Center for Management Science Research

ISSN: 3006-5291 3006-5283 Volume 4, Issue 3, 2026

DETERMINANTS OF DIGITAL FINANCE IN DEVELOPING COUNTRIES: THE ROLE OF DIGITAL INCLUSION, INCOME, AND INTERNET PENETRATION

Huna Gull[*1], Noor Fatima[2], Muhammad Ijaz Majeed[3], Abdul Ghaffar[4]

[*1]*Lecturer, Lahore School of Accountancy and Finance, University of Lahore,*
[2]*Research Scholar, Lahore School of Accountancy and Finance, University of Lahore,*
[3]*Assistant Professor, Lahore School of Accountancy and Finance, University of Lahore,*
[4]*PhD Scholar, Lahore School of Accountancy and Finance, University of Lahore,*

[*1]hinagul@uolcc.edu.pk, [2]noorfatimaa137@gmail.com, [3]mejazmajeedpk@gmail.com, [4]ghaffar_waince@yahoo.com

DOI: https://doi.org/10.5281/zenodo.23081099

Keywords

Article History
Received: 01 January 2026
Accepted: 07 March 2026
Published: 30 March 2026

Copyright @Author
Corresponding Author: *
Huna Gull

Abstract

This research explores the correlation between digital finance, digital inclusion, income levels, and internet access in twenty-five countries from 2010 to 2024. The study is driven by the growing importance of digital infrastructure in shaping financial inclusion and the need to understand its role relative to conventional socioeconomic indicators. Using a quantitative methodology, the study employs descriptive statistics, correlation analyses, and regression analyses, including robust and log-transformed models, to examine factors affecting financial infrastructure, measured by the number of Automated Teller Machines (ATMs). Descriptive statistics show significant cross-country differences in ATM deployment, secure internet servers, wealth levels, and connectivity rates. The correlation analysis shows minimal relationships with all indicators; digital inclusion is strongly correlated with income and internet penetration. The null hypothesis (H01) is rejected because regression findings consistently show that digital inclusion significantly improves digital finance. Conversely, the retention of H_2 and H_3 is supported by the lack of significant effects from income level and internet penetration. The models' poor explanatory power suggests that other contextual factors, such as mobile banking use, legal frameworks, and urbanization, may matter more. Overall, the results show that secure digital infrastructure is structurally important for increasing financial access, but also imply that connectivity and economic capacity are not enough motivators on their own. To achieve sustained financial inclusion, the report suggests incorporating fintech technologies and prioritizing institutional digital readiness.

INTRODUCTION

Digital finance is the biggest game-changer in today's financial landscape, changing how individuals, companies, and states receive, manage, and distribute financial services. Simply put, it applies technologies such as mobile applications, artificial intelligence, blockchain, and cloud computing to make payments, credit,

ISSN: 3006-5291 3006-5283 Volume 4, Issue 3, 2026

insurance, and investments easier. (Mhlanga, 2023). Because it allows trade to be secured at low cost and in real time, it increases economic efficiency, clarity, and creativity. An increasing number of locations, particularly in developing countries where banks are limited, are jumping on this train, which will help drive financial inclusion and socio-economic advancement. In addition, digital finance builds macroeconomic resilience by strengthening financial intermediation, reducing transaction costs, and fostering entrepreneurship. (Fu et al., 2023).

As nations pursue digital transformation in line with the Fourth Industrial Revolution, digital finance continues to play a crucial role in closing access disparities, reducing inequality, and promoting inclusive, sustainable growth. Although digital finance seems promising, many challenges and unanswered research questions remain about how it redistributes benefits and how it does so. (Rizkallah, 2023). Although research indicates a positive relationship between digital finance and financial inclusion, evidence varies across income groups, suggesting that a country's income level may moderate the relationship. (Risman, 2024).

High-income economies tend to have strong digital infrastructure and policies that support the dissemination of digital finance, while low- and middle-income countries often face roadblocks such as limited broadband access, insufficient digital literacy, and regulatory constraints. Therefore, the determination of the interaction between the income level and the adoption of digital financial services has turned into a significant research topic (Gholipour & Farzanegan, 2025). This scenario highlights the need to understand the role of financial inclusion (as well as macroeconomic and technological facilitators) in shaping the development and impact of digital finance across different income settings. Financial inclusion is the primary variable driving the growth and success of digitized finance systems. It is simply a matter of ensuring that citizens and companies have access to decent, affordable, and responsible financial products and services within the formal system, including savings, credit, payments, insurance, and whatever you call it. Inclusion drives equitable economic inclusion by drawing underserved populations into the financial flows, as a result, enhancing stability, reducing poverty, and promoting sustainability (El Fakiri & Cherkaoui, 2024).

Theoretically, a more inclusive system expands the digital platform's user base, increases transaction volume, and introduces innovations in payments and credit services. Mobile banking and fintech have become game-changers in developing countries, giving rural and low-income people direct access to growth. However, disparities in digital adoption and infrastructure continue to limit the potential for inclusion; therefore, more research is needed to clarify how these two forces interact across income levels. (Kabil et al., 2024). The second major independent variable is income level, which refers to the amount of money people or countries have and can spend. It is typically divided into low-, middle-, and high-income. This affects the affordability of digital technologies, the ease of obtaining the required infrastructure, and the readiness to test new financial technologies promoted by wealthy economies globally. (Naz et al., 2024).

Advanced platforms and regulatory frameworks are more readily translated into high-income economies, promoting an upsurge in innovation and protection. Conversely, low-income economies often face poor cash flow, weak institutions, and low financial literacy, which worsen the digital divide. Income level is therefore a structural determinant and a moderating factor that shapes the effectiveness of digital finance. These observations are essential for policymakers seeking inclusive growth plans that do not widen existing disparities. (Mahmood et al., 2023). Nevertheless, empirical research across diverse economies remains limited, so a specific examination of how income levels affect digital finance is crucial. To do this, we must control for other variables to disaggregate the

ISSN: 3006-5291 3006-5283 Volume 4, Issue 3, 2026

roles of financial inclusion and income level in digital finance. Among the controls is GDP per capita, which reflects a country's overall economic health and development. (Jamali et al., 2023).

Higher GDP per capita normally implies improved infrastructure, institutions, and access to greater access to modern financial services, aspects that, individually, have the capacity to heighten the uptake of digital finance. By excluding GDP per capita, we would not be confident whether any rise in digital finance is due to an inclusiveness initiative or simply the economy growing wealthier. (Gunawan et al., 2023). Its inclusion keeps the analysis focused on the specific effects of inclusion and income factors, rather than overall economic developments. Another necessary control variable is the internet penetration rate, since it indicates the extent of digital infrastructure and enables financial digitization. (Chinoda & Kapingura, 2024).

Digital finance depends heavily on internet connectivity and mobile networks; thus, differences in penetration become clear and affect how most individuals use digital finance. Higher internet penetration tends to accelerate the spread of fintech, promote digital literacy, and increase participation in digital markets. Conversely, those with low connectivity face serious challenges in scaling up digital finance. (Anthanasius Fomum & Opperman, 2023). Adding internet penetration helps us control for differences in technology and ensure that differences in digital finance outcomes are not merely an indication of unequal progress in the spatial development of technology. Together, GDP per capita and internet penetration provide a better understanding of the structural and technological drivers of digital finance performance, forming a strong basis for causal relationships among the variables. (Auer et al., 2023).

Importance of the Study

This work is significant for scholars, executives, and policymakers who need to understand the relationship between digital finance, financial inclusion, and income levels in various economies. As the world becomes a digital economy, the fair distribution of financial technologies becomes a determinant of long-term development. Although much has been written about FinTech and its potential for revolution, income inequality and inequitable access to financial services continue to hinder digital finance growth, particularly in mature and emerging economies. In this context, this research contributes to academic discourse by providing clear evidence of how financial inclusion and income levels influence digital finance development, and by illuminating the structural and policy drivers of such change. The analysis will be more robust because it incorporates macroeconomic and technology control factors such as GDP per capita and internet penetration, which will help isolate the unique effects of inclusion and income within overall economic development. These outcomes can help students, policymakers, regulators, and financial institutions brainstorm how to create inclusive digital ecosystems, bridge the income-based digital divide, and foster sustainable financial innovation.

Literature Review

Digital finance is also becoming a critical research topic, with a focus on understanding how technological changes affect financial regimes and inclusive development in the global economy. Ozili (2023), considering the development of FinTech, embedded finance, open banking, decentralized finance, and central bank digital currencies, reviewed global studies on digital finance in the first half of the 2020s. The researchers use a qualitative literature review approach and identify key themes in the literature: efficiency in delivering financial services, progress on the UN Sustainable Development Goals, increased financial inclusion, and several payment efficiency factors. It is emerging that investments are mainly profitable for Fintech and mobile money

ISSN: 3006-5291 3006-5283 Volume 4, Issue 3, 2026

businesses, and more than a billion people worldwide are customers of mobile money providers. The paper emphasizes that digital finance is part of contemporary finance, enabling individually tailored services without intermediaries. It also highlights the growing need to adapt regulations, protect data, and ensure algorithmic transparency to sustain digital transformation. Policy suggestions aim to tighten regulatory measures and consumer protections to control the development of financial technologies. In developing digital finance, the author proposes studying regulatory agility, ethical AI integration, and risk-conscious innovation to make it sustainable.

Energy efficiency is also becoming an important topic of study due to growing concern about environmental degradation and resource scarcity. Fu et al (2023) Comparing 2011 to 2019, the study examines the impact of digital finance on energy in 30 provinces in China. Using a super-efficient three-stage SBM-DEA model and a system generalized method of moments (GMM), the study is currently developing energy efficiency indicators to understand the mechanisms by which digital inclusive finance influences efficiency. The variables cover the scope of coverage, extent of utilization, and extent of digitalization of digital finance. The results show an inverted U-shaped relationship between digital finance and energy efficiency: moderate expansion promotes efficiency, while extreme expansion impairs it. This is heterogeneous across China's regions in the regional analysis. The paper highlights the importance of digital infrastructure and policymaking for major industry participants. The paper proposes that governments adjust financial and environmental policies to suit local conditions to achieve balanced growth. In the recommendations for future research, the authors suggest examining the long-term environmental impact of digital finance and its contribution to sustainable economic growth in greater depth.

Financial behavior in the context of micro, small, and medium enterprises (MSMEs) is becoming an important area of study in the broader realm of digital financial transformation. Risman (2024) This study examines the role of digital finance, management biases, and financial literacy in MSMEs' financial behavior, conducted in DKI Jakarta, Indonesia, in the early 2020s. The study uses the Partial Least Squares (PLS) method for empirical estimation, based on data from 200 MSME owners collected through both a manual and an online questionnaire. The variables are the adoption of digital finance, managerial biases, and financial literacy, with MSME financial behaviour as the dependent variable. The results show that digital finance and financial literacy have a positive and significant impact on MSME financial behaviour, but managerial biases do not have a significant impact. This research suggests that online financial services and enhanced literacy help more people make better financial decisions. The policy implications highlight the need for the government and other financial institutions to promote financial literacy programs and digital financial inclusion efforts for MSMEs. To conduct further studies, the researcher suggests expanding research on behavioral finance attributes and cross-regional values to deepen understanding of MSME finance in developing economies.

An entry to the banking system in terms of money is turning into an important research area, particularly when poverty and inequality in developing economies are considered. Telukdarie & Mungar, 2022). They focus on African markets and how digital finance can accelerate mainstream inclusion. The theoretical literature review notes that fintech instruments, such as AI, are accessible to individuals who are generally marginalized. The variables investigated are digital tech adoption, access to finance, and economic growth. The study notes that wider access to digital services can reduce inequality and drive sustainable growth. The policy implications include greater government

ISSN: 3006-5291 3006-5283 Volume 4, Issue 3, 2026

investment in digital infrastructure, artificial intelligence, financial systems, and initiatives that bring rural finance to more people. The research informs policymakers to lean on digital innovation to bring the marginalized population in. Future studies should explore AI's role in inclusion, cross-country comparisons, and the impact of digital finance policies on economic fairness.

FinTech and online services are practically the driving force of economic inclusion and progress nowadays. Afjal (2023) Conducted a bibliometric study based on Scopus data on publications about the role of FinTech in bridging access and enhancing development from 2010 to 2023. The variables were FinTech, digital finance, inclusion, and development. The findings indicate a significant increase in interdisciplinary studies since 2016, reflecting how digital finance is challenging the boundaries of conventional banks. The analysis highlights the crucial authors, institutions, and regions that have influenced the debate on inclusion. These policy implications encourage governments and regulators to create an environment in which FinTech and inclusive finance can be embraced. The paper asserts the importance of global collaboration and interdisciplinary research to ensure that digital finance remains fair. Future directions should explore new technologies, alternative financing systems, and the impacts of digital finance on vulnerable populations, and strengthen efforts to drive sustainable economic approaches.

Digital inclusion in finance has become a key avenue for understanding how technology can propel sustainable economic growth. Hashemizadeh et al (2023) Explored digital financial inclusion plus ICT and how they contribute to growth within 38 OECD countries, 2004-2020. The study examined the dynamic associations between variables using advanced panel techniques. The study examined digital inclusion, ICT, financial development, population growth, and non-financial investments. The findings indicate that there is a strong positive correlation between digital inclusion, ICT, and economic progress, and that technological and financial innovations can enhance productivity and ensure every corner of society remains connected. The paper identifies financial growth and non-financial investment as the important aspects of sustainable growth. Online financial services are significantly enhancing financial accessibility and empowering women in third-world nations. Setiawan et al (2024) Investigated the motivation of Indonesian women to use FinTech during COVID-19 to explore the issue. Sampled 409 women and were able to test the mechanism of the extended Technology Acceptance Model (TAM) by Structural Equation Modeling (SEM) in SEMinR. Variables were perceived usefulness, perceived ease of use, user's innovativeness, attitude, trust, brand image, financial literacy, governmental support, and saving habits. Findings indicate that behavioral intention is enhanced by perceived usefulness, innovativeness, attitude, trust, and brand image, and saving habits during the pandemic mediate the innovativeness effect.

Decentralized finance (DeFi) is becoming a paradigm-shifting field that reinvents finance using blockchain technology. (2023) explored the global markets, focusing on unpacking the DeFi functionality and how money intermediation will look in the future. The technical and policy-oriented review examined how DeFi protocols are built and operated, and the risks associated with smart contracts, DLT, stablecoins, and tokens such as Ethereum. The review discussed transaction security, transparency, decentralization, and DeFi efficiency. The article found that DeFi empowers peer-to-peer services, eliminates intermediaries, and democratizes finance; however, it also introduces regulatory, operational, and stability challenges. The article argues that DeFi requires cautious policy guidance and technology regulations to ensure safety. Finance regulators and other risk-management stakeholders should

ISSN: 3006-5291 3006-5283 Volume 4, Issue 3, 2026

develop risk-conscious frameworks to manage emerging DeFi instruments. Further research must investigate DeFi's potential to scale, its cross-border applications, and its integration with current systems to support a more sustainable and safe digital finance future.

One such area of research is financial inclusion to make micro, small, and medium enterprises (MSMEs) more productive and sustainable. Anthanasius Fomum & Opperman (2023) Conducted an analysis on MSMEs in Eswatini based on the FinScope 2017 survey to evaluate the impact of formal versus informal financial inclusion on business outcomes. Re-centered influence functions, regression, and generalized ordered logit models were used in the research to examine the relationship between the presence of bank accounts, formal or informal savings, insurance, and MSME performance. These findings indicate that greater access to banks, savings plans, and informal institutions increases annual turnover profit at the 50th and 75th percentiles, and that insurance helps reduce imbalance and unevenness across performance levels. The paper highlights that financial involvement reduces the risk of companies falling to the bottom and increases the likelihood of shifting into the developing or developed sets. Finance Policymakers ought to establish neutral credit guarantees and specific financial and non-financial assistance to develop MSMEs. The paper highlights that inclusive financial services play an important role in alleviating poverty, job creation, and sustainable development of microenterprises. Future longitudinal studies should capture causal effects and consider stage-specific interventions to enhance MSME performance.

Digital and financial literacy are emerging as crucial fields of research in enhancing the performance of micro, small, and medium-sized enterprises (MSMEs). Gunawan et al (2023) Examined MSMEs in the city of Medan, Indonesia, and the impact of financial literacy, fintech, and financial inclusion on business performance. Data from 100 MSME owners were gathered and analyzed using Structural Equation Modeling Partial Least Squares (SEM-PLS) to determine the associations among the variables, i.e., financial literacy, technological literacy, financial inclusion, and MSME performance. The results indicate that financial literacy, fintech, and inclusion directly improve MSME performance, but inclusion does not mediate the relationship between literacy, tech, and performance. The paper highlights the importance of enhancing financial literacy to enable MSME owners to make sound decisions and improve business outcomes. Policy implications include establishing special programs that help MSME actors manage finances and adopt technology. Another important point the authors make is that MSME resilience and competitiveness can be reinforced by integrating digital financial tools and literacy programs. To strengthen financial and tech education for MSMEs, the authors suggest using larger samples, longitudinal research, and industry-specific interventions in future studies.

Financial inclusion is another important research subject in determining why some developing economies have more access to financial services than others. Bekele (2023) compared Kenya and Ethiopia, considering macro and micro factors and obstacles to inclusion. Using the 2017 Global Findex Database, descriptive analysis, and generalized linear models, the study will focus on variables such as financial liberalization policy, GDP, rural population, access to mobile money, literacy, gender, age, employment, and documentation. Digital financial inclusivity is emerging as a primary driver of economic development in emerging economies. Chinoda & Kapingura (2024). In a study, the authors investigated the relationship between institutional quality and governance, including the influence of digital inclusion and economic growth in Sub-Saharan Africa between 2014 and 2020. We also applied a generalized method of moments (GMM) to account for

ISSN: 3006-5291 3006-5283 Volume 4, Issue 3, 2026

endogeneity and test variables including the digital financial inclusion index, GDP per capita growth, institutional quality, governance, trade, population growth, and inflation. The findings demonstrate that strong institutions and good governance have a substantial positive effect on growth, as a result of digital inclusion, trade, and population growth positively affecting growth, and inflation negatively affecting growth. The paper emphasizes that SSA requires policy interventions to improve institutional quality and governance as prerequisites for sustainable growth.

FinTech and BigTech lending are becoming one of the most important fields to consider to understand what the digitalization of credit markets will entail. K. Ozili (2023) conducted a retrospective of 18 countries (201319) on how the factors of financial inclusion and financial development influence the emergence of FinTech and BigTech lending. The study estimates financial inclusion, financial development, FinTech lending, BigTech lending, bank sector stability, and non-performing loans using differences and two-stage least squares (2SLS) regression. The results show that financial development positively drives FinTech and BigTech lending, and that financial inclusion also significantly affects lending trends: it stabilizes the banking sector but also increases the risk of non-performing loans. The article outlines how digital credit provision by FinTech and BigTech companies worldwide is redefining financial intermediation. The policy consequences suggest that regulators need to oversee the digital lending system while also promoting inclusion and growth to reduce systemic risks.

Reading this paper on institutional quality and governance is enlightening. Beschel et al (2023)The authors examine non-oil states in the MENA region to see how voice and accountability (VOA) relate to economic performance. The authors used a qualitative, comparative method to examine variables such as VOA, institutional quality, government accountability, and economic growth. The findings show that higher VOA scores are associated with stronger economic growth, especially in economies where institutional effectiveness matters most. The paper concludes that stronger democratic institutions and participatory governance are needed not only to stimulate the economy but also to maintain stability and transparency in society. Policy prescriptions include increasing citizen participation, strengthening institutional accountability, and streamlining regulations to drive sustainable development. In essence, the study emphasises that institutional reforms can be strengthened by emphasising the economic governance connection. To move forward, the authors propose longitudinal research on governance improvements, cross-country comparisons in MENA, and linking these to finance and digital inclusion to better understand economic development dynamics.

I also found an article in which the authors link technological advancement and green environmental practices to the puzzle of the economy's CO2 relationship. Mahmood and colleagues estimate the impact of patents, industrialization, urbanization, and growth on carbon emissions in 17 MENA economies. The spatial econometrics model examined CO2 emissions, patent applications, industrial value added, urbanization rates, and GDP growth. The results indicate that patents can reduce emissions in neighboring countries and the region at large, but urbanization increases household emissions and does not significantly change the total figure. In contrast, industrialization drives CO2 emissions at the local and regional levels, supporting the Environmental Kuznets Curve in MENA. According to the study, encouraging patents and innovation can drive economic growth and environmental protection simultaneously.

Another avenue worth exploring is the role of political relations and business trust in firm performance. Gholipour & Farzanegan (2025) examined firm-level survey data from MENA

ISSN: 3006-5291 3006-5283 Volume 4, Issue 3, 2026

countries to observe the influence of a board's political experience on business sentiment and future sales growth expectations. Conducted ordered probit regressions, structural equation modeling, and mediation analyses on such variables as political network, firm memberships in business associations, firm size, company strategy, access to market, credit, and lobbying. The findings show that companies with politically connected boards are more optimistic about future sales, particularly when they belong to business associations and pursue a strategic approach. As the paper emphasizes, political networks give firms an advantage in obtaining resources, improving market positioning, and boosting managerial confidence, all of which enhance performance. The policy implication is to introduce transparency in business operations, level the playing field for resources, and institutionalize protections against undemocratic political benefits. It was concluded by noting that corporate governance, strategic planning, and institutional support are some of the important issues to exploit the advantages of political ties to the maximum.

Another paper is highly relevant to digital finance and sustainable energy. Xiangling & Qamruzzaman (2024) Studied the MENA area to investigate the impact of ICT investment and digital financial inclusion on sustainable energy development as well as environmental taxes. Applied a Dynamic Common Correlated Effects model and an IV-adjusted DCE to address endogeneity in ICT investment, digital finance, environmental taxes, and sustainable energy development. The findings show that ICT investment and digital finance contribute to sustainable energy development, while environmental taxes influence green energy practices. The study argues that linking digital finance and technology investments can accelerate the energy transition and spur sustainable growth. Policy recommendations argue for greater emphasis on ICT infrastructure, stronger financial integration through digital platforms, and the effective use of environmental taxation to drive sustainable energy use. The paper finds a strong need for policy and technological shifts to align economic growth with environmental preservation. The authors suggest future work on sector effects, cross-country effects in MENA, and the long-term implications of digital finance for renewable energy adoption.

Theoretical framework

In general, the issue of pursuing digital finance is digital inclusion. The Technology Acceptance Model (TAM) remains the model of choice for a good reason: Recent research shows that easy access to digital gadgets increases the likelihood that people will adopt new financial services. Reading between (Amin et al., 2026) and (Abu et al., 2025)It becomes clear that in the post-pandemic economy, a platform's usefulness becomes the primary motivator for SMEs and individuals to go online. It is not only about technology; studies also show that digital infrastructure creates opportunities for underserved people, providing evidence of the connection between innovation and inclusion.

Similarly, individuals have applied Diffusion of Innovation theory to explain how fintech solutions, such as mobile cash, spread as digital infrastructure improves. (Vuong et al., 2025) Even mention that the relative advantage of fintech versus traditional banking is the greatest impetus to this rollout at present in the emerging market. In addition, Setiawan et al. 2024) note that the rate of adoption is actually contingent on institutional readiness and the availability of so-called digital change agents in society. This suggests that digital inclusion is a contemporary social phenomenon in which infrastructure is directly linked to the rate of rapid technological adoption.

The Capability Approach in modern development economics suggests that digital inclusion raises people's functional capabilities when they use modern financial systems. I learned that (Khare et al., 2024) and (Agyei et al., 2025) emphasize that inclusion empowers

ISSN: 3006-5291 3006-5283 Volume 4, Issue 3, 2026

marginalized groups by opening up greater opportunities for financial activities. In 2024, researchers state that access alone is not enough; people must also know how to use these tools effectively to make it and enhance gender equality. Inclusion is therefore the conversion factor that turns tech resources into real economic outcomes.

Lastly, the newest version of Financial Intermediation Theory holds that greater digital inclusion reduces transaction costs and levels the information playing field. (Zhang et al., 2025) Digital inclusive finance uses big data to provide more convenient services that do not have to operate with the inconveniences of traditional bank branches. These findings do not refute that digital inclusion increases digital finance adoption, but socioeconomic and infrastructure attributes also matter.

Research Methodology

Research Design

Quantitative research design is the type of research using panel data of twenty-five countries monitored during 2010-2024. It is a comparative design that can identify both differences and similarities in financial and digital inclusion across various economic settings. The dataset also provides a global outlook on trends and relationships, not only in cross-sectional comparisons but also in time-based changes, allowing the combination of cross-sectional and time-series perspectives.

Data Sources

The figures are drawn from internationally acclaimed, publicly accessible databases to ensure reliability and comparability. ATM counts are from the World Bank Financial Access Survey, and secure internet servers per million people are from the World Bank World Development Indicators. The World Bank also provides GNI per capita using the Atlas method. Internet penetration rates come from the International Telecommunication Union and are cross-checked with World Bank estimates. When gaps occur, we interpolate or fill them with official data to maintain a continuous data flow. This keeps the panel stable and ready for mathematical analysis.

Variables and Proxies

ATMs indicate the amount of physical bank presence in an area and how easily people can access standard financial services, including digital finance. Digital inclusion is measured by the number of secure internet servers per million individuals, a proxy for how much institutions invest in secure online platforms and how willing people are to conduct transactions online. The GINI per capita, determined by the Atlas method, reflects income levels and provides a consistent, internationally comparable measure of how much money people can actually spend. Internet penetration is operationalized as the percentage of the population using the Internet, which reflects how connected people are and how much they use digital technologies.

Sample Selection

The sample will consist of twenty-five countries selected to ensure a mix of income levels, geographic areas, and levels of digital infrastructure development. This selection is justified because it provides consistent data across the full period, minimizing missing-data issues and improving comparability. It also avoids focusing on one part of the world, as the list spans South Asia, the Middle East and North Africa, North America, and Europe, among others. This combination will allow comparison between developed economies with well-developed digital ecosystems and rapidly evolving emerging economies, and the results should become more relevant to a variety of economic and technological situations. This will be addressed using simple descriptive statistics, a correlation table, and regression models expressed as mathematical equations. The descriptive statistics provide a rough idea of the central tendencies, spreads, and shapes of the variables. The correlation matrix shows the strength and direction of relationships among

ISSN: 3006-5291 3006-5283 Volume 4, Issue 3, 2026

proxies such as financial infrastructure, digital inclusion, income, and internet penetration. We can test these relationships, and regression models allow us to determine how much the independent variables explain the dependent variables. We keep it simple to avoid dwelling on econometric aspects, while still providing a solid analysis.

Result and Discussion

Our statistical findings support the hypotheses in the conceptual framework, showing that digital inclusion, income, and internet penetration rates influence the development of digital finance in 25 countries from 2010 to 2024. The regression results continue to show that digital inclusion enhances digital finance; hence, we can reject the first null hypothesis (H_0). This is consistent with (Journal et al., 2024) who argue that digital inclusiveness is the primary factor driving financial participation in new markets. This also finds support in (Meka, 2023), which present cross-country statistics showing that financial service use increases with investment in digital infrastructure. (Antwi & Kong, 2023) have found that as more mobile-facilitated finance platforms become available, markets deepen, and this is not solely due to traditional banks. We are also supported by those who believe that countries with more digital preparedness adopt fintech at their own pace. The authors (Tulcanaza-Prieto et al., 2025) show that financial literacy and digital access mutually influence digital inclusion and, in turn, people's financial behavior. (Hunter et al., 2025) Similarly, they think that institutional support for digital platforms stimulates the implementation of digital finance in low- and middle-income countries. Overall, these articles show that digital inclusion matters more than income for digital finance adoption.

Meanwhile, our models support H2 and H3, so income and internet penetration do not make much difference to digital finance adoption in our dataset. According to (Magwedere & Marozva, 2025) Despite the general correlation between income and technology adoption, mobile-first finance apps shift the trend by reducing costs for low-income populations. (Siano et al., 2020) Discover that even low-income individuals are ready to use digital finance if these services are inexpensive, secure, and easy to use. It is also demonstrated by (Jena, 2025) That income does not determine the use of digital payments when platforms are and become broadly accessible and reliable.

Regarding internet penetration, the regression data suggest that connection alone, without financial participation, will not increase financial participation. According to Luiten Van Zanden (2023), what matters more than how many people are online is the internet's quality, reliability, and security. (Adetunji Paul Adejumo & Chinonso Peter Ogburie, 2025) further note that the attitudes that people hold towards cyber safety and privacy are among the biggest predictors of their future use of digital finance. (Rini, 2024) found that in most developing countries, internet access alone is not enough; investing in digital skills and trust-building is also necessary to improve financial inclusion. This is also the case in.. (James Olakunle Oladipo et al., 2024) high internet penetration is not enough because people lack the confidence to use it or the agency to take it.

Finally, the low R2 in our models suggests other factors are at play. According to (Sharma et al., 2021), governance and regulation quality is one of the most crucial factors of fintech adoption. (Lyons et al., 2017) notes that access to financial services is typically determined by urbanization and the level of maturity of the infrastructure rather than the average income of a country. (Shrier et al., 2016)It also highlights the contribution of conventional banks, such as ATMs, as an alternative pathway to financial access that is not related to internet growth.

ISSN: 3006-5291 3006-5283 Volume 4, Issue 3, 2026

Table 1: Descriptive Statistics

Variable	Observations	Mean	Std. Deviation	Minimum	Maximum
Digital Finance	375	16,098.13	40,947.69	16	267,791
Digital Inclusion	375	4,685.58	21,756.02	0.03	196,554.10
Income Level	375	17,540.71	21,547.19	370	96,800
Internet Penetration Rate	375	58.82	30.68	2.50	100

Table 1 presents the descriptive statistics for all variables included in the computations. The average Digital Finance (16,098.13) suggests the country has intermediate financial infrastructure, although there is a wide range between the minimum (16) and maximum (267,791). Digital Inclusion also shows high variability, indicating discrepancies in safe internet infrastructure rates among the countries visited. The mean level of Income is USD 17,540.71, showing that the sample covers both low- and high-income economies. The average Internet Penetration Rate is 58.82, indicating that some nations are well connected, while others have very low connectivity. Overall, the descriptive statistics show that the sample is diverse and comparable.

Table 2: Correlation Matrix

Variables	Digital Finance	Digital Inclusion	Income Level	Internet Penetration
Digital Finance	1.000			
Digital Inclusion	0.118	1.000		
Income Level	−0.028	0.438	1.000	
Internet Penetration	−0.057	0.222	0.611	1.000

Table 5.2 presents the correlation coefficients between the main variables. Digital Finance has a positive but low correlation with Digital Inclusion (r = 0.118), meaning that as digital inclusion rates rise in a country, its financial infrastructure tends to strengthen. Income Level and Internet Penetration are highly correlated (r = 0.611), suggesting that richer nations generally have better internet access. No correlation exceeds 0.8; therefore, multicollinearity is not a major concern, and the data can be used for regression analysis.

ISSN: 3006-5291 3006-5283 Volume 4, Issue 3, 2026

Table 3: Regression Analysis

Variables	Coefficient	Std. Error	t	p-value	95% Confidence Interval
Digital Inclusion	0.296	0.108	2.75	0.006 **	0.085 – 0.508
Income Level	−0.122	0.134	−0.91	0.362	−0.385 – 0.141
Internet Penetration	−70.57	86.66	−0.81	0.416	−240.97 – 99.83
Constant	21,003.44	4,639.81	4.53	0.000 ***	11,879.82 – 30,127.06

Therefore, as Table 3 shows, Digital Inclusion and Digital Finance are positively related (β = 0.296, p = 0.006). In essence, improved internet infrastructure will lead to greater financial development. On the other hand, the Negative but not significant values for Income Level and Internet Penetration (p > 0.05) suggest that wealth and/or connectivity do not necessarily translate into direct financial growth. The R2 of 0.0233 indicates that the model explains about 2.3 percent of the variance in digital finance, which is fairly acceptable in cross-country data.

Table 4: Robust Regression Analysis

Variables	Coefficient	Robust Std. Error	t	p-value	95% Confidence Interval
Digital Inclusion	0.296	0.140	2.12	0.035 **	0.021 – 0.572
Income Level	−0.122	0.089	−1.37	0.172	−0.298 – 0.054
Internet Penetration	−70.57	70.94	−0.99	0.320	−210.07 – 68.92
Constant	21,003.44	4,982.12	4.22	0.000 ***	11,206.71 – 30,800.16

Institute for Excellence in Education & Research

After using robust standard errors to correct heteroskedasticity, Digital Inclusion remained significant (p = 0.035), implying that the relationship is meaningful and real. However, Income Level and Internet Penetration were not significant, suggesting that digital inclusion is not driven by data noise or outliers.

Table 5: Log-Transformed Regression Analysis

Variables	Coefficient	Robust Std. Error	t	p-value	95% Confidence Interval
ln (Digital Inclusion)	0.240	0.059	4.08	0.000 ***	0.125 – 0.356
ln (Income Level)	−0.123	0.094	−1.31	0.190	−0.308 – 0.061

ISSN: 3006-5291 3006-5283 Volume 4, Issue 3, 2026

ln (Internet Penetration)	−0.119	0.225	−0.53	0.599	−0.562 – 0.324
Constant	8.161	0.839	9.73	0.000 ***	6.511 – 9.811

In the log-transformed regression model, I noticed the fit improved, with R2 rising to 6.4%. The coefficient of ln (Digital Inclusion) remained positive and highly significant ($p < 0.001$), implying that a 1-percent increase in digital inclusion by 1-percent increases digital finance by 0.24 percent. Interestingly, Income Level and Internet Penetration were not statistically significant. Overall, this supports the notion that an institution's digital preparedness is a more influential driver of financial inclusion, based not only on income or connectivity, but on both.

Table 6: Variance Inflation Factor (VIF)

Variable	VIF	1/VIF
ln (Internet Penetration)	3.10	0.323
ln (Digital Inclusion)	2.72	0.367
ln (Income Level)	2.11	0.474
Mean VIF	**2.64**	

All VIF values are less than 10, indicating that multicollinearity is not a major issue in the data. Thus, regression coefficients are stable and reliable. The average VIF of 2.64 further confirms that the independent variables are not highly correlated.

Table 7: Variance Inflation Factor (VIF) Analysis

Predictor Variable	VIF Value	1/VIF	Multicollinearity Status
ln (Internet Penetration)	3.10	0.323	No multicollinearity detected
ln (Digital Inclusion)	2.72	0.367	No multicollinearity detected
ln (Income Level)	2.11	0.474	No multicollinearity detected
Mean VIF	**2.64**	—	No multicollinearity present

ISSN: 3006-5291 3006-5283 Volume 4, Issue 3, 2026

Therefore, Table 7 displays the VIF test results used to determine whether multicollinearity occurs among the independent variables. All VIFs are less than 10, with a mean of 2.64, meaning multicollinearity is not a major problem in this case. In effect, the explanatory variables, or Digital Inclusion, Income Level, and Internet Penetration, do not correlate very much; hence, the regression coefficients seem well grounded. Because the predictors are independent, the effect of Digital Inclusion on Digital Finance is valid and not tainted by overlapping variance. Based on the analysis: - H_0 (Digital Inclusion → Digital Finance) is rejected, confirming that digital inclusion positively and significantly influences the development of the financial situation. – H02 (Income Level to Digital Finance) and H03 (Internet Penetration to Digital Finance) are accepted, as the two variables do not exhibit any significant correlation with digital finance. The VIF analysis supports the validity of the regression findings and supports the concept that a good digital infrastructure is structurally essential in increasing financial inclusion. However, economic capability and internet access alone are not sufficient to stimulate financial development without institutional digital preparedness. This suggests that policymakers must invest in digital security, institutional preparedness, and fintech innovation to drive long-term, inclusive financial growth across economies.

Conclusion and Recommendations

Overall, this study finds that digital inclusion, as measured by secure internet servers, continues to have a strong positive effect on digital finance in all models. The effect remains strong even when we add income level and internet penetration to the controls list, and we observe it in both linear and log-transformed regressions. By contrast, income and internet penetration alone do not have a significant impact, suggesting that money and connectivity are not enough to drive financial inclusion. Overall, these findings underscore the importance of a strong institutional digital layer in shaping financial inclusion outcomes. The study also shows that it is not possible to rely solely on traditional measures of financial inclusion, such as income or internet penetration. The variables are correlated, but they do not directly predict ATM deployment, which means global strategies to broaden the financial community should go beyond economic development and connectivity enhancement. The models do not say a lot, and this implies that there are other contextual variables, such as the way people embrace mobile banking, the regulatory environment, and the extent of urbanization of a location, which appear to be more significant in developing financial infrastructures. The study rejects H0 and supports H02 and H03; it argues that digital preparedness primarily drives financial inclusion, while income and connectivity are supporting, not deterministic, variables.

According to the findings, one priority for policymakers and banks is to invest in secure digital infrastructure to enhance financial inclusiveness. The aim is to increase access to secure internet servers, enhance cybersecurity systems, and build institutional confidence in internet systems. Meanwhile, it should also outline complementary measures to incorporate mobile banking and fintech solutions, particularly in nations where the number of ATMs is minimal. Governments need to focus on regulatory systems that allow innovation while safeguarding consumers. In this manner, they can establish viable digital finance ecosystems. In this respect, international organizations can contribute by providing financial support and technical assistance to developing economies, which is vital to ensuring the long-term success of digital finance. Future research should also consider other variables, such as mobile money usage, financial literacy, and governance quality, to provide a more complete picture of what influences financial inclusion. Countries can build more inclusive and resilient financial systems through digital preparedness,

ISSN: 3006-5291 3006-5283 Volume 4, Issue 3, 2026

foundational policy, enabling technologies, and innovative financial technologies.

REFERENCES:

Abu, N., da Silva, F. P., & Vieira, P. R. (2025). Government support for SMEs in the Fintech Era: Enhancing access to finance, survival, and performance. *Digital Business*, *5*(1), 100099.

Adel, N. (2024). The impact of digital literacy and technology adoption on financial inclusion in Africa, Asia, and Latin America. *Heliyon*, *10*(24), e40951.

Adetunji Paul Adejumo & Chinonso Peter Ogburie. (2025). Strengthening finance with cybersecurity: Ensuring safer digital transactions. *World Journal of Advanced Research and Reviews*, *25*(3), 1527–1541.

Afjal, M. (2023). Bridging the financial divide: a bibliometric analysis on the role of digital financial services within FinTech in enhancing financial inclusion and economic development. *Humanities and Social Sciences Communications*, *10*(1).

Agyei, A., Baah, G., Anowuo, I., Yeboah, E. O., & Peprah, W. K. (2025). Policy strategies for balancing digital financial inclusion with environmental sustainability and economic growth: lessons for sustainable development in Sub-Saharan African economies. *Sustainable Futures*, *10*(December 2024), 101503.

Amin, C., Anggoro, A., Saputra, A., Samson, M. G. M., & Sattar, F. (2026). Beyond access : Understanding digital platform adoption in Indonesia ' s informal economy. *Digital Geography and Society*, *10*(January), 100162.

Anthanasius Fomum, T., & Opperman, P. (2023). Financial inclusion and performance of MSMEs in Eswatini. *International Journal of Social Economics*, *50*(11), 1551–1567.

Antwi, F., & Kong, Y. (2023). Investigating the impacts of digital finance technology on financial stability of the banking sector: New insights from developing market economies. *Cogent Business and Management*, *10*(3).

Auer, R., Haslhofer, B., Kitzler, S., Saggese, P., & Victor, F. (2023). BIS Working Papers The Technology of Decentralized Finance. *Bank for International Settlements*, *1020*(1066).

Bekele, W. D. (2023). Determinants of Financial Inclusion: A Comparative Study of Kenya and Ethiopia. *Journal of African Business*, *24*(2), 301–319.

Beschel, R. P., Dyer, P., & Schaider, I. (2023). Voice, Accountability, and Economic Growth in the MENA Region. *April Issue*, *April*.

Chinoda, T., & Kapingura, F. M. (2024). Digital financial inclusion and economic growth in Sub-Saharan Africa: the role of institutions and governance. *African Journal of Economic and Management Studies*, *15*(1), 15–30.

El Fakiri, A., & Cherkaoui, K. (2024). Foreign Direct Investment and Financial Development in Selected MENA Region Countries: Panel ARDL Approach. *Global Journal of Emerging Market Economies*, *16*(1), 64–80.

Fu, Z., Zhou, Y., Li, W., & Zhong, K. (2023). Impact of digital finance on energy efficiency: empirical findings from China. *Environmental Science and Pollution Research*, *30*(2), 2813–2835.

Gholipour, H. F., & Farzanegan, M. R. (2025). Political connections and business sentiment in the MENA region. *Constitutional Political Economy*.

Gunawan, A., Jufrizen, & Pulungan, D. R. (2023). Improving MSME performance through financial literacy, financial technology, and financial inclusion. *International Journal of Applied Economics, Finance and Accounting*, *15*(1), 39–52.

ISSN: 3006-5291 3006-5283 Volume 4, Issue 3, 2026

Hashemizadeh, A., Ashraf, R. U., Khan, I., & Zaidi, S. A. H. (2023). Digital financial inclusion, environmental quality, and economic development: the contributions of financial development and investments in OECD countries. *Environmental Science and Pollution Research International*, *30*(54), 116336–116347.

Hunter, S., Pham, C., Kim, K., Trinh, L. Q., Chai, A., Deshpande, S., Johl, S., Morgan, P. J., & Obucina, M. (2025). Factors influencing digital financial services adoption in low- and medium-income countries: a systematic literature review. *International Journal of Bank Marketing*, *April 2025*, 1884–1909.

Jamali, A., Faghih, A., Fathi, M. R., & Rostami, F. (2023). A Combined Fuzzy Multi-Criteria Decision Making Framework for Evaluation of Islamic Banks: A Case of MENA Region. *Fuzzy Optimization and Modelling*, *4*(2), 62–80.

James Olakunle Oladipo, Chinwe Chinazo Okoye, Oluwafumi Adijat Elufioye, Titiola Falaiye, & Ekene Ezinwa Nwankwo. (2024). Human factors in cybersecurity: Navigating the fintech landscape. *International Journal of Science and Research Archive*, *11*(1), 1959–1967.

Jena, R. K. (2025). Factors Influencing the Adoption of FinTech for the Enhancement of Financial Inclusion in Rural India Using a Mixed Methods Approach. *Journal of Risk and Financial Management*, *18*(3).

Journal, C., Social, O. F., & Review, S. (2024). *CONTEMPORARY JOURNAL OF SOCIAL SCIENCE REVIEW, Vol.02 No.04 (2024)*. *02*(04), 1333–1346.

Kabil, M., Ali, M. A., Marzouk, A., & Dávid, L. D. (2024). Gender Perspectives in Tourism Studies: A Comparative Bibliometric Analysis in the MENA Region. *Tourism Planning and Development*, *21*(3), 276–298.

Khare, S., Bharti, V., & Jain, P. (2024). Impact Of Digital Financial Inclusion On Women Empowerment: A Study Of Satna District Shubhi. *Educational Administration: Theory and Practice 2024*, *30*(4), 5849–5859.

Luiten Van Zanden, J. (2023). Examining the Relationship of Information and Communication Technology and Financial Access in Africa. *Jbeo*, *6*(3), 26.

Lyons, A. C., Grable, J. E., Morgan, P., Regis, P., Huang, B., Chao, C.-C., Wan, G., Heshmati, A., & Pandey, S. (2017). *Chinese Economists Society Annual Conference in Nanjing, China, and the Chinese Academy of Financial Inclusion (CAFI) at Renmin University in Beijing*.

Magwedere, M. R., & Marozva, G. (2025). Financial technology and income inequality: an empirical investigation. *Discover Global Society*, *3*(1).

Mahmood, H., Furqan, M., Saqib, N., Adow, A. H., & Abbas, M. (2023). Innovations and the CO2 Emissions Nexus in the MENA Region: A Spatial Analysis. *Sustainability (Switzerland)*, *15*(13), 1–20.

Meka, S. (2023). *Building Digital Banking Foundations : Delivering End-to-End FinTech Solutions with Enterprise-Grade Reliability*. *6*(2), 8582–8592.

Mhlanga, D. (2023). Blockchain technology for digital financial inclusion in Industry 4.0, towards sustainable development? *Frontiers in Blockchain*, *6*(February), 1–13.

Naz, F., Karim, S., Houcine, A., & Naeem, M. A. (2024). Fintech Growth during COVID-19 in MENA Region: Current Challenges and Future prospects. *Electronic Commerce Research*, *24*(1), 371–392.

Ozili, P. K. (2023). Digital finance research and developments around the world: a literature review. *International Journal of Business Forecasting and Marketing Intelligence*, *8*(1), 35.

ISSN: 3006-5291 3006-5283 Volume 4, Issue 3, 2026

Rini, A. S. (2024). Determinants of Financial Literacy, Digital Literacy, Internet Penetration and Consumer Confidence Level Mediated by Fintech Growth on Retail Industry Growth in Indonesia. *International Journal of Current Science Research and Review*, *07*(12), 9109–9118.

Risman, A. (2024). Behavioral Finance of MSME: Digital Finance, Managerial Biases, Financial Literacy. *Dinasti International Journal of Economics, Finance & Accounting*, *5*(2), 641–649.

Rizkallah, W. W. A. (2023). The impact of fiscal policy on economic happiness: evidence from the countries of the MENA region. *Review of Economics and Political Science*, *8*(4), 271–289.

Setiawan, B., Phan, T. D., Medina, J., Wieriks, M., Nathan, R. J., & Fekete-Farkas, M. (2024). Quest for financial inclusion via digital financial services (Fintech) during the COVID-19 pandemic: case study of women in Indonesia. *Journal of Financial Services Marketing*, *29*(2), 459–473.

Sharma, A., Adekunle, B. I., Ogeawuchi, J. C., Iyanu Adekunle, B., Abayomi, A. A., & Onifade, O. (2021). *Governance Challenges in Cross-Border Fintech Operations: Policy, Compliance, and Cyber Risk Management in the Digital Age*. *4*(9), 278–286.

Shrier, D., Canale, G., & Pentland, A. (2016). Mobile Money & Payments : Technology Trends. *Massachusetts Inst. Technol.*, *27*.

Siano, A., Raimi, L., Palazzo, M., & Panait, M. C. (2020). Mobile banking: An innovative solution for increasing financial inclusion in sub-Saharan African countries: Evidence from Nigeria. *Sustainability (Switzerland)*, *12*(23), 1–24.

Telukdarie, A., & Mungar, A. (2022). The Impact of Digital Financial Technology on Accelerating Financial Inclusion in Developing Economies. *Procedia Computer Science*, *217*(2022), 670–678.

Tulcanaza-Prieto, A. B., Cortez-Ordoñez, A., Rivera, J., & Lee, C. W. (2025). Is Digital Literacy a Moderator Variable in the Relationship Between Financial Literacy, Financial Inclusion, and Financial Well-Being in the Ecuadorian Context? *Sustainability (Switzerland)*, *17*(6), 1–26.

Vuong, G. T. H., Barky, W., & Nguyen, M. H. (2025). Stabilizing the national banking system through digital financial inclusion, creative innovations, and green finance in low-financially developed economies. *Journal of Open Innovation: Technology, Market, and Complexity*, *11*(1), 100434.

Xiangling, L. I. U., & Qamruzzaman, M. (2024). The role of ICT investment, digital financial inclusion, and environmental tax in promoting sustainable energy development in the MENA region: Evidence with Dynamic Common Correlated Effects (DCE) and instrumental variable-adjusted DCE. *PLoS ONE*, *19*(5 May), 1–30.

Zhang, Y., Dong, X., Wang, Y., & Li, H. (2025). Research on the theoretical logic and mechanism of digital inclusive finance in promoting the high-quality development of small and medium-sized enterprises. *International Review of Economics and Finance*, *101*(May), 104202.