

Labor Migration and Economic Growth Nexus in Bangladesh: An ARDL Approach to Co-Integration Analysis

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Abstract

Accelerated globalization and the thirst for economic emancipation of the people create demographic shifts from developing countries to developed countries. To assist policymakers in effective decision making regarding labor migration and economic growth, our paper explores the hidden dynamics between labor migration and economic growth in Bangladesh from 1988 to 2020. The study was developed based on the auto regressive distributed lag (ARDL) framework to capture long-run and short-run dynamics among the variables. To find the directional relationship, we also perform the Toda Yamamoto causality test to find the short-run impact on the dependent variables. The existence of co-integration among the variables is demonstrated by the bounds test result. The empirical results show the long and short-run positive significant relationship between international labor migration and exchange rate. However, there is no significant impact of inflation and GDP on labor migration from Bangladesh. The causality approach indicates a unidirectional causality between labor migration and exchange rate, GDP growth and exchange rate. This study suggests that the devaluation of the local currency against US dollar can boost labor migration from Bangladesh.

Keywords: labor migration, economic growth, ARDL, co-integration, causality, Bangladesh.

I. INTRODUCTION

Globalization itself increases the demand for foreign workers through which low- and middle-income labor-exporting countries create economic transformation that is a significant driver of international labor migration. Noticeably, this geographical shift for migration is commonly occurs from global south to the global north region (Tipayalai, 2020). Also, south-south migration trends are also increasing rapidly because of the tendency of laborers to migrate from less-developed economies to newly emerging countries in the developing world (Hujo & Piper, 2010). Therefore, this sort of migration is undoubtedly interlinked with a labor exporting and importing country's economy. Although rapid economic growth is viewed positively, it has a negative effect on socioeconomic factors (Wang & Conesa, 2022).

Bangladesh is one of the world's most important labor exporters. Every year, a substantial number of individuals willingly relocate to another country for both long and short-term jobs. Since 1976, about 13 million Bangladeshi laborers have moved to around 165 countries for work. Among them, 916,463 were female migrant workers between the

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years 1991 to 2020. Approximately 10 million Bangladeshis are residing overseas, with 2.4 million permanent migrants. Bangladesh is now the fifth most migrant export country in the world. The Gulf Cooperation Council (GCC) member states are the most prominent destinations for Bangladeshi migrants. According to the IOM report 2020, more than 5 million migrants are living in the Gulf States, contributing over 65% of total overseas migration from Bangladesh. Undoubtedly, the results of this labor migration directly support poverty reduction and boost the rural economy as the majority percent of the laborers are rural unskilled people.

According to the (ICT Division Bangladesh, 2020) report, Bangladesh received \$18.32 billion in remittances in 2019, representing around 40% of Bangladesh's total foreign exchange earnings. Income from labor migration was the key contributor to Bangladesh towards becoming a lower-middle-income country in 2015. With the trend of fastest-growing economies, Bangladesh is registering as a developing nation, which has raised some questions such as: (1) Is there any short-run or long-run nexus between labor migration and economic growth factors? (2) Does any unidirectional or bidirectional, or no directional causality exist between the aforementioned factors? Thus we are expecting to employ a quantitative simulation from the perspective of Bangladesh.

Of course, we are not the first to look at Bangladesh's economic growth. Some studies (Paul et al., 2011; Datta & Sarkar, 2014; and Bairagi & Kamal, 2019) are tried to find out the relationship between the output of labor migration (remittances) and the economic growth of Bangladesh. However, despite the widespread perception direct impact of the labor migration that boosts output, there is no solid evidence in the literature to support this claim from the perspective of Bangladesh. Therefore, our study is designed to look over the aforementioned objective following a comprehensive review of literature, research methods for ARDL, co-integration analysis, short-run and long-run impact analysis, and causality analysis to find the directional relationship among the variables such as GDP, inflation, exchange rate, and labor migration.

II. LITERATURE REVIEW

Previous study has shown that worldwide migration has increased dramatically over the last fifty years, despite the fact that people are traveling to long-distance countries to meet their needs (Arango, 2000). Globalization, diversity, and economic progress were identified as the key drivers of international migration (Czaika, 2015). According to previous studies (Morley, 2006; Asad et al., 2016; Keita, 2016; and Öztürk & Özdil, 2020), there is a mixed association between international labor migration and economic development in origin countries. Furthermore, a few research investigated the relationship between international labor migration and economic development using the ARDL model (Khan et al., 2019).

Tipayalai (2020) examined the connection between international labor migration and Thailand's regional economic development. Economic growth was considered as a dependent variable in the study, with physical capital, high and low skilled workers serving as independent variables. The information was gathered in between 2003 to 2015. The study discovered that there is a significantly positive association between international skilled labor migration and regional economic development in Thailand employing panel data regression analysis.

Asad et al. (2016) conducted research in Pakistan to evaluate the relationship between labor migration and economic growth. From 1975 through 2010, the study gathered annual data from different sources including the world bank database, the world economy database, and the international labor organization (ILO) database. The data was

analyzed using a variety of econometric methodologies. The multivariate and bivariate co-integration technique used by Johansen and Juselius (1990) discovered a long-run relationship between labor migration and economic growth. According to the Granger-causality method, there was a unidirectional relationship between labor migration and economic growth. Finally, the OLS estimations indicated that labor mobility has a significant positive impact on economic growth. Furthermore, the vector error correction model (VECM) demonstrates that labor migration has no impact on economic growth in Pakistan since remittances from labor migration are rarely used for investment but rather for spending.

Keita (2016) investigated the effect of migratory movements on bilateral exchange rates and hence the economic growth. From 1980 to 2011, data was collected from 30 OECD countries. The study took into account an equation derived from a model (micro-founded random utility maximization) that is used for non-observed heterogeneity between non-migrants and migrants. The study discovered that migration has a considerable impact on the bilateral exchange rate, and thus on the economy's growth. The study also discovered that a 10 percent real appreciation of the destination country's currency is directly linked to an increase in international migration flows of 18.2–19.4 percent.

Morley (2006) investigated the relationship between per capita GDP and labor migration in Australia, Canada and USA using the auto regressive distributed lag (ARDL) estimations and Granger-causality test. The annual data was gathered between 1930 and 2002. According to ARDL estimates, per capita GDP and labor migration have a long-term association. In the long term, the Granger non-causality test indicated that there is a one-way or unidirectional causality between per capita GDP and labor migration. Furthermore, the Granger non-causality technique demonstrates that there is no short-run causality between per capita GDP and labor migration. Similarly, Salt (1992) researched the future of international labor mobility and found that developing countries are enhancing their economies through expanding labor movement.

Öztürk and Özdil (2020) looked into the association between per capita GDP and migratory flows in 19 countries that are members of the Organization for Economic Cooperation and Development (OECD). The annual data was gathered from the OECD database from 1990 to 2016. The study used the auto regressive distributed lag (ARDL) model to examine the data. In the long run, ARDL estimation revealed a significant positive connection between per capita GDP and migratory flows. Furthermore, the analysis discovered a short-run negative association between per capita GDP and migrant flows in 19 OECD nations. Kelley (1965) investigated international labor migration and economic growth in Australia for 70 years, from 1865 to 1935. The study discovered that international labor mobility has a positive influence on the economic growth of Australia.

The influence of remittances from foreign labor migration on Pakistan's economic development was studied using the auto regressive distributed lag (ARDL) model (Khan et al., 2019). According to the study, remittances, gross domestic savings, and foreign direct investment all had a positive and significant association with GDP, whereas inflation and consumption had a negative and significant relationship with Pakistan's economic progress. In Pakistan, Faheem et al. (2020) investigated the relationship between migrant remittances and economic growth. The study indicated that migrant remittance has a favorable significant relationship with Pakistan's economic growth using the linear auto regressive distributed lag (ARDL) and the nonlinear auto regressive distributed lag (NARDL).

The association between migrant remittance influx and economic development was investigated using the granger causality test under the vector auto-regression (VAR) model using time series data in Bangladesh, Sri Lanka, and India from 1977 to 2006 (Siddique et al., 2012). The study showed significant, insignificant, and bidirectional or two-way relationships between international migrant remittance influx and economic development in Bangladesh, India, and Sri Lanka over the study period. Aboulezz (2015) also used ARDL estimations to investigate the relationship between migrant remittance inflow and economic development in Kenya from 1993 to 2014, and concluded that remittance inflow had a significant impact on the country's economic progress.

Different studies have applied the diverse approaches to evaluating the relationship between international labor migration and economic development and found mixed results. The results vary depending on the nation, data size, and variables. As a result, more research on this topic is needed to contribute to the literature that will aid in drawing conclusions about the actual relationship. A few papers are used the ARDL model to study the relationship between labor migration and economic development. So, in this paper we will try to contribute to the literature gap.

III. RESEARCH METHODOLOGY

3.1. Data Collection

In our study the data is based on the secondary in nature, which is collected from the website of Bangladesh Bank (Central Bank of Bangladesh) in between 1988 to 2020. To measure the significant impact of labor migration on the economy growth, a total number of four variables are used in our study. Where the dependent variable (number of migrant workers) and the other three independent variables (inflation rate, exchange rate, gross domestic product (GDP) growth was selected as indicators of macroeconomic change.

Table 1

Literature Survey Based on Methodology

Author (s)	Sample and Period	Methodology	Major Finding (s)
Morley (2006)	Australia, Canada, and USA (1930 to 2002)	ARDL estimation and Granger-causality test.	According to ARDL estimates, per capita GDP and labor migration have a long-term association. The Granger-causality test revealed that per capita GDP and labor migration had a one-way or unidirectional causal relationship.
Jawaid and Raza (2012)	China and Korea (1980-2009)	Johansen co-integration method, Error correction model (ECM) and Granger causality test.	In the short run, there was a significant positive association between migrant remittance inflow and economic development in Korea, whereas this relationship was insignificant in China. The study also discovered a one-way or unidirectional association between migrant remittances and economic progress in both countries.
Siddique et al. (2012)	Bangladesh, Sri Lanka, and India (1977-2006)	VAR model, Granger causality test.	International migrant remittance inflows and economic development in Bangladesh, India, and Sri Lanka had significant, insignificant, and bidirectional or two-way relationships.

To be continued Table 1.

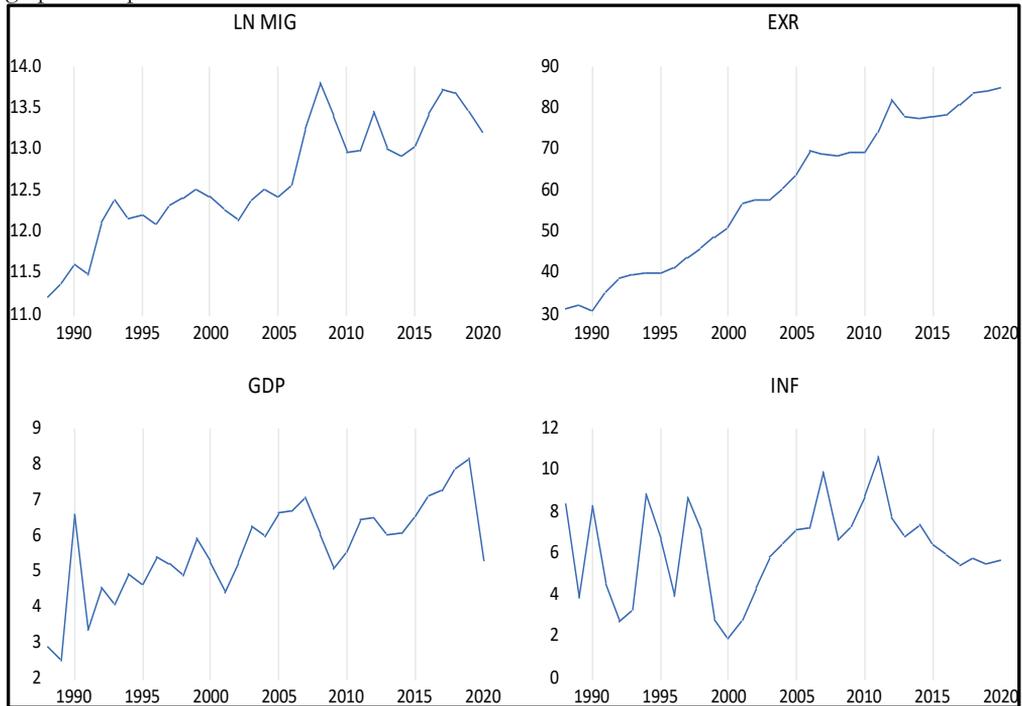
Author (s)	Sample and Period	Methodology	Major Finding (s)
Asad et al. (2016)	Pakistan (1975 to 2010)	Johansen and Juselius co-integration, Granger-causality approach, OLS estimations and VECM.	The long-run association between labor migration and economic growth was discovered using the co-integration technique. There was a unidirectional relationship between labor migration and economic growth. The OLS estimations indicated that labor mobility has a considerable beneficial impact on economic growth. Furthermore, the vector error correction model demonstrates that labor migration has insignificant impact on economic growth of Pakistan. Since remittances from labor migration are rarely used for investment but rather for spending. The study discovered that migration has a considerable impact on the bilateral exchange rate, and thus on the economy's growth. The study also discovered that a 10% real appreciation of the destination country's currency is directly linked to an increase in international migration flows of 18.2%-19.4%.
Keita (2016)	30 OECD countries (1980 to 2011).	Micro-Founded Random Utility Maximization (RUM)	In Pakistan, remittance inflow, gross domestic savings, and foreign direct investment all had a significantly positive association with GDP, whereas inflation and consumption had a significant and negative relationship with economic development.
Khan et al. (2019)	Pakistan (1976-2016).	ARDL model and Granger-causality test.	Migrant remittances had a positive and significant impact with Pakistan's economic growth.
Faheem et al. (2020)	Pakistan (1976-2018)	ARDL and non-linear ARDL.	According to ARDL estimates, per capita GDP and migrant flows have a positive long-term association but a negative short-term relationship.
Öztürk and Özdil (2020)	OECD Countries (1990-2016)	ARDL estimation.	In Thailand, there is a strong relationship between international skilled labor migration and regional economic development.
Tipayalai (2020)	Thailand (2003-2015)	The panel data regression analysis.	

Table 2
Summary of the Operationalization of the Variables

Variable	Acronym	Operationalization
Dependent Variable:		
Migration of Workers	LN MIG	The natural logarithm of the number of migrant workers from Bangladesh to abroad.
Independent Variables:		
Inflation Rate	INF	Inflation rate of Bangladesh.
Exchange Rate	EXR	Exchange rate of US Dollar to Taka.
Growth of Gross Domestic Product	GDP	The growth of all finished goods and services in economy.

Figure 1
Graphical Representation of the Variables

The variables in our study are time series data in nature. The data is collected from the time period 1988-2020 in Bangladesh. The following graphs of dependent and independent variables have consistency and stability over the time period. No negative values were found, as we see in the graphical representation of the variables below:



3.2. Auto Regressive Distributed Lag (ARDL) Approach

Several research papers are investigated in our study to find the short-run and long-run relationships between dependent and independent variables. Furthermore, different methods are used in the methodological literature survey to find the optimal relationship within the variables, such as ARDL, Granger-causality, Engle Granger, Johansen and Juselius co-integration, and VAR model. ARDL co-integration approach helps to provide valuable insights for developing short-run and long-run relationships. The model of ARDL is a standard least-squares regression that considers the dependent and independent variables' lags (Pesaran & Shin, 1995). Pesaran and Shin (1995) and Pesaran et al. (2001) published studies about the ARDL method, which is popularized later for finding the linear relationship based on the appropriate lag selection model.

ARDL model has several advantages over the (Engle & Granger, 1987; Johansen & Juselius, 1990) co-integration approach. For example, other models perform poorly with small samples, whereas the ARDL method is not. The ARDL method also has several benefits that do not require that the model variables be integrated in the same order. For example, when the variables have a mixed integrated order of zero I (0) and one I (1), the ARDL technique can be used significantly (Pesaran et al., 2001).

Insert Table 3 here.

The descriptive statistics of the variables used to run the ARDL model are shown in Table 3. After analyzing time series data for the past 33 years, we discovered that

Bangladesh’s mean labor migration is ln 12.63, its average inflation is 6.20 percent, its average exchange rate is BDT 59.49, and its average GDP growth is 5.64 percent. The Jarque–Bera (JB) statistics, on the other hand, is used to determine the normality of the collected data. Table 3 shows that all of the variables are distributed normally, because the p value (0.05) exceeds the 5% level of significance.

Table 3
Descriptive Statistics

Variables	Obs.	Mean	Std. Div.	Min	Max	JB Statistics
LN MIG	33	12.63	0.6886	11.20	13.79	0.751(.6867)
INF	33	6.20	2.1747	1.94	10.62	0.606(.7384)
EXR	33	59.49	17.919	30.85	84.9	2.799(.2466)
GDP	33	5.647	1.3140	2.50	8.15	1.071(.5853)

IV. RESULTS AND DISCUSSION

4.1. Model Specification

In order to estimate the empirical relationship between international labor migration and economic growth variables of Bangladesh, we have developed following functional model -

$$\mathbf{MIG}_t = \delta_0 + \delta_1 \mathbf{INF}_t + \delta_2 \mathbf{EXR}_t + \delta_3 \mathbf{GDP}_t + \epsilon_t \dots\dots\dots 1$$

The log linear transformation of equation (1) is stated below-

$$\mathbf{LN\ MIG}_t = \delta_0 + \delta_1 \mathbf{INF}_t + \delta_2 \mathbf{EXR}_t + \delta_3 \mathbf{GDP}_t + \epsilon_t \dots\dots\dots 2$$

Where,

δ_0 : intercept;

$\delta_1, \delta_2, \delta_3$: variables’ coefficients/elasticity;

ϵ_t : random error term; and

Subscript t : year.

4.2. Unit Root Test

Measuring integration between and among variables is a prerequisite for modeling time-series data. The unit root tests are commonly used to assess the time series data’s stability and stationarity (McCoskey & Selden, 1998). There are several approaches to measure the unit roots, such as the Augmented Dickey-fuller test (ADF test) and Phillips-Perron (PP) test (Phillips & Perron, 1988) simultaneously used by (McCoskey & Selden, 1998; Enders & Lee, 2012). The framework to develop the hypothesis of the ADF and PP test is given below-

$$\mathbf{X}_t = \rho_0 + \delta \mathbf{X}_{t-1} + \sum_{j=1}^m \Phi_j \Delta \mathbf{X}_{t-j} + \mu_t \text{ [with constant term only]} \dots\dots\dots 3$$

$$\mathbf{X}_t = \rho_0 + \rho_{1t} + \delta \mathbf{X}_{t-1} + \sum_{j=1}^m \Phi_j \Delta \mathbf{X}_{t-j} + \mu_t \text{ [with constant and trend only]} \dots\dots\dots 4$$

Equation (3) and (4) is constructed following the constant and trend terms separately to justify the variables under investigation, which would be proceeded by Schwarz info Criterion (SC) method following the appropriate lag length criteria. Following the framework developed, the ADF and PP test result is shown in Table 4.

Insert Table 4 here.

The ADF and PP test results in Table 4 depict all the variables at level form are operationalized here non-stationarity as p-value exceeds 5% level of significance except the variable inflation Rate and GDP. Inflation and GDP are stationary at the level form I

(0), and both ADF and PP test shows their stationarity. According to the difference form, LN MIG and EXR are stationary at the first difference I (1), but none is significant at I (2).

Table 4
Results of Unit Root Test (ADF and PP Test)

Model (Constant Terms) (Level Form)			Model (Constant and Trend Terms) (Level Form)		
Variables	ADF (P-value)	PP (P-value)	Variables	ADF (P-value)	PP (P-value)
LN MIG	0.4271	0.1509	LN MIG	0.0174**	0.4985
INF	0.0070**	0.0070**	INF	0.0196**	0.0177**
EXR	0.8376	0.7457	EXR	0.3915	0.4429
GDP	0.0134**	0.0169**	GDP	0.0003***	0.0002***
Model (Constant Terms) (Difference Form)			Model (Constant and Trend Terms) (Difference Form)		
Variables	ADF (P-value)	PP (P-value)	Variables	ADF (P-value)	PP (P-value)
LN MIG	0.0000***	0.0001***	LN MIG	0.0000***	0.0001***
INF	0.0000***	0.0001***	INF	0.0000***	0.0000***
EXR	0.0001***	0.0000***	EXR	0.0001***	0.0000***
GDP	0.0000***	0.0000***	GDP	0.0000***	0.0000***

Notes: ***, **, and * = significant at 1% level, 5% level, and 10% level.

Now we can proceed the auto regressive distributed lag (ARDL) method introduced by (Pesaran & Shin, 1995; Pesaran et al., 2001) to determine the long run and short run relationship dynamics because there is no level of relationship of the variables at I (2). Also, to employ the suggested ARDL approach, we selected the appropriate lag length considering the Schwarz info Criterion (SC) method, which is simultaneously used by (Attari & Javed, 2013; Abedin et al., 2020).

4.3. The Bounds Testing Approach for Co-Integration

To examine the co-integrating relationship between migrant labors and economic growth determinants, this study employs the bounds testing approach for co-integration. The ARDL bounds test approach (Pesaran et al., 2001) is distinguished from other types of co-integration methods such as (Engle & Granger, 1987; Johansen, 1992; and Gregory & Hansen, 1996). This co-integration approach can be used if the variables are integrated at I (0), and I (1) or a combination of both forms. Therefore, the following equation 5 is developed to assess among the variables have co-integration or not.

$$\Delta \text{LN MIG}_t = \delta_0 + \sum_{i=1}^{p1} \delta_{1i} \Delta \text{LN MIG}_{t-i} + \sum_{i=0}^{p2} \delta_{2i} \Delta \text{INF}_{t-i} + \sum_{i=0}^{p3} \delta_{3i} \Delta \text{EXR}_{t-i} + \sum_{i=0}^{p4} \delta_{4i} \Delta \text{GDP}_{t-i} + \delta_5 \Delta \text{LN MIG}_{T-1} + \delta_6 \Delta \text{INF}_{T-1} + \delta_7 \Delta \text{EXR}_{T-1} + \delta_8 \Delta \text{GDP}_{T-1} + \mu_{1t} \dots\dots\dots 5$$

To calculate the optimum lag length, we used the lags length selection process of Schwarz info criterion (SC). The Schwarz info criterion is adopted because it considers both statistical goodness of fit and the various parameters used in estimation to achieve a particular degree of fit.

The hypothesis of F statistics is shown below:

H₀: $\delta_5 = \delta_6 = \delta_7 = \delta_8 = 0$ (no level relationship)

H₁: $\delta_5 \neq \delta_6 \neq \delta_7 \neq \delta_8 \neq 0$ (level relationship)

Table 5
Bound Test Approach Results

		10% Level of Significance		5% Level of Significance		1% Level of Significance	
K	I (0)	I (1)	I (0)	I (1)	I (0)	I (1)	
3	2.37	3.20	2.79	3.67	3.65	4.66	
Functional Format			F-Statistic				
F _{LN_MIG} (LN MIG/INF, EXR, GDP)			4.9275***				

Notes: ***, **, and * = significant at 1% level, 5% level, and 10% level.

Hence, the F statistics value found in Table 5 depicts that the variables in constructed ARDL model have strong co-integration as it exceeds the critical bound of I (1) in 90%, 95%, and 99% level of significance. However, the null hypothesis of F statistics is rejected, and we can establish that variables are significantly co-integrated and have a long-run relationship. Finally, the results of the bounds testing approach demonstrate that the variables are going in the same direction towards a long-run equilibrium.

4.4. Estimation of Long-Run Equation

Using the bounds test method, we revealed the presence of long-run relationship dynamics of co-integration with the variables. In equation (6), which is expected to assess the long-run connection among the variables, is constructed to find the coefficients value of long-run estimating model followed by the ARDL technique. The lag length for the variables is selected by Schwarz info criterion (SC) method to find the long-run dynamics of the relationship.

$$LN\ MIG_t = \phi_0 + \sum_{j=1}^{p1} \phi_{1j} LN\ MIG_{t-j} + \sum_{j=0}^{p2} \phi_{2j} INF_{t-j} + \sum_{j=0}^{p3} \phi_{3j} EXR_{t-j} + \sum_{j=0}^{p4} \phi_{4j} GDP_{t-j} + \epsilon_t \dots\dots\dots 6$$

Table 6
Long Run Estimation Results

Dependent Variable: LN MIG		Lag: (2, 1, 0, 0)		
Explanatory Variables	Long-Run Coefficients	t-statistic	P-value	
INF	0.0443	1.20	0.241	
EXR	0.0224	4.03	0.005***	
GDP	0.1535	1.45	0.158	
C	10.175	19.44	0.000***	

Notes: ***, **, and * = significant at 1% level, 5% level, and 10% level.

The empirical findings in Table 6 reveal that throughout the long run, the exchange rate has a strong positive impact on Bangladeshi labor migration. In contrast, inflation and GDP growth do not significantly impact the migration of labor in Bangladesh.

We found the long-run coefficient value of the exchange rate is significant and positive at a 1% level of significance. Therefore, the devaluation of domestic currency against US dollar directly impacts the number of migrant workers from Bangladesh. This study shows that a 1 percent increase in labor migration indicates to an escalation of the exchange rate by 2 percent in the long run. The above results support the findings of (Keita, 2016). From the above analysis coefficients, this study states that devaluating the domestic currency against US dollar can boost-up labor migration flow in a country.

The empirical results also reveal that inflation and GDP growth rate do not have any significant relationship with the labor migration from Bangladesh. Despite the fact

that the outcome defies expectations, (Morley, 2006; Öztürk & Özdil, 2020) found a significant positive impact on GDP growth but in our study time period of 1988-2020, have no significant relationship we found.

4.5. Estimation of Short-Run Equation

After confirming the relationship of long-run, the Error Correction Model (ECM) is also applied for estimating the short-run relationship among the variables. Negative and significant ECM is required, with a coefficient value limiting zero to one. After a short-run shock that confirms the model’s stability, the ECM value reflects the speed with which the model adjusts to long-run equilibrium. Formulae for measuring the short-run dynamics followed by the ARDL approach is expected to find from the following equation 7:

$$\Delta \text{LN MIG}_t = \varphi_0 + \sum_{j=1}^{p1} \varphi_{1j} \Delta \text{LN MIG}_{t-j} + \sum_{j=0}^{p2} \varphi_{2j} \Delta \text{INF}_{t-j} + \sum_{j=0}^{p3} \varphi_{3j} \Delta \text{EXR}_{t-j} + \sum_{j=0}^{p4} \varphi_{4j} \Delta \text{GDP}_{t-j} + \lambda \text{ECM}_{t-1} + \mu_t \tag{7}$$

The appropriate lag length to run the short run equation is selected by (SC) criterion under the automatically adjustments of lags. The result of short run estimation is shown in Table 7.

Table 7
Results of Short Run Estimations:

Dependent Variable: $\Delta \text{LN MIG}$		Lag: (2, 1, 0, 0)	
Explanatory Variables	Short-Run Coefficients	t-statistic	P-value
ΔINF	-0.0042	-0.25	0.803
ΔEXR	0.0128	1.87	0.072*
ΔGDP	0.0882	1.55	0.132
ECM(-1)	-0.5746	-5.36	0.000***
R-squared	0.5049		
R-squared (Adjusted)	0.4695		

Notes: ***, **, and * = significant at 1% level, 5% level, and 10% level.

The short-run estimations from Table 7 indicate that the value of the ECM (-1) coefficient was found significant and negative, as we expected earlier. This estimation result indicates that a shock in labor migration will be adjusted by 0.57 in the following year. This means any shock in labor migration flow will be corrected in the next year by 57%. The error correction model (ECM) also advocates that labor migration will be readjusted to the long-run equilibrium after each short-run shock of the independent variables. The relationship dynamics of the short-run parameters are similar to those observed in the long-run assessments.

The value of coefficients of the explanatory variables reveals that the exchange rate positively correlated with the labor migration from Bangladesh to other countries of the world. This implies that one percentage change in the exchange rate will bring a positive change in labor migration at 1.28% in the short run. In the context of labor migration with economic growth indicators as exchange rate and migration, our result is partially supported by (Gao, 2015; Shin, 2021).

Insert Table 8 here.

Before drawing any decisive conclusion on the constructed models shown in the previous equations, adjusting all the uncertainties in outputs raised from different sources is necessary. Diagnostic tests shown in Table 8 considerably make sense that the building block of the constructed equation is corrected by the maximum possible diagnostic and

prognostic approaches (Saltelli, 2002; Eric Fosu & Magnus, 2006; and Daoud, 2018). The results of four diagnostic tests, including lagrange multiplier serial correlation, autoregressive conditional heteroskedasticity (ARCH), Jarque-Bera (JB) normality, and Ramsey’s misspecification (RESET) show that our analysis have passed all the diagnostic tests because null hypothesis has been rejected, which shows the ARDL model results consistency and efficiency.

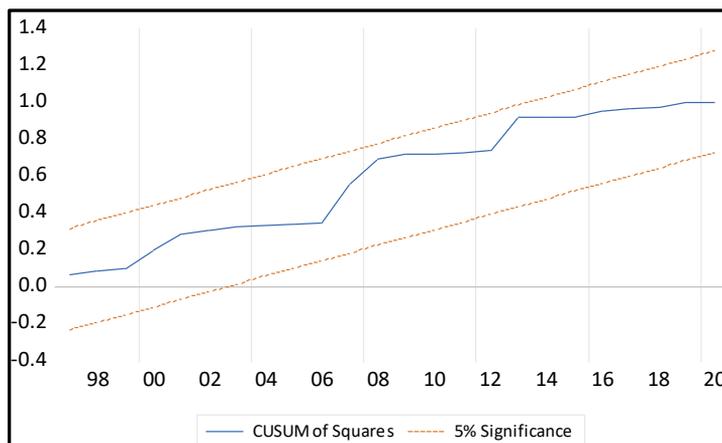
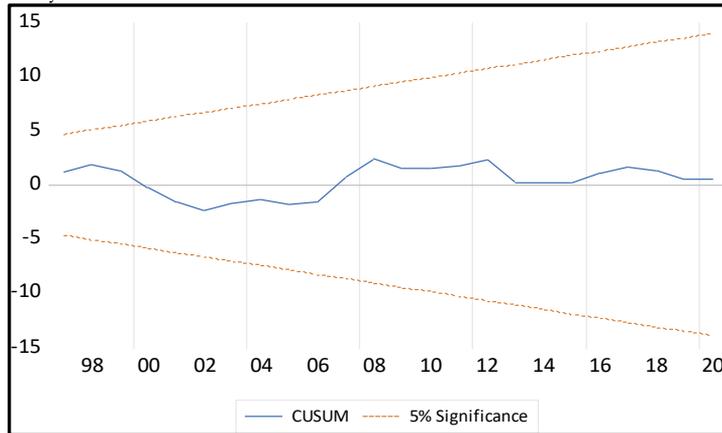
Table 8
Diagnostic Tests

Diagnostic Tests		
Tests Name	Chi2 Value	P-value
B-G LM Serial Correlation	3.9562	0.1383
ARCH (Heteroskedasticity)	1.7981	0.4082
JB (Normality)	0.0221	0.9889
Misspecification Test	1.2750	0.5286

Notes: ***, **, and * = significant at 1% level, 5% level, and 10% level.

Figure 2
Test of Stability

A well-specified and well-executed ARDL model must test for the presence of parameter stability (Pesaran & Shin, 1995). Since, there is no chance of knowing when a structural break will occur or not by evaluating the regression equation to see whether it is stable or not for time series data. For this, CUSUM and CUSUMSQ test of stability is important to know the stability of the above analysis.



To check the stability of the model, we used the cumulative sum (CUSUM) and cumulative sum of squares (CUSUMSQ) methods to calculate recursive residuals from the ARDL model. The plots of CUSUM and CUSUMSQ are within the 5% critical bounds proposed by (Brown et al., 1975) indicating that the model under study’s long-run coefficients is stable. In Figure 2, the study shows that the findings are in line with the ARDL model’s expected coefficient and also dynamically stable. It also suggests that between 1998 and 2020, long-run relationships and coefficients are stable to establish relationships among the variables.

4.6. Granger Causality Test

We perform the analysis to find out the probable causative relation among the variables chosen for the investigation by using Granger causality test, as proposed by (Toda & Yamamoto, 1995; Dolado & Lütkepohl, 1996). The Granger causality testing is used to assess whether the variables have a short-run causal relationship or not. When the underlining unit roots fully satisfy the co-integration I (0) and I (1) in the level form, we can proceed for the causality test. According to (Toda & Yamamoto, 1995 ; Dolado & Lütkepohl, 1996), the VAR framework is mentioned here.

$$\begin{pmatrix} \text{LN MIG}_t \\ \text{INF}_t \\ \text{EXR}_t \\ \text{GDP}_t \end{pmatrix} = \begin{pmatrix} C_1 \\ C_2 \\ C_3 \\ C_4 \end{pmatrix} + \sum_{i=1}^k M \begin{pmatrix} \text{LN MIG}_{t-i} \\ \text{INF}_{t-i} \\ \text{EXR}_{t-i} \\ \text{GDP}_{t-i} \end{pmatrix} + \sum_{j=1}^{\text{dmax}} w \begin{pmatrix} \text{LN MIG}_{t-k-j} \\ \text{INF}_{t-k-j} \\ \text{EXR}_{t-k-j} \\ \text{GDP}_{t-k-j} \end{pmatrix} + \begin{pmatrix} \mu_{1t} \\ \mu_{2t} \\ \mu_{3t} \\ \mu_{4t} \end{pmatrix} \dots\dots\dots 8$$

$$M = \begin{pmatrix} \phi_{11i} & \phi_{12i} & \phi_{13i} & \phi_{14i} \\ \phi_{21i} & \phi_{22i} & \phi_{23i} & \phi_{24i} \\ \phi_{31i} & \phi_{32i} & \phi_{33i} & \phi_{34i} \\ \phi_{41i} & \phi_{42i} & \phi_{43i} & \phi_{44i} \end{pmatrix}$$

$$W = \begin{pmatrix} \delta_{11k+j} & \delta_{12k+j} & \delta_{13k+j} & \delta_{14k+j} \\ \delta_{21k+j} & \delta_{22k+j} & \delta_{23k+j} & \delta_{24k+j} \\ \delta_{31k+j} & \delta_{32k+j} & \delta_{33k+j} & \delta_{34k+j} \\ \delta_{41k+j} & \delta_{42k+j} & \delta_{43k+j} & \delta_{44k+j} \end{pmatrix}$$

From the equation (8), in a standard VAR framework having level form variables, here k is the lag length. The Schwarz info criterion (SC) method has been selected for finding the value of k. The denotation of maximum number of integration is **dmax**. Inflation and GDP are stationary at I (0), and LN MIG and EXR are stationary at I (1). As a result, the maximum order of integration is **dmax**= 1. The following analysis of causality analysis based on the covariance matrix is given below:

Table 9
Granger Causality Test (Toda-Yamamoto)

Description	LN MIG	INF	EXR	GDP
LN MIG		0.0603 (0.9703)	2.5710 (0.2765)	1.5680 (0.4566)
INF	2.4713 (0.2906)		0.2372 (0.8881)	0.4553 (0.7964)
EXR	5.4544 (0.0654)*	1.8869 (0.3893)		10.5406 (0.0051)***
GDP	2.0212 (0.3640)	3.5356 (0.1707)	3.6430 (0.1618)	

Notes: ***, **, and *= significant at 1% level, 5% level, and 10% level.

The relationship dynamics between long run and short run of the variables were discovered using the ARDL approach. Here we also use the previous approach of

causality test to examine the causality effects and directions among the variable in order to validate our findings (Foda & Yamamoto, 1995; Dolado & Lütkepohl, 1996). We intend to identify the unidirectional, bidirectional, or no directional causality relationship between the variables using this approach. Table 9 shows that there are short-run unidirectional causal relationships between (LN MIG \rightarrow EXR) and (GDP \rightarrow EXR). This finding suggests that the labor migration from Bangladesh is interrelated to the exchange rate development of Bangladesh.

V. CONCLUSION

From 1988 through 2020, we examined the relationship between the rise of labor migration and Bangladesh's economic development nexus. We discovered the variables that influence labor migration from Bangladesh using the ARDL bounds test, long-run and short-run estimations, and the Granger causality framework. According to our long-run and short-run estimates, the exchange rate significantly impacts labor migration, while the country's GDP growth rate and inflation do not. CUSUM and CUSUMSQ confirmed the relationship's stability from 1998 to 2020, and the estimated model also passed all the diagnostic tests.

From a policy standpoint, creating stability in foreign reserves in a developing country like Bangladesh's remittance inflow significantly impacts development growth (Majumder, 2016). For this reason, labor migration would be a possible way to boost the foreign currency reserve due to the remittance inflow send by the migrant labors. Furthermore, Bangladesh is an import-oriented country, so the foreign currency reserve and exchange rate stability are a big issue in managing inflation and fulfilling local commodity demands. Although we didn't find a significant relationship between GDP growth and labor migration in our study, it was very expected as (Morley, 2006; Öztürk & Özgül, 2020) found a significant relationship between the variables. During the study period, Bangladesh's GDP growth was stable and eye-catching, but we can conclude this labor migration from Bangladesh to abroad have no impact on the GDP growth of the country.

As a result, to boost remittance as well as labor migration from our country, policymakers must accelerate and regulate exchange rate and labor migration strategies so that our country's foreign currency reserve will be at a satisfactory level. Since our research seeks to find only short-run and long-run causal links between labor migration and various macroeconomic indicators, future researchers may include other macroeconomic indicators as well as qualitative factors like skilled and unskilled migrants, migrant philosophy, migration beliefs, and thoughts etc. So that policymakers can easily differentiate the impact of changes on the economy, which is the future recommendation compared to the current study due to the unavailability of information.

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