

Effects of Remittances on Income Inequality in Bangladesh: A Macroeconomic Analysis

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Author's contribution

The sole author designed, analyzed, interpreted and prepared the manuscript.

Article Information

DOI: 10.9734/SAJSSE/2021/v12i430320

Editor(s):

(1) Dr. John M. Polimeni, Albany College of Pharmacy and Health Sciences, USA.

Reviewers:

(1) Anna Rosokhata, Sumy State University, Ukraine.

(2) Zuriadah Ismail, University Pendidikan Sultan Idris, Malaysia.

Complete Peer review History: <https://www.sdiarticle4.com/review-history/73471>

Received 01 September 2021

Accepted 05 November 2021

Published 16 November 2021

Original Research Article

ABSTRACT

This study attempts to examine the effects of remittances on income inequality in Bangladesh over the period of 1990 to 2016. The study period has been chosen based on data availability at macro level. To serve the purpose, Autoregressive Distributed Lag (ARDL) cointegration technique is applied since unit root test confirms a combination of variables some which are stationary at level and others become stationary after first difference. The error correction model estimated by reparametrizing the ARDL model after having confirmation about the existence of long run relationship through bound test. An inverted U-shaped relationship between the remittances and income inequality has been found by the study. Remittances increase income inequality in short run and decrease income inequality in the long run. In the long run an increase in remittances by 1 per cent reduces the income inequality by 11 per cent on an average. The adjustment coefficient has the expected negative sign at 1 per cent level of significance which ensure a monotonically convergent adjustment towards the equilibrium with the speed of 21.65 per cent. Among other control variables, private credit increases income inequality in the long run and decrease it in the short run. Exchange rate and inflation either have very negligible effects or no significant effects both in short run and in long run. Based on the findings, it could be suggested that the country should take proper steps to encourage investment of remittances in productive activities to accumulate capital which could ensure the path of accruing the beneficial impacts of remittances on income inequality in the long run.

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Keywords: *Income Inequality; International Remittances; Short Run and Long Run Effects; the Autoregressive Distributed Lag (ARDL) Model; Error Correction Model (ECM).*

1. INTRODUCTION

A common phenomenon of many developing countries is enhanced economic growth accompanied with declining poverty but rising income inequality [1,2]. While the major components of globalization that influence income inequality are international migration and remittances [3]. The direction and magnitude of effects of remittances on income inequality are not unambiguous [4], and often depends on other factors. Ahlburg [5] Stark et al. [6,7] and others found that remittances could reduce income inequality in country of origin. But Adams [8] Connell [9] and others showed that remittances increase income inequality. The insignificant effects of remittances on income inequality also exist [10,11]. The theoretical prediction of Lipton [12] and Stark et al. [13] is that income inequality could rise with increased remittances if poorest households have lower opportunity to migrate which has been confirmed by the empirical study of Leones and Feldman [14] Also, Ratha [15] showed that inequality decreases with increased level of remittances. Some macroeconomic country level studies represent both positive and negative effect of remittances. Remittances could not significantly affect income inequality in Philippines [16], reduced income inequality in recipients' countries slightly [17] but increased income inequality in Egypt [18]. The effects of remittances on income inequality also differ in short run and in long run. The long run effects are mostly shaped by the returns to accumulated human capital of remittance recipient households. Shen et al. [19] reported that the impacts of remittances on inequality could have opposite sign in short run and in long run representing an inverted -U shaped relationship.

Despite the conflicting findings, remittances appeared as blessings for developing countries. Remittances could develop the human capital [20] develop entrepreneurship [21,22], reduce child labor [23] constitute safety net support during natural or economic disasters [24] etc. But sometimes, labor supply could be reduced by remittances recipients [25,26], by increasing reservation wage and less work incentive [27].

Remittances are very important for Bangladesh like other developing countries. Remittances

reduce poverty in Bangladesh by working as a source of microfinance [28,29]. The country is experiencing high income inequality. According to Solt [30] the gross Gini coefficient index of Bangladesh was 37.2 during 1980 which declined to 36 until 1991 and began to increase every year since 1992 with a highest value (39.1) during 2005 to 2007. Until 2010, the country had a Gini coefficient index around 39 which became 36.1 in 2016 [30] Since there is tendency to underestimate the true situation of inequality in the whole world [31] the country might be experiencing higher income inequality than this officially stated figures. Since, reduction of income inequality is the 10th goal among the 17 sustainable development goals (SDGs), utmost importance should be given in tackling income inequality of the country. Osmani and Sen [32] conducted a micro level study for Bangladesh and found that income inequality widened but the consumption distribution remained more equal for the 2000s decade due to unequal effects of international remittances. Empirical studies about the nexus of remittance and income inequality in Bangladesh at macro level are yet to be conducted.

Therefore, this study is an attempt to contribute in the existing literatures of remittances and income inequality by analyzing this relationship for Bangladesh using annual data of remittances receipts, income inequality and other control variables from 1991 to 2016. Since, the data on Gini Coefficients which is used to represent income inequality are available up to year 2016 for Bangladesh, the study period could not be extended beyond 2016. There are controversies about measurement of income inequality for which it is difficult to compare them over time or across countries. As, Solt's [30] Gini coefficients are comparable over time and across countries, current study uses Solt's [30] Gini coefficients to represent income inequality. The Autoregressive Distributed Lag (ARDL) cointegration technique appeared as appropriate one since unit root analysis for stationarity of relevant series revealed a combination of I (0) and I (1) series. The existence of cointegration is confirmed by the bound test. Therefore, in order to get short run dynamics and long run relationships among the variables, the ARDL model is reparametrized into Error Correction Model (ECM). It is found that in the long run remittances reduce the income inequality in Bangladesh. The estimated

lagged error term is found to be negative and highly significant. The deviations from equilibrium path of current year's income inequality will be corrected by 21.65 per cent per year. Therefore, restoring the long run equilibrium path for income inequality in Bangladesh might take several years.

The rest of the study is organized as follows: related theoretical and empirical literatures are reviewed in section-2, methodological issues, variable explanations and model selection process are discussed in section-3, the findings along with their analysis are presented in section-4, and finally a concluding remark is presented in section-5.

2. LITERATURE REVIEW

The whole contributions of remittances on income distribution could not be captured due to the presence of associated risk, inadequate rural insurance, imperfect credit markets etc. which resulted ambiguous findings.

2.1 The Ambiguous Effects of Remittances on Income Inequality

Investigating the effects of remittances on inter-household income distribution, Ahlburg Brown and Connell postulated that remittances could reduce inequality in origin countries. Before these, Connell found that initially, inter-household income inequality could be widened due to remittances if the migrants come from richest households. Regarding this, theoretical prediction is that with high emigration costs, the possibility of emigration from poorest households declines with declining opportunity of getting remittances and accelerating the inequality in migrant's home countries. This theoretical prediction has been confirmed by the country level empirical study of Leones and Feldman. Also, Bang et al. [33] found that remittances improve income distribution by increasing expenditures of poor households more than rich households in Kenya. Analyzing for rural Pakistan, Shams and Kadow [34] show that a major reduction in income inequality occurred with remittances. Recently, using a panel dataset for 18 Latin American countries from 2000-2013, Vacaflores [35] estimate that international remittances reduces income inequality and poverty in that region.

Adopting the counterfactual approach that is taking remittances as substitutes for domestic income rather than as exogenous income

source, some studies focused to find the differences in level of inequality between with remittances/migration and without remittances/migration. Inequality is found to be increasing with increased level of international remittances in Egypt and in Philippines [36] Brown and Jimenez [37] analyzed the remittances - inequality nexus for Tonga and Fiji by taking remittances as exogenous and counterfactual approach. While using the first approach, they found that remittances reduce inequality but it does not have any significant impacts when second approach has been adopted. In Ghana foreign remittances widened income inequality more than domestic remittances did [38] but in Philippines no significant effects of remittances on inequality are found. A recent study by Song et al. [39] find that remittances increase income inequality in 20 developing countries (major remittances recipients) during 1980 to 2016.

Some macroeconomic analysis at global level also found conflicting results. Analyzing for 10 Latin America and Caribbean countries, Acosta et al. found that remittances reduce income inequality in recipients' countries slightly. Similar results have been claimed by the study of Chauvet and Mesple-Soms [40] in which a larger panel data of 64 countries for 1988-1998 has been taken into account.

2.2 Short-Run and Long Run Effects

The long run effects are important parts of overall effects of remittances which occur through reshaping income distribution, accumulation of assets etc. and short run effects of remittances occur through changing household's income both directly and indirectly. Using the sample of Mexican household farms for 1982 and 1988, Taylor [41] found that remittances had both direct and indirect effects on household's income where the indirect effects was negative in 1982 which became positive during 1988. Improving this framework and assuming that indirect effects of remittances by relaxing income constraints are weaker for richest household who does not have such liquidity constraints, Taylor and Wyatt found that the effects are higher for household staying in lower segments of income distribution. According to Stark et al. the long run effects of remittances on income distribution are mostly shaped by the returns to accumulated human capital of recipient households and the short run effects of remittances on income distribution depends on the possibility of getting migration opportunities. The study also stated that

migrant's history and the possibility of obtaining the opportunity of migration as well as some remittances increasing components such as education, skill etc. largely influence the effect of migration on the village's income distribution. Stark et al. also emphasized that inequality rises with migration at the initial stage with few migrants and influenced by the percentage of remittances of household's total income who received remittances. The improve networking among households could enhance the migration opportunity which makes the effects of remittances on income distribution more equal. Through empirical analysis, the study found an equal effect of remittances from USA to Mexico on a village of Mexico which have a longer international migration history. On the other hand, an unequal effect of remittances from Mexico to USA has been found in the village which has few international migration histories. Developing a dynamic model Shen et al. predicted that the relationship between inequality and remittances/migration in the origin countries might have the possibility to exhibit inverted U-shaped pattern thorough intergenerational wealth accumulation- a same results as depicted by migration network theory with different explanation. That means, the impacts of remittances on inequality could have opposite sign in short run and in long run with an increasing trend of income inequality in short run and then a declining trend of it overtime perhaps due to "trickle-down" effects and wealth transfer across generations. These results hold true under the condition of no labor exchange and existence of sufficiently poor low productivity households. Under the same condition remittances are found to reduce income inequality in the long run.

2.3 Some Merits and Demerits of Remittances

Although literatures have conflicting findings regarding the effects of remittances on income inequality, there is no doubt that remittances have several positive effects in recipient countries. Mohapatra et al. argued that remittances are effective safety net tools to support a country that have large number of migrants at abroad during sudden shocks either natural or economic. They found that per capita consumption was higher for remittances recipients' household than others after the flood of 1998 and in Ethiopia, remittance recipients households cope better with drought without selling households assets. Remittances

increased the ability of household's expenditure on education, health, skill etc. in Mexico which eventually helped to develop the human capital. Studies by McCormick and Wahba stated that return migrants could develop entrepreneurship by using their income, skill and foreign knowledge in least developed countries (LDCs). Rozelle et al. [42] argued that remittances help to improve rural development and increase productivity in China. As well as child labor reduces as remittances increases in Tanzania Turing to the negative effects of remittances, Clements and McKenzie theoretically predicted that less work incentives might be associated with more remittances supply. This is due to the fact that households having more remittances increases their reservation wage to offer their labor supply. Taylor and Lopez-Feldman found that remittances received households lowered their labor supply in Mexico which negatively affects the labor-intensive production. It is found by the study of Ebeke and Goff that remittances could mitigate unequal income distribution to some extent in those countries which have low brain drain and migration cost as well as high average income etc. The authors derived the results from some countries located in Mediterranean Basin from a pool of 80 developing countries from 1970 to 2000.

3. REMITTANCES AND INCOME INEQUALITY IN BANGLADESH

Being a very smooth source of foreign exchange [43] Remittances are very important for a labor abundant country like Bangladesh. It could support the country by working as counter-cyclical [44]. At macro level remittances increase the foreign exchange reserve, improves the balance of payments, helps to pay foreign debt and import payments etc. [45]. At micro level remittances increases household's income which in turn increases their consumption, savings and investment abilities which eventually increases capital accumulation [46] Khan empirically derived those remittances could positively affect the per capita income of households. According to Osmani [47] the three key factors namely-agricultural sector's non farming, readymade garments (RMG) and remittances reduces the overall poverty of Bangladesh significantly. Remittances could work as potential sources of micro finance and hence it could be considered as one of important pro-poor initiatives for the country. But examining the uses of remittances dynamically, de Bruyn and Kuddus [45] could not

find any confirm that remittances could reduce poverty. Investigating the trend of income inequality in rural Bangladesh in the decade of 2000s by Using the successive rounds of Household Income and Expenditure Survey (HIES) data, Osmani and Sen found that income inequality widened but the consumption distribution remained more equal during the study decade. The study identified unequal effects of international remittances as one of the major reasons for these contradictory findings.

According to Solt [30] inequality is widening in Bangladesh gradually. In 1980 the gross Gini coefficients index was 37.2 which declined to 36 and remained around it until 1991. In 1992 it became again 37 and began to increase gradually each year. Gross Gini coefficients became highest (39.1) during 2005 to 2007, remained around 39 until 2010. After that it began to decline slightly and reached to 38.6 during 2016. The income shared held by highest and lowest groups of population of Bangladesh are shown in Table 1. Evidences of income inequality are clear from the data reported in Table 1.

According to Bangladesh Bank (2021), average remittances in Bangladesh was 1306.47 USD Million between 2012 and 2020. Within this period, the country received highest number of remittances (2598.21 USD Million dollar) during July, 2020. Before that during 2017, only 856 USD Million, a record number of low remittances have been experienced by the country. Starting from more than 3 per cent of GDP, the contribution of remittances in GDP increased over the time in Bangladesh. In 2012, personal remittances received by the country was 10.59 per cent of GDP which began to decline from 2013 and reached to 6.07 per cent in 2019.

4. METHODOLOGY

The relationship between income inequality and international remittances of Bangladesh could be expressed by following simple equation-1. The dependent variable, Gini coefficient in logarithmic terms represents the income inequality which is collected from Solt's (2020) Standardized World Income Inequality Database (SWIID).

$$\ln Gini_t = \beta_0 + \beta_1 \ln Remittances_t + \beta_2 \ln X_t + \varepsilon_t \quad (1)$$

The major independent variable, Remittances is the personal remittances receipts (current US\$). Data on remittances are collected from World Development Indicators (WDI) from World Bank. All other control variables used in this study are represented by the variable X. Other control variables are Private Credit (Domestic credit to private sector as per cent of GDP), annual Exchange rate (BDT per \$) and Inflation (Consumer Price Index). Data for Private Credit and Inflation are collected from World Development Indicators (WDI) from World Bank. Exchange rate data is collected from UNCTAD data center (see Table: A1 in appendix for details of data sources). Like dependent variable, all control variables except exchange rate are expressed in logarithmic terms. The error term is represented by ε . Subscripts t stands for the study time period, from 1990 to 2016. That is data for all macroeconomic variables are collected from 1990 to 2016. The study period is chosen based on data availability. Data on Gini Coefficients which is the dependent variable for are found to be available up to 2016. So, it would not be possible to extend the study period beyond 2016.

Regarding the expected hypothesized outcome, it is expected that $\beta_1 > 0$ or $\beta_1 < 0$ significantly or insignificantly. These hypothesized outcomes are expected since theoretical and empirical studies reviewed in literature review section showed ambiguous effects of remittances in income inequality. Before doing regression analysis to find the actual affects, it is necessary to examine the stationarity of each time series discussed above. Dickey-Fuller [48] unit root test is applied to find out whether series are stationary or non-stationary. Based on DF tests results the estimation techniques could be chosen. If all variables are stationary at levels, Ordinary Least Squares (OLS) could be applied. If all variables, are I (1) that is stationary at first differences, Vector Error Correction Model (VECM) could be applied if series are cointegrated. If series are not cointegrated VAR model could be appropriate. Finally, if some variables are I (0) and others are I (1), that is if some variables are stationary at level while others become stationary after first differences, the autoregressive distributed lag (ARDL) should be applied if there are co-integration in the model. Before testing for co-integration between the series, the order of integration needs to be identified. The Schwarz Bayesian criterion (SBC) has been set as the criteria of selecting lag length in this study. After selecting the order, this study adopted the

autoregressive distributed lag (ARDL) bounds test of Pesaran et al. [49] to test for co-integration. Bound test creates robust result even with the small sample size and generates critical values with 30 sample size which increases the test's popularity [50] As well as like other methods, bound test method does not need similar order of integration. For model which contains endogenous control variables, bound test generates robust results. The identification of cointegration leads towards next step of estimating error correction model. A significant negative adjustment coefficient could permit to estimate the Error Correction Model (ECM) calculating both short run and long run relationship while the major focus should be given on long run relationships. Finally, to investigate whether the assumptions of regression model are satisfied or not some tests namely Jarque-Bera test for checking the residual's normality, Durbin's alternative test for autocorrelation, LM test for autoregressive conditional heteroskedasticity (ARCH), White's test for heteroskedasticity, Cameron & Trivedi's decomposition of IM-test for heteroskedasticity, skewness & kurtosis are applied by the study. As well as, to test for model's stability CUSUM Squares test is applied.

5. RESULTS AND DISCUSSION

5.1 Descriptive Statistics Analysis and Stationarity Tests Results

The descriptive statistics of related variables are shown in Table 2.

Sufficient variations from the mean value of corresponding variables are observed from Table 2. Number of observations remain same as time period (1990 to 2016) which is 27. Dickey-Fuller (DF) tests results (see Table: A2 in appendix) reveal that lnInflation is stationary at I (0), that is it is stationary in levels. Rest of the variables are found to be stationary at I (1), that is they are non-stationary at level but become stationary after taking first differences. Therefore, a combination of variables is found some of which are stationary at level and some are stationary after first differences.

5.2 Bound Test Analysis for Correlation Test

The bound test of Pesaran et al., (2001) has been done and results are represented in Table 3.

Table 1. Income Share Held by Highest and Lowest Groups

Year	Income Share Held by			
	Highest 10 per cent	Lowest 10 per cent	Highest 20 per cent	Lowest 20 per cent
1983	21.9	4.1	35.8	9.7
1985	23.4	4.5	37.2	10
1988	24.6	4.2	38.6	9.4
1991	23.3	4.1	37.4	9.6
1995	28.1	3.8	42.4	8.8
2000	27.9	3.7	42.7	8.6
2005	28	3.8	42.5	8.8
2010	26.9	3.9	41.5	8.9
2016	26.8	3.7	41.4	8.6

Source: World Bank Development Indicators, World Bank (2021)

Table 2. Descriptive Statistics

Variables	Observations	Mean	St. Dev	Minimum	Maximum
lnGini	27	3.65	0.02	3.61	3.67
lnRemittances	27	21.99	1.06	20.46	23.45
lnPrivate Credit	27	3.28	0.38	2.68	3.81
Exchange Rate	27	58.26	15.35	34.57	81.86
lnInflation	27	1.73	0.46	0.46	2.43

Source: Study Findings

Table 3. Pesaran/Shin/Smith (2001) ARDL Bounds Test for Cointegration Analysis

Panel-A		F-statistics=15.71							
Critical Values	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)	
	L(1)	L(1)	L(05)	L(05)	L(025)	L(025)	L(01)	L(01)	
	2.45	3.52	2.86	4.01	3.25	4.49	3.74	5.06	
Panel-B		t-statistics= - 3.503							
Critical Values	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)	
	L(1)	L(1)	L(05)	L(05)	L(025)	L(025)	L(01)	L(01)	
	-2.57	-3.66	-2.86	-3.99	-3.13	-4.26	-3.43	-4.60	

The null hypothesis is that there is no level relationship in the long run/ series are not cointegrated. The alternative hypothesis is that there is level relationship in the long run/series are cointegrated. The decision of test results could be taken based on either F-statistics or t-statistics. If the computed F-statistics is greater than from the critical values of all I (1) regressors, the null hypothesis no level relationships could be rejected in favor of alternative hypothesis of existence of long run relationships between independent and dependent variables. If the computed t-statistics is lower than the critical values of all I (1) regressors, the null hypothesis of no level relationships could be rejected in favor of alternative hypothesis. An inconclusive result might be generated if computed F-statistics and t-statistics lie between the critical values of all I (0) and I (1) regressors. The panel-A of Table 3, represents the information related to F-statistics. F-statistics is greater than for all I (1) regressors. Therefore, null hypothesis of no cointegration could not be accepted. The information related to t-statistics are shown in panel-B of Table 3. Since t-statistics is lower than for all I (1) regressors. Therefore, null hypothesis of no cointegration could not be accepted. So, there are cointegration among the variables. The unit root results from subsection 5.1 and bound test results in this subsection justifies the use of ARDL cointegration technique for estimating error correction model. The estimated results are discussed in following subsection.

5.3 Long Run and Short Run Error Correction Model (ECM) Estimates

The estimated results of both long run and short run coefficient are represented in Table 4. The coefficient of short run adjustment process is represented by the coefficient of ECM which is negative and statistically significant at 1 per cent level of significance. These results reconfirm the conclusion derived from bound test that a long run relationship exists between the variables.

The value of ECM in t-1 period is -0.2 which lies between 0 to -1. This means that a part of previous year's error is the correction to the Inqini in current year. As independent variables change, a monotonically convergent process is occurred by the ECM adjustment in the long run equilibrium. The estimated lagged error term is 0.21649 which means that the speed of adjustment is 21.65 per cent, a relatively quicker error correction process towards equilibrium. This implies that the deviations from equilibrium path of current year's income inequality will be corrected by 21.65per cent per year. Therefore, restoring the long run equilibrium path for income inequality in Bangladesh might take several years. The crucial result shown in Panel-A of Table 4, is that on an average increase in remittances by one per cent significantly reduces the income inequality by 11 per cent in Bangladesh, holding all other things constant. This result support the claims that in poorest developing countries, globalization contributed to reduce income inequality [51,52].

In short run (see Panel-B of Table 4), it is found that remittances are significantly increasing income inequality which is similar to the findings of Rodriguez (1998) in Philippines, Adams (1991) in Egypt, Iqbal and Sattar in Pakistan etc.

Combining the findings in both Panels of Table 4, it is summarized that the impact of remittances on income in equality is positive in short run and negative in long run. These exhibit an inverted U-shaped relationship between income inequality and remittances as predicted by Shen et al. As remittances increases, income inequality increases in short run and income inequality begins to decrease as remittances increases more. The underlying reasons of this inverted U-shaped pattern might be the existence of intergenerational wealth accumulation and transfers overtime which could reduce inequality in long run with trickle down effects Since, most of the remittances received by Bangladesh are in the form of transfers to family and friends which

are mostly expended for consumption purpose and some people remit to invest or save (De Bruyn and Kuddus, 2005), capital accumulation process could take longer time and inequality reducing effects of remittances might reveal in the long run. In the short run remittances increases income inequality due to the pattern of migration history, migration opportunity and endowment conditions of migrant's households. The income of to 20 per cent households (top quintile) increased more than other quintiles primarily due to international remittances and non-agricultural activities by self-employment. Evidences could be found from the study of Osmani and Sen "As much as 45 per cent of the incremental rural income between 2000 and 2010 was contributed by foreign remittance, and almost 90 per cent of the incremental remittance income went to the top quintile". The authors stated that at that time most of remittances received households were from the top 20

quintile and due to remittances ,70 per cent income inequality increased. In terms of sign, the opposite effects of private credit are found by the study. In long run increase in private credit by one per cent significantly increases the income inequality by 36 per cent on an average (cet. per.). But in short run private credits are found to reduce the income inequality. These two results confirm the U-curve relationship between income inequality and private credit. The exchange rate does not affect income inequality in long run and it has almost zero significant affect in short run. The effect of inflation is insignificant in long run. A very negligible effect of inflation is observed during short run.

Some diagnostic tests have been carried out to examine whether the model satisfies the assumptions of classical linear regression model (CLRM) or not. Diagnostic test results are shown in Table 5.

Table 4. Long Run and Short Run Error Correction Model Estimates

Variables	Coefficients	
Panel-A: Long Run Estimates (Dependent Variable: lnGini)		
lnRemittances	-0.11	(0.001) ***
lnPrivate Credit	0.36	(0.000) ***
Exchange Rate (BDT per Dollar)	-0.001	(0.077) *
lnInflation	-0.0003	(0.935)
Panel-B: Short Run Estimates (Dependent Variable: D.lnGini)		
Constant	1.06	(0.005) ***
lnGini (LD).	-.160	(0.355)
lnRemittances		
D	0.024	(0.004) ***
LD	0.025	(0.005) ***
L ₂ D	0.01	(0.035) **
lnPrivate Credit		
D	-0.05	(0.002) ***
LD	-0.021	(0.014) **
L ₂ D	-0.038	(0.000) ***
Exchange Rate (BDT per Dollar)		
D	0.0002	(0.039) **
lnInflation		
D	0.0001	(0.279)
LD	-0.002	(0.027) **
L ₂ D	0.002	(0.005) ***
ECMt-1	-.21649	(0.01) ***
Adj-R ²	0.9371	

*** and ** indicates that tests results are significant at 1 per cent and 5 per cent level of significance respectively. D indicates the first difference of corresponding variables. L and L₂ indicates the first and second lagged values of corresponding variables

Table 5. Diagnostic Tests Results

Diagnostic Tests	Computed Statistics	P-values
Jarque-Bera normality test	Chi-Square: 6.139	0.05
Durbin's alternative test for autocorrelation	F-Statistics: 12.085 (lags=1)	0.01
	F-Statistics: 6.194 (lags=2)	0.04
LM test for autoregressive conditional heteroskedasticity (ARCH)	Chi-Square: 0.176	0.68
White's test for heteroskedasticity	Chi-Square: 24.00	0.40
Cameron & Trivedi's decomposition of IM-test		0.40
Heteroskedasticity	Chi-Square: 24	0.28
Skewness	Chi-Square: 18.67	0.17
Kurtosis	Chi-Square: 1.87	
The CUSUM of Squares Tests for the stability of regression model	CUSUM ² : Stable	

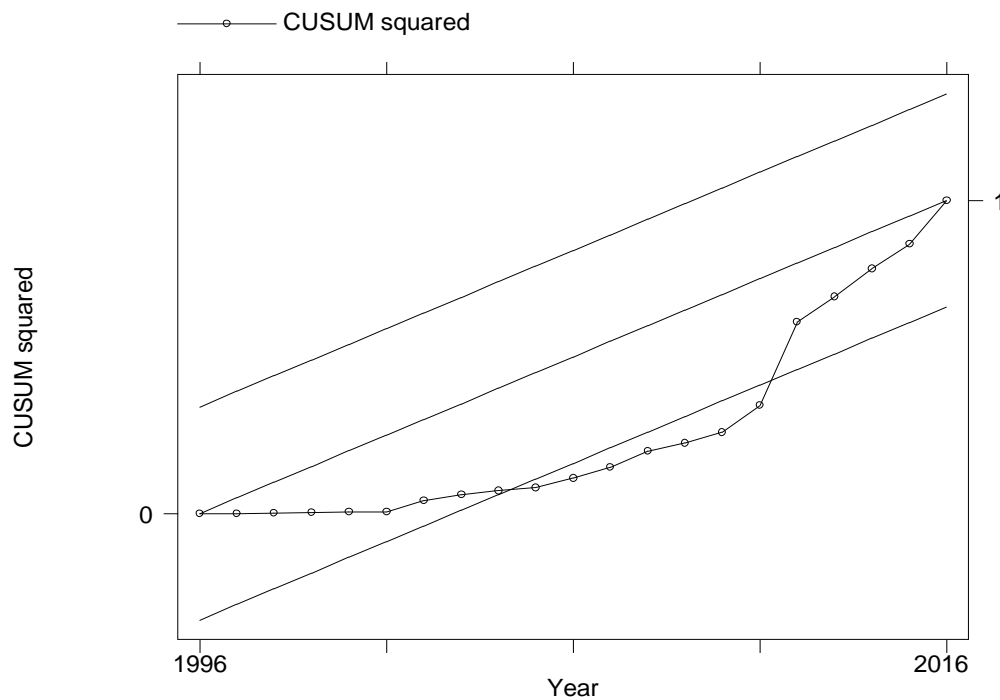


Fig. 1. The CUSUM of Squares Tests for the Stability of Regression Model

It is clear that the model has satisfied the normality assumptions of error terms. The p-values of Durbin's alternative test for autocorrelation are 0.01 and 0.04 for lags 1 and lags 2 respectively which confirm that there is no serial correlation. The results of LM test (P-value-0.68) for autoregressive conditional heteroskedasticity (ARCH) showed that there are no ARCH effects. As well as the p-value (0.40) of White's test for heteroskedasticity confirms that there is no heteroskedasticity. Cameron &

Trivedi's decomposition of IM-test also represents no heteroskedasticity, skewness and kurtosis. The CUSUM Squares tests for the stability of regression model also resulted a stable model. The result is represented in Fig. 1.

It is clear from the Figure-1 that the CUSUM squares lie between the critical bounds at 5 per cent level of significance. Therefore, all of this diagnostic test results justifies that a well-designed functionally formed model is estimated

in this study and the estimated parameters are stable.

6. CONCLUSION

Theoretical predictions as well as empirical findings about the nexus of remittances and income inequality are not straightforward. Whether remittances could reduce or increase income inequality in recipient countries vary with the empirical approach used-remittances considered as exogeneous or as a substitute for home income, with the types of remittances considered-internal or international, uses of remittances in home country -productive uses or non-productive uses and with the country itself which is examined. Although some micro level studies have been conducted to examine the relationship between remittances and income inequality in Bangladesh, evidence of analyzing the relationship at macro level could not be found. Therefore, this study focuses to examine the relationship between abovementioned variables at macro level by using annual time series data of relevant variables from 1990 to 2016. A monotonically convergent process towards the equilibrium with the adjustment speed of 21.65 per cent per year has been found. That means any short run deviation from equilibrium in income inequality will be corrected by 21.65 per cent per year in the long run. The study findings confirm that remittances could significantly reduce the income inequality of the country in the long run. But in the short run an income inequality increasing effects of remittances are found. Therefore, an inverted U Curve relationship between income inequality and remittances has been identified by the study. An opposite result is found in case of effects of private credit on income inequality. Private credit which is used as one of regressors, is found to increase income inequality in the long run but decrease it in the short run. Effects of other control variables namely exchange rate and inflation are found to be either negligible nor insignificant both in short run and in long run.

This study concludes that Bangladesh could use remittances to reduce income inequality in the long run. Therefore, the country should take proper steps to ensure the productive use of remittances by the recipient households by providing incentive to invest remittances in productive activities. Investment of remittances in productive activities would increase capital accumulation which could increase the adjustment speed towards long run equilibrium.

Since data on income inequality could not be found beyond 2016, study period could not be extended beyond 2016. Therefore, further macro level studies could investigate the relationship between income inequality and remittances in Bangladesh by using alternative measures of variable, alternative methods and extending the time period if data become available.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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APPENDIX

Table A1. Description of Variables and Data Sources

Variables	Description of Variables	Data Sources
InGini	Gros Gini Coefficient Index expressed in logarithmic terms.	Solt (2020) Standardized World Income Inequality (SWIID) Database, Version 9.1, May 2021
InRemittances	Personal remittances, received (current US\$) in logarithmic terms	World Development Indicators, World Bank.
InPrivate Credit	Domestic credit to private sector (per cent of GDP) in logarithmic terms	World Development Indicators, World Bank.
Exchange Rate	Annual nominal currency rate (BDT per dollar)	Data Bank of United Nations Conference on Trade and Development (UNCTAD)
InInflation	Consumer Price Index in logarithmic terms	World Development Indicators, World Bank.

Table A2. Dickey-Fuller (DF) Test for Unit Root

Level of Significance	DF Critical Values		
	1 per cent (-3.74)	5 per cent (-2.997)	10 per cent (-2.63)
Variables	Test Statistics	P-values	
InGini	0.013	0.994	
D.InGini	-6.55	0.00***	
InRemittances	-0.745	0.83	
D.InRemittances	-3.308	0.01**	
InPrivate Credit	-0.331	0.92	
D.InPrivate Credit	-5.749	0.00***	
Exchange Rate	-0.834	0.81	
D. Exchange Rate	-4.209	0.00***	
InInflation	-3.331	0.013***	
D.In Inflation	-5.688	0.00***	

*** and ** indicates that tests results are significant at 1 per cent and 5 per cent level of significance respectively. D. indicates the first difference of corresponding variables

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Peer-review history:
The peer review history for this paper can be accessed here:
<https://www.sdiarticle4.com/review-history/73471>