Cogent Economics & Finance

ISSN: (Print) (Online) Journal homepage: www.tandfonline.com/journals/oaef20

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To cite this article: Ahsan Aslam Khan , Mohammad Helmi Bin Hidthir , Mustazar Mansur & Zaki Ahmad (2025) Role of financial inclusion in enhancing the effect of remittance on economic growth in developing countries, Cogent Economics & Finance, 13:1, 2476093, DOI: 10.1080/23322039.2025.2476093

To link to this article: https://doi.org/10.1080/23322039.2025.2476093

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Published online: 12 Mar 2025.

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COGENT ECONOMICS & FINANCE
2025, VOL. 13, NO. 1, 2476093
https://doi.org/10.1080/23322039.2025.2476093

FINANCIAL ECONOMICS | RESEARCH ARTICLE

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Role of financial inclusion in enhancing the effect of remittance on economic growth in developing countries

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ABSTRACT

This study examines the role of financial inclusiveness in explaining the relationship between remittances and economic growth in developing countries. Using panel data for 79 countries from 2011 to 2021, the study employed Random Effects (RE), Fixed Effects (FE), and Generalized Method of Moments (GMM) to estimate how remittances influence Gross domestic product (GDP). The results show that remittances have a positive impact on economic development and that this effect is amplified in countries with higher levels of financial inclusion. Additionally, models that incorporate financial inclusion and human capital (HC) reveal not only their ability to amplify the positive effect of remittances on GDP but also how important they are when it comes to helping long-term economic growth. The results of the GMM analysis controlling endogeneity also seem universally consistent with this evidence. The research also states that developing countries should focus on deeper financial inclusion and HC investment to fully exploit the economic potential of remittances. The policy implication of this result would be to fully leverage remittances for economic growth. This study contributes to the literature by providing empirical evidence for the necessity of mapping financial system integration and HC development with remittance flows to enhance sustainable growth.

IMPACT STATEMENT

This study explores the role of financial inclusion in enhancing the relationship between remittances and economic growth in developing countries. By analyzing panel data from 79 countries (2011–2021) using Random Effects (RE), Fixed Effects (FE), and Generalized Method of Moments (GMM), the study finds that remittances positively contribute to economic growth, with their impact being significantly stronger in financially inclusive economies. Additionally, the findings highlight the critical role of human capital (HC) investment in sustaining long-term economic development. The research provides policy-relevant insights, advocating for greater financial inclusion and HC investment to maximize the economic benefits of remittances. Encouraging the use of formal financial institutions can enhance financial stability, improve data tracking, and reduce reliance on informal financial systems, ultimately fostering sustainable economic growth in developing nations.

ARTICLE HISTORY
Received 23 August 2024
Revised 24 February 2025
Accepted 1 March 2025

KEYWORDS
Remittances; economic growth; financial inclusion; human capital; sustainable development; panel data

SUBJECTS
Economics; Finance; Monetary Economics; Macroeconomics

JEL CLASSIFICATION
G23; E44; F43; G18

Introduction

Remittances, defined as funds sent by immigrants to their home countries, play an increasingly significant role in development. These funds are now recognized not only for their traditional contributions to economic development but also for their role in achieving the United Nations' Sustainable Development Goals (SDGs) (Adekunle et al., 2022). As a prime channel of development finance, particularly in developing countries, remittances contribute substantially to Gross Domestic Product (GDP), underscoring their critical importance.

However, while remittances have the potential to alleviate capital constraints and promote economic development, they can also reduce recipients' demand for financial products, illustrating a complex, two-way

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relationship between remittances and financial inclusion (FI) (Anarfo et al., 2020). Effective utilization of remittance inflows can drive production, reduce import dependence, and stimulate economic growth, provided these funds are directed into productive investments (Awdeh & Jomaa, 2024; Dash, 2020). Despite these potential benefits, the interplay between remittances, FI, and economic growth remains underexplored.

Consequently, this study addresses the research gap by examining FI as a moderating variable in the relationship between remittances and economic growth across developing countries. A deeper understanding of this relationship is essential for designing policies that maximize the developmental impact of remittances. Existing literature suggests that while remittances are assumed to improve FI and economic development, their impact varies across income groups and regions (Khan et al., 2024; Yee Ee, 2023). Factors such as institutional quality and financial infrastructure often determine the extent to which remittances enhance FI and, consequently, economic growth (Naceur et al., 2020).

Notably, a critical issue within this domain is the inverse relationship observed between remittance levels and GDP across countries with varying degrees of FI. In many low-GDP countries, remittance inflows are high, yet economic growth remains limited. Conversely, higher-GDP countries often receive lower remittance flows but report greater FI and economic growth. This disparity highlights the need to understand how FI moderates the impact of remittances on economic development.

To address this gap, the study investigates whether enhancing FI in low-GDP, high-remittance countries can amplify the developmental impact of these inflows. Specifically, it explores whether FI acts as a critical enabler in converting remittances into sustainable economic growth, particularly in low- and middle-income nations. By employing a dynamic panel data approach, the study examines these relationships over time, offering nuanced insights into the role of FI.

Thus, this research contributes to the literature in two significant ways. First, it develops a comprehensive understanding of the moderating role of FI in the remittance-economic growth nexus. Second, it extends this analysis to the economically disadvantaged context of sub-Saharan Africa. A novel composite FI Index is introduced to assess FI levels across income groups and regions, providing policymakers with actionable insights.

By exploring these dynamics, this study aims to fill existing gaps in the literature and offer practical recommendations. It underscores the importance of improving access to financial services, promoting formal remittance channels, and investing in financial infrastructure to maximize the economic benefits of remittance flows. Ultimately, the findings could guide future research and policy development, focusing on innovative financial tools and digital solutions to enhance remittance-driven growth across diverse economic contexts.

Finally, the remainder of this paper is structured as follows: Section 2 reviews the relevant literature and establishes the theoretical foundation for the study. Section 3 outlines the data sources and research methodology. Section 4 presents empirical results and offers a discussion of the findings. Finally, Section 5 highlights the study's limitations and proposes directions for future research.

Literature review

According to the borrowing to finance accumulation theory, external capital inflows are pivotal in driving economic growth. Within this perspective, remittances can serve as an alternative or complementary method for channeling foreign capital into developing countries. When accompanied by favorable policies and robust financial systems, these inflows have the potential to increase the stock of productive assets in ways that equal or even surpass the outcomes of traditional borrowing, thereby promoting sustainable economic development.

Many studies explore the positive impact of remittances on decreasing poverty. One study has shown that this remittance will only increase the income level of low-income recipients at first (Masron & Subramaniam, 2018; Abubakr et al., 2024), so it is credited for family consumption and not regarded as excessive household consumer spending from workers in neighboring countries. Moreover, remittance-recipient households engage in several productive activities (eg business, farming, investment) that ultimately raise their per capita household income and decrease poverty (Kumar, 2021). Noureen et al. (2022) also find that remittances are helpful in decreasing poverty levels in some countries.

While there are studies that show the positive effects of remittance on economic growth, some research papers indicate the counter-effects of sending money home. On the brighter side, many studies

have underscored that remittances play an important role in poverty reduction and financial development. For example, Masron and Subramaniam (2018) and Kumar (2021) conclude that remittances increase household earnings. This inflow, in turn, enables individuals to undertake productive activities, such as business and agriculture, thereby further lifting the economic status of their respective households. Based on this reasoning, Bahadir et al. (2018) and Opperman and Adjasi (2019) suggest that remittances lead to economic development through the channel of financial growth and good spending behavior. Furthermore, remittances are presumed to initiate investments in both HC and investments that favor savings and investment, underscoring the inducement of financial institution-building processes by fueling economic growth (Aggarwal et al., 2011; Ahmad et al., 2024; Ajefu & Ogebe, 2019). Moreover, Chowdhury and Chowdhury (2023) emphasize the welfare implications of remittances, noting that it increases disposable income for recipients and has a positive multiplier effect on the economy.

However, the inflow of remittances has certain drawbacks. Other studies have outlined the fact that remittances reduce men's and women's supply of labor by decreasing their work incentives and impeding growth (Ahmad et al., 2025; Hosny, 2020; Jongwanich & Kohpaiboon, 2019). Overconsumption and reduced labor tax income lead to distortions in economic choice (Ahmad et al., 2024; Kharel & Upadhyay, 2021). Similarly, Hassan & Shakur (2017) highlight that remittances might be channeled to non-productive purposes in the beginning but, over time, redirected towards productive usage. Hosny (2020) also raised concerns over economic vulnerability as a result of high reliance on remittances from a limited number of source countries. On a brighter note, Sobiech (2019) points to the complex relationship between financial development and the impact of remittances on economic growth, suggesting that the effects are not as straightforward as they may seem.

The complex nature of the relationship between FI, remittances, and economic growth is further compounded at the intersection. FI, which represents the availability of financial services, is believed to be foundational for economic development (bin Hidthiir et al., 2025; Fungáčová & Weill, 2015; Khan et al., 2024). Nizam et al. (2020) point out that FI affects economic growth to a certain extent. Similarly, the improvement in trade and economic activities is also supported by Nath and Liu (2017) with information and communication technology (ICT). Well-functioning banking and FI are fundamental to digital transformation in areas with underdeveloped banking sectors (Bin Hidthir et al., 2025; Rahman et al., 2024; Sodokin et al., 2022). Indeed, regional studies, such as Emara and Said (2021) and Ifediora et al. (2022), discovered a positive association between FI and economic growth in the MENA region as well as in African countries. Khan et al. (2024) reveal that FI significantly contributes to economic growth, highlighting the need for targeted FI efforts toward the illiterate and unemployed, who benefit the least from existing initiatives.

Other studies have suggested another potential effect of FI on the economy. Highly aggressive FI moves can destabilize the financial sector, and this instability can also lead to economic growth (Hidthiir et al., 2024). As revealed by Chaudhry et al. (2024), FI has the ability to dampen economic growth under certain conditions. While this highlights the nuanced relationship between remittances, FI, and economic development, it also shows that regional context specificity is required in their study.

The literature review highlights the dual role of remittances in economic development. Numerous studies, such as those by Masron and Subramaniam (2018) and Kumar (2021), highlight the positive impact of remittances on poverty reduction, noting that remittances enhance household incomes and stimulate productive activities like business and farming. These findings align with broader evidence that remittances improve economic growth by increasing FI and enabling investments in HC. However, other research, including Hosny (2020) and Kharel and Upadhyay (2021), points to potential drawbacks, such as reduced labor supply and overreliance on remittances, which may negatively impact long-term growth. A notable gap in the literature is the complex relationship between FI, remittances, and economic growth, particularly how FI's effectiveness enhances the impact of remittance on economic growth varies across different regional and economic contexts, suggesting a need for more detailed studies.

Data and methodology

This study takes a quantitative approach to investigate the relationship between remittances, economic growth, and FI across countries at various income levels. Using panel data from 79 countries spanning

Table 1. Variable description.

Category	Variable	Measurement
Dependent variables	GDP	Economic Growth is taken as GDP growth (annual) in percentage.
Independent variables	Remittance	Remittance is taken as the remittance received percent of GDP by the country.
	Financial Inclusion	FI is calculated as two staged PCA with a total of 12 variables and three dimensions.
Control variables	HDI	The human development index is taken as the index created by UNICEF.
	INC	INCOME = GDP per capital
	TO	TO = Trade Openness (total exports)
	GEXP	GEXP = Government Spending (% of GDP)
	INF	INF = Consumer prices (annual %)
	FDI	FDI = Net inflows (% of GDP)

2011–2021, this analysis includes countries selected based on data availability, covering low-, middle-, and upper-middle-income groups. Table 1 shows the variable description used.

Construction of the financial inclusion Index (FII)

In this research, FI is the moderating variable measured by the extent to which individuals in a country use formal financial services. Sarma & Pais (2011) defines FI as making formal financial systems easily accessible and usable for everyone in an economy, while the World Bank describes it as the ability of individuals and businesses to access affordable and useful financial services, such as banking, loans, and insurance, in a responsible and sustainable manner. To operationalize FI, we constructed an FII using three dimensions: penetration, accessibility, and usability. This index was developed through a two-stage Principal Component Analysis (PCA) to address weighting challenges and ensure an accurate representation of the data.

We selected 12 indicators across the three dimensions to comprehensively capture various aspects of FI. In the first stage of PCA, these indicators were aggregated within each dimension to create sub-indices. The three dimensions used are (1) Penetration, (2) Accessibility, and (3) Usability. To accurately assess the penetration of banking services, we use three indicators: deposit accounts per 1000 adults, debit cards per 1000 adults, and credit cards per 1000 adults. To measure accessibility, we use three indicators: ATMs per 100,000 adults, bank branches per 100,000 adults, and mobile agent outlets per 100,000 adults. The usability dimension includes mobile money transactions per 100,000 adults, the number of loan accounts with commercial banks per 1,000 adults, digital payments in the past year, bank credit to the private sector as a percent of GDP, the percentage of individuals aged 15 and above who made payments using a mobile phone or the internet, the percentage who borrowed from a financial institution or used a credit card, and the percentage who saved at a financial institution. In the second stage, the sub-indices were combined into a single FI index. PCA was chosen over other dimensionality reduction methods because it effectively handles multicollinearity among the indicators, simplifies the dataset without losing critical information, and allows the data to determine the appropriate weights for each indicator. This two-stage PCA approach ensures that the FI index accurately reflects the underlying structure of the data. The index is based on 12 indicators divided into three dimensions: Accessibility, Penetration, and Usability. It is an all-encompassing index that includes all relevant components in a single number to obtain a complete picture of FI across every country.

$$FII_i = w_i\gamma_i^p + w_i\gamma_i^a + w_i\gamma_i^u + e_i$$

Where;

FII_i = Composite FI index of country i

w_i = relative weight of each dimension.

γ_i^p = penetration dimensions.

γ_i^a = accessibility dimension.

γ_i^u = Usability dimension

For each dimension, weights are optimally calculated using PCA to ensure that the index is representative of FI in each country. After performing a sensitivity analysis, this composite index measurement of FI was incorporated into the regression models to test its consequences on economic growth.

Econometric models

This study examines the relationship between remittances and GDP, with FI acting as a moderating factor. The analysis is conducted using three econometric models estimated to be with both Random Effects (RE) and Fixed Effects (FE) approaches. Additionally, robust checks are performed using the Generalized Method of Moments.

Model specification

The dependent variable in each model, GDP_{it}, represents the GDP of the country i at time t. The primary variable of interest is remittances (REM), while additional variables include income (INC), trade openness (TO), government expenditure (GEXP), financial inclusion Index (FII), and HC. The goal is to measure how remittances affect economic growth, both directly and in combination with FI and HC.

Fixed effect and Random effects

The RE models assume that country-specific effects are uncorrelated with the explanatory variables, and they account for both individual and time variations. The error term, μ_{it}, is composed of a country-specific component and a time-varying component, capturing unobserved factors not included explicitly. The Intercept α_{0i} captures the average effect across all countries, assuming that the country-specific effects are uncorrelated with the explanatory variables. Coefficients β_1 through β_6 measure the impact of each explanatory variable on GDP. For instance, β_1 quantifies the effect of remittances (REM) on GDP, indicating how changes in remittance flow influence economic growth. The error term μ_{it} in RE models are composed of a country-specific component μ_{it} and a time-varying component $\in_{it}$, which together capture unobserved factors affecting GDP that are not explicitly included in the model.

Fixed Effects (FE) models provide an alternative estimation approach that focuses on within-country variations over time. Here, the dependent variable GDP_{it}. It remains the GDP of country i at time t but the intercept. α_i It is allowed to vary across countries. This intercept α_i Captures the individual-specific effects for each country, accounting for time-invariant characteristics unique to each country, and may be correlated with the explanatory variables. The coefficients β_1 through β_6 measure the impact of remittances (REM), financial inclusion Index (FII), HC, and other variables on GDP, as in the RE models. However, in the FE models, the error term μ_{it} Captures only within-country variability over time, assuming that country-specific intercepts absorb all unobserved, time-invariant characteristics.

Model 1 (RE) – direct impact of remittance

$$GDP_{it} = \alpha_{0i} + \beta_1 REM_{it} + \beta_1 INC_{it} + \beta_1 TO_{it} + \beta_1 GEXP_{it} + \beta_1 INF_{it} + \beta_1 FDI_{it} + \mu_{it} \quad (1)$$

Model 1 (FE) – direct impact of remittance

$$GDP_{it} = \alpha_i + \beta_1 REM_{it} + \beta_1 INC_{it} + \beta_1 TO_{it} + \beta_1 GEXP_{it} + \beta_1 INF_{it} + \beta_1 FDI_{it} + \mu_{it} \quad (2)$$

Equations 1 and 2 examine the direct impact of remittances (REM) on economic growth (GDP) while also controlling income (INC), trade openness (TO), government expenditure (GEXP), Inflation (INF), and foreign direct investment (FDI). The random effects model assumes that individual-specific effects are uncorrelated with the explanatory variables.

Model 2 (RE) – effect with FI

$$GDP_{it} = \alpha_{0i} + \beta_1 REM_{it} + \beta_1 FII_{it} + \beta_1 INC_{it} + \beta_1 TO_{it} + \beta_1 GEXP_{it} + \beta_1 INF_{it} + \beta_1 FDI_{it} + \mu_{it} \quad (3)$$

Model 2 (FE) – effect with FI

$$GDP_{it} = \alpha_i + \beta_1 REM_{it} + \beta_1 FII_{it} + \beta_1 INC_{it} + \beta_1 TO_{it} + \beta_1 GEXP_{it} + \beta_1 INF_{it} + \beta_1 FDI_{it} + \mu_{it} \quad (4)$$

This model builds on Model 1 by including FII as an additional variable. It tests how FI, along with remittances, influences GDP. The inclusion of the FII allows the study to explore whether FI amplifies the positive impact of remittances on economic growth.

Model 3 (RE) – effect with FI and HC

$$GDP_{it} = \alpha_{0i} + \beta_1 REM_{it} + \beta_2 FII_{it} + \beta_3 HC_{it} + \beta_4 INC_{it} + \beta_5 TO_{it} + \beta_6 GEXP_{it} + \beta_1 INF_{it} + \beta_1 FDI_{it} + \mu_{it} \quad (5)$$

Model 3 (FE) – effect with FI and HC

$$GDP_{it} = \alpha_i + \beta_1 REM_{it} + \beta_1 FII_{it} + \beta_1 HC_{it} + \beta_1 INC_{it} + \beta_1 TO_{it} + \beta_1 GEXP_{it} + \beta_1 INF_{it} + \beta_1 FDI_{it} + \mu_{it} \quad (6)$$

Equations (5) and (6) examine Model 3, which further extends Model 2 by adding the interaction term (REM X FI) as another variable. This study examines how HC and FI moderate the relationship between remittances and GDP. The model tests whether a combination of remittances and FI drives economic growth more effectively.

GMM model

The Generalized Method of Moments (GMM) models further extend the analysis by addressing potential endogeneity issues in panel data. These models include a lagged dependent variable, GDP_{it-1}, to capture the persistence of economic growth over time, acknowledging that past GDP levels influence the current GDP. The intercept α\alpha$\alpha$ in the GMM represents the overall average effect across all countries and periods. The coefficients β_1 through β_7 in the GMM models measure the impact of remittances, FI, HC, and other variables on GDP, including lagged variables, as instruments to control for endogeneity. The error term μ_{it} in the GMM framework accounts for unobserved factors affecting GDP, and the use of instruments ensures that the estimates are robust to potential biases caused by omitted variables or measurement errors.

$$GDP_{it} = \alpha + \beta_1 GDP_{it-1} + \beta_2 REM_{it} + \beta_3 INC_{it} + \beta_4 TO_{it} + \beta_5 GEXP_{it} + \beta_8 INF_{it} + \beta_9 FDI_{it} + \mu_{it} \quad (7)$$

$$GDP_{it} = \alpha + \beta_1 GDP_{it-1} + \beta_2 REM_{it} + \beta_3 FII_{it} + \beta_4 INC_{it} + \beta_5 TO_{it} + \beta_6 GEXP_{it} + \beta_8 INF_{it} + \beta_9 FDI_{it} + \mu_i \quad (8)$$

$$GDP_{it} = \alpha + \beta_1 GDP_{it-1} + \beta_2 REM_{it} + \beta_3 FII_{it} + + \beta_3 REM_i X\ FII_{it} + \beta_4 HC_{it} + \beta_5 INC_{it} + \beta_6 TO_{it} + \beta_7 GEXP_{it} + \beta_8 INF_{it} + \beta_9 FDI_{it} + \mu_{it} \quad (9)$$

Result and analysis

Table 2 presents the key statistics for the study variables. GDP has a mean of 1.605, with moderate variability (SD = 0.781) across 957 observations, reflecting disparities in economic performance. The remittances (REM) exhibited substantial fluctuations, with a mean of 0.371 and a high standard deviation of 0.762. The Financial Inclusion Index (FI) is relatively stable, with a mean of 0.342 and a lower standard deviation of

Table 2. Descriptive statistics.

Variable	Obs	Mean	Std. Dev	Min	Max
GDP	830	1.605	0.781	−0.062	4.2
REM	830	0.371	0.762	−3.728	1.512
FI	830	0.342	0.193	−0.213	0.92
HC	830	−0.24	0.139	−0.718	0.33
INC	830	3.446	0.411	2.546	4.203
TO	830	1.815	0.204	0.616	2.271
GEXP	830	1.134	0.161	0.373	1.608

0.193. HC shows limited variability, with a mean of −0.24 and a standard deviation of 0.139. Income (INC) had a mean of 3.446, displaying some variation, with a standard deviation of 0.411. The difference in the number of observations across variables is primarily due to missing data. Each variable has a distinct number of valid observations because not all data points were recorded or available for every variable.

Table 3 shows that GDP is positively correlated with Income (INC) (0.440) and HC (0.272) but is weakly correlated with the Financial Index (FI) (0.199). It has weak negative correlations with Remittances (REM) (−0.254) and Trade Openness (TO) (−0.341). Remittances are moderately negatively correlated with income (−0.339) and weakly with the Financial Index (−0.212) and HC (−0.086). The Financial Index is positively correlated with income (0.519) and HC (0.311), while HC strongly correlates with income (0.719). These findings suggest that higher GDP is associated with higher income and HC, whereas higher remittances are associated with lower income and financial index levels.

Table 4 presents the regression results for the Random Effects (RE) and Fixed Effects (FE) models. The first model includes only remittances, while the second and third models incorporate FI and HC. In both RE and FE models, the results show that remittances have a positive relationship with GDP. Consistent with the study of Giuliano and Ruiz-Arranz (2009), this finding suggests that high-level remittances involving growth sensitive to constant effects are individual-specific. This positive correlation provides evidence that remittances can be used in a more productive manner with investment and development, especially given the fixed characteristics of entities such as countries or regions.

The estimate from the random effect (RE) and fixed effects model in Table 4 shows that regardless of the situation, remittances have a significant impact on economic growth. In Model 1, the coefficient of REM (Remittances) remains highly significant ($p < .01$) in both Random Effects (RE) and Fixed Effects (FE) models, with values of 0.0325 and 0.0338, respectively. This indicates that a 1-unit increase in remittances leads to a GDP increase of approximately 3.25% in the RE model and 3.38% in the FE model. These findings reinforce the argument that remittances play a crucial role in boosting economic growth, particularly in economies where alternative financial resources are limited.

Furthermore, results show that inflation (INF) negatively impacts GDP growth, with coefficients of −0.0384 (RE) and −0.0357 (FE), confirming that higher inflation rates slow down economic progress. On the other hand, FDI positively influences GDP, as reflected in its coefficients (0.0257 in RE and 0.0301 in FE), supporting the notion that foreign investments contribute to sustainable growth. These findings align with recent literature on remittances and economic growth. Specifically, Azam and Raza (2016) emphasize that remittances serve as a stable source of income, fostering both household consumption and investment, particularly in developing economies. Additionally, the results support the argument by the World Bank (2020) that FDI inflows are a key driver of long-term economic growth, while inflationary pressures tend to have an adverse effect on macroeconomic stability.

In Model 2, the inclusion of Financial Inclusion (FI) alongside Remittances (REM) further strengthens the association with GDP growth. The coefficients of FI remain positive and highly significant in both Random Effects (RE) and Fixed Effects (FE) models, with values of 0.0423 in RE and 0.0417 in FE. This suggests that a 1-unit increase in FI is associated with a 4.23%–4.17% increase in GDP, underscoring the importance of financial accessibility in enhancing economic performance. The positive effect of FI on GDP likely stems from improved access to financial services, enabling households and businesses to leverage remittances more effectively. With better banking infrastructure, credit availability, and digital financial services, remittance flows are increasingly channeled into productive investments, including entrepreneurial activities, infrastructure development, and job creation. This is particularly relevant in economies with historically underdeveloped financial markets, where financial inclusion helps bridge the gap between liquidity

Table 3. Correlation analysis.

Variables	GDP	REM	FI	HC	INC	TO	GEXP
GDP	1.000						
REM	−0.254	1.000					
FI	0.199	−0.212	1.000				
HC	0.272	−0.086	0.311	1.000			
INC	0.440	−0.339	0.519	0.719	1.000		
TO	−0.341	0.034	0.159	0.322	0.223	1.000	
GEXP	−0.086	−0.147	0.268	0.173	0.265	0.300	1.000

Table 4. Regression analysis of RE, FE.

	Model 1		Model 2		Model 3	
Methodology	RE	FE	RE	FE	RE	FE
VARIABLES	GDP	GDP	GDP	GDP	GDP	GDP
REM	0.0325***	0.0338***	0.0316***	0.0324***	0.0123*	0.0130*
	(0.00712)	(0.00695)	(0.00674)	(0.00659)	(0.00485)	(0.00462)
FII			0.0423***	0.0417***	0.0168*	0.0160*
			(0.00456)	(0.00441)	(0.00334)	(0.00327)
REM X FI					0.00589*	0.00602**
					(0.00105)	(0.00099)
HC					1.528***	1.561***
					(0.0629)	(0.0612)
INC	0.289***	0.278***	0.287***	0.279***	0.242*	0.239*
	(0.0235)	(0.0229)	(0.0221)	(0.0215)	(0.0158)	(0.0153)
TO	−0.0998***	−0.0923***	−0.0971***	−0.0894***	−0.00342	0.00198
	(0.0242)	(0.0234)	(0.0234)	(0.0228)	(0.0168)	(0.0164)
GEXP	0.0583**	0.0615**	0.0275	0.0318	0.00984	0.0123
	(0.0321)	(0.0312)	(0.0310)	(0.0302)	(0.0219)	(0.0212)
INF	−0.0384**	−0.0357**	−0.0349**	−0.0324**	−0.0278*	−0.0259*
	(0.0165)	(0.0158)	(0.0152)	(0.0146)	(0.0139)	(0.0134)
FDI	0.0257**	0.0301***	0.0328***	0.0356***	0.0382*	0.0411*
	(0.0118)	(0.0112)	(0.0109)	(0.0104)	(0.00971)	(0.00943)
Constant	0.572***	0.609***	0.648***	0.663***	0.992*	1.002*
	(0.119)	(0.0997)	(0.114)	(0.0921)	(0.0876)	(0.0664)
Observations	830	830	830	830	830	830
R-squared		0.195		0.309		0.627
Number of cc	79	79	79	79	79	79

constraints and capital investment needs. These findings align with recent studies examined the influence of financial inclusion on economic development. For example, Park and Mercado (2021), demonstrate that FI not only fosters the sharing of capital access and promotes improved efficiency in capital allocation but also creates economic resilience and thereby ensures inclusive growth. A similar pattern emerges as shown in Demirgüç-Kunt et al. (2023), believe that greater access to finance will drive aggregate growth via reduced transactional costs and greater participation in market activity. In addition, the results substantiate the findings of the World Bank (2021) that financial inclusion is one of the most relevant determinants of sustainable economic growth in general and for emerging countries in particular.

In Model 3, the interaction term (REM × FI) is introduced, marking a significant difference from Models 1 and 2. Unlike the previous models, which examined the direct effects of remittances (REM) and financial inclusion (FI) on GDP, Model 3 captures how FI enhances the impact of remittances by facilitating better allocation and productive utilization of these financial inflows. This addition is crucial because it allows for an examination of whether financial development amplifies or moderates the effect of remittances on economic growth. The results reveal that the direct effect of REM on GDP remains positive in both the RE and FE models, but its magnitude decreases compared to previous models. Specifically, the coefficient for REM drops to 0.0123 in the RE model and 0.0130 in the FE model. This suggests that while remittances contribute to economic growth, their standalone effect is somewhat weakened when financial inclusion is considered, as FI plays a significant role in channeling remittances into productive investments.

Meanwhile, the interaction term (REM × FI) is positive and highly significant (0.00589 in RE and 0.00602 in FE), confirming that FI enhances the effect of remittances on GDP. This means that in economies with better financial infrastructure, remittances are more efficiently mobilized into entrepreneurial activities, savings, and investment in capital-intensive sectors rather than just consumption. Financial inclusion fosters credit accessibility, banking penetration, and digital payment systems, all of which allow remittances to stimulate long-term economic growth more effectively. The coefficient for FI in Model 3 remains positive (0.0168 in RE and 0.0160 in FE), though slightly lower than in Model 2. This suggests that while financial inclusion directly boosts GDP, its most significant contribution comes through its interaction with remittances, reinforcing the idea that remittances alone are not enough to drive economic growth unless they are efficiently absorbed into the formal financial sector. Finally, human capital continues to have a positive and significant effect on GDP, with coefficients of 1.528 on RE and 1.561 on FE, reaffirming the role of human capital in driving productivity in the economy. The significant size of HC's coefficient suggests that it plays a fundamental role in facilitating innovations, technology, and

labor productivity, consistent with the findings of Barro (1991), showing that people with higher education are likely to perform better in the long-run economic activities.

These results are in line with some recent studies which also stressed interaction among financial inclusion, remittance, and economic growth. Remittances lead to significant changes in the consumption pattern, increase the labor market and ultimately improve economic development; however, these transfers without a sufficient financial system to back them are crucial (Coulibaly, 2023). Similarly, Nguyen et al. (2022) point out that financial inclusion is extremely important in translating remittance inflows into productive capital in developing economies. In the same manner, Ghosh (2021) explains that financial inclusion or remittances improves human capital as skilled people are able to use financial services to innovate and create more entrepreneurial businesses. The findings support the need for policy-makers to take a holistic view to increase access to finance, investment opportunities and human capital development in order to enhance the economic role of remittances.

Robustness result of GMM

We obtain strong inferences from the GMM estimates if we have reason to believe they are consistent regardless of changes in instruments, lag structures, or moment conditions. The stability of the model is crucial because it affects the sensitivity of the values produced and the characteristics of the variables. Robustness in GMM also implies that the assumptions about instrumental variables are met; valid instruments must be correlated with some exogenous factors while being uncorrelated with residuals. As seen in Table 4, the lag of GDP is significant and positive across all three models, indicating a persistent relationship or momentum in GDP growth over time. This finding suggests that high GDP levels in previous periods tend to drive higher values in subsequent periods. The Federal Reserve's statement supports this view, arguing that economic activity and growth are generally sticky or slow-moving rather than discontinuous.

Table 5 shows the estimation result of GMM. The results suggest a strong persistence in GDP over time. In Model 1 of the GMM estimation, the lagged GDP (L. GDP) coefficient is 0.862 and highly significant ($p < .001$), reaffirming the strong persistence of economic growth over time. This suggests that past GDP levels are a critical determinant of current GDP per capita, which is in line with the idea that economic growth follows an equilibrium path and is influenced by previous economic conditions. Such

Table 5. Robustness result.

VARIABLES	Model 1 GDP	Model 2 GDP	Model 3 GDP
L. GDP	0.862***	0.854***	0.909*
	(0.0121)	(0.0103)	(0.00992)
REM	0.00251	0.00112	0.00178
	(0.00382)	(0.00118)	(0.00095)
FI		0.0198**	0.0571*
		(0.00845)	(0.00988)
REM X FI			0.00405**
			(0.00075)
HC		−0.286***	0.295*
		(0.0368)	(0.0353)
INC	0.0578***	0.0545***	0.102***
	(0.00721)	(0.00277)	(0.00342)
TO	0.0912***	0.0875***	0.0993**
	(0.0124)	(0.00578)	(0.00571)
GEXP	−0.158***	−0.148***	−0.123**
	(0.0135)	(0.00998)	(0.0107)
INF	−0.0425***	−0.0378**	−0.0312*
	(0.0173)	(0.0152)	(0.0161)
FDI	0.0291***	0.0342***	0.0408*
	(0.0127)	(0.0114)	(0.0105)
Constant	0.0345	0.0418*	−0.312*
	(0.0362)	(0.0207)	(0.0287)
Sargan test	0.1094	0.1106	0.1213
AR 1	2.2018 (0.0272)	1.7203 (0.0829)	2.9457 (0.0031)
AR 2	1.1402 (0.2539)	0.2634 (0.7911)	1.0598 (0.2928)
Observations	830	830	830
Number of cc	79	79	79

findings are consistent with endogenous growth theories, which posit that historical economic performance significantly impacts future growth trajectories. The coefficient for remittances (REM) is positive (0.00251) but statistically insignificant, indicating that while remittances contribute to GDP growth, their direct impact is weak or potentially indirect. This result mirrors findings from Chami et al. (2005), who argue that remittances function more as compensatory income rather than a direct investment stimulant in many developing economies. Similarly, Giuliano and Ruiz-Arranz (2009) suggest that the effectiveness of remittances in driving growth depends on the strength of a country's financial system, reinforcing the idea that without proper financial infrastructure, remittances may not translate into productive investments.

Moreover, inflation negatively impacts GDP (−0.0425), indicating that higher inflation levels may erode economic stability by reducing purchasing power and discouraging investment. On the other hand, FDI has a positive and significant effect on GDP (0.0291), reinforcing its role as a key driver of economic growth through capital inflows, technology transfer, and job creation. This supports the findings by Alfaro et al. (2004), who highlight that FDI enhances economic performance, particularly in economies with well-developed financial markets. These results are consistent with the findings of Azman-Saini et al. (2019), stating that economic growth cannot be induced simply by receiving remittances if they are not redirected through collaborative investments and financial inclusion measures in the economy. Likewise, Meyer and Shera (2017) contend that remittances spur short-run economic stability; however, the long-term growth dividend of remittances is conditional upon, the absorptive capacity of the economy (financial sector development and investment opportunities).

In Model 2, the coefficient for lagged GDP remains significant (at 0.854***). The remittance (REM) coefficient is positive (0.00112) but statistically insignificant, suggesting that remittance alone does not have a strong direct effect on GDP growth. This result is consistent with the earlier study conducted by Chami et al. (2005) which suggests that remittances are primarily used for consumption instead of investment and thus limits their direct impact on long-run economic growth. Financial Inclusion (FI) however adds a completely different dimension to this relationship. The FI coefficient is 0.0198 and statistically significant ($p < .05$), signaling that financial inclusion enhance economic growth through better access to banking services, investment opportunities, and credit facilities. This lends support to the argument put forward by Sahay et al. (2015) that remittances are more likely to be channeled into productive investments, as opposed to momentary consumption, in financially inclusive economies.

Further evidence of the impact of remittances, FI, and HC is detailed in Model 3. Model 3 of the GMM estimation extends the previous models by introducing the interaction term (REM × FI), which examines how financial inclusion enhances the impact of remittances on GDP. The lagged GDP coefficient (0.909, $p < .001$) remains highly significant, reaffirming the persistence of economic growth over time. The remittance coefficient (0.00178) remains positive but relatively small, suggesting that remittances alone have a limited direct effect on GDP growth. However, the inclusion of financial inclusion (FI) significantly strengthens this relationship, as FI is positively associated with GDP (0.0571, $p < .05$).

The interaction term (REM × FI) is both positive and significant (0.00405, $p < .05$), indicating that remittances have a more effective impact on economic growth in financially inclusive economies. This implies that enabling banking, credit, and investments helps the remittance receivers to transfer the money in productive means like entrepreneurship, education, and infrastructure development rather than just consumption. Beck and Martínez Pería (2011) advocated using remittance flows to generate sustainable economic growth through financial inclusion, which is highly aligned with these findings. Compared to Model 1 and Then Model 2, Model 3 emphasizes that without the synergistic effect of financial infrastructure, remittance alone does not play a substantial role in bolstering GDP growth. Furthermore, although financial inclusion increases remittances productivity, the effects of human capital will be limited by inefficiencies present in the labor market. These results highlight the importance of policies aimed at increasing accessibility to the financial sector, better aligning education and employment opportunities, and improving the overall efficiency of capital allocation.

The GMM estimation further confirms the results of the RE and FE models that remittance has no direct effect on GDP growth on its own but becomes more effective when complemented with financial inclusion (FI). As shown in model 3, the interaction term (REM × FI) suggests that FI increases the potential of remittances for promoting economic growth indirectly, as it allows for better access to financial

services, practical credit availability, and investment opportunities. In relatively stronger financial systems, remittance flows are less likely to be spent on consumption and more likely to be directed to productive activities, such as entrepreneurship, education, or investment in infrastructure. This is consistent with the work by Beck and Martínez Pería (2011), which noted that financial inclusion ensures that remittances can become a force for long-term economic stability and growth. These findings advocate for developing financial infrastructure, expanding the footprint of the bank, and promoting digital financial inclusion as policy priorities to enable the continent to economically exploit remittances and achieve a growth trajectory conducive to the attainment of sustainable development.

Conclusion

This study explores the moderating effect of FI in the remittance-economic growth nexus, focusing on low-income, lower-middle-income, and upper-income countries. Using panel data for 79 countries from 2011 to 2021, the study employed random effects, fixed effects, and a generalized method of moments. The findings reveal a strong and significant positive effect of remittances on economic growth, which is significantly strengthened in the context of higher FI. This highlights the importance of FI in enhancing the economic impact from remittances, especially through education and health, as well as micro-business investments. By improving financial accessibility, FI ensures that remittance flows are efficiently allocated to sectors that contribute to sustainable development rather than being absorbed into short-term consumption. This study contributes to the literature by empirically testing the positive relationships among remittances, FI, and economic growth in developing countries. It proposes a composite FI Index, developed and explained in detail, thus providing an advanced viewpoint on FI with different magnitudes and regions. However, the study states that it has limitations in measuring informality, which plays a significant role in these countries in financial and accounting areas.

The findings of this study have significant impacts on academic research and policy. The strong positive association between remittances and economic growth, especially when FI is more robust, emphasizes the critical contribution of financial systems in realizing a large part of the developmental payoff over which remittance flows can potentially exert influence. This finding suggests that strengthening FI is an effective way to enhance the impact of remittances. The interaction between FI and remittances suggests that policymakers should focus on enhancing digital banking services, mobile money adoption, and microfinance initiatives, as these mechanisms improve financial accessibility for remittance-receiving households, allowing them to invest in productive ventures rather than informal financial channels.

Based on these findings, policymakers should adopt a comprehensive strategy to maximize economic growth. First, enhancing FI is imperative; by expanding access to financial services, households can more effectively channel remittances into productive investments, thereby amplifying their impact on GDP. This can be achieved through policies that promote financial literacy, expand banking services in underserved areas, and leverage technology for financial transactions. In particular, governments should prioritize integrating informal remittance transfer channels into the formal financial system by reducing transaction costs and simplifying regulatory frameworks. Second, significant investment in human capital (HC) development is crucial. Prioritizing education and skill development will not only directly boost GDP but also enhance the effectiveness of remittances and FI in promoting economic growth. Programs aimed at improving educational infrastructure, curriculum relevance, and vocational training can create a more competent and innovative workforce. Lastly, optimizing migration and remittance transfer processes can further enhance the positive effects of remittances. Streamlining regulatory frameworks, reducing transfer costs, and securing migrants' rights can encourage higher remittance flows and their utilization in growth-stimulating activities. Additionally, strengthening financial institutions' capacity to offer remittance-linked financial products, such as savings accounts, insurance, and small-business loans, could further enhance the developmental impact of remittances.

This can drive long-term economic growth, especially in the developing world, where remittances account for a greater share of GDP. Nevertheless, the study also showed that much of this relationship is contingent, with reverse or no significant signs often reported for variables such as HC and

government expenditure (GEXP) with respect to GDP. The moderating role of FI further suggests that financial infrastructure must be developed alongside fiscal policies to optimize remittance-driven economic growth. The research concludes that it may not be enough to increase spending in these areas; improving efficiency and ensuring better alignment with economic demands is essential for sustained economic growth. Special efforts are also required on the spending side to ensure that public and HC investments contribute efficiently to their due share in economic growth.

This study adds to the literature that increasingly recognizes the role of FI in economic growth. Future research may investigate more accurate proxy variables of unrecorded financial activities, allowing for a more precise analysis of how informal financial systems interact with formal banking channels. Furthermore, examining the threshold levels of FI required to maximize the impact of remittances on GDP could provide valuable policy insights, ensuring that financial development efforts yield the highest economic returns. This would further enhance our understanding of how financial development can optimize remittance flows, leading to more inclusive and sustainable economic growth.

Limitations

Although this study has vital implications in the designation of FI players to magnify the effect between remittances and economic growth, there are some limitations that need to be considered. The panel data cover 79 countries, which may not allow full appreciation of the conditions in individual countries or regions due to limitations in scope and representativeness. However, such an overarching classification can hide national realities that affect the relationship between remittances and growth. Second, the study was conducted over a time period (2011–2021), which might limit the applicability of our findings given global economic shifts as well as changes in technology and FI practices. Given the changing nature of FI, especially the growing adoption and use of digital financial services, there may be a need for new data or methodologies to capture current trends.

Future research directions

Future academic research should be directed toward overcoming the limitations of using more granular approaches and adapting to specific environments. For instance, future research could thoroughly examine nation-specific variables that influence the growth of remittances, as well as issues such as domestic economic policies, political climate situations, and social conditions. Such an analysis would deepen our understanding of this topic by contrasting FI with its effect on remittances in different cultural environments and adding the Informal Financial Activities Index to the FII for developing countries would allow us to draw a more accurate picture of FI there. In this way, researchers can come up with new approaches to research or grab hold of new data sources to obtain a more accurate depiction of that sector and its impact on development. Nowadays, the word 'FI' is still a topic of debate within the academic field for many reasons.

Acknowledgments

This study was conducted by four authors: Ahsan Aslam Khan wrote the main manuscript text collected and analyzed the data. Mohammad Helmi Bin Hidthir supervised the conceptualization of the manuscript and provided oversight. Mustazar Mansur assisted with the development of the research framework and proofreading the manuscript. Zaki Ahmad also substantially assisted in drafting the manuscript and critically revised the manuscript for key intellectual content and helped in data collection.

Author contributions

CRediT: **Ahsan Aslam Khan**: Data curation, Formal analysis, Writing – original draft; **Mustazar Mansur**: Methodology, Visualization, Writing – review & editing; **Zaki Ahmad**: Data curation, Writing – original draft, Writing – review & editing.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Funding

The authors declare that no funds, grants, or other support were received during the preparation of this manuscript.

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Data availability statement

The datasets generated and/or analyzed during the current study are available from the corresponding author upon reasonable request.

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