

Remittance and Inflation Nexus in Bangladesh: Application of Dynamic ARDL Model with Linear Trend

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Abstract

Remittance is one of the major sources of financial inclusion in Bangladesh. The contribution of remittance to the economy gradually increases with respect to time. The current study investigates the nexus between remittance and inflation by considering data from 1975 to 2019. The results of the Augmented Dickey Fuller (ADF) unit root indicate the variables are stationary at mixed order like as $I(0)$ and $I(1)$. Through the ADF test, this study conducts a dynamic autoregressive distributed lag (ARDL) model with considering the linear trend. The remittance has a significant and positive impact to raise inflation in the short run but is insignificant in the long run. The estimation found the speed of adjustment, Error correction term (ECT) is 69% and bound testing criteria indicate the long-run association among the variable. This investigation also concludes that the exchange rate has a positive impact on inflation where the real exchange rate has no positive impact to raise inflation in Bangladesh. The empirical findings suggest the productive and safe investment rather expense in consumption purpose due to reducing the consequence of remittance inflows on inflation in Bangladesh.

Keywords: Remittance, Inflation, Exchange Rate, Interest Rate, ARDL

JEL Classification: E31, F24, F31

Introduction

The economic development of developing nations is driven by foreign remittances. Bangladesh is one of the emerging nations all over the world where its economy is modified by the large volume of remittance inflows, foreign direct investment (FDI), readymade garments (RMG), pharmaceuticals, and others factors. Whatever, Remittance is the term used to describe the money sent back to a home country by those who work abroad (Cohen, 2005). Remittances are the lifeblood of the country's economy and one of the driving forces behind the development. Remittances are one of the key sources of foreign exchange for a developing country like Bangladesh (Azad, 2005; Chowdhury, 2011; Hasan *et al.*, 2019). Its significance

and role greatly outweigh development aid from various states and institutions, and it is far more stable than the flow of private lending and portfolio equity. Remittances account for around 12% of total GDP and contribute to economic development in Bangladesh. Remittances sent by expatriates have made a substantial contribution to Bangladesh's economic progress. According to Bangladesh Bank (BB) authority, remittances totaled 16.42 billion in FY 2018-19 and 18.20 billion in FY 2019-20, representing the greatest remittance collection to date. After readymade clothes, expatriates make the second-largest contribution to the economy, and they play a critical part in keeping the country's economy afloat. Bangladesh Bank presently has a record level of reserves, totaling US\$ 36 billion by the end of June 2020, thanks to expatriates.

This contribution is so significant that when the economic slump that began in the United States in 2006 drew the attention of the entire world, these expatriates became the key for Asian countries like Bangladesh and saved the inhabitants of this country as well as the economy's wheel (Jha *et al.*, 2010).

Moreover, the remittances flow in Bangladesh has been rising besides inflation also shows a volatile trend where inflation is also increasing. Now, it is an important issue to examine the relation between remittances and inflation. Is there any relation or not, this is a vital question in current researches. The term inflation means the raising of price level with respect to time and others factors like political instability, corruption, export and import barriers, control of interest rate, natural disorder, and others. Inflation and economic growth have causal relation where Mundell (1965) and Tobin (1965) dispute that inflation is the root of the individual to surrogate money into a bond and others interest raising possessions, this escorts to increased capital formation and, as a result, positive economic growth. Fischer and Modigliani (1978), on the other hand, claim that inflation and economic growth have a pessimistic and nonlinear correlation.

Whatever, remittance is directly related to household consumption, the standard of living, raising social value as well as social security, raising aggregate demand, and others. In that case, remittance is directly or indirectly related to the rising price level. There are various potential manners by which remittance can affect the inflation rate in an economy. First is through the demand side of an economy; with the increment in the remittance inflow in a

country, the buying force of beneficiaries' increments, so the demand of services and products increments is raised (Narayan *et al.*, 2011; Ball *et al.*, 2013; Muktadir-Al-Mukit, 2018). As there is no adjustment of the output level of a nation, so this expansion demand household and national level with no adjustment of the inventory of goods and services will squeeze the costs of wares vertical way. Subsequently, inflation creates with the expansion of remittance inflow. Another clarification of the positive effect of remittance on expansion is through the part of the money supply of an economy. With the inflow of remittance, the reserve in the central bank has been raised. Since the remittance is directly related to the reserves of Bangladesh, it has an impact on inflation. As per the rule of money supply, it has a significant relation to the price level of an economy, the ultimate result is to cause inflation. The balance of payment (BOP) has an impact on foreign exchange and foreign reserves to maintain the money supply in Bangladesh (Rahman & Dilanchiev, 2021).

Moreover, the current study aims to fill the following objectives through this research. The main objective is to analyze the nexus between remittance and inflation in Bangladesh. The specific objectives are:

- i. To estimate the impact of remittance on inflation
- ii. To identify the short-run dynamics between those factors
- iii. To identify the long-run impact of remittance on inflation

This study has been conducted through empirical analysis by using an applied econometrics model and statistics. The next section has been representing the

literature review in section 2, section 3 for methodology, section 4 representing the results and discussion, and finally conclusion and policy recommendation section presented in section 5.

Literature Review

Even though Bangladesh is a small country on the world map, the speed with which its economy is growing is surprising the globe. Bangladesh's economy is built on the backs of remittances. Bangladesh is already on the road to economic greatness; it is no longer a pipe dream, but a reality. And the remittances supplied by millions of Bangladeshi workers around the world are assisting in the development of this thriving economy. Whatever a large number of literature are available to determine inflation all over the world but there is no specific study has been conducted in Bangladesh to determined the remittances and inflation nexus. The inflation and GDP growth nexus is also examined largely worldwide as well as in Bangladesh. Inflation and growth nexus in Bangladesh is examined by Paul (2013), Majumder (2016), Sumon and Miyan (2017), Uddin (2019), and Khan (2020). The inflation and growth nexus in global perspective analyze by Singh and Kalirajan (2003), Iqbal and Nawaz (2009), Bick (2010), Marbuah (2010), Huang *et al.* (2010), Hwang and Wu (2011), Fakhri (2011), Doguwa (2012), Behera and Mishra (2016), Tenzin (2019) and Baklouti and Boujelbene (2019). Moreover, the remittance inflation nexus has been examined by researchers outside Bangladesh. Mughal (2013) inspects the impact of remittances as an advancement procedure if there should be an occurrence of Pakistan, and discovers that remittance affects expanding the interest push expansion. The examination proposes that

remittances ought to be treated as an impermanent stream and can be used to advance the macroeconomic circumstance yet it ought not to be considered as long term stratagem. Policy implication and economic reform have a significant impact on both remittances and FDI (Majumder & Rahman, 2020). Narayan *et al.* (2011) examine the effect of remittance on inflation and the examination utilizes the GMM technique. It's anything but an expansion in inflation that raises domestic price (by expanding the money supply) which could cause an increment in the real exchange rate (EXR). Outcomes of the investigation also show that remittances will, in general, have a measurable impact on the inflation rate in developing nations and they can measure short-run and long-run impact. The volatile trend of the exchange rate is creating consequences on export-import as well as overall economic condition (Rahman *et al.*, 2020). By using data from 1973 to 2000, Mubarik (2005) investigate threshold level inflation and found more than 9% threshold inflation to modify the economic growth in Pakistan. A causal relation of GDP to inflation was found by Umaru and Zubairu (2012) in Nigeria. Rahman and Habib (2021) investigate the economic and non-economic determinants of remittance in Bangladesh. By using the DSGE model, Mandelman (2012) investigate the inflation remittance relation in the Philippines for the period 1995 to 2009 as he needs to distinguish the proof that features the function of remittances. The expansion in remittance diminishes worker supply in-home (receiving) nation, hence expanding real wages alongside the increment in consumption demand, which squeezes the price of domestic merchandise, in this way inflation raises. Therefore, the remittance inflation nexus

has been examined by researchers outside Bangladesh for example; Nisar and Tufail (2013), Yussuff (2018), Ghauri *et al.* (2019), and Dilanchiev *et al.* (2021). Moreover, in light of the empirical literature in the accompanying area, we are of the view that there is not an examination that should inspect the effect of foreign remittances on inflation in Bangladesh. Hence, this examination aims to investigate the short-run and long-run impact of remittance on the inflation rate in Bangladesh by using updated data and an effective econometric method.

Methodology

ADF Unit Root Test

Since the uses of time series data, it is familiar that Augmented Dickey Fuller (ADF) test is one of the best methods of testing the unit root of a variable. In this process, the unit root has been examined by considering the lagged order of selected variables and error or residuals estimations. Whatever the ADF test has the subsequent equations:

$$\Delta Y_t = \beta_1 + \beta_2 t + \tau(Y_{t-1}) + \gamma_t \sum_{i=1}^f \Delta Y_{t-1} + \varepsilon_t \quad (1)$$

Where; ε_t are an error module and ADF term R_{t-1} is the lagged order criteria.

Dynamic ARDL Model with Linear Trend

The autoregressive distributed lag (ARDL) method was primarily introduced by Pesaran *et al.* (1999) and then enhanced by Pesaran *et al.* (2001). Through this method, we have used a dynamic case of the dependent variable with one period lag (INF_{t-1}) where the estimation also considered the linear trend. The short-run equation of the linear trend ARDL model is:

$$\begin{aligned} \Delta LNINF_t = & \beta_0 + \beta_1 TREND_{t-1} + \beta_2 LNINF_{t-1} \\ & + \beta_3 LNEXR_{t-1} \\ & + \beta_4 LNREM_{t-1} \\ & + \beta_5 LNRINR_{t-1} \\ & + \sum_{j=1}^k \gamma_{1j} \Delta TREND_{t-j} \\ & + \sum_{j=1}^k \gamma_{2j} \Delta LNINF_{t-j} \\ & + \sum_{j=0}^k \gamma_{3j} \Delta LNEXR_{t-j} \\ & + \sum_{j=0}^k \gamma_{4j} \Delta LNREM_{t-j} \\ & + \sum_{j=0}^k \gamma_{5j} \Delta LNRINR_{t-j} \\ & + \varepsilon_t \quad (2) \end{aligned}$$

Where, Δ is first difference term, ε_t is the error tem and $\beta_1, \beta_2, \beta_3, \beta_4$ and β_5 communicate to the long-run coefficients and short run dynamics showed by $\gamma_{1j}, \gamma_{2j}, \gamma_{3j}, \gamma_{4j}$ and γ_{5j} . Therefore, the estimated long run equation got from the following consideration:

$$\begin{aligned} LNINF_t = & \beta_0 + \beta_1 TREND_{t-1} + \beta_2 LNINF_{t-1} \\ & + \beta_3 LNEXR_{t-1} + \beta_4 LNREM_{t-1} \\ & + \beta_5 LNRINR_{t-1} \\ & + \varepsilon_t \quad (3) \end{aligned}$$

When, the long-run association exists among the variable, then the error correction model has been executed. The equation of ECT is:

$$\begin{aligned} \Delta \text{LNREC}_{it} = & \beta_0 + \sum_{j=1}^k \gamma_{1j} \Delta \text{TREND}_{t-j} \\ & + \sum_{j=1}^k \gamma_{2j} \Delta \text{LNINF}_{t-j} \\ & + \sum_{j=0}^k \gamma_{3j} \Delta \text{LNEXR}_{t-j} \\ & + \sum_{j=0}^k \gamma_{4j} \Delta \text{LNREM}_{t-j} \\ & + \sum_{j=0}^k \gamma_{5j} \Delta \text{LNRINR}_{t-j} \\ & + \tau \text{ECT}_{t-1} + \varepsilon_t \quad (4) \end{aligned}$$

Where, τ represents the lag of the next period which means the ECT diving force moves in equilibrium at the rate of speed. The term ECT means the speed of adjustment for disequilibrium circumstances to move an equilibrium position. To establish a long-run association we must consider the ECT estimation which may take a negative sign with considerable significance level.

Table 1: Details of Selected Variables

Variable Form	Variable Details
INF	Inflation, GDP deflator (annual %)
RINR	Real interest rate (%)
REM	Personal remittances, received (% of GDP)
EXR	exchange rate

Source: WDI (2021)

Econometric Results Analysis

The first concentration of result analysis is on measuring the descriptive statistics of the selected variable. The result of descriptive statistics is presented in Table 2. There are some important criteria have used in descriptive analysis like as mean, median, maximum value, minimum value, standard deviation, skewness, and kurtosis. The mean value of LNINF, LNREM, LNRINR, and LNEXR are 1.85, 1.30, 1.57, and 3.77 respectively.

Econometric Model Specification

A functional form of the econometric model is presented in equation no 5. The econometric model specification is presented in equation no 6 and the model specification with log transformation is presented in equation no 7.

$$\text{INF} = f(\text{EXR}, \text{REM}, \text{RINR}) \quad (5)$$

$$\begin{aligned} \text{INF}_t = & \alpha_0 + \alpha_1 \text{EXR}_t + \alpha_2 \text{REM}_t \\ & + \alpha_3 \text{RINR}_t \\ & + \varepsilon_t \quad (6) \end{aligned}$$

$$\begin{aligned} \text{LNINF}_t = & \alpha_0 + \alpha_1 \text{LNEXR}_t + \alpha_2 \text{LNREM}_t \\ & + \alpha_3 \text{LNRINR}_t + \varepsilon_t \quad (7) \end{aligned}$$

Where, t denotes time and ε_t denotes error term known as residual. Intercept term has presented by α_0 where α_1 to α_3 are the coefficients of independent variables. The details of the selected variable are presented in Table 1.

The median values of those variables are 1.91, 1.24, 1.71, and 3.81 respectively. Standard deviations of selected variables like LNINF, LNREM, LNRINR, and LNEXR are 0.77, 0.79, 0.81, and 0.58 respectively and those are negatively skewed where the kurtosis values are 13.48, 6.12, 3.14, and 2.25 respectively. The results of descriptive statistics declared that the consistency of data and assure that, there is no inconsistency in the data set.

The ADF unit root result indicates that inflation (LNINF) and real interest rate

(LNRINR) have no unit root at level means the variables are stationary at level with 1% significance level which is presented in Table 3. Stationary at level indicates the integration level I(0). On the other hand, remittance (LNREM) and exchange rate (LNEXR) have unit root at the level that is the case of non-stationary at level I(0) but when it moves on 1st difference, the variables are stationary, they have no unit root. So, remittance and exchange rate are stationary at 1st difference where the integration level is I(1). Now, we see that some variables are stationary

at and some are stationary at 1st difference. Such kinds of the situation (missed order, I(0) and I(1)) suggests the autoregressive distributed lag (ARDL) model and We have used the dynamic ARDL model with considering the linear trend in regression process. Based on AIC and SIC criteria, optimum lag is 1 by level using vector autoregressive (VAR) process which result is presented in Table 4.

Table 2: Descriptive Statistics

Criteria	LNINF	LNREM	LNRINR	LNEXR
Mean	1.85	1.30	1.57	3.77
Median	1.91	1.24	1.71	3.81
Maximum	3.24	2.36	3.52	4.80
Minimum	-1.86	-1.69	0.00	2.71
Std. Dev.	0.77	0.79	0.81	0.58
Skewness	-2.35	-1.32	-0.55	-0.36
Kurtosis	13.48	6.12	3.14	2.25
Jarque-Bera	242.03***	30.54***	2.23	2.00

Note: *** represents 1% significance level.

Source: Author's estimation

Table 3: ADF Unit Root Test Results

Variable	At Level		At 1st Differences	
	Intercept	Trend and Intercept	Intercept	Trend and Intercept
LNREM	-2.44	-1.70	-9.86***	-9.93***
LNINF	-3.56***	-3.55***	-5.66***	-5.62**
LNRINR	-3.82***	-4.22***	-7.39***	-7.34***
LNEXR	-2.77*	-2.42	-4.49***	-4.01**

***, ** and * presents 1%, 5% and 10% level of significance.

Table 4: Optimum Lag Selection

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-99.42	NA	0.00	5.04	5.21	5.11
1	3.69	181.07	2.62*	0.79*	1.63*	1.10*
2	11.19	11.70	0.00	1.21	2.72	1.76
3	32.01	28.43*	0.00	0.98	3.15	1.77

*, indicates 5% level of significance

Source: Author's estimation

The result of the dynamic ARDL model has presented in Table 5. The outcome of

this investigation explains that, positive relation between exchange rate (LNEXR) and inflation (LNINF). This result also

indicates that a positive association exists between remittances (LNREM) to inflation (LNINF). There is a negative relation exist between the real interest rate (LNRINR) to inflation (LNINF). The dynamic ARDL model shows that the coefficient of LNXER is 0.06 which is positive but statistically insignificant to explain inflation in Bangladesh. The marginal effect of remittance (LNREM) is 0.85 to explain inflation that indicates if a one percent increase of remittance inflows is accelerated the inflation is 0.85% and this estimation is significant at a 10% level. Lag of remittance LNXER(-1) is also a positive impact on inflation in

Bangladesh but this output is not significant by a considerable level. The real interest rate has no positive impact on inflation because its coefficients are negative and significant at 1% lever but the one-period lag of real interest rate LNRINR(-1) is positive to speed up inflation at the significance level at 5%. The coefficient of the assumed trend is negative to explain the inflation by the regression process. The result of short-run dynamics is presented in Table 6 with the error correction term (ECT). The short-run dynamics indicate a similar impact of exchange rate and remittance on inflation.

Table 5: Results of Dynamic ARDL Model

Variable	Coefficient	t-Statistic	Prob.*
LNINF is the dependent variable			
LNINF(-1)	0.31**	2.14	0.04
LNXER	0.06	0.06	0.95
LNXER(-1)	0.44	0.44	0.66
LNREM	0.85*	1.69	0.10
LNREM(-1)	-0.58	-1.35	0.18
LNRINR	-0.84***	-4.76	0.00
LNRINR(-1)	0.30**	1.82	0.05
C	0.34	0.12	0.91
@TREND	-0.03	-0.70	0.49
R-squared	0.58		
Adj.R-squ.	0.49		
F-statistic	5.97		
Prob(F-stat.)	0.00		
D-W stat	2.13		

***, ** and * presents 1%, 5% and 10% level of significance

Source: Author's estimation

The coefficient of real interest is negative and significant, the coefficient is -0.84 at a 1% level of significance, which results explain that consistent interest rate is known as the market rate. The speed of adjustment, term ECT is -0.69 which is negative and significant at 1% level where the estimation process moves towards equilibrium at 69% speed in the particular economy. Moreover, long-run coefficients are showed in Table

7. In the long run, LNXER and LNREM have a positive impact but it's not significant where LNRINR has no positive impact on raises inflation. Estimated coefficients of the long-run cointegration equation are presented in the following equation no 8.

$$\begin{aligned} \text{Cointeq} = & \text{LNINF} - (0.7310 * \text{LNXER} \\ & + 0.3832 * \text{LNREM} \\ & - 0.7800 * \text{LNRINR} \\ & + 0.4969 - 0.0388 \\ & * @\text{TREND}) \end{aligned} \quad (8)$$

Table 6: Results of Short Run Dynamics

Variable	Coefficient	t-Statistic	Prob.
D(LNEXR)	0.06	0.06	0.95
D(LNREM)	0.85*	1.69	0.10
D(LNRINR)	-0.84***	-4.76	0.00
D(@TREND())	-0.03	-0.70	0.49
CointEq(-1)/ECT	-0.69***	-4.80	0.00

***, ** and * presents 1%, 5% and 10% level of significance

Source: Author's estimation

Table 7: Results of Long Run Coefficients

Variable	Coefficient	t-Statistic	Prob.
LNEXR	0.73	0.47	0.64
LNREM	0.38	0.70	0.49
LNRINR	-0.78***	-2.82	0.01
C	0.50	0.12	0.91
@TREND	-0.04	-0.69	0.49

*** presents 1% level of significance

Source: Author's estimation

Table 8: Results of Dynamic ARDL Bounds Test

Test Statistic	Value	k
F-statistic	6.87	3.00
Critical Value Bounds		
Significance Level	10 Bound	11 Bound
10%	3.47	4.45
5%	4.01	5.07
3%	4.52	5.62
1%	5.17	6.36

Source: Author's estimation

Table 9: Results of Residual Diagnostics

Serial Autocorrelation (LM Test)		Heteroskedasticity (BPG) Test	
Obs*R-squ.	Prob. Chi-Squ.	Obs*R-squ.	Prob. Chi-Squ.
1.57	0.46	6.29	0.62

Source: Author's estimation

Therefore, the result of the ARDL bound testing approach is in Table 8. The estimated F statistics is 6.87. Lower bounds are assumed 3.47, 4.01, 4.52 and 5.17 for 10%, 5%, 3% and 1% significance level respectively. Similarly upper bounds are assumed 4.45, 5.07, 5.62 and 6.36 for 10%, 5%, 3% and 1% significance level respectively. The null hypothesis (H_0)

assumed; there are no long-run associations among the variables. The results of F statistics is 6.87 and it exceeds the upper bound at 10%, 5%, 3%, and 1% significance level which rejects the null hypothesis (H_0). The residual diagnostic result is presented in Table 9 where we assumed H_0 is no serial autocorrelation and no heteroskedasticity in the estimation. The evidence shows the Obs*R-squ. for the case of serial

autocorrelation and heteroskedasticity are 1.57 and 6.29 with Chi-Squ. probability 0.46 and 0.62 respectively. This probability is failed to reject the H_0 . Correlogram-Q-statistics for residual diagnostic and CUSUM test for stability diagnostic are also presented in *Appendix-A* and *Appendix-B* respectively. The overall estimation concludes that inflation and remittance nexus is positive, where inconsistent or volatile exchange rate also a positive impact on inflation in Bangladesh but real interest rate has no positive impact on inflation in Bangladesh's economy.

Conclusion

A time series analysis from 1976 to 2019 has been conducted to estimate the nexus between remittance and inflation nexus with considering other monetary factors like exchange rate and real interest rate which are closely related to remittance as well inflation in Bangladesh. World development indicators (WDI) published by World Bank (WB) is the key data source of this study. Whatever, recognizing the importance of remittances to the country's economy, the government is taking steps to boost them. Reducing the cost of remittances to migrants, empowering foreign bank branches and exchange houses to send remittances, bolstering the drawing system of banks and financial institutions in the countries where migrants work, and encouraging them to send remittances through expatriate welfare banks. The workforce export sector is slowly becoming a key issue in Bangladesh's overall socio-economic situation. However, this sector's potential has yet to be completely realized. It should be kept in mind that if the government ramps up diplomatic efforts to boost workforce exports, the

advantages of manpower exports and remittances will flow in the same way as our economy's favorable sectors. Furthermore, the result analysis indicates the mixed order of integration has been founded by using the ADF unit root test where some variables are stationary at $I(0)$ and some are $I(1)$. In that case, we have used a dynamic ARDL model considering the linear trend. The results of the dynamic ARDL model shows the remittance has a positive impact on inflation and similar result found in the short-run case as well as long-run dynamics but insignificant in long run. Bounds testing of dynamic ARDL approach shows F-stat 6.87 which exceeds the upper bound at 10%, 5%, 3%, and 1% significance level. Bound testing indicates the long-run association among the variables. The speed of adjustment, term ECT is -0.69 which is negative and significant at 1% level where assessment procedure moves towards equilibrium at 69% speed in the exacting economy. The remittance would be more effective for Bangladesh's economy if the remittance comes from a formal chain rather informal chain like the Hundi system. When the remittance is controlled by formal management, it has less chance to raise inflation because of government and central banks use this asset through productive investment and welfare programs. The government and Bangladesh Bank have made a number of initiatives to discourage hundi from increasing remittance income in Bangladesh's manpower export sector, but it has not been fully eliminated. Currently, hundi accounts for 23.30 percent of all remittances received in the country, primarily from the Middle East and Korea. Due to the difficulties in sending remittances through banking channels, many expatriates are sending money to the country via hundi. On the

other hand, the government's 2% monetary incentive is playing a critical role in preventing hundi. The remittance should be utilized in productive investment rather than consumption purposes to prevent inflation. Unproductive investment of foreign remittances would be reduced if the small and medium enterprise policies are more flexible and patronized by the government and legal authority. Moreover, safe and productive investment of remittances flows should be the main concentration to protect inflation in the case of remittance-inflation nexus in Bangladesh.

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