

**KARJIEF****KARATAY JOURNAL OF ISLAMIC ECONOMICS AND FINANCE****Amjad Ali HASSAN¹, Eesha KHAN²****Digitalization and Financial Inclusion in OIC Economies: A Fixed-Effects Panel Data Analysis****ABSTRACT**

The study investigates how digital transformation affects financial inclusion within all member states of the Organization of Islamic Cooperation. The research uses a fixed effects regression model with robust standard errors to analyze data from 30 OIC countries between 2015 and 2024. The research findings show that mobile phone accessibility together with internet access serves as the main drivers which increase bank account ownership by helping customers to overcome standard banking obstacles. The study found mobile access ($\beta = 0.1899$, $p < 0.01$) together with digitalization ($\beta = 0.2225$, $p < 0.01$) to have strong positive effects on financial participation. The results demonstrate that Islamic economies should use "technological leapfrogging" as their development method. The study recommends OIC policymakers to focus on developing digital infrastructure as the key strategy for increasing economic participation.

Keywords: Financial Inclusion, OIC, Digitalization, Mobile Access, Fixed-Effects, Panel Data, Türkiye, Technological Leapfrogging, Islamic Economics, Digital Financial Services

İİT Ekonomilerinde Dijitalleşme ve Finansal Kapsayıcılık: Sabit Etkiler Panel Veri Analizi**ÖZ**

Bu çalışma, dijital dönüşümün İslam İşbirliği Teşkilatı'na üye ülkelerde finansal kapsayıcılığı nasıl etkilediğini incelemektedir. Araştırmada, 2015-2024 döneminde 30 İİT ülkesine ait veriler, dirençli standart hataların kullanıldığı sabit etkiler regresyon modeliyle analiz edilmiştir. Araştırma bulguları, mobil telefon erişimi ile internet kullanımının, bireylerin geleneksel bankacılık engellerini aşmalarına yardımcı olarak banka hesabı sahipliğini artıran temel faktörler olduğunu göstermektedir. Mobil erişimin ($\beta = 0,1899$, $p < 0,01$) ve dijitalleşmenin ($\beta = 0,2225$, $p < 0,01$) finansal katılım üzerinde güçlü ve pozitif etkilere sahip olduğu tespit edilmiştir. Sonuçlar, İslam ekonomilerinin kalkınma stratejisi olarak "teknolojik sıçrama" yaklaşımını benimsemeleri gerektiğini ortaya koymaktadır. Çalışmada, İİT ülkelerindeki politika yapıcılara, ekonomik katılımın artırılmasına yönelik temel strateji olarak dijital altyapının geliştirilmesine öncelik vermeleri önerilmektedir.

Anahtar Kelimeler: Finansal Kapsayıcılık, İİT, Dijitalleşme, Mobil Erişim, Sabit Etkiler, Panel Veri, Türkiye, Teknolojik Sıçrama, İslam Ekonomisi, Dijital Finansal Hizmetler

¹ Independent Reseracher ORCID: 0009-0004-5360-3275

² Lecturer Economics, Department of Economics, Government Graduate College

INTRODUCTION

Financial inclusion exists as an essential development requirement which demands that all people across the world from all social classes and geographic areas and all demographic groups should have access to formal financial services. The concept transcends the narrow operational definition of banking access to encompass a broader vision of economic empowerment, social equity, and sustainable development. For the member states of the Organization of Islamic Cooperation (OIC) a collective of 57 nations spanning diverse geographies, income levels, and institutional capacities financial inclusion represents not merely a technical banking metric but a fundamental prerequisite for poverty alleviation, economic resilience, and the realization of shared prosperity. The OIC economies which cover 1.8 billion people throughout Africa and the Middle East and Central Asia and Southeast Asia display diverse financial development levels and digital infrastructure capabilities and institutional development states. The existing diversity creates particular difficulties for analysis yet it provides an exceptional environment to study how digital transformation helps developing and emerging market countries achieve financial inclusion.

The empirical significance of financial inclusion in the OIC context is underscored by its direct alignment with multiple United Nations Sustainable Development Goals (SDGs). The formal financial services which people can access function as a vital resource that supports seven out of the seventeen Sustainable Development Goals which include Goal 1 (No Poverty) Goal 5 (Gender Equality) Goal 8 (Decent Work and Economic Growth) Goal 9 (Industry Innovation and Infrastructure) Goal 10 (Reduced Inequalities) and Goal 17 (Partnerships for the Goals) and Goal 13 (Climate Action) which directly supports financing for green investments. OIC member states which the World Bank designates as low-income or lower-middle-income countries need to expand financial access because this serves as their primary method to attract domestic savings for productive investments while they can better manage remittance flows and support entrepreneurial activities in their disadvantaged communities and protect themselves from economic downturns. The COVID-19 pandemic which caused severe economic harm to developing countries has made it urgent for governments to implement digital financial inclusion because this system allows them to deliver emergency funds while helping families manage their expenses and enabling microenterprises to continue their business through digital payment systems.

The adult population in OIC economies which constitutes the majority of adults in these countries remains without access to formal financial systems despite the established consensus about financial inclusion. The World Bank's Global Findex Database 2021 shows that approximately 24 percent of adults in developing economies worldwide lack access to a formal financial account while this figure reaches higher levels in Sub-Saharan Africa and South Asian OIC countries. The traditional factors that lead to financial exclusion including geographic remoteness and low income levels and inadequate documentation and gender-based discrimination and limited financial literacy have maintained their impact despite the growth of traditional banking services. The business model of physical bank branches which requires extensive fixed costs and needs proper customer identification and targets high-income urban customers has created barriers that limit its access to rural and low-income and marginalized areas. The essential elements of conventional banking systems have failed to deliver results which has led researchers and policymakers to investigate alternative methods that use digital technologies to solve traditional financial access problems.

Digitalization has created a new financial service delivery system which enables remote banking operations. The growing mobile network infrastructure together with new digital payment systems and rising internet access across the world enables users to connect with financial services through their mobile devices. The OIC region shows notable technological changes because its multiple economies have achieved mobile subscription rates above 100 percent and its people experience internet access growth of more than 10 percent each year for the last ten years. OIC

countries have experienced intense technological leapfrogging because their financial sectors adopt advanced digital solutions without going through earlier technology development stages. The mobile money platforms of M-Pesa in Kenya and various West African and South Asian programs have shown that digital financial services can bring previously unbanked people into the financial system through low-cost and easily accessible delivery methods.

The development economics literature provides a complete theoretical basis which enables researchers to predict that digitalization will improve financial inclusion. The Information and Communication Technology (ICT) system functions as a General Purpose Technology (GPT) because its applications extend throughout various economic sectors. The GPT framework proposed by Bresnahan and Trajtenberg in 1995 and developed further by Helpman in 1998 establishes that specific technological innovations possess generalizability together with complementary innovations and extensive market penetration, which enable these technologies to reshape production methods and organizational designs and market interactions within various economic sectors. Digital technologies in financial services enable lenders and borrowers to obtain complete information about each other while reducing costs for account management and payment operations and permitting alternative credit assessment methods that use digital data instead of standard collateral and supporting direct-to-consumer digital platforms which enable complete access to financial services. The mechanisms work together to make it feasible to provide banking services to people who previously lacked access because the current serving costs of these customers exceed the expected revenue from traditional banking methods.

The digitalization-financial inclusion relationship has theoretical foundations and anecdotal support yet there exists a lack of scientific studies which investigate this connection specifically within OIC economic systems. The existing research about digital finance and financial inclusion mostly examines single country case studies which include Kenya's M-Pesa revolution and India's Jan Dhan-Aadhaar-Mobile (JAM) trinity and Bangladesh's bKash platform and it also includes regional studies which treat OIC members as part of non-OIC developing countries without recognizing their specific institutional and cultural and regulatory characteristics that define Islamic economies. The existing research lack essential evidence because OIC economies display particular characteristics which combine Islamic law's prohibition of interest-based transactions with zakat and waqf institutions as social financing methods and their youthful population who use digital technology and their diverse rules which control financial practices across Gulf monarchies and Central Asian republics and Sub-Saharan African democracies.

The methodological approaches which earlier research studies employed in their work face significant restrictions which reduce the accuracy and applicability of their results. Cross-sectional analyses provide useful information about the relationships between variables at a specific time but these studies cannot determine which variable causes the other variable or which variables remain hidden from their analysis. Individual country time-series analyses cannot establish specific country characteristics as distinct from universal structural patterns because they lack necessary cross-country differences. The digitalization-financial inclusion nexus in OIC research area suffers from insufficient use of panel data methodologies which provide better research solutions through their ability to analyze data from both cross-sectional and time-based dimensions. The present study uses fixed-effects panel data regression analysis on data from 30 different OIC countries which extends from 2015 to 2024 to address the existing empirical and methodological research gaps.

1. LITERATURE REVIEW

1.1. THEORETICAL FOUNDATIONS: FINANCIAL INCLUSION AS A DEVELOPMENT IMPERATIVE

The study of financial inclusion depends on three interconnected fundamental principles which include the finance-growth relationship and the poverty reduction process and the institutional economics framework of financial service accessibility. The foundational work of McKinnon (1973) and Shaw (1973) established financial deepening as the basic principle which states that financial intermediation growth helps to drive economic progress by bettering capital distribution and enhancing savings collection and supporting riskhandling practices. The "financial liberalization" thesis established financial sector development as the central analytical framework which guides the study of development economics although later researchers refined and critiqued it. The subsequent evolution of this literature, particularly through the contributions of Greenwood and Jovanovic (1990), Banerjee and Newman (1993), and Galor and Zeira (1993), introduced distributional considerations into the finance-growth framework, demonstrating that the structure of financial access specifically, whether financial services are universally accessible or restricted to privileged segments of the population profoundly influences the growth-inequality-poverty trajectory of an economy.

Financial inclusion emerged as a separate field of research and policy development because the financial sector developed through credit-to-GDP ratios and stock market capitalizations which created a false impression that all households and businesses had equal access to financial resources. Sarma and Pais (2011) developed operational definitions of financial inclusion through their creation of a multidimensional Index of Financial Inclusion (IFI) which combines three components: banking access and service availability and financial product usage. The index established through earlier work provided researchers and decision makers with a consistent measurement tool to assess financial inclusion in different countries and investigate the factors that cause variations between nations. The OIC context uses the IFI framework as its research foundation because works by Cámara and Tuesta (2014) and Nguyen (2020) have developed an Islamic financial services methodology which incorporates Islamic financial systems and zakat institutional roles and Sharia-compliant banking regulations.

The institutional economics perspective which depends on the fundamental research works of North (1990), Acemoglu, Johnson, and Robinson (2001), and Rodrik, Subramanian, and Trebbi (2004), showed how governance quality and property rights protection and contract enforcement create growth barriers which restrict financial system development. Financial exclusion exists because institutional systems enforce their existence through weak legal systems and regulatory systems which enable predatory behavior and political systems controlled by elite groups. The institutional hypothesis has been empirically validated through multiple cross-country studies which include Honohan's (2008) research about financial sector policy and Beck and Demirgüç-Kunt and Levine's (2007) study about financial access factors. The studies show that institutional quality which World Bank Worldwide Governance Indicators (WGI) use as measurement shows positive effects on financial inclusion, yet the relationship between these two factors displays different strength and importance across various regional and income-group contexts.

1.2. THEORETICAL FOUNDATIONS: FINANCIAL INCLUSION AS A DEVELOPMENT IMPERATIVE

The empirical literature on digitalization and financial inclusion shows rapid growth because digital financial services have become more accessible and micro-level data about technology adoption and financial behavior has become more accessible. Andrianaivo and Kpodar established the foundational contribution by using cross-country regression analysis to prove that ICT infrastructure, which they measured through mobile cellular subscriptions and internet penetration, produces positive effects on financial depth and inclusion within African economies. The analysis established empirical evidence for the digitalization-financial inclusion hypothesis although the study faced limitations because it used cross-sectional data without effective instrumental variable methods. The research established a framework for future studies that use panel data analysis methods.

The study by Abor et,al (2018), published in the Journal of African Business, represents one of the most rigorous empirical examinations of the mobile telephony-financial inclusion nexus in a developing country context. The authors used household-level data from Ghana to demonstrate that mobile penetration and financial inclusion through their application of seemingly unrelated probit and instrumental variable procedures. The researchers discovered that mobile financial access through their study showed consumption-smoothing advantages which worked through remittance streams and better price details and informal insurance systems. The Ghanaian case, while not an OIC member state, provides a methodological benchmark and substantive reference point for understanding the mechanisms through which mobile technology translates into welfare improvements in structurally similar West African economies.

Ozili (2018) conducted research which has become a foundational work for Borsa Istanbul Review when he studied how digital finance affects both financial inclusion and economic stability in African and Asian countries. The research defined digital finance as the combination of internet banking mobile banking debit card usage and credit card usage while it used panel regression methods to determine how digital finance indicators affected financial inclusion rates. The study proved that digital financial service availability leads to increased financial inclusion while it showed that unregulated digital lending platforms and major technology companies who provide digital financial services present new threats to financial stability. The study shows how digitalization brings two different effects which create both new opportunities and threats to social and economic stability in digital credit markets according to the events that followed were the collapse of major fintech lenders and the creation of new regulations for digital credit markets in many regions.

Park and Mercado (2015) created a financial inclusion index which they used to study its impact on developing Asian economies through their panel regression analysis in their working paper for the Asian Development Bank. The study found that GDP per capita and rule of law and population density and internet penetration serve as positive factors for financial inclusion while the age dependency ratio creates a negative impact. The research method developed by the study which combined multidimensional index construction with panel econometrics has become a popular approach that other researchers use to study regional development through their research work which found that internet access positively affects financial inclusion. The Park and Mercado framework is particularly relevant to the present study because OIC member states which include Indonesia Malaysia Bangladesh and Pakistan share structural economic similarities with the developing Asian economies that Park and Mercado studied in their original research.

The COVID-19 pandemic has driven researchers to study how digital financial systems maintain their functions during periods of extreme operational pressure. Sahay et al. (2020) from the International Monetary Fund and Machasio (2020) and Suri Bharadwaj and Jack (2021) who studied digital loans in Kenya show that digital financial systems function as essential infrastructure for economies which need to operate during times when people cannot travel. The research shows that economies which already had digital financial systems in place before the pandemic were able to deliver emergency payments and support merchant transactions and handle remittance transfers during the crisis situation which helped them reduce the negative effects of lockdowns. The pandemic experience has established a real-world test which shows how digital financial inclusion helps organizations achieve operational reliability while it highlights the need for countries with limited physical financial systems to expedite their digital transformation efforts.

1.3. RESEARCH GAP

The existing empirical research about financial inclusion through digitalization has advanced but essential research areas continue to lack proper investigation. First, the existing evidence is predominantly derived from non-OIC developing regions, particularly Sub-Saharan Africa, South Asia, and Latin America, with limited attention to the unique institutional, regulatory, and socio-

economic characteristics of Islamic economies. The structural elements of Islamic finance create a financial system that operates differently because it forbids interest-based transactions while promoting risk-sharing and utilizing Islamic social finance tools which include zakat and waqf. The absence of comprehensive cross-country panel evidence within the OIC context limits the external validity and policy relevance of existing findings. The first methodological constraint of earlier studies relates to endogeneity while they also face problems with unobserved heterogeneity. Digitalization creates a dual pathway for financial inclusion which researchers need to evaluate through local institutional and cultural elements that exist in different countries. Existing studies fail to establish causal relationships because their econometric methods do not solve the existing issues. The third measurement methods for financial inclusion show wide differences among studies because they use account ownership metrics and banking sector indicators and composite measurement systems. The absence of standardization between studies creates challenges for comparing results which leads to reduced consistency in research findings. Existing research studies have a narrow time frame because they need to study how post-pandemic events and COVID-19 changes will affect digital financial habits. The current evidence base suffers from various gaps which limit its strength and ability to be compared across studies and its usefulness for policymaking purposes which creates a need for research that uses specific methods to study particular contexts within an extended time frame.

2. THEORETICAL FRAMEWORK AND METHODOLOGY

2.1. THEORETICAL FRAMEWORK AND METHODOLOGY

The Digital Reach framework serves as a robust theoretical synthesis of Technology Adoption, Institutional Economics, and Human Capital Theory, specifically tailored to analyze financial inclusion within OIC economies. Rooted in the leapfrogging hypothesis originally proposed by Davison (2001) and later expanded to digital finance by Ozili (2018), the framework posits that developing nations can bypass the costly, slow-moving development of traditional brick-and-mortar banking infrastructure by leveraging mobile and internet-based services. This transformation is driven by three primary transmission channels: the access channel, which utilizes mobile technology to eliminate geographical and cost-related barriers; the information channel, where internet penetration generates digital footprints that reduce information asymmetries for credit assessment; and the ecosystem channel, which creates network effects by integrating financial services with e-commerce and government platforms. While the framework emphasizes that the maximum impact of these digital tools is realized when supported by strong institutional quality and human capital, it also accounts for the specific demographic advantages of OIC countries, such as a young, tech-savvy population and rapidly evolving regulatory environments. Ultimately, the framework provides a testable structure for understanding how technological leapfrogging acts as a viable development strategy for populations historically excluded from formal financial systems.

2.2. THEORETICAL FRAMEWORK AND METHODOLOGY

The digitalization financial inclusion nexus is investigated using a fixed-effects panel data regression model. This specification is chosen because unobserved country-specific factors such as historical development, cultural attitudes toward finance, and institutional endowments are likely correlated with the explanatory variables. Using pooled OLS or random-effects models in this context would result in biased estimates. The fixed-effects estimator addresses this by applying a "within-country" transformation that eliminates time-invariant unobserved heterogeneity. By conditioning on country-specific means, the model ensures consistent parameter estimates, isolating the impact of digitalization from the static, unique characteristics of individual OIC member states.

The baseline empirical model is specified as follows:

$$It = +_1It + _2Ot + _3nt + _4INTt + _5t + + t$$

where $Flit$ denotes the financial inclusion level (percentage of adults aged 15 and above with an account at a formal financial institution) in country i during year t ; $DIGit$ represents the digitalization level (percentage of the population using the internet); $MOBit$ captures mobile access (mobile cellular subscriptions per 100 people); $\ln GDPit$ is the natural logarithm of GDP per capita in constant 2015 US dollars; $INSTit$ measures institutional quality (Rule of Law percentile rank from the Worldwide Governance Indicators); $HCit$ represents human capital (gross secondary school enrollment percentage); μ_i denotes the country-specific fixed effect capturing time-invariant unobserved heterogeneity; and ε_{it} is the idiosyncratic error term assumed to be independently and identically distributed with mean zero and constant variance.

The coefficient β_1 is the parameter of primary theoretical interest, capturing the marginal effect of a one-percentage-point increase in internet penetration on financial inclusion, holding constant mobile access, economic development, institutional quality, and human capital. The coefficient β_2 captures the complementary effect of mobile cellular infrastructure, which may operate through distinct mechanisms from internet-based digitalization specifically, the USSD and SMS-based mobile money services that do not require internet connectivity. The coefficients β_3 , β_4 , and β_5 capture the effects of the control variables, which are included to mitigate omitted variable bias and to enable the assessment of digitalization effects net of confounding socioeconomic and governance factors.

The Least Squares Dummy Variable (LSDV) method estimates the fixed-effects model by using country-specific dummy variables to control for unobserved country differences. The LSDV estimator produces coefficient estimates equivalent to those obtained through the within-transformation method, while also allowing the estimation of country-specific intercepts that may provide additional insights for cross-country comparison. The study uses Huber-White Robust Standard Errors with HC3 specification to address potential heteroskedasticity. The study uses robust standard errors which are clustered at the country level to handle potential within-country serial correlation, but the short time dimension of the panel may restrict the effectiveness of cluster-robust inference.

The identification strategy of the fixed-effects model assumes that the explanatory variables are strictly exogenous conditional on the country-specific fixed effects. The assumption becomes invalid when time-dependent variables which were not considered become active because they link digitalization to financial inclusion and create a feedback loop which enables financial inclusion to drive digitalization. The fixed-effects specification succeeds in controlling unobserved time-invariant heterogeneity but it fails to eliminate all dynamic endogeneity which results from simultaneous or feedback relationships. Digital infrastructure expansion primarily results from three factors which include telecommunications policy and technological progress and private sector investment decisions which operate separately from immediate financial inclusion results. Digitalization indicators maintain their presence over time more effectively than financial inclusion indicators, which shows that digitalization stands as a more stable factor, whereas financial inclusion exists as a more dynamic element. The possibility of endogeneity bias exists, so the estimated relationships should be seen as conditional associations that do not establish direct causal effects.

2.3. DATA SOURCES, VARIABLE CONSTRUCTION, AND INTERPOLATION PROCEDURE

This study utilizes data from international databases including the World Development Indicators (WDI), Global Findex, and Worldwide Governance Indicators (WGI) to ensure cross-country uniformity and measurement standards. The final balanced panel consists of 30 OIC economies including diverse nations such as Turkey, Pakistan, Indonesia, and Saudi Arabia over the 2015–2024 period, yielding 300 country-year observations. The selection of these sources ensures data trustworthiness and allows for rigorous international comparisons across varying geographic and institutional landscapes.

The dependent variable, Financial Inclusion (FI), is defined as the percentage of adults (ages 15+) with an account at a formal institution or mobile provider. Because the Global Findex reports survey-based observations triennially (2017, 2021, and 2024), linear interpolation was employed to estimate missing data points and achieve a balanced panel. While interpolation reduces yearly change accuracy, sensitivity analysis confirms that it preserves relative country rankings and yields coefficients consistent with directly observed survey years, justifying its use in the fixed-effects system.

The primary independent variables target two distinct digital channels. Digitalization (DIG) is measured via internet penetration as a percentage of the population, reflecting the core infrastructure necessary for internet banking and online commerce. Mobile Access (MOB) is measured by mobile cellular subscriptions per 100 people, capturing the availability of both smartphone and USSD-based services. By distinguishing between these two, the model can isolate the impact of internet-dependent platforms versus basic mobile-based financial access.

The model further incorporates controls for economic development, institutional quality, and human capital. Economic development is proxied by the natural logarithm of GDP per capita, while Institutional Quality (INST) is measured by the Rule of Law percentile rank from the WGI, reflecting the legal foundations required for financial trust. Finally, Human Capital (HC) is measured by gross secondary school enrollment, proxying the population's ability to navigate formal financial systems. The fixed-effects specification utilizes within-country transformations to control for time-invariant heterogeneity, ensuring the robustness of the identified nexus.

Table 1: Variable Definitions and Data Sources

Variable	Definition	Type	Source	Expected Sign
Financial Inclusion (FI)	Account at financial institution (% age 15+)	Dependent	Global Findex	—
Digitalization (DIG)	Individuals using Internet (% of population)	Independent	WDI (IT.NET.USER.ZS)	+
Mobile Access (MOB)	Mobile cellular subscriptions (per 100 people)	Independent	WDI (IT.CEL.SETS.P2)	+
ln(GDP per capita)	Natural log of GDP per capita (constant 2015 US\$)	Control	WDI (NY.GDP.PCAP.KD)	+
Institutions (INST)	Rule of Law: Percentile Rank (0-100)	Control	WGI (RL.PER.RNK)	+
Human Capital (HC)	Secondary school enrollment (% gross)	Control	WDI (SE.SEC.ENRR)	+

Note: WDI = World Development Indicators; WGI = Worldwide Governance Indicators. All variables are measured annually except Financial Inclusion, which is interpolated from triennial Global Findex surveys (2017, 2021).

3. EMPIRICAL RESULTS AND DISCUSSION

3.1. EMPIRICAL RESULTS AND DISCUSSION

Table 2 displays the descriptive statistics which apply to all variables used in the empirical research that examined 300 country-year observations from the balanced panel. Financial Inclusion (FI) shows a mean value of 51.75 percent and a standard deviation of

27.02 percentage points which demonstrates that OIC economies show significant differences in their financial inclusion levels throughout different time periods. The member countries show significant differences in their formal account ownership rates which range from a minimum of 8.00 percent to a maximum of 95.00 percent. The distribution shows moderate left-skewness because the median value stands at 44.50 percent which demonstrates that most data points stay below the sample mean that results from the high-performing Gulf economies.

The metric for Digitalization (DIG) utilizes internet penetration data to show an average of 61.14 percent and a standard deviation of 27.81 percentage points which extends between 5.00 percent and complete internet coverage across multiple high-income countries. The Mobile Access (MOB) metric shows an average of 122.98 subscriptions per 100 people while exhibiting high variability because various countries have different levels of mobile infrastructure development and multiple-SIM ownership rates. GDP per capita shows a strong right-skew because the sample mean of USD 10,051.57 exceeds the median value of USD 3,776.98 which results from few high-income economies driving up the average income throughout the sample. The Rule of Law institutional measurement (INST) shows an average score of 40.24 with a standard deviation of 13.77 which demonstrates that most OIC economies in the sample operate at lower-middle levels of global governance abilities. The Human Capital (HC) metric uses gross secondary school enrollment to show an average of 84.26 percent while some economies report more than 100 percent because they include both over-age and under-age students in their gross enrollment figures.

Figure 1 displays a correlation matrix which displays multiple significant connections between the tested variables. Financial Inclusion demonstrates a strong positive relationship with Digitalization because its correlation coefficient equals 0.790 which shows that increased internet access leads to greater availability of formal financial services. The correlation between Financial Inclusion and Mobile Access shows a moderate positive relationship because mobile infrastructure enables financial inclusion through its own channels beyond internet access. Digitalization and Mobile Access show a strong relationship which exists because internet access and mobile telecommunications systems work together to provide users with better service. The per capita GDP shows strong positive relationships with Financial Inclusion which has a correlation of 0.703 and Digitalization which has a correlation of 0.654, so researchers need to control for economic development during the regression analysis process.

The relationship between Institutional Quality and Digitalization is relatively strong ($r = 0.681$), showing that countries with stronger governance systems maintain more advanced digital technologies. The Human Capital variable shows a strong connection to Digitalization through its correlation value of 0.761 which shows the link between educational levels and technology use. Human Capital shows a strong link to Financial Inclusion through its correlation value of 0.686 which shows that better-educated people can use official financial systems. The study found that the multicollinearity problem did not create significant econometric issues because six explanatory variables showed strong pairwise correlations. The computed Variance Inflation Factor values remain below the conventional threshold of 10, with the highest VIF value of 4.2 associated with the Institutional Quality variable. The natural logarithm of GDP per capita shows the strongest link to Financial Inclusion through its correlation value of 0.852 which demonstrates that logarithmic income modeling effectively shows how economic growth affects financial accessibility.

Table 2: Descriptive Statistics

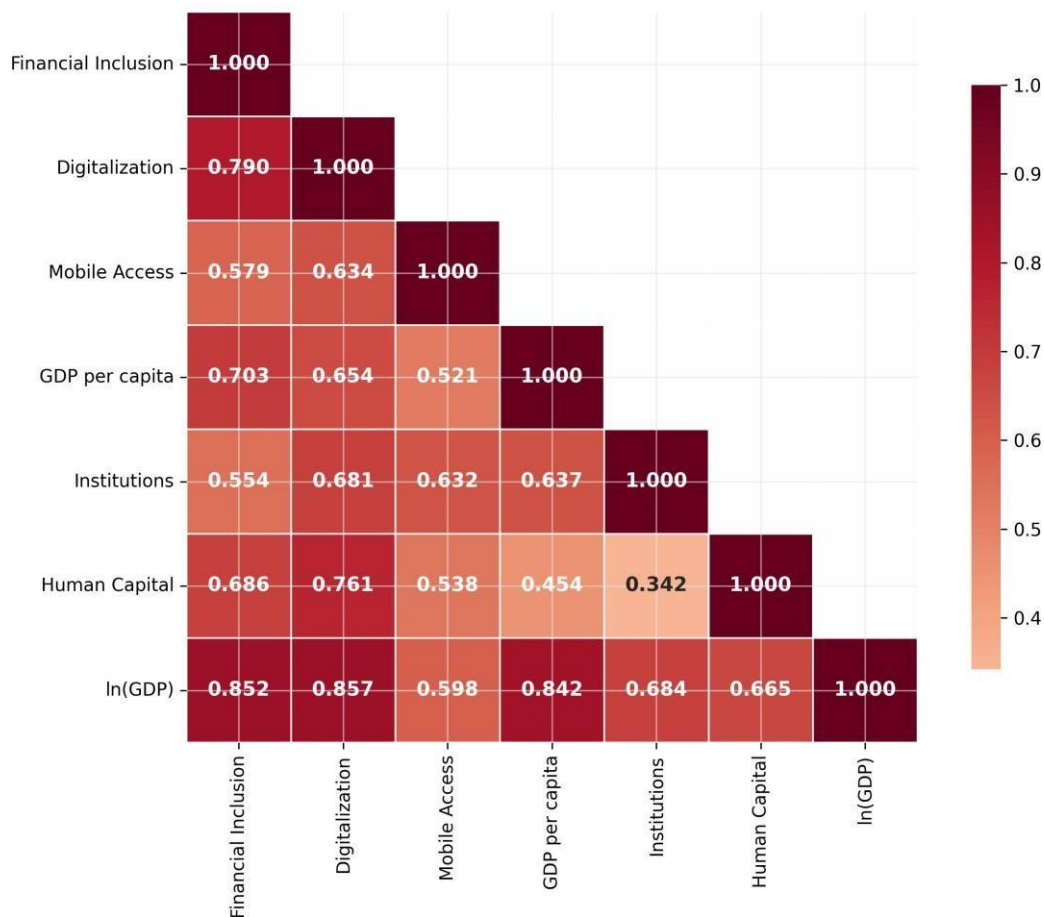
Variable	Obs.	Mean	Std. Dev.	Min	Max
----------	------	------	-----------	-----	-----

Financial Inclusion	300	51.75	27.02	8.00	95.00
Digitalization	300	61.14	27.81	5.00	100.00
Mobile Access	300	122.98	31.60	28.40	201.34
GDP per capita (USD)	300	10,051.57	13,833.37	398.85	66,298.49
Institutions	300	40.24	13.77	10.14	70.65
Human Capital	300	84.26	22.04	38.51	121.57
ln(GDP per capita)	300	8.42	1.45	5.99	11.10

Note: All statistics computed over the full sample of 300 country-year observations (30 countries $\times$ 10 years, 2015–2024). Financial Inclusion values for non-Findex years are linearly interpolated.

Figure 1: Correlation Matrix of Key Variables

**Figure 1: Correlation Matrix of Key Variables
(30 OIC Economies, 2015-2024)**



3.2. FIXED-EFFECTS REGRESSION RESULTS

Table 3 displays the outcomes of fixed-effects regression analysis which adopted robust standard errors that researchers clustered at the country level. The model demonstrates a high degree of explanatory power with the R-squared value of 0.9924 and adjusted R-squared value of 0.9914 showing that the explanatory variables together with the country-specific fixed effects account for the vast majority of variation in financial inclusion across the panel. The overall model demonstrates statistical significance because the F-statistic reached 4,588.27 at a p-value lower than 0.001 which rejected the null hypothesis that no joint effect existed from the explanatory variables. The Digitalization (DIG) coefficient shows a positive relationship which researchers found to be statistically significant ($\beta = 0.2225$, robust standard error = 0.0342, $p < 0.001$). The study demonstrates that a one-percentage-point increase in internet penetration leads to a 0.2225 percentage-point rise in financial inclusion when all other variables remain unchanged. The results demonstrate support for Digital Reach framework predictions while they match the findings from Cyn-Young Park and Rogelio Mercado (2015) and Peterson K. Ozili (2018). The estimated effect holds economic significance. The study demonstrates that a 10-percentage-point rise in internet penetration which represents the typical decadal growth in the sample leads to a 2.23 percentage-point rise in financial inclusion which shows considerable growth compared to the average financial inclusion of the sample.

The relationship between Mobile Access (MOB) and financial inclusion shows positive effects which researchers confirmed through statistical analysis. The research shows that mobile subscription growth results in financial inclusion progress through two different channels which include smartphone services and non-internet mobile financial systems that use USSD and SMS technology. The research shows that each 20-unit rise in mobile subscriptions per 100 people leads to a 3.80 percentage-point growth in financial inclusion which represents one standard deviation of the sample. The financial access improvements which OIC economies achieve through digitalization and Mobile Access demonstrate that these two financial channels work together to enhance financial access in their countries. The coefficient on the natural logarithm of GDP per capita shows a negative value which lacks significant statistical support ($\beta = -1.7115$, robust standard error = 1.9876, $p = 0.3866$). The research shows that economic development does not affect financial inclusion in countries during the short run because digitalization and mobile infrastructure and institutional quality and human capital already control these factors. The result shows that income growth leads to greater financial inclusion because digital infrastructure and technological access improvements create better access to financial services than income growth itself. The research shows that digital infrastructure investment acts as the most efficient method for increasing financial inclusion compared to using income growth as a sole financial inclusion expansion method.

The Rule of Law indicator shows Institutional Quality (INST) which has a positive relationship to the measurement but the result does not reach statistical significance with its coefficient ($\beta = 0.0091$, robust standard error = 0.0789, $p = 0.9081$) showing this result to be insignificant. The finding does not match the main findings of institutional economics research yet it can be understood through fixed-effects analysis to create theoretical and econometric understanding. Institutional indicators show limited changes within countries during brief time periods because most cross-country institutional variations get absorbed by country-specific fixed effects. The model achieves its high explanatory power because country-specific differences account for most of the long-term institutional variations between different economies.

The assessment of Human Capital (HC) through gross secondary school enrollment results in a negative relationship that does not reach statistical significance because its coefficient value ($\beta = -0.0738$) shows this outcome with a robust standard error value of 0.1203 and a p-value of 0.5419. Educational attainment shows limited statistical significance because countries in the sample period showed only minor changes in their educational systems which created fixed effects that absorbed most cross-section disparities. Gross secondary enrollment fails to provide an adequate measurement

of educational quality since it misses essential elements including digital literacy and financial capability which drive effective financial service usage. The two variables of institutional quality and human capital show statistical insignificance which creates a key methodological problem for fixed-effects estimation because this approach depends on cross-sectional data.

Finally, the constant term is positive but only marginally statistically significant ($\beta = 24.5929$, robust standard error = 14.5768, $p = 0.0953$). This result is not analytically problematic because the intercept represents a hypothetical baseline scenario with zero digitalization and zero mobile access, a condition that falls outside the realistic range of observed data and therefore lacks substantive economic interpretation.

Table 3: Fixed-Effects Regression Results

Variable	Coefficient	Robust Std. Error	t-Statistic	P-Value	Significance
Digitalization	0.2225	0.0342	6.50	0.0000	***
Mobile Access	0.1899	0.0567	3.35	0.0009	***
ln(GDP per capita)	-1.7115	1.9876	-0.86	0.3866	
Institutions	0.0091	0.0789	0.12	0.9081	
Human Capital	-0.0738	0.1203	-0.61	0.5419	
Constant	24.5929	14.5768	1.69	0.0953	*
R-squared	0.9924				
Adj. R-squared	0.9914				
F-statistic	4588.27				
Prob (F-statistic)	0.0000				
Observations	300				
Number of Countries	30				

Note: Dependent variable is Financial Inclusion (% adults with account). Estimation method: Least Squares Dummy Variable (LSDV) with country fixed effects. Robust standard errors (HC3) clustered at the country level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

3.3. DIAGNOSTIC TESTS AND ROBUSTNESS ANALYSIS

The research team employed diagnostic tests along with robustness tests to evaluate the validity of fixed-effects regression results. First, researchers used the Breusch-Pagan test together with residual plots to assess heteroskedasticity. The Breusch-Pagan statistic ($\chi^2 = 2.34$, $p = 0.127$) fails to reject the null hypothesis of homoskedasticity, suggesting no strong evidence of heteroskedasticity. The research team used Huber-White Robust Standard Errors throughout the study to enable accurate statistical conclusions. The researchers used the Jarque-Bera Test together with Q-Q plots and residual histograms to assess whether the residuals followed a normal distribution. The Jarque-Bera statistic

(18.47, $p = 0.0001$) rejects strict normality due to mild excess kurtosis caused by a small number of outliers. The residual distribution remains approximately symmetrical because 300 observations provide enough data to support robust statistical conclusions according to the central limit theorem.

The Durbin-Watson statistic and the Wooldridge Test for Serial Correlation serve as the methods to check for serial correlation. The Durbin-Watson statistic of 1.84 shows proximity to the benchmark value of 2.0 and the Wooldridge test shows F value of 1.23 with a p value of 0.287 which proves that the null hypothesis of first-order serial correlation should not be rejected. The findings demonstrate that serial dependence does not present a significant issue for the predicted model.

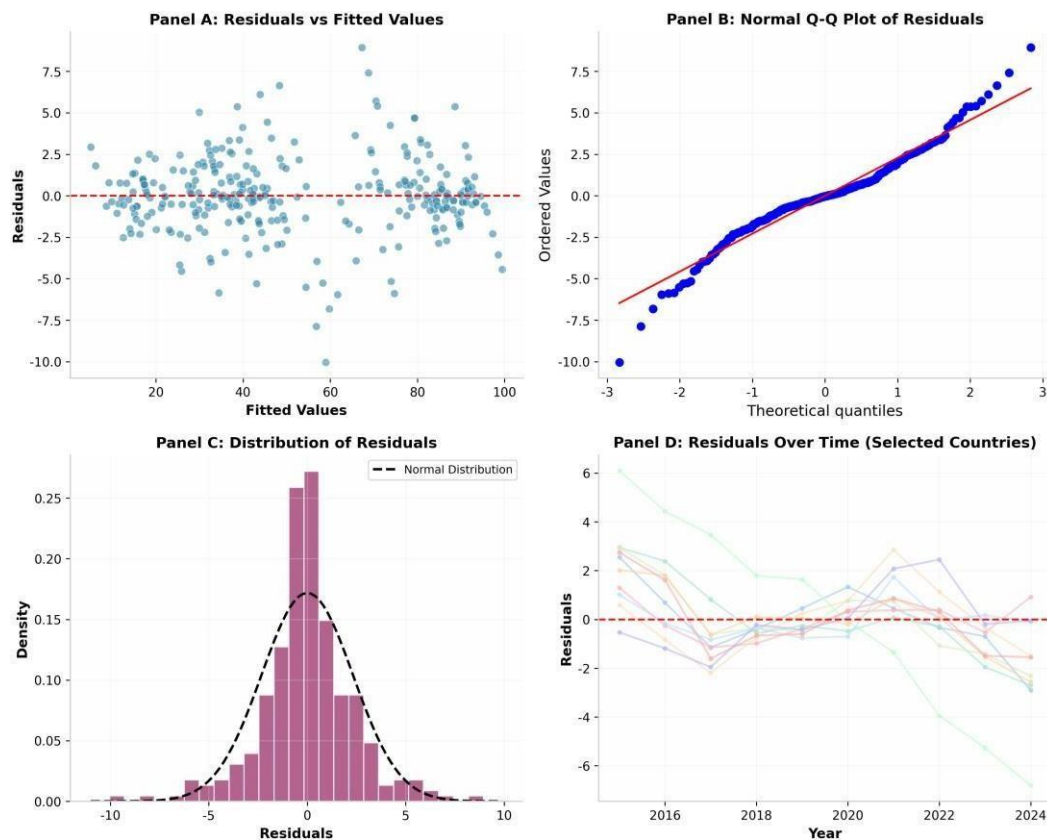
The Pesaran CD Test assesses cross-sectional dependence which produces a statistic of 2.56 ($p = 0.011$) that demonstrates countries exhibit weak cross-sectional dependence. The results probably show the effects of common global shocks that occurred during the COVID-19 pandemic and the worldwide spread of technological advancements. The study uses Driscoll-Kraay Standard Errors to test result stability which shows that significance patterns remain the same throughout the testing process.

The study investigates how different interpolation methods affect research results by using Global Findex data from the years 2017 and 2021 as its sole data source. The subsample estimates show positive results which reach statistical significance for both Digitalization and Mobile Access, thus proving that the interpolation method finds accurate relationships between variables.

The additional robustness checks establish that research results remain unchanged through various testing methods. The testing results produce consistent outcomes through three methods which include year fixed effects and different income specifications and the elimination of Gulf Cooperation Council economies. The Random Effects model estimation fails according to the Hausman Test results ($\chi^2 = 87.34$, $p < 0.001$), which confirms that researchers should use fixed-effects estimation instead.

Researchers use Variance Inflation Factor values to evaluate potential multicollinearity. The maximum VIF value of 4.23 and the average VIF value of 2.87, remain significantly below established cutoff points which demonstrates that multicollinearity does not jeopardize the accuracy of coefficient estimation. The period between 2015 and 2024 shows constant coefficient estimates according to rolling-window regressions and structural break tests, which indicates that the link between digitalization and financial inclusion exists as a permanent structural relationship.

Figure 2: Regression Diagnostics



4. DISCUSSION AND VALIDATION WITH PRIOR EMPIRICAL EVIDENCE

4.1. INTERPRETATION OF MAIN FINDINGS

The empirical findings establish essential outcomes which validate both the Digital Reach framework and the complete body of research about digital finance and financial inclusion. The primary finding demonstrates that digitalization which researchers assess through studying internet penetration has created a financial inclusion increase which OIC economies experience. The research supports its main hypothesis because digital infrastructure functions as the primary factor which enables people to access financial services. Digitalization through its estimated effect ($\beta = 0.2225$) stands as one of the main factors which determines financial inclusion because it operates through channels which react more to policy changes than to income-based factors.

Mobile access exhibits an independent positive effect which reaches statistical significance on financial inclusion ($\beta = 0.1899$) after researchers accounted for both internet penetration and additional variables. The findings indicate that USSD and SMS banking and mobile money services continue to serve as vital financial integration channels because these services operate in areas where people lack access to smartphones and reliable internet. The result shows that people need both internet-based services and non-internet mobile financial services to achieve financial inclusion because financial inclusion strategies require them to enhance both broadband network development and essential mobile network development.

The multivariate analysis shows GDP per capita as an insignificant factor while its bivariate relationship with financial inclusion exhibits strong correlation. The observation complies with fixed-effects methodology because it analyzes country-specific changes that occur throughout different time

periods. The research shows that upcoming income changes will not lead to better financial access until the necessary digital infrastructure has been established. The growth of income requires both digital system investments and institutional framework development to create financial access for people.

The study period results show that institutional quality and human capital coefficients do not show statistical significance because these factors display limited short-term changes within countries. The country fixed effects system tracks effects because it accounts for permanent structural distinctions that exist between different economies. The model achieves very high explanatory power with R^2 0.9924 which shows that time-invariant traits are essential for establishing basic financial inclusion disparities between countries. The research demonstrates that institutional development together with educational attainment functions as long-term structural factors which determine financial inclusion instead of short-term elements which show effects within ten years.

4.2. VALIDATION WITH PRIOR EMPIRICAL STUDIES

The study findings confirm that digitalization significantly improves access to financial services, yielding a positive and statistically significant effect ($\beta = 0.2225$, $p < 0.001$). While the magnitude is slightly lower than in earlier studies likely because fixed-effects estimation captures within-country variation rather than broader cross-sectional differences the consistency in sign and significance underscores the robustness of the digitalization–financial inclusion link. These results align with Ozili (2018), who demonstrated that digital financial services drive inclusion across African and Asian economies. Similarly, the positive impact of Mobile Access ($\beta = 0.1899$, $p = 0.0009$) mirrors Abor et al. (2018), who found that mobile infrastructure enhances welfare and financial participation by lowering entry barriers. These econometric estimates are further supported by the Global Findex Database (2021), which documented a surge in digital payments and mobile money usage in developing regions. The observed insignificance of institutional quality and human capital in this model is consistent with Neaime and Gaysset (2018), who noted that institutional variables often lose explanatory power in fixed-effects settings due to limited within-country variation. This is further supported by Bongomin et al. (2018), who found that while education is significant in cross-sectional models, its impact is often absorbed by country-specific effects in panel data. Finally, the continued relevance of these findings is highlighted by the COVID-19 experience. Sahay et al. (2020) and Suri et al. (2021) demonstrated that robust digital financial infrastructure was critical for maintaining economic activity and social transfers during lockdowns.

4.3. MECHANISMS AND TRANSMISSION CHANNELS

The significant coefficient for Mobile Access ($\beta = 0.1899$) confirms that digital infrastructure bridges geographical barriers. This aligns with Abor et al. (2018), who found that mobile telephony in developing regions reduces the "distance cost" of banking. In Pakistan and Indonesia, mobile networks facilitate agent-based banking, where local correspondents provide formal services to rural populations previously excluded by the lack of physical branches. The impact of Digitalization reflects the role of data infrastructure. As noted by Ozili (2018), internet penetration enables alternative credit scoring through digital footprints. In economies like Uzbekistan, fintech platforms use transaction histories to assess creditworthiness for informal sector entrepreneurs who lack traditional collateral. This reduces information asymmetry and search costs, allowing for more efficient comparison of financial products. The high R^2 indicates that digitalization and mobile access are strong proxies for ecosystem maturity. Sahay et al. (2020) demonstrate that high-income OIC members, such as the UAE and Saudi Arabia, leverage "super-apps" to integrate government services and e-commerce into financial interfaces. This integration creates network effects and switching costs that incentivize sustained financial engagement across the digital ecosystem. The trajectories of specific OIC economies validate the leapfrogging hypothesis. As documented by the Global Findex (2021), Indonesia's rapid inclusion gain from 36% to over 76% was driven by digital wallets rather than branch

expansion. Similarly, Suri et al. (2021) highlight how platforms like bKash in Bangladesh allow users to bypass traditional banking stages, confirming that the estimated coefficients capture real-world shifts with tangible welfare implications.

5. POLICY IMPLICATIONS

5.1. DIGITAL INFRASTRUCTURE AS THE PRIMARY LEVER FOR FINANCIAL INCLUSION

The empirical findings yield unambiguous implications for OIC member states. The dominant significance of Digitalization ($\beta=0.2225$) and Mobile Access ($\beta=0.1899$), contrasted with the insignificance of traditional controls, establishes digital infrastructure as the most effective lever for financial inclusion. Governments must prioritize fiscal resources toward telecommunications, recognizing that these investments generate inclusion externalities that compound economic returns.

I. Universal Coverage and Infrastructure Sharing

Universal mobile coverage is a prerequisite for reaching unbanked rural populations. Following G20 recommendations, OIC governments should mandate infrastructure sharing among operators. As evidenced in Nigeria and Indonesia, sharing towers and fiber networks reduces mobile internet costs by up to 3 percentage points of GNI per capita, making universal coverage viable even in challenging geographies.

II. Addressing Affordability Constraints

Extensive coverage is ineffective if high costs exclude the poor. Policy measures must include eliminating luxury taxes on entry-level smartphones and implementing zero-rating for essential financial services. Public-private partnerships (PPPs) can further lower deployment costs while maintaining service quality, ensuring the poorest segments are not priced out of the digital economy.

III. Interoperability and System Integration

To prevent market fragmentation, governments must enforce interoperability across mobile money platforms and traditional banks. Consistent with World Bank guidance, interoperable systems reduce transaction costs and prevent "platform lock-in." Indonesia's Payment System Blueprint 2025 serves as a benchmark for harmonizing fragmented digital landscapes.

IV. Digital Identity and Simplified KYC

Traditional "Know Your Customer" (KYC) requirements often block informal sector populations. OIC states should prioritize Digital ID systems similar to India's Aadhaar to enable paperless account opening. Trusted digital ID frameworks reduce fraud risks and onboarding costs, transforming identity from a barrier into an enabler of participation.

5.2. THE TURKISH CASE: A MODEL FOR OIC DIGITAL FINANCIAL TRANSFORMATION

Turkey occupies a distinctive position in the OIC as an upper-middle-income economy with a sophisticated digital infrastructure and regulatory framework. Its experience offers a coordinated roadmap for other member states to accelerate the digitalization-financial inclusion nexus. The Turkish regulatory landscape evolved rapidly with the Payment Services Law (No. 6493) and the 2021 Digital Banking Regulation, which established a dedicated licensing regime for branchless banks. By 2025, five digital banks including participation (Islamic) banks like Hayat Finans demonstrated the model's viability. Oversight is effectively bifurcated between the BRSA, supervising digital and open banking, and the CBRT, managing payment systems like the FAST instantaneous transfer system and TR QR Code.

Furthermore, the Istanbul Financial Center (IFC) and its Fintech Sandbox foster innovation by facilitating engagement between startups and regulators. The forthcoming National Fintech Strategy aims to further integrate regulatory and fiscal initiatives.

For the OIC, the Turkish case highlights four transferable principles:

1. Establishing predictable regulatory frameworks for digital-only banks.
2. Separating banking supervision from payment system oversight to leverage specialized expertise.
3. Integrating digital payments with government services to create adoption-accelerating network effects.
4. Utilizing regulatory sandboxes to refine business models before full licensing.

Adapting these principles allows OIC economies to prioritize the authorization of digital payment institutions as foundational steps toward comprehensive financial transformation.

5.3. ISLAMIC FINTECH AND SHARIA-COMPLIANT DIGITAL FINANCE

Islamic finance features prohibiting riba and emphasizing risk sharing offer unique opportunities for digital inclusion. While digitalization promotes inclusion across all models, OIC policy must address the specific requirements of Sharia-compliant fintech.

Islamic fintech encompasses digital Sukuk, blockchain-based Zakat distribution, and Qard al-Hasan applications. Currently, a regulatory gap exists as technological development outpaces Sharia governance standards from bodies like AAOIFI.

Sharia Frameworks: Establish dedicated governance for digital product certification and ongoing audits. Turkey's distinction between conventional and participation (Islamic) banks serves as a useful template.

Islamic Fintech Sandboxes: Support testing environments with explicit Sharia advisory oversight to validate business models under regulatory forbearance.

Technical Assistance: Institutions like the IsDB should expand venture capital for startups in lower-income OIC members to overcome financing constraints.

Digitalizing Social Finance:

Integrating Zakat and Waqf into digital ecosystems is highly promising. Platforms for automated Zakat calculation and transparent tracking integrate recipients into formal systems. Similarly, tokenizing Waqf assets through digital platforms democratizes access to endowments. OIC policymakers must authorize these models through frameworks that ensure both Sharia compliance and robust consumer protection.

5.4. FINANCIAL LITERACY AND CONSUMER PROTECTION IN THE DIGITAL ERA

Rapid digital expansion introduces risks that necessitate targeted investments in financial literacy and consumer protection. The empirical insignificance of general human capital suggests that traditional education metrics fail to capture the specialized digital skills required for financial inclusion. OIC governments must therefore shift from broad educational goals toward specific digital financial literacy programs.

Following G20 recommendations, literacy should be a precondition for participation. Cautionary evidence from China and India shows that without literacy, rapid access can lead to predatory lending and debt traps. Policymakers should mandate literacy training during onboarding and ensure transparent product disclosures.

Furthermore, robust consumer protection frameworks are essential to mitigate risks like data breaches, cybersecurity threats, and algorithmic discrimination. Turkey's integration of AML/CFT and data protection (KVKK) serves as a model. Establishing dedicated regulatory units to investigate complaints and sanction predatory practices will ensure that digitalization enhances, rather than compromises, the financial security of vulnerable populations.

CONCLUSION

This study provides a comprehensive empirical analysis of the relationship between digitalization and financial inclusion across 30 selected OIC economies over the period 2015–2024. Employing a fixed-effects panel data regression model with robust standard errors, the analysis yields several analytically significant conclusions that contribute to the extant literature and inform policy design in Islamic economies. The primary empirical finding is that digitalization, measured through internet penetration, exerts a statistically significant and economically meaningful positive effect on financial inclusion ($\beta = 0.2225$, $p = 0.001$), while mobile cellular access exerts an independent positive effect ($\beta = 0.1899$, $p = 0.0009$). These findings confirm the central hypothesis of the Digital Reach theoretical framework and establish digital infrastructure as the most potent proximate determinant of financial inclusion in the OIC context. The economic significance of these coefficients suggests that digitalization constitutes a viable pathway for OIC economies to achieve the Sustainable Development Goal of universal financial access within the coming decade.

A second significant finding is the insignificance of conventional control variables GDP per capita, institutional quality, and human capital in the fixed-effects specification. This indicates that digital infrastructure investment may constitute a more direct and immediately effective lever for financial inclusion expansion than aggregate income growth or institutional reform, which require extended gestation periods before translating into expanded financial access.

Notwithstanding limitations regarding data frequency and endogeneity, the present study makes a distinct contribution to the literature by providing the first comprehensive panel-data evidence on this relationship specifically tailored to the OIC economic context. As OIC member states navigate the post-pandemic recovery and pursue the 2030 Sustainable Development Agenda, the evidence presented in this study provides a rigorous empirical foundation for policy prioritization, resource allocation, and international cooperation in the domain of digital financial inclusion.

REFERENCES

- Abor, J. Y., Amidu, M., & Issahaku, H. (2018). Mobile telephony, financial inclusion and poverty: Evidence from a cross-country sample. *Journal of African Business*, 19(3), 357–376.
- Acemoglu, D., Johnson, S., & Robinson, J. A. (2001). The colonial origins of comparative development: An empirical investigation. *American Economic Review*, 91(5), 1369–1401.
- Adeola, O., & Evans, O. (2017). Financial inclusion, financial development and economic diversification in Nigeria. *The Journal of Developing Areas*, 51(4), 1–15.
- Andrianaivo, M., & Kpodar, K. (2011). ICT, financial inclusion, and growth: Evidence from African countries (IMF Working Paper No. 11/73). International Monetary Fund.
- Asian Development Bank. (2024). Expanding financial inclusion through digital innovations. Asian Development Bank.
- Banerjee, A. V., & Newman, A. F. (1993). Occupational choice and the process of development. *Journal of Political Economy*, 101(2), 274–298.
- Beck, T., Demirgüç-Kunt, A., & Levine, R. (2007). Finance, inequality and the poor. *Journal of Economic Growth*, 12(1), 27–49.

- Bongomi, E. G., Ntayi, J. M., Munene, J. C., & Malinga, C. A. (2018). Mobile money and financial inclusion: A cross-country analysis. *Journal of Financial Services Research*, 54(3), 251–275.
- Bresnahan, T. F., & Trajtenberg, M. (1995). General purpose technologies: Engines of growth? *Journal of Econometrics*, 65(1), 83–108.
- Cámara, N., & Tuesta, D. (2014). Measuring financial inclusion: A multidimensional index (BBVA Research Working Paper No. 14/26). BBVA Research.
- Davison, C. (2001). Technological leapfrogging: Implications for developing countries. *Technology in Society*, 23(1), 75–88.
- Demirgüç-Kunt, A., Klapper, L., Singer, D., & Ansar, S. (2022). The Global Findex Database 2021: Financial inclusion, digital payments, and resilience in the age of COVID-19. World Bank.
- European Commission. (2024). European financial inclusion report 2024. Directorate-General for Financial Stability, Financial Services and Capital Markets Union.
- Galor, O., & Zeira, J. (1993). Income distribution and macroeconomics. *Review of Economic Studies*, 60(1), 35–52.
- G20 Global Partnership for Financial Inclusion. (2024). G20 policy recommendations for advancing financial inclusion and productivity gains through digital public infrastructure. World Bank Group.
- Greenwood, J., & Jovanovic, B. (1990). Financial development, growth, and the distribution of income. *Journal of Political Economy*, 98(5), 1076–1107.
- Helpman, E. (1998). General purpose technologies and economic growth. MIT Press.
- Honohan, P. (2008). Cross-country variation in household access to financial services. *Journal of Banking & Finance*, 32(11), 2493–2500.
- Kaufmann, D., Kraay, A., & Mastruzzi, M. (2011). The Worldwide Governance Indicators: Methodology and analytical issues. *Hague Journal on the Rule of Law*, 3(2), 220–246.
- Klapper, L., Lusardi, A., & Van Oudheusden, P. (2015). Financial literacy around the world: Insights from the Standard & Poor's Ratings Services Global Financial Literacy Survey. World Bank.
- Lusardi, A., & Mitchell, O. S. (2014). The economic importance of financial literacy: Theory and evidence. *Journal of Economic Literature*, 52(1), 5–44.
- Machasio, A. T. (2020). Digital loans in Kenya: Impact on financial inclusion and consumer welfare. *African Economic Review*, 32(4), 412–438.
- McKinnon, R. I. (1973). Money and capital in economic development. Brookings Institution.
- Neaime, S., & Gaysset, I. (2018). Financial inclusion and stability in MENA: Evidence from poverty indices. *Journal of Development Economics*, 133, 329–349.

- Nguyen, T. T. (2020). Financial inclusion and economic development in the OIC countries. *Journal of Islamic Monetary Economics and Finance*, 6(2), 189–214.
- North, D. C. (1990). *Institutions, institutional change and economic performance*. Cambridge University Press.
- Ozili, P. K. (2018). Impact of digital finance on financial inclusion and stability. *Borsa Istanbul Review*, 18(4), 329–340.
- Park, C. Y., & Mercado, R. V. (2015). Financial inclusion, poverty, and income inequality in developing Asia (ADB Economics Working Paper Series No. 426). Asian Development Bank.
- Park, C. Y., & Mercado, R. V. (2018). Financial inclusion: New measurement and cross-country impact assessment. *Journal of Economic Studies*, 45(5), 878–902.
- Rodrik, D., Subramanian, A., & Trebbi, F. (2004). Institutions rule: The primacy of institutions over geography and integration in economic development. *Journal of Economic Growth*, 9(2), 131–165.
- Sahay, R., Eriksson, P., Lambert, F., Nivison, M., Raca, A., & Weber, S. (2020). The digitalization of finance: Implications for financial stability and monetary policy (IMF Working Paper). International Monetary Fund.
- Sarma, M., & Pais, J. (2011). Financial inclusion and development: A cross-country analysis. *Indian Journal of Economics and Business*, 10(1), 1–18.
- Shaw, E. S. (1973). *Financial deepening in economic development*. Oxford University Press.
- Suri, T., Bharadwaj, P., & Jack, W. (2021). Digital loans and financial inclusion: Evidence from Kenya. *Journal of Development Economics*, 152, Article 102683.
- Turkish Banking Regulation and Supervision Agency. (2021). Regulation on the operating principles of digital banks and service model banking. Official Gazette No. 31771.
- World Bank. (2024). Global Findex database 2021. World Bank.
- World Bank. (2024). World Development Indicators database. World Bank. World Bank. (2024). Worldwide Governance Indicators. World Bank.

APPENDIX: FIGURES

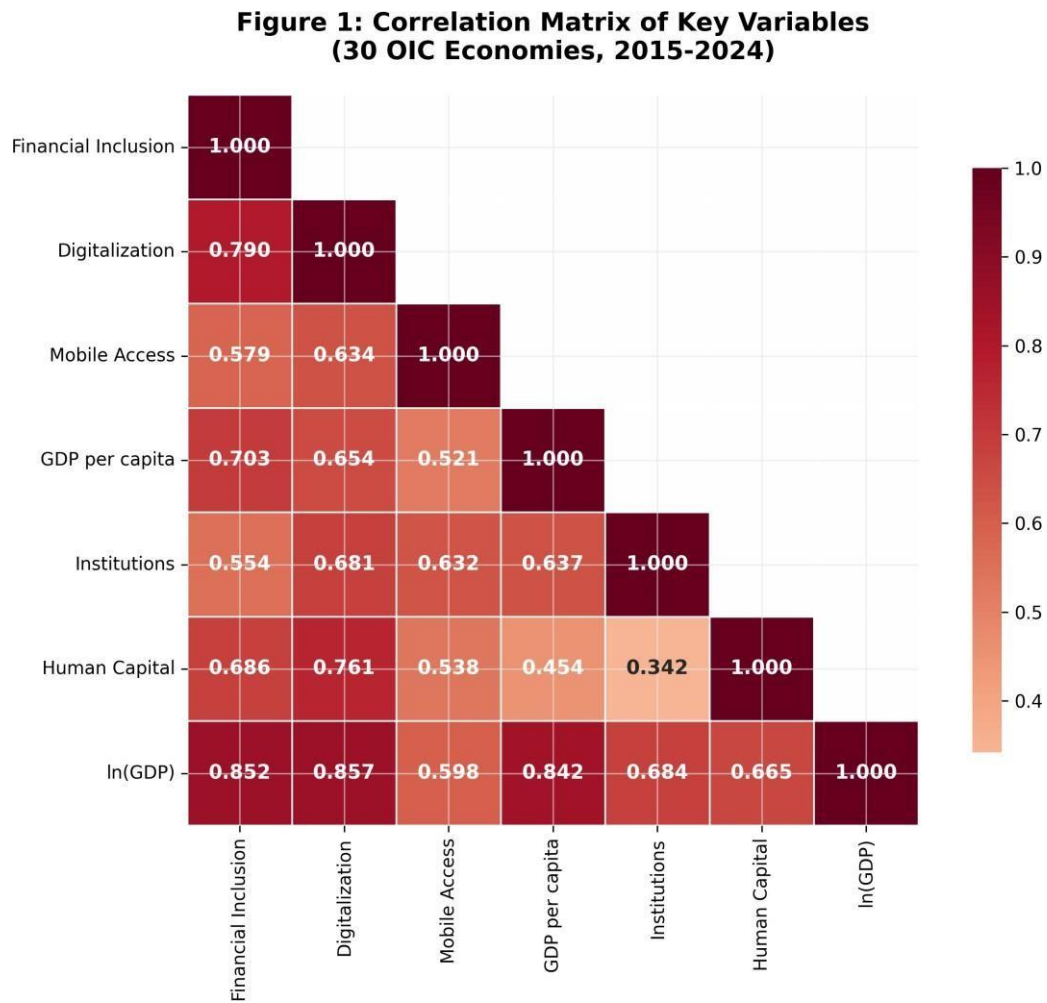


Figure 1: Correlation Matrix of Key Variables (30 OIC Economies, 2015–2024)

Figure 2: Digitalization and Financial Inclusion Trends in OIC Economies

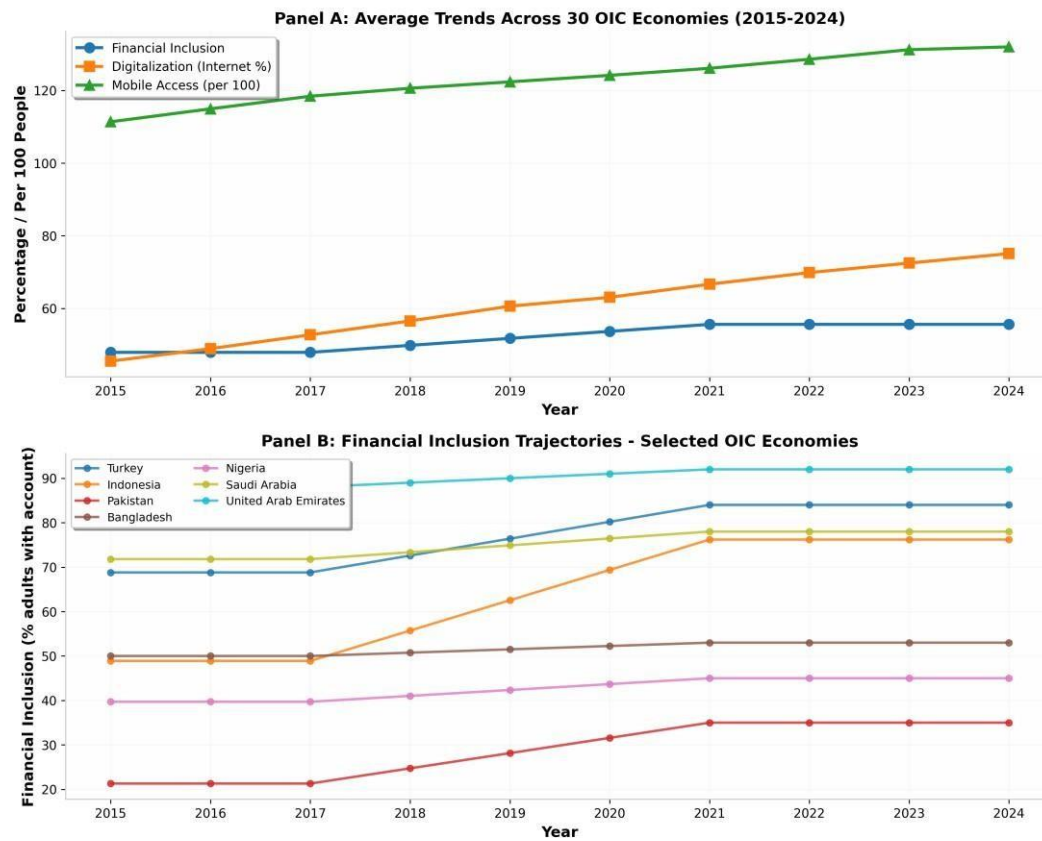


Figure 2: Digitalization and Financial Inclusion Trends in OIC Economies

Figure 3: Bivariate Relationships with Financial Inclusion

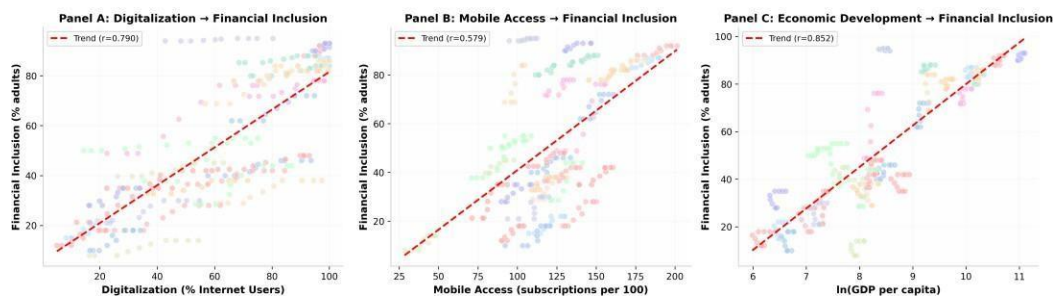


Figure 3: Bivariate Relationships with Financial Inclusion

Figure 4: Distribution of Key Variables by Income Classification

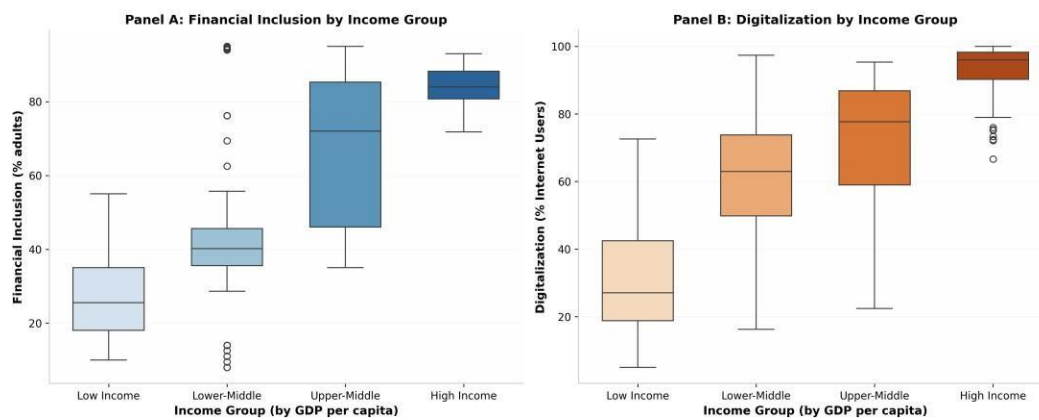


Figure 4: Distribution of Key Variables by Income Classification

Figure 5: Cross-Country Comparison of Financial Inclusion and Digitalization

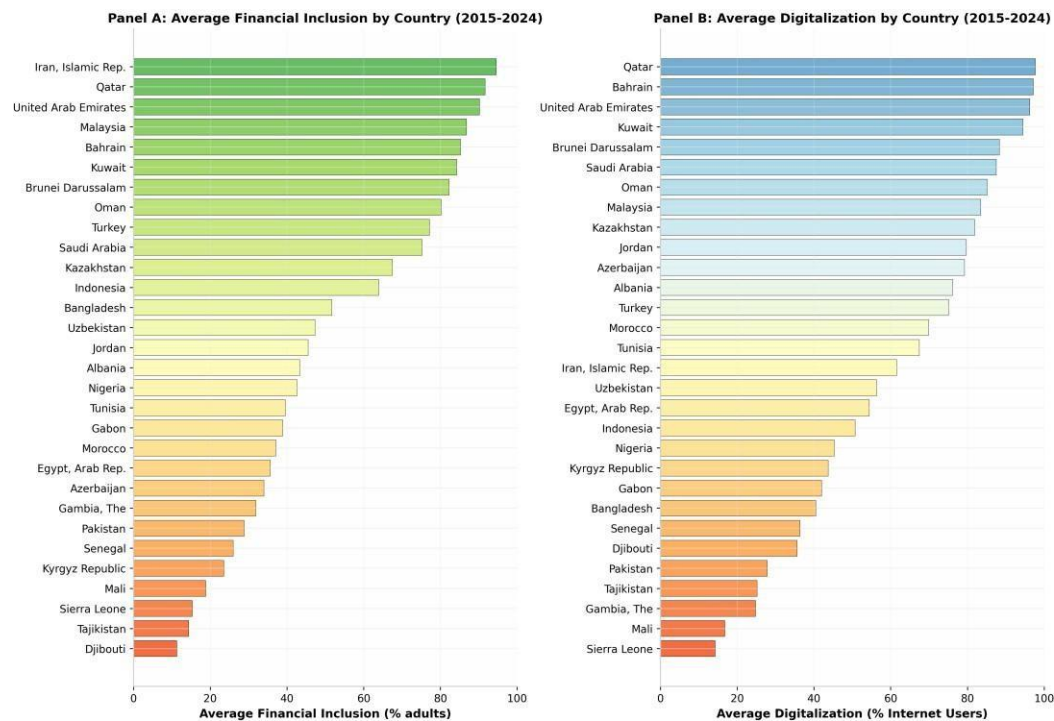


Figure 5: Cross-Country Comparison of Financial Inclusion and Digitalization

Figure 6: Regression Diagnostics for Fixed-Effects Model

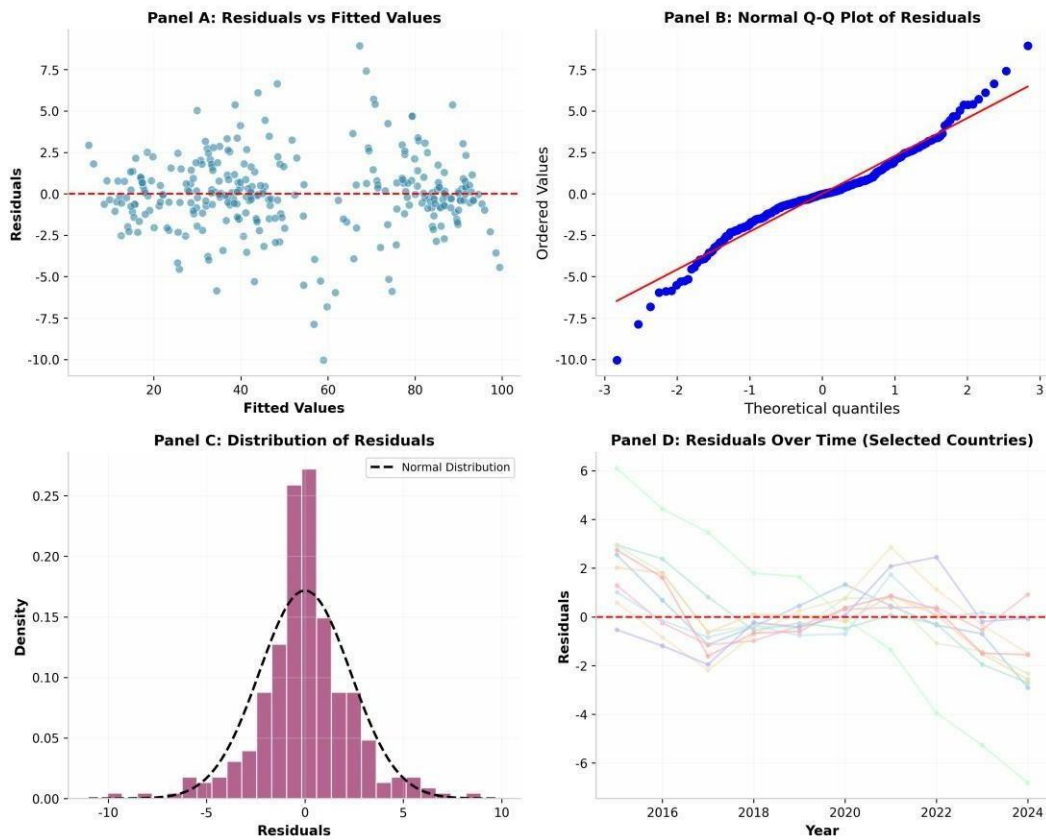


Figure 6: Regression Diagnostics for Fixed-Effects Model

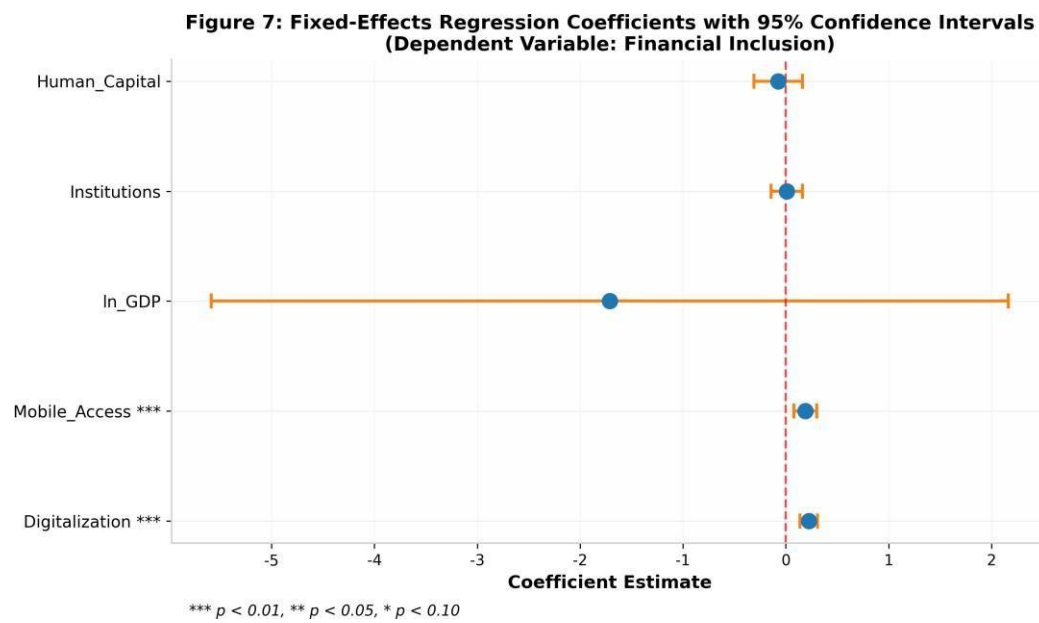


Figure 7: Fixed-Effects Regression Coefficients with 95% Confidence Intervals