Economic Vulnerabilities and the Inflow of Remittance in Bangladesh

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Abstract:

Bangladesh needs to depend on foreign remittance as an essential source of funds for its overall development. The country's position is seventh in the world with respect to remittance recipients (WB, 2022). The economy of Bangladesh has become increasingly integrated with other countries around the globe and as a result, it suffers from economic shocks like the Russia-Ukraine war. In this paper, an initiative has been to explore whether economic shock resulting from economic vulnerability has affected the foreign remittance flow of Bangladesh. To capture both local and international vulnerabilities, variables like local dollar exchange rate, inflation, interest rate, global oil price, and gold price have also been considered in this study as these variables became highly volatile during this crisis. The findings of this study are fascinating as they reveal that contrary to our traditional belief, the dollar exchange rate significantly affects foreign remittance flow, remittance flow is more affected by other economic variables like inflation, interest rate, price of gold and oil, etc.

Keywords: Economic Vulnerability, Exchange Rate, Workers' Remittance, Remitter

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1.0 Introduction

In developing countries, remittance plays a vital role in stabilizing the BOP, mostly in developing countries, increased remittance inflow can support the economy during an economic slowdown and help to recover from the vulnerabilities caused by an economic shock. In Bangladesh, remittance plays a vital role by contributing towards infrastructural development, poverty reduction and economic growth (Khatun and Muntasir 2012). For most developing countries remittance became a reliable source of external funding and accumulation of capital.

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Economic vulnerability which leads to economic shock can be defined as the likelihood that a country's economic development process is hampered by the occurrence of external undesirable and unforeseen events (Guillaumont, 2008). Economics shocks are unexpected events that are beyond control, that dramatically change the economic conditions of the countries exposed to it and leave a significant negative impact on the economy (Geithner 2003). In underdeveloped nations, foreign remittances are considered an essential source of steady household income for the remitters' families. The yearly remittances sent home by South Asian migrant workers are substantial and contribute significantly to the growth and development of both the source and recipient country (Sutradhar, 2020). Remittances are utilized to boost national savings and eliminate pressures on foreign exchange reserves and balance of payments during vulnerable periods of the economy. It also contributes towards the development budget of the recipient country. In developing nations, the four important sources of foreign capital are foreign direct investment (FDI), portfolio investment, workers' remittance, and official development assistance (ODA). Over the last few years, remittance has expanded dramatically as a very important source of foreign currency reserves. Remittances currently exceed development aids by more than threefold and excluding China are more than fifty percent greater than FDI (Ratha, 2021).

The COVID pandemic caused unfavorable developments in most developing economies' external sectors (OECD, 2020). This global pandemic situation has exposed many countries around the globe to an increased risk of recession, currency volatility, increased unemployment, inflation, and price hikes of essential commodities among many other adversities. COVID-19 cases caused mobility restrictions which posed a threat to foreign employment and remittance flow to developing countries. However, Bangladesh performed relatively well in post-pandemic economic recovery and its remittance flow was not adversely affected. The transition from cash to digital transfer channels, which occurred at the height of the COVID-19 pandemic in 2020 helped to keep the remittance flow of Bangladesh uninterrupted. The Bangladeshi Government also offered different support programs from tax waivers and other incentives to keep the remittance flow uninterrupted. As a result of this post-COVID in 2020, Bangladesh experienced an increase in remittance flow by about 6% (USD 23 billion in 2021) (World Bank, 2021).

As a whole the developing countries' remittance is affected by structural characteristics and macroeconomic conditions of both source and recipient economics in times of economic shock. The recipient countries' business cycle is also negatively correlated with remittance flow and the recipient countries' business cycle gets adversely affected in response to exogenous shocks (Bettin, Presbitero, and Spatafora, 2015). After COVID, the Russia-Ukraine war the globe again experienced some sort of economic stock. It created supply chain disruptions around the globe resulting in volatilities in the commodity market. Almost all countries around the

globe suffered economic slowdowns due to unchecked inflation. As economies around the globe are more integrated than ever, the spillover effect of economic shocks has become more pronounced.

As for Bangladesh the first visible challenge after Russia Ukraine war is its depreciating currency value resulting in soaring import costs which created further pressure over its BOP figure which is mostly deficit in nature. Bangladesh registered a current account deficit of $18.7 billion in FY22, which is almost four times greater than the previous year (Bangladesh Bank, 2022). Such circumstance necessitates increased internal short- and long-term borrowings by the government, foreign currency reserve depletion overnight and BOP position becoming vulnerable creating the need for further external debt. In the past few decades, policymakers (Mamun & Kabir, 2023) have tried to establish some relationship between unexpected swings in exchange rates and foreign remittance flow. While the majority of past studies considered the host and home countries' macroeconomic variables (national income, GDP growth, unemployment, etc.) as control variables of respective models (Shah et al., 2022), this study additionally includes the international price levels of relevant essential commodities that affect both the host and home economies as well as the economic agents' decisions. The findings are fresh additions to the body of knowledge as they offer an empirical examination of the impact of local and international economic vulnerabilities on the inflow of remittances in the Bangladeshi context. The volatilities of the exchange rate, interest rate, inflation, gold and oil prices are taken as the proxy for economic vulnerability because these factors become mostly affected in times of economic difficulties. This research's insights are expected to aid policymakers in multiple ways and also open an avenue for further research in this relevant field.

2.0 Literature Review

As the economies of all the countries around the globe have become more integrated than before they cannot avoid economic shocks experienced by any country across the globe. Some of the major economic indicators of a country like GDP, exchange rate, inflation, interest rate etc. get severely affected. The literature study of this paper is organized in two parts, in the first part, a literature review on the significance of remittance towards economic growth of developing countries is briefly explored and in the second part how different economic indicators are affecting remittance flow have been investigated.

There are mostly two threads in the economic literature that connect remittance and exchange rates (Kuncoro, 2020). Firstly, it is based on how remittance inflow affects exchange rates, i.e. remittance-led theories regarding exchange rates and secondly, it is an exchange rate-led hypothesis regarding remittance. Kuncoro (2020) has placed emphasis on neoclassical theory and identified a number of factors on which remittance inflow is dependent. According to him worker's income, the relative price

of the goods/services at the receiving country to the host country, the prices of substitutes and complements (related goods), distance, cost of transportation, qualitative factors in the home country, neighboring countries are the major factors affecting remittance flow. His research mostly focuses on the second thread of literature i.e. exchange rate-led hypothesis regarding remittance, according to him the receiving economies have benefited from the increased economic growth driven by the influx of foreign exchange earnings from workers' remittances. His research also claims that remittance flow has made the recipient countries less reliant on borrowing money from other countries to cover current account deficits and pay for economic development programs.

A study on 71 developing countries was done by Adams (2005), where a strong positive association between growth and poverty has been evidenced. Another extensive study on 39 developing counties is done by Upadhyaya et al., (2008), where they have used panel data from 1980 to 2004 and found a positive impact of remittance on economic growth. Gupta (2009) has done a study on Sub-Saharan countries and found that a stable flow of remittance has a direct poverty-mitigating effect and promotes financial development. Ekanayake et al., (2020) have done a similar study on a few Latin American countries and their study revealed that worker remittances have a positive effect on long-run economic growth but in the short run the effect is mixed.

However, Barajas (2005) came up with a different finding where he has evidenced a negative relationship between remittance flow and economic growth. A recent study on three prominent South Asian countries i.e. Bangladesh, India and Pakistan has been done by Sutradhar (2020) and in the same year by Otoo and Chi (2020) on an African country Ghana and the findings of these are very similar in nature, according to them remittance does not contribute to economic growth because it is not spent on investment or development purpose but on personal consumption and debt payments by the recipient household.

Despite the mixed effect, the importance of remittance is undeniable both at the macro and micro level. As for Bangladesh Abedin et al., (2021) have evidenced a significant positive impact of remittance on domestic investment in the long run. According to him, the depreciation of Bangladeshi currency increases remittance which afterwards increases domestic investment.

In the second part of the literature study, the effect of macroeconomic factors on the amount of remittance flow has been investigated. In the late twenties, Lucas and Stark (1985) have done an interesting study where they discovered personal self-interest as the sole motive to remit money. A year later, Straubhaar (1986) has carried out a study on Turkey, he has investigated the relationship between exchange rates, interest rates and remittance and found both exchange rates and interest rates favorably impact remittances in Turkey. Faini (1994) has again investigated the relationship

between the real exchange rate and remittance and concluded that the real exchange rate crucially affects the volume of remittances.

According to a study conducted by Higgins, Hysenbegasi, and Pozo (2004), where they have tried to find the connection between workers' remittances, exchange rate uncertainty and potential economic return. Their study has concluded when the exchange rate in the recipient country becomes volatile then the volume of remittances is low. Their study has also concluded that if immigrants decide to develop a domestic asset base then the depreciation of their home currency relative to that of the host country would induce them to send more remittances. On the other hand, if they decide to send a set amount of local money back home to help family and friends, they will transfer less. So, there can be a trade-off between the wealth effect and the substitution effect depending on individual preferences. According to the research work done by Amuedo-Dorantes and Pozo (2004), Mexican workers in the US are quite sensitive to changes in the US economy. Their study has observed that remittances went up a lot because there were more risks associated with income in the US. It has indicated the workers' responsiveness to the host country's economic condition.

In the year 2005, a considerable number of studies have been done to find out the factors affecting remittance and these studies covered both the home and host county conditions. According to Aydas, Metin-Ozcan, and Neyapti (2005), the political and economic stability of the home and host county affect the amount of money workers send home. A study done by Chami (2005) has a different focus, he focused on the GDP of the host country and suggested that the host country's GDP has a statistically positive impact on the amount of remittance flow. Chamon et al. (2005) have tried to find the relationship between remittance, economic growth and currency depreciation and observed remittance is positively impacted by the growth and the depreciation of the host country's currency, while for the home country, the impact is negative. Silva (2005) came up with a similar finding but he additionally concentrated on exchange rate volatility i.e. remittance association is positive with home country depreciation and negative with exchange rate. Vangas Silva Huang (2005) has done a study on remittance where it is shown host country's economic conditions have more influence on remittance than that of the home country. Finally, Gupta (2005) has done a study on India and found that political uncertainty, interest rate, and exchange rate depreciation of the home country influence the flow of remittances.

According to Bouhga-Hagbe (2006), devaluation of the home currency has stimulated remittances in the short run but has lowered migrants' confidence in the domestic economy over the long run. Barua, Majumder, and Akhtaruzzaman (2007) have carried out a study on Bangladesh using annual data showed that the depreciation of the native currency is positively associated with workers' remittances in Bangladesh. Hasan (2008) has done another study on Bangladesh where he found domestic rate of

interest, exchange rate and the host country's GDP affect remittance flow positively and significantly.

According to El-Sakka (2008), who has examined the data on the Jordanian economy from 1970 to 2002 and revealed that domestic economic growth is a significant factor in the influx of remittances. The findings also demonstrate that the remittances sent by emigrants are affected by the shifts in the value of the currency exchange rates. Vargas-Silva (2009) observed a bidirectional causal relationship between remittances and exchange rates. Begum and Sutradhar (2012) have done a study on Bangladesh and observed that home and host countries' GDP is an important determinant of remittance flow. Lin (2011) has carried out a study covering the period between 1975 and 2016 and found that a rise in Tongan currency value has some negative effect on the growth of remittances to households. Nekoei (2013) came up with a finding similar to Lin (2011), he has reconfirmed that strengthening of home currency reduces remittance flow because when converted into domestic currency it will result in a lesser amount.

According to a study done by Rahman, Foshee, and Mustafa (2013) on Mexico, the effect of changes in exchange rate on remittance flow is more pronounced and they have also suggested that the recipient country should follow an exchange rate policy that promotes remittance flow from the host to the home country. Ali (2014) has done a study on some Asian countries using a multivariate time series regression model to show the relationship between remittance and a number of independent variables like inflation, deposit interest rate, different skill categories, and exchange rate. In this study, he has observed that deposit interest rate and semi-skilled migrant workers significantly and positively affected remittance flow whereas exchange rate and unskilled workers negatively affected remittance flow.

Datta and Sarker (2014) have done a study on Bangladesh and found that GDP, domestic exchange rate and crude oil price positively and significantly affect remittance inflow in Bangladesh. Mallick and Mahalik (2016) have found that the flow of remittance is influenced by a number of factors such as the growth rate and interest rate differentials between the home and host, per capita income of host countries, along with the household consumption, and development of the financial sector of the home country. A study has been done on Pakistan by Alam, Wasim, and Ahmad (2017) where they tried to identify the factors that will lead to remittance inflow in Pakistan. Their study has revealed that the exchange rate, domestic interest rate, gold prices, political stability, real GDP, development expenditures, and stock market performance are the most significant predictors of remittances over that period. Moreover, the research has demonstrated that exchange rate depreciation leads to positive remittance flow. Another study has been done by Akhter and Masih (2018) on annual remittance figures in Bangladesh has found that annual remittances received are significantly affected by the exchange rate in the long run and investment

motive will also determine how the exchange rate has influenced the remittance flow. Sikandar, Yasin, and Muhammad (2019) have done a study on Pakistan for the period 1973 to 2012 and it is seen that among the numerous macroeconomic indicators, the most important ones influencing remittance flow are exchange rate and inflation. Their study has also revealed a negative impact of exchange rate uncertainty on the inflow of remittances. Rahman, Selim and Haque (2019) have done a study on Bangladesh where they tried to examine the effect of exchange rate and overseas employment on remittance and found that remittance flow increases due to the depreciation of domestic currency and also significantly increases by an increase in overseas employment. Additionally, they have found global oil prices and deposit interest might affect remittance flow in the short run.

Recently, Rahman and Habib (2021) have carried out a study in Bangladesh and concluded that the exchange rate volatility does not have a positive effect on remittance flow. The study also revealed that corruption control has a favorable effect on remittance inflows. Mahmud et. al., (2021) have done another study on Bangladesh to capture the impact of Covid-19 on remittance and found that an increase in exchange rate and petroleum price will increase remittance. Bhatt and Kharel (2021) have also tried to investigate the link between Nepalese remittance inflow (an endogenous variable) and the exogenous variables of exchange rate and workers have found that the devaluation of the Nepalese rupee with the US dollar (or increase in the exchange rate) increases the remittance inflow. Finally, Jijin, Mishra, and Nithin (2021) have also tried to determine the macroeconomic predictors of remittances in India and concluded that currency rate, oil price, and domestic GDP are the prime forecasters. Their findings also revealed that migrants are more susceptible to oil price fluctuations in their host economies.

From the above discussion, it is evident that the remittance flow of developing countries is affected by some economic factors and by the overall economic conditions of the home and host countries. As for Bangladesh, there are a limited number of research works in this area, so in this paper, a further attempt has been made to examine the potential impact of remittance flows during economic vulnerabilities. For this purpose, a monthly data set has been investigated because it will help us to get a clear picture of how the economy of Bangladesh is affected in the last three years due to two major economic shocks i.e. COVID-19 and the Russia-Ukraine war.

3.0 Research Methodology

The above-mentioned brief literature assessment is mostly nation-specific covering different time periods and there is no strong agreement on the causal relationships. This section's goal is to create an analytical framework. A detailed justification of the explanatory and control variables selected for a model developed for this study is

given in the literature study. Pozo (2004), Silva (2005), EI-Sakka(2008), Lin(2011), Mustafa et al. (2013) and many others in different studies have found some association between remittance flow and exchange rate. The exchange rate plays a significant role in determining how much money migrant employees can send home and any change will cause the currency of origin to appreciate or depreciate. In other words, any increase in the value of the currency of origin (or decline in the value of the currency in the home nation) may attract more individuals to work abroad and send back their money. On the other hand, Ali (2014), Datta and Sarker (2014), Halleck and Mahalik (2016), Ahmad et. al. (2017), Muhammad (2019), Rahman and Habib (2021) and many others in different studies have found some association between domestic interest rate, inflation, oil price, gold price and remittance flow. Domestic interest rate and inflation rate play vital roles, especially for the recipient country. In this same connection, the prices of oil, and gold might also influence remittance inflow from abroad because these are interrelated with the exchange rate. As a result, in this study, all these macroeconomic factors have been considered as the representatives of economic vulnerability which might also affect the variability of remittance inflow.

Hence, we can construct the remittances (REM) model which is a function of the exchange rate (TK/USD) (EXR), interest rate (home country) (INR), inflation rate (home country) (INF), gold price (international) (GOLD), and oil price (international) (OIL):

$$\Delta\,(REM) = f\,(\Delta\,(EXR), \Delta\,(Q)) \text{ ---------- (1)}$$

Where Q represents all other macroeconomic variables. More operationally, equation (1) could be transformed into a linear relationship by incorporating other variables:

$$\Delta\,(REM) = \alpha_i + \beta_1 \Delta\,(EXR)_t + \beta_2 \Delta\,(INR)_t + \beta_3 \Delta\,(INF)_t + \beta_4 \Delta\,(GOLD)_t + \beta_5 \Delta(OIL)_t + \varepsilon_t$$

Monthly data have been used for the sample periods from August 2009 to July 2022. We employ the following indicators: worker remittances, exchange rate, interest rate, inflation rate, gold price, and oil price.

Δ (REM) = variability of the sum of remittances, migrants transfer to Bangladesh using the formal channel.

Δ (EXR) = variability of the exchange rate of the US dollar against the domestic currency (BDT) at the monthly average rate.

Δ (INR) = variability of interest rate of scheduled Banks' weighted average.

Δ (INF) = variability of inflation (CPI) rate on a 12-month average basis (Base: 2005-06=100).

Δ (GOLD) = variability of the price of Gold USD/Troy Ounce Gold (London).

Δ(OIL) = variability of the price of Oil USD/Barrel Petroleum (UK Brent).

The total raw observation is 156 sample points. The data are derived from the monthly trends published by the Central Bank of Bangladesh.

To estimate the variabilities of the variables, the techniques used by Devpura and Narayan (2020) have partially been applied here. And hence, this paper used log percentage returns to measure variabilities based on the work of Garman and Klass (1980);

$$Var_t = 0.5*[ln(HR) - ln(LR)]^2 - [2ln2 - 1] * [ln(ER) - ln(OR)]^2$$

where;

Var_t = *the variability of a variable;*

HR = *the highest rate;*

LR = *the lowest rate;*

ER = *the end rate;*

OR = *the opening rate;*

To ensure stationarity of the time series data, lag selection must be done carefully because too many lags could raise forecast errors, and too few could leave out essential information. Three information criterion approaches have been utilized to determine the lag. Schwarz's Bayesian information criterion, Akaike's information criterion, and Hannan and Quinn's information criterion (HQIC). The optimal lag has been found to be one based on SBIC and HQIC for monthly data.

A series with a unit root has many trends and is not stationary. After taking one lag for all variables, the Augmented Dickey-Fuller (ADF) test for stationarity has indicated no unit root in the data. Autocorrelation is the correlation between original and lagged data. The results of the Durbin-Watson alternative test and the Portmanteau test can not confirm that there is no serial correlation at lag order (1). Hence, we have employed an econometrics method called Cochrane-Orcutt estimation for the regressions for correcting first-order autocorrelation in regression analysis. Autocorrelation occurs when the errors in a regression model are correlated with each other. This violates the assumption of independent and identically distributed errors, which can lead to biased estimates of the regression coefficients and incorrect inference.

The Cochrane-Orcutt method involves transforming the original model into a generalized least squares model, which allows for the estimation of an autoregressive parameter that captures the autocorrelation in the errors. This method iteratively estimates the autoregressive parameter until convergence is reached.

Numerous studies have investigated the performance of the Cochrane-Orcutt method compared to the Newey-West estimator and the HAC estimator and have found that Cochrane-Orcutt method performs well in correcting for first-order autocorrelation, while others have found that it may not be robust to higher-order autocorrelation.

A study by Godfrey (1978) compared the Cochrane-Orcutt method to the Newey-West estimator and has found that the Cochrane-Orcutt method was more efficient when the autocorrelation was weak, but less efficient when the autocorrelation was strong. Another study by Payne and Ewing (1997) compared the Cochrane-Orcutt method to the HAC estimator and has found that the Cochrane-Orcutt method was more efficient in small samples but less efficient in large samples. Despite these mixed findings, the Cochrane-Orcutt method remains a widely used method of correcting for first-order autocorrelation in regression analysis. Its simplicity and ease of implementation make it an attractive option for researchers, especially those with limited computational resources.

To further investigate the impacts of those macroeconomic factors on remittance inflows, the Autoregressive Distributive Lag (ARDL) Bound test methodology (Pesaran et al. 1996) has been used in this study. ARDL co-integration technique has a number of benefits in comparison to Johansen and Juselius (1990) and Engle and Granger (1987). The ARDL co-integration technique is particularly effective when the data size is small, can be applied regardless of whether I(0), I(1), or both occur in the order of the regressors and finally avoids evaluating a larger number of criteria, such as identifying deterministic elements and the order of VAR. The ARDL model can be specified as below:

$$\begin{aligned}\Delta\,(REM)_t = {} & \alpha_o + \beta_1 (REM)_{t-1} + \beta_2\,(EXR)_{t-1} + \beta_3\,(INR)_{t-1} + \beta_4\,(INF)_{t-1} \\ & + \beta_5\,(GOLD)_{t-1} + \beta_6\,(OIL)_{t-1} + \sum_{i=1}^{n} \theta_1 \Delta (REM)_{t-1} \\ & + \sum_{i=1}^{n} \theta_2 \Delta (EXR)_{t-1} + \sum_{i=1}^{n} \theta_3 \Delta (INR)_{t-1} + \sum_{i=1}^{n} \theta_4 \Delta (INF)_{t-1} \\ & + \sum_{i=1}^{n} \theta_5 \Delta (GOLD)_{t-1} + \sum_{i=1}^{n} \theta_6 \Delta (OIL)_{t-1} + \varepsilon_t\end{aligned}$$

The augmented ARDL model can be specified as follows:

$$\begin{aligned}(REM)_t = {} & \alpha_o + \sum_{i=1}^{n} \theta_1 (REM)_{t-i} + \sum_{i=1}^{n} \theta_2 (EXR)_{t-i} + \sum_{i=1}^{n} \theta_3 (INR)_{t-i} \\ & + \sum_{i=1}^{n} \theta_4 (INF)_{t-i} + \sum_{i=1}^{n} \theta_5 (GOLD)_{t-i} + \sum_{i=1}^{n} \theta_6 (OIL)_{t-i} + \varepsilon_t\end{aligned}$$

Nevertheless, even after creating such long-term bondage, there is a potential for short-term disequilibrium. The following can be used to estimate the short-run parameters from the error correction mechanism to rectify disequilibrium:

$$(REM)_t = \alpha_o + \sum_{i=1}^{n} \theta_1 \Delta(REM)_{t-i} \sum_{i=1}^{n} \theta_2 \Delta(EXR)_{t-i} + \sum_{i=1}^{n} \theta_3 \Delta(INR)_{t-i} \sum_{i=1}^{n} \theta_4 \Delta(INF)_{t-i} + \sum_{i=1}^{n} \theta_5 \Delta(GOLD)_{t-i} \sum_{i=1}^{n} \theta_6 \Delta(OIL)_{t-i} + \delta\, ECT_{t-1} + \varepsilon_t$$

where δ denotes the speed of adjustments to equilibrium in case of any shock *and* ECT_{t-1} represents the error correction term. The expected sign of the term (ECT_{t-1}) is negative to ensure the convergence to the desired equilibrium path.

Finally, required standard diagnostic tests have been conducted by investigating for heteroscedasticity, the autocorrelation function of the residuals, serial correlation, and normality, to ensure the appropriateness of the statistical approaches.

4.0 Findings and Discussion

The fundamental statistics for all relevant variables, including mean, median, and extreme (maximum and minimum) values, are shown in Table-1. Each median value is relatively close to its respective mean. The proximity of the median to the mean value suggests that the distribution of all relevant variables is normally distributed. Additionally, the range of values—the difference between the minimum and maximum—varies, particularly for remittance inflows. The exchange rate's range and other variables' range values are essentially identical. They are in line with how the standard deviation is set up.

Table-1 : Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Rem	156	1.66	13.54	-39.57	41.6
Exr	156	0.2	0.78	-1.6	5.57
Inr	156	-0.34	1.55	-5.05	5.1
Inf	156	0.05	2.08	-8.04	7.82
Gold	156	0.45	3.38	-6.61	11.84
Oil	156	0.79	9.35	-40.04	32.9
Time	156	78.5	45.18	2009/08	2022/07

Source: Authors' calculations

Variabilities of remittance inflows and exchange rates are shown to be causally linked. As previously mentioned, the increase in remittance inflows is a result of the domestic currency's depreciation. On the other hand, among other variables, only the variability of oil price shows a causal relationship with the remittance variability. This might

happen since the oil price variability influences the income variabilities of the significant remittance senders of Bangladesh.

Table-2 : Causality Test

Pairwise Granger Causality Tests			
Null Hypothesis:	Obs	F-Stat	Prob.
ΔEXR does not Granger Cause ΔREM	154	4.16	0.02
ΔINR does not Granger Cause ΔREM	154	1.32	0.27
ΔINF does not Granger Cause ΔREM	154	0.73	0.49
ΔGOLD does not Granger Cause ΔREM	154	0.88	0.42
ΔOIL does not Granger Cause ΔREM	154	6.06	0.003

Source: Authors' calculations

Afterwards, the following estimations have been done to explore the direction and degree of relationships among the dependent and independent variables.

Table-3 : Estimation Results

	(1) rem	(2) Rem	(3) rem	(4) Rem	(5) Rem
exr	2.596**				
	(2.80)				
inr		1.601*			
		(2.10)			
inf			0.340		
			(1.00)		
gold				0.132	
				(0.56)	
Oil					0.313***
					(3.96)
C	1.102	1.589*	1.587*	1.552*	1.373*
	(1.68)	(2.43)	(2.43)	(2.35)	(2.24)
N	155	154	155	155	155

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Source: Authors' calculations

Variabilities in currency rates have a positive and significant impact on remittance variabilities (Model 1). As a result, when migrant employees send money home, they take the exchange rate market into account. This outcome opposes the findings of Dakila and Claveria, who found that exchange rates have a negligible impact on remittance inflows (2007).

We then plug in other variables in subsequent models and found that interest rate, inflation rate, and oil price variabilities have positive relationships with remittance variabilities (Model 2, 3, 4) which imply that changes in interest rate, inflation rate, and gold price change the remittance inflow. This might also happen due to the impacts of these factors on incomes, savings, and investment decisions. In Model 5, the oil price variability shows positive and significant relationships with the remittance variability. It might imply that the changes in oil prices significantly change the incomes of the remittance senders.

ARDL Bound Test for Co-integration

According to the findings of the ARDL Bound test for co-integration (Table-5). the computed F-statistic (56.893) is greater, compared to other lower and upper bounds at 1%, 2.50%, 5%, and 10% critical values respectively. Because the null hypothesis expresses no co-integration according to the result of the Bound test, the null hypothesis should be rejected. The long-run nexus proved that, over the long term, variabilities of remittance inflows, exchange rates, interest rates, inflations, prices of gold and oil move following a similar pattern. The following sections identify and depict the long-run and short-run characteristics after establishing the co-integrating relationship.

Table-4 : VAR Lag-Length Selection Criteria

Lag	LL	LR	FPE	AIC	HQIC	SBIC
0	-3170.65		2.0e+08	41.8243	41.889	41.9835
1	-2949.86	441.58	2.6e+07*	39.7613*	40.3432*	41.1937*
2	-2891.27	117.19	2.80E+07	39.8324	40.9315	42.538
3	-2842.3	97.939*	3.40E+07	40.0302	41.6465	44.009
4	-2800.55	83.488	4.70E+07	40.3231	42.4566	45.5751

*Note: * indicates the lowest criteria of each variable. Source: Authors' calculations*

Table-5 : Bound test for Co-integration

F-statistic 56.893

Level of Significance	Lower Bound I(0)	Upper Bound I(1)
10%	2.03	3.13
5%	2.32	3.50
2.50%	2.60	3.84
1%	2.96	4.26

Source: Authors' calculations

Long-run Result

The long-run coefficients from Table-6 suggested that exchange rate variability and oil price variability had a positive and significant (at a 10% and 1% significance level) impact on remittance inflows. Remittance variability will increase by 2.4 percent for every 1 percent increase in the exchange rate, and by 0.34 percent for every 1 percent increase in the price of oil. The outcome suggests that external economic conditions due to oil price and local exchange rate may influence the inflow of remittances.

Table-6 : ARDL Long-run Coefficients

Variable	Coefficient	Standard Error	t-statistic	Probability
Exr	2.430073	1.011131	2.40	0.018
Inr	-.3135164	.4543859	-0.69	0.491
Inf	-.0158616	.3347187	-0.05	0.962
Gold	.0697582	.2280906	0.31	0.760
Oil	.3484686	.0849414	4.10	0.000
Food	.3001723	.2584335	1.16	0.247

Source: Authors' calculations

Short-run Result

T result of ARDL short-run coefficients is represented in Table-8. The sign and coefficient associated with the error correction model (ECM) is the most important part of the short-run model. If any shock arises in the short run the error correction term measures convergence towards equilibrium. According to earlier work (Banerjee *et al.,* 1998), an effective ECM term is considered a necessary proof for having a stable long-run relation. The ECM term in our model is negative and statistically significant, confirming the expected adjustment towards the long-run equilibrium.

Table-7 : ARDL Short-run Coefficients

Variable	Coefficient	Standard Error	t-statistic	Probability
exr D1.	-2.014395	1.459132	-1.38	0.170
inr D1.	1.849831	.7106602	2.60	0.010
inf D1.	-.0252003	.7468563	-0.03	0.973
gold D1.	.2004329	.302314	0.66	0.508
oil D1.	-.2632406	.1106975	-2.38	0.019
food D1.	-.077278	.326836	-0.24	0.813
C	1.325113	1.022848	1.30	0.197
CointEq (-1)	-1.57864	0.40231	-5.27	0.000

Source: Authors' calculations

Diagnostic Test

To ensure the suitability of the test results and avoid the misspecification of the model, the conduction of diagnostic tests is necessary to confirm that serial correlation, heteroscedasticity, and non-normality cases will not arise in the case of our long-run coefficients and ECM term. Table-8 shows the ARDL model diagnostic test results.

Table-8 : ARDL Diagnostic Test

Diagnostic Test	Test Statistic	p-value
Autocorrelation LM test	0.932	0.3343
Serial Correlation LM Test	0.932	0.3343
Heteroscedasticity Test	4.05	0.7042
Normality Test	2.7956	0.2478

Source: Authors' calculations

The serial correlation LM is used for testing with serial correlation. When the association p-value indicates that there is no serial correlation the Breusch-Godfrey test is used. The heteroscedasticity test utilized in this instance is the Breusch-Pagan-Godfrey (BPG) test. This model is unaffected by the issue because the null hypothesis indicating no heteroscedasticity cannot be rejected. The Jarque-Bera normality test is adjusted high p-value indicates that the residuals have a normal distribution. Since instability issues may result from incorrect modelling of short-run characteristics, testing the constancy of long-run factors is necessary (Bahmani and Oskooee, 2001). The CUSUM and CUSUMSQ tests are used to achieve this goal and support the model's stability. Recursive residual plots are shown in Figure-1 and Figure-2.

The model is said to be stable by the test if the plots remain within the critical boundaries. Further supporting the model's stability is the fact that the plots of CUSUM and CUSUMSQ residuals shown in Figure-1 and Figure-2 are found inside crucial boundaries at a 5% significance level.

Figure-1: Stability Test (CUSUM Test)

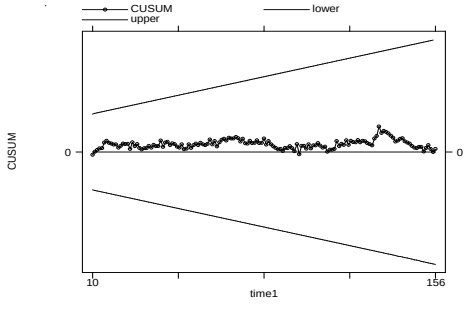
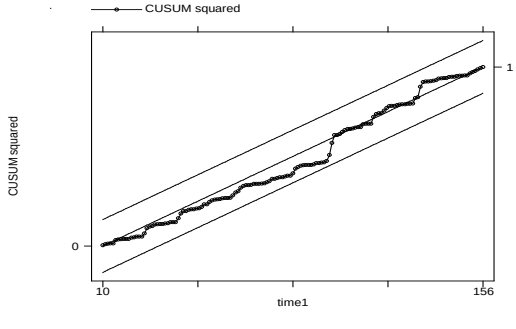


Figure-2: Stability Test (CUSUMSQ Test)



Source: Authors' calculations

5.0 Conclusion

It is significantly perceived that workers' remittances will play a significant role in the country's economic development in the upcoming decades. Nevertheless, it is difficult to locate sufficient studies examining the influence of local and international economic vulnerabilities on workers' remittances in Bangladeshi studies. In this work, considerable effort has been made to investigate the aforesaid matter of adopting high-frequency data. Results provide suggestions regarding some macroeconomic variables that should be closely monitored since the variability of those variables has varying degrees of influence over the variability of remittance inflow. Workers' migration and remittance benefit Bangladesh as an emerging economy. Due to the magnitude of remittance sent by migrant workers, they are often referred to as "Remittance Heroes". Therefore, remittances' role in foreign exchange supply should be a top priority for the monetary authority. In our macroeconomic policy improving the competitiveness of migrant workers abroad must be incorporated to ensure stable exchange rates and maintain appropriate foreign exchange reserves. Policymakers should have a thorough understanding of the factors that might enhance or impede remittance flow. A stable remittance inflow is indispensable for the smooth recovery of the country from any external shocks or economic vulnerabilities. In order to make a more comprehensive study if it was possible to acknowledge the remittance flowing inside the country through informal channels it would have been possible to get a clear idea about the remittance flowing inside the country. The government of our country has taken an initiative by introducing a 2.5% incentive on the remittance flowing from outside countries, if more such initiatives can be taken then it is possible to channel the remittance flowing from informal to formal channels.

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