after 2000 may be the reason for the

downturn of BDT values against the USD. The statistics evident in Table 1 have strengthened this possibility as the interest rate was significantly higher after 2000, which reached its peak in 2017 and the consumer price index became parallel to this skyrocketing interest rate. Furthermore, as per the economic theory, the increase in the interest rate and inflation can depreciate currency by rising imports. On the other hand, the increased interest rate can also appreciate the currency by increasing the demand for foreign capital.

1.2. Theoretical Background of the Research

Many classical and contemporary economic theories have highlighted the relationship between interest rates, inflation, and exchange rates. Their findings, however, were not similar which has made this a long-debated issue in macroeconomics. Several economic theories such as the international Fisher Effect (IFE), the theory of Purchasing Power Parity (PPP), the views of Keynesian and Chicago schools, etc. have produced the following different conclusions.

The International Fisher effect is an extended form of the Fisher effect which postulates a positive correlation between nominal interest rate and expected rate of inflation. According to the theory, as is stated by Dornbush, Fischer, and Startz (2009), the country will tend to experience depreciation in relation to its currency value if it has a higher rate of interest compared to its trading partners. According to the theory of Purchasing Power Parity, the ratio of purchasing power of the two countries is a strong determinant of the nominal exchange rate. The real exchange rate turns out to be less than 1(%) if a country faces higher inflation in comparison with another country. This implies that the country has to depreciate its currency value to make the real exchange rate equal to 1(%).

Furthermore, the views of the Chicago school and Keynesian thought can also be some good examples in analyzing the interest rate, inflation and exchange rate relationship. The Chicago school considers the fluctuation in interest rate a prime source for the deviation of the nominal exchange rate. The school believes that the higher cost of production, which is caused by the higher lending interest rate, leads to an increase in the exchange rate of domestic currency because the country now faces inflation and depreciation(Frankle, 1979).

Alternatively, the Keynesian views find an appreciation of domestic currency value due to the effect of increased nominal interest rate in the domestic financial market. Keynes explains this relationship based on the theory of sticky prices. The theory argued that any increase in nominal interest rate, which might be the result of the tight monetary policy, eventually leads to an increase in real interest rate because there is a sticky price in the goods market. The higher rate of real interest rate would, therefore, bring foreign capital to the country. Hence, following the Keynes view, there would be an appreciation of domestic currency value as the inflow of foreign capital will increase the demand for domestic currency in the foreign exchange market.

2. Literature Review

This section explores different types of literature on the nexus between interest rate, inflation, and exchange rate for the different economies. The aim is to understand how the exchange rate of Bangladesh and many other countries respond to the changes in the interest rate and inflation. For example, by using Structural Vector Autoregressive (SVAR) and Cholesky Factorization method (Karim, 2019) found that the increase in domestic interest rate attracts foreign investors and thereby causes the appreciation of Bangladesh Taka against USD. On the other hand, Chowdhury and Hossain (2014) have shown that the increase in interest rate in Bangladesh creates a depreciation of the Taka in terms of USD. Likewise, Amin, Murshed, and Chowdhury (2018) and Hossain and Ahmed (2009) have found a similar result.

Now, in the context of the global economy, the work of Carneiro and Rossi (2013) and Shodipe (2018) are good examples to start with. In their seminal work, the authors argued that prudent macroeconomic policy is necessary for the economy to prevent further appreciation of currency value which has been caused by the increase in interest rate. However, a cross-country analysis by Kui SI, Xiao-Lin, Chang, and Lu (2018) has also shown positive

movement between interest rate and exchange rate for the economy of BRICS countries. On the other hand, (Hacker, H. Kim, & Manson, 2009) showed that the increase in interest rate leads to appreciating the currency value in the short run for selected seven pairs of countries. Yung (2017) has concluded that the interest rate is negatively related to the exchange rate. The work of Khan, Teng, and Khan (2019) has also estimated negative effects of interest rate and inflation on the exchange rate in the Chinese economy. Saraç and Karagöz (2016) in their work, however, interestingly found no evidence that a higher interest rate can cause exchange rate differentials in Turkey's economy.

Hossain (2002) argued that the increase in the consumer price index leads to a higher nominal exchange rate in Bangladesh. Murshed (2018), on the other hand, has found no evidence of Granger causality from inflation to exchange rate in Bangladesh. Ali, Mahmood, and Bashir (2015) have studied the relationship between inflation, interest rate and exchange rate for the Pakistan economy and found bi-direction Granger causality between inflation and exchange rate. Dilmaghani and Tehranchian (2015), on the other hand, alleged that a country with a higher domestic inflation rate faces devaluation of its currency value. The seminal work by Sean, Pastpipatkul, and Boonyakunakorn (2019) demonstrated that the increase in money supply causes inflation in Cambodia and the increased inflation depreciates its currency value in consequence. Similarly, Joof and Jallow (2020) argued that a 1% increase in the inflation rate in the Gambia result from a 0.39% devaluation of domestic currency value against the US dollar. The works by Fetai, Koku, Caushi, and Fetai (2016) have found that the exchange rate volatility is the supreme cause of generating inflationary pressure in Western Balkan countries.

3. Data and Methodology

The entire data set deployed in this research has been collected from two sources, the World Development Indicators (WDI) of the World Bank (WB) and the World Economic Outlook of IMF. However, this study employed the Autoregressive Distributive Lag (ARDL) model developed by Pesaran, Shin, and Smith (2001) to investigate the short-run and long-run relationship between the studied variables. This method was used because it provides some advantages compared to other traditional methods like (Engle & Granger, 1987) two-step procedures and Johansen and Juselius (1990). For example, the ARDL model is likely to be more efficient, even with a small sample size, whereas the Johansen Juselius test requires a relatively large sample size to obtain valid results (Ghatak & Siddiki, 2001). An additional advantage of this model is that it can determine the level of relationship between the variables even if the regressors are integrated at different orders such as I(0) and I(1). On the contrary, the Johansen Juselius test provides results if the variables are integrated at I (1).

Furthermore, the ARDL model is successful to address the endogeneity problem. This is because it allows satisfactory lags that can provide unbiased long-run estimates and valid t-statistics even when the time series are not integrated at the same level. Moreover, this approach can also provide the simultaneous assessment of the long-run and short-run effects of one variable on another. The following model shows the long-run relationship of the time series.

$$\Delta ERt = \alpha_1 + \beta_1 ER_{t-i} + \beta_2 IR_{t-i} + \beta_3 INF_{t-i} + \sum_{i=1}^{p} \theta_i \Delta ERt\text{-}^{i} + \sum_{i=1}^{p} \lambda_i \Delta NIRt\text{-}I + \sum_{p}^{i=1} \psi_i \Delta NINF_{t-i} + \varepsilon_{1t} (1)$$

$$\Delta IR_t = \alpha_2 + \beta_1 IR_{t-i} + \beta_2 ER_{t-i} + \beta_3 INF_{t-i} + \sum_{i=1}^{p} \theta_i \Delta ERt\text{-}^{i} + \sum_{i=1}^{p} \lambda_i \Delta NIRt\text{-}I + \sum i=1 \psi i \Delta NINFt\text{-}i + \varepsilon 2t (2)$$

$$\Delta INFt = \alpha 3 + \beta 1 INFt\text{-}i + \beta 2 ERt\text{-}i + \beta 3 IRt\text{-}i + \sum pi=1 \theta i \Delta ERt\text{-}i + \sum pi=1 \lambda i \Delta NIRt\text{-}I + \sum pi=1 \psi i \Delta NINFt\text{-}i + \varepsilon 3t (3)$$

Where, Δ stands for the first difference operator, α_i (i= 1....3) is the constant term, β_i (i=1...3) represents coefficients of the lagged levels, θ_i, λ_i, and $\boldsymbol{\psi}_i$ (i= 1-p) signifies the coefficients of lagged variables and ε_{it} (i= 1...3) implies the error terms which is assumed to be serially uncorrelated. The lag length is denoted by p which is determined by the minimum value of Schwartz Information Criteria (SIC). However, the equation can be

divided into two parts. The first portion which is denoted by β_i represents the long-run relationship. On the contrary, the portion with the summation sign would provide the short-run dynamics of error correction.

The ARDL bound test provides the Wald test (F-statistics) that estimates the long-run cointegration among variables. The lagged level variables are restricted to zero to form a null hypothesis. Pesaran et al. (2001) have argued that the calculated F-statistics need to be compared with upper bound and lower bound critical values for the estimation of the relationship. According to the model, the null hypothesis would be rejected if the value of calculated F-statistics goes above the value of the upper bound. On the other hand, if the calculated F-statistic value is found below the lower bound critical value, the null hypothesis cannot be rejected. However, the inference remains inconclusive if the value of F-statistics is positioned within these two bounds. If cointegration exists, the model would look into the estimation of long-run coefficients and short-run parameters along with Error Correction. Therefore, the ARDL model with error correction term is presented below to estimate the long-run and short-run coefficients.

$$\Delta ER_t = \alpha_1 + \beta_1 ER_{t-i} + \beta_2 IR_{t-i} + \beta_3 INF_{t-i} + \sum_{i=1}^{p} \theta_i \Delta ER_{t-i} + \sum_{i=1}^{p} \lambda_i \Delta NIR_{t-I} + \sum_{i=1}^{p} \psi_i \Delta NINF_{t-i} + \delta_1 ECT_{ti} + \varepsilon 1t \quad (4)$$

$$\Delta IR_t = \alpha 2 + \beta 1 IR_{t-i} + \beta 2 ER_{t-i} + \beta 3 INF_{t-i} + \sum pi=1 \theta i \Delta ER_{t-i} + \sum pi=1 \lambda i \Delta NIR_{t-I} + \sum pi=1 \psi i \Delta NINF_{t-i} + \delta 2\ ECT_{t-i} + \varepsilon 2t \quad (5)$$

$$\Delta INF_t = \alpha_3 + \beta_1 INF_{t-i} + \beta_2 ER_{t-i} + \beta_3 IR_{t-i} + \sum_{i=1}^{p} \theta_i \Delta ER_{t-i} + \sum_{i=1}^{p} \lambda_i \Delta NIR_{t-I} + \sum_{i=1}^{p} \psi_i \Delta NINF_{t-i} + \delta_3\ ECT_{ti} + \varepsilon 3t \quad (6)$$

Equation 4 presents the target model of this research which estimates the effects of inflation and interest rate on the exchange rate with the error correction term. In the same vein, Equation 5 and 6 postulates the effects of corresponding explanatory variables in the equations when interest rate (ΔIR) and inflation (ΔINF) at time t appear as dependent variables. The error correction term in the equation stands for the long-run equilibrium speed of adjustment. However, the convergence to the long-run equilibrium would occur if the sign of the error correction term is found negative and the coefficient of the term is significant.

4. Results and Discussion

Although the ARDL bound testing approach can accommodate variables in any order such as I(0), I(1), or their mixture, it cannot be employed in any of the variables integrated at order 2 that is I(2). Therefore, the ARDL approach requires testing the stochastic properties of the time series to be confirmed that none of the variables are I (2). The widely used Augmented Dickey-Fuller test is employed in this research to make sure the stochastic properties of the variables.

Table 2. Unit root test (ADF) for the period of 1980 to 2021.

Intercept			**With Trend and Intercept**	
	Series at Level	**First Difference**	**Series at level**	**First Difference**
Variables	**Test Statistic**	**Test Statistics**	**Test Statistics**	**Test Statistics**
LN ER	-5.28 (0) *	-3.91(0)*	-4.07(0)*	-6.42(1)*
LN IR	-0.27(1)	-3.75(0)*	-1.35(1)	-4.22(0)*
LN INF	-1.51(1)	-7.29(1)*	5.86(0)*	-7.22(1)*

Notes: * denotes rejection of null hypothesis at a 5% level of significance. The figure in parenthesis indicates the optimal lag length determined by Schwartz Information Criteria (SIC).

The results depicted in Table 2 indicate some mixed integrations. For example, while the variable LNER is confirmed stationary at I(0), the variable like LNIR exhibits stationary at I(1). This dichotomy continues for

LNINF as well. The variable LNINF is found stationary at I(1) with intercept but if we check its unit root in the case of with trend and intercept it does not need the first difference to be stationary. Hence, Table 2 indicates that the order of integration of the series is a mixture of I(0) and I(1) and none of the series are I(2). Thus, the unit root results indicate that the paper needs to employ the ARDL approach the order of integration is a mixture of I(0) and I(1) and none of them are I(2).

The ARDL bounds testing method will check co-integration for equations (4), (5) and (6) where each variable appears LHS simultaneously. This method provides F-statistics at a 5% level of significance as presented in Table3.

Table 3. ARDL bound test for co integration.

Functions	**Value of F Statistics**	**Critical Values at a 5% level of significance**		**Inferences**
		I(0)	I(1)	
F(LNER/LNIR, LNINF)	27.2*	3.1	3.87	Cointegrated
F(LNIR/LNER, LNINF)	2.45	3.1	3.87	Not cointegrated
F(LNINF/LNER, LNIR)	9.12*	3.1	3.87	Cointegrated

Note: 1: * indicates the rejection of the Null Hypothesis at a 5% level of Significance.

This method determines co-integration among variables if the F-statistics value is greater than the upper bound value produced at a 1% or 5% or 10% level of significance (Pesaran et al., 2001). According to the results, the long-run cointegration relationship is evident among the variables when LNER and LNINF appear as dependent variables as the values of calculated F-statistics of these functions are greater than the 5% upper bound value. The estimated results show there is a stable long-run relationship between interest rate, inflation, and exchange rate in Bangladesh. On the contrary, the changes in the nominal exchange rate and inflation do not have any long-term effects on the interest rate when the interest rate appears as a dependent variable.

However, in this research, my target model is (4) where the exchange rate appears as a dependent variable and the bound test result confirms the long-run relationship among the variables of this model. That being said, we need the long-run estimators of the model to measure the effects of regressors on the dependent variable. The optimal lag length is determined by the Schwartz Information Criteria (SIC) criterion which selects ARDL (1, 1, 0) model. The results of long-run coefficients are presented in Table 4.

Table 4. ARDL long run and short run approach with LNER as dependent variable.

Function	**Coefficient**	**Std. Error**	**t-Statistic**	**Probability**
LNIR	-1.05	0.39	-2.69	0.01
LNINF	0.18	0.10	1.69	0.09
C	0.62	0.12	5.18	0.00
D(LIR)	0.11	0.07	1.46	0.15
CointEq(-1)*	-0.10	0.01	-10.9	0.00

Note: * indicates ECM value is negative and Significant.

The long-run approach provides the long-run coefficients of regressors and probability value of t-statistics. The coefficient of LNIR is estimated at -1.058382 and the probability of t-statistics suggests this result is highly significant. This long-run estimator advocates the negative relationship between interest rate and exchange rate. The nominal exchange rate in Bangladesh decreases by 105% per annum if the nominal lending interest rate rises by 1% in the long run. This finding goes parallel to the Keynesian thought which postulates that a unit increase in interest rate appreciates the currency value to a greater extent. On the contrary, inflation (LNINF) in Bangladesh is positive, but insignificant long-run effects on the nominal exchange rate. The exchange rate of BDT depreciates by 17.6% per annum against USD for a 1% increase in the general price level in Bangladesh.

The short-run effect of the interest rate is not similar to the long-run effect. The effects of the interest rate on the exchange rate are positive in the short run. As shown by the results, the increase in interest rate by 1% point depreciates the currency value of BDT by 10.6% in the short run. These short-run effects are also statistically insignificant as the P-value of t-statistics is greater than 5%. However, the error correction term is statistically significant. The negative sign before it implies that the long-run disequilibrium will turn back to a steady-state by any external shock imposed on the economy. The lower value (-0.0101283) of the error correction term is indicating that it will take a longer period to make the adjustment process.

5. Conclusion and Policy Recommendations

The stability in the exchange rate regime is crucial for Bangladesh's economy due to its recent economic growth relying heavily on foreign exchange earnings. Its export earnings and remittance inflow would significantly increase cost if there is unsteadiness in the exchange rate. The economy would cost the payment of import bills and external debt as well if the exchange rate cannot be kept under control. However, it is a challenge for Bangladesh to keep the exchange rate under control in the floating exchange rate system. Except for the RMG export and the remittances, the country has not any significant economic strength that can make the BDT stronger against the USD. On the contrary, the amount of money outgoing from Bangladesh is increasing rapidly. Hence, the stability in the interest rate and inflation is crucial for Bangladesh as these two have direct impacts on both the inflow and outflow of money.

The empirical results of this study have been found by using the ARDL method are statistically significant as the coefficient of the cointegrating equation has been found negative and the probability value of t-statistics is less than 5%. In the long run, the impact of inflation and interest rate on the exchange rate is not similar. The exchange rate appreciated by 105.8% for a 1% increase in interest rate. On the other hand, the exchange rate depreciated by 17.6% if the inflation rate goes up by 1%. In the short run, however, the increase in the interest rate causes a little depreciation of BDT. Moreover, the value of the error correction term is found very low which is only at 1.01%. The slower adjustment indicates that the economy will take a longer time to correct any disequilibrium in the interest rate and inflation to get the exchange rate into a steady-state situation.

The monetary policy is therefore requiring efficient management of interest rate and inflation as the exchange rate in Bangladesh is found highly elastic to the interest rate which can impact badly on the foreign exchange earnings. Paradoxically, an increased interest rate can be an effective strategy for Bangladesh, while the exchange rate depreciates sharply. However, the monetary authority in Bangladesh should also consider the slow adjustment process toward the long-run equilibrium in the exchange rate. The value of the speed of adjustment is found extremely low which would entail higher associated costs if the monetary authority fails to keep interest rate and inflation stable.

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