Determinants and Sustainability of Remittances in Bangladesh: Do Skilled or Unskilled Labor Migrants Matter?

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Research Article

Abstract

Purpose: *Remittances from overseas workers constitute a significant contribution to Bangladesh's foreign exchange earnings. This study aims to examine the major determinants of remittance, with a focus on the skill composition of labor migrants and the sustainability of remittance inflows in Bangladesh.*

Methods: *This paper employed the ARDL Bound testing approach for estimation because of several advantages. To verify the consistency of the ARDL method's results, this study also employed the Dynamic OLS and Fully Modified OLS methods. This study used annual time series data from 1976 to 2021. Data are collected from the Bureau of Manpower Employment and Training, World Development Indicators, and International Financial Statistics.*

Results: *This paper found that unskilled labor migrants are a significant determinant of remittance inflows in Bangladesh. This is a new finding, differing from previous empirical findings for Bangladesh. Moreover, the domestic country's GDP, petroleum price, and exchange rate also significantly influence the inflows of remittances in Bangladesh. Additionally, it was found that remittance inflows followed an upward trajectory, with a sharp increase since 2001 and sustained over the period. By employing the ARIMA (12,1,11) forecasting model using monthly data, it is also found that given the current policies and existing migration trends, remittance flows are expected to increase in the upcoming years.*

Implications: *The findings of this study suggest that the inflow of remittances can be influenced by implementing proper policies in Bangladesh. As unskilled labor migrants are one of the significant determinants of remittance inflow in Bangladesh, it is necessary to explore new countries, except the GCC, based on those countries' needs and willingness to hire migrant workers from Bangladesh. Moreover, allowing the depreciation of exchange rates consistent with economic fundamentals will increase the inflow of remittances in Bangladesh.*

Originality*: This paper focuses on the skill composition of labor migrants as a determinant of remittance inflows and analyzes the sustainability and near-term outlook of remittance inflows in Bangladesh.*

Limitations: *This paper utilizes annual data from 1976 to 2021 and cannot expand the sample period beyond 2021 due to the unavailability of GDP data for certain GCC countries.*

Keywords: Remittances, Sustainability, ARDL, Exchange rate, Bangladesh

1. Introduction

In recent decades, labor migration has become a significant component of the global economy. Substantial reforms in the economies of many developed and emerging countries have opened up opportunities for labor migration. That is why the issue of labor migration has become a great interest of policymakers in many

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countries, and it is one of the fundamental issues of policy dialogue and international cooperation (Islam, 2010). According to estimates by the World Bank, there were 302.1 million migrants worldwide, with 252.0 million of these classified as economic migrants (World Bank, 2024). Bangladesh has a population of 170.0 million, with a population density of 955 persons per square kilometer (BBS, 2023). According to the Bangladesh Bureau of Statistics estimation, the labor force in Bangladesh stands at 73.4 million (aged 15 and above), growing at a rate of 1.9% per year, with a high unemployment rate (BBS, 2023). The unemployed labor force under the age of 25 exceeded 16 million in 2022 (BBS, 2023).

Additionally, a significant number of unskilled and semi-skilled laborers in Bangladesh are underemployed, providing a deep pool of exportable workforce resources (Islam, 2010). The scarcity of employment opportunities in the domestic job market leads many to consider migrating abroad for a better livelihood. Moreover, the Government of Bangladesh (GoB) takes initiatives to export this huge workforce abroad. Exporting a considerable number of unskilled and semi-skilled labor forces abroad creates an opportunity for Bangladesh to earn a considerable amount of remittance income. Remittances from overseas workers constitute a significant contribution to Bangladesh's foreign exchange earnings, playing a crucial role in the country's economy. The sustainability of remittance inflows has become an important policy concern, given their increasing potential for the development of both micro and macro economies, particularly in terms of current account financing. Bangladesh's economy experienced steady growth of more than 6.0% over the last few years before the COVID-19 pandemic outbreak (Bangladesh Planning Commission, 2022). On its path to economic progress, the influx of remittances plays a vital role in bolstering Bangladesh's economy. It is elevating the living standards of recipient households, facilitating national saving and investment, and strengthening the country's foreign exchange reserves. The flow of remittances is one of the major sources of foreign earnings, second only to ready-made garments in Bangladesh (BB, 2023). Bangladesh is the sixth-largest recipient of remittances among developing countries and the 3rd largest among South Asian countries, following India and Pakistan (World Bank, 2024).

Remittance income increased from $24 million in 1976 to $22.1 billion in 2023 (BB, 2023). Moreover, remittance contributed about 69.26% of foreign exchange reserves and accounted for 4.7% of GDP in FY23 (BB, 2023). Remittances also help offset deficits in the balance of trade in goods and services and have a positive impact on the overall balance of payments situation. It is evident from previous empirical studies that inflow of remittances contributed significantly to the economy of Bangladesh through fostering economic growth (Wadood & Hossain, 2015; Ale et al., 2018; Islam, 2021; Upama, 2023; Mostafa & Wadud, 2024), reducing poverty level (Masuduzzaman, 2014; Dey & Basak, 2024; Mostafa & Wadud, 2024), helped in improving balance of payments and increasing foreign exchange reserves (Naima et al., 2025), enhancing national savings (Hossain & Hasanuzzaman, 2013) and increasing velocity of money for the last three decades. During the COVID-19 pandemic, the inflow of remittances remained steady. It surprisingly served as a dynamic source of capital inflows, which was beneficial for a stable balance of payments. Declining the inflow of remittances is a matter of concern for the Bangladesh economy, as it strengthens the economy against any external economic shock. Moreover, the sustainability of remittance inflows is also crucial due to its potential development in both micro and macro economies. Thus, assessing the determinants and sustainability of remittances has been crucial for the Bangladeshi economy in order to inform its monetary and exchange rate policies. Several studies (Nabi, 2009; Nurnaher & Sutradhar, 2012; Islam & Nasrin, 2015; Hasan & Rubayyat, 2015; Ahmed, 2022) conducted empirical research on determinants of remittances in Bangladesh. However, few studies focus on the level of skill of migrant workers, and their findings on skill compositions vary widely. Moreover, none of the previous studies examined the sustainability of remittances in Bangladesh.

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This paper makes two key contributions to the existing literature: (i) focusing on the level of skill of migrant workers as a determinant of remittance inflows and (ii) analyzing the sustainability and near-term outlook of remittance inflows in Bangladesh.
The remaining part of this paper is organized in the following manner. Section 2 presents the Literature review, and Section 3 outlines the data and methodology. Results are found in Section 4. Discussions are described in section 5. Section 6 addresses sustainability and the near-term outlook. Finally, section 7 concludes the paper and offers policy recommendations.

2. Literature Review

Existing theoretical and empirical research suggests that various economic factors, as well as non-economic factors such as political and social factors, influence whether and to what extent migrant workers remit money to their home country. Considering the economic factors, two approaches dominate the existing literature on the determinants of remittances. These are microeconomic factors and macroeconomic factors. The empirical work of Lucas and Stark (1985) is a pioneering research study in this area, and this study developed a model to analyze the remittances of migrant workers at the micro level. In their research, Lucas and Stark (1985) classified workers' remittances as having both altruistic and self-interest motives. Later, other researchers, such as Ilahi and Jafarey (1999), Foster and Rosenzweig (2001), and Agarwal and Horowitz (2002), tested the altruistic versus self-interest motive of remittances at the microeconomic level. Concurrently, other researchers, such as Faini (1994), Glytsos (1997), and El-Sakka and McNabb (1999), investigated the macroeconomic determinants of remittances using aggregate data. In addition to these, some empirical studies have investigated how non-economic factors, such as age,(Cox, 1987; De La Brière et al., 2002); Amedeo-Dorantes & Pozo, 2006), gender (Osaki, 2003; Basilio et al., 2009), family size (Hoddinott, 1994; De La Brière et al., 2002), marital status (Carling, 2008) level of education (Schiopu & Siegfried, 2006; Bollard et al., 2011), intention to return to the home country (Brown, 1997; Glytsos, 1997; Gubert, 2002; Cai, 2003; Bauer & Sinning, 2011), and religious affiliation (Connor, 2011; Roman & Goschin, 2011) contribute to remittance flows to the home country.
Currently, a vast number of empirical studies exist regarding the microeconomic, macroeconomic, and other social and political determinants of remittances, utilizing various econometric techniques and methodologies across different periods and, countries and regions.
Schiopu and Siegfried (2006) investigated the behavior of remittances for altruistic and investment reasons by using a panel dataset of bilateral flows from 21 Western European countries to 7 neighboring EU nations. The findings of this research revealed that altruism played a key role in remittance decisions. Moreover, the correlation between the GDP differential of the home country and host countries and the average amount remitted per migrant was positive and significant.
According to an IMF working paper by Gupta (2005), the increasing flow of remittances to India is attributed to a higher rate of expatriate outflow, growth in migrants' overall income, as well as favorable economic conditions in the countries of origin. The study, however, showed that remittances are insensitive to changes in depreciation of the exchange rate, changes in interest rates, political instability, and fluctuations in oil prices, income, and favorable economic conditions in the countries where these migrants reside.
Alper and Neyapti (2006) studied the determinants of remittance inflow using monthly data from January 1992 to December 2003 for Turkey. It was found that interest rate differentials, inflation, GDP growth, and the black market exchange rate were significant determinants of remittance inflows in Turkey. Faini (2007) investigated the relationship between the skill composition of labor migrants and the inflow of remittances. The findings of this paper stated that skilled migrants send less money to their home country compared to unskilled migrants.
Carling (2008) investigated the factors affecting the variation in remittance flows. The findings of this paper indicate that non-economic factors, such as marital status and the geographical location of recipients, play a significant role in determining remittance flows. Adams (2009) investigated the factors that determine the

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inflow of remittances in developing countries, using the skill level of labor, interest rates, exchange rates, and poverty. The findings of this study revealed that the skill composition of labor is a significant determinant of remittance-receiving countries.

The determinants of remittances to Tonga were analyzed by Lin (2011) using quarterly data from 1994Q1 to 2009Q1 and found that the growth of remittances decreases in the case of Tongan currency appreciation, and it increases with respect to higher GDP growth and lower unemployment rates in host countries.

Zaman et al. (2014) examined the macroeconomic factors influencing remittance inflows to Pakistan using time series data from 1973 to 2010 and employed the autoregressive distributed lag (ARDL) model. The results of the study indicate that the number of migrant workers, income level at home, depreciation of the exchange rate, and rate of inflation at origin matter in the determination of inflows to the country.

Alam et al. (2017) analyzed the economic factors influencing workers' remittances to Pakistan using empirical data analysis, employing annual data for the period 1975-2016 and a multivariate regression and error correction model (ECM). The results of this study showed that real GDP, exchange rate, interest rate, development expenditures, gold prices, stock market performance, political stability, and political instability are the significant antecedents of workers' remittances. Mallick (2017) investigated the key motives behind remittances from migrant workers in 11 major Asian countries using panel regressions. A higher growth rate, interest rate, and capital market returns at home, along with investment and financial deepening, were found to be significant for the inflow of remittances into Asia.

Jijin et al. (2022) examined the macroeconomic determinants of remittances in India using an ARDL approach with quarterly data from 1996Q2 to 2019Q4. They found that domestic GDP, oil price, and exchange rate substantially impact the flow of remittances in India.

Ali and Murtaza (2022) analyzed the macroeconomic determinants of remittances for Pakistan from 1982 to 2017, considering both skilled and unskilled workers. Remittance was found to be positive and significant for unskilled migrant workers while negatively affecting skilled migrant workers.

The macroeconomic determinants of remittance inflows to Nepal were investigated by Acharya and Ojha (2024) from 1993 to 2021 and found that the global oil price, exchange rate, and domestic output influence remittance inflows in Nepal in the long run.

Barua et al. (2007) studied workers' remittances in Bangladesh using bilateral data from 10 major countries from 1993 to 2005. It was found that income differentials between home and host countries, as well as the devaluation of the domestic currency, have a positive correlation with the inflow of remittances in Bangladesh.

The macroeconomic determinants of remittance flow to Bangladesh were examined by Nabi (2009) from 1981 to 2006. The findings of this study revealed that the income of the host and home countries, financial development, exchange rates, and inflation rates play a significant role in remittance inflows in Bangladesh.

A study by Nurnaher and Sutradhar (2012) examined the behavior and determinants of remittance inflows in Bangladesh, utilizing yearly data from 1981 to 2011. It found that some regulatory and institutional measures taken by the Government of Bangladesh (GoB) and the Bangladesh Bank (BB) had an impact on the flow of remittances in Bangladesh.

Using the time series data from 1975 to 2010, Shah and Amir (2011) found that the number of migrant workers, exchange rate, oil price, and GDP at the current market price were significant determinants of remittance for Bangladesh.

Ali (2012) used data from Bangladesh from 1976 to 2011 to identify the macroeconomic factors influencing foreign remittances. According to the study, the coefficients for professional and unskilled migrants were negative and significant, whereas those for semi-skilled migrants were positive and significant.

Islam and Nasrin (2015) investigated the main driving forces of remittances in Bangladesh from 1977 to 2011 using annual data. The results of this study revealed that the GDP of the home country and host

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country, skilled labor forces, exchange rate, and petroleum prices are the major determinants of remittance inflows in Bangladesh.

Hasan and Rubayyat (2015) examined the determinants of remittance flows to Bangladesh using panel data from 13 countries from 2000 to 2014. They found that the number of migrant workers, export, import, consumer price index (CPI), government expenditure, and devaluation of the home country's currency or appreciation of the host country's currency are the major determinants of remittance in Bangladesh.

Barua and Farhana (2020) investigated the effect of macroeconomic factors and financial sector development on remittance flows to Bangladesh using bilateral data from 12 countries from 2005 to 2017. Their results show that host country income differentials vis-à-vis Bangladesh are not statistically significant, suggesting that altruistic motives were not the main motive of remittances during the period examined

Ahmed (2022) studied the macroeconomic determinants of remittances in Bangladesh from 1976 to 2021. He found that, in the long run, the economic conditions of the home country and host countries, as well as the exchange rate, influence the remittance inflow to Bangladesh.

Table 1 Summary of previous studies in the context of Bangladesh

Author(s)	Variables	Period & methodology	Findings
Barua et al. (2007)	Workers' remittances, migration stock, income differentials, nominal exchange rate, real interest rate differentials, inflation differentials.	Panel data, bilateral data of 10 major countries during 1993-2005, feasible GLS method.	Income differentials between home and host countries, as well as the devaluation of the domestic currency, have a positive correlation with the inflow of remittances in Bangladesh.
Nabi (2009)	Remittances flow, stock of workers abroad, domestic GDP, GDP of host countries, exchange rate, domestic inflation, and financial sector development.	Yearly time series during 1981-2007, OLS Method.	The income of the host and home countries, financial development, exchange rates, and rates of inflation play a significant role in remittance inflows in Bangladesh.
Nurnaher & Sutradhar (2012)	Remittance inflow, total migrant workers, exchange rate, host country's GDP, and inflation rate of the domestic country.	Yearly time series during 1980-2011, OLS Method.	The inflation rate of the domestic country and the host country's GDP are significant determinants of remittances inflow to Bangladesh.
Ali (2012)	Foreign remittance, number of workers in foreign countries in professional category, skilled category, semi-skilled category, un-skilled category, CPI, deposit rate, DSE all-share price index, exchange rate.	Yearly time series data during 1976-2011, OLS Method.	Semi-skilled labor migrants, deposit rates, and exchange rates are significant determinants of foreign remittances in Bangladesh.
Islam & Nasrin (2015)	Remittance inflow, exchange rate, domestic GDP, host country's GDP, petroleum price, number of skilled labor migrants, number of unskilled labor migrants.	Yearly time series during 1977-2011, OLS Method.	The GDP of the home country and host country, skilled labor forces, exchange rates, and petroleum prices are the major determinants of remittance inflows in Bangladesh.
Hasan & Rubayyat (2015)	Remittance, final consumption expenditure, general government final consumption expenditure, foreign direct investment, labor force, exports, imports, CPI, and exchange rate.	Panel data, bilateral data from 13 countries during 2000-2014, Pooled OLS, Fixed effects, and random effects Model.	Number of migrant workers, export, import, consumer price index (CPI), government expenditure and devaluation of home country's currency or appreciation of the host countries currency are the major determinants of remittance in Bangladesh.
Barua & Farhana (2020)	Remittances flow, stock of migrant workers, ratio of GDP of home country and host countries, inflation differentials, bilateral nominal exchange rate, and deposit rate in home country.	Panel Data, bilateral data from 12 major countries during 2005-2017, Fixed effects model.	Inflation differential has a significant impact on remittance inflows to Bangladesh.
Ahmed (2022)	Remittance, exchange rate, per capita GDP of the home country, and per capita GDP of host countries.	Yearly time series data during 1976-2021, Johansen co-integration test, and VECM.	The economic conditions of the home country and host countries, as well as the exchange rate, influence the remittance inflow to Bangladesh.

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3. Methodology

3.1.Data and Variables

Existing empirical studies suggest that the main determinants of remittance inflows in Bangladesh are the domestic country's GDP, host counties GDP, petroleum price, exchange rate, and the number of migrant workers going abroad. Thus, this study utilizes annual time series data for all variables from 1976 to 2021 for empirical analysis. Data are collected from the Bureau of Manpower Employment and Training (BMET), World Development Indicators (WDI) of the World Bank, and International Financial Statistics (IFS) of the IMF.

In this study, the inflow of remittance (REM) is defined as money transferred by a migrant worker to their home country. GDP_d denotes the domestic country's GDP and GDP_h denotes the host countries GDP. An increase in GDP_d will eventually increase the inflow of remittances in the home country. Moreover, an increase in GDP_h will also increase the inflows of remittances to home country. The exchange rate (EX) is defined as the exchange rate between the Taka and the dollar. Depreciation of Taka will increase the inflow of remittances in Bangladesh. Migration is defined as the number of migrant workers staying abroad for their livelihoods. The relationship between the number of migrant workers and the inflow of remittances is expected to be positive. The destination of the majority of migrant workers from Bangladesh is the Middle East countries. The most revenue-generating sector in these Middle Eastern countries is the petroleum industry. Therefore, the Petroleum price (PP) is used as a determinant of remittances. The relationship between the inflow of remittances and the price of petroleum is also expected to be positive.

3.2. Model Specification

This study estimated the following log-log models for the period of 1976-2021 to investigate the determinants of remittances inflow to Bangladesh by following previous studies (Nabi, 2009; Nurnaher & Sutradhar, 2012; Islam & Nasrin, 2015):

$$lnREM_t = \beta_0 + \beta_1 lnGDPd_t + \beta_2 lnPP_t + \beta_3 lnEX_t + \beta_4 lnMig_t + \mu_t \dots\dots\dots\dots\dots (1)$$

$$lnREM_t = \beta_0 + \beta_1 lnGDPh_t + \beta_2 lnPP_t + \beta_3 lnEX_t + \beta_4 lnMig_t + \mu_t \dots\dots\dots\dots\dots (2)$$

Here, $lnREM_t$ = log of remittances inflow, $lnGDPd_t$= log of domestic GDP, $lnGDPh_t$= log of GDP of GCC countries, $lnEX_t$= log of exchange rate, $lnPP_t$ = log of petroleum price, $lnMig_t$ = log of labor migrated (unskilled or skilled and or total migrants' workers).

3.3. Estimation Strategy

This study utilizes time series data to examine the determinants and sustainability of remittances in Bangladesh from 1976 to 2021. Due to the non-stationary nature of financial time series data, it is essential to test for stationarity. To avoid spurious regression results, this study first tests the stationarity of all variables employed in Equations 1 and 2 using the ADF test (Dickey & Fuller, 1979) and the PP test (Phillips & Perron, 1988). Secondly, following the results of stationarity, this study estimates the Model by using the Auto Regressive Distributed Lag (ARDL) model prescribed by Pesaran et al. (2001). Thirdly, a co-integration test was conducted to determine whether a co-integration relationship exists among the variables using the ARDL bound test approach. As a co-integration relationship exists among the variables, this study estimates both the short-run and long-run models. Finally, this study examines diagnostic tests, including the Breusch-Pagan-Godfrey test for heteroskedasticity, the Breusch-Godfrey Lagrange multiplier (LM) test for serial correlation, the Jarque-Bera (J-B) test for normality, and the CUSUM and CUSUM of squares test for stability.

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This paper utilizes the ARDL Bound test approach due to its several advantages. First, this approach is the most appropriate method when the variables have a mixed order of integration, specifically I(0) or I(1). Moreover, in the case of small samples, this method is advantageous and provides a more precise estimate. Furthermore, in the presence of endogeneity, the lag specification in the ARDL model gives fair estimations of the long run.

3.4.The ARDL Bound Testing Method

The ARDL method was developed by Pesaran et al. (2001) to test co-integration among the mixed order of variables I(0) and I(1) in the Model. This method combines the Ordinary Least Squares method with the conditional Unrestricted Error Correction Method (UECM). Moreover, following a simple linear transformation, this method can also be used to build a dynamic error correction model (Banerjee et al., 1993). Furthermore, without omitting any long-run information, this method integrates short-run dynamics and long-run equilibrium.

Equation (1) can be presented as follows, with the ARDL specification prescribed by Pesaran et al. (2001) :

$$\Delta lnREM_t = \alpha_0 + \sum_{i=1}^{p} \beta_{1i} \Delta lnREM_{t-i} + \sum_{i=0}^{q} \beta_{2i} \Delta lnGDPd_{t-i} + \sum_{i=0}^{r} \beta_{3i} \Delta lnPP_{t-i} + \sum_{i=0}^{m} \beta_{4i} \Delta lnEX_{t-i} + \sum_{i=0}^{n} \beta_{5i} lnmig_{t-i} + \beta_6 lnREM_{t-1} + \beta_7 lnGDPd_{t-1} + \beta_8 lnPP_{t-1} + \beta_9 lnEX_{t-1} + \beta_{10} lnMig_{t-1} + \varepsilon_t \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (3)$$

The restricted ECM model presented in Equation (3) is defined as follows:

$$\Delta lnREM_t = \alpha_1 + \sum_{i=1}^{p} \beta_{1i} \Delta lnREM_{t-i} + \sum_{i=0}^{q} \beta_{2i} \Delta lnGDPd_{t-i} + \sum_{i=0}^{r} \beta_{3i} \Delta lnPP_{t-i} + \sum_{i=0}^{m} \beta_{4i} \Delta lnEX_{t-i} + \sum_{i=0}^{n} \beta_{5i} \Delta lnMig_{t-i} + \gamma ecm_{t-1} + \epsilon_t \dots\dots\dots\dots\dots\dots (4)$$

Equation (2) can be presented as follows, with the ARDL specification prescribed by Pesaran et al. (2001):

$$\Delta lnREM_t = \alpha_0 + \sum_{i=1}^{p} \beta_{1i} \Delta lnREM_{t-i} + \sum_{i=0}^{q} \beta_{2i} \Delta lnGDPh_{t-i} + \sum_{i=0}^{r} \beta_{3i} \Delta lnPP_{t-i} + \sum_{i=0}^{m} \beta_{4i} \Delta lnEX_{t-i} + \sum_{i=0}^{n} \beta_{5i} lnmig_{t-i} + \beta_6 lnREM_{t-1} + \beta_7 lnGDPh_{t-1} + \beta_8 lnPP_{t-1} + \beta_9 lnEX_{t-1} + \beta_{10} lnMig_{t-1} + \varepsilon_t \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (5)$$

The restricted ECM model presented in Equation (5) is defined as follows:

$$\Delta lnREM_t = \alpha_1 + \sum_{i=1}^{p} \beta_{1i} \Delta lnREM_{t-i} + \sum_{i=0}^{q} \beta_{2i} \Delta lnGDPh_{t-i} + \sum_{i=0}^{r} \beta_{3i} \Delta lnPP_{t-i} + \sum_{i=0}^{m} \beta_{4i} \Delta lnEX_{t-i} + \sum_{i=0}^{n} \beta_{5i} \Delta lnMig_{t-i} + \gamma ecm_{t-1} + \epsilon_t \dots\dots\dots\dots\dots\dots (6)$$

Here, Δ denotes the first differences. The coefficient of the lagged difference variables indicates short-run dynamics. The coefficient of error correction term (ECM) indicates the speed of adjustment to the

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equilibrium after a shock. If the value of γ is less than 0, that indicates the path converges to equilibrium, and the Model will be stable.

4. Estimation Results

4.1.Stationary Test

This paper employed the ADF test, as well as the PP test, to test for the presence of a unit root, considering the challenge of selecting an appropriate unit root test. According to Inder (1993), using both the ADF and the PP test is a safe option when conducting a unit root test. To select the optimal lag, Schwartz Information Criterion (SIC) was utilized. The results of the unit root test are presented in Tables 2 and 3, confirming that none of the variables are I(2).

Table 2: Unit root test results of the ADF Test

Augmented Dicky Fuller Unit Root Test Results				
Variables	**Model**	**Level**	**First Difference**	**Integration**
ln (REM)	intercept & trend	-2.70	-8.27	I(1)
		[0.23]	[0.00]	
ln (EX)	intercept & trend	-1.57	-5.52	I(1)
		[0.79]	[0.00]	
ln (PP)	intercept & trend	-1.98	-7.64	I(1)
		[0.30]	[0.00]	
ln (skilled_mig)	intercept & trend	-3.76	-7.62	I(0)
		[0.03]	[0.00]	
ln (unskilled_mig)	intercept & trend	-3.76	-5.61	I(0)
		[0.03]	[0.00]	
ln (total_mig)	intercept & trend	-4.13	-6.16	I(0)
		[0.01]	[0.00]	
ln (GDPd)	intercept & trend	-0.06	-8.47	I(1)
		[0.99]	[0.00]	
ln (GDPh)	intercept & trend	0.26	-6.38	I(1)
		[0.97]	[0.00]	
P-values are in the parentheses.				

Table 3: Unit root test results of PP Test

Phillips Perron Unit Root Test Results				
Variables	**Model**	**Level**	**First Difference**	**Integration**
ln (REM)	intercept & trend	-5.69	-8.17	I(0)
		[0.00]	[0.00]	
ln (EX)	intercept & trend	-0.71	-5.99	I(1)
		[0.97]	[0.00]	
ln (PP)	intercept & trend	-1.90	-7.85	I(1)
		[0.33]	[0.00]	
ln (skilled_mig)	intercept & trend	-3.63	-17.81	I(0)
		[0.04]	[0.00]	
ln (unskilled_mig)	intercept & trend	-4.21	-5.37	I(0)
		[0.01]	[0.00]	
ln (total_mig)	intercept & trend	-4.19	-12.12	I(0)
		[0.00]	[0.00]	
ln (GDPd)	intercept & trend	0.19	-8.50	I(1)
		[0.99]	[0.00]	
ln (GDPh)	intercept & trend	-0.01	-6.50	I(1)
		[0.95]	[0.00]	
P-values are in the parentheses.				

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It is evident from the unit root test results in Table 2 and Table 3 that the variables employed in equations (1) and (2) are of mixed order of integration. That is why the ARDL model is the best choice for testing the short and long-run relationships among the variables in the models.

4.2. ARDL Bound test results for co-integration

This study employed the bounds test approach to determine whether long-run relationships exist among the variables in equations (1) and (2). The results of the bound tests are reported in Table 4 and Table 5. Based on labor composition, such as skilled, unskilled, and total labor migrants, this study employed the ARDL bound test for three different specifications. Model 1, Model 2, and Model 3 are specified for unskilled labor migration, skilled labor migration, and total labor migration, respectively. Table 4 shows that in all specifications, the estimated F-statistic value is greater than all upper-bound values.

Table 4: ARDL Bound test results for Equation (3)

F-Bound Test for Model-1				
F-Bounds Test			Null Hypothesis: No levels of relationship	
Test Statistic	Value	Significance	I(0)	I(1)
F-statistic	9.55	10%	2.2	3.09
k	4	5%	2.56	3.49
		2.5%	2.88	3.87
		1%	3.29	4.37
F-Bounds Test for model-2			Null Hypothesis: No levels of relationship	
Test Statistic	Value	Significance	I(0)	I(1)
F-statistic	14.79	10%	2.2	3.09
k	4	5%	2.56	3.49
		2.5%	2.88	3.87
		1%	3.29	4.37
F-Bounds Test for model-3			Null Hypothesis: No levels relationship	
Test Statistic	Value	Significance	I(0)	I(1)
F-statistic	15.32	10%	2.2	3.09
k	4	5%	2.56	3.49
		2.5%	2.88	3.87
		1%	3.29	4.37

It indicates the rejection of the null hypothesis and suggests that a co-integrating relationship exists among the variables in the Equation (3). Therefore, the co-integrated relationship between remittances and its determinants is being examined.

Table 5: ARDL Bound test results for Equation (5)

F-Bound Test for Model-4				
F-Bounds Test			Null Hypothesis: No levels of relationship	
Test Statistic	Value	Significance	I(0)	I(1)
F-statistic	3.69	10%	2.2	3.09
k	4	5%	2.56	3.49
		2.5%	2.88	3.87
		1%	3.29	4.37
F-Bounds Test for model-5			Null Hypothesis: No levels of relationship	
Test Statistic	Value	Significance	I(0)	I(1)
F-statistic	4.39	10%	2.2	3.09
k	4	5%	2.56	3.49
		2.5%	2.88	3.87
		1%	3.29	4.37
F-Bounds Test for model-6			Null Hypothesis: No levels of relationship	
Test Statistic	Value	Significance	I(0)	I(1)
F-statistic	3.37	10%	2.2	3.09
k	4	5%	2.56	3.49
		2.5%	2.88	3.87
		1%	3.29	4.37

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This study applied the same specification for Equation (5) to test the bound test, and the results of the bound test are presented in Table 5. The bound test results in Model 4 (specified for unskilled labor migration) showed that the estimated F-statistic value surpasses the upper bound values at the 5% level. Moreover, in Model 5 (specified for skilled labor migration) and Model 6 (specified for total labor migration), the estimated F-statistics exceed upper bound values at the 1% and 10% level, respectively. The bound test results indicate that co-integrating relationship among the variables in Equation (5).

4.3. Long run dynamics

The long-run relationship between remittances and their determinants is examined by relying on the ARDL-bound testing approach. The long-run estimated results of equations (3) and (5) are presented in Table 6 and Table 7.

Table 6: Long run estimation results of Equation (3)

	Dependent Variable: *lnREM*		
Independent Variables	Model-1	Model-2	Model-3
	Coefficients	Coefficients	Coefficients
ln (GDPd)	0.98***	0.92***	0.92***
	[0.095]	[0.108]	[0.135]
ln (PP)	0.52***	0.53***	0.53***
	[0.040]	[0.046]	[0.048]
ln (EX)	1.11***	1.31***	1.21***
	[0.143]	[0.136]	[0.154]
ln (unskilled_mig)	0.12*	…..	…..
	[0.051]	…..	…..
ln (skilled_mig)	…..	0.05	…..
	…..	[0.046]	…..
ln (total_mig)	…..	…..	0.095
	…..	…..	[0.064]
Constant	-10.27	-9.67	-9.88
	[0.806]	[0.916]	[1.077]
S.E. are in parentheses, *** = 1% level of significance, **= 5% level of significance and *= 10 % level of significance			

This paper estimated Equation (3) with three different specifications, considering unskilled labor migrants, skilled labor migrants, and total labor migrants. The long-run results are presented in columns 1, 2, and 3 of Table 6. The first column of Table 6 shows estimated coefficients of domestic GDP ($lnGDP_d$), Petroleum Price (lnPP), Unskilled labor migration abroad (lnunskilled_mig), and exchange rate (lnEX). It is evident from the first column of Table 6 that the coefficient of domestic GDP (lnGDPd), petroleum price (lnPP), and the exchange rate (lnEX) are positive and significant at the 1.0 percent level. Moreover, the coefficient of unskilled labor migrants (lnunskilled_mig) is significant at the 10% level. Furthermore, about 99 percent of the variation in remittance inflow could be independently explained by these four variables.

The coefficient of the domestic country' GDP is positive (0.98) and significant at the 1.0 percent level, and indicates that increasing the home country's GDP will increase the remittance inflow to Bangladesh. The coefficient of the petroleum price (0.52) is positive and significant at the 1.0 percent level, suggesting that an increase in oil prices is likely to increase the inflow of remittances in Bangladesh. The coefficients of unskilled, skilled, and total labor force are 0.12, 0.05, and 0.09, respectively (Table 6). Only the coefficient of unskilled labor is significant at the 10.0 percent level, while the coefficients of skilled labor migrants and total labor migrants are not significant at all. The coefficient of the exchange rate is 1.11. The finding suggests that the depreciation of the Bangladeshi Taka encourages the inflow of remittances to Bangladesh.

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The estimation results of models 2 and 3 suggest that skilled labor migrants and total labor migrants are not significant.

The estimated long-run results of Equation (5) are displayed in Table 7. It is evident from the results that only the coefficients of the petroleum price and exchange rate are significant at the 1% level of Significance. Other variables, such as the GDP of host countries (in the case of GCC countries), unskilled labor migrants, skilled labor migrants, and total labor migrants, are not significant at all.

Table 7: Long-run estimation results of Equation (5)

Dependent Variable: *lnREM*			
Independent Variables	Model-4	Model-5	Model-6
	Coefficients	Coefficients	Coefficients
ln (GDPh)	-0.74	0.32	0.003
	[1.292]	[0.393]	[0.661]
ln (PP)	0.84***	0.60****	0.60***
	[0.319]	[0.116]	[0.174]
ln (EX)	3.11***	2.24***	2.44***
	[1.008]	[0.181]	[0.350]
ln (unskilled_mig)	-0.27	…..	…..
	[0.301]	…..	…..
ln (skilled_mig)	…..	-0.060	…..
	…..	[0.069]	…..
ln (total_mig)	…..	…..	-0.03
	…..	…..	0.128
Constant	5.60	-5.67	-2.81
	[13.642]	[3.794]	[6.380]
S.E. are in parentheses, *** = 1% level of significance, **= 5% level of significance and *= 10 % level of significance			

4.4. Short-run dynamics

The short-run results of Equation (3) are presented in Table 8. It is evident from Table 8 that the short-run coefficients of petroleum price and exchange rates are positive and statistically significant in all specifications.

Table 8: Short-run results of Equation (3)

Dependent Variable: *lnEM*			
Independent Variables	Model-1	Model-2	Model-3
	Coefficients	Coefficients	Coefficients
ln (GDPd)	-5.84	-6.04	-6.13
	[0.000]	[0.720]	[0.717]
ln (PP)	0.12***	0.11***	0.11***
	[0.034]	[0.035]	[0.034]
ln (EX)	0.94***	1.11***	1.07***
	[0.265]	[0.284]	[0.279]
ln (unskilled_mig)	0.14	…..	…..
	[0.031]	…..	…..
ln (skilled_mig)	…..	0.04	…..
	…..	[0.034]	…..
ln (total_mig)	…..	…..	0.063
	…..	…..	[0.042]
CointEq(-1)	-0.88***	-0.78***	-0.78***
	[0.105]	[0.075]	[0.075]
Selected Model	ARDL(2, 2, 3, 4, 1)	ARDL(2, 1, 3, 4, 0)	ARDL(2, 1, 3, 4, 0)
R-squared	0.847	0.817	0.998
F-statistic	877.38	846.91	840.33
Prob(F-statistic)	0.00	0.00	0.00
Durbin-Watson stat	2.25	2.14	2.24
S.E. are in parentheses, *** = 1% level of significance, **= 5% level of significance and *= 10 % level of significance			

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However, the domestic GDP and skill composition of labor migrants are positive but not significant. The estimated lag error term is negative and significant, which implies the existence of a correction mechanism in case of deviation from long-run equilibrium. Short-run estimated results of Equation (5) are shown in Table 9. The determinants of remittances in the short run are not significant.

Table 9: Short-run results of Equation (5)

	Dependent Variable: *ln (Remit)*		
Independent Variables	Model-4	Model-5	Model-6
	Coefficients	Coefficients	Coefficients
ln (GDPh)	-1.36	-0.83	-0.88***
	[0.246]	[0.216]	[0.260]
ln (PP)	0.03	0.05	0.01
	[0.041]	[0.043]	[0.043]
ln (EX)	0.38	0.89***	56.00
	[0.366]	[0.369]	[0.384]
ln (unskilled_mig)	0.14	…..	…..
	[0.043]	…..	…..
ln (skilled_mig)	…..	-0.030	…..
	…..	[0.040]	…..
ln (total_mig)	…..	…..	-0.09
	…..	…..	0.107
CointEq(-1)	-0.27***	-0.54***	-0.38***
	[0.051]	[0.095]	[0.076]
Selected Model	ARDL (3, 2, 4, 4, 2)	ARDL (3, 3, 3, 4, 0)	ARDL (4, 3, 4, 4, 0)
R-squared	0.812	0.771	0.789
F-statistic	556.05	485.82	455.17
Prob(F-statistic)	0.00	0.00	0.00
Durbin-Watson stat	2.28	1.90	1.92
S.E. are in parentheses, *** = 1% level of significance, **= 5% level of significance and *= 10 % level of significance			

4.5. Diagnostic Tests

The diagnostic test results are represented in Table 10. The heteroscedasticity test results indicate that the variance of the error components in the Model remains constant, which reflects the presence of homoscedasticity in the Model. The LM test results suggest that indicates that autocorrelation does not exist among the variables in the Model.

Table 10: Diagnostic Test Results for model-1 of Equation (3)

Diagnostic Tests		
	Coefficients	Prob
Heteroskedasticity Test (Breusch-Pagan-Godfrey)	1.041	0.451
Serial Correlation LM Test (Breusch-Godfrey)	1.841	0.181
Normality Test (J-B)	0.05	0.977
Cusum test	Stable	
Cusum of square test	Stable	

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The CUSUM and CUSUM of square tests were employed to test the stability of the Model over time, and the results show that both are stable. It is evident from Figures 1 and 2 that, at a 5% significance level, the Model is stable, as the residual values remain within the confidence intervals.

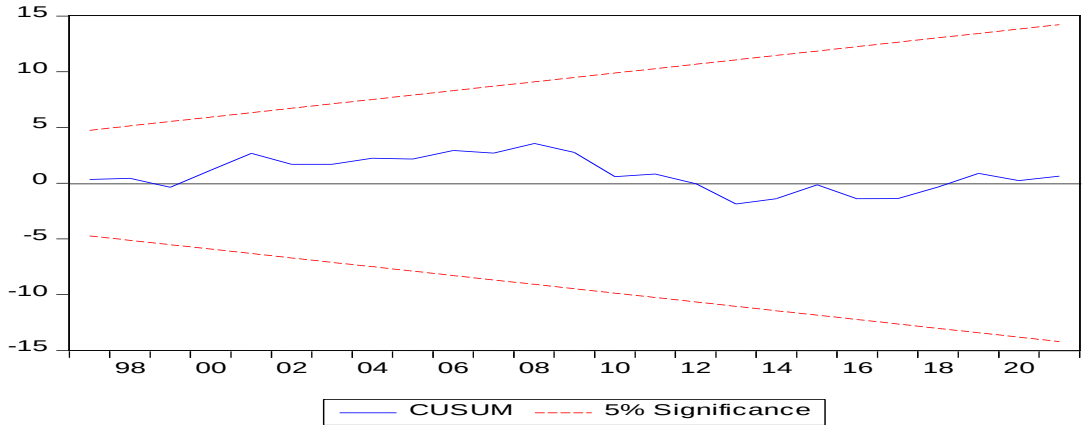

Fig.1: CUSUM

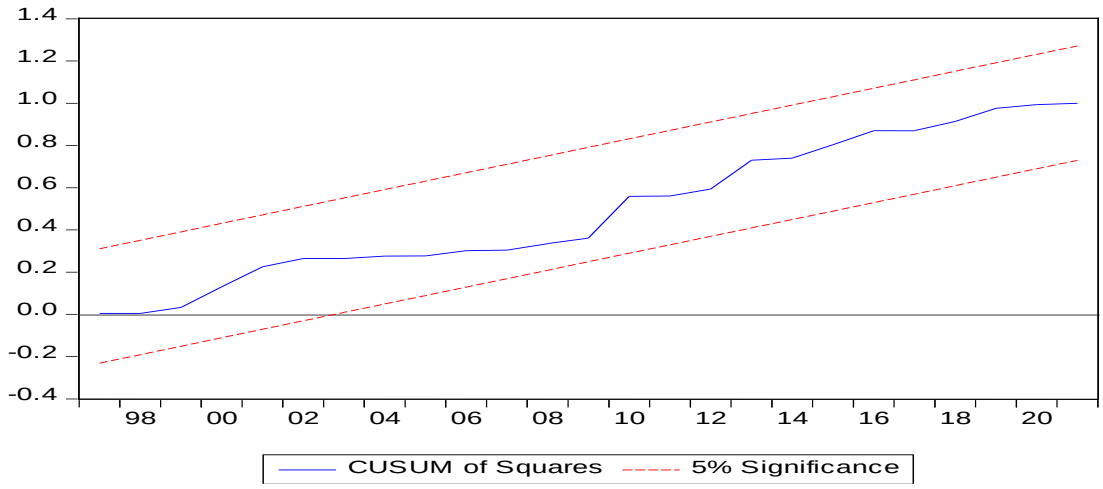

Fig 2: CUSUM of square

4.6. Robustness Check

It is essential to test the sensitivity of long-run parameters obtained from the ARDL before concluding the study. Therefore, to verify the consistency and robustness of the ARDL method's results, this study employed the Dynamic OLS (Stock & Watson, 1993) and Fully Modified OLS (Phillips & Hansen, 1990) methods.

Table 11: Estimation Results of Dynamic Least Squares (DOLS)

Dependent Variable: *ln (REM)*				
Independent Variables	Coefficient	Std. Error	t-Stat	Prob.
ln (GDPd)	0.77***	0.10	7.80	0.00
ln (PP)	0.53***	0.07	7.93	0.00
ln (EX)	0.85***	0.22	3.82	0.00
ln (unskilled_mig)	0.32***	0.09	3.63	0.00
Constant	-9.37***	0.83	-11.29	0.00
***= Significance at 1% level.				

Dynamic OLS (DOLS) is an estimation approach suggested to solve the finite sample bias of OLS caused by endogeneity issues when estimating regression models based on co-integrated variables. This Model can address simultaneity bias as well as small sample bias by incorporating both leads and lags (Kurozumi &

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Hayakawa, 2009). Moreover, Fully Modified OLS (FMOLS) is a semi-parametric estimation approach that provides consistent parameters even with small sample sizes. This approach effectively addresses the problems of endogeneity, serial correlation, omitted variable bias, and measurement errors, and allows for heterogeneity in the long-run parameters.

Table 12: Estimation Results of Fully Modified Least Squares (FMOLS)

Dependent Variable: *ln (REM)*				
Independent Variables	Coefficient	Std. Error	t-Statistic	Prob.
ln (GDPd)	0.84***	0.15	5.76	0.00
ln (PP)	0.38***	0.08	4.84	0.00
ln (EX)	0.84***	0.27	3.08	0.00
ln (unskilled_mig)	0.35***	0.10	3.44	0.00
Constant	-10.39***	1.12	-9.28	0.00
***= Significance at 1% level				

This study re-estimates Equation (1) and Model 1 using the DOLS and FMOLS, and the estimated results are presented in Table 11 and Table 12. The estimated results of DOLS and FMOLS reconfirm the findings of the ARDL model. The estimated results of DOLS and FMOLS indicate that GDP in the domestic country, petroleum prices, exchange rates, and the unskilled labor force are significant determinants of remittance in Bangladesh.

5. Discussions

Remittance is one of the major sources of foreign currency for Bangladesh, and a decline in remittance inflows has become a matter of concern for the Bangladeshi economy. Therefore, inflows of remittances are considered the lifeline of the economy, especially helping cushion the deficit in the balance of payments. The estimation results indicate that the domestic country's GDP is positive and statistically significant in the long run, suggesting that GDP has a positive and significant impact on remittance inflows in Bangladesh. This finding aligns with the findings of Shah and Amir (2011) and Islam and Nasrin (2015) for Bangladesh, highlighting the investment behavior of migrant workers. It also suggests that under the poor economic conditions of the domestic country, Bangladeshi migrants send more remittances to Bangladesh. On the other hand, the GDP of source countries (GCC countries) is not statistically significant, which contradicts the findings of Hasan (2008). Considering the composition of the labor force, it is found that only the number of unskilled workers is statistically significant.

In contrast, the number of skilled labor migrants and total labor migrants is not statistically significant. These are new findings and differ from the results of previous studies such as Shah & Amir (2011), Ali (2012), Islam & Nasrin (2015), and Hasan & Rubayyat (2015) for Bangladesh but are similar to those of Faini (2007) and Adams (2009) for other countries. The finding suggests that, with a large number of unskilled labor migrants going abroad, Bangladesh received more remittances. This is a crucial finding, as most migrant workers from Bangladesh are unskilled and stay in the GCC countries temporarily. Therefore, they tend to send more money to the country as they plan to return to Bangladesh. Moreover, they are more concerned about their family's livelihood. The coefficient of the exchange rate is positive and significant, indicating that depreciation of the exchange rate increases the inflows of remittances. This is because, as the Bangladeshi Taka depreciates, there are incentives for migrant workers to remit more money to the country, as their families receive a higher amount. The coefficient of the exchange rate is greater than unity, implying that the exchange rate has a more significant influence on remittance inflows in Bangladesh. This finding is consistent with the findings of Nabi (2009), Hasan (2008), Shah and Amir (2011), Ali (2012), Islam and Nasrin (2015), and Ahmed (2022). The coefficient of petroleum price is also positive and significant, indicating that if the petroleum price increases, the migrants' labor sends more money to Bangladesh. The finding aligns with the findings of Shah and Amir (2011) and Sarkar and Datta (2014).

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Most of the migrant workers from Bangladesh are in the oil-rich Gulf Cooperation Council (GCC) countries. Therefore, the rise in petroleum prices can increase their ability to send more money. The positive and significant coefficient of oil price implies that oil shocks may hinder the inflows of remittances in Bangladesh.

The sustainability of remittance inflows has become an important policy concern, given their increasing potential for the development of both micro and macro economies. Therefore, this study analyzed the sustainability of remittances by using a trend line. Statistically, a variable's sustainability can be measured by observing its trend line trajectory. Moreover, trend lines are used to visualize and interpret the long-term behavior of a variable. Therefore, in analyzing the sustainability of remittance inflows, this study utilizes the trend line. The trend line in Figure 3 demonstrates that remittance inflows followed an upward trajectory, with a sharp increase since 2001, representing steady growth over the period. Interestingly, it is observed from the trend line of remittance inflows during the period of shocks, which tend to surge beyond expectations. Particularly, this phenomenon becomes most noticeable during the global financial crisis (2008-2009) and the COVID-19 pandemic (2020-2021) periods. This happened due to the altruistic behavior of remittance during the shock period.

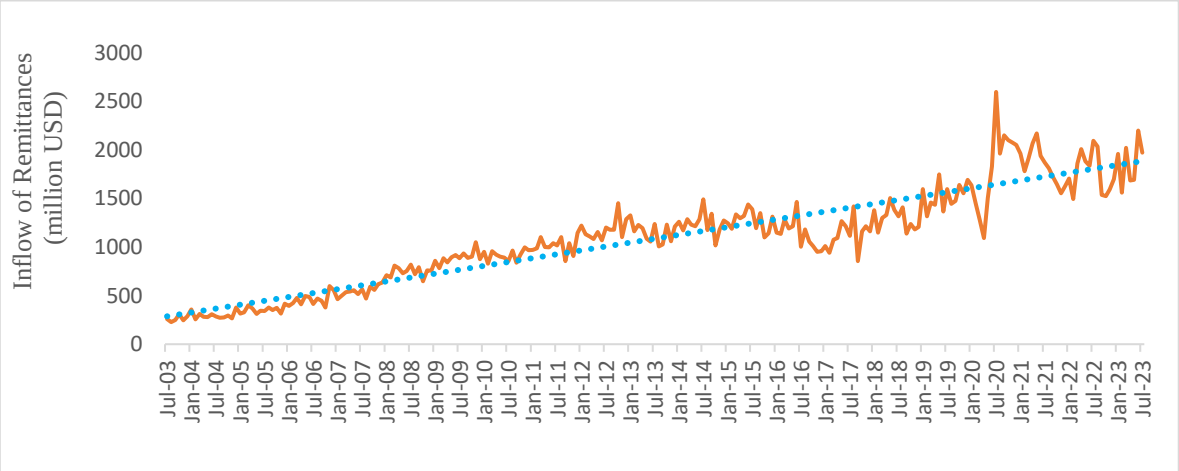

Fig. 3: Trends of Remittances

To analyze future remittance behavior, this study forecasts a simple ARIMA (12,1,11) model by using monthly data for the next five years. Figure 4 displays both the forecasted values and the actual values. It is clear from Figure 4 that, given the current policies and existing migration trends, remittance flows are expected to increase in the upcoming years.

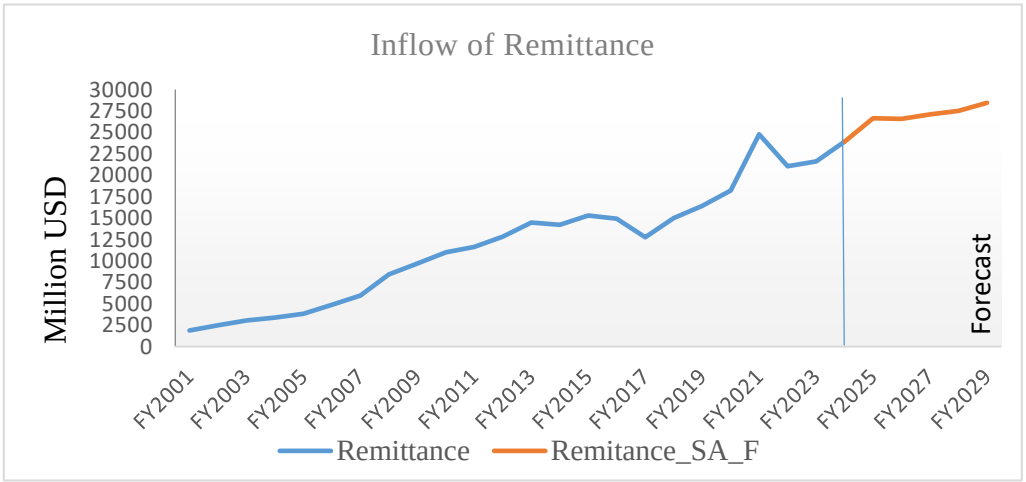

Fig. 4: Actual and Forecast of Remittances

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6. Conclusion and policy recommendations

This study aimed to investigate the determinants of remittances with special consideration of the skill composition of labor migrants and its sustainability during the period from 1976 to 2021. By employing the ARDL, DOLS, and FMOLS, it found that the coefficient of unskilled labor migrants is a significant determinant of remittance inflows in Bangladesh. This is a new finding, differing from previous empirical findings for Bangladesh. Other variables, such as the domestic country's GDP, petroleum prices, and exchange rates, also significantly influence the inflows of remittances in Bangladesh. Moreover, it was found that remittance inflows followed an upward trajectory, with a sharp increase since 2001 and sustained over the period. By employing the ARIMA (12,1,11) forecasting model using monthly data, it is also found that, given the current policies and existing migration trends, remittance flows are expected to increase in the years to come. The findings of this study suggest that the inflow of remittances can be influenced by implementing proper policies in Bangladesh. As unskilled labor migrants are one of the major determinants of remittance inflow in Bangladesh, it is necessary to explore new countries, except the GCC, based on those countries' needs and willingness to hire migrant workers from Bangladesh. Moreover, the coefficient of the exchange rate is greater than unity, implying that the exchange rate has a more significant influence on remittance inflows in Bangladesh. Therefore, BB may allow the depreciation of exchange rates consistent with economic fundamentals. Exchange houses in corresponding host countries should be more active in keeping in touch with migrant workers. The government can offer incentives to the exchange house to allow them to charge no fees for all types of remittances. Bangladesh's mission abroad may need to play a significant role in increasing the remittance inflow. In this case, they might provide technical support to those who are being denied due to a lack of proper documentation of migration.

7. Limitations and Directions for Future Studies

This paper utilizes annual data from 1976 to 2021 and cannot expand the sample period beyond 2021 due to the unavailability of GDP data for some GCC countries. Future research can extend the sample period beyond 2021. Moreover, some other macroeconomic variables, such as inflation differential and deposit rate in the home country, can be included in the econometric Model as important determinants of remittances in Bangladesh.

Conflict of interest: The author declares no conflict of interest.

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