Journal of Economic Cooperation and Development, **47**, 1 (2026), 95-132

Determinants of Financial Inclusion in Extended BRICS Countries

Mohammad Imdadul Haque[1], Abdul Azeez N.P.[2] and S. M. Jawed Akhtar[3]

ABSTRACT

Financial inclusion plays a crucial role in fostering the economic development of a nation. This research explores the determinants of financial inclusion in the recently extended BRICS countries, encompassing diverse economic landscapes. Using panel data methods, the analysis reveals that GDP per capita negatively affects financial inclusion, suggesting that higher economic output per capita might not uniformly translate into increased financial inclusion. Conversely, gross fixed capital formation emerges as a positive contributor, indicating that increased investment in fixed assets, including financial infrastructure, correlates with higher financial inclusion. Internet usage positively impacts financial inclusion, emphasizing the role of digital connectivity. However, mobile usage and primary education did not exhibit statistical significance in predicting financial inclusion. These results underscore the need for nuanced policy interventions tailored to these diverse nations' economic, technological, and educational contexts. Emphasizing inclusive digital financial solutions becomes imperative as these countries embrace rapid technological advancements.

ملخص

للشمول المالي دور محوري في تعزيز التنمية الاقتصادية لأي بلد. يستعرض هذا البحث العوامل المحددة للشمول المالي في دول مجموعة البريكس الموسعة حديثا، والتي تشمل مشهدا اقتصاديا متنوعا. باستخدام أساليب البيانات المجمعة، يكشف التحليل أن نصيب الفرد من الناتج المحلي الإجمالي يؤثر سلبا على الشمول المالي، ما يعني أن ارتفاع حصة الفرد من الناتج الاقتصادي قد لا

[1] Department of Economics, Aligarh Muslim University, Aligarh, India
E-mail: dr.imdad.amu@gmail.com
[2] Department of Economics, Aligarh Muslim University, Aligarh, India
E-mail: abdulazeeznp@gmail.com
[3]Department of Economics, Aligarh Muslim University, Aligarh, India
E-mail: drsmjawed@gmail.com

يعني بالضرورة انعكاسه على نحو موحد في تعزيز الشمول المالي. وعلى العكس من ذلك، يبرز إجمالي تكوين رأس المال الثابت باعتباره من العوامل الإيجابية، ما يشير إلى أن زيادة الاستثمار في الأصول الثابتة، بما في ذلك البنية التحتية المالية، يرتبط بارتفاع مستوى الشمول المالي. ولاستخدام الإنترنت أثر إيجابي على الشمول المالي، بما يؤكد دور الاتصال الرقمي. لكن استخدام الهاتف المحمول والتعليم الابتدائي لم يعكسا دلالة إحصائية مهمة في التوقعات المتعلقة بالشمول المالي. وهذه النتائج تبرز الحاجة إلى تدخلات رصينة على مستوى السياسات تكون مصممة على نحو يتسق والسياقات الاقتصادية والتكنولوجية والتعليمية المتنوعة لمختلف البلدان. وبات التأكيد على الحلول المالية الرقمية الشاملة أمرا ضروريا في ظل اعتماد هذه البلدان للتكنولوجيا المتطورة باستمرار.

RÉSUMÉ

L'inclusion financière joue un rôle crucial dans la promotion du développement économique d'une nation. Cette étude explore les déterminants de l'inclusion financière dans les pays BRICS récemment élargis, qui présentent des paysages économiques diversifiés. À l'aide de méthodes d'analyse de données de panel, l'étude révèle que le PIB par habitant a un effet négatif sur l'inclusion financière, ce qui indique qu'une augmentation du PIB par habitant ne se traduit pas nécessairement par une augmentation de l'inclusion financière. En revanche, la formation brute de capital fixe apparaît comme un facteur positif, ce qui indique qu'une augmentation des investissements dans les actifs fixes, y compris les infrastructures financières, est associée à une plus grande inclusion financière. L'utilisation d'Internet a un impact positif sur l'inclusion financière, soulignant le rôle de la connectivité numérique. Cependant, l'utilisation des téléphones portables et l'enseignement primaire n'ont pas montré de signification statistique dans la prédiction de l'inclusion financière. Ces résultats soulignent la nécessité d'interventions politiques nuancées, adaptées aux contextes économiques, technologiques et éducatifs de ces différents pays. Il devient impératif de mettre l'accent sur des solutions financières numériques inclusives à mesure que ces pays adoptent des avancées technologiques rapides.

Keywords: Financial inclusion, Gross fixed capital formation, BRICS, Internet usage, Mobile usage, Panel data analysis.

JEL Classification: G190, O16, O57

1. Introduction

Financial inclusion in BRICS countries and the extended BRICS context is critical in fostering economic development and ensuring that a larger population can access financial services. These countries encompass diverse economic landscapes, ranging from emerging markets to more established economies. "Financial inclusion refers to the availability and accessibility of affordable financial services and products for all individuals and businesses, regardless of their economic status" (Asli et al., 2017; Beck, 2016; Cámara & Tuesta, 2017). It is crucial in reducing poverty, inequality and promoting a sustainable inclusive economic growth (Ratnawati, 2020; Truc & Nguyen, 2021). It is not merely an end, but is supported by a growing body of evidence demonstrating significant benefits for individuals. Many studies indicate that active participation in the financial system enables individuals to initiate and expand businesses, invest in education, make personal financial decisions, manage risks, and withstand financial shocks (Dai, 2021; Ghosh & Hom Chaudhury, 2020; Ozili, 2020). Access to financial accounts, savings, and payment mechanisms has enhanced savings rates, empowered women, stimulated productive investment, and encouraged consumption (Ahmed, Sharma, & Gopinathan, 2021; GPFI, 2016; Mahajan & Singla, 2017; C. Singh & Kumar, 2017). Financial inclusion catalyses individual empowerment and broader economic development.

All the BRICS and extended BRICS nations have recently embraced rapid technological advancement, providing an opportunity to leverage digital financial solutions for quick financial inclusion (RBI, 2021). These innovations, including mobile wallets, peer-to-peer lending platforms, and robo-advisors, offer new and convenient avenues for people to manage their finances (Li & Meyer-Cirkel, 2021; Yang et al., 2021). It facilitates global connectivity by allowing individuals and businesses to engage in cross-border transactions, fostering international trade and economic cooperation (GSMA, 2019). Governments of these countries recognize the importance of digital financial inclusion and have implemented many policy initiatives to promote it. These may include digitized payment systems and platforms, speedy internet services, subsidies for digital services, regulatory frameworks, and financial education to support the growth of the finance sector (OECD & IDB, 2016; Singh & Rana, 2017; Widarwati et al., 2022). It leads to the transformative impact of technology on financial services by bridging

gaps, empowering individuals, especially women, and creating a more inclusive, sustainable and efficient financial ecosystem (Banerjee, Kamlesh, & Dennis, 2017; Haider, 2018; Patankar, Vyas, & Tyagi, 2017; World Bank, 2015). Indeed, as technology advances, the imperative of ensuring universal participation in the digital economy becomes more apparent. This promotes inclusivity by enabling a broader population segment to access essential financial services (Dai, 2021; Economist Impact, 2022; Hasan et al., 2022; Liu et al., 2021; Lyons et al., 2019).

In the context of the BRICS nations, there is potential for cross-border financial inclusion initiatives that facilitate financial transactions and collaborations between member countries. It is a critical engine of economic development, poverty reduction, and social progress in BRICS countries. This could enhance economic and financial cooperation and trade within the BRICS framework (Bhurat, 2019). It promotes a more inclusive and resilient financial system, contributing to these nations' overall stability and well-being. Therefore, this paper tries to understand the importance of gross domestic product (GDP) per capita, gross fixed capital formation (GFCF), primary education, internet and mobile usage on the financial inclusion (financial institution access index) of BRICS and extended BRICS countries. To establish the relationship, the current study tests the hypotheses that economic growth, investments, primary education internet and mobile usage positively influences financial inclusion.

The recent expansion of BRICS membership to include Argentina, Egypt, Ethiopia, Iran, Saudi Arabia, and the United Arab Emirates (UAE) creates an important context for examining the determinants of financial inclusion across diverse economic environments. These newly admitted countries show substantial variations in financial inclusion outcomes, driven by differences in economic development, investment capacity, digital infrastructure, mobile penetration, and education levels. High-income economies such as Saudi Arabia and the UAE demonstrate advanced digital banking ecosystems supported by strong financial infrastructure and proactive fintech investment strategies, leading to high levels of formal financial access (IMF, 2023). In contrast, low-income economies such as Ethiopia face limited banking penetration, rural service accessibility challenges, and low internet and digital literacy rates, which significantly constrain financial inclusion (World Bank, 2024). Middle-income countries like Argentina and Egypt experience moderate

levels of financial access but continue to struggle with macroeconomic instability and governance issues that weaken public trust and reduce system efficiency (African Development Bank, 2023; IMF, 2024).

Differences in technological capability further widen disparities across the expanded BRICS group. The UAE and Saudi Arabia rank among global leaders in broadband infrastructure and mobile connectivity, enabling rapid adoption of digital payments and app-based financial services (UNCTAD, 2024). Meanwhile, countries such as Egypt and Ethiopia continue to encounter digital divides, particularly among rural and low-income populations (Egyptian Ministry of Planning, 2024). Similar variations are evident in mobile penetration and telecom-driven financial inclusion, where digital ecosystems flourish in Saudi Arabia, the UAE, and Iran but remain in early development stages in Ethiopia despite major initiatives such as TeleBirr (World Bank, 2024). Education and digital literacy further reinforce these patterns by shaping individuals' ability to adopt and effectively use digital financial tools (UNCTAD, 2024).

The inclusion of these diverse economies within the BRICS bloc provides a unique comparative perspective for analysing the determinants of financial inclusion. Their heterogeneity, spanning high-income digital leaders to transitioning low-income economies, allows deeper insight into whether economic strength, digital infrastructure, investment climate, or institutional and regulatory environments exert the strongest influence on financial inclusion outcomes. This variation enhances external validity and expands the policy relevance of financial inclusion research beyond the original BRICS framework (IMF, 2023; UNCTAD, 2024).

2. Theoretical Framework

The study develops a three-channel theoretical framework in which financial inclusion is driven by economic capacity (FDP per capita and GFCF), digital access (internet and mobile penetration), and the human capital channel (education). These channels interact in such a way that education raises the returns to digital connectivity and capital formation conditions how income translates into inclusive financial access. In other words, financial inclusion, which is proxied by the Financial Institutions Access Index (FIAI), increased due to the interaction of economic capacity, public and private investment in infrastructure, digital connectivity, and human capital endowment. Anchored in existing

literature, this study develops a comprehensive theoretical framework that integrates three major channels influencing financial inclusion in the extended BRICS economies.

Economic –Capacity Channel (Income and Investment)

Economic development enhances the capability of individuals to engage with the formal financial system. Higher GDP per capita expands financial capacity of individuals, which enable increased usage of banking and payment services (Kim et al., 2018; Ratnawati, 2020). Access to formal savings, borrowing, credit, and insurance increases as income rises, thereby improving demand-side financial inclusion (Beck, 2016; Hegde & Guruprasad, 2025; King, R.G.; Levine, 1993; Park & Mercado, 2015a; Ratnawati, 2020). Many emerging countries, including the extended BRICS, experience structural dualism, where a modern, developed financial sector coexists with a large informal sector. In this context, increasing GDP may lead to disproportionate financial accessibility, particularly for higher-income and urban communities. At the same time, it fails to penetrate low- and rural-income communities, which creates a gap in accessibility (Boukhatem & Moussa, 2023; Schumpeter, 1912). Simultaneously, gross fixed capital formation (GFCF) strengthens the financial channels and infrastructure essential for accessibility of these services, including bank branches, ATM and other payment networks (Hasan, Iftekhar; De Renzis, Tania; Schmiedel, 2012; Schumpeter, 1912). Investment in infrastructure promotes financial deepening and the distribution of services, particularly in underserved regions (Boukhatem & Moussa, 2023; Van Der Lugt, 2018). However, the relationship between financial inclusion and economic growth is not uniform in all stages.

The structural dualism pattern also aligns with the inclusive growth literature and the Kuznets hypothesis, suggesting that inequalities may initially increase during the early phase of economic growth before benefits begin to reach disadvantaged segments (Kuznets, 1955; Ravallion, 2014). Accordingly, economic prosperity, without deliberate inclusion policies, can concentrate financial services within privileged groups who already hold formal accounts and assets. This theoretical perspective explains why GDP per capita demonstrates a negative and significant effect in the empirical model (Demirgüç-Kunt et al., 2022; Lewis, 1954; Park & Mercado, 2015b). Therefore, higher growth alone

does not guarantee inclusive access to finance, unless supported by strong redistributive and financial sector outreach policies.

Digital Access Channel (Internet Connectivity and Mobile Phone Penetration)

Digital connectivity directly reduces the transaction barriers and operational costs associated with accessing financial services. The broader internet connectivity, along with wide smartphone adoption, may facilitate digital banking, mobile wallets, fintech platforms, and online payments, which allow users to access financial services remotely and efficiently (Dai, 2021; Economist Impact, 2022; GSMA, 2019; Suhrab et al., 2025). The access to mobile phone also facilitates financial interactions and payment transactions, even without physical infrastructure or bank branches, thereby enhancing financial inclusion, particularly in geographically dispersed regions (Fernandes et al., 2021; Li & Meyer-Cirkel, 2021; Muthiora, 2015; Rana et al., 2020; S. Singh et al., 2024). The transformative role of digital technology has been recognised as an engine of inclusive finance by global agencies and researchers alike (Banerjee et al., 2017; Demirgüç-Kunt et al., 2022). Therefore, digital access strengthens financial inclusion by enhancing the availability, convenience, and usage of financial services.

Although global evidence from the literature establishes that mobile penetration play a transformative tool for expanding financial access, especially the M-Pesa model in Sub-Saharan Africa (Lyons et al., 2019), the mere presence of mobile devices does not guarantee financial utilisation. In many extended BRICS countries, mobile usage is primarily driven by basic voice/data functions, often without mobile money or mobile banking enablement (Fernandes et al., 2021; Frydrych & Aschim, 2014). Weak interoperability, limited merchant-acceptance networks, low awareness of DFS, trust deficits, and regulatory frictions often restrict users from transitioning from communication use to financial usage (Hasan et al., 2022; Ozili, 2020). As a result, mobile penetration alone fails to fully capture digital finance readiness, which theoretically explains why mobile subscriptions have an insignificant effect in the empirical model.

Human-Capital Channel (Education and Capability)

Education enhances ability of an individual to understand, trust, and participate in formal financial markets by improving cognitive skills and financial decision-making (Khera et al., 2021; Lyons et al., 2019). More educated individuals are more likely to use formal accounts and adopt digital finance (Patankar et al., 2017; Prasad et al., 2018). However, the impact of education is not uniform at all levels. The researchers argue that basic and primary education does not adequately translate into financial or digital literacy, thereby limiting its impact on financial behaviour (Ozili, 2018; Shen et al., 2020; C. Singh & Kumar, 2017). The influence of education becomes stronger where financial awareness and digital literacy programs complement traditional schooling (Haider, 2018; Hasan et al., 2022). Thus, the human capital channel relies on both the quality and relevance of education, particularly in financial matters, to achieve financial inclusion outcomes.

3. Literature Review

Despite notable variations among BRICS nations, all constantly stress the importance of accelerating financial inclusion as a principal policy objective. An expanding body of empirical research highlights the positive impact of financial inclusion on economic growth and development in emerging economies like those in the BRICS group (Aad et al., 2020; Adedokun & Ağa, 2021; Beck et al. 2007; Finau et al.2016; I. Hasan et al. 2012; Jalilian & Kirkpatrick, 2005; Mialou & Amidzic, 2017). Alosheibat et.al, (2023) and Boukhatem & Moussa (2023) investigated the relationship between financial inclusion and economic growth in the context of the MENA region and found existence of a long-term relationship between the two. Economic development tends to thrive in economies with higher levels of financial inclusion, as improved access to financial services empowers marginalized groups to engage in entrepreneurial and other financial activities. Scholars such as Schumpeter (1912) highlight the crucial role of the banking system in economic growth, while King, R.G., and Levine (1993) argue that a well-planned, competent and efficient financial system enhances economic growth and productivity.

The concept of financial inclusion has gained prominence since the 19th century due to heightened awareness of financial exclusion among

vulnerable populations. It plays a critical role in fostering extensive, inclusive, and sustainable economic growth within a nation's economic landscape (Ferrata, 2019; Khaki & Sangmi, 2017; Khera, Ng, Ogawa, & Sahay, 2021; Kim, Yu, & Hassan, 2018; Park & Mercado, 2015; Truc & Nguyen, 2021). It ensures that people, especially in developing nations, have easy and affordable access to financial products and services, namely savings accounts, loans, insurance, and investment opportunities (Ghosh & Hom Chaudhury, 2020; Lyons et al., 2019; Ozili, 2020; Shen et al., 2020). Facilitating financial inclusion fosters both economic stability and inclusive growth by guaranteeing that a broad segment of the population can avail themselves of financial resources. (Barik & Pradhan, 2021; Boukhatem & Moussa, 2023). This means that economic development benefits are distributed more evenly across society.

The BRICS countries are actively developing payment markets and methods, especially in the digitalized era (RBI, 2021). However, the characterization of these markets and methods varies depending on specific indicators and timeframes. Each BRICS country has its unique economic and financial landscape, and they may experience different levels of development in their payment markets. China has been leading in digital payments and has a highly developed mobile payment ecosystem. India has also seen unparalleled growth in digital payments, mainly in Unified Payment Interference (UPI), driven by many initiatives like demonetization and the promotion of digital financial services (RBI, 2021). Barik and Pradhan (2021) explored the impact of financial inclusion on financial stability in the BRICS countries during the period from 2005 to 2015. Their empirical results indicate a noteworthy negative effect of financial inclusion on financial stability. This adverse impact is linked to various factors, including the swift expansion of credit to the private sector, a decline in credit standards, challenges in credit assessment, a rise in non-performing assets, instances of credit defaults, and inadequacies in the supervision of the banking sector. Control variables include inflation and GDP growth rate, showing an inverse and significant effect of inflation and a positive and significant effect of GDP growth rate on financial stability. Despite the massive efforts and implementation of various measures, the BRICS countries still reveal a bleak picture in terms of financial inclusion, particularly when it comes to the access and usage of accounts (Ahmed et al., 2021; Demirgüç-Kunt et al., 2022). Barriers to financial inclusion, such as inadequate documents required, inadequate trust in the financial system, financial and general

illiteracy and inadequate level of income, pose significant challenges for individuals and communities seeking access to financial services (Azeez & Akhtar, 2021; Bekele, 2023; Patra & Gupta, 2020; Rana et al., 2019).

Many literatures focus on the determinants of financial system and financial inclusion in BRICS countries including government policies, technological advancements, and consumer behaviour (Ahmed et al., 2021; Ghosh & Hom Chaudhury, 2020; Liu et al., 2021). Bhurat's (2019) analysis of financial inclusion among BRICS nations also reveals a positive correlation between internet access and digital transactions. The usage of debit/credit cards is linked to a higher number of active accounts (Baker, 2021; Fernandes et al., 2021; Pandey et al., 2023; Prasad et al., 2018). Existing literature has emphasized the significance of many micro-level factors, including age, gender, educational qualifications, and income levels of individuals and households, as crucial determinants of financial inclusion(Akileng et al., 2018; Zhang & Posso, 2019). In contrast, few studies have examined macro-level factors and their impact on financial inclusion.

Recent studies point to a wide mix of economic, institutional, technological, and demographic factors that shape financial inclusion across emerging economies, offering relevant lessons for the Extended BRICS group. Evidence from BRICS countries shows that financial inclusion strengthens financial stability once participation reaches a certain threshold, with institutional quality playing a key moderating role highlighting the importance of effective governance and sound regulation (Talbi & Sebai, 2025). Research on the wider BRICS+ region also finds notable differences in inclusion levels and shows that employment, education, income, and digital access are major drivers, while mistrust, high financial costs, and weak digital infrastructure continue to limit progress (Kumar et al., 2025).

Macroeconomic and institutional factors such as GDP growth, education, internet penetration, and regulatory quality are consistently linked to higher levels of inclusion, whereas inflation tends to hinder it (Abokor et al., 2024). Within the core BRICS economies, financial inclusion has been shown to reduce income inequality, and its impact is stronger where institutional structures are more robust, underscoring the need for governance improvements to support inclusive development (Onatunji,

2025). Other evidence indicates that expanding access to financial services can also support environmental sustainability by improving access to green financing and clean technologies (Tekin, 2024). At the micro level, digital financial services, financial literacy, and supportive institutional arrangements significantly boost participation among underserved groups, including women-led MSMEs, demonstrating the transformative potential of digital financial ecosystems (Charumathi & Raghunathan, 2025).

Taken together, the literature suggests that digital infrastructure, institutional quality, economic growth, education, financial literacy, and regulatory reforms are central to strengthening financial inclusion and provide clear guidance for coordinated policy efforts across the Extended BRICS economies. While many studies focus on micro-level determinants, there needs to be more research examining macro-level factors' impact on financial inclusion in BRICS countries. The literature has yet to comprehensively explore the broader macro-economic and institutional influences shaping financial inclusion outcomes in these diverse nations. Addressing this gap would provide a more nuanced understanding of the complex dynamics surrounding financial inclusion in the extended BRICS context.

4. Data and Methodology

The study intends to establish the impact of economic growth, investment, mobile usage, internet usage and education on financial institutional access for the BRICS countries. The Financial Institutions Access Index (FIAI) is constructed by IMF using bank branches per 100000 adults and ATMs per 100000 adults. FIAI has used a proxy for financial inclusion. GDP per capita (constant LCU) is taken as the proxy for economic growth; Gross fixed capital formation (% of GDP) is taken as the proxy for investments; individuals using the internet (% of population) is taken as the proxy for internet usage; Mobile cellular subscriptions (per 100 people) is taken as the proxy for mobile usage; Primary education, (pupils) is taken as the proxy for education. Except for the FIAI, for which IMF provides the data, all other variables data are taken from the World Bank. The detailed description of each variable used in the model is explained in Table 1. The study is based on annual data for the period 2011 to 2021 for extended BRICS countries (Brazil, Russia, India, China,

and South Africa, Argentina, Egypt, Ethiopia, Iran, Saudi Arabia, and UAE).

The Financial Institution Access Index (FIAI) is taken as the dependent variable, as it captures the supply-side accessibility of formal financial services, which comprises infrastructure indicators, including the density of bank branches, coverage of ATMs, and availability of Point of Sale (POS) terminals (IMF, 2022). Generally, financial inclusion is measured by using a single indicator proxy, such as account ownership or credit penetration. However, by taking FIAI, the study uses a multidimensional and objective assessment of physical access to financial institutions across countries (Demirguc-Kunt & Klapper, 2012; Sarma & Pais, 2008). In the context of BRICS countries, a significant portion of the population may possess bank accounts. However, they still face infrastructural or geographical constraints that limit their use of financial services. Therefore, FIAI more accurately capture and reflects financial inclusion capacity rather than just formal bank account ownership.

To address the case of missing values we will use the rule that if less than 5% of the observations had missing values in either the dependent variable or the key explanatory variable, then we plan to use listwise deletion and drop those rows. Also, if none of the variable had more than 20% missingness, then neither imputation nor variable removal will be done Allison, 2002; Schafer & Graham, 2002). And, to limit the influence of extreme values, we plan to winsorize all numeric variables at the 1st and 99th percentiles. This approach keeps every observation in the dataset while pulling in only the most extreme outliers, which helps improve the stability of the estimates without distorting the underlying data (Ghosh & Vogt, 2012; Tukey, 1962). Finally, all variables were converted to natural logarithms to normalize their scale and reduce skewness (Wooldridge, 2010; Greene, 2018). Log-transformation is a standard practice in econometric modelling and is fully adequate here, as fixed-effects and random-effects models do not require z-score mean-standardization (Baltagi, 2021).

The model to be estimated is:

$$FIAI = f[GDP, GCF, Internet, Mobile, Education]$$

The research employs both fixed effect and random effect panel data methodologies to estimate the model described earlier. The fixed effect model examines the association between the dependent and explanatory variables while controlling for country-specific factors that might influence the dependent variable. In this approach, the variability observed between different entities is considered non-random and is assumed to be correlated with the explanatory variables. This time-invariant properties of entities are contained in the intercept term of the fixed effect model. Here, the impact of omitted variables is fixed as they are assumed to be correlated with the explanatory variables. Here, fixed effect refers to the parameters which are constant across different entities. The fixed effect model can be represented as:

$$Y_{it} = \beta_0 + \beta_1 X_{it} + \alpha_i + \varepsilon_{it}$$

where, Y_{it} represents the dependent variable of entity i at time t; X_{it} represents the explanatory variable of entity i at time t ; β_0 represents the intercept; β_1 represents the coefficient of the explanatory variable; α_i represents the fixed effect for entity i; ε_{it} represents the error term

The random effect model considers that the error terms are uncorrelated with the explanatory variables, so the time-invariant variables are allowed as explanatory variables. Here, random effect refers to the parameters that differ between entities. When there are no omitted variables, or the omitted variables are unrelated to the explanatory variables, then this model is preferred over the fixed effect model. Further, this method is better as the fixed effect model fails to estimate the effect of time-invariant explanatory variables whose values do not change over time.

$$Y_{it} = \beta_0 + \beta_1 X_{it} + u_i + \varepsilon_{it}$$

where, Y_{it} represents the dependent variable of entity i at time t; X_{it} represents the explanatory variable of entity i at time t ; β_0 represents the intercept; β_1 represents the coefficient of the explanatory variable; $u_i$is random effect of i entity; ε_{it} represents the error term.

Table: 1 Variable Description

Variable Name	Variable Description
Financial Institutions Access Index (FIAI)	This index comprises data on the density of bank branches and ATMs per 100,000 adults, sourced from IMF data. It measures accessibility of financial institutions within a given population. (IMF Data)
GDP per capita (GDPC) (constant LCU)	It represents the GDP divided by the midyear population. Calculated at constant local currency values, it encompasses the sum of gross value added by all resident producers, accounting for product taxes and subsidies not included in the product values. (World Bank Data).
Gross fixed capital formation (GFCF) (% of GDP)	GFCF includes expenditures on land improvements, plant and machinery acquisitions, and infrastructure construction such as roads, railways, schools, etc. The percentage of GDP indicates the proportion of these investments relative to the overall economic output. (World Bank Data).
Individuals using the internet (% of the population)	It signifies the percentage of the population using the internet within the last three months. It encompasses various devices such as computers, mobile phones, personal digital assistants, gaming machines, and digital TVs. (World Bank Data).
Mobile cellular subscriptions (per 100 people)	It denotes the number of individuals per 100 people who have access to a public mobile telephone service utilizing cellular technology. The indicator incorporates postpaid subscriptions and active prepaid accounts used within the last three months. (World Bank Data).
Primary education, (pupils)	It is measured by total number of pupils enrolled at the primary level, encompassing both public and private schools. (World Bank Data).

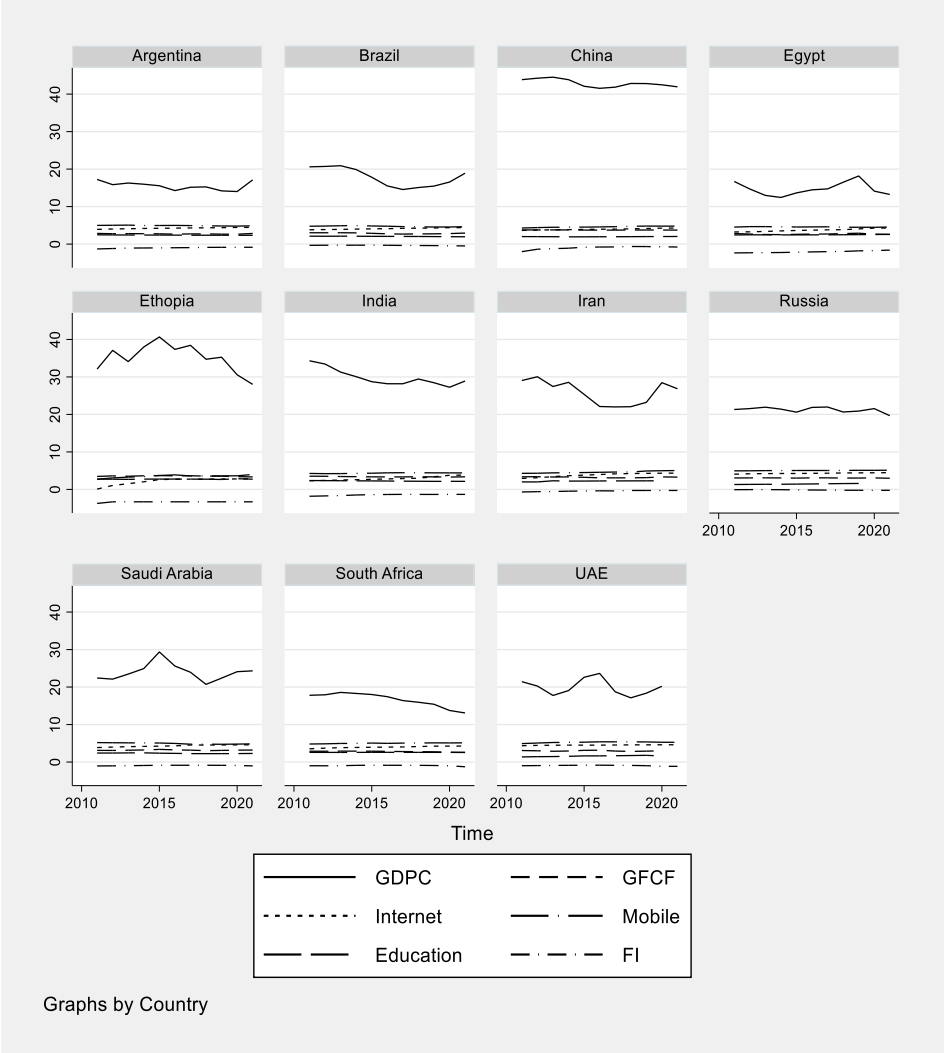
The descriptive statistics for various variables, namely FIAI, GDPC, GFCF, internet usage and mobile access, are given in Table 2. It reveals a moderate FIAI level with a mean of 0.417 and notable variability (standard deviation of 0.244) across observed entities. Economic output per capita (GDPC) averages 21,660.15, showing considerable variability (standard deviation of 18,477.92). The rate of investment in fixed assets (GFCF) has a mean of 23.996, and mobile phone usage averages 120.2505, with both exhibiting variability. Internet usage (mean: 56.0283) and education levels (mean: 9.7239) also show variability. Skewness and kurtosis indicate some asymmetry and heavier tails in the distributions. Overall, the data reflects diverse levels and patterns across the variables in the dataset.

Table: 2 Variable-wise Descriptive Statistics

	FIAI	**GDPC**	**GFCF**	**Mobile**	**Internet**	**Education**
Mean	0.417357	21660.15	23.996	120.2505	56.02827	9.723868
Median	0.399651	14619.59	21.56055	121.0672	58.32795	9.670031
Maximum	0.953622	71782.15	44.51877	221.3088	100	17.42384
Minimum	0.02389	1336.067	12.44601	15.38551	1.100	3.720124
Std. Dev.	0.24362	18477.92	8.820963	44.33273	26.33372	3.337645
Skewness	0.338068	1.410321	0.880839	-0.04421	-0.296472	0.029168
Kurtosis	2.383171	4.050159	2.762058	2.761862	2.153282	2.280585
Jarque-Bera	4.22309	45.67174	15.80062	0.32263	5.387087	2.409446
Probability	0.121051	0.0000	0.000371	0.851024	0.067641	0.299775

The descriptive statistics for various variables across the BRICS nations, as well as extended BRICS countries is given in graph and appendix I. These details provide a comprehensive overview of the central tendency, variability, and range of each variable across the specified countries, offering insights into these nations' economic, technological, and educational landscapes. It underlines significant fluctuations in economic indicators and technology adoption across these countries. Various factors could influence these variations, including, global economic conditions, and technological advancements of these nations.

Figure 1: Graphical representation of the data



5. Empirical Results

The result of fixed effect regression model is given in Table 3. The large F-statistic and the associated p-value (Prob > F = 0.000) show the overall significance of the model and suggest that at least one of the independent variables is significantly related to the financial inclusion. The intercept (cons) is -5.0198, and it is statistically significant with a t-statistic of -3.97 and a p-value of 0.000 at the 0.05 significance level.

Table:3 Results of Fixed Effect Regression Model

Variables	Coefficient	Std. err.	t	P>t	[95% conf.	interval]
Cons.	-5.0198	1.264304	-3.97	0.000	-7.5301	-2.50949
GDPC	-0.05652	0.024473	-2.31	0.023	-0.10511	-0.00793
GFCF	1.359906	0.553362	2.46	0.016	0.261192	2.45862
Internet	0.206838	0.051784	3.99	0.000	0.104019	0.309657
Mobile	0.126679	0.128455	0.99	0.327	-0.12837	0.381729
Education	-0.17495	0.247751	-0.71	0.482	-0.66686	0.316967

F(5, 94) = 7.99; Prob>F = 0.000

The coefficient for GDPC is -0.05652, indicating that for a one-unit increase in GDPC, the financial inclusion decreases by approximately 0.05652 units. The associated t-statistic is -2.31, and the p-value is 0.023, suggesting that GDPC is statistically significant at the 0.05 significance level. The coefficient for GFCF is 1.359906, indicating that for a one-unit increase in GFCF, the dependent variable increases by approximately 1.359906 units. The associated t-statistic is 2.46, and the p-value is 0.016, suggesting that GFCF is statistically significant at the 0.05 significance level. The coefficient for internet usage is 0.206838, indicating that the dependent variable increases by approximately 0.206838 units for a one-unit increase in internet usage. The p-value is 0.000, indicating that internet usage is statistically significant at the 0.05 significance level. The coefficient for mobile use is 0.126679, but it has a non-significant p-value of 0.327, suggesting that mobile usage may not be statistically significant in predicting the dependent variable. The coefficient for Education is -0.17495, but with a non-significant p-value of 0.482, indicating that education may not be statistically significant in predicting the dependent variable. Thus, GDPC, GFCF, and internet usage appear statistically significant, while mobile usage and primary education are not at the 0.05 significance level.

Table:4 Results of Random Effect Regression Model

Variables	Coefficient	Std. err.	z	P>z	[95% conf.	interval]
Cons.	-5.0297	1.269943	-3.96	0.000	-7.51874	-2.54066
GDPC	-0.06009	0.023939	-2.51	0.012	-0.10701	-0.01317
GFCF	1.422376	0.547216	2.6	0.009	0.349853	2.494899
Internet	0.196336	0.051431	3.82	0.000	0.095533	0.297139
Mobile	0.219311	0.120708	1.82	0.069	-0.01727	0.455894
Education	-0.40188	0.215497	-1.86	0.062	-0.82425	0.020486
Wald chi2(5) = 7.99; Prob>chi2 = 0.000						

Table 4 shows random effect regression results for the dependent variable financial inclusion. The intercept is statistically significant (p-value = 0), indicating that the model predicts a significantly different financial inclusion score when all independent variables are zero. The Chi-Square: Wald chi2(5) is 7.99 with probability (Prob > chi2) of 0.000. The overall model is statistically significant, suggesting that at least one of the independent variables significantly predicts financial inclusion.

The coefficient of GDPC is -0.06009, interpreting that a one-unit increase in GDPC is associated with a decrease of 0.06009 units in financial inclusion, holding other variables constant. The coefficient is statistically significant (p-value = 0.012), suggesting that GDPC significantly impacts financial inclusion. However, this might be due to a concentration of financial services and resources in higher-income segments of the population, leaving lower-income individuals with limited access to financial services in BRICS countries. Factors such as income inequality may also influence the negative association, where higher GDPC may not necessarily translate into improved financial inclusion for all population segments.

The positive coefficient for GFCF (1.422376) in the regression results suggests that an increase in gross fixed capital formation is associated with increased financial inclusion. The coefficient is statistically significant (p-value = 0.009), indicating a significant impact of GFCF on financial inclusion. GFCF represents the total investment in fixed assets within an economy, including infrastructure. As countries experience the

economic development and increased capital formation, financial inclusion might have a positive impact. A positive coefficient may suggest that higher investment in financial infrastructure increases financial inclusion, such as banking facilities, ATMs, and digital payment systems. Increased capital formation may lead to expanding and improving formal financial and banking services.

The variable internet usage has a positive coefficient (0.196336) and shows that increased internet usage is associated with increased financial inclusion. The coefficient is statistically significant (p-value = 0), suggesting a significant impact of internet usage on financial inclusion. Higher Internet usage may be indicative of increased access to digital financial services. This coefficient suggests that countries with a higher prevalence of internet usage are more likely to use mobile and other digital devices for financial transactions, digital banking, mobile payments, and other online financial services. The transformative effect of increased internet usage on the financial landscape aligns with the broader financial inclusion goals.

The positive coefficient for the variable mobile usage (0.219311) in the regression results suggests that increased mobile usage is associated with increased Financial Inclusion. Mobile devices provide a convenient means of accessing financial services, particularly in areas with limited physical banking infrastructure. The positive coefficient may suggest that as mobile usage increases, individuals find it easier to access and use financial services, increasing financial inclusion. However, this relationship is not statistically significant (p-value = 0.069).

The negative coefficient for the education variable (-0.40188) suggests that increased education is associated with decreased financial inclusion. Higher education levels are associated with a higher level of financial literacy, enabling individuals to make informed choices about their financial activities. This may lead to a lower reliance or trust in certain formal financial services, particularly if individuals are adept at managing their finances through alternative means. However, this coefficient is not statistically significant.

The Hausman test results are shown in Table 5, and it assesses the validity of preferring between fixed effect (fe) and random effect (re) models in panel data analysis. The test compares coefficients from a fixed effects model (b-fe) and a random effect model (B-re) for the specified variables.

Null Hypothesis (H0): No systematic difference exists between the fixed and random effects models.

Table: 5 Hausman Test Results

Variables	Coefficients		(b-B) Difference	Sqrt(diag(V_b-V_B)) Std.err.
	(b) fe	(B) re		
GDPC	-.0565227	-.0600886	.003565	.0050842
GFCF	1.359906	1.422376	-.0624702	.0822488
Internet	.2068378	.1963361	.0105017	.0060386
Mobile	.1266785	.2193109	-.0926323	.0439348
Education	-.1749471	-.40188	.2269329	.1222354
Chi2(5) = 7.34; Prob>chi2 = 0.1964				

The coefficients for each variable indicate the difference between the fixed effect (fe) and random effect (re) estimates. Positive values suggest that the fixed effect is larger than the random effect, while negative values indicate the opposite. In the case of GDPC**, t**he fixed effects estimate is slightly smaller than the random effect estimate, but the difference is not statistically significant. However, the fixed effect estimate of GFCF is smaller than the random effect estimate, and the difference is statistically significant. Similarly, the fixed effect estimate of internet usage is slightly larger than the random effect estimate, but the difference is not statistically significant. The fixed effect estimate of mobile use is significantly smaller than the random effect estimation. Finally, the fixed effect estimate of variable education is considerably smaller than the random effect estimate. The chi-squared statistic (Chi2) tests whether the coefficients from the fixed and random effects models differ significantly. The p-value associated with the chi-squared statistic (Prob>chi2) confines statistical significance. In this case, a p-value of 0.1964 suggests not to reject the null hypothesis at a conventional significance level (e.g., 0.05). It signifies that the differences between the fixed effects and random effects models are not statistically significant overall and hence random effects model is deemed suitable.

The time dummy variables in the model were included to check whether certain years experienced events or changes that affected all countries in the same way—for example, global economic cycles, policy shifts, or

technological transitions. Using 2011 as the reference year, the coefficients for the years 2012 to 2021 show only very small differences, ranging roughly between –0.27 and +0.03, and none of these differences are statistically significant. This means that, after accounting for the other variables in the model, there were no noticeable jumps or drops in the dependent variable from one year to another that could be linked to common time-specific influences. Essentially, the results suggest that there were no major shocks or widespread events across the sample period that significantly changed the outcome variable for all countries together. As a result, most of the variation in the dependent variable appears to come from differences between countries, rather than changes over time. Given the lack of significance, it may even be reasonable to remove the time dummies as the joint significance test (Appendix 2 and 3) confirms that they do not improve the overall model.

Further, to assess whether any of the potential endogeneity between GDP per capita and financial inclusion, Durbin (score) and Wu–Hausman tests were performed by instrumenting GDPC using log of GDPC as the instrumental variable. To assess whether GDPC suffers from endogeneity, Durbin (score) and Wu–Hausman tests are performed. Here the null hypothesis states that the variable is exogenous, meaning not correlated with the error term. Towards this, first we estimate the model using the instrumental variable (IV) approach using the IV-2SLS framework (Appendix 4). The results of the Durbin and Wu–Hausman endogeneity tests show high p-values (0.9037 and 0.9074), indicating that we fail to reject the null hypothesis that GDPC is exogenous (Appendix 5). This implies that GDPC does not suffer from endogeneity, and therefore the Random Effects model without instrumental variables is appropriate as the IV model does not improve the estimates. It thereby validates the appropriateness of the Random Effects (RE) model.

The result implies unobserved heterogeneity in the samples of studied countries, and these country-specific characteristics are not included in the model. The results indicate that the country-specific effects impacting financial institutional access are random and are not correlated with GDP per capita, gross fixed capital formation, frequency of mobile cellular subscriptions, percentage of population using the internet and number of pupils with primary education. The BRICS countries vary among themselves. These unobservable country-specific factors influence the

formation of financial access in BRICS countries, and the difference between the BRICS countries continues from 2011 to 2021. The mean value of FIAI for the study period varies from 0.03 for Ethiopia to 0.86 for Russia. Similarly, the mean GDP per capita varies from 1847 for Ethiopia to 66881 for UAE. The countries have similar differences in other variables like GDP per capita, investment, internet usage, mobile subscriptions, and education (Appendix 1). This unobserved heterogeneity may be due to differences in wealth, economic policies, awareness, socio-economic condition, institutional quality or any other item that is not observed directly through data.

6. Conclusion

Financial inclusion is pivotal in promoting economic development and guaranteeing widespread access to financial services. The paper considered various factors influencing financial inclusion, including GDP per capita, gross fixed capital formation, primary education, internet usage, and mobile access. The results from fixed and random effects regression models provided practical insights into the relationship between these variables and the financial inclusion. Both models underscored the significance of GDP per capita, GFCF, and internet usage in influencing financial inclusion. The results from the preferred RE model indicates that a one percent increase in GFCF, internet usage, and mobile usage increases financial inclusion by 1.42, 0.19, and 0.21 percent respectively. Also, a one percent increase in GDPC and primary education is associated with a decrease in financial inclusion to the tune of 0.06 and 0.4 percent, respectively.

A noteworthy finding was the negative coefficient for GDP per capita, suggesting that higher economic output per capita is associated with decreased financial inclusion. It could imply that the benefits of economic prosperity may not be uniformly distributed across the BRICS nations. However, GFCF emerged as a significant positive contributor to financial inclusion in both models. It suggests that increased investment in fixed assets, including financial infrastructure, positively correlates with higher levels of financial inclusion. Internet usage positively impacted financial inclusion, emphasizing the role of digital connectivity in enhancing access to financial services. While positively associated with financial inclusion in the random effects model, mobile usage did not exhibit statistical significance in the fixed effects model. Primary education,

while hypothesized to influence financial inclusion positively, did not demonstrate statistical significance in either model. It may indicate that the impact of primary education on financial inclusion is nuanced and affected by various contextual factors not captured in this study. Institutional quality, consumer protection measures, and financial literacy may serve as mediating factors. For example, countries in ASEAN that have heavily invested in financial literacy programs, such as Indonesia and Malaysia, show stronger linkages between education and digital financial adoption. In contrast, several MENA economies share similar challenges with extended BRICS countries, where educational attainment does not necessarily lead to enhanced digital or financial empowerment due to regulatory frictions and low DFS awareness.

When compared with other emerging blocs, such as ASEAN and MENA, the BRICS economies display mixed progress—leading in financial infrastructure scale but lagging in equitable outreach and digital readiness. Policy learning from regions like ASEAN could help advance consumer digital literacy and interoperability frameworks. This results also support global development agendas. Enhancing digital access and financial infrastructure aligns directly with SDG 8 (Decent Work and Economic Growth) by enabling greater participation of individuals and MSMEs in the formal economy. Furthermore, investments in digital and financial infrastructure strengthen SDG 9 (Industry, Innovation and Infrastructure), reinforcing innovation-led and inclusive growth pathways for the extended BRICS.

In conclusion, this paper light on the intricate dynamics of financial inclusion in the extended BRICS countries. It highlights the need for nuanced policy interventions considering economic, technological, and educational factors. Policy initiatives should prioritize inclusive digital financial solutions as these nations continue to embrace technological advancements. Bridging the financial inclusion gap can contribute to individual empowerment and broader economic development and social progress within these diverse and dynamic nations.

References:

Aad, E., Young, S., Kinzinger, A., & Lohiya, N. (2020). Cashing Out : Economic Growth through Payment Digitisation. *Mastercard, Proprietary and Confidentia, White Paper*, *1*(1), 1–16. Retrieved from https://newsroom.mastercard.com/mea/files/2020/05/Mastercard-White-Paper-Cashing-Out-Economic-Growth-through-Payment-Digitisation1.pdf

Abokor, M. H., Musse, A. H., & Ali, A. A. (2024). Macroeconomic and institutional determinants of financial inclusion: Empirical evidence from East African countries. Journal of Financial Economic Policy, 16(3), 455–476.

Adedokun, M. W., & Ağa, M. (2021). Financial inclusion: A pathway to economic growth in Sub-Saharan African economies. *International Journal of Finance and Economics*, (January), 1–17. https://doi.org/10.1002/ijfe.2559

African Development Bank. (2023). *African Economic Outlook*. African Development Bank Group.

Ahmed, F., Sharma, R. L., & Gopinathan, R. (2021). Understanding Financial Inclusion in the BRICS. *Academy of Marketing Studies Journal*, *25*(6), 1–10.

Akileng, G., Lawino, G. M., & Nzibonera, E. (2018). Evaluation of Determinants of Financial Inclusion in Uganda. *Journal of Applied Finance & Banking*, *8*(4), 47–66. Retrieved from http://www.scienpress.com/Upload/JAFB%2FVol 8_4_4.pdf

Alosheibat, S. D., Banikhalid, H. H., & Alawneh, A. (2023). Impact of Financial Inclusion on Economic Growth during the Period 2011 – 2021 : A Cross-sectional Study of Lower-Middle- Income Countries, *13*(6), 148–154.

Allison, P. D. (2002). Missing data. Sage Publications.

Asli Demirguc-Kunt Leora Klapper, & Singer, D. (2017). *Financial Inclusion and Inclusive Growth: A Review of Recent Empirical Evidence* (8040). Retrieved from file:///C:/Users/DELL/Downloads/SSRN-id2958542.pdf

Azeez, N. P. A., & Akhtar, S. M. J. (2021). Digital Financial Literacy and Its Determinants: An Empirical Evidences from Rural India. *South Asian Journal of Social Studies and Economics*, *11*(2), 8–22. https://doi.org/10.9734/sajsse/2021/v11i230279

Baltagi, B. H. (2021). Econometric analysis of panel data (6th ed.). Wiley-Blackwell.

Baker, L. (2021). Everyday Experiences of Digital Financial Inclusion in India's 'Micro-Entrepreneur' Paratransit Services. *Environment and Planning*, *53*(7), 1810–1827. https://doi.org/10.1177/0308518X211026320

Banerjee, A., Kamlesh, K., & Dennis, P. (2017). Financial literacy, awareness and inclusion. *ISI Working Paper*, (September).

Bank, W., & Bank, W. (n.d.). Measuring Financial Inclusion: Explaining Variation in Use of Financial Services across and within Countries.

Barik, R., & Pradhan, A. K. (2021). Does Financial Inclusion Affect Financial Stability: Evidence from BRICS Nations? *The Journal of Developing Areas*, *55*(1). https://doi.org/10.1353/jda.2021.0023

Beck, T. (2016). Financial Inclusion – Measuring Progress and Progress in Measuring. In *This Paper was Written for the Fourth IMF Statistical Forum "Lifting the Small Boats: Statistics for Inclusive Growth"* (pp. 1–33).

Beck, T., Demirgüç-Kunt, A., & Levine, R. (2007). Finance, Inequality and the Poor. *Journal of Economic Growth*, *12*(1), 27–49. https://doi.org/10.1007/s10887-007-9010-6

Bekele, W. D. (2023). Determinants of Financial Inclusion : A Comparative Study of Kenya and Ethiopia. *Journal of African Business*, *24*(2), 301–319. https://doi.org/10.1080/15228916.2022.2078938

Bhurat, C. (2019). Brics Nations and Financial Inclusion: a Comparative Study of the Brics Nations Using Various Finanical Inclusion Indicators. In *IISES International Academic Conference, London* (pp. 5–22). https://doi.org/10.20472/iac.2019.045.005

Boukhatem, J., & Moussa, F. Ben. (2023). Financial Inclusion, Institutional Quality, and Economic Growth in MENA Countries: Some Evidence from Panel Cointegration. *Macroeconomics and Finance in Emerging Market Economies*, 1–24. https://doi.org/10.1080/17520843.2023.2284455

Cámara, N., & Tuesta, D. (2017). Measuring Financial Inclusion : A Multidimensional Index. *Bank of Morocco – CEMLA – IFC Satellite Seminar at the ISI World Statistics Congress on "Financial Inclusion,"* (July). Retrieved from https://www.bis.org/ifc/publ/ifcb47p.pdf

Charumathi, B., & Raghunathan, V. (2025). Financial inclusion and resilience of women-led MSMEs in India: The mediating role of digital financial adoption. Journal of Global Entrepreneurship Research, 15(2), 1–23.

Dai, W. (2021). Development and Supervision of Robo-Advisors under Digital Financial Inclusion in Complex Systems. *Complexity*, *2*(3), 1–12. https://doi.org/10.1155/2021/6666089

Demirguc-Kunt, A., & Klapper, L. (2012). *Measuring Financial Inclusion The Global Findex Database* (WPS6025; 6025, Issue April). https://openknowledge.worldbank.org/bitstream/handle/10986/6042/WPS6025.pdf?sequence=1&isAllowed=y

Demirgüç-Kunt, A., Klapper, L., Dorothe Singer, & Ansar, S. (2022). *Global Findex Database 2021: Financial Inclusion, Digital Payments, and Resilience in the Age of Covid-19*. Washington, DC: https://doi.org/10.1596/978-1-4648-1897-4

Economist Impact. (2022). *Five Year Lookback Report, The Inclusive Internet Index*. Retrieved from https://impact.economist.com/projects/inclusive-internet-index/downloads/ei-meta_3i_5yr_lookback_report_0.pdf

Egyptian Ministry of Planning. (2024). *Annual Report on Digital Transformation and Public Service Delivery*. Government of Egypt.

Fernandes, C., Borges, M. R., & Caiado, J. (2021). The contribution of digital financial services to financial inclusion in Mozambique: an ARDL model approach. *Applied Economics*, *53*(3), 400–409. https://doi.org/10.1080/00036846.2020.1808177

Ferrata, L. (2019). Digital Financial Inclusion - An Engine for "Leaving No One Behind." *Public Sector Economics*, *43*(4), 445–458. https://doi.org/10.3326/pse.43.4.6

Finau, G., Rika, N., Samuwai, J., & McGoon, J. (2016). Perceptions of Digital Financial Services in Rural Fiji. *Information Technologies and International Development*, *12*(4), 11–21.

Frydrych, J., & Aschim, H. (2014). Extending Reach: Mobile Money in Rural Areas: Findings Based on the State of the Industry Report. In *GSMA* (Issue October).

Ghosh, D., & Vogt, A. (2012). *Outliers: An Evaluation of Methodologies*. Advances in Statistics, 2012, 1–27.

Ghosh, C., & Hom Chaudhury, R. (2020). Determinants of Digital Finance in India. *Innovation and Development*, *0*(0), 1–20. https://doi.org/10.1080/2157930X.2020.1850012

GPFI. (2016). *G20 High-Level Principles for Digital Financial Inclusion*. *GPFI*. Retrieved from https://www.gpfi.org/sites/gpfi/files/G20 High Level Principles for Digital Financial Inclusion.pdf

GSMA. (2019). *Mobile Connectivity Index Methodology*. Retrieved from https://www.gsma.com/mobilefordevelopment/wp-content/uploads/2019/07/GSMA-Mobile-Connectivity-Index-Methodology-2019.pdf

Greene, W. H. (2018). Econometric analysis (8th ed.). Pearson.

Haider, H. (2018). *Innovative Financial Technologies to Support Livelihoods and Economic Outcomes*. Brighton, UK. Retrieved from https://gsdrc.org/wp-content/uploads/2018/07/Digital_financial_services.pdf

Hasan, I., Renzis, T. De, & Schmiedel, H. (2012). *Retail Payments and Economic Growth* (19). Retrieved from https://www.econstor.eu/bitstream/10419/212222/1/bof-rdp2012-019.pdf

Hasan, M., Noor, T., Gao, J., Usman, M., & Abedin, M. Z. (2022). Rural Consumers' Financial Literacy and Access to FinTech Services. *Journal of the Knowledge Economy*, (0123456789). https://doi.org/10.1007/s13132-022-00936-9

Hegde, P. R., & Guruprasad, L. S. (2025). Nexus between digital financial inclusion and economic growth: a panel data investigation of Asian economies. *Journal of Economic and Administrative Sciences*. https://doi.org/10.1108/JEAS-09-2023-0253

IMF. (2022). Financial Access Survey (FAS) Database. *International Monetary Fund*.

IMF. (2023). Financial Access Survey: Global Trends in Financial Inclusion. *International Monetary Fund.*

IMF. (2024). Middle East and Central Asia Regional Economic Outlook. International Monetary Fund.

Jalilian, H., & Kirkpatrick, C. (2005). Does financial development contribute to poverty reduction? *Journal of Development Studies*, *41*(4), 636–656. https://doi.org/10.1080/00220380500092754

Khaki, A. R., & Sangmi, M. U. D. (2017). Does access to finance alleviate poverty? A case study of SGSY beneficiaries in Kashmir Valley. *International Journal of Social Economics*, *44*(8), 1032–1045. https://doi.org/10.1108/IJSE-10-2015-0277

Khalsa College for Women. (2016). Level of Financial Literacy Among Youth. *International Journal of Business Management and Scientific Research*, *14*, 37–44. Retrieved from http://eminencejournal.com/images/pdf/Fe8.pdf

Khera, P., Ng, S., Ogawa, S., & Sahay, R. (2021). *Is Digital Financial Inclusion Unlocking Growth ?* (WP/21/167 No. WP/21/167). Retrieved from https://www.imf.org/-/media/Files/Publications/WP/2021/English/wpiea2021167-print-pdf.ashx

Kim, D. W., Yu, J. S., & Hassan, M. K. (2018). Financial inclusion and economic growth in OIC countries. *Research in International Business and Finance*, *43*, 1–14. https://doi.org/10.1016/j.ribaf.2017.07.178

King, R.G.; Levine, R. (1993). Finance, Entrepreneurship and Growth: Theory and Evidence. *Journal of Monetary Economics*, *32*, 513–542. https://doi.org/https://doi.org/10.1016/0304-3932(93)90028-E

Kumar, M., Al Muraqab, N., Bshivanna, P., Moonesar, I. A., Braendle, U. C., & Rao, A. (2025). Evaluation of financial inclusion and financial well-being in expanded BRICS economies. Foresight and STI Governance, 19(1), 50–63.

Kuznets, S. (1955). Economic Growth and Income Inequality. *The American Economic Review*, *45*(1), 1–28.

Lewis, W. A. (1954). Economic Development with Unlimited Supplies of Labour. *Manchester School*, *22*(2), 139–191.

Li, J., & Meyer-Cirkel, A. (2021). Promoting Financial Literacy through a Digital Platform: A Pilot Study in Luxembourg. *International Journal of Finance and Economics*, *26*(1), 73–87. https://doi.org/10.1002/ijfe.1777

Liu, G., Huang, Y., & Huang, Z. (2021). Determinants and Mechanisms of Digital Financial Inclusion Development: Based on Urban-Rural Differences. *Agronomy*, *11*(9), 1–22. https://doi.org/10.3390/agronomy11091833

Lyons, A., Kass-Hanna, J., Liu, F., Greenlee, A., & Zeng, L. (2019). Building Financial Resilience Through Financial and Digital Literacy in South Asia and Sub-Saharan Africa. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.3496562

Mahajan, P., & Singla, A. (2017). Effect of Demonetization on Financial Inclusion in India. *International Journal of Science Technology and Management*, *6*(01), 1282–1287.

Mialou, A., & Amidzic, G. (2017). Assessing Countries' Financial Inclusion Standing — A New Composite Index. *Journal of Banking and Financial Economics*, *2*(8), 105–126. https://doi.org/10.7172/2353-6845.jbfe.2017.2.5

Muthiora, B. (2015). Enabling Mobile Money Policies in Kenya - Fostering a Digital Financial Revolution. *GSM Association*, *January*, 30.

OECD & IDB. (2016). *Broadband Policies for Latin America and the Caribbean: A Digital Economy Toolkit*. *OECD Publishing, Paris*. https://doi.org/10.1787/cab74066-en

Onatunji, O. G. (2025). The Potency of Financial Inclusion for Income Inequality Reduction in BRICS Economies: Does Institutional Quality Matter? *Global Journal of Emerging Market Economies*, 17(1), 49–72.

Ozili, P. K. (2018). Impact of Digital Finance on Financial Inclusion and Stability. *Borsa Istanbul Review*, *18*(4), 329–340. https://doi.org/10.1016/j.bir.2017.12.003

Ozili, P. K. (2020). Contesting Digital Finance for the Poor. *Digital Policy, Regulation and Governance*, *22*(2), 135–151. https://doi.org/10.1108/DPRG-12-2019-0104

Pandey, A., Kiran, R., & Sharma, R. K. (2023). Investigating the Determinants of Financial Inclusion in BRICS Economies: Panel Data Analysis Using Fixed-Effect and Cross-Section Random Effect. *Sustainability*, *15*(2), 1603. https://doi.org/10.3390/su15021603

Park, C.-Y., & Mercado, R. J. (2015). Financial Inclusion, Poverty, and Income Inequality in Developing Asia. *SSRN Electronic Journal*, (426). https://doi.org/10.2139/ssrn.2558936

Patankar, R., Vyas, S. K., & Tyagi, D. (2017). Achieving Universal Digital Literacy for Rural India. *ACM International Conference Proceeding Series*, *Part F1280*, 528–529. https://doi.org/10.1145/3047273.3047325

Patra, G., & Gupta, Y. (2020). Determinants of Digital Payment Services and Behavioral Loyalty among Generation Y. *Pacific Business Review International*, *13*(4), 30–45.

Poverty, U., & Inclusion, F. (2015). How to Measure Financial Inclusion, 1–7.

Prasad, H., Meghwal, D., & Dayama, V. (2018). Digital Financial Literacy: A Study of Households of Udaipur. *Journal of Business and Management*, *5*(5), 23–32. https://doi.org/10.3126/jbm.v5i0.27385

Rana, N. P., Luthra, S., & Rao, H. R. (2019). Key Challenges to Digital Financial Services in Emerging Economies: the Indian Context. *Information Technology and People*, *33*(1), 198–229. https://doi.org/10.1108/ITP-05-2018-0243

Ratnawati, K. (2020). The Impact of Financial Inclusion on Economic Growth, Poverty, Income Inequality, and Financial Stability in Asia. *The Journal of Asian Finance, Economics and Business*, *7*(10), 73–85. https://doi.org/10.13106/jafeb.2020.vol7.no10.073

Ravallion, M. (2014). Income Inequality in the Developing World. *Science*, *344*(6186), 851–855.

RBI. (2021). *BRICS Digital Financial Inclusion Report- India*. Retrieved from https://rbidocs.rbi.org.in/rdocs/Publications/PDFs/BRICSDIGITAL7330275ABF0C4198B581897DF2C131CA.PDF

Sarma, M., & Pais, J. (2008). Financial Inclusion and Development: A Cross Country Analysis. *In Annual Conference of the Human Development and Capability Association, New Delhi*, *168*(10–13), 1–30. https://doi.org/10.1002/jid

Schafer, J. L., & Graham, J. W. (2002). Missing data: Our view of the state of the art. Psychological Methods, 7(2), 147–177.

Schumpeter, J. . (1912). *Theorie Der Wirtschaftlichen Entwicklung*. *Dunker & Humblot, Leipzig*. Harvard University Press, Cambridge, MA, 1934.

Shen, Y., Hueng, C. J., & Hu, W. (2020). Measurement and Spillover Effect of Digital Financial Inclusion : A Cross-Country Analysis. *Applied Economics Letters*, *00*(00), 1–6. https://doi.org/10.1080/13504851.2020.1853663

Shen, Y., Hueng, C. J., & Hu, W. (2020). Using Digital Technology to Improve Financial Inclusion in China. *Applied Economics Letters*, *27*(1), 30–34. https://doi.org/10.1080/13504851.2019.1606401

Singh, C., & Kumar, R. (2017). Financial Literacy among Women - Indian Scenario. *Universal Journal of Accounting and Finance*, *5*(2), 46–53. https://doi.org/10.13189/ujaf.2017.050202

Singh, S., & Rana, R. (2017). Study of consumer perception of digital payment mode. *Journal of Internet Banking and Commerce (JIBC)*, *22*(3), 1–14.

Singh, S., Jatana, N., Sehgal, S., Anand, R., Arunkumar, B., & Ramesh, J. V. N. (2024). Making Digital Payments Accessible Beyond Sight: A Usability Study of UPI-Based Smartphone Applications. *IEEE Access*, *12*(December 2023), 6830–6841. https://doi.org/10.1109/ACCESS.2023.3348840

Suhrab, M., Pinglu, C., & Qian, N. (2025). Role of Technological Innovation for Enhancing Financial Inclusion to Reduce Income Inequality in BRICS Economies. In *Asia-Pacific Journal of Regional Science* (Vol. 9, Issue 4). Springer Nature Singapore. https://doi.org/10.1007/s41685-025-00375-9

Talbi, O., & Sebai, M. (2025). Exploring the Relationship between Financial Inclusion and Financial Stability in BRICS Countries: A Panel Smooth Transition Regression Analysis. *Development and Sustainability in Economics and Finance*, 6, 100042.

Tekin, B. (2024). The Catalyzing Role of Financial Inclusion in Decoding Environmental Challenges: Empirical Evidence from Emerging Economies. *Economics & Politics*, 36(4), 1315–1339.

Truc, T., & Nguyen, H. (2021). Measuring Financial Inclusion: A Composite FI Index for the Developing Countries. *Journal OfEconomics and Development*, *23*(1), 77–99. https://doi.org/10.1108/JED-03-2020-0027

Tukey, J. W. (1962). The future of data analysis. The Annals of Mathematical Statistics, 33(1), 1–67.

United Nations Conference on Trade and Development. (2024). *Digital Economy Report.* UNCTAD.

Van Der Lugt, C. (2018). Digital Finance and Citizen Action: In Financing the Future of Climate-smart Infrastructure. February, 51.

Widarwati, E., Solihin, A., & Nurmalasari, N. (2022). Digital Finance For Improving Financial Inclusion Indonesians ' Banking, 11(January 2021), 17–30.

World Bank. (2015). *Empowering Women through Financial Inclusion*. Retrieved from https://www.worldbank.org/en/news/feature/2015/08/05/empowering-women-through-financial-inclusion

World Bank. (2023). *Argentina Economic Update: Macroeconomic Performance and Policy Implications.* World Bank Group.

World Bank. (2024). *Global Financial Development Report: Infrastructure and Financial Inclusion.* World Bank Group.

Wooldridge, J. M. (2010). *Econometric Analysis of Cross Section and Panel Data* (2nd ed.). MIT Press.

Yang, J., Wu, Y., & Huang, B. (2021). Digital Finance and Financial Literacy: An Empirical Investigation of Chinese Households. *SSRN Electronic Journal*, (1209). https://doi.org/10.2139/ssrn.3806419

Zhang, Q., & Posso, A. (2019). Thinking Inside the Box: A Closer Look at Financial Inclusion and Household Income. *Journal of Development Studies*, *55*(7), 1616–1631. https://doi.org/10.1080/00220388.2017.1380798

Appendices

Appendix 1: Extended BRICS Country-wise Descriptive Statistics

Variable	**Obs**	**Mean**	**Std. Dev.**	Min	Max	Range
Argentina						
FIAI	11	0.374835	0.051896	0.273519	0.430754	0.157235
GDPC	11	23044.79	1470.454	19685.22	24647.63	4962.41
GFCF	11	15.54292	1.107262	14.0162	17.24828	3.23208
Internet	11	70.45627	11.8606	51	87.15071	36.15071
Mobile	11	140.0731	11.48871	121.6002	158.9155	37.3153
Education	11	11.04565	0.450973	10.52502	11.90402	1.379
Brazil						
FIAI	11	0.704696	0.046457	0.61639	0.750058	0.133668
GDPC	11	14926	545.8107	14109.76	15751.48	1641.72
GFCF	11	17.82319	2.480404	14.55899	20.91192	6.35293
Internet	11	62.99019	12.62006	45.69	81.34269	35.65269
Mobile	11	114.4196	15.21168	95.38505	137.9776	42.59255
Education	11	7.784495	0.425654	7.092652	8.318922	1.22627
China						
FIAI	11	0.398394	0. 125701	0.133896	0.527047	0.393151
GDPC	11	13484.1	2609.9	9680.098	17657.5	7977.402
GFCF	11	42.9179	1.044141	41.55236	44.51877	2.96641
Internet	11	54.40791	11.17944	38.3	73.05324	34.75324
Mobile	11	101.0772	17.32344	72.67381	122.8133	50.13949
Education	11	7.27218	0.223837	6.932713	7.627662	0.694949
Egypt						
FIAI	11	0.132837	0.035156	0.094853	0.200881	0.106028
GDPC	11	10978.06	735.8529	10264.06	12180.45	1916.39
GFCF	11	14.7026	1.75805	12.44601	18.17191	5.7259
Internet	11	44.31761	16.61541	25.6	72.06	46.46
Mobile	11	96.86789	6.155162	88.73336	106.7758	18.04244
Education	10	12.17883	0.58679	11.50897	13.32156	1.81259
Ethiopia						
FIAI	11	0.035524	0.003859	0.02389	0.036688	0.012798
GDPC	11	1847.198	344.1854	1336.067	2319.161	983.094
GFCF	11	35.12196	3.745484	28.0253	40.67127	12.64597

Internet	11	11.48141	6.113395	1.1	16.6981	15.5981
Mobile	10	34.89679	11.74327	15.38551	53.62353	38.23802
Education	11	15.5511	0.777528	14.33425	17.42384	3.08959
India						
FIAI	11	0.236463	0.03956	0.161857	0.268027	0.10617
GDPC	11	5635.763	842.2512	4374.232	6677.185	2302.953
GFCF	11	29.84616	2.268629	27.25042	34.31342	7.063
Internet	11	21.44457	12.7618	10.07	46.31	36.24
Mobile	11	78.16277	7.160157	67.84854	86.31709	18.46855
Education	8	9.413869	0.773811	8.669429	10.75975	2.090321
Iran						
FIAI	11	0.665415	0.089725	0.507732	0.755261	0.247529
GDPC	11	14617.19	446.3824	14010.86	15302.2	1291.34
GFCF	11	25.92974	3.096729	22.0058	30.05397	8.04817
Internet	11	51.85934	21.89771	19	78.59574	59.59574
Mobile	11	104.4652	28.51628	73.40952	154.5543	81.14478
Education	9	9.182224	1.018151	7.432137	10.01484	2.582703
Russia						
FIAI	11	0.868176	0.066499	0.789559	0.953622	0.164062
GDPC	11	26262.87	900.1871	24972.08	28193.84	3221.76
GFCF	11	21.22817	0.70612	19.67796	21.98214	2.30418
Internet	11	74.40038	9.118714	58	88.21385	30.21385
Mobile	11	155.9447	8.181315	141.7866	168.9847	27.1981
Education	9	4.246025	0.429251	3.720124	4.932891	1.212767
Saudi Arabia						
FIAI	11	0.396386	0.029024	0.353824	0.425453	0.071629
GDPC	11	46834.63	1335.064	44642.76	48691.27	4048.51
GFCF	11	23.94315	2.278654	20.72098	29.35602	8.63504
Internet	11	77.48017	19.37732	47.5	100	52.5
Mobile	11	144.1629	25.31688	115.2712	179.0989	63.8277
Education	11	10.35379	0.8853	9.420228	11.63274	2.212512
South Africa						
FIAI	11	0.387105	0.041256	0.284994	0.424723	0.13973
GDPC	11	13749.97	366.7747	12815.91	14017.41	1201.5
GFCF	11	16.60813	1.870208	13.09187	18.57871	5.48684
Internet	11	55.20765	12.50206	33.97	72.31049	38.34049
Mobile	11	150.7559	15.37781	122.0365	168.9244	46.8879

Education	11	13.23175	0.159414	12.96149	13.5224	0.56091
UAE						
FIAI	11	0.391095	0.040054	0.316399	0.433241	0.116842
GDPC	11	66881.06	5007.674	57815.17	71782.15	13966.98
GFCF	10	19.92173	2.125097	17.1283	23.64431	6.51601
Internet	11	92.26545	7.040398	78	100	22
Mobile	11	194.1701	26.56984	136.7594	221.3088	84.5494
Education	9	4.863035	0.661713	3.906099	6.010623	2.104524

Appendix 2: RE model with time dummies

Variable	**Coefficient**	**Std. Err.**	**z**	**P>|z|**	**95% CI (Lower)**	**95% CI (Upper)**
GDPC	-0.08319	0.03401	-2.45	0.014	-0.14984	-0.01653
GFCF	2.20376	0.87763	2.51	0.012	0.48364	3.92388
Internet	0.51085	0.17925	2.85	0.004	0.15952	0.86218
Mobile	0.47448	0.26321	1.8	0.071	-0.04141	0.99036
Education	-0.57228	0.16726	-3.42	0.001	-0.9001	-0.24447
2012	0.00888	0.22143	0.04	0.968	-0.42512	0.44288
2013	-0.00185	0.21677	-0.01	0.993	-0.42672	0.42301
2014	-0.04172	0.2276	-0.18	0.855	-0.48781	0.40438
2015	0.01514	0.22903	0.07	0.947	-0.43375	0.46404
2016	-0.06017	0.22498	-0.27	0.789	-0.50112	0.38078
2017	-0.06428	0.23118	-0.28	0.781	-0.51739	0.38883
2018	0.03693	0.26818	0.14	0.89	-0.48869	0.56255
2019	-0.13021	0.24078	-0.54	0.589	-0.60212	0.3417
2020	-0.20546	0.25633	-0.8	0.423	-0.70785	0.29693
2021	-0.27071	0.26975	-1	0.316	-0.79941	0.25798
_cons	-8.86805	2.26738	-3.91	0	-13.312	-4.42407

Appendix 3: Test of joint significance (testparm i.Ti me)

Restriction			
1	2012.Time	=	0
2	2013.Time	=	0
3	2014.Time	=	0
4	2015.Time	=	0
5	2016.Time	=	0
6	2017.Time	=	0
7	2018.Time	=	0
8	2019.Time	=	0
9	2020.Time	=	0
Chi-square (10) = 2.54; Prob > chi2 = 0.9903			

Appendix 4: IV Regression Output Summary (ivregress 2sls)

Variable	**Coefficient**	**Std. Error**	**z-value**	**P > z**	**95% Confidence Interval**
GDPC	-0.0619367	0.0500931	-1.24	0.216	[-0.1601173 , 0.036244]
GFCF	1.692715	1.267602	1.34	0.182	[-0.7917393 , 4.17717]
Internet	0.4714656	0.1477008	3.19	0.001	[0.1819773 , 0.7609539]
Mobile	0.5777635	0.2282934	2.53	0.011	[0.1303167 , 1.02521]
Education	-0.6370001	0.1656635	-3.85	0.000	[-0.9616946 , -0.3123057]
_cons	-8.047179	2.992046	-2.69	0.007	[-13.91148 , -2.182877]

Appendix 5: Test of Endogeneity (estat endogenous)

Test	**Statistic**	**p-value**
Durbin (score) chi2(1)	0.01462	0.9037
Wu-Hausman F(1,92)	0.01359	0.9074