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CHAPTER 1
INTRODUCTION

Remittances are the funds that migrant workers send back to their home countries to support their families. **Ratha et al. (2024)** in their **World Bank's Migration and Development Brief**, described remittances as the movement of funds from the country of work back to a home country. In recent decades, remittances have emerged as one of the most significant and stable sources of external finance, often exceeding the foreign direct investment (FDI) and official development assistance (ODA) in many lower and middle-income countries. Remittances are a vital financial lifeline for millions of families in South Asia. For countries like **India, Pakistan**, and **Bangladesh**, where large populations work abroad, remittances has become a critical component of household income and also plays a crucial role in maintaining national economic stability. According to data from the World Bank, these three South Asian countries rank among the top recipients of remittances globally, with India consistently holding the first position. These inflows not only help families meet their day-to-day needs but also contribute to national foreign exchange reserves, poverty reduction, education, healthcare, and investment in small enterprises.

Financial inclusion means that individuals have access to and can use affordable financial products and services to meet their needs such as savings accounts, loans, insurance, and payment systems. Raghuram Rajan Committee (2009) defines Financial Inclusion as "the universal access to a wide range of financial services at a reasonable cost. This includes not only banking products, but also other financial services, such as insurance and equity products". It is not just about opening a bank account; it is about making sure people can use these services easily, safely, and regularly. Financial inclusion is important because it helps people manage their money, save for emergencies, invest in education or businesses, and protect themselves against financial shocks.

Digital infrastructure refers to the basic technology and systems that allow digital communication and transactions to happen in a more secure and cost-effective manner. This includes mobile phone networks, internet connectivity, online banking platforms, and digital payment systems. In the context of remittances, digital infrastructure makes it possible for people to send and receive money quickly and securely, often using just a mobile phone or a computer with a sound internet connectivity and access to digital banking.

Despite the scale and impact of remittances, there remains a significant policy and academic interest in understanding the conditions that facilitate their formal transfer and effective use. In this context, two factors have drawn increasing attention which are digital infrastructure and financial inclusion. The rapid growth of digital technologies and mobile banking has transformed the traditional methods of sending and receiving remittances. Innovations such as **mobile money services, internet banking**, and improved **ATM** accessibility have made remittance transfers quicker,

safer, cost-effective and more convenient. This digital transformation is especially important for remittances, which have historically been expensive and slow due to reliance on informal or cash-based systems. Similarly, financial inclusion - measured by access to formal banking services, **number of bank accounts**, and **loans availability** has become a major policy goal, aiming to connect underserved populations to the formal financial system. Moreover, financial inclusion is often seen as both a consequence and a catalyst of remittance inflows. On one hand, the availability of bank branches, ATMs, mobile banking apps, and other financial infrastructure makes it easier for recipients to access their remittances securely and efficiently. On the other hand, the regular inflow of remittances incentivizes financial service providers to target remittance-receiving households with tailored products like savings accounts, insurance, or micro-loans, further increasing the extent of financial inclusion. With better digital infrastructure such as mobile networks, broadband, and internet availability along with easier access to banking and financial services in the home country, there is now a greater opportunity for migrant workers to send money home safely, quickly, and at lower costs through formal channels and the recipients can have the ease of safe and quick access to the remittances.

The existing body of research shows that remittances are not just a vital source of external finance but also significantly influence macroeconomic outcomes like economic growth, inflation, unemployment and financial sector development. A study by **Jawaid and Raza (2016)** observed that stable and increasing remittance inflows have a positive impact on economic growth of South Asian countries by improving household incomes and boosting consumption. **Adams (2011)** confirmed that international remittances have a positive and significant impact on poverty reduction and economic development. Also, there are numerous studies which examine the effect of remittances on financial development and financial inclusion emphasizing how remittances are not just income support for households, but also an effective tool to promote financial inclusion in the economy. Several studies argue that remittances act as an important gateway for unbanked or underserved populations to enter the formal financial system. When migrants send money back home through formal channels such as banks, microfinance institutions, or mobile money services, the recipients are more likely to open bank accounts, use financial services, and develop a habit of saving or investing.

Most studies focus on either the macroeconomic outcomes of remittances or the traditional determinants like migration trends and economic growth. There is limited research integrating digital infrastructure variables with financial inclusion and analysing their joint impact on the inflow of remittances, especially in South Asian countries. While existing research has looked at why people send remittances or how macroeconomic factors affect remittance flows, not enough attention has been given to the role of digital infrastructure and financial inclusion in shaping remittance flows, especially in South Asian countries where both digital growth and migration are significant. There is a growing need to understand whether rise in access and usage of digital infrastructure and stronger financial systems actually help in increasing the amount of remittances.

Given the large fraction of young population of India, Pakistan, and Bangladesh migrating to other countries for better work opportunities and the strong social and economic ties they maintain with their home countries, it is important to assess how improvements in digital and financial ecosystems make an impact on remittance flows. This is particularly relevant for countries like Bangladesh, India, and Pakistan, where a large portion of the population remains underbanked. Although there has been a lot of discussion around digital growth and financial inclusion in policy debates, it was noticed that not much detailed research has been done on how these factors actually affect remittance inflows, especially in the context of South Asian countries.

In recent years, technological advancement and the spread of digital tools such as mobile phones, broadband internet, and online banking platforms have fundamentally changed the means of sending and receiving money. At the same time, efforts to expand financial inclusion through increased access to banking services, mobile money, and digital payment systems have become national priorities in India, Pakistan, and Bangladesh. These countries are also in different stages of digital and financial development. By creating separate indices for digital infrastructure and financial inclusion and analysing their individual and combined impact on remittance inflows, this research offers new insights for policymakers in these countries.

There is limited empirical research that focuses specifically on how digital infrastructure and financial inclusion interact to influence remittance inflows. Particularly in the South Asian context, where both digital and financial ecosystems are at developing stage and are unevenly accessible in these lower and middle-income countries, it becomes crucial to investigate whether improvements in these areas leads to higher remittance inflows. This research contributes to the existing literature by empirically analysing how digital infrastructure and financial inclusion, which are the two emerging dimensions of economic development in today's global economy, affect remittance inflows, both individually and through their interaction in the South Asian countries of India, Pakistan and Bangladesh. The study introduces an interaction term between digital infrastructure and financial inclusion, captured by their respective indices which are empirically constructed in this study. The focus of this study is specifically on South Asian countries, which are among the largest recipients of remittances globally yet still face significant challenges in the development of digital infrastructure and in facilitating access to basic financial services.

The primary objective of this study is to assess the impact of digital infrastructure on remittance inflows in the South Asian countries of India, Pakistan, and Bangladesh. It also aims to examine how financial inclusion influences the inflow of remittances in these countries. The study seeks to estimate both the short-run and long-run relationships between digital infrastructure, financial inclusion, and remittance inflows, providing a deeper understanding of how these factors interact over time. The findings of this study can help governments design better digital and financial policies to encourage the use of formal remittance channels, reduce reliance on costly informal methods, and ultimately improve the financial well-being of millions of remittance-receiving households.

CHAPTER 2
REVIEW OF LITERATURE

In recent years, digital infrastructure and financial inclusion has emerged as a key area of research for understanding their impact on economic growth and development and how remittance inflows can enhance this effect.

Jemiluyi & Jeke (2024) found that Digital technology, particularly internet usage and mobile cellular subscriptions positively influence remittance inflows in Sub-Saharan Africa. Similarly, **Nguyen (2025**) found that digitalisation measured through internet usage and mobile subscriptions significantly boosts remittance inflows by reducing transaction costs and promoting formal channels. **Pandikasala et al. (2020)** showed that financial development and openness significantly impact remittances in both the short and long run. Known for their counter cyclical nature, remittances remain stable during economic downturns, unlike other financial flows.

2.1. Role of Remittances in Enhancing Macroeconomic Outcomes

Much of the literature focuses on the contribution of remittances to improving access to financial services and enhancing macroeconomic outcomes, often highlighting the importance of financial inclusion in amplifying the development impacts of remittances. **Khan et al. (2025)** studied on South Asia and showed that remittances have a positive impact on economic development and financial inclusion of remittance recipients promotes savings, investment, and use of formal financial products, leading to greater economic stability and growth in the long run. **Mannan & Farhana (2023)** showed that remittances enhance digital financial inclusion in Bangladesh, increasing the likelihood of e-bank account ownership and mobile banking usage. According to **Ogede et al. (2023)**, the interaction of financial inclusion and remittances has a significant impact on the country's economic development and the study concludes that the interaction of remittances with the measures of financial inclusion will lead to economic growth at a faster rate than when there is no interaction with financial inclusion. **Karim et al. (2022)** found that the interaction between financial sector development and remittances mitigates the negative influence of income inequality in South Asian remittance-recipient economies. **Chuc et al. (2021)** observed that financial inclusion strengthens the growth-enhancing effect of remittances, helping migrant-sending countries boost their economic growth. **Lyons et al. (2021)** observed that Fintech development is positively linked to financial inclusion in terms of savings, borrowing, and remittances in emerging economies. **Saydaliyev et al. (2020)** examined the combined indirect effect of remittance inflows via human capital and financial inclusion on economic growth in developing and developed countries and found that in remittance-receiving developing countries, financial inclusion and human capital serve as key drivers of economic growth. However, **Issabayev et al. (2020)** observed that the relationship between remittances and financial inclusion is non-linear, with positive effects observed only in countries with high remittance levels but noted a negative impact in countries with lower inflows. **Naceur et al (2020)** also found a U-shaped relationship between remittances and financial inclusion suggesting

that when remittance levels are low they tend to replace formal credit channels and reduce the demand for bank credit while not being sufficient to boost the supply of credit from banks whereas at higher remittance levels they complement bank credit by increasing household savings within the formal banking system. Similarly, **Emara & Zhang (2021)** found that the improvement in digitization may initially increase the remittances inflow leading to an increase in the stock of remittances received and once the digitization index reaches its threshold level further improvement in digitization tends decrease as penetration increases, giving rise to a decline in the rate of remittances.

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A considerable body of research has examined the impact of remittances on financial inclusion, economic growth, poverty reduction, and overall development. **Inoue (2024)** found that the interaction term between Digital Financial Inclusion (DFI) and remittances is positive and statistically significant, indicating they are substitutes in the poverty-reduction process. The effectiveness of DFI in reducing poverty is weakened by high remittance inflows, and vice versa. **Zaarour et al. (2024)** used panel VAR and found that remittances positively impact investment and economic growth in developing countries. **Taylor and Grimes (2019)** observed that new digital platforms in international remittances to developing countries lower costs and risks, enabling financial inclusion and economic development, while also fostering local innovation and competition among core platforms. **Khera et al. (2021)** found that digital financial inclusion is positively associated with economic growth, accelerating GDP per capita growth suggesting that increasing digital financial inclusion in payments can boost annual economic growth by up to 2.2 percentage points. **Islam (2021)** showed that Remittance inflow has a positive impact on economic growth in South Asia through both GLS and FMOLS estimations. **Barnabé (2021)** found that remittances have a negative short-term but positive long-term effect on financial inclusion in Africa. **Saydaliyev et al. (2020)** observed that remittances are associated with better financial inclusion when there is better institutional quality. Trust in financial institutions can enhance the positive impact of remittances on financial inclusion. **Arthur et al. (2020)** found that formal diaspora remittances had a positive and statistically significant effect on financial inclusion in Kenya. **Anarfo et al. (2020)** found a reverse causality between financial inclusion and migrant remittances in sub-Saharan Africa and observed that promoting financial inclusion can attract more migrant remittances, which can promote economic growth and financial sector development. **Ajefu & Ogebe (2019)** found that remittances have a positive and significant effect on the probability that in Nigeria, households will own a bank account suggesting that reducing barriers to remittance inflows can improve financial inclusion. **Aga & Peria (2014)** in their working paper used World Bank survey data, including about 10,000 households in five countries -Burkina Faso, Kenya, Nigeria, Senegal, and Uganda and found that receiving international remittances increases the probability that households in Sub-Saharan Africa open a bank account. **Machasio (2018)** found that remittances have a positive impact on financial inclusion through their effect on financial sector development and remittance inflows increase financial inclusion by about 2.49%. **Siddique et al. (2016)** found that foreign remittances contribute 4.2% to the total income of South Asia, indicating a significant proportion of GDP and this has a significant positive impact on poverty alleviation in South Asia. Furthermore, **Sahoo et al. (2020)** found that remittances positively influence human development in South

Asia, alongside factors such as life expectancy and human capital. However, **Ullah (2017)** observed that the full potential of remittances for development may not be realized due to challenges in channeling and utilizing these funds, as well as underdeveloped financial sectors. Despite these limitations, remittances remain a crucial contributor to GDP growth in South Asian countries, highlighting their importance for regional economic development. **Bettin et al. (2014)** found that remittances act as a substitute for financial development, helping to overcome the financing constraints of households living in countries with less efficient financial institutions, it also observed that remittances are facilitated by financial development in the source province but substitute for financial development in the recipient country. **Siddique et al. (2012)** investigated the causal link between remittances and economic growth in three countries, Bangladesh, India and Sri Lanka and showed a one-way causal relationship from remittances to economic growth in Bangladesh no causal relationship between growth in remittances and economic growth in India but a two-way directional causality in Sri Lanka. **Cooray (2012)** observed that migrant remittances have a significant positive effect on economic growth in South Asia, with interactive effects through education and financial sector development. **Adams (2011)** found that international remittances have a positive and significant impact on poverty reduction and lowering inequality, health and education, investment and savings, labour supply and participation, and economic growth and development.

2.2. Impact of Remittances on Financial inclusion and Financial Development

Several studies were found that examined the impact of remittances on financial inclusion and financial development. Some of them are discussed in this section. **Murshed et al. (2023)** found that higher mobile subscriptions, and lower corruption levels improve financial inclusivity in South Asia. According to this study, higher economic growth inhibits financial inclusion in South Asia. **Deheri (2022)** used the ARDL model and revealed that remittances negatively influence financial development in the short run, while they positively influence it in the long run and the IRF analysis shows that financial development responds positively to one standard positive shock to remittance inflows. **Basnet et al. (2021)** found a positive and significant impact of remittances on financial development and suggested that a 1%-point increase in remittances increases the credit to the private sector by greater than 1% points. **Rana & Tasneem (2016)** observed that remittance inflows in South Asia improved financial development indicators such as private credit and deposits. Contrary to this, **Chowdhury (2016)** revealed that while remittances positively influence economic growth, financial development does not act as a substitute or complement in this relationship. **Uddin et al. (2022)** demonstrated that increasing the number of bank branches reduces reliance on informal remittance channels by up to 2.3%. In India, the expansion of banking services under PMJDY has similarly improved access to formal channels, though rural regions still face infrastructure deficits. **Bhattacharya et al. (2018)** used dynamic system generalized method of moments (sys-GMM) and found that remittances promote financial development, with lower elasticity in developing countries compared to developed countries. **Williams (2016)** found that remittances are significantly positively associated with financial development in sub-Saharan Africa and noted that a 10% increase in remittances increases domestic private credit by 0.43% with a cumulative effect of 1.84%.

Karikari et al. (2016) found that the causal relationship between remittances and financial development is significant in the short run but not in the long run. A better financial system fosters receipts of remittances and increases the propensity to remit via formal channels. **Shahzad (2014)** found that remittance inflows have a positive and significant impact on financial sector development in South Asia and economic growth and FDI enhance financial development while inflation and exports deteriorate it. **Inoue and Hamori (2016)** found that remittance inflows encourage the growth of banking networks, particularly in developing countries in Asia and Oceania. These findings highlight the need for continued investment in banking infrastructure, particularly in underserved regions, to facilitate the formalization of remittance flows and maximize their socio-economic benefits. Contrary to this, **Brown et al. (2013)** finds a negative relationship between remittances and financial deepening in developing countries at the macroeconomic level. At the microeconomic level, a strong perverse relationship is found in Azerbaijan, where remittances deter the use of formal banking services and a weak positive relationship is observed in Kyrgyzstan regarding remittances and financial literacy. **Kumar (2013)** used the ARDL bounds approach to explore the short-run and long-run nexus between remittance inflows, financial development and ICT and observed that remittances and their interaction with ICT have positive effects on income in the Philippines, but negative effects when interacting with financial development. **Noman & Uddin (2011)** found that remittances and banking sector development positively influence GDP in South Asian countries. **Singh (2010)** argued that IT-enabled remittance products, such as mobile wallets and digital payment platforms, significantly reduce transaction costs and increase efficiency. Yet, the uneven adoption of these technologies highlights the need for targeted financial literacy programs and digital infrastructure development to ensure equitable benefits.

2.3. Factors Affecting the Remittances

Remittance inflows are among the most critical sources of external finance for many developing economies. In South Asia, remittances constitute a substantial share of GDP as well as the foreign exchange reserve. They are vital source of income in the migrants' households for consumption and often contributes to poverty reduction and economic resilience.

Studies have identified several determinants of remittance inflows. **Yoshino et al. (2019)** found that per capita GDP growth in origin countries and wage growth rates in destination countries are positively correlated with remittance inflows and other factors positively associated with remittance inflows include real effective exchange rates, education levels, trade openness, and political stability whereas net foreign direct investment (FDI) inflows are negatively related to remittances which suggests a shift from remittances to FDI as countries develop. **Mallick (2017)** found that higher interest rates, capital market returns, and financial deepening in home countries positively impact remittance inflows. **Hor and Pheang (2017)** investigated the macroeconomic factors and non-economic factors influencing the migrant workers' remittances flow to Cambodia, Laos, Myanmar, and Vietnam and found that the GDP per capita of origin country, the official exchange rate of the home country, and political stability index of home country have significant negative effects on remittance inflows to these countries. **Jijin et al. (2022)** found that crucial

macroeconomic variables such as exchange rate, oil price, and domestic GDP substantially impact the flow of remittances in India. **Tabit and Moussir (2016)** assessed the various macroeconomic determinants of migrants' remittances for a panel of 22 developing countries and found origin country's GDP, the host country's GDP, inflation, financial development and institutional quality as major determinants of personal remittances. **Denis et al. (2013)** found that remittance receipt of the previous year, broad money growth, taxes, inflation, lending rate and age dependency ratio are significant determinants of remittances in African countries. **Ahmad (2008)** found that the real remittances in Pakistan are positively related with real GDP, real growth rate, and unemployment rate, and negatively related with real wage rate, literacy rate, and bank spread rate and suggests introducing financial innovations and creating a friendly environment for migrant workers to invest and providing incentives to bridge the saving-investment gap.

2.4. Literature Gap

Based on the literature review carried out for the study, it was found that most studies focused on exploring how digital infrastructure and financial inclusion contribute to economic growth. However, there is limited research that directly examines how these factors influence remittance inflows particularly in South Asian countries.

A considerable body of research has examined the impact of remittances on financial inclusion, economic growth, poverty reduction, and overall development, there is a noticeable lack of studies investigating the reverse relationship that is, how financial inclusion and digital infrastructure influence remittance inflows

Much of the literature focuses on the contribution of remittances to improving access to digital and financial services and enhancing the macroeconomic outcomes, often highlighting the importance of financial inclusion in amplifying the development impacts of remittances. However, very few studies have explored whether better digital infrastructure and greater financial inclusion actually lead to an increase in remittance inflows

This study seeks to bridge this gap by exploring how digital infrastructure and financial inclusion directly influence remittance inflows in developing economies I focus on major South Asian countries India, Pakistan Bangladesh which are among the largest remittance recipient countries and where remittances play a crucial role in the economy.

Therefore, this study aims to address the questions that how does digital infrastructure affect remittance inflows in South Asian countries of India, Pakistan and Bangladesh? It also examines whether financial inclusion play a significant role in increasing the inflow of remittances in South Asian countries of India, Pakistan and Bangladesh? This study, therefore, aims to explore the following hypotheses.

H1: Digital infrastructure index has a positive and significant long-run effect on the inflow of remittances in India, Pakistan and Bangladesh

H2: Financial inclusion has a positive and significant long-run effect on the inflow of remittances in India, Pakistan and Bangladesh

CHAPTER 3
RESEARCH METHODOLOGY

This study adopts a quantitative panel data analysis approach to analyse the short-run and long-run effects of digital infrastructure and financial inclusion on remittance inflows across three South Asian countries of India, Pakistan, and Bangladesh, over the period from 2005 to 2023.

3.1. Data and Sources

This study uses a balanced panel using secondary annual data collected from reliable sources such as World Development Indicators (WDI), World Bank (2023) and Financial Access Survey (FAS), International Monetary Fund (IMF) (2023).

Table 3.1: Definition of Variables

Variable	Definition	Measurement	Data Source
Remittance	Personal remittances, received as a percentage of GDP	% of GDP	WDI
Mobile cellular subscription	Total no. of subscriptions to a public mobile telephone service	Sum	WDI
Individuals using the internet	Individuals using the Internet as a percentage of population	%	WDI
Fixed Broadband Subscription	Fixed broadband subscriptions per 100 people	Weighted average	WDI
Deposit Accounts	No. of deposit accounts with commercial banks per 1,000 adults	Per 1,000	FAS-IMF (2023)
Loans	Outstanding loans from commercial banks as a percentage of GDP	% of GDP	FAS-IMF (2023)
ATM	Number of ATMs per 100,000 adults	Per 100,000	FAS-IMF (2023)
GDP per capita	gross domestic product divided by midyear population (current US$)	current US$	WDI
Exchange Rate	Official exchange rate in local currency Unit per US$ (period average)	LCU per US$	WDI
US GDP	GDP of the US in current US$	current US$	WDI

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Inflation	Inflation, consumer prices (annual %)	%	WDI
Lending interest rate	Bank rate that usually meets the financing needs of the private sector	%	WDI

UNCTAD (2022) emphasized that digital infrastructure is critical to enabling cross-border e-transactions and mobile-based remittance services. **ITU (2020)** reports that countries with stronger broadband and internet infrastructure have greater access to digital remittance platforms and banking services. **Nyugen (2025)** has also emphasised internet users and fixed broadband subscriptions as proxies for digitalization. **Jemiluyi and Jeke (2024)** used two indicators of ICT—fixed broadband and mobile cellular subscriptions. **Emara & Zhang (2020**) employed **Infrastructure of Digital Services Index** constructed using15 indicators such as telecommunication investment, fixed broadband connections and coverage, number of secure servers, and satellites. **Emara and Zhang (2020**) also employed **Digital Connectivity Index** constructed using 11 indicators such as mobile broadband subscription and penetration, smartphone users, and pay TV penetration.

Chuc et al. (2021) created a Financial Inclusion Index from 4 financial indicators using Principal Component Analysis technique: number of commercial bank branches per 100,000 adults, number of ATMs per 100,000 adults, Number of depositors from commercial banks per 1000 adults), Number of borrowers from commercial banks per 1000 adults. **Naceur et al. (2020)** used number (in log) of branches of commercial banks per 100,000 adults and the number of ATMs per 100,000 adults to measure the access to financial services and log of deposit accounts with commercial banks per 1,000 adults and the log of the number of borrowers at commercial banks per 1,000 adults to measure the usage of financial services.

As digital and financial systems have many aspects, I measured their overall status by developing indices including several variables. Principal Component Analysis (PCA) was applied to reduce the problems of arbitrary weighting and multicollinearity in regression models.

To measure how digitally enabled a country is, a Digital Infrastructure Index *(dig_infra)* was created using three crucial indicators taken from World Development Indicators (WDI), World Bank (2023) that are log of mobile cellular subscriptions (per 100 people) which measures the extent of mobile network coverage and how many people have access to it, log of individuals using the internet as a percentage of population reflecting how much people use internet-based services and log of fixed broadband subscriptions (per 100 people) demonstrating the availability of high-speed internet in a population. A nation with advanced digital infrastructure makes it easier, cheaper and safer to move money. Digital channels (such as mobile banking or online remittance services) are more popular with migrants if the country receiving the money has strong digital services.

Likewise, a Financial Inclusion Index (*fin_inclusion*) was created that measures how accessible and useful financial services are for people in each country using loans as percentage of GDP which measures the access to formal credit, log of number of deposit accounts per 1000 adults which describes how common it is for people to have access to common banking services and log of ATMs per 100,000 adults which measures if there is access to liquid money.

Although our selection of control variables is guided by existing literature, we have carefully chosen macroeconomic indicators that are most relevant to the specific context of our study.

Fagiolo and Rughi (2023) indicated a non-linear relationship between remittance flows and per capita income at home country due to altruistic motives dominating at lower income levels and self-interested motives at higher levels. **Denis et al. (2013)** found that remittance receipt is inversely related to GDP per capita and real effective exchange rate while positively related to the lending rate. According to **Hassan and Holmes (2018)**, the long-run responsiveness of remittances to changes in real lending rates is negative. **Omobitan (2012)** found a significant cointegration relationship between remittances and economic indicators in Nigeria, including consumer price index and gross domestic product and also indicated that there is a negative relationship between inflation and remittance inflows as he suggested that improving remittance inflows requires inflation to be kept under control. The IMF and other international organizations often highlight US economic performance as a key determinant of the global economic outlook. For many countries, especially in South Asia, the US is a major source of remittances. When the US economy grows, migrants there generally earn more and send more money home, making US GDP a strong driver of global remittance trends. Therefore, the total GDP of the US is used as a proxy to capture the global economic condition in this study.

Table 3.2: Variable Description

Category	Variable Name	Transformation	Abbreviation
Dependent Variables	Remittance (as % of GDP)	As it is	remitt
Independent Variables	Digital Infrastructure Index	As it is	dig_infra
	Financial Inclusion Index	As it is	Fin_inclusion
Control Variables	GDP per capita	Log Transformed	ln_gdppc
	Exchange Rate	Log Transformed	ln_exchange
	USA GDP	Log Transformed	ln_usa_gdp
	Inflation	As it is	inflation
	Lending interest rate	As it is	interest_rate

3.2. Econometric Model

Given the structure of the data covering multiple countries over time and the presence of variables with different orders of integration I(0) and I(1), the Pooled Mean Group (PMG) Auto-Regressive Distributed Lag (ARDL) model developed by **Pesaran, Shin, and Smith (1999)** has been employed to model both short-run fluctuations and long-run equilibrium relationships among the variables.

Long-run Specification:

$$\mathbf{REMITTit = \alpha i + \beta 1 DIG\_INFRAit + \beta 2 FIN\_INCLUSIONit + \beta 3 (DIG\_INFRA \times FIN\_INCLUSION)it + \gamma \cdot Xit + \varepsilon}$$

Where, REMITTit denotes Remittances as a percentage of GDP for country i at time t (2005–2023). The key explanatory variables include DIG_INFRA, which is the digital infrastructure index, and FIN_INCLUSION, the financial inclusion index. Xit is the vector of control variables in the model , while εit captures the error term or residuals.

The interaction term DIG_INFRA × FIN_INCLUSION reflects the combined influence of digital and financial infrastructure, helping to assess whether their joint impact on remittance inflows is greater than the effect of each component on its own.

Short-run Error Correction Specification:

$$\mathbf{\Delta REMITTit = \phi i (REMITTi,t-1 - LRi,t-1) + \sum \delta k \Delta Xit-k + \mu it}$$

Where, ΔREMITTit represents first-difference of Remittances (% of GDP) for country i at time t. ϕi is the error correction coefficient i.e., speed of adjustment coefficient for country i. (REMi,t−1−LRi,t−1) represents the error correction term. REMITTi,t−1 denites the lagged value of Remittances (% of GDP) for country I while, LRi,t−1 is the lagged long-run equilibrium value for country i. The term ∑δkΔXit−k represents the sum of short-run dynamic effects of the explanatory variables and μit captures the error term.

Before estimating the PMG-ARDL model, the panel unit root tests were conducted to check the stationarity of each variable, which is a prerequisite for ARDL modeling. Multiple Tests were used for this purpose such as Im, Pesaran and Shin (IPS) test developed by **Im, Pesaran, and Shin (2003)**, The Fisher-type ADF Test originally developed by Fisher (1932) and further extended to panel data by **Maddala and Wu (1999)** and **Choi (2001),** Fisher-type Phillips-Perron test, a panel data unit root test based on the Phillips-Perron test developed by **Phillips and Perron (1988)** and further extended to panel data by **Maddala and Wu (1999)** and **Choi (2001).** Cross-Sectionally Augmented IPS (CIPS) test proposed by **Pesaran (2007)** was also used to account for cross-sectional dependence in the panel.

After stationarity checks, Panel Cointegration test was conducted to check for the existence of a long-run equilibrium relationship between remittance inflows and the explanatory variables. The Kao Residual Panel Cointegration Test developed by **Kao (1999)** was employed for this purpose. **Kao (1999)** used “Dickey-Fuller (DF) and Augmented Dickey-Fuller (ADF)-type unit root tests for residuals that is, εit as a test for the null hypothesis of no cointegration”

CHAPTER 4

RESULTS AND DISCUSSIONS

4.1. Descriptive Statistics

Table 4.1: Descriptive Statistics

Variable	Mean	Median	Max.	Min.	Std. Dev.	Skewness	Kurtosis
remitt	5.43	5.07	10.59	2.60	2.33	0.62	2.18
ln_cellular	19.05	18.90	20.89	16.01	1.20	-0.07	2.77
ln_deposit	6.45	6.43	7.76	5.03	0.69	0.11	2.22
ln_exchange	4.36	4.35	5.63	3.72	0.37	0.99	4.82
ln_gdppc	11.60	11.70	12.14	10.84	0.33	-0.51	2.31
ln_internet	2.36	2.47	4.05	-1.42	1.05	-0.89	4.62
ln_usa_gdp	30.52	30.49	30.95	30.20	0.21	0.42	2.16
loans	33.28	36.19	52.98	13.47	12.35	-0.24	1.68
interest_rate	11.03	10.61	19.32	7.12	2.31	0.78	4.18
inflation	8.18	7.04	30.77	2.53	4.60	2.66	12.44
ln_broadband	-0.43	0.04	2.01	-4.79	1.69	-0.98	3.43
ln_atm	1.81	2.12	3.22	-1.60	1.07	-1.15	4.23

Table 4.1 shows key summary statistics for all the variables used in the study, including remittance inflows (as a percentage of GDP), digital infrastructure indicators, financial inclusion measures, and macroeconomic control variables. On average, remittances account for about 5.43% of GDP, with some variation across time and countries (ranging from 2.6% to 10.59%). Most of the independent variables appear to be fairly normally distributed, with moderate skewness and kurtosis values. However, inflation shows a particularly high degree of variation and positive skewness, with a maximum of 30.77% and a kurtosis of 12.44, indicating occasional inflation spikes in some years or countries. The financial inclusion variables, such as deposit accounts (ln_deposit) and ATMs (ln_atm), show relatively stable distributions. The GDP per capita

(ln_gdppc) and U.S. GDP (ln_usa_gdp) variables have low variability, reflecting more stable economic trends.

4.2. Results of Stationarity tests and Panel Cointegration test

Before estimating the long-run and short-run relationships between remittance inflows and the explanatory variables, the stationarity of each variable was checked. For this purpose, panel unit root tests such as Cross-sectionally Augmented Im-Pesaran-Shin test (CIPS) developed by **Pesaran (2007)** was used to account for cross-sectional dependence in the panel data. Based on the CIPS test, log of number of ATMs per 100,000 adults, log of no. of deposit accounts with commercial banks per 1,000 adults, log of mobile cellular subscription, log of fixed broadband subscriptions per 100 people, log of exchange rate and log of GDP per capita were found to be stationary at level i.e., I(0) whereas the dependent variable- remittance as % of GDP was found to be stationary at first difference. Log of individuals using the Internet as a percentage of population, loans as a percentage of GDP, lending interest rate and inflation were found to be stationary at first difference, meaning they are I(1).

The variable log of US GDP had the same value across all cross-sections because it is a global-level variable and not country-specific. Therefore, standard panel unit root tests could not be applied. Instead, I used time-series unit root tests – Fisher Augmented Dickey-Fuller (ADF) test developed by **Dickey and Fuller (1979)** and the Phillips-Perron (PP) test developed by **Phillips and Perron (1988)** and it was found to be stationary at first difference.

To complement the CIPS test, traditional unit root tests, such as **Im et al. (2003)** – IPS test, **Dickey and Fuller (1979)** Fisher- ADF test and Phillips-Perron (PP) test were applied to reconfirm the stationarity of the variables under no cross-sectional dependence, and to ensure robustness of the results. Based on CIPS test, the digital infrastructure index and financial inclusion index was found to be stationary at level ($p < 0.05$). The stationarity findings confirmed that none of the variables are I(2). This made the PMG ARDL model a valid and appropriate choice for estimating both the short-run dynamics and long-run equilibrium relationships in my panel dataset.

To test for the existence of a long-run equilibrium relationship among the chosen independent and control variables, the **Kao residual panel cointegration** test developed by **Kao (1999)** was employed. As shown in Table, the **ADF t-statistic is -5.061** and is statistically significant at the 1% level (**$p < 0.01$**). This strongly rejects the null hypothesis that there is no cointegration among the variables. The results confirm the presence of a **stable long-run relationship** among the selected variables across the panel countries. This result means PMG ARDL estimator should be used which allows each group's behaviour to vary in the short-term but not in the long-term. The fact that variables are cointegrated allows to investigate both immediate and lasting impacts of digital technology and financial inclusion on money sent home by migrants.

4.3. Results of PMG-ARDL Estimation

This research used the PMG-ARDL approach to look at both the short- and long-term relationships between digital infrastructure, financial inclusion and remittances in

South Asia. According to the model, how countries respond in the short term can be different, but in the long term, their response patterns are supposed to be the same.

Table 4.2: Long Run Equation

Variable	Coefficient	Std. Error	t-Statistic	Probability
DIG_INFRA	2.490906	0.099651	24.99633	0.0000
FIN_INCLUSION	4.480316	0.101518	44.13331	0.0000
DIG_INFRA x FIN_INCLUSION	0.497850	0.056114	8.872165	0.0000
LN_GDPPC	-35.81775	0.346462	-103.3815	0.0000
LN_EXCHANGE	-0.180553	0.112056	-1.611281	0.1214
LN_USA_GDP	14.37780	0.149341	96.27471	0.0000
INFLATION	-0.147639	0.002275	-64.90378	0.0000
INTEREST_RATE	0.021866	0.008713	2.509587	0.0199

Table 4.3: Short Run Equation

Variable	Coefficient	Std. Error	t-Statistic	Probability
COINTEQ01	-0.445025	0.285147	-1.560688	0.0809
D(DIG_INFRA)	-0.271681	1.462170	-0.185807	0.8543
D(FIN_INCLUSION)	-1.710453	2.830226	-0.604352	0.5518
D(DIG_INFRA x FIN_INCLUSION)	-1.072101	0.485983	-2.206048	0.0381
D(LN_GDPPC)	-27.37883	21.32237	-1.284043	0.2125
D(LN_EXCHANGE)	-4.532269	5.215172	-0.869055	0.3942
D(LN_USA_GDP)	7.700903	2.406902	3.199508	0.0041
D(INFLATION)	-0.089249	0.088125	-1.012749	0.3222
D(INTEREST_RATE)	0.512025	0.461673	1.109064	0.2794

Table 4.4: Model Diagnostics

Statistic	Value
Root MSE	0.226053
S.D. dependent var	0.739434
Mean dependent var	0.081914
S.E. of regression	0.364587
S.E. of regression	0.364587
Sum squared residuals	2.924316
AIC	-0.978599
SC	0.275907
HQC	-0.491055
R- Squared	0.9045
Adj R- Squared	0.8862
Log likelihood	62.89006

Long-run results, as shown in table 4.2, indicates that better digital infrastructure and greater financial inclusion are both positive for remittances and they influence each other positively. Nevertheless, short-term results are insignificant, meaning that changes in remittances happen slowly when shocks or reforms take place.

A one unit increase in *dig_infra* (Digital Infrastructure Index) is associated with an increase of approximately 2.49 percentage points in remittances as a share of GDP in the long run, keeping other factors constant. This relationship is statistically significant at the 1% level ($p < 0.01$), showing strong evidence for a positive long-run impact on the inflow of remittances. Improved digital infrastructure such as wider internet access, more mobile subscriptions, and better broadband makes it easier, faster, and cheaper for migrants to send money home. This reduces transaction costs and increases the use of formal remittance channels, leading to higher recorded remittance inflows relative to GDP in South Asian economies.

A one unit increase in *fin_inclusion* (Financial Inclusion Index) is associated with an increase of approximately 4.48 percentage points in remittances as a share of GDP in the long term, keeping other variables constant. This effect is highly statistically significant at the 1% level ($p < 0.01$). Greater extent of financial inclusion means more people have access to bank accounts and financial services, which makes it easier for families to receive remittances through secure, formal channels. This encourages both the sending and receiving of remittances, increasing their share in the economy of South Asian countries.

A one-unit increase in the interaction term between the Digital Infrastructure Index and the Financial Inclusion Index is associated with an increase of approximately 0.50

percentage points in remittances as a share of GDP in the long run, keeping all other variables constant. The positive and significant interaction term ($p < 0.01$) indicates that the combined effect of digital infrastructure and financial inclusion is greater than their individual effects. This means that when both are enhanced together, remittances as a share of GDP increase by more than the effect of either variable alone, demonstrating a complementary relationship between digital and financial access.

A 1% increase in GDP per capita is associated with a decrease of approximately 35.87 percentage points in remittances as a share of GDP in the long run, holding other variables constant. This effect is highly statistically significant at the 1% level ($p < 0.01$) which means that in long run, as South Asian countries develop and income grows, remittances might decline in importance as a share of GDP as there can be a potential reduction in emigration due to increase in the availability of economic opportunities in the home country itself. This is part of the development transition.

The coefficient of *ln_exchange* is negative (-0.18), but it is not statistically significant ($p = 0.12$), so there is no strong evidence of a long term relationship between the exchange rate and remittance inflows in this model.

The US is a major destination for migrants from many developing countries, especially in South Asia and thus, one of the largest sources of remittance inflows. A 1% increase in the United States GDP is associated with a 14.38 percentage point increase in remittances as a share of GDP, holding other factors constant and it is highly statistically significant at the 1% level ($p < 0.01$) which shows that when the US economy grows, the migrants are able to earn more and can send more money home, boosting remittance inflows in South Asian countries.

A one percentage point increase in the inflation rate is associated with a decrease of approximately 0.147 percentage points in remittances as a share of GDP in the long run, holding other variables constant. This effect is highly statistically significant at the 1% level ($p < 0.01$) which means that higher inflation in the recipient country reduces the purchasing power of remittances and might signal macroeconomic instability, which could discourage migrants from sending money or reduce the effectiveness of those remittances.

A one percentage point increase in the lending interest rate is associated with an increase of approximately 0.022 percentage points in remittances as percentage of GDP, statistically significant at the 5% level ($p = 0.0199$) in the long run, holding other factors constant. This suggests that when lending interest rates rise, borrowing becomes more expensive for households and small businesses in the home country. Migrants may respond by sending more remittances to help their families avoid costly loans for expenses such as education, healthcare, or business financing.

The table 4.3 shows the short run equilibrium results. The negative and statistically significant coefficient ($p < 0.10$) of the Error Correction Term (COINTEQ01) suggests that if remittances deviate from their long-run equilibrium, about 44.5% of the disequilibrium is corrected in the next period. This moderate adjustment speed reflects a stable long-run relationship and confirms that the model is dynamically stable.

Additionally, a rise in the US GDP has a large and significant positive impact ($p < 0.01$) on remittances in the short run. A 1% increase in US GDP leads to a 7.70 percentage point increase in remittances as a share of GDP in the short run. This reflects the strong and immediate connection between economic conditions in the United States and the ability of migrants to send money home. This result confirms that remittance inflows to South Asia are sensitive to economic performance in developed economies, particularly the U.S., which remains one of the top remittance-sending countries globally.

The short-run results from the ARDL model in table 4.3 show that not all variables influencing remittance inflows have an immediate effect. Most notably, the interaction between digital infrastructure and financial inclusion is significant and negative in the short run ($p < 0.05$). This suggests that when both digital and financial systems are rapidly expanded together, there may be initial disruptions or adjustment costs that temporarily reduce remittance flows. This could be due to people needing time to adapt to new technologies or changes in how remittances are processed.

Other variables, such as changes in digital infrastructure or financial inclusion alone, GDP per capita, inflation, and interest rates, do not have significant short-run effects. This indicates that while these factors are important in the long run, their immediate impact on remittance flows is limited.

The table 4.4 shows the multiple diagnostic checks for the model. A strong R-squared of 0.9045 and adjusted R-squared of 0.8862 demonstrate that the model fits the data reasonably well and that there is not much autocorrelation in the data. The Adjusted R-squared confirms that even after adjusting for the number of predictors, the model retains a high level of explanatory power, suggesting a well-fitted and robust model. The research confirms that digital inclusion and changes in the monetary system strengthen the association between reforms and future patterns of remittances in the region.

To test the validity of the independence assumption across countries, multiple cross-sectional dependence tests were conducted on the residuals of the PMG ARDL model using the Breusch-Pagan LM test developed by **Breusch and Pagan (1980)**, Pesaran scaled LM, and the Pesaran Cross Dependence test developed by **Pesaran (2004)** and all tests failed to reject the null hypothesis of no cross-sectional dependence.

The results came as, Breusch-Pagan LM test statistic = 1.815359, with a p-value of 0.6116, Pesaran scaled LM test statistic = -0.483628, with a p-value of 0.6287, Pesaran CD test statistic = -0.57, with a p-value of 0.5664 which collectively confirms that residuals are uncorrelated across cross-sections, thus supporting the suitability of the PMG estimation approach for the given panel structure.

CHAPTER 5

CONCLUSION, FUTURE SCOPE AND SOCIAL IMPACT

5.1. Conclusion

This study analyses the effect of digital infrastructure and financial inclusion on the inflow of remittances in South Asian countries of India, Pakistan and Bangladesh over the period of 2005-2023. The study employed **Pesaran, Shin, and Smith's (1999)** Pooled Mean Group (PMG) Autoregressive Distributed Lag (ARDL) model and explored both the short-run and long-run dynamics of this relationship, while also accounting for important control variables such as GDP per capita, exchange rate, inflation, GDP of the US, and lending interest rate.

Before estimating the main model, the **Kao (1999)** residual-based panel cointegration test was employed to check whether a long-run relationship existed between remittance inflows and the explanatory variables. The results of this test showed statistical evidence of cointegration, suggesting that remittance flows are indeed tied to macroeconomic fundamentals and policy-linked variables over the long term.

The findings reveal that digital infrastructure measured through the digital infrastructure index constructed from mobile cellular subscriptions, internet usage, and fixed broadband subscriptions using Principal Component Analysis (PCA) has a positive and significant impact on remittance inflows in the long run. This suggests that better access to digital tools helps migrants and their families to use formal and more efficient channels for sending and receiving money. Therefore, when digital services are easily available and widely used, people are more likely to send money back home using safe, trackable, and formal means.

Financial inclusion, as measured by the financial inclusion index constructed from number of outstanding loans, number of deposit accounts in commercial banks and number of ATMs, is positively related to remittance inflows in the long run. This shows that when more people have access to the banking system, it becomes easier and more attractive to receive remittances through formal financial institutions. It highlights the role of inclusive banking systems in increasing the remittance inflows in the South Asian economies due to smoother remittance transfer facilities.

The study also found that the interaction of digital infrastructure and financial inclusion has a long run positive and significant impact of remittances inflows. This means that the combined effect of digital infrastructure and financial inclusion is greater than their individual effects. The interaction term demonstrates that both digital infrastructure and access to banking and financial services adds extra impact on remittances when both are improved at the same time. It suggests that benefits of improved digital infrastructure for remittance inflows are magnified when accompanied by greater financial inclusion.

Among the control variables, GDP per capita in the home country had a negative and significant effect, suggesting that as the domestic economy improves, dependence on remittance inflows may decrease. The long-run effect of the exchange rate on remittance inflows was negative and insignificant. Inflation has a significant negative impact on the remittance inflows as higher inflation erodes the value of remittances in the recipient country, leading the migrants to reduce the overall volume of money they send. The US GDP which indicates the global economic conditions, had a positive impact on remittance inflows in the South Asian countries both in short run and in long

run reaffirming that higher income levels in remittance sending countries lead to more remittance inflows. Higher lending interest rates in recipient countries are linked to a modest increase in remittance inflows suggesting that when borrowing becomes more expensive locally, families may depend more on remittances to meet their financial needs.

The negative and significant error correction term points to the convergence towards long-run equilibrium and confirms the presence of a stable long-run relationship among the variables. This means that even if short-term fluctuations occur, the system eventually returns to a long-term path. While the long-run relationships were stable, the short-run effects were generally weaker and less stable. This suggests that policy changes or shocks may not affect remittances immediately, but improvements in infrastructure and financial systems create impact on the remittance inflows over time.

To verify the reliability of the panel model, the study conducted cross-sectional dependence tests using multiple methods including **Breusch and Pagan (1980)** Breusch-Pagan LM, **Pesaran (2004)** Pesaran Scaled LM, and Pesaran CD tests. All three tests gave insignificant results ($p > 0.05$), indicating the absence of cross-sectional dependence in the residuals of the model. This suggests that economic shocks or unobserved factors in one country are not significantly correlated with those in the others. The lack of cross-sectional dependence confirms that the chosen PMG-ARDL model provides robust and unbiased estimates.

Overall, this study provides strong empirical support for both research hypotheses regarding the long-run impact of digital infrastructure and financial inclusion on remittance inflows in India, Pakistan, and Bangladesh. The results show that the growth of digital infrastructure and the extent of financial inclusion have a significant impact on remittance inflows to South Asia, in addition to global economic growth and domestic stability. Countries that invest in building robust digital ecosystems and inclusive financial services can expect stronger, more resilient remittance flows, which are critical for household welfare and macroeconomic stability in the region.

5.2. Policy Implications

The findings from this research offer several important insights for policymakers in India, Pakistan, and Bangladesh. Since foreign remittances play a vital role in maintaining household income, boosting foreign exchange reserves, and promoting economic growth and development. Therefore, increasing the inflow of foreign remittances, particularly through official channels, should continue to be a top policy priority. Moreover, understanding the short-term and long-term dynamics of this relationship between digital infrastructure, financial inclusion and remittances can help policymakers identify which areas require investment and reform to ensure that remittance inflows are maximised and effectively used for development purposes.

The study found that when people have better access to digital services, they are more likely to use formal banking channels to send and receive money. Governments should continue to invest in expanding affordable internet access, improving broadband coverage, and increasing mobile network reliability, especially in rural and underserved areas. Public-private partnerships (PPP) with telecom companies could be an effective way to roll out infrastructure rapidly and at scale.

The analysis shows that financial inclusion is a significant factor influencing remittance inflows. This suggests that when people have access to basic financial services, such as bank deposit accounts, availability of ATMs, and credit access, it becomes easier and safer to receive money from abroad through formal banking systems. Policy efforts should focus on expanding banking services in remote and marginalized communities. Initiatives like mobile banking units, simplified KYC norms for migrants' families, and digital banking apps in local languages can help bridge the financial inclusion gap. Governments should also support community awareness campaigns that promote trust and familiarity with basic banking and financial systems.

This research strongly supports the idea that digital infrastructure and financial inclusion are the critical tools for economic resilience in migrant-dependent countries. In the long run, investing in these areas can not only boost remittance inflows but also channel them into productive uses such as enhancing the per capita income and promoting savings and investment.

Policymakers must therefore see remittances not just as passive income flows but as a lever for financial development, poverty reduction, and inclusive growth. The more financially included and empowered people are, the more likely they are to participate in formal financial systems thus, making remittances safer, faster, and more impactful.

5.3. Limitations of the Study

While this study makes meaningful contributions to understanding the impact of digital infrastructure and financial inclusion on the remittance inflows in South Asian countries of India, Pakistan and Bangladesh, it is important to acknowledge its limitations.

The study focuses only on three countries - India, Pakistan, and Bangladesh. While these are major remittance-receiving countries in South Asia as well as in Sub-Saharan Africa, the findings may not be generalizable to other developing economies or even to all South Asian nations, such as Sri Lanka or Nepal.

The analysis uses official data and does not account for informal remittance flows such as hawala. In countries where informal channels are still active, this may understate the total volume of remittances and miss factors that influence why people bypass formal systems.

The indicators used for financial inclusion and digital infrastructure may evolve faster than annual data can capture. Some rapid policy changes or digital disruptions (like UPI in India) might not be reflected adequately in the dataset.

5.4. Future Research Directions

While this study provides important insights into how digital infrastructure and financial inclusion influence foreign remittance inflows in India, Pakistan, and Bangladesh, it also opens several areas for future research.

Research could be expanded to assess why people still use informal channels and how digital and financial access can incentivize formalization of remittance flows. This will be especially useful for policy interventions targeting the reduction of illicit flows.

Future research could explore how migration-related policies such as work visas, labour agreements, or diaspora engagement policies and labour market conditions in host countries influence remittance behaviour. Incorporating variables such as remittance transaction fees, foreign exchange regulations, and compliance requirements (like KYC norms) can help understand how policy frameworks affect remittance volumes and channel choice. Understanding the push and pull factors of migration, along with remittance trends, would give a more holistic understanding of the overall migration-remittance-development nexus. Although this study does not account for COVID-19 or geopolitical shocks, future research could assess how such events disrupt remittance flows, especially in countries with large diaspora populations. These areas can help deepen our understanding and address the limitations of this research.

REFERENCES

1. Abdul Mannan, K., & Farhana, K. M. (2023). Digital financial inclusion and remittances: An empirical study on Bangladeshi migrant households. *FinTech*, *2*(4), 680-697.

2. Adams Jr, R. H. (2011). Evaluating the economic impact of international remittances on developing countries using household surveys: A literature review. *Journal of Development Studies*, *47*(6), 809-828.

3. Ahmad, N., Hussain, Z., Sial, M. H., Hussain, I., & Akram, W. (2008). Macroeconomic determinants of international migration from Pakistan. *Pakistan Economic and Social Review*, 85-99.

4. Aga, G., & Martinez Peria, M. S. (2014). International remittances and financial inclusion in Sub-Saharan Africa. *World Bank Policy Research Working Paper*, (6991).

5. Ajefu, J. B., & Ogebe, J. O. (2019). Migrant remittances and financial inclusion among households in Nigeria. *Oxford Development Studies*, 47(3), 319–335.

6. Anarfo, E. B., Amewu, G., & Dzeha, G. C. (2020). Financial inclusion and migrant remittances in Sub-Saharan Africa: a panel VAR approach. *International Journal of Social Economics*, 47(7), 809-829.

7. Arthur, E. K., Musau, S. M., & Wanjohi, F. M. (2020). Diaspora remittances and financial inclusion in Kenya. *European Journal of Business and Management Research*, *5*(2).

8. Barnabe, A. Y. (2021). Migrant remittances and financial inclusion in Africa: a dynamic and long-run approach. In *Handbook of Research on Institution Development for Sustainable and Inclusive Economic Growth in Africa* (pp. 153-168). IGI Global Scientific Publishing.

9. Basnet, H. C., Koirala, B., Upadhyaya, K. P., & Donou-Adonsou, F. (2021). Workers' remittances and financial development: The case of South Asia. *International Review of Economics*, 68, 185-207.

10. Bettin, G., Presbitero, A. F., & Spatafora, N. L. (2017). Remittances and vulnerability in developing countries. *The World Bank Economic Review*, *31*(1), 1-23.

11. Bhattacharya, M., Inekwe, J., & Paramati, S. R. (2018). Remittances and financial development: empirical evidence from heterogeneous panel of countries. *Applied Economics*, *50*(38), 4099-4112.

12. Breusch, T. S., & Pagan, A. R. (1980). The Lagrange multiplier test and its applications to model specification in econometrics. *The review of economic studies*, *47*(1), 239-253.

13. Brown, R. P., Carmignani, F., & Fayad, G. (2013). Migrants' remittances and financial development: Macro-and micro-level evidence of a perverse relationship. *The World Economy*, *36*(5), 636-660.

14. Choi, I. (2001). Unit root tests for panel data. *Journal of international money and Finance*, *20*(2), 249-272.

15. Choi, I. (2006). Nonstationary panels. *Econometric theory*, *1*, 511-539.

16. Chowdhury, M. (2016). Financial development, remittances and economic growth: Evidence using a dynamic panel estimation. *Margin: The Journal of Applied Economic Research*, *10*(1), 35-54.

17. Chuc, A. T., Li, W., Phi, N. T. M., Le, Q. T., Yoshino, N., & Taghizadeh-Hesary, F. (2022). The necessity of financial inclusion for enhancing the economic impacts of remittances. *Borsa Istanbul Review*, *22*(1), 47-56.

18. Cooray, A. (2012). Migrant remittances, financial sector development and the government ownership of banks: Evidence from a group of non-OECD economies. *Journal of International Financial Markets, Institutions and Money*, *22*(4), 936-957.

19. Cooray, A. (2012). The impact of migrant remittances on economic growth: evidence from South Asia. *Review of International Economics*, *20*(5), 985-998.

20. Deheri, A. (2022). The nexus between remittance inflows and financial development in India: substitutes or complements?. *The Indian Economic Journal*, *70*(4), 597-614.

21. Denis, N., Omeje, A. N., & Asogwa, H. T. (2013). Determinants of remittance: Panel evidence from selected countries in Africa. *Journal of Economics and Sustainable Development ISSN2222-1700*, *4*(20), 2013.

22. Dickey, D. A., & Fuller, W. A. (1979). Distribution of the estimators for autoregressive time series with a unit root. *Journal of the American statistical association*, *74*(366a), 427-431.

23. Emara, N., & Zecheru, D. (2022). Is the Impact of Digitization on Domestic Inflation Non-Linear? The Case of Emerging Markets. *The Case of Emerging Markets (March 21, 2022)*.

24. Fagiolo, G., & Rughi, T. (2023). Exploring the macroeconomic drivers of international bilateral remittance flows: A gravity-model approach. *Economies*, *11*(7), 195.

25. Hassan, G. M., & Holmes, M. J. (2019). How do workers' remittances respond to lending rates?. *International Migration*, *57*(5), 21-36.

26. Hor, C., & Pheang, P. (2017). Analysis determinant factors effect on migrant workers' remittances flow to the CLMV Countries. *International Journal of Economics and Financial Issues*, *7*(2), 202-207.

27. Im, K. S., Pesaran, M. H., & Shin, Y. (2003). Testing for unit roots in heterogeneous panels. *Journal of econometrics*, *115*(1), 53-74.

28. Inoue, T. (2024). Digital financial inclusion, international remittances, and poverty reduction. *Journal of economic structures*, *13*(1), 8.

29. Inoue, T., & Hamori, S. (2016). Do workers' remittances promote access to finance? Evidence from Asia-Pacific developing countries. *Emerging Markets Finance and Trade*, *52*(3), 765-774.

30. Islam, M. S. (2022). Do personal remittances influence economic growth in South Asia? A panel analysis. *Review of Development Economics*, *26*(1), 242-258.

31. Issabayev, M., Saydaliyev, H., Avsar, V., & Chin, L. E. E. (2020). Remittances, institutions and financial inclusion: new evidence of non-linearity. *Global Economy Journal*, *20*(01), 2050002.

32. Jawaid, S. T., & Raza, S. A. (2016). Effects of workers' remittances and its volatility on economic growth in South Asia. *International Migration*, *54*(2), 50-68.

33. Jemiluyi, O. O., & Jeke, L. (2024). Remittance inflows in a digital economy: A Sub-Saharan African experience. *Journal of Infrastructure, Policy and Development*, *8*(4), 2838.

34. Jijin, P., Mishra, A. K., & Nithin, M. (2022). Macroeconomic determinants of remittances to India. *Economic Change and Restructuring*, *55*(2), 1229-1248.

35. Kao, C., Chiang, M. H., & Chen, B. (1999). International R&D spillovers: an application of estimation and inference in panel cointegration. *Oxford Bulletin of Economics and statistics*, *61*(S1), 691-709.

36. Karikari, N. K., Mensah, S., & Harvey, S. K. (2016). Do remittances promote financial development in Africa?. *SpringerPlus*, *5*, 1-21.

37. Karim, N., Tariq, M., & Khan, M. A. (2022). An empirical study on the relationship of financial sector development, remittances inflows, and income inequality in South Asian Countries. *Review of Economics and Development Studies*, *8*(1), 73-83.

38. Khan, A. A., Hidthir, M. H. B., Mansur, M., & Ahmad, Z. (2025). Role of financial inclusion in enhancing the effect of remittance on economic growth in developing countries. *Cogent Economics & Finance*, *13*(1), 2476093.

39. Khera, P., Ogawa, M. S., & Sahay, M. R. (2021). *Is digital financial inclusion unlocking growth?*. International Monetary Fund.

40. Kumar, R. R. (2013). Linking remittances with financial development and ICT: a study of the Philippines. *International Journal of Economics and Business Research*, *5*(4), 379-399.

41. Lyons, A. C., Kass-Hanna, J., & Fava, A. (2022). Fintech development and savings, borrowing, and remittances: A comparative study of emerging economies. *Emerging Markets Review*, *51*, 100842.

42. Machasio, I. (2018). *Do remittance flows promote financial inclusion?* (No. 26-2018). MAGKS Joint Discussion Paper Series in Economics.

43. Maddala, G. S., & Wu, S. (1999). A comparative study of unit root tests with panel data and a new simple test. *Oxford Bulletin of Economics and statistics*, *61*(S1), 631-652.

44. Mallick, H. (2017). Determinants of workers' remittances: An empirical investigation for a panel of eleven developing Asian economies. *The World Economy*, *40*(12), 2875-2900.

45. Murshed, M., Ahmed, R., Al-Tal, R. M., Kumpamool, C., Vetchagool, W., & Avarado, R. (2023). Determinants of financial inclusion in South Asia: The moderating and mediating roles of internal conflict settlement. *Research in International Business and Finance*, *64*, 101880.

46. Naceur, M. S. B., Chami, M. R., & Trabelsi, M. (2020). *Do remittances enhance financial inclusion in LMICs and in fragile states?*. International Monetary Fund.

47. Nguyen, V. B. (2025). The Impact of Digitalization on International Remittances in Developing Economies: The Paradox of Institutional Development. *Global Journal of Emerging Market Economies*, *17*(1), 7-21.

48. Noman, A. M., & Uddin, G. S. (2011). Remittances and banking sector development in South Asia. *International Journal of Banking and Finance*, *8*(4), 47-66.

49. Ogede, J. S., Oduola, M. O., Yinusa, O. G., & Raimi, L. (2023). Modelling the influence of financial inclusion on the remittance growth nexus in Nigeria. *Economic Annals*, *68*(237), 137-163.

50. Omobitan, O. A. (2012). Reconciling International Migrants' Remittances Flow Determinants: The Case of Nigeria. *European Scientific Journal*, *8*(19).

51. Pandikasala, J., Vyas, I., & Mani, N. (2022). Do financial development drive remittances? Empirical evidence from India. *Journal of Public Affairs*, *22*(1), e2269.

52. Pesaran, M. H. (2007). A simple panel unit root test in the presence of cross-section dependence. *Journal of applied econometrics*, *22*(2), 265-312.

53. Pesaran, M. H., Shin, Y., & Smith, R. P. (1999). Pooled mean group estimation of dynamic heterogeneous panels. *Journal of the American statistical Association*, *94*(446), 621-634.

54. Phillips, P. C., & Perron, P. (1988). Testing for a unit root in time series regression. *biometrika*, *75*(2), 335-346.

55. Rana, R. H., & Tasneem, F. (2016). Does Remittance Inflow Promote Financial Development in South Asia?. *Asian journal of social sciences & humanities*, *5*(2), 86-100.

56. Rodima-Taylor, D., & Grimes, W. W. (2019). International remittance rails as infrastructures: Embeddedness, innovation and financial access in developing economies. *Review of international political economy*, *26*(5), 839-862.

57. Sahoo, M., Sucharita, S., & Sethi, N. (2020). Does remittance inflow influence human development in south Asian countries? An empirical insight. *Business Strategy & Development*, *3*(4), 578-589.

58. Saydaliyev, H. B., Chin, L., & Mohamed, A. (2022). Remittance inflow and economic development: interaction with financial inclusion and human capital. *Migration and Development*, *11*(3), 876-893.

59. Saydaliev, H. B., & Chin, L. (2023). The necessity of social infrastructure for enhancing educational attainment: Evidence from high remittance recipient LMICs. *Economic Change and Restructuring*, *56*(3), 1823-1847.

60. Shahzad, S. J. H., Adnan, N., Sajid, A. L. I., & Naveed, R. A. Z. A. (2014). Impact of remittances on financial development in South Asia. *Review of Economic and Business Studies*, *7*(2), 11-29.

61. Siddique, H. M. A., Shehzadi, I., Manzoor, M. R., & Majeed, M. T. (2016). Do international migration and remittances reduce poverty in developing countries?.

62. 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.

63. Singh, B. (2010). Workers' remittances to India: An examination of transfer cost and efficiency. *International Migration*, *48*(5), 63-88.

64. Tabit, S., & Moussir, C. E. (2016). Macroeconomic determinants of migrants' remittances: evidence from a panel of developing countries. *International Journal of Business and Social Research*, *6*(7), 1-11.

65. Uddin, M. A., Ichihashi, M., & Barua, S. (2022). Financial sector development and the preference for informal remittance channels: evidence from Bangladesh. *The Journal of Development Studies*, *58*(6), 1231-1258.

66. Ullah, A. A. (2017). Do remittances supplement South Asian development?. *Remittances Review*, *2*(1), 31-45.

67. Williams, K. (2016). Remittances and financial development: Evidence from sub-Saharan Africa. *African Development Review*, *28*(3), 357-367.

68. Yoshino, N., Taghizadeh-Hesary, F., & Otsuka, M. (2019). *Determinants of international remittance inflows in middle-income countries in Asia and the Pacific* (No. 964). ADBI Working Paper Series.

69. Zaarour, F., Haddad, G., & Ajimi, A. (2024). Remittances and economic growth: Panel VAR. *Journal of the Knowledge Economy*, 1-18.