University of Tehran Press

Interdisciplinary Journal of Management Studies (IJMS)

Online ISSN: 2981-0795

Home Page: https://ijms.ut.ac.ir

The Effects of Digital Financial Inclusion on Human Development in Developing Countries: Evidence from MM-QR with Fixed Effect

Kabiru Kamalu[1] | Wan Hakimah Binti Wan Ibrahim[2*] | Umar Bala[3]

1. Department of Management, Faculty of Business and Management, Universiti Sultan Zainal Abidin, Gong Badak, 21300, Kuala Terengganu, 21300, Malaysia. E-mail: kamalu.kabiru@ymail.com
2. Corresponding Author, Department of Management, Faculty of Business and Management, Universiti Sultan Zainal Abidin, Gong Badak, 21300, Kuala Terengganu, Malaysia. E-mail: wanhakimah@unisza.edu.my
3. Department of Economics, School of Business and Economics, University Putra Malaysia. Email: umarbala@upm.edu.my

ARTICLE INFO

Article type:
Research Article

Article History:
Received 08 April 2024
Revised 23 July 2025
Accepted 29 July 2025
Published Online 08 December 2025

Keywords:
Digital financial inclusion,
Human development,
Remittances,
Quality governance,
Quantile regression.

ABSTRACT

This study examines the effect of digital financial inclusion on the conditional distribution of human development in 37 developing countries with available data from 2004 to 2021. The study uses the Method of Moment Quantile Regression (MM-QR) with a fixed effect that examines the effect of digital financial inclusion on the different levels of human development. The findings indicate that digital financial inclusion promotes human development, with a more significant impact in countries with very high human development. In addition, the findings indicate that high-quality governance enhances the positive effect of digital financial inclusion on human development. The results of this study were robust when we used the System Generalized Method of the Moment (SGMM) estimator. The study concludes that the effect of digital financial inclusion on human development varies in developing countries, depending on each country's level of human development. Policymakers should focus on policies that will speed up the digitalization process and increase access and coverage of digital financial services, such as mobile money, e-wallets, QR code payments, and blockchain technology, especially in countries with low and medium levels of human development.

JEL: O16; O15; F24

Cite this article: Kamalu, K.; Wan Ibrahim, W. & Bala, U (2026). The Effects of Digital Financial Inclusion on Human Development in Developing Countries: Evidence from MM-QR with Fixed Effect. *Interdisciplinary Journal of Management Studies* (*IJMS*), 19 (1), 41-56. http//doi.org/10.22059/ijms.2025.374206.676627

 Publisher: University of Tehran Press.
DOI: http//doi.org/10.22059/ijms.2025.374206.676627

1. Introduction

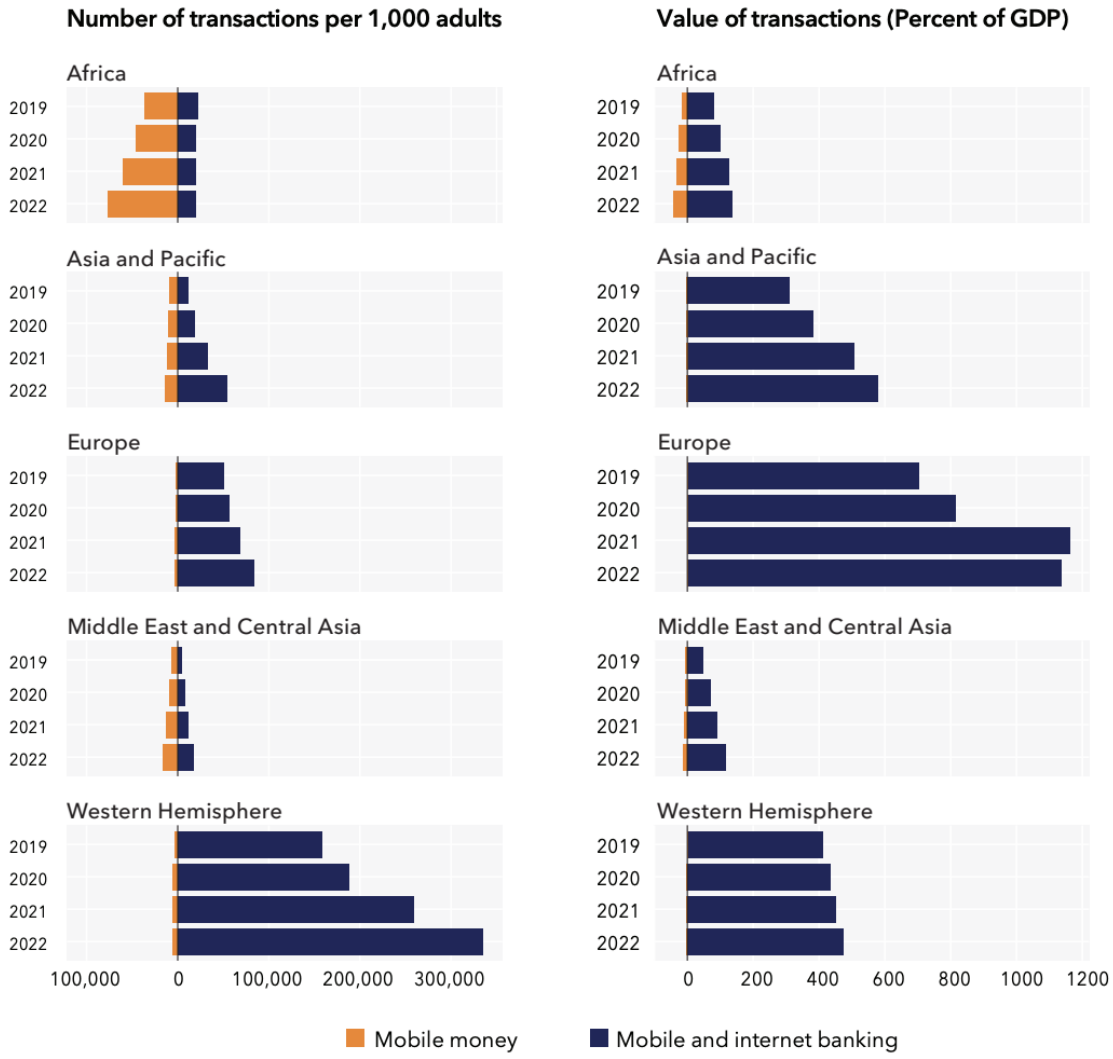
The pervasive availability of information and communication infrastructures, as well as the growing adoption of mobile phones, presents an opportunity for the financial sector to leverage digital platforms, which transform the entire financial environment (F. Wang et al., 2024). Digitalization of the financial sector paves the way for innovative financial services that play a significant role in reducing financial risk, access to financial services, boosting economic activities, job creation, income, human capital development, and access to healthcare, which directly promote overall human development (Lin & Peng, 2025). In addition, digitalization has brought profound changes in how financial services are being accessed and utilized globally, especially during Covid 19 pandemic, which promotes business activities, increases income, and improves living standards and overall human development. Although alternative service providers such as retail agents and mobile money are growing in developing countries, the relevance of traditional means such as ATMs and bank branches continues to decline (Demirgüç-Kunt et al., 2021). The frequency and size of global digital financial transactions have increased, indicating the growth of digital financial services, especially in the aftermath of Covid 19, which saw the expansion of online services industries, higher digital financial inclusion, and enhanced human development.

Digital financial inclusion means accessibility, availability, and usage of financial services and information through digital platforms, which minimizes transaction costs and increases coverage of the financial system (Jose & Ghosh, 2025). It uses Internet banking, mobile applications, e-wallets, blockchain technology, and other digital tools to provide traditional financial services for financially excluded individuals and firms. Moreover, digital financial services have made it possible for rural and underbanked communities to enjoy formal financial services, reducing income gap and poverty and promoting inclusive growth and development (Afroze & Rista, 2022). Financial Access Survey (2023), which is the annual report on financial access by the International Monetary Fund (IMF), indicates that the value of mobile money transactions rose from 26% to 35% of GDP in developing countries, while there was a greater than 20% increase in the number of online and mobile banking transactions per 1,000 people in OECD countries (FAS, 2023). Figure 1 indicates that the digital finance trend is growing worldwide. Despite this development in the financial sector, a significant percentage of the adult population in developing countries is still financially excluded (IMF, 2022), which impedes progress in human development (Kamalu & Ibrahim, 2023).

The current century has seen a greater acceleration of technological development and changes in the financial services industry than in any previous period in history, with the financial sector leading the adoption of digitalization and significantly influencing overall human well-being (FAS, 2023). The use of digital platforms to render conventional financial services will positively affect all the dimensions of human development-decent living, human capital, and longevity (Anakpo et al., 2023; Mabrouk et al., 2023; Sharma & Díaz Andrade, 2023). Leveraging on digitalization of financial inclusion has the potential to eliminate poverty, narrow the income gap, promote capital accumulation, and access to essential services, which has a positive impact on human development (F. Wang et al., 2024). The three prominent dimensions of human development represent 7 out of the 17 Sustainable Development Goals (goals 1, 2, 3, 4, 8, 10, 16), which can be achieved by an effective and efficient inclusive financial system (Swain & Min, 2023).

This study examines whether digital financial inclusion can unlock human development in developing countries**.** This study argues that developing countries' per capita GDP, natural resource endowments, HDI scores, remittance, and good governance are heterogeneous. Therefore, the effect of digital financial inclusion may vary between these countries. This study examines the effect of digital financial inclusion on the conditional distribution of human development in developing countries. In addition, this study argues that the effect of digital financial inclusion on human development can be influenced indirectly through the moderating role of quality governance. Quality governance entails putting the necessary structures, processes, standards, and oversight in place to deliver safe and people-centered essential services (Banik et al., 2023). We contribute to the literature in threefold. First, this study is different from prior research by exploring the heterogeneity of developing countries to examine the effect of digital financial inclusion on different levels of human development (low, medium, high, and very high), using the quantiles method (Q1-Q4). Second, this study evaluates the moderating role of quality governance on the digital financial inclusion-human development nexus in

developing countries. Most previous studies estimated the direct effect of digital financial inclusion on either one of the dimensions of human development or the human development index. However, this current study indirectly examines the effect of digital financial inclusion on human development via the role of quality governance. Third, we use the Method of the Moment Quantile Regression (MM-QR), with fixed effects proposed in Machado and Silva (2019), which examines the effect of digital financial inclusion on different levels (low, medium, high, and very high) of human development. This method differs from the traditional quantile method used in previous studies; it uses a fixed effect that accounts for the unobserved heterogeneity in the panel. Additionally, we use the General Method of the Moment (GMM) for robustness.



Source: (FAS, 2023)

Fig. 1. Trends of Digital Financial Services

The remaining part of this study discusses the literature review in section 2; in section 3, the study explains the methods of analysis and data; section 4 presents and discusses the study's findings; and the last part, section 5, presents the study's conclusions, policy implications, and recommendations.

2. Literature Review

2-1.Concept of Digital Financial Inclusion

The term "digital financial inclusion" describes the application of digital technologies to provide availability and accessibility of affordable financial services to people and firms that are excluded or historically underserved in the conventional financial system (Sharma & Díaz Andrade, 2023). When

financial services are digitalized, individuals can easily access and utilize various financial services to start or expand their businesses, develop human capital, and access essential services to improve their lives. Digitalization of financial services also provides unlimited access to payment systems, which boost economic activities and promote capital accumulation and access to loans, among other services. According to a report by the Bank for International Settlements (BIS), FinTech companies primarily assist the traditional banking environment by providing payment, clearing, and settlement gateways, which expands access to formal financial services to marginalized and underserved individual firms and, hence, boost business activities, reduce poverty and income inequality not only in developing countries but also in developed societies. Nearly all countries have determined that financial inclusion and entrepreneurial growth are the best tools and solutions for tackling social and economic issues ranging from unemployment, poverty, and inequalities attaining sustainable growth (J. Wang et al., 2025). Therefore, digital financial inclusion seeks to close the gap between the "unbanked" people and financial intermediaries, thereby advancing progress in human development.

2-2. Approach to Human Development

The approach to human development is considered a significant paradigm shift after World War II from the widely accepted traditional approaches that consider growth in GNI per capita as a primary driver for economic development. The idea of putting the human being at the center stage of all development policies evolve due to the failure of the changes in per capita income to address the growing income gap and poverty in the face of economic challenges of the 1970s, particularly in newly independent nations (Stewart, 2019). The novel contribution to the human development approach was made in the work of Sen (1989), which introduced a capability approach as the theoretical framework for a human-centered approach. Sen (1989) argued that the capability approach is a complete departure from the classical approach, which Sen (1989) criticized as consequentialist, overlooking the means and focusing on the end. Rather than asserting that the well-being of an individual is a function of his income, Sen argued that it is determined by his capability. He defined capability as the freedom of an individual to “do and be” what he chooses in society, such as to be educated, healthy, nourished, ride a bicycle, drive a car, etc. Therefore, we argued that digital financial inclusion will serve as a condition that will provide the needed capability to achieve higher human development. Harnessing digital technologies in the financial sector will increase accessibility and usage of financial services, improving human development (Sharma & Díaz Andrade, 2023).

Sharma and Díaz Andrade (2023) argued that for an economy to fully realize the benefits of digital financial inclusion for human development, issues including cybersecurity, digital literacy, data protection, and infrastructural deficiencies must be addressed. Together, governments, financial institutions, tech companies, and civil society groups can establish a conducive atmosphere that protects consumer rights, guarantees fair access, and encourages responsible use of digital financial services. Moreover, digital financial inclusion makes a substantial contribution to human development by increasing access to formal financial services, reducing poverty, empowering disadvantaged populations, promoting job creation, strengthening perseverance, and improving access to education and healthcare. In addition, digital financial inclusion provides access to basic healthcare services and quality education through better management of finances, savings, and access to various digital financial services (Demirgüç-Kunt et al., 2021; Eid, 2024; Kamalu & Wan Ibrahim, 2022; Meniago, 2025). It also promotes women's empowerment, particularly in Muslim countries, where women cannot go out freely; hence, they can enjoy financial services through digital platforms, thereby enhancing their overall well-being (Mabrouk et al., 2023; Sujarwo et al., 2022).

Due to the higher rate of multidimensional poverty, income gap, and inadequate access to financial services for the teeming population in developing countries, particularly in low and lower-middle income countries, the level of human development, though improving in some areas, is deteriorating for disadvantaged groups, ethnic minorities, low-income household, and women. The question for this study is whether digital financial inclusion can promote human development in developing countries. Furthermore, this study argues that quality institution can play significant role in enhancing the impact of digital financial inclusion on human development. Based on the argument that poor institutions are responsible for higher level of financial exclusion, which causes a low level of human development,

the following question arises: do quality institutions moderate the effect of digital financial inclusion on human development?

2-3. Digital Financial Inclusion and Human Development

Although the global economy experienced significant expansion after World War II, various instability greeted the world economy and brought untold hardship to people, especially the economic crisis of the late 1970s (Gonzalez, 2018), which necessitated a paradigm shift that questioned the classical postulation of income as the measure of well-being (Stewart, 2019). In his work, Sen, (1979) maintained that GNP/GDP per capita is only an aspect of human well-being. Therefore, Sen's quest for a comprehensive measure of well-being cantered on people led to the emergence of the concept of human development, which is all about improving people's freedom and opportunities to live better. Sen (1989) developed the idea and provided a theoretical foundation in the capability approach, which serves as the foundation for measuring and comparing human development across the globe, using a simple human development index (HDI). The HDI consist of three most significant dimensions of human development, which are human capital dimension, health care dimension, and decent living dimension

The capability approach highlights the significance of enhancing people's freedoms and capabilities to live decent and meaningful life. Nussbaum (2011) considers the capability approach as the freedom to make significant decisions and participate extensively in community affairs in such a way as to achieve optimal happiness and higher human development. The approach considers other issues such as mitigating multidimensional poverty, ensuring gender and income equality to achieve higher level of human wellbeing. Therefore, human development approach that emphasised on expanding individual capabilities is regarded a better replacement for income-led growth, which is an inadequate and uncomprehensive measure of economic development. Moreover, the three crucial dimensions of the HDI represent 7 out of the 17 Sustainable Development Goals (SDGs), which can be achieved with an inclusive financial system (UNSDG, 2019).

Literature synthesized substantial and multidimensional linkages between digital financial inclusion and human development and opined that increasing access to finance using digital flatforms will improve the level of human development (FAS, 2023; Sharma & Díaz Andrade, 2023; Tay et al., 2022). All dimensions of human development (income, human capital, health) could be improved using financial technologies (fintech) that can deliver affordable and accessible financial services to disadvantaged people and underserved communities. Human capital development and access to affordable healthcare services can enhance significantly through modern digital financial services, thereby promoting human development. Access to digital credit and savings accounts will facilitate investment in education, provide employment opportunities, and grant access to health services that strengthen individual capabilities to enjoy higher human development. Additionally, individuals who have access to digital financial services are certainly more likely to have successful start-ups, grow their wealth, achieve greater job satisfaction, and live decently (Mabrouk et al., 2023).

Anakpo et al. (2023) argued that the digitalization of the financial sector gives small and medium firms, as well as businesses without formal access to financial services, an opportunity to use digital financial platforms. Furthermore, Afroze and Rista (2022) maintained that access to digital financial services reduces the income gap, alleviates poverty, increases access to essential services, empowers women and ethnic minorities, improves their overall capabilities, and achieves higher human development. Demirgüç-Kunt et al. (2021) are of the opinion that whenever there is availability of digital financial platforms that provide easy access to financial services to women and vulnerable people, it will reduce the gender and income gaps, as well as promote higher human development. Moreover, digitalized financial sector that provides internet banking, e-wallet, and mobile money services may empower disadvantaged people to enjoy financial services that promote inclusivity and improve their lives (Anakpo et al., 2023; Chinoda & Kapingura, 2024; Kanungo & Gupta, 2021). Apart from access to financial services, fintech can promote financial literacy, asset accumulation, and financial freedom, which promote human development.

Based on the above assertions and related findings, we formulate our first hypothesis.

H_1: Digital financial inclusion has a significant impact on the conditional distribution of human development in developing countries.

Moreover, this study argued that quality institutions may enhance digital financial inclusion-human development nexus in developing countries. Due to the intricate nature of the digital financial inclusion-human development nexus in developing countries, quality institutions can be a significant moderator. In the digitalized financial ecosystem, quality institutions function as regulators and facilitators, which regulate and promote access to affordable digital financial services for marginalized, "unbanked," and "underbanked" individuals, groups, and communities. Ogunola et al. (2024) argued that institutions that place a high priority on cybersecurity, data protection, and financial education will boost public trust in digital financial services, which will encourage more adoption, especially by financially excluded people and small-scale businesses, thereby promoting growth and development. Effective and efficient institutions always guarantee that digital financial products and services are in line with a wider development goal that enhances social inclusion, inclusive growth, human capital development, and access to quality healthcare services (Krishna et al., 2025), thereby promoting higher human development (Kamalu & Ibrahim, 2024). Meniago (2025) also argued that the quality of institutions shapes digital financial products and services in such a way that it catalyses economic activities, employment, and income, which accelerates achieving higher human development. The above evidence justifies the formulation of the following hypothesis

H_2: Quality institutions have a significant effect on the digital financial inclusion-human development nexus in developing countries.

2-4. Empirical Literature

Available empirical evidence on digital financial inclusion is scanty, whereas available evidence shows that financial inclusion promotes human development in India by using inter-state analysis (Kuri & Laha, 2017) in countries of the world (Datta & Singh, 2019), sub-Saharan Africa (Matekenya et al., 2020), frontier economies (Ababio et al., 2020), south Asia (Banerjee, 2020), Nigeria (Soyemi et al., 2020), low and lower-middle income countries (Abdelghaffar et al., 2023; Tissaoui et al., 2024), BRICS member countries (Pandey, 2023), Africa (Matekenya et al., 2024), Bangladesh, India and Pakistan (Chowdhury & Chowdhury, 2024), middle-income countries (Essa et al., 2025), Turkey (Boğa & Erkişi, 2025), among others, confirming the positive effect of financial inclusion on human development globally. Most of these previous studies were on the financial inclusion-human development nexus. However, studies on digital financial inclusion used individual dimensions of human development, while this current study uses the Human Development Index (HDI).

Previous studies found that digital financial inclusion has significant positive effect on economic growth (Ahmad & Majeed et al., 2021; Chinoda & Kapingura, 2024; Liu et al., 2021; Meniago, 2025; Naumenkova et al., 2019; J. Wang et al., 2025). Moreover, Ji et al. (2021) revealed that digital financial inclusion reduces rural-urban income inequality. The work conducted by Tay et al. (2022) documented evidence that digital financial inclusion reduces poverty and promotes sustainable development in developing Asian countries. Sujarwo et al. (2022) reported that finance digital literacy promotes local products produced by women, thereby empowering women in Indonesia. Additionally, Anakpo et al. (2023) found that digital financial services promote financial inclusion and sustainable growth and development. Other studies indicated that digital financial inclusion mitigates multidimensional poverty of households in China (F. Wang et al., 2024) and promotes development in rural areas (Lin & Peng, 2025). Contrarily, Kanungo and Gupta (2021) reported that although digital finance promotes banking service delivery, it barely promotes human well-being.

The empirical literature reviewed in this current study highlighted the shortage of studies that examine digital financial inclusion-human development nexus in developing countries. Most of the studies in the literature examined financial inclusion-human development, ignoring digitalization as inclusive finance. Moreover, few studies that used digital financial inclusion examined its impact on growth, rural development, poverty, and income inequality. In addition, these studies used methods that provide mean estimators, such as GMM, FMOLS, CUP-FM, DOLS, etc. Nonetheless, our current study filled these gaps by examining the effect of digital financial inclusion on the conditional distribution of human development in developing countries. In addition, this study examines the

indirect effect of digital financial inclusion on the conditional distribution of human development via the role of quality governance in developing countries.

3. Methodology

This study examines the effect of digital financial inclusion on the distribution of human development in developing countries, using data from 37 developing countries (listed in Appendix A) from 2004 to 2021. The countries are selected based on the availability of the full dataset for the variables. We used various diagnostic checks on the data and applied the MM-QR with a fixed effect. Human development is the dependent variable, and digital financial inclusion is the variable of interest. In addition, remittance, quality governance, government spending, population, and FDI are the control variables.

3-1. Study Variables and Measurements

Human development is the dependent variable, measured by the Human Development Index (HDI). The HDI was first created in 1990 by the United Nations Development Program (UNDP), using three dimensions of knowledge, health, and decent living. First, the knowledge dimension is measured by average years of school enrolment and completion. Secondly, the health dimension is measured by life expectancy at birth (using average years). Thirdly, decent living is measured by income per capita. The HDI data is sourced from the Human Development Report (HDR, 2022), released yearly by the United Nations Development Programme (UNDP). Digital financial inclusion (DFI) is the independent variable of interest in this study, which is proxied by a digital financial inclusion index (DFI), constructed using three dimensions of digitalization and follows the innovative financial inclusion agenda (United Nations, 2018) for achieving sustainable development goals (SDGs, 2030). We use mobile cellular subscription per 100 people, internet subscription per 100 people, and fixed broadband subscription to construct DFI using Principal Component Analysis (PCA). The data are sourced from the World Development Indicators (WDI), the World Bank database.

This study uses five critical determinants of human development as control variables. Firstly, remittance is measured by personal remittance inflows (% of GDP) obtained from world development indicators. Rapoport and Docquier (2005) argued that migrant workers remit to their country of origin for three reasons, including altruism, insurance, and physical capital investment. Relevant literature established that remittances positively affect human development (Adenutsi, 2010; Borja, 2020; Sahoo et al., 2020). Secondly, government expenditure is measured by government final consumption expenditure (% of GDP). Government spending stimulates economic activities, promotes effectived emand, and provides social amenities, social security, etc., promoting overall well-being (Xiong et al., 2022). The third control variable is a population measured by the annual growth of the population. Population growth is an important macroeconomic variable that determines the level of economic activities, markets, and workforce population. This study argued that an increase in population means an increase in the market and the stock of human capital and, consequently, a higher level of human development.

Another essential control variable is foreign direct investment, measured by FDI inflows (% of GDP). Foreign direct investment affects human development positively or negatively, depending on the circumstances prevailing in the host country (Masanja, 2018). This study expects FDI to have a positive effect on human development in developing countries. All data on control variables are obtained from world development indicators (World Bank 2022). Lastly, the study used the average of the three governance indicators to measure quality governance in developing countries. The indicators include the rule of law, control of corruption, and regulatory quality. To achieve higher quality in governance, the application of the rule of law must be impartial, regulations must be followed religiously, and corruption must be minimized so that the available resources are channeled to deliver essential services that improve the lives of the masses (Kassi et al., 2022). The data for the control variables were obtained from the World Bank database.

Table 1. Data and Measurements

S/N	Variable	Measurements	Source
1	Human development	Human Development Index (HDI)	HDR
2	Digital financial inclusion	Digital financial inclusion index:	
		-Mobile cellular per 100 subscribers	WDI
		-Internet per 100 subscribers	WDI
		-Fixed broadband per 100 subscribers	WDI
3	Remittance	Remittance inflows (% of GDP)	WDI
4	Quality governance	By averaging regulatory quality, rule of law, and control of corruption.	WGI
5	Government spending	Government final consumption expenditure	WDI
6	Population	Population growth	WDI
7	Foreign Direct Investment (FDI)	FDI inflows (% of GDP)	WDI

NB: HDR is the human development report; WDI is the world development indicator; WGI is the world governance indicators

Table 1 presents the study's variables, their measurements, and sources. It begins with human development as the dependent variable, digital financial inclusion as the independent variable of interest, and five other variables used as control variables that also determine human development in developing countries.

3-2. Estimation Strategy

The estimation strategy of this study follows the following steps. Firstly, the study used the homogeneity test by Pesaran and Yamagata (2008) to examine the slope coefficients of the study variables. Secondly, the study used three cross-section dependency tests, including the LM test by Breusch and Pagan (1980), the Bias-corrected Scaled LM, and the Cross-section Dependency (CD) test by Pesaran (2004). Thirdly, the study used two-panel unit root tests; one from the first generation (Maddala & Wu, 1999) and the other from the second generation (Pesaran, 2007). Fourthly, the study employs the MM-QR estimator, as provided in Machado and Silva (2019), to examine whether the effect of digital financial inclusion (DFI) differs on the conditional distribution of human development. This study follows the MM-QR model by Wolde-Rufael and Mulat-Weldemeskel (2022) as follows.

$$Q_Y\left(\tau \setminus x_{i,t}\right) = \left[\propto_i + \gamma_i q(\tau)\right] + \grave{X}_{i,t}\,\beta + \grave{W}_{i,t}\,\delta q(\tau) \tag{1}$$

Thus, $Q_Y(\tau \setminus x_{i,t})$ is the standard quantile distribution of the dependent variable (HDI), $\grave{W}_{i,t}$ is the vector of k known component of $\grave{X}_{i,t}$ which satisfies the Machado and Silva (2019) condition that normalized E(U)=0, and E(|U|)=1. The empirical model is as follows:

$$QLnHDI_{i,t}\left(\tau_k \mid \alpha_i, x_{i,t}\right) = \propto_i + \beta_1 DFI_{i,t} + \beta_2 LnRM_{i,i} + \beta_3 LnGS_{i,t} + \beta_4 LnPG_{i,t} + \beta_5 LnFI_{i,t} + \beta_6 QG_{i,t} + \mu_{i,t} \tag{2}$$

$$QLnHDI_{i,t}\left(\tau_k \mid \alpha_i, x_{i,t}\right) = \propto_i + \beta_1 DFI_{i,t} + \beta_2 LnRM_{i,i} + \beta_3 LnGS_{i,t} + \beta_4 LnPG_{i,t} + \beta_5 LnFI_{i,t} + \beta_6 QG_{i,t} + \beta_7 \left(DFI * QG\right)_{i,t} + \mu_{i,t} \tag{3}$$

where $QLnHDI_{i,t}(\tau_k|\alpha_i,\ x_{i,t})$ is the conditional distribution of the human development across the low, medium, high, and very high human development. DFI is the digital financial inclusion; LnRM is the remittance inflows; GS stands for government expenditure; LnPG signifies the population growth; LnFI represents the FDI, and QG is the quality governance. The parameters to be estimated are β_1 to β_6, and β_7 is the interaction $(DFI * QG)_{i,t}$ parameter.

In addition to the cointegrating estimators, this study used System-GMM method as proposed by Arellano and Bover (1995) for robustness checks. This method accounts for endogeneity, serial correlation, has higher degrees of freedom, and provides robust standard errors. System GMM estimators can offer efficient and consistent parameters by employing moment conditions based on lagged values of variables, particularly when the panel is dynamically structured and have unobserved common effects that is individual to each cross-section in the panel (Law, 2018). The System-GMM provides consistent estimators when time dimension (T) is less than cross-sections dimension (N). Based on that condition, this study used three years average for all our variables from 2004 to 2021,

which gives us 6 periods observations. Therefore, T=6 and N=37, which is consistent with the System-GMM conditions.

4. Results Presentation

The results of this study are presented in stages, starting with the results for the descriptive statistics, followed by the correlation matrix, homogeneity test, cross-sectional dependency, panel unit root tests, and lastly, the results of MM-QR and GMM models.

Table 2. Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
LnHDI	666	-0.3914	0.7140	-1.0302	0.8030
DFI	666	0.1435	-0.2178	-1.4696	1.9038
LnRM	666	0.5122	0.0948	-6.1144	3.7789
LnGS	656	2.5215	0.5408	-0.0563	3.4013
LnPAG	647	0.7735	0.4633	-0.7287	1.9946
LnFI	659	0.8569	-1.1928	-6.0888	4.1770
QG	666	-1.2870	-0.3291	-2.1001	1.2241

Ln means a variable is in logarithms form.

The results of the descriptive statistics presented in Table 2 indicate that the statistical values for all the variables, including mean value, standard deviation, minimum and maximum values, are within the expected range; therefore, the possibility of outliers in the data has been ruled out.

Table 3. Correlation Matrix

Variables	LnHDI	DFI	LnRM	LnGS	LnPAG	LnFI	QG
LnHDI	1.0000						
DFI	0.2606	1.0000					
LnRM	0.0258	-0.1931	1.0000				
LnGS	0.1420	0.3061	-0.1334	1.0000			
LnPAG	-0.0149	-0.3497	-0.0984	0.1873	1.0000		
LnFI	0.0249	-0.1004	0.0399	0.1736	-0.0177	1.0000	
QG	0.3710	0.0037	-0.2812	0.0161	-0.4120	-0.3201	1.0000

Ln means that the variable is in logarithms.

Table 3 presents the results of the correlation matrix, which provides correlation coefficient between the variables used in this study. The results for the correlation matrix indicated that all variables have significant positive correlation with the dependent variable (LnHDI), except LnPAG with a negative correlation, which indicated that the selected variables are significant determinants of human development. The correlation between independent variables is not larger, indicating that there is no multicollinearity in the dataset.

Table 4. Homogeneity test

Null Hypothesis	Delta	P-value
Homogenous Slope	17.020	0.002
	19.621	0.000

Table 4 presents the results of the homogeneity test, with the null hypothesis (H_0) stating that all variables have a homogenous slope. The result is statistically significant at 1% in both two statistics of Delta. As a result, this study failed to accept the null hypothesis, confirming that all the variables have heterogeneous slope coefficients, implying that common effect may affects each cross-section differently. Therefore, an estimator that allows slopes to change in response to time-specific factors may better capture the underlying complexities of the data and provide a consistent and efficient parameters (Hashem Pesaran & Yamagata, 2008). Hence, the rejection of the null hypothesis validates the choice of MM-QR estimator, which provides parameters at different quantiles (levels of human development).

Table 5. Cross-section Dependency Tests

Variable	Breusch-Pagan LM Test	Bias-corrected Scaled LM	Pesaran CD Test
LnHDI	6350.9***	102.62***	72.747***
DFI	4027.1***	54.704***	22.004***
LnRM	2495.9***	23.132***	0.5065*
LnGS	2245.7***	17.974***	4.5451***
LnPAG	5670.9***	88.601***	31.816***
LnFI	1749.9***	7.7505***	2.0013***
QG	8167.4***	140.08***	90.372***

***, ** & * stands for 1%, 5% and 10% significance level.

Table 5 present the results of cross-sectional dependency test. The study conducted three tests, and the results failed to accept the null hypothesis of cross-section independence, which confirmed that there is cross-sectional dependency among the sample of countries in this study.

Additionally, the results of panel unit root tests reveal that all the variables have unit roots at a level and reject the null hypothesis of unit roots at the first difference at 1% level in the CIPS test; therefore, all the study variables are I (1).

Table 6. MM-QR Results

Dependent Variable: LnHDI						
Variables	**Location**	**Scale**	**Q25**	**Q50**	**Q75**	**Q95**
DFI	0.147	0.191	0.045**	0.075***	0.244***	1.002***
LnRM	0.211	0.364	-0.170***	-0.074**	0.396*	1.840
LnGS	0.051	0.071	0.013	0.24	0.087**	0.367*
LnPAG	1.226	2.033	0.141***	0.460***	2.255***	10.32***
LnFI	0.012	-0.025	-0.002	-0.002***	-0.024***	0.123
QG	0.210	0.289	0.056**	0.101*	0.356***	1.501***
DFI*QG	0.063	0.147	0.026*	0.126***	0.183**	1.225**
_CONS	-16.98	-24.33	-4.001	-7.817**	-29.30	-125.8*

***, ** & * stands for 1%, 5% and 10% significance level

Table 6 presents the results of the MM-QR estimator that examines the effect of digital financial inclusion (DFI) on the conditional distribution of human development in developing countries. The annual Human Development Report (HDR-UNDP) categorized countries into four levels of human development based on their scores in the HDI. This study uses the four levels of human development to form four quantile groups (low, medium, high, and very high). The results in Table 6 indicate that DFI has positive and significant coefficients at 1% to 5% across all the quantiles, but the coefficients are higher at higher quantiles (Q75-Q95). These results indicate that a 1% increase in digital financial inclusion will increase human development by 0.045% to 1.002% in developing countries. Therefore, digital financial inclusion promotes human development in developing countries, while the effect is greater in countries with high human development. The higher coefficient for countries with very high levels of human development results from the availability of ICT infrastructure and various digital payment systems in those countries, compared to countries with low levels of human development. Therefore, our result is similar to those of Liu et al. (2021), and Naumenkova et al. (2019), confirming that digital financial inclusion promotes economic growth.

Additionally, in Table 6, the results of the control variables indicate that remittance has a negative and significant coefficient at the 1% level in the lower quantile (Q25) and at the 5% level in the medium quantile (Q50), with a positive and significant coefficient at the 10% level in the high quantile (Q75), and a positive but insignificant coefficient in the very high quantile (Q95). Based on the findings, a 1% decrease in remittance inflows will increase human development, thereby confirming the development-pessimist hypothesis, stating that remittance harms the development prospect of developing countries (Bird & Choi, 2020; Kamalu et al., 2022; Olaniyan, 2019; Seriño, 2012). The results also indicate that government spending (LnGS) has positive but insignificant coefficients at the low and medium quantiles, while positive and significant coefficients both at the high quantiles (Q75) and the very high quantiles (Q95). The findings show that government spending does not significantly promote human development in countries with lower quantiles, but it does in countries with higher quantiles. Furthermore, population growth (LnPAG) increases human development in all developing

countries, but the effect is more significant in countries at higher quantiles. Moreover, FDI was found to reduce human development in developing countries with medium and high HDIs, while it was insignificant in countries with low and very high HDIs. The results of another control variable indicate that quality governance (QG) promotes human development in all quantiles, but the effect is more significant at a very high quantile (Q95).

In Table 6, the coefficients of the interaction term (DFI*QG) are positive and significant across all the quantile groups, with a higher effect in countries at higher quantiles. These findings imply that digital financial inclusion promotes higher human development conditioned upon quality governance in developing countries. The impact is higher in countries with very high human development. The lower coefficient for countries at low quantiles is due to weak institutions, as these countries have negative scores in almost all the six governance indicators. Weak institutions promote all sorts of evils in human society, deteriorate welfare, and erode the confidence and trust of potential investors, thereby negatively affecting the performance of all economic indicators and, consequently, lowering human development.

Table 7. Results for System GMM

Variables	1 One Step	2 Two Step	3 Two Step (Robust)	4 Two Step (Interaction)
$LnHDIt_{-1}$	0.7195*	0.8918*	0.8918*	0.9211*
DFI	0.0253*	0.0241*	0.0241**	0.0068
LnRM	-0.0334*	-0.0337*	-0.0337*	-0.0437*
LnGS	-0.0267*	0.0316*	0.0316***	0.0289*
LnPAG	-0.0765*	-0.0589*	-0.0589	-0.0530*
LnFI	-0.0028	-0.017**	-0.0017***	-0.0016
DFI*QG				0.0122*
Constant		0.0319*	0.0319	-0.0079
No. of Groups	47	47	47	47
No. of Instruments	25	26	26	27
Sargan Test	113.87*	23.526		23.0933
AR (1)		0.2757**	0.1403**	1.1087***
AR (2)		0.7861	0.7351	-0.1969

***, ** & * stands for 1%, 5% and 10% significance level

The results of SGMM (Table 7) justified the findings in Table 6, obtained using the MM-QR estimator. The fundamental difference is that the strength of coefficients in MM-QR is greater than the coefficients obtained using SGMM, and the coefficient of population growth (LnPAG) has a positive sign in Table 6, while it is negative in Table 7, revealing that population growth negatively affects human development. The coefficient of interaction (DFI*QG) also has a similar result, which confirms the vital role of quality governance (QG) in enhancing the positive effect of digital financial inclusion on human development in developing countries.

5. Discussions and Conclusion

This study examined the effects of digital financial inclusion on the conditional distribution of human development in developing countries, using MM-QR with fixed effect, with the data covering 2004 to 2021. Based on the findings established in this study, we failed to reject the hypothesis that digital financial inclusion has a significant effect on the conditional distribution of human development. Therefore, the study concluded that the effect of digital financial inclusion on human development in developing countries depends on the level of human development. The evidence revealed that digital financial inclusion is capable of unlocking human development in developing countries, with a strong positive effect in countries with higher human development. In addition, this study failed to reject the hypothesis that quality institutions have a significant impact on digital financial inclusion-human development nexus in developing countries. Thus, this study concluded that quality governance enhances the positive effect of digital financial inclusion on human development, while it is greater in countries with higher human development. The findings were robust when the SGMM was used; only the coefficients of MM-QR were stronger. Based on the findings of the control variables, lower remittance inflows promote human development in developing countries with low and medium human

development. However, the opposite was reported in developing countries with high human development.

Another vital piece of evidence obtained in this study indicates that government final consumption expenditure has an insignificant influence on increasing human development in countries at low and medium levels of human development, whereas, on the other hand, it promotes human development in developing countries with high and very high human development. Moreover, population growth promotes human development in developing countries, but the effect is greater in countries with higher human development. The evidence also indicates that lower FDI promotes human development in developing countries with medium and high human development, while it is insignificant in countries with very high human development. The results also revealed that quality governance promotes human development in developing countries, with a greater effect in member countries at a very high level of human development.

5-1. Policy Implication

The major findings of this study have very important policy implications for policymakers in developing countries. Firstly, policymakers in developing countries should formulate policies to promote digital financial inclusion; for instance, they should prioritize the digitalization of all sectors of the economy through massive investment in ICT infrastructures, particularly in remote areas. They should establish communal fixed broadband centers in remote communities, particularly in developing countries with low incomes, which have a higher percentage of people outside formal financial systems. That will give them access to constant internet and allow them to enjoy the digital financial services available. Moreover, policymakers and stakeholders in the financial sector should promote financial literacy to increase awareness of digital financial services and their benefits. In addition, they should focus on building strong institutions to provide good governance, which will increase people's confidence to use digital financial services and, hence, higher human development.

Despite the vital role of digital financial inclusion in promoting human development, there are certain consequences that bedevil the use of digital platforms for financial services. The consequences include problems such as financial fraud, online scams, identity theft, online gambling, love scams, cyber threats and attacks, data breaches, digital divide, and lack of financial secrecy. Therefore, policymakers should formulate strong regulatory frameworks that can protect consumers, uphold best practices, enact a strong data protection law, effect measures to enhance cyber security and create massive campaigns to create awareness of the dangers of digitalization and preventive measures. Financial institutions should also invest heavily in cybersecurity and educating their customers on the proper use of digital financial services.

The practical implications of this study's findings may suggest that policymakers should explore the advantages of digital financial services, increasing their wider reach to include more individuals, particularly in remote locations, rural communities, minority groups and women, especially full-time housewives. This will expose them to various opportunities not only in their localities but also around the globe, which can improve their lives, boost their income, provide them with access to health services, enrol their wards to school, and invest in their small and medium scale businesses. In addition, digital financial assets, such as Bitcoins, metaverse, non-fungible tokens, and other digital assets, may represent the future of digital finance. Therefore, policymakers should devise a policy framework that can regulate and control activities in the digital world in such away as to derive benefits and prevent exploitation.

Due to the inadequacy of data, this study is unable to cover a wide range of developing countries. Thus, future research should strive to cover more countries.

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Appendix A

Table A. List of the Sample of Countries

S/N	Countries						
1	Angola	11	Comoros	21	Kyrgyzstan	31	Senegal
2	Bangladesh	12	China	22	Mali	32	Sri Lanka
3	Belarus	13	Egypt	23	Malaysia	33	Tajikistan
4	Bolivia	14	Gabon	24	Myanmar	34	Tanzania
5	Botswana	15	Guatemala	25	Morocco	35	Tunisia
6	Burkina Faso	16	Honduras	26	Mexico	36	Viet Nam
7	Brazil	17	India	27	Nigeria	37	Zambia
8	Cabo Verde	18	Jamaica	28	Pakistan		
9	Cameroon	19	Jordan	29	Paraguay		
10	Cambodia	20	Kenya	30	Philippines		