Independent University **Bangladesh (IUB)**

IUB Academic Repository

Department of Economics Thesis Paper

2026-08

Investigating the nexus between economic growth and remittance, trade openness, and investment

Rahman, Md Hasibur

Independent University, Bangladesh (IUB)

https://ar.iub.edu.bd/handle/11348/1590

Downloaded from IUB Academic Repository

Investigating the nexus between economic growth and remittance, trade openness, and investment

by

Md Hasibur Rahman
ID: 1822239

A Research Paper Presented in Partial Fulfillment
of the Requirements for the Degree
Bachelor of Science in Economics

INDEPENDENT UNIVERSITY, BANGLADESH

August, 2026

Investigating the nexus between economic growth and remittance, trade openness, and investment

Investigating the nexus between economic growth and remittance, trade openness, and investment

by

Md Hasibur Rahman
ID: 1822239

Mr Shamil M. Al-Islam
Lecturer A
Department of Economics
School of Business and Entrepreneurship (SBE)
Independent University, Bangladesh

DECLARATION

The research paper has been done under the supervision of Mr Shamil M. Al-Islam. The topic has been approved by my supervisor. This paper contains no material published elsewhere or extracted in whole or in part from a research project/thesis/article by which I have qualified for or been awarded another degree or diploma. No other person's work has been used without due acknowledgment in the main text of the research paper. This research paper has been undertaken to fulfill the requirement of ECN 490.

_____

Md Hasibur Rahman

ID: 1822239

Date: _____

Acknowledgement

First and foremost, I would like to thank the Almighty for granting me the strength, patience and perseverance to complete this research paper.

None of this would have been possible without my mother who has given me continuous support and encouragement throughout this journey and for that I am eternally grateful.

My supervisor, Mr Shamil M. Al-Islam, deserves my sincere gratitude for his continuous guidance and patience with me during the course of this research. I greatly appreciate his insights and feedback which contributed to this paper

I also want to express my gratitude to the Head of the Department Dr. Md. Khaled Saifullah for his support throughout my tenure in the program.

Finally, I would like to thank all of the faculty members that I have had the privilege of being taught by. It is their teaching and guidance that have made me grow to love economics truly.

TABLE OF CONTENTS

Declaration **4**

Acknowledgement **5**

Abstract **7**

Chapter 1: Introduction **8**

Chapter 2: Literature Review **9**

Chapter 3: Methodology **12**

3.1 A Note on the Selection of the Variables 12

3.2 Limitations 13

Chapter 4: Result and Analysis **13**

4.1 Multicollinearity Diagnostics 14

4.2 Unit Root Test 14

4.3 CUSUM of Squares Test 15

4.4 ARDL Model Selection and Short-Run Estimates 16

4.5 Bounds Testing for Long-Run Relationship 18

4.6 Short-Run Dynamics: Error Correction Model 19

4.7 Serial Correlation 20

4.8 Heteroskedasticity 20

4.9 Discussion of the Results 21

4.9.1 Coefficient Significance 21

4.9.2 Short Run vs Long Run Relation 23

Chapter 5: Conclusion **24**

Chapter 6: References **26**

Abstract

This study looks at the relationship between remittance and GDP per capita growth, with trade openness and investment (gross capital formation) acting as the other control variables, using an ARDL bounds testing framework. While the bounds test confirms a long run cointegrating relationship among the variables (F-statistic = 10.038), and an error correction term of -0.916 (suggesting speed of correction to be 92% within a year), only investment is found to be both statistically significant in the short and the long run. Individually, trade openness is found to be statistically significant in the short in its contemporaneous form, however insignificant jointly with its lagged forms, and insignificant in the long run, while remittance, the key variable in question, has no statistically significant impact on GDP per capita growth in both the short and the long run.

Chapter 1: Introduction

Remittance inflow has grown substantially from the developed world to the developing world in the last two decades, facilitated by factors such as a fall in transaction costs for international money transfers, due to technological progress and innovation (Giuliano and Ruiz-Arranz, 2005)

Over the past few decades, a dramatic uptick in the remittance inflow volume has been observed, the latest estimate being $656 billion in 2023 (World Bank, 2024), reflecting a 5.8% increase year-on-year; since the mid-1990s, remittance inflows to developing countries have categorically exceeded the figures for both FDI and official development assistance (ODA) to developing countries. At the theoretical level, Lucas and Stark (1985) differentiate between altruism, where household income falls induces higher flow of remittance, and self-interest, where remittances are used for various consumption nd investment related purposes.

Since as early as 1942, Bangladesh has seen a trend of steady migration outwards, which has resulted in a constant flow of remittance to the nation (Mahmood, 1991) and the flows have increased significantly over time. Overall, between 1979 and 2008, an average growth rate pf 19% has been observed (Hussain and Naeem, 2009) owing to the existence of 7.1 million emigrants in the period spanning 1976 to 2010. Bangladesh has been in the top ten remittance-recipient countries since 2009 with annual remittance inflows of over US$10 billion, which is 10.2 per cent of GDP (Ratha, Mohapatra and Xu, 2008). Notably, illicit inflow mechanisms such as *hundi* bypassing the formal banking channels make it difficult to ascertain the exact figure of remittance flowing into the country. It is estimated that the unofficial remittance inflow could be 50 to 200 percent of the recorded remittances (Aggarwal, Demirgüc-Kunt and Peria, 2006).

In Bangladesh, a series of factors are responsible for this explosive growth of remittance inflow. Macroeconomic reforms since the late 1990s, such as the introduction of new exchange houses in migrant-source countries, increased drawing arrangements, the establishment of annual thresholds for remittances transferred through foreign exchange dealers, bank supervision, and quicker remittance disbursement processes, have all led to this rising trend. These dynamics can be summed up globally and locally to provide a rational explanation for the growing share of remittances in external financial flows of Bangladesh.

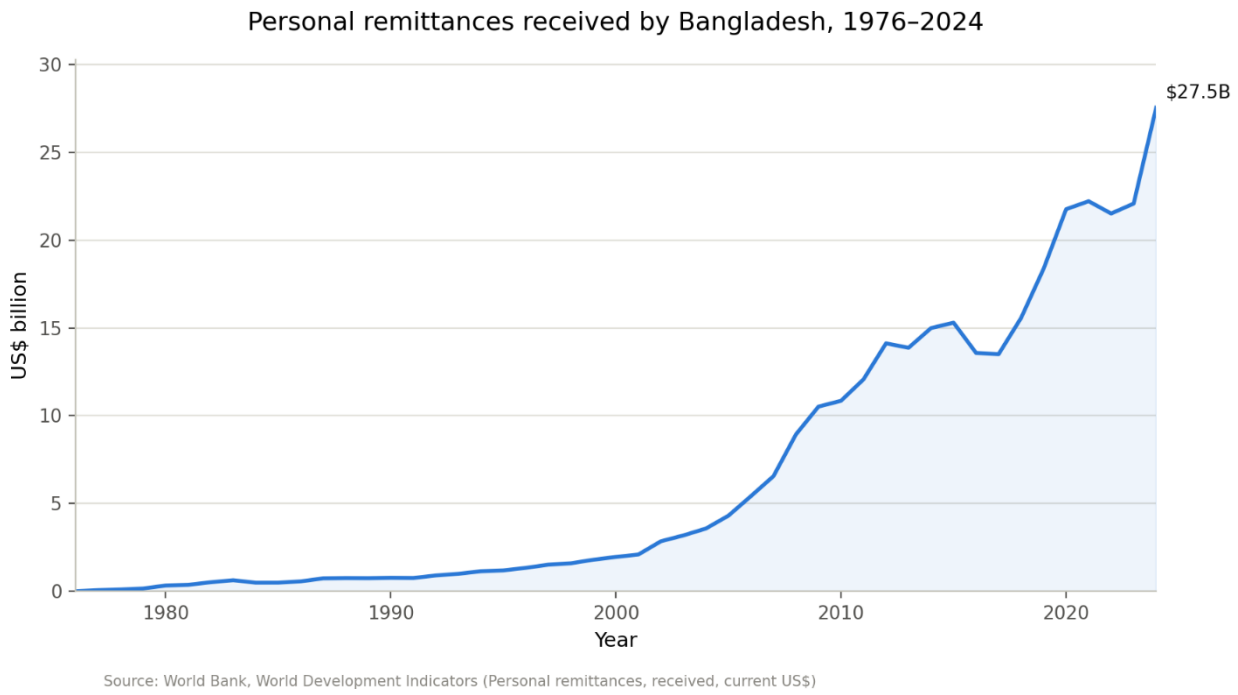


Figure 1: Personal remittance received, Bangladesh (1976-2024)

Chapter 2: Literature Review

Remittances account for more external fund inflow than any other channels or mechanisms (Ratha, 2003). In addition to aggregate effects, the remittance literature includes household-level effects - e.g., Edwards and Ureta, 2003, find that in El Salvador, school retention is directly achieved through flow of remittance. However, the effects of remittance on economic growth is a matter that is not yet settled. Some important studies suggest remittances are detrimental and/or ineffective for growth. Using a cross-country sample of a large number of countries, Chami, Fullenkamp and Jahjah (2005) have attributed moral hazard as the causing effect of the negative impact of remittance on growth: with rising remittance income, households reduce the effort and time required to increase household output, thus leading to overall reduced output. The results are reflected in a similar IMF study (2005) looking at remittance and economic growth over a span of 30 years and 100 countries: no statistically significant relation is found to exist between remittances and per-capita growth, or remittances and other migration-related activities such as education and investment. The authors posit, however, that measurement issues may hide the actual relationship between remittances and growth because remittances are known to be countercyclical in nature. Dhar and Gazi (2023), looking at specifically Bangladesh, Sri Lanka, and Vietnam, within the span of 1990 to 2009, find that remittances, which flow towards unproductive consumption and investment in

unproductive sectors in these countries, have a negative impact on economic growth. For Bangladesh specifically, no short run or long run relationship between remittance and economic growth exists.

Other country/regional studies have reported positive, but mixed, results. Faini (2007) found that due to income from remittance, households can avoid the credit constraints characterizing such households, and also use the remittance income for savings, ultimately leading to economic growth. In the Philippines, Ang (2007) finds a positive and statistically significant effect at the national level, concluding that when remittance income is channeled towards productive activities, not consumption, economic growth is achieved. A study by Glytsos (2005) find that the growth effect of remittances is asymmetric, with the losses due to a fall in remittances offsets the gains from a rise. In a study employing five-year averages across approximately seventy countries and a system-GMM approach, Giuliano and Ruiz-Arranz (2009), find that remittance is a substitute for formal credit, ensuring financial access for those receiving it. This directly impacts financially underdeveloped countries where access to credit still remains a pressing issue. With the inclusion of other control variables such as governance and institutional-quality indicators in a wider cohort of countries, Catrinescu et al. (2009) also find a positive, insignificant relation between remittances and growth, with capital formation and institutional capacity having more robust impacts on growth. Lastly, a study by the World Bank (2006) that adopts migration- and distance-based instruments (based on the geographic concentration of the country's migrants in specific OECD destinations and on the conditions of the destination economies) shows a consistent positive relationship between remittances and growth; however, the exclusion of investment seems to negate, or reduce the impact, of remittance. Remittance, when coupled with education, financial depth, and institutional quality, in the same study reveals a negative direct coefficient of remittance, followed by positive interaction terms, indicating that remittances augment growth only when other complementary variables are accounted for.

In the context of Bangladesh, a number of papers have looked at the relationship between remittance and economic growth. Paul and Das (2011), using data from 1979 to 2009, have used a two variable model – with GDP the dependent variable, and remittance inflow the independent variable – and found that there exists a “significant and positive long-run relationship between remittances and GDP,” while no short run relation is found. Since this study employs very limited number of variables in the model specification, including just one explanatory variable, there exists significant room to build on the study by using other econometric tools. The same author, Paul et al. (2011), uses the ARDL bounds test to look at relation between GDP and remittance, and causality is tested using the Granger causality test. The Granger test finds that interestingly, it is GDP that Granger causes remittance, implying that as GDP moves, remittance moves in the same direction. The ARDL bounds test shows that there exists a statistically significant cointegrating relation between remittance and GDP in the long run, while short run effects are

statistically insignificant. While running the Error Correction Model, the it is found that 43–54% of "last year's disequilibria are corrected in the current year, suggesting a good speed of adjustment."

Using a host of variables, Rahman (2009) employs the ARDL bounds testing approach to look at the effects of remittance, exports, and FDI on the real GDP of Bangladesh, India, Sri Lanka and Pakistan. The author does not find any significant long run relationship between exports, FDI, and remittance and real GDP – a finding that contradicts common economic sense. However, with F-statistic, a joint statistically significant effect of all variables on real GDP is found. Chowdhury (2011), using cointegration analysis and a Vector Error Correction Model (VECM) for the period 1971-2008 shows that increases in remittance inflows have been an important driver of growth and development of the financial sector in Bangladesh – a sector whose development can be inferred to have positive impacts on economic growth, though not backed by this particular study. Siddique et al. (2010), again use just two variables, per capita remittance and economic growth, to see the effects of remittance on economic growth for Bangladesh, India and Sri Lanka. In the case of Bangladesh, they find that there exists no long run cointegrating relation between the two variables. However, using the Granger causality test, they do find that remittance Granger causes economic growth. Finally, Uddin and Sjo (2013) perform a Johansen's vector autoregression (VAR) analysis for the impact of remittance inflows and financial development on economic growth using annual data spanning 1976–2011, and conclude that both remittance inflows and financial development are positively associated with long-run GDP growth, and that remittance inflows are also a short-run buffer against income shocks. Islam (2022), also find a similar result – using South Asian data from 1986-2019, find that remittance has a positive impact on economic growth. The study uses a model which incorporates trade openness and FDI as control variables, a model similar to the one employed in the present study.

One of the few studies that looks at variables other than remittance in the model to explain economic growth, Sutradhar (2019) employs pooled OLS, FE and RE models, and uses the explanatory variables remittance, FDI, growth in exports, growth in exchange rate in USD, and growth in gross capital formation, to see their effects on GDP per capita of Bangladesh. It is found that there exists a negative and significant impact of remittance on GDP per capita growth. Another study by Hasan and Shakur (2017), looking at a number of variables including remittance and their effects on per capita GDP growth, there exists a non-linear relationship between remittance and per capita GDP growth, with remittance having a negative impact on the per capita GDP at first, and then having a positive impact.

In more recent studies, a meta-analysis of 95 studies by Cazachevici, Havranek and Horvath (2020), they have found that approximately 40% of studies find a positive relation between remittances and economic growth, 40% find no correlation, while the rest 20% find a negative relation between remittance and

economic growth. Additionally, this meta-analysis finds that region plays a role in determining relationship between remittance inflow and economic growth – it is found that remittance plays an important positive role when it comes to growth in Asia, but not in Africa.

Overall, the remittance-growth relationship is not an open-and-shut case – there exists significant debate as to what role, if any, remittance plays on economic growth. It appears to be highly dependent on sample composition, time period, instrumentation strategy and — most consistently — the inclusion of interacting structural conditions (namely, financial depth and institutional quality etc.)

Chapter 3: Methodology

Most of the studies are done in the context of Bangladesh with very parsimonious models to estimate the relationship whereas there is space to introduce more predictor variables in the model to estimate the effects of the relationship on economic growth. Thus, upon inspection of the remittance-growth literature, and the wider economic growth literature corpus, a few variables are identified that could predictably have an impact on economic growth. The function of interest in this study is as follows:

$$GDPGROWTH = f(REMINFLOW, X, e)$$

where the dependent variable *GDPGROWTH* is the annual per capita GDP growth rate, *REMINFLOW* is the annual remittance inflow as ratio of GDP (the key explanatory variable), *X* is a vector of control variables found in standard studies researching economic growth and their association with various independent factors. As such, *X* consists of (i) trade openness, computed by taking the sum of imports and exports and dividing by the real GDP; and (ii) investment in the form of gross capital formation. *e* is the error term.

As such, the final model is thus:

$$GDPGROWTH = REMINFLOW + OPENNESS + INVESTMENT + e$$

All variables are log converted.

Data from 1960 – 2024 is collected from World Development Indicators from World Bank DataBank.

3.1 A Note on the Selection of the Variables:

While remittance inflow is the key explanatory variable and is thus included in the model by default, a discussion needs to be had concerning the inclusion of the other two variables:

i) OPENNESS (Trade Openness): Theories have suggested that trade openness can affect GDP per capita growth in various ways, including resource reallocation, technology diffusion, and market expansion. Romer (1990) suggests that access to trading partners results in technology spillovers and access to a wider variety of intermediate and capital goods – all factors for permanent growth due to openness. In particular, Sachs and Warner (1995) and Frankel and Romer (1999) have identified a positive trade and growth link in their research. Remittance - growth literature has also contained studies using trade openness, such as those by Giuliano and Ruiz-Arranz (2005), Ramirez and Sharma (2008) and Meyer and Shera (2017) as well as others. Therefore, it is appropriate to include this variable to estimate the GDP per capita growth rate.

ii) INVESTMENT (Gross Capital Formation): In both neoclassical growth model as well as endogenous growth model, gross capital formation is an important factor of economic growth. In Solow's (1956) seminal study of the growth model, it is capital accumulation that drives an economy towards a steady state of output production. The relationship between gross capital formation and the effect on the economic growth is a basic relation which is applied in every macroeconomics textbook, so there is no need to explain the influence of this variable.

3.2 Limitations:

While other studies have used population growth, FDI, technological progress, and a myriad of other explanatory variables in their models, it is important to note that due to the dearth of official data, small observation sizes, and restricted data quality, it is difficult to run any sort of econometric tool with the limited number of data available. Hence, the explanatory variable list is kept to the minimum necessary to be able to use econometric tools effectively, without having to increase the list of variables.

With regards to structural breaks, while a structural break is found in a particular year (1987), inclusion of a dummy and interaction terms lead to the near singular matrix problem due to small number of observations and loss of degrees of freedom. The use of only a dummy variable is not really helpful either because the dummy variable is not found to be statistically significant.

Chapter 4: Result and Analysis

Empirical Results

4.1 Multicollinearity Diagnostics

Variance Inflation Factors			
Sample: 1960 2025			
Included observations: 47			
	Coefficient	Uncentered	Centered
Variable	Variance	VIF	VIF
LINVESTMENT	0.043553	3273.897	7.157574
LOPENNESS	0.058855	23.14319	3.068245
LREMINFLOW	0.063929	531.6087	4.495474
C	45.74551	6148.446	NA

Table 1: Variance Inflation Factor

	LGDPGROWTH	LINVESTMENT	LOPENNESS	LREMINFLOW
LGDPGROWTH	1	0.621435795	0.674479531	0.515788623
LINVESTMENT	0.621435795	1	0.818306485	0.880064332
LOPENNESS	0.674479531	0.818306485	1	0.688466795
LREMINFLOW	0.515788623	0.880064332	0.688466795	1

Table 2: Correlation

The assumption of multicollinearity among the regressors was tested by calculating Variance Inflation Factors (VIFs) for the model in which the per capita GDP growth is regressed on the remittance inflows as a percentage of its GDP, its trade openness level and its level of gross capital formation. The centered VIF values for LINVESTMENT (7.16), LREMINFLOW (4.50) and LOPENNESS (3.07) are all lower than the conventional value of 10 (Gujarati & Porter, 2009) which suggests that multicollinearity was not significant, though present — as expected given the theoretical linkages among investment, remittances and trade openness. Comparative high VIF for LINVESTMENT, in conjunction with high bivariate correlation with LOPENNESS (0.81) and LREMINFLOW (0.88) necessitates some precautions in interpreting the individual coefficient for LINVESTMENT; however, the individual coefficient is retained in the final model since the VIFs are still within acceptable limits.

4.2 Unit Root Test

Table: ADF Unit Root Test					
Variables	Level		1st difference		Remarks
	C	C & T	C	C & T	
LREMINFLOW	0	0.3575	0	0	I(0)
LOPENNESS	0.6486	0.8632	0	0	I(1)

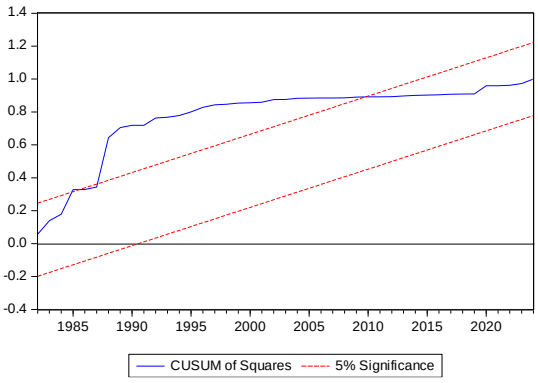
LINVESTMENT	0.8753	0.0392	0.0053	0.0262	I(1)
LGDPGROWTH	0	0	0	0	I(0)
Table: Phillips Perron Unit Root Test					
Variables	Level		1st difference		Remarks
	C	C & T	C	C & T	
LREMINFLOW	0.0003	0.0001	0	0	I(0)
LOPENNESS	0.6321	0.8594	0	0	I(1)
LINVESTMENT	0.6876	0.0392	0	0	I(1)
LGDPGROWTH	0	0	0	0	I(0)

Table 3: Unit Root test result

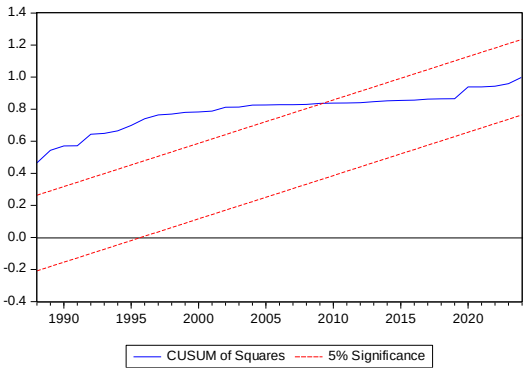
The first step before estimating the long-run and short-run dynamics of the model is to determine the order of the integration of each series, which will determine the method of cointegration to be used. The Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) test were used here with and without constant terms and with and without trend terms. Both the results show that LGDPGROWTH and LREMINFLOW are stationary at level (I(0)), whereas LOPENNESS and LINVESTMENT are non-stationary at level (I(0)) but are stationary after first difference (I(1)). Most importantly, none of the series is an integrated series of order two, I(2), which is required to use the Autoregressive Distributed Lag (ARDL) bounds testing approach to the cointegration. According to Pesaran, Shin, and Smith (2001), when there are variables of mixed order ie I(0) and I(1), Johansen Cointegration test cannot be used; as such, the ARDL testing approach, which is designed for variables of mixed order upto I(0) and I(1), and small sample sizes, is employed.

4.3 CUSUM of Squares test:

A CUSUM of squares test was conducted to check for instability and structural breaks. The following graph is obtained:



With the blue line breaching the upper red line at the 1987 mark, there is a possibility of a temporary structural break at 1987. Introducing a dummy variable with value equals 1 at 1987 and 0 elsewhere, and running the CUSUM of squares test again with all the variables plus the dummy carriable, the following graph is obtained:



There does not seem to be much improvement in the stability of the parameters, as evidenced by the fact that the blue line is still outside the bounds of the upper red line for much of the time. Furthermore, the p-value of the dummy variable is 0.9991, suggesting statistical insignificance.

Thus, the dummy variable is dropped when running the ARDL model.

4.4 ARDL Model Selection and Short-Run Estimates:

Dependent Variable: LGDPGROWTH				
Method: ARDL				
Maximum dependent lags: 4 (Automatic selection)				
Model selection method: Akaike info criterion (AIC)				
Selected Model: ARDL(1, 3, 2, 0)				
Note: final equation sample is larger than selection sample				
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed				
bandwidth = 4.0000)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.*
LGDPGROWTH(-1)	0.084424	0.169209	0.498934	0.621
LINVESTMENT	6.105086	3.704667	1.647945	0.1086
LINVESTMENT(-1)	-9.519812	6.259404	-1.52088	0.1375
LINVESTMENT(-2)	9.643967	5.209129	1.851359	0.0728
LINVESTMENT(-3)	-5.927629	1.837316	-3.22624	0.0028
LOPENNESS	1.05453	0.42624	2.474028	0.0185
LOPENNESS(-1)	-0.902762	0.669472	-1.34847	0.1864

LOPENNESS(-2)	0.120636	0.421356	0.286304	0.7764
LREMINFLOW	-0.007337	0.492108	-0.01491	0.9882
C	-6.399404	4.537947	-1.4102	0.1676

Table 4: ARDL results

Since there is heteroskedasticity present while running the ARDL model, the HAC/Newey-West standard errors is used to produce a robust covariance matrix that handles both serial correlation and heteroskedasticity simultaneously (Newey and West, 1987).

The model was estimated between 1977 and 2024 (44 observations adjusted), with per capita GDP growth (LGDPGROWTH) as the dependent variable, and remittance inflows as a percentage of GDP (LREMINFLOW), trade openness (LOPENNESS), and gross capital formation (LINVESTMENT) the independent variables.

The ARDL model estimated explains 72.98% of the variance of the dependent variable as indicated by R-squared of the estimated model. The regressors are together significant for the highly significant F-statistic (10.20423, p = 0.00). The Akaike Information Criterion (AIC) method was applied to identify the optimum lag lengths for automatically choosing the best model for all 500 candidate models, and the ARDL (1,3,2,0) model was chosen as the best model.

LGDPGROWTH(-1) is statistically insignificant with a p-value of 0.621, suggesting that lagged values of per capita GDP does not significantly affect the per capita GDP growth of this year. The coefficients of investment for the current year, last year, and the yar before that, are statistically insignificant. The coefficient of -5.927629 with a p value of 0.0028 is significant (LINVESTMENT), suggesting that the investment performed three years prior negatively affects the investment performed in the current year. The current year LOPENNESS is significant (coefficient = 1.05453, p-value = 0.0185) while lagged values are insignificant. Finally, LREMINFLOW is statistically insignificant (p-value = 0.9882) indicating that there is no short run relationship between remittance inflow and per capita GDP growth for this model.

4.5 Bounds Testing for Long-Run Relationship

ARDL Long Run Form and Bounds Test				
Dependent Variable: D(LGDPGROWTH)				
Selected Model: ARDL(1, 3, 2, 0)				
Levels Equation				
Case 2: Restricted Constant and No Trend				

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LINVESTMENT	0.329424	14%	2.318011	0.0266
LOPENNESS	0.297522	44%	0.681321	0.5003
LREMINFLOW	-0.008014	0.538416	-0.014884	0.9882
C	-6.989486	5.686922	-1.229046	0.2275
EC = LGDPGROWTH - (0.3294*LINVESTMENT + 0.2975*LOPENNESS				
-0.0080*LREMINFLOW -6.9895)				
F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Signif.	I(0)	I(1)
			Asymptotic: n=1000	
F-statistic	10.03776	10%	2.37	3.2
k	3	5%	2.79	3.67
		2.50%	3.15	4.08
		1%	3.65	4.66

Table 5: Bounds test

The ARDL bounds testing approach of Pesaran, Shin and Smith (2001) was used to test for the presence of long run (cointegrating) relationship among the variables.

The computed F-statistic (10.038) is much greater than the upper bound I(1) critical value at the 1% significance level (5.412 finite sample, n = 45) and thus the null hypothesis of no levels relationship is rejected. Thus, we can conclude that there exists a statistically significant long run cointegrating

relationship between per capita GDP growth, investment, trade openness and remittance inflows. Individually, the variable LINVESTMENT is found to be statistically significant - LINVESTMENT (0.329, p = 0.027), while the other variables are statistically insignificant - LOPENNESS (0.298, p = 0.500), and LREMINFLOW (−0.008, p = 0.988). This situation of strong joint co-integration, while weak individual long-run significance, is not uncommon in ARDL applications where the sample size is limited, and consistent with the residual multicollinearity effects that are found in earlier. The results of this study are consistent with the results of Rahman (2009) and Siddique et al. (2010) who also do not find any long run cointegrating relation between remittance and per capita GDP growth. Moreover, this study confirms the results of Rahman (2009) who also conclude that long run cointegration relationship exists between the variables and the dependent variable, but not between the variables themselves.

4.6 Short-Run Dynamics: Error Correction Model

ARDL Error Correction Regression				
Dependent Variable: D(LGDPGROWTH)				
Selected Model: ARDL(1, 3, 2, 0)				
ECM Regression				
Case 2: Restricted Constant and No Trend				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LINVESTMENT)	6.105086	1.879135	3.248882	0.0026
D(LINVESTMENT(-1))	-3.716338	2.160046	-1.72049	0.0944
D(LINVESTMENT(-2))	5.927629	1.115619	5.313311	0
D(LOPENNESS)	1.05453	0.487208	2.164435	0.0375
D(LOPENNESS(-1))	-0.120636	0.503275	-0.239702	0.812
CointEq(-1)*	-0.915576	0.122247	-7.48955	0

Table 6: ECM

In the ECM regression, the error correction term CointEq(-1) was estimated at −0.916 (t = −7.490, p = 0.000) with the result being that every 1 percent deviation from the long-run equilibrium is corrected by 92 percent within one year. This is an unusually fast speed of adjustment in support of the strength of the underlying long-run relationship indicated by the bounds test.

4.7 Serial Correlation

Breusch-Godfrey Serial Correlation LM Test:				
F-statistic	0.072259	Prob. F(2,32)		0.9304

Obs*R-squared	0.19782	Prob. Chi-Square(2)		0.9058

Table 7: Breusch-Godfrey Serial Correlation LM Test result

A Breusch-Godfrey LM test was performed to test for correlation in the residuals. The results for the ARDL(1,3,2,0) specification are presented as follows: the value of F-statistic is 0.072 with p-value = 0.9304 , which fails to reject the null hypothesis of no serial correlation.

4.8 Heteroskedasticity:

Heteroskedasticity Test: Breusch-Pagan-Godfrey				
F-statistic	3.904222	Prob. F(9,34)		0.0018
Obs*R-squared	22.36212	Prob. Chi-Square(9)		0.0078
Scaled explained SS	28.56831	Prob. Chi-Square(9)		0.0008
Prob(F-statistic)	0.001751			

Table 8: Breusch-Pagan-Godfrey test result

Breusch-Pagan-Godfrey test was used to evaluate the heteroskedacity. The result (F = 3.904, p = 0.0018, Obs*R-squared = 22.362, p = 0.0078) rejects the null hypothesis of homoskedasticity at the 1% level, suggesting heteroskedasticity. Since heteroskedasticity is detected, the HAC/Newey-West standard errors is used when estimating the ARDL model.

4.9 Discussion of the Results:

4.9.1 Coefficient Significance:

i) Investment: this variable has been found to be statistically significant in both the short run (in lagged form of -3) and the long run. In the short run, the coefficients of the variables LINVESTMENT, LINVESTMENT(-1), LINVESTMENT(-2), and LINVESTMENT(-3) are 6.105086, -9.519812, 9.643967, -5.927629 respectively. This fluctuation in sign and magnitude is due to the fact that each lagged term of investment is collinear, and correlated with each. Upon computing the VIF on the (1,3,2,0) lag specification model, this is confirmed:

Variance Inflation Factors			
Sample: 1960 2025			
Included observations: 44			
	Coefficient	Uncentered	Centered

Variable	Variance	VIF	VIF
LINVESTMENT	13.72456	13110274	16833.69
LINVESTMENT(-1)	39.18013	37115101	50856.72
LINVESTMENT(-2)	27.13502	25505767	37777.85
LINVESTMENT(-3)	3.375729	3151878	4875.386

The centered VIFs are highly inflated, which indicates severe multicollinearity among LINVESTMENT and its lags. This is another explanation why other short-term coefficients, apart from LINVESTMENT(-3), are turned out to be statistically insignificant.

However, investment in the short run is jointly significant, with a F-statistic pf 3.68703 and its p-value of 0.0134, as confirmed by the Wald test:

Wald Test:			
Test Statistic	Value	df	Probability
F-statistic	3.68703	(4, 34)	0.0134
Chi-square	14.74812	4	0.0053
Null Hypothesis: C(2)=0, C(3)=0, C(4)=0, C(5)=0			

Thus, we can conclude that investment and its lagged terms are jointly significant in the short run, while investment alone is significant in the long run.

ii) Openness: trade openness is found to be statistically significant in the short run in its level form, while the lagged forms are statistically insignificant, and long run it is found to be statistically insignificant. The Walds test confirming joint statistical insignificance (F-statistic = 2.39, p-value = 0.085) is given below:

Wald Test:			
Test Statistic	Value	df	Probability
F-statistic	2.398287	(3, 34)	0.0851
Chi-square	7.194861	3	0.0659
Null Hypothesis: C(6)=0, C(7)=0, C(8)=0			

The VIF for the lagged structure of openness is as follows:

	Coefficient	Uncentered	Centered
Variable	Variance	VIF	VIF

LOPENNESS	0.181681	645.4371	50.01754
LOPENNESS(-1)	0.448192	1794.413	131.7423
LOPENNESS(-2)	0.177541	759.4132	55.60188

With high Centered VIF values (>10), this suggests severe multicollinearity among the lagged terms, resulting in insignificant coefficients.

In addition to the statistical explanation, a possible economic explanation is provided by Rodrigues and Rodrik (2000) who do not find any statistically significant inverse relationship between the level of trade barriers and economic growth, implying that trade openness, alone, with no other conditions, such as property rights protection, rule of law, low corruption, and effective governance, cannot lead to productivity gains, which is what is required for economic growth.

iii) Remittance inflow: Remittance is found to be statistically insignificant across both the short run and the long run, a finding supported by earlier research such as Giuliano and Ruiz-Arranz (2009), Catrinescu et al. (2009), and others. While the ARDL model did not specify any lags for remittance, keeping only the contemporaneous variable in the model, a Wald test applied on this confirms no joint significance (F-statistic = 0.000222, p-value = 0.9882):

Wald Test:			
Test Statistic	Value	df	Probability
t-statistic	-0.01491	34	0.9882
F-statistic	0.000222	(1, 34)	0.9882
Chi-square	0.000222	1	0.9881
Null Hypothesis: C(9)=0			

An explanation for the lack of significance of remittance may be its role as a source of investment fund for the financially less developed countries in which the credit constraint is high, as suggested by Giuliano and Ruiz-Arranz (2006). Therefore, the impact of remittance are incorporated in the investment variable, which is positively and significantly related to GDP per capita growth in both short and long runs.

Additionally, in the present study, the correlation matrix does show high correlation between remittance inflow and investment, as seen in the table below:

	LGDPGROWTH	LINVESTMENT	LOPENNESS	LREMINFLOW
LGDPGROWTH	1	0.621435795	0.674479531	0.515788623

LINVESTMENT	0.621435795	1	0.818306485	0.880064332
LOPENNESS	0.674479531	0.818306485	1	0.688466795
LREMINFLOW	0.515788623	0.880064332	0.688466795	1

4.9.2 Short Run vs Long Run relation:

i) Individual Coefficients: The present study finds that it is solely investment, in the form of gross capital formation, that has any meaningful impact on GDP per capita growth. As the effects of remittances is absorbed into the investment channel, with remittance recipients financing capital investment (at the household level, this capital investment could be water pumps for irrigation, sewing machines for textiles, diesel generators for electricity, and so on and so forth) using the remittance funds, it is ultimately investment that is influencing economic growth. Likewise, trade openness, without other conditional factors that can influence productivity, does not in any statistically significant way influence GDP per capita growth in the short and long run.

ii) Joint significance: The study finds that while individually openness and remittance inflow are not significant, all three variables are jointly significant, and there exists a long run cointegrating relationship with economic growth. This is a testament to Bangladesh's export oriented growth story over the past few decades, where capital investment specifically in the RMG sector, financed in part by dollars flowing in the form of remittance, and trade policies easing import of capital machinery, have all played a role hand-in-hand to expedite economic growth.

Chapter 5: Conclusion

The present study sets out to investigate the relation between remittance and economic growth in the form of GDP per capita growth, with trade openness and investment (gross capital formation) as control variables. Using an ARDL bounds testing framework and data spanning 1960-2025, the study adds to the existing literature body through its findings.

The bounds test result, where a F-statistic value of 10.038 is found, proves that a joint long term cointegrating relationship between remittance inflow, trade openness, investment and GDP per capita growth exists, with the F-statistic comfortably exceeding the upper bound critical value at 1% significance level. Additionally, an error correction term of -0.916 is found, which suggests that any disturbances in the long term equilibrium is corrected 92% within a year.

However, this long run cointegration is not consistently found across the variables when looking at them individually. Investment, in the form of gross capital formation, is found to be significant in the long run, and jointly (with its lagged variables) significant in the short run. This is consistent with Solow's traditional growth theory, which emphasizes the role of capital accumulation in an economy's growth trajectory. Trade openness, without complementary variables such as property right, governance, etc. is only found to be significant in the short run (however no joint statistical significance exists), with no long term statistically significant relation between trade openness and economic growth. Remittance, while not significant in both the short run and the long run, does not necessarily mean that it does not play a role in the economic growth story of Bangladesh. Rather, the high correlation between remittance and investment (0.88), suggests that remittance is at least in part financing the capital accumulation process across remittance receiving households in the country – thus driving economic growth through the investment channel.

A note on the structural instability of the parameters needs to be mentioned, a glaring limitation of this study. While a CUSUM of squares test is run on the variables, and a structural break in the year 1987 is identified, no tools employed have found to be rectifying this issue. The inclusion of structural break dummies does not seem to solve the issue of parameter instability, with the dummy variable itself being statistically insignificant; thus it was intentionally dropped from the study.

Taken together, the findings of the study have clear policy implications, while also necessitating farther research into specific facets found within this study. For example, on the policy implication side, the statistically significant short term and long term relationship between investment and economic growth suggests that the government should take necessary policy initiatives to drive higher investment into capital accumulation for not only factories, but also in the household level – in the form of water pumps, irrigation pumps, tractors, etc. that are traditionally invested into by remittance receiving households. Furthermore, the exact avenues where remittances are being channeled into, is also a field that needs to be studied in depth. The present author is actively working on chalking out the details and requirements of such a study.

Chapter 6: References

Aggarwal, R., Demirguc-Kunt, A., & Peria, M. M. (2006). Do workers' remittances promote financial development?

Ang, A., Jha, S., & Sugiyarto, G. (2009). Remittances and household behavior in the Philippines. *Asian Development Bank Economics Working Paper*, (188).

Catrinescu, N., Leon-Ledesma, M., Piracha, M., & Quillin, B. (2009). Remittances, institutions, and economic growth. *World Development*, *37*(1), 81-92.

Cazachevici, A., Havranek, T., & Horvath, R. (2020). Remittances and economic growth: A meta-analysis. *World Development*, *134*, 105021.

Chami, R., Fullenkamp, C., & Jahjah, S. (2005). Are immigrant remittance flows a source of capital for development? *IMF Staff Papers*, *52*(1), 55-81.

Chowdhury, M., & Rabbi, F. (2011). Workers' remittances and real exchange rate in Bangladesh: a cointegration analysis. *Manuscript, University of Western Sidney*.

Chowdhury, E. K., Dhar, B. K., & Gazi, M. A. I. (2023). Impact of remittance on economic progress: Evidence from low-income Asian frontier countries. *Journal of the Knowledge Economy*, *14*(1), 382-407.

Edwards, A. C., & Ureta, M. (2003). International migration, remittances, and schooling: evidence from El Salvador. *Journal of Development Economics*, *72*(2), 429-461.

Faini, R. (2007). Remittances and the brain drain: Do more skilled migrants remit more? *The World Bank Economic Review*, *21*(2), 177-191.

Frankel, J. A., & Romer, D. (1999). Does trade cause growth? *American Economic Review*, *89*(3), 379-399.

Giuliano, P., & Ruiz-Arranz, M. (2005). *Remittances, finance development and growth*. International Monetary Fund Working Paper 05.

Giuliano, P., & Ruiz-Arranz, M. (2006). Remittances, financial development. Bonn: The Institute for the Study of Labor (IZA).

Giuliano, P., & Ruiz-Arranz, M. (2009). Remittances, financial development, and growth. *Journal of Development Economics*, *90*(1), 144-152.

Glytsos, N. P. (2005). The contribution of remittances to growth: A dynamic approach and empirical analysis. *Journal of Economic Studies*, *32*(6), 468-496.

Hussain, Z., & Naeem, F. (2009). Remittances in Bangladesh: determinants and 2010 outlook. *End Poverty in South Asia: A Blog to Promote Dialog on Development in South Asia*. Available: blogs.worldbank.org/endpovertyinsouthasia/remittances-bangladesh-determinants-and-2010-outlook-0

Lucas, R. E., & Stark, O. (1985). Motivations to remit: Evidence from Botswana. *Journal of Political Economy*, *93*(5), 901-918.

Mahmood, R. A. (1995). Data on migration from Bangladesh. *Asian and Pacific Migration Journal*, *4*(4), 531-541.

Meyer, D., & Shera, A. (2017). The impact of remittances on economic growth: An econometric model. *EconomiA*, *18*(2), 147-155.

Newey, W. K., & West, K. D. (1987). Hypothesis testing with efficient method of moments estimation. *International Economic Review*, *28*(3), 777-787.

Paul, B. P., & Das, A. (2011). The remittance-GDP relationship in the liberalized regime of Bangladesh: Cointegration and innovation accounting. *Theoretical & Applied Economics*, *18*(9), 41.

Paul, B. P., Uddin, M. G. S., & Noman, A. M. (2011). Remittances and output in Bangladesh: an ARDL bounds testing approach to cointegration. *International Review of Economics*, *58*(2), 229-242.

Pesaran, M. H., Shin, Y., & Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. *Journal of Applied Econometrics*, *16*(3), 289-326.

Rahman, M. (2009). Contributions of exports, FDI and expatriates' remittances to real GDP of Bangladesh, India, Pakistan and Sri Lanka. *Southwestern Economic Review*, *36*, 141-153.

Ramírez, M. A., & Sharma, H. (2009). Remittances and growth in Latin America: A panel unit root and panel cointegration analysis. *Estudios Económicos de Desarrollo Internacional: Economic Studies of International Development*, *9*(1), 5-36.

Ratha, D. (2005). Workers' remittances: an important and stable source of external development finance. *Remittances: Development Impact and Future Prospects*, *9*, 19-51.

Ratha, D., Mohapatra, S., & Xu, Z. (2008). *Outlook for Remittance Flows 2008-2010: Growth expected to moderate significantly, but flows to remain resilient* (p. 11). World Bank, Washington, DC.

Rodriguez, F., & Rodrik, D. (2000). Trade policy and economic growth: a skeptic's guide to the cross-national evidence. *NBER Macroeconomics Annual*, *15*, 261-325.

Romer, P. M. (1990). Endogenous technological change. *Journal of Political Economy*, *98*(5, Part 2), S71-S102.

Sachs, J. D., & Warner, A. (1995). Natural resource abundance and economic growth.

Siddique, A., Selvanathan, E. A., & Selvanathan, S. (2012). Remittances and economic growth: Empirical evidence from Bangladesh, India and Sri Lanka. *Journal of Development Studies*, *48*(8), 1045-1062.

Solow, R. M. (1956). A contribution to the theory of economic growth. *The Quarterly Journal of Economics*, *70*(1), 65-94.

Sutradhar, S. R. (2020). The impact of remittances on economic growth in Bangladesh, India, Pakistan and Sri Lanka. *International Journal of Economic Policy Studies*, *14*(1), 275-295.

Uddin, G. S., & Sjö, B. (2013). Remittances, financial development and economic growth in Bangladesh. *South Asia Economic Journal*, *14*(2), 261-273.