Inflow of Remittances and its Impact on Economic Growth of Bangladesh

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Abstract

In general, it is ruminated that workers' remittance is one of a major source for external finance and economic growth for developing countries like Bangladesh. This study pinpoints the influence of workers' remittances (WRs) on the economic growth of Bangladesh by analyzing time series data of 43 years from 1976 to 2018 drawn out from the World Bank database. Using ARDL, we have tried to investigate the relationship of gross domestic product (GDP) with remittances and some other variables such as gross capital formation (a proxy of capital stock) and employed labor force. The study finds that 1% increase of remittance earning induces to increase GDP by 0.37%. It can be concluded from the regression results that there exists a significant positive relationship between WRs and economic growth in Bangladesh. However, there are some fluctuations of remittance flow in Bangladesh in recent years. Hence, this study acclaims that Bangladesh should take suitable initiatives for keeping an increasing trend of remittances in the coming years and make pragmatic policies that inspire and stimulate the inflow of remittances through proper channel for economic growth and development.

Keywords: Remittances; Economic Growth; Productivity; Panel Data Analysis; Bangladesh

1. Introduction

Workers' remittances (WRs) are the cash inflows in foreign exchange coming from abroad into their home country. It is a prime root of foreign exchange earnings and these large inflows of remittances have vast effects to the economy. Migration plays a critical role in the economy in two main ways: First, by shrinking unemployment and second, by supplying remittance inflows for the country.

Among South Asia, Bangladesh is a lower-middle-income country. In spite of a number of problems, the country is moving forward over time. Its overseas employment consists of professional, skilled, semi-skilled, and less-skilled labor forces. In every year, near about two million young people are added to the labor force (BBS, 2013). However, the country lacks the ability to create sufficient jobs to absorb them. The country's population increased from 71 million in 1976 to 161 million in 2018 while the total working population or labor forces (age group-20–54) augmented to 91.44 million in 2018 from 31.73 million in 1976 (World Bank, 2019). Figure 1 presents the increasing trends of population and labor force of Bangladesh. This huge number of workforce needs to be absorbed in employment to make certain their involvement in the economic advancement of the country as well as to improve their standard of living. Migration of a huge number of labor force results higher remittance inflows in the country. It is notable that inflow of remittances is increasing over the years in Bangladesh which plays a significant role in the advancement of the migrant families and the country as well. Thus, remittances turn into an essential aspect for the socioeconomic progress of Bangladesh. It has a significant role to maintain a favorable balance of

Figure 1: Total population and labor force in Bangladesh from 1976 to 2018
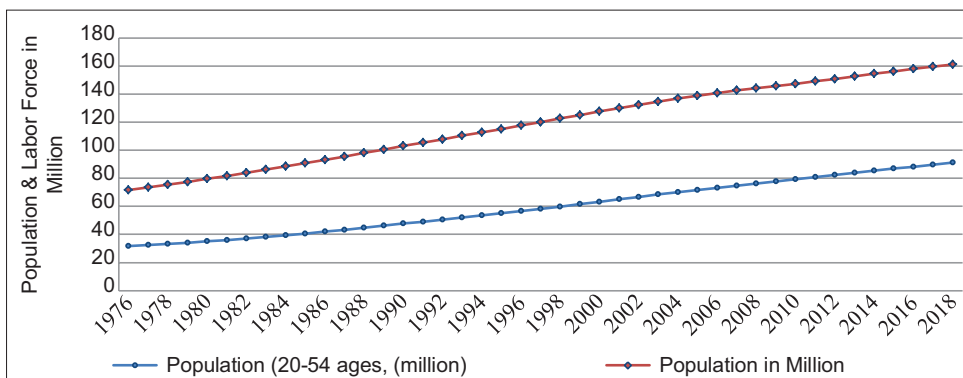
Source: World Development Indicators, World Bank (2019)

payment and to enrich foreign currency reserve and also has a great contribution to gross domestic product (GDP) of the country (Islam, 2011).

The remittances flow in Bangladesh has grown not only in size but also in its importance regarding the share of GDP. Remittances represent the second-largest source of foreign currency earnings followed by exports, which have contributed above 10% of GDP (Chowdhury, 2012), though the share fell down at about 6% in 2018 (World Bank 2019). Hasan (2006) shows that remittances have a significant macroeconomic impact at the household level, but the more impact or benefit of remittance income is the alleviation of poverty. Jongwanich (2007) finds that remittances have a positive but marginal impact on economic growth in Asia and Pacific countries. Therefore, it is important to determine the effect of remittances on the household and the economy. Thus, this study attempts to explore the relationship between WRs and economic growth of Bangladesh.

The organization of the paper is as follows. Following the introduction Section 2 discusses the literature review on the relationship between remittances and economic growth. Section 3 states the motivation behind the paper, that is, research question and the objectives while Section 4 shows the migration and remittance dynamics in Bangladesh. Section 5 shows trends of GDP and GDP growth and a comparative analysis of remittances and GDP growth. Data and methodology are described in Section 6. Section 7 shows the results of ARDL estimation. Finally, in Section 8, we present our concluding statements and provide recommendations according to our findings.

2. Literature Review

WRs have been growing speedily in developing countries. To identify the impact of WRs on the economy a number of studies have been conducted and found there is a mix opinion about the relationship of WRs and economic growth. Most of the existing studies illustrated the positive, direct and indirect growth effect of remittances, especially for the developing countries employing cross country data. However, some studies also shown a negative relationship between WRs and economic growth.

Sarkar et al. (2018) showed the relationship between remittances and economic growth in Bangladesh. They used time-series data from 1995 to 2016 from the World Bank database and Bangladesh Bank statistics to measure the relationship of remittance and GDP with some other variables. Pearson's correlation coefficient is estimated between the variables. The study revealed that there is a positive relationship of remittance with the GDP in Bangladesh.

Paul and Das (2011) conducted a study on Bangladesh from 1979 to 2009 to examine the remittance-GDP interaction in both the long run and short run with a comprehensive approach by applying co-integration tests and especially the vector error correction (VEC) model to get the estimates

on the co-integrating vector and short-run dynamics. The study found a long-run positive relationship between remittances and GDP.

Wadood and Amzad (2015) investigated the nexus between remittances and economic growth in Bangladesh using time series data over 40 years of the period from 1972 to 2013. They showed the causal link between remittances and economic growth in Bangladesh by employing a number of econometric techniques, that is, Johansen cointegration approach, VEC model, and the Granger causality test. From the cointegration tests, they suggested that there exists a long-run relationship between remittances and economic growth in Bangladesh.

Abu Siddique et al. (2012) conducted a study on remittances and economic growth on South Asian countries (Bangladesh, India, and Sri Lanka). The study explored the causal link between remittances and economic growth by employing the Granger causality test with vector autoregression (VAR) framework using time series data over a period of 25 years from 1980 to 2005. The empirical analysis identified that remittances have a mixed response with economic growth. The study found no causal relationship between remittances and economic growth in Bangladesh and India. However, for Sri Lanka, a two-way causal relationship is found between remittances and economic growth.

Jawaid and Raza (2012) studied the data of 7 years of 113 countries to determine the connotation of WRs and economic growth and identified from an empirical investigation that there exists a significant direct relationship between WRs and economic growth. They also recognized that WRs are contributing more in high-income countries.

Cooray (2012) showed in a study using panel data over the period from 1970 to 2008. The study examined the impact of remittances on economic growth in South Asia. He also combined remittances among other variables into a growth model and found that remittances have a significant positive influence on economic growth.

Jongwanich (2007) used panel data from 1993 to 2003 to identify the relationship of workers' remittance with poverty and economic growth. Seventeen developing countries of Asia and the Pacific region were included in the study and resolved that WRs have a significant direct relationship with economic growth as well as with poverty alleviation.

Datta and Sarkar (2014), in a study on Bangladesh, tried to observe the impact of remittances on economic growth using ARDL framework taking only two variables into consideration remittance and GDP. The study suggested that remittances can raise growth and development also can inhibit crises of the balance of payment.

Iqbal and Sattar (2005) studied the data of Pakistan to see the contribution of remittances on economic growth. With empirical analysis of time series data from 1973 to 2003, they exposed that WRs are the vital basis of economic growth in Pakistan.

Dilshad (2013) identified the impact of remittances on the economic growth of Pakistan using time series data of 22 years from 1999 to 2012 using the regression model. The results concluded that there exists a substantial positive relationship between remittances and economic growth in Pakistan.

Chami et al. (2003) anticipated the negative relationship between remittance and economic growth. They found a negative impact of remittances on economic growth as it shrinks the motivation to work by the migrant family members. The study used data including 84 recipient countries and annual observations for the period of 1970–2004. The results showed that remittances have no impact on economic growth.

3. Research Question and Objectives

Although high migration rate sometimes worsen the economic circumstances of a country, yet this high migration can be a source of huge WR. It is in question that, are these remittances really causing economic growth? In this backdrop, the research question is what is the impact of WR on the economic growth of Bangladesh? Therefore, the objectives of this study are:

- To detect the impact of worker's remittances on the economic growth of Bangladesh and
- To recommend some policy implications on the basis of analysis.

4. Migration and Remittance Dynamics in Bangladesh

From the early 1990s, Bangladesh has appeared as one of the main manpower exporting country in South Asia. The inflow of remittances increases over time due to the steady growth of migration from Bangladesh which is promising to the development of Bangladesh. Hence, the relationship between remittances and migration are noticeable. Both are strongly correlated with poverty reduction and socioeconomic progress of Bangladesh. Over the past 43 years, the number of Bangladeshi labor migrants gradually increased from around 6000 (0.006 million) in 1976 to more than 1,008,000 (1.008 million) in 2017 which has declined to some extent to 734,000 (0.734 million) in 2018 (World Bank, 2019) which has been shown in Figure 1.

4.1. Trend in migration

Bangladesh has been participating in the supply of global labor market as a labor surplus country. A large number of labor force of this country migrate overseas for both in short and long-term employment in every year. Figure 2 shows the trend in overseas employment from the period of 1976 to 2018. A total number of around 734,000 (0.734 million) manpower was exported in 2018. Since the beginning of manpower export in 1976, the number of overseas employment grew steadily without a few exceptions till 2006. There was a sharp rise in overseas employment in 2007 and 2008 followed by a sharp decline in 2009 and 2010 which may be occurred due mainly the global financial crisis of that time. In 2011 and 2012 overseas employment further turned up and with some fluctuations, it reached at the highest level and stood at 1.008 million in 2017 which has recently fell down at 0.734 million in 2018.

4.2. Trend in remittance

Remittances contribute ominously to the economic development of the country by mounting foreign exchange reserve and income. WRs as a percentage of GDP had an increasing trend over the years since the beginning of manpower export in 1976 (Figures 3 and 4). Worker's remittances have increased from USD 0.019 billion in 1976 to USD 15.56 billion in 2018. The contribution of remittances to GDP increases from <1% in 1976 to around 5.8% in 2018 which was as high as around 11% in 2009 and 2012 (Figure 4).

5. Trends of GDP and GDP Growth

For the past 20 years, Bangladesh has been maintaining about 6% growth. The country has newly moved into the lower-middle-income country from a low-income country. It has found that the GDP of Bangladesh was US$ 9.76 billion in 1976 which was increased by more than 27 times in 43 years at US$ 269.63 billion in 2018. Figures 5 and 6 provide the trends of GDP and its yearly growth. It
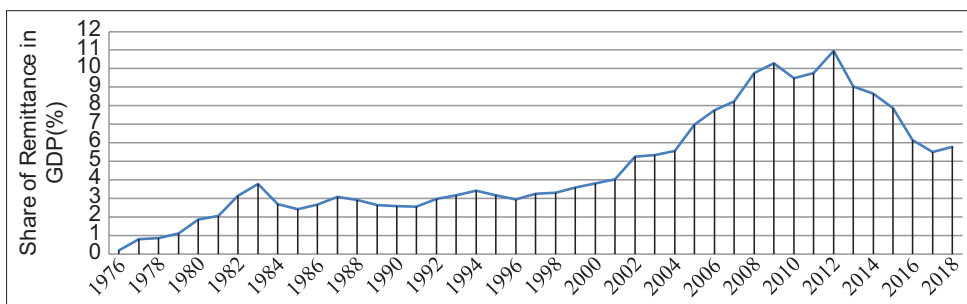
Figure 2: Migration of labor force in Bangladesh from 1976 to 2018
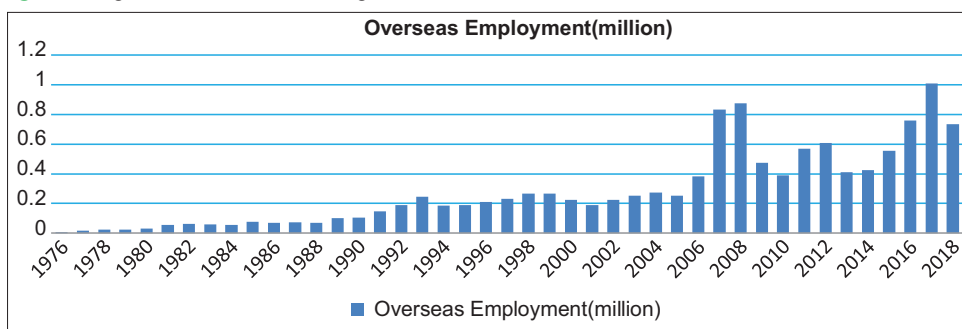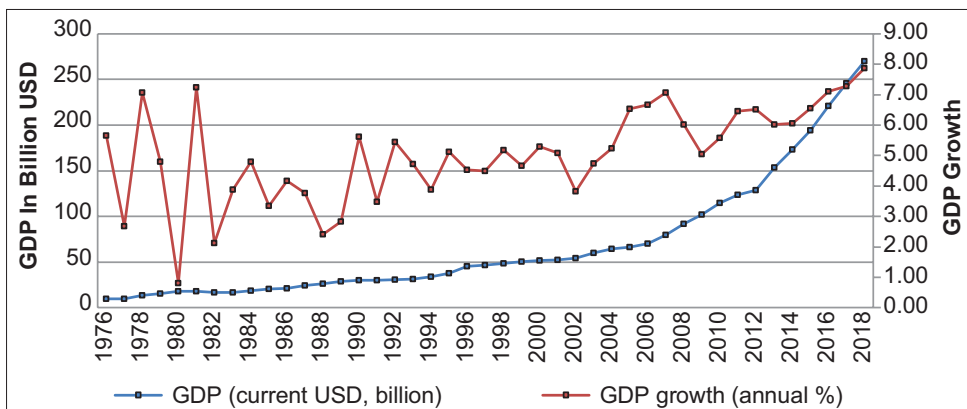

Source: World Development Indicators, World Bank (2019)

Figure 3: Inflow of Remittances in Bangladesh from 1976 to 2018
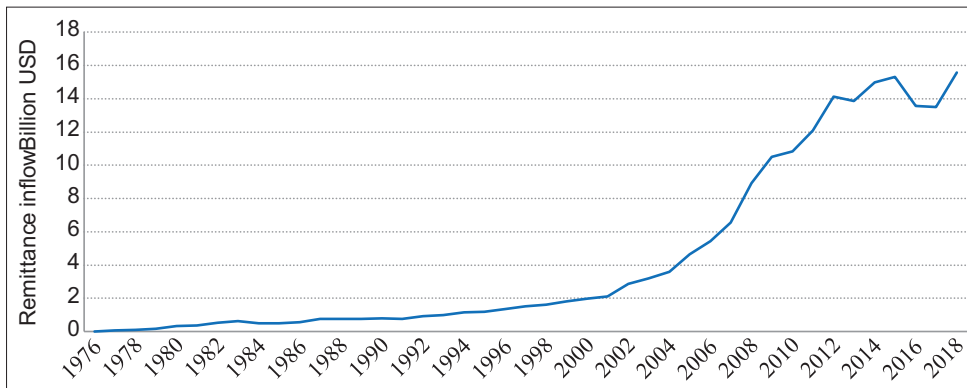
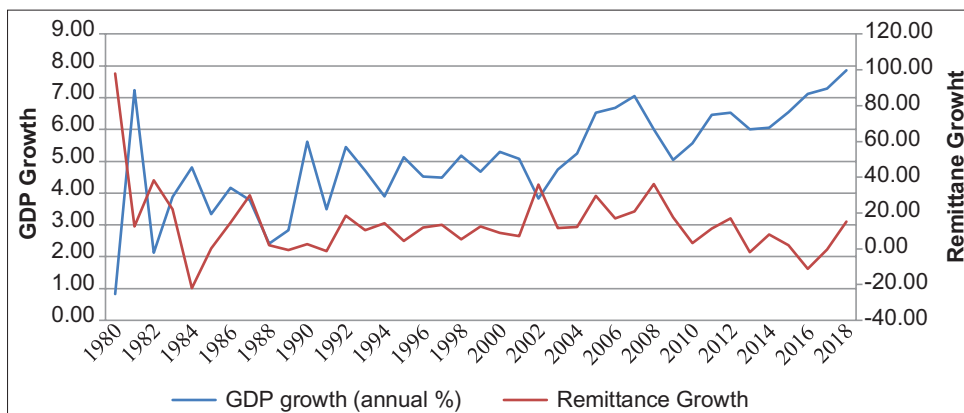**Source:** World Development Indicators, World Bank (2019)

Figure 4: Share of Remittance as a percent of GDP in Bangladesh from 1976 to 2018

Source: World Development Indicators, World Bank (2019)

Figure 5: GDP and its growth (%) in Bangladesh from 1976 to 2018

Source: World Development Indicators, World Bank (2019)

is exposed that Bangladesh has, kept an increasing trend of GDP over the years while GDP growth fluctuated sometimes. However, the GDP growth of Bangladesh recorded as high as 7.9% in 2018 from 5.7% in 1976. In spite of some difficulties, Bangladesh economy is growing speedily where remittances and private sector growth is contributing significantly.

Figure 6: Comparison between GDP growth and remittance growth

Source: World Development Indicators, World Bank (2019)

5.1. Comparison among remittances and GDP growth in Bangladesh

Inflows of remittances can support to improve a country's development prospects and economic stability. In Bangladesh, remittances are growing steadily as an external financial source for development. It can play an important role in reducing poverty by generating ample welfare for migrants. It augments savings, consumption, and investment in stimulating the economy of Bangladesh. Therefore, remittances have a multiplier effect on GDP growth or economic development of Bangladesh.

6. Data and Methodology

6.1. Type and sources of data

This study used secondary data collected from World Development Indicators, World Bank (2019). Data are annual time series covered the period from 1976 to 2018. The data set includes nominal GDP (Y), population ages 20–54 (LF) as active labor force, gross capital formation (GFC) as capital stock and workers' remittances (WRs) as a policy variable.

Nominal GDP (Y): The GDP is the value of all goods and services produced in the country for a year which is measured at current market prices. GDP is calculated in billion USD.

Labour force (LF): There are no time-series data for active LF or employment data in Bangladesh. Therefore, we use the total population aged 20–54 as a proxy for active LF.

Gross fixed capital formation (GFC): The gross capital formation is used a proxy for capital stock. GFC is calculated in billion USD.

WRs: WRs are the inflows of foreign exchange sent by the Bangladeshi expatriates to their home country. WR is calculated in billion USD.

6.2. Model specification

From the basis of the literature review, the model for exploring the impact of WRs on economic growth has been derived from the production function framework. Waheed and Aleem (2008), Jawaid and Raza (2012), and Iqbal and Sattar (2005) also used the model. The production framework is:

$$Y = f(A, L, K) \tag{1}$$

Here, "Y" represents the GDP; L represents the employed LF; K represents the stock of capital; and A represents the total productivity of economic factors. Impact of WRs may be identified through A (Waheed and Aleem, 2008; Jawaid and Raza, 2012).

$$A = g\ (WR) \tag{2}$$

Here WR represents WRs. By substituting (2) in (1):

$$Y = f\ (L, K, WR) \tag{3}$$

The empirical model for estimation of this general production function can be developed in logarithmic form as follows:

$$lnY = \beta_0 + \beta_1 LLF_t + \beta_2\ ln\ LGFC_t + \beta_3\ ln\ LWR_t + u_t \tag{4}$$

In the above model Y represents the GDP, β_1 represents the coefficient of employed LF, β_2 represents the coefficient of GFC as a percentage of GDP, β_3 represents the WRs, and u represents the error term. It is expected that the sign of β_1, β_2, and β_3 is to be positive.

Although our objective is to examine the long-run relationship among GDP, LF, gross capital formation, and remittances, we want to get an initial indication of long-run causality between them. As shown in Morley (2006), Granger causality tests on levels can provide us an indication about the direction of long-run causality between the variables in place. However, the results from the ARDL approach will be regarded as final in justifying the long-run relationships in this model.

Before running any regression model using time series data, it is worthwhile to see the nature of data, that is, whether there is a unit root. The choice of the most appropriate unit root test is difficult in practice. Enders (1995) suggested that a safe choice is to use both types of unit root tests – the augmented Dickey-Fuller (1981) and the Phillips–Perron (1988) tests. The augmented Dickey-Fuller (ADF) tests adjust Dickey-Fuller test to take care of possible serial correlation in the error terms by adding the lagged difference terms of the regress Phillips–Perron (PP) test use nonparametric statistical methods to take care of serial correlation in the error terms without adding the lagged difference terms (Gujarati, 2003). We implement both unit root tests for all variables. If unit root tests show that all variables have a unit root at the levels but stationary at their first differences, then the variables are considered as cointegrated of order one, that is, $I(1)$. If the variables are characterized as cointegrated or $I(1)$, there can be found a long-run relationship among them by the cointegration analysis techniques.

6.3. ARDL model

All the variables must be integrated in the same order in traditional cointegration tests, while ARDL approach is applicable irrespective of whether the variables are purely I(0), purely I(1), or mutually integrated (Pesaran et al., 2001). ARDL approach has a number of advantages over the traditional cointegration tests (e.g., Engle and Granger, 1986 and Johansen and Juselius, 1990). First, different variables can take a different number of lags in ARDL model, while traditional cointegration tests require a uniform number of lags. Second, the ARDL model generally provides unbiased estimates of the long-run model and valid t-statistic even when some of the regressors are endogenous (Harris and Sollis, 2003. p. 18). Third, this approach can correct the small sample bias (Pesaran and Shin, 1999).

The ARDL bounds testing approach is based on the ordinary least square (OLS) estimation of a conditional unrestricted error model (ECM). According to this approach, we can express equation (4) in the following form:

$$\Delta LY_t = b_0 + b_1 LY_{t-1} + b_2 LF_{t-1} + b_3 LGFC_{t-1} + b_4 LWR_{t-1} + \sum_{i=1}^{p} e_i \Delta LY_{t-i} + \sum_{i=0}^{p} f_i \Delta LLF_{t-i}$$

$$+ \sum_{i=0}^{p} g_i \Delta LGFC_{t-i} + \sum_{i=0}^{p} h_i \Delta LWR_{t-i} + u_t \tag{5}$$

Where Δ is the first difference operator and p is the maximum number of lags.

The first step of the ARDL bound testing approach is to estimate equation (5) by OLS method and then perform Wald test or F-test for the joint significance of the coefficient of the lagged level variables of the model, where the null hypothesis is:

H_0: $b_1 = b_2 = b_3 = b_4 = 0$ against the alternative hypothesis of:
H_1: $b_1 \neq b_2 \neq b_3 \neq b_4 \neq 0$.

Pesaran et al. (2001) established two sets of critical values for *F*-test of which one set in the lower critical bound assumes that all independent variables are *I(0)* and the other hand, in the upper critical bound assumes that all independent variables are *I(1)*. If the estimated *F*-statistic exceeds their respective upper critical values, we conclude that there is evidence of a long-run relationship among the variables irrespective to the order of integration of the variables. If the calculated value of the F-statistic is smaller than the lower critical bound, then the null hypothesis of no cointegration cannot be rejected. On the other hand, if the F-statistic lies between the bounds, an inference cannot be drawn without knowing the order of integration of the underlying regressors.

In the second step of the ARDL bound testing approach is to estimate the long-run relationship. If there is evidence of cointegration in the first step, then following ARDL (*m, n, q*) long-run model is estimated:

$$LY_t = c_1 + \sum_{i=1}^{m} e_{1i}LY_{t-i} + \sum_{i=0}^{n} f_{1i}LLF_{t-i} + \sum_{i=0}^{q} g_{1i}LGFC_{t-i} + \sum_{i=0}^{r} h_{1i}LWR_{t-i} + u_{1t} \tag{6}$$

Where *m, n,* and *q* are the optimal number of lags of the variables and other variables are previously defined.

Finally, in the third step, the ARDL specification of the short-run dynamics can be derived by constructing an error correction model (ECM) of the following form:

$$\Delta LY_t = c_2 + \sum_{i=1}^{p} e_{2i}\Delta LY_{t-i} + \sum_{i=0}^{p} f_{2i}\Delta LLF_{t-i} + \sum_{i=0}^{p} g_{2i}\Delta LGFC_{t-i} + \sum_{i=0}^{p} h_{2i}\Delta LWR_{t-i} + kECM_{t-1} + u_{2t} \tag{7}$$

where ECM_{t-1} is the error correction term (ECT) and is defined as:

$$ECM_t = LY_t - c_1 - \sum_{i=1}^{m} e_{1i}LY_{t-i} - \sum_{i=0}^{n} f_{1i}LLF_{t-i} - \sum_{i=0}^{q} g_{1i}LGFC_{t-i} - \sum_{i=0}^{r} h_{1i}LWR_{t-i} + u_{1t} \tag{8}$$

All the coefficients of the equation (7) represent the short-run dynamics of the model's convergence to the equilibrium and *k* represents the speed of adjustment.

7. Empirical Findings

7.1. Graphical presentation of data

The first step in any time series data is to inspect of the graphical presentation of the data to understand the features of the data such as forms of trend, direction of trend, structural breaks, and stationarity. The graphical presentation of the data in the natural log form for the variables is given in Chart 1. The figure shows that all variables – *LY, LLF, LGFC,* and *LWR* are upward and might have a deterministic trend.

7.2. Granger causality test

The results of Granger causality tests for lags 1 through 3 for the variables – *LY, LLF, LGFC,* and *LWR* are shown in Table 1 in Appendix 1. Results show that pairwise causality comes from *LLF* to *LY* and from *LGFC* to *LY* and from *LWR* to *LY* significantly at lag 2. Moreover, these causal relationships are not unidirectional at all lags. However, for simplicity, we may consider *LLF, LGFC,* and *LWR* as causes of *LY*.

7.3. Unit root test for stationarity

The unit root tests – ADF and PP – with data on *LY*, *LLF*, *LGFC*, and *LWR* were performed at levels and at the first difference for both with the intercept and trend term. Results of unit root tests are presented in Table 2 in Appendix 1. The both ADF and PP test result show that *LGFC* is stationary at the 5% level of significance, but *LY, LLF,* and *LWR* are stationary at the first difference at the 5% level of significance. Therefore, we conclude that *LGFC* might be *I*(0) and *LY, LLF,* and *LWR* are *I*(1).

7.4. ARDL bound test

To find a long-run relationship among the variables, the bounds test is applied. The result of bounds test is presented in Table 3 in Appendix 1. It is evident from Table 3 that the estimated F-statistic is 15.37, which is higher than all bound values at different levels of significance. The test result suggests that the null hypothesis of no relationship is rejected. Hence, it can be concluded that there is a long-run relationship among *LY, LLF, LGFC,* and *LWR*.

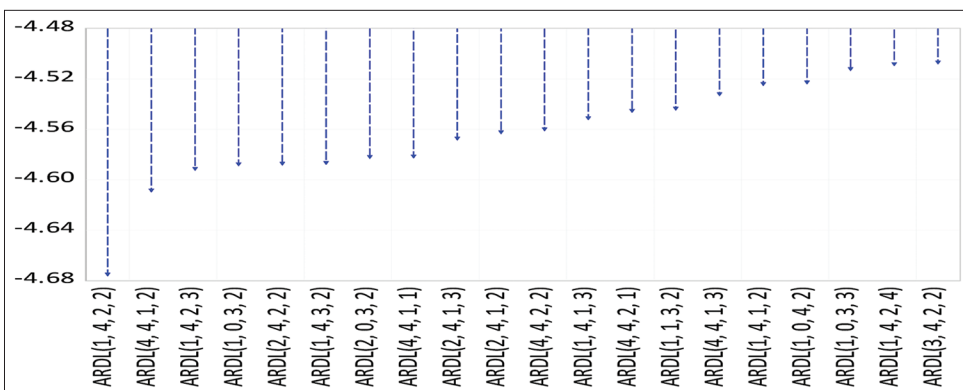## 7.5. Model selection criteria

Based on the Schwarz information criterion (SIC), the optimal lag length has been selected. According to the SIC, among the top 20 models, our best model for this study is ARDL (1, 4, 2, 2) model. The criterion for variables lag order selection is presented in Chart 2.

Chart 1: Trends in *LY, LLF, LGCF*, and *LWR*
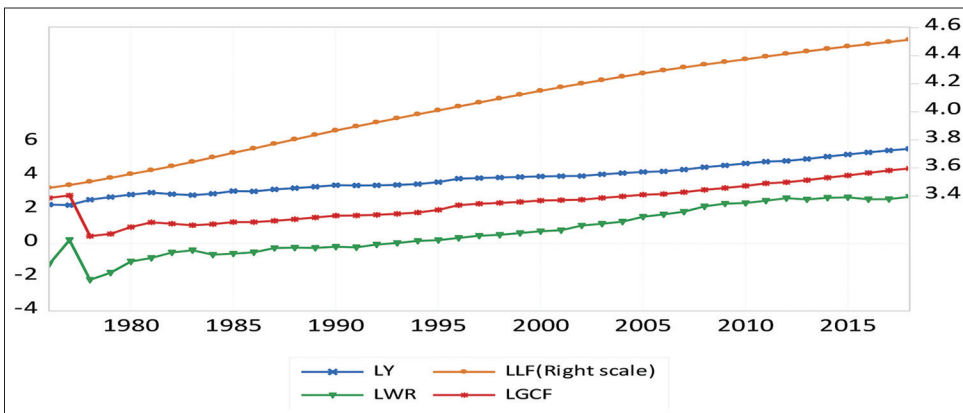
Chart 2: Schwarz criteria (top 20 models)

7.6. Long-run relationship

The long-run relationship is presented in Table 4 in Appendix 1. The result of estimation of *LY* equation shows that *LGFC* and *LWR* have a positive and significant effect on *LY* while *LLF* has a negative and significant effect on *LY*. Since there is no yearly series on employment data, *LF* is not truly a representation of employment or active workforce. The coefficient of *LWR* is 0.37 which indicates if *WR* increases by 1%, *Y* increases by 0.37%, and the coefficient of *LGFC* is 1.01 which indicates if *GFC* increases by 1%, *Y* increases by 1.01%. On the other hand, the coefficient of *LLF* is −1.93 which indicates if *LF* increases by 1%, *Y* decreases by 1.93% which indicate surplus labor.

7.7. Short-run dynamics

While a long-run co-integration among the variables exists, we can apply ECM to find short-run dynamics of the variables. Table 5 in Appendix 1 shows the result of ECM of the ARDL model (1, 4, 2, 2). From Table 5, we see that LLF and LGFC have a short-run significant positive effect on LY. On the other hand, LWR has a short-run significant negative impact on LY. The negative short-run impact of WRs on GDP indicates that an increase in WR can rise aggregate demand directly, which, in turn, increase the price level and ultimately decrease demand for the output. However, the most important term is the sign and value of the coefficient on the ECT. The negative sign on ECT confirms the expected convergence process in the long-run dynamics of LLF, LGFC, LWR, and LY. The coefficient of ECT_{t-1} is 0.26 and statistically significant at 1% level which indicates that 26% of the last year's disequilibria are corrected in the current year. Hence, once a shock happens, it takes nearly 4 years to adjust LF, GFC, and WRs to restore long-run relation with GDP (Y) variable. It is considered as a good speed of adjustment in the relationship process following a shock.

7.8. Diagnostic tests

The robustness of the ECM has been passed by most important diagnostics tests – normality, autocorrelation, heteroscedasticity, and stability tests. The Jarque-Bera statistic confirms the normality behavior of the estimated residual series. Breusch–Godfrey serial autocorrelation (LM) test confirms that the ARDL model is free from serial autocorrelation. The Breusch-Pagan-Godfrey test confirms that the residuals are homoscedastic. Cumulative sum (CUSUM) of recursive residuals and the CUSUM of square tests are applied to assess the parameter stability (Pesaran and Pesaran, 1997). The figures in Appendix 2 plot the results for CUSUM and CUSUM squares tests. The statistics of the CUSUM and CUSUM squares fall inside the critical bands of the 5% confidence intervals of parameter stability which indicate that there exists stability in the estimated coefficients of ECM over the sample period. Moreover, the adjusted R^2 (0.92) shows that the estimated equation is fitted well (Table 6).

8. Conclusion and Policy Suggestions

In this paper, we examined the impact of workers' remittance on economic growth through time series regression analysis with ARDL model. The regression results show that the coefficient of *LWR* is 0.37 which indicates if *WR* increases by 1%, *Y* increases by 0.37% and the coefficient of *LGFC* is 1.01 which indicates if *GFC* increases by 1%, *Y* increases by 1.01%. Therefore, we can conclude that WRs have an encouraging impact on economic growth and there exists a significant positive relationship between WRs and economic growth in Bangladesh. However, the negative impact of LF on GDP indicates that there exists surplus LF in Bangladesh's economy. Hence, it is essential for Bangladesh to increase overseas employment opportunities which will contribute more on GDP. On the other hand, the positive impact of GFC indicates Bangladesh economy needs more investment to absorb excess labor force into the production process.

It is recommended that Bangladesh should make pragmatic policies that inspire and stimulate the inflow of remittances through the proper channel because some remittances are still coming through

unofficial channels. Since, these remittances are also a prominent source of foreign exchange that can support to stun the balance of payment problem. Proper utilization of these WRs can also contribute to attain sustainable development. Hence, Bangladesh should utilize these inflows of remittances efficiently for economic growth and development.

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Appendix 1

Table 1: Pairwise Granger causality tests

	Test hypothesis	F-statistics in lags		
		1	**2**	**3**
1	*LLF* does not Granger Cause *LY*	0.05 (0.82)	**9.10** (0.00)	1.54 (0.22)
	LY does not Granger Cause *LLF*	**5.67** (0.02)	1.54 (0.23)	0.82 (0.49)
2	*LGFC* does not Granger Cause *LY*	1.98 (0.167)	8.86 (0.00)	**2.82** (0.05)
	LY does not Granger Cause *LGFC*	**38.11** (0.00)	**424.11** (0.00)	**32.25** (0.03)
3	*LWR* does not Granger Cause *LY*	**5.01** (0.03)	**7.17** (0.00)	2.25 (0.10)
	LY does not Granger Cause *LWR*	**18.70** (0.00)	**16.30** (0.00)	2.60 (0.07)
4	*LGFC* does not Granger Cause *LLF*	**56.76** (0.00)	**0.99** (0.38)	0.49 (0.69)
	LLF does not Granger Cause *LGFC*	**26.92** (0.00)	**80.35** (0.00)	2.29 (0.10)
5	*LWR* does not Granger Cause *LLF*	**17.12** (0.00)	0.45 (0.64)	0.58 (0.64)
	LLF does not Granger Cause *LWR*	**16.92** (0.00)	**13.47** (0.00)	**11.58** (0.00)
6	*LWR* does not Granger Cause *LGFC*	**4.65** (0.04)	**52.87** (0.00)	2.37 (0.09)
	LGFC does not Granger Cause *LWR*	0.09 (0.77)	**18.92** (0.00)	2.55 (0.07)
	Observations	42	41	40

Figures in the parenthesis are *P*-values used to decide on causality at the 5% significance level. *F* statistic is bold when level of significance at least 5%

Table 2: Unit root tests

Variables	In levels		In first difference		Order of integration
	With intercept	**With intercept and trend**	**With intercept**	**With intercept and trend**	
Augmented Dickey-Fuller test statistic					
LY	0.56 (0.99)	−1.12 (0.91)	**−5.40** (0.00)	**−5.33** (0.00)	I(1)
LLF	**−8.33** (0.00)	−010 (0.99)	0.33 (0.98)	**−6.03** (0.00)	I(1)
LGFC	−0.42 (0.90)	**−6.47** (0.00)			I(0)
LWR	−1.01 (0.74)	−2.27 (0.44)	−3.47 (0.02)	−2.78 (0.22)	I(1)
Phillips–Peron test statistic					
LY	0.49 (0.98)	0.49 (0.98)	**−5.40** (0.00)	**−5.33** (0.00)	I(1)
LLF	−3.52 (0.01)	2.16 (1.00)	−0.39 (0.90)	**−6.59** (0.00)	I(1)
LGFC	−0.23 (0.93)	**−11.21** (0.00)			I(0)
LWR	−0.53 (0.87)	**−4.85** (0.00)	**−12.02** (0.00)	**−11.99** (0.00)	I(1)

Figures in the parenthesis are *P*-values used to decide on unit roots at the 5% significance level. *F* statistic is bold when level of significance at least 5%

Table 3: Bound tests

F statistic	Number of regressors	Number of observations	Level of significance	Critical value bounds	
				I(0)	**I(1)**
15.37	3	39	10%	2.93	4.02
			5%	3.55	4.80
			1%	5.02	6.61

F statistic is bold when level of significance is 1%

Table 4: Long-run coefficients of ARDL model

Criterion	Model	Regressors		
		LLF	*LGFC*	*LWR*
SIC	ARDL (1,4,2,2)	−1.93*** (4.24)	1.01*** (8.97)	0.37*** (3.56)

Dependent variable: LY

Figures in the parenthesis are *t*-values. ***Indicates the coefficients are significant 1% levels

Table 5: Short-run dynamics

Regressors	Coefficients	t-values
Δ *LLF*	1.19	0.35
Δ *LLF(t-1)*	−4.80	−0.87
Δ *LLF(t-2)*	1.71	0.34
Δ *LLF(t-3)*	10.83***	3.62
Δ *LGFC*	0.95***	20.78
Δ *LGFC(t-1)*	−0.11***	−3.48
Δ *LWM*	0.03	1.21
Δ *LWM(t-1)*	−0.08***	−4.23
ECT(t-1)	−0.26***	−8.28

Dependent variable: Δ LCPI

Figures in the parenthesis are *t*-values. ***Indicates the coefficients are significant at 1% levels. "Δ" stands for difference operator. "ECT" stands for error correction term

Table 6: Diagnostic tests

Test for	Test statistic	Probabilities	Conclusion
1. Normality (JB test)	0.10	0.95	Residuals are normally distributed
2. Breusch–Godfrey serial correlation (LM test)	1.29	0.29	No autocorrelation
3. Heteroscedasticity (Breusch-Pagan-Godfrey)	0.65	0.75	No heteroskedasticity
4. Goodness of fit (Adjusted R^2)		0.92	Well fitted of data

Appendix 2